Knowledge Organisers
Summer Term – Year 11

Name: _____

Please remember:
- It is to be kept inside your knowledge organiser book
- It is to be brought into school every day

Regular retrieval throughout a scheme of learning (daily, weekly and monthly) has been proven to **reduce the rate of forgetting**, supporting you to **retain more** in long term memory- making assessments/ exams way easier! The challenge for you as a student is to make sure you use your knowledge organiser for each subject properly to help you to know more and remember more over time. We've created this walk through to support you in using your knowledge organiser- for more support speak to your subject teachers.

Using your Knowledge Organiser

1	2	3	4	5
Look	**Cover**	**Write**	**Check**	**Repeat**
Start with a **small section of knowledge** that you want to remember e.*g Henry VIII's wives in History*. Read through this section of the knowledge organiser (a couple of times if it helps)	Now **cover up this section** of your knowledge organiser with a post it note or scrap paper.	**Self quiz- what can you remember** and rewrite? Make sure you do this without looking back at your knowledge organiser.	**Remove the post it and check for accuracy**- did you get the key terminology? Was it spelt correctly? Was the order correct? If you drew a diagram, how much of this did you get correct? Most importantly- what did you miss out?	After a short break away from your knowledge organiser repeat the look, cover, write, check **until you can recall all of the facts correctly without prompts.** This process can be used for any new knowledge that you want to acquire. It is good idea to do this on a regular basis, once a week.

Strategy 1- Look, cover, write, check – A really simple but effective way to use your knowledge organiser. Focus on a specific area of your knowledge organiser.

1	2	3	4	5
Focus	**Big ideas**	**Explain it**	**Link it**	**Record it**
Make it manageable by selecting an area of your KO where your learning is not secure. Don't waste time going off something you can already do!	Pick out the main points or the **big ideas** in this section.	**Explain what you know** about the main points (this could be written or shared verbally – a friend, a family member.	Now, see **how it links to other areas** within the subject. *E.g Eating meat – causes global warming. Cows produce methane which is a greenhouse gas.*	**Write down as many 'think it, link it' ideas** as you can in your book. See if you can beat others in you class!

Strategy 2- Think it, link it – Great for connecting the big ideas in your subject. How does 'x' relate to 'y'. What are the key factors which make an equation/ experiment/ process work? Challenge yourself to see how many links you can make!

1	2	3	4	5
Select topic	**Prepare quiz**	**Answer it**	**Self check**	**Repeat**
Decide **which area you want to be quizzed** on (this might build up over time)	Get someone else to **prepare 10 random questions** on that topic to challenge you.	**Set a time limit** (depending on the number of questions) and answer the questions without looking at your KO.	Now look at your KO to **self check**- make a note of your score. Celebrate your successes and make a note of anything you missed or got incorrect.	**Return to this section** in 2/3 weeks- see if you can improve your score! Re-do those questions that you missed or got incorrect.

Strategy 3- Knowledge quiz – You might try this after a few weeks of using your knowledge organiser. Get someone to set you 10 questions using your knowledge organiser. These could be spellings, key words, processes, equations etc to see how much you can remember! Record your score and see if you can beat your personal best each half term!

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Your Task:

Prepare a spoken presentation on a specific topic. The duration of the whole assessment should be around **8 minutes.**

✓ Key Criteria

✓ • Presentations must be **formal (b)**.

✓ • Presentations must be **planned** and organised.

✓ • You must listen to and respond appropriately to **questions and feedback**.

Top Tips

✓ Ensure you use Standard English(a),

✓ Look at your audience,

✓ Don't just read from your notes,

✓ Don't have too many words on your power point (if you are using one) and

✓ Present your ideas on something you are passionate about.

Practise until you believe that you can deliver your speech with confidence.

Assessment Objectives:

❑ •**AO7:** Demonstrate presentation skills in a formal setting

❑ • **AO8:** Listen and respond appropriately to spoken language, including to questions and feedback on presentations

❑ • **AO9:** Use spoken Standard English effectively in speeches and presentations.

	Key terms	Definition
A	**Standard English**	English that is clear and most easily understood by a wide audience. It is the 'correct' form of English.
B	**Formal**	Language that doesn't use any slang or abbreviations.
C	**Sophisticated**	Complicated or showing higher level knowledge.

STEP 1: Choosing your Topic

Your topic should be of interest to you. Think carefully about whether you will be able to speak in a sophisticated and formal way about it though! You must talk for _4 minutes_ so ensure that it's something you are knowledgeable about.

Topics that have been successful in previous years:

- Does rap music glorify gang culture?

- Gaming: is it good for young people?

- Technology and its impact on our generation.

- Social Media: Benefits and Flaws

- Should animals be used for testing/ human entertainment?

OR Choose a topic you're interested in. Previous successful topics:

- Is basketball a fair sport given it picks based on height and speed?

- Do we still need to travel abroad when we can see it all on the internet?
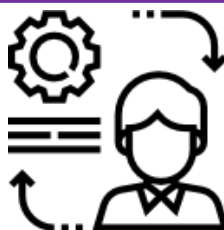
Step 2: Getting Started

To get started, answer the following questions:
- **What** is important about this topic?
- **Who** are you presenting to?
- **Why** have you chosen this topic and **why** should your audience listen?

Step 4: Practise

Read through your presentation to parents, guardians and friends.

Step 3: Planning your Presentation

You must make sure you plan and practise your presentation. Your organisation and preparation will improve your confidence and this will result in a higher grade.

1. **Break your topic down into smaller sections:**

- Introduction,

- Statistics,

- Facts,

- Specific cases/ case studies/ anecdotes or

- Personal opinion.

2. Do your research:

- You could look online for appropriate articles, documentaries etc.

- You could read some books/ magazines/ newspapers/ blogs.

- You should discuss your topic with friends and family to gain their ideas and inspiration.

3. Engagement Strategies: methods you could use to enhance your presentation:

- True/False with the audience

- Audience interaction .

- Some students have even played instruments and worn costumes!

- Emotive language, rhetorical questions, shocking facts/ statistics.

- When presenting, adapt your tone of voice, use hand gestures and eye contact!

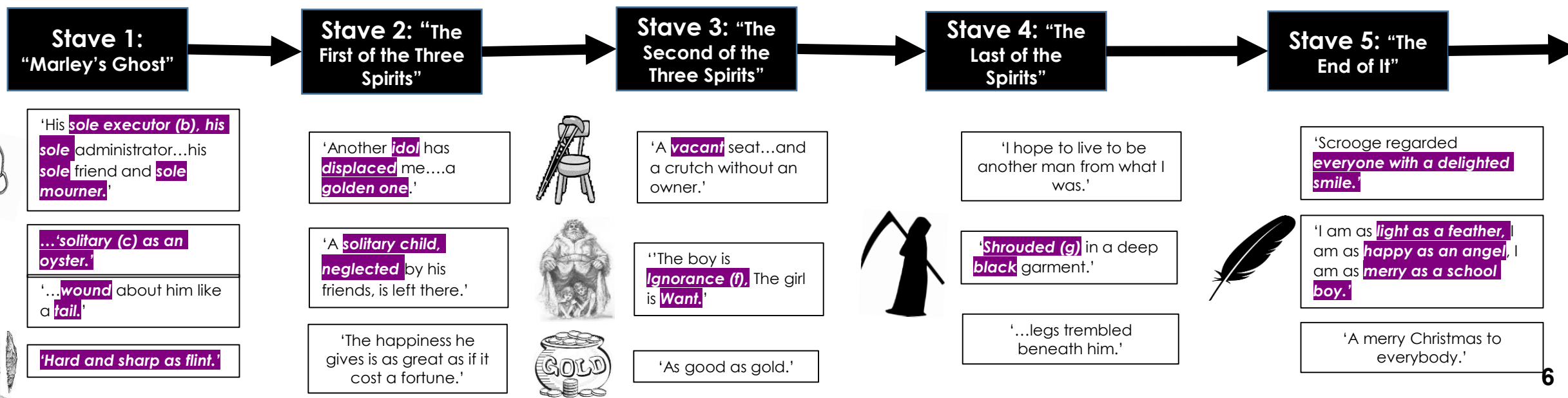**Plan the questions for the questions you may be asked and how you will respond to them.**

1. The **narrator** informs the reader that Jacob Marley (former business partner) died 7 years ago.
2. Scrooge described as mean and **miserly** (d).
3. Harsh weather and harsh conditions towards Bob Cratchit.
4. Scrooge is mean towards Fred, his nephew.
5. He refuses to donate money to the Portly gentleman.
6. He sees the face of Jacob Marley in his door knocker.
7. He is visited by Jacob Marley (**bound in chains**) who informs him that he will be visited by three spirits.

1. **The Ghost of Christmas Past** visits Scrooge.
2. Scrooge his taken back to his childhood and sees his former self alone at school.
3. We are introduced to his sister – Fan and the poor relationship with his father.
4. Scrooge is then taken to **Fezziwig** where we see him enjoying himself at a party. He interacts with people.
5. Scrooge is then shown his former fiancée **Belle** and how they split. He becomes upset when he sees **Belle** and her family in another vision.
6. He demands to be taken home.

1. **The Ghost of Christmas Present** visits Scrooge.
2. He takes him to see Bob Cratchit and his family. Scrooge is surprised at how little the family have.
3. He is then taken to his nephew, Fred's house. Fred and his guests mock Scrooge and his **miserly (d)** ways.
4. He is then taken to a poor part of the city and introduced to **Ignorance (f)** and **Want.**
5. The spirit becomes frustrated and leaves him there.

1. **The Ghost of Yet To Come is shrouded in darkness** : silent and scary.
2. He is taken to the city and instructed to listen to a group of businessmen who are discussing the recent death of a man who was not very well-liked.
3. He is taken to **Old Joe's shop** where a dead man's belongings are being pawned.
4. He is then taken to a bedroom where he sees a corpse (h).
5. Scrooge demands to see **tenderness** surrounding the death. He is then taken to the Cratchit's and learns the death of **Tiny Tim.**
6. Scrooge wants to identify the dead man and he is taken to his grave.

1. Scrooge awakes **disorientated** and worries he has missed Christmas.
2. He is **joyful** when he learns he hasn't.
3. He orders and pays for the biggest turkey to be delivered to the Cratchit family.
4. He apologises and **donates** a healthy sum of money to the portly gentleman, to give to the poor.
5. He visits Fred and his wife and asks to join them for dinner.
6. He is **jovial** next day, playing a trick on a terrified Bob, who arrives late to work.
7. He gives Bob a pay rise and pays for treatment for Tiny Tim.
8. Scrooge is **reformed**! A complete **contras** to Stave One.

Stave 1: "Marley's Ghost" → **Stave 2:** "The First of the Three Spirits" → **Stave 3:** "The Second of the Three Spirits" → **Stave 4:** "The Last of the Spirits" → **Stave 5:** "The End of It"

'His **sole executor (b), his sole** administrator...his **sole** friend and **sole mourner.**'

...'**solitary (c) as an oyster.**'

'...**wound** about him like a **tail.**'

'**Hard and sharp as flint.**'

'Another **idol** has **displaced** me....a **golden one**.'

'A **solitary child, neglected** by his friends, is left there.'

'The happiness he gives is as great as if it cost a fortune.'

'A **vacant** seat...and a crutch without an owner.'

''The boy is **Ignorance (f),** The girl is **Want.**'

'As good as gold.'

'I hope to live to be another man from what I was.'

'**Shrouded (g)** in a deep **black** garment.'

'...legs trembled beneath him.'

'Scrooge regarded **everyone with a delighted smile.**'

'I am as **light as a feather,** I am as **happy as an angel,** I am as **merry as a school boy.**'

'A merry Christmas to everybody.'

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Christmas

Decline of Christmas

At the beginning of the Victorian period, the celebration of Christmas was in decline. The **Industrial Revolution,** in full swing in Dickens' time, allowed workers little time for the celebration of Christmas.

Dickens describes the holidays as "a good time: a kind, **forgiving, charitable,** pleasant time: the only time I know of in the long calendar of the year, when men and women seem by one consent to open their shut-up **hearts freely,** and to think of other people below them as if they really were fellow-passengers to the grave, and not another race of creatures bound on other journeys."

Christian Values

Family

The role of the Family

The **Victorian** family was considered to be a very valuable part of the everyday life throughout the era. By today's standards, families were often considered to be very large. In 1870, you would find that the average household family contained five or six children.

Scenes of **family harmony (m)** and cosy firesides in many of Charles Dickens' stories seem in stark contrast to his own family life. Later Dickens' own family was marked by strife as his relationship with his wife deteriorated and his sons seemed to have inherited their paternal grandfather's trouble handling finances.

Reflection of Dickens' life

Responsibility

1834 Poor Law

Victorian society ignored the **poverty (e)** of its poorest. On the one hand were the rich who enjoyed comfort and feasting at Christmas, and on the other were children forced to live in dreadful conditions in **workhouses**.

Dickens uses the novel to present his feelings that the **rich** must help the **poor** in order for the world to be **improved**, and that it is the **rich's responsibility** to help the **poorest** in society. He exposes the unfair treatment of the poor, and shows that the **stereotypes** that the poor are lazy are untrue, which he does by using the Cratchit's, six children.

Stereotyping poorer citizens (J)

Redemption (i)

Role of religion

The Victorians were **religious** Many believe that the novella (a) should be seen as an allegory (n) of the Christian concept of redemption (i). **Redemption** is the idea of being saved from sin or evil.

Because Dickens **experienced** life living in **poverty** and **wealth** he wanted the **moral** message of the **novella** (a)to be that all human beings have the opportunity to behave in **kinder** ways towards each other. He wanted people to see the joy **redemption** (i) brings.

Performing kind deeds

	Key Terms	Definition
A	Novella	A **novella** or short **novel** is a work of narrative prose fiction, longer than a short story but shorter than a **novel.**
B	Executor	Someone responsible for following through on a task or duty.
C	Solitary	Existing alone.
D	Miserly	Reluctant to spend.
E	Poverty	Not having enough material possessions or income for a person's needs.
F	Ignorance	Lack of knowledge or information.
G	Shrouded	Cover or envelop so as to conceal from view.
H	Corpse	A dead body
I	Redemption	The action of saving or being saved from sin, error, or evil.
J	Citizens	A person of that country.
K	Misanthrope	Someone who hates other humans.
L	Clerk	Someone who keeps records.
M	Harmony	Things working well together.
N	Allegory	A story which is about one thing but has a hidden meaning.

Characters

Jacob Marley
Scrooge's old business partner who comes back as a ghost to warn him. He is **wrapped in a chain.**

Ghost of Christmas Past
A shapeshifting ghost with a **candle on top** of its head. It shows Scrooge the past.

Fezziwig
Scrooge's former boss who was nice and hosted parties for his workers.

Employs(S.2) → **Scrooge**
A rich Victorian misanthrope (k).

Shows a vision of (S.2):

Ghost of Christmas Present
A jolly ghost who looks **like Santa Claus**, only dressed in green. **He shows Scrooge the present and introduces him to two starving children, Ignorance (f)** and **Want.**

Ghost of Christmas Yet to Come
A ghost dressed in black who **looks like the Grim Reaper.** This ghost does not speak and shows Scrooge what could happen in the future if he does not change.

Belle
Scrooge's old girlfriend who he rejected in favour of money. He sees a vision of her future with a family.

Fan
Scrooge's younger sister..

Fred
Scrooge's nephew who invites him to Christmas dinner.

Employs → **Bob Cratchit**
Scrooge's clerk

Martha Cratchit
The eldest Cratchit child.

Belinda Cratchit
The second eldest Cratchit child.

Peter Cratchit
The third eldest Cratchit child.

Emily Cratchit
Bob's wife who hates Scrooge.

Tiny Tim
Bob's disabled son.

The twins
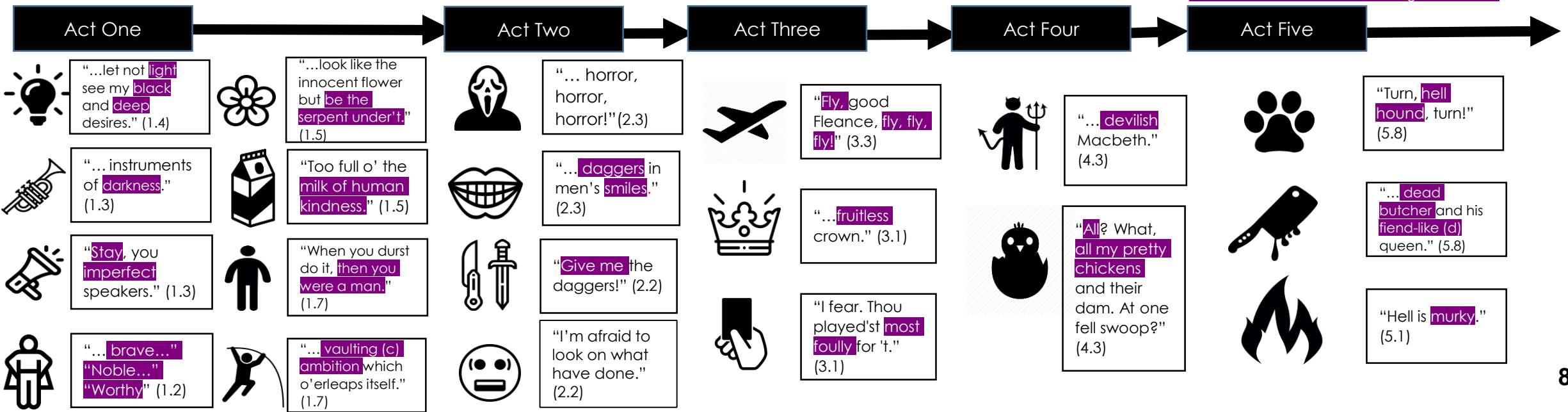The youngest Cratchit children.

7

ORMISTON SWB ACADEMY

1. The witches meet on the heath.
2. Macbeth and Banquo have fought and won a battle. They are praised for their bravery by the Captain.
3. The witches meet Macbeth and Banquo and they make three predictions. They predict that Macbeth will become Thane of Cawdor and eventually king. Banquo is told that he will not become king but that his children will be. Shortly after, Macbeth is told he is the new Thane of Cawdor!
4. Macbeth plans for Duncan to stay at his castle.
5. Lady Macbeth convinces Macbeth to kill King Duncan.
6. Duncan arrives at Macbeth's castle.
7. Macbeth tells Lady Macbeth he will not murder Duncan. However, she convinces him to go ahead with the murder.

1. Macbeth sees a dagger in front of him on his way to go and kill King Duncan.
2. Macbeth murders King Duncan. Macbeth's guilt is apparent as he appears covered in blood. Lady Macbeth feels no guilt and places the daggers on Duncan's guards.
3. The dead body is discovered by Macduff. Duncan's sons, Malcolm and Donalbain, run away: one to England and one to Ireland.
4. Macbeth and his wife become king and queen of Scotland.

1. Macbeth questions Banquo. He is suspicious of Banquo. As a result, he plans his murder with the help or murderers.
2. Banquo is murdered by the hired murderers but his son, Fleance, manages to escape.
3. At the coronation (a) banquet, Macbeth sees the ghost of Banquo at the table. Lady Macbeth persuades everyone that Macbeth is ill and they must leave and is furious at Macbeth.
4. Hecate, the witches's leader, is angry that the witches meddled with Macbeth without her permission.
5. Lennox shares his suspicions about Macbeth.

1. The witches share three more prophecies (b):
2. Macbeth is told that: he must fear Macduff; that he will not be harmed by anyone born of a woman and that he will never be defeated until Birnam Wood moves to 'High Dunsinane Hill.' They also share a vision of Banquo.
3. Macbeth has Macduff's wife and children murdered.
4. In England, Malcolm tests Macduff's loyalty and checks they are on the same side, wanting the same things.

1. Lady Macbeth sleepwalks: she is overcome with guilt and loneliness.
2. The rebels discuss the impending battle.
3. Macbeth declares he has nothing to fear from the battle. He appears confident.
4. The doctor reports on Lady Macbeth's condition. Macbeth orders him to cure her.
5. Malcom and Macduff's forces march to Dunsinane castle, disguising themselves with branches from the trees of Birnam Wood.
6. Lady Macbeth dies off stage.
7. Macbeth realises that he is not going to win but decides to at least die fighting.
8. Malcolm prepares for battle.
9. Macbeth kills young Siward.
10. Both Macduff and Macbeth fight and Macbeth is killed. His head displayed on a spike, as he was a traitor. Macduff is able to kill him as he reveals he was born by caesarean (k) section.
11. Malcolm is crowned the new king of Scotland.

Act One → **Act Two** → **Act Three** → **Act Four** → **Act Five**

"…let not light see my black and deep desires." (1.4)

"…look like the innocent flower but be the serpent under't." (1.5)

"… horror, horror, horror!" (2.3)

"Fly, good Fleance, fly, fly, fly!" (3.3)

"… devilish Macbeth." (4.3)

"Turn, hell hound, turn!" (5.8)

"… instruments of darkness." (1.3)

"Too full o' the milk of human kindness." (1.5)

"… daggers in men's smiles." (2.3)

"…fruitless crown." (3.1)

"All? What, all my pretty chickens and their dam. At one fell swoop?" (4.3)

"…dead butcher and his fiend-like (d) queen." (5.8)

"Stay, you imperfect speakers." (1.3)

"When you durst do it, then you were a man." (1.7)

"Give me the daggers!" (2.2)

"I fear. Thou played'st most foully for 't." (3.1)

"Hell is murky." (5.1)

"… brave…" "Noble…" "Worthy" (1.2)

"… vaulting (c) ambition which o'erleaps itself." (1.7)

"I'm afraid to look on what have done." (2.2)

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ORMISTON SWB ACADEMY

Kingship

The Great Chain of Being | **The Divine Right of Kings**

People believed that God set out an order for everything in the universe. This was known as **the Great Chain of Being**. On Earth, God created a social order for everybody and chose where you belonged. In other words, the king or queen was in charge because God put them there and they were only answerable to God (the **Divine Right of Kings**). This meant that **disobeying (n) the King was a sin.**

Religion

Ambition

Supernatural

King James I | **Witchcraft**

One of the most active centres of **witch hunting** was Scotland, where up to 4,000 people were burnt. This was due to royal witch-hunter King James I. **King James I wrote a book called 'Daemonologie'** in which he supported and encouraged the trials of witches. He believed the witches were controlled by the devil and he **described witchcraft as "high treason (e) against God".**

Appearance vs. Reality

Fate vs. Freewill

Gender

Gender stereotypes | **The Role of Women**

Men assumed a **dominant** position in the society; making it **patriarchal (f)**. The main responsibility of married women was to take care of the household matters and raise children. Before marriage, a girl was under the control of her father, after marriage her husband and after the death of her husband, her son. **Women** were made to depend on their male relatives throughout their lives and had **no power**.

Masculinity

Ambition

Kingship

King James I | **Treachery and Regicide**

King James did not tolerate **Catholics** and this led a group of them to plot to kill him and everyone sitting in the Houses of Parliament on **November 5th, 1605**. This was **known as the Gunpowder Plot** which had failed. Shakespeare's Macbeth was likely written in 1606 in the aftermath of the Gunpowder **Treason**. Along with its responsive nature, it is known that Shakespeare wrote the play with the intent of honouring and displaying loyalty to King James I as a **cautionary (g) tale.**

Religion

Revenge

	Key terms	Definition
A	**Coronation**	Where the king or queen is officially crowned.
B	**Prophecies**	A prediction of what will happen.
C	**Vaulting**	High and leaping over something.
D	**Fiend**	An evil spirit or demon.
E	**Treason**	Betraying your country.
F	**Patriarchy/al**	Men being dominant in society.
G	**Cautionary**	Something to make you take notice and perhaps stop.
H	**Tyrannical**	Being cruel with power.
I	**Regicide**	The act of killing the king.
J	**Righteous**	Behaving in the 'right' way or being morally good.
K	**Caesarean**	Being cut from the womb rather than a natural birth.
L	**Coven**	A group of witches.
M	**Succumbs**	Being unable to stop something negative happening.
N	**Disobey**	To go against orders.

Characters

Hecate
The leader of the witches' coven (l).

Three Witches
They meet Macbeth on the heath after his first battle and give Macbeth and Banquo prophecies (b) about their lives.

Influences A1.s3 →

Macbeth
Originally the Thane of Glamis…

Banquo
The loyal friend of Macbeth who witnesses the Witches' original prophecies (b) with him. His suspicions about Duncan's death lead Macbeth to act.

Kills A3.s4

Kills A2.s2

Duncan
The original King of Scotland.

Malcolm
Duncan's first son who is eventually crowned King of Scotland. He flees to England when his father is murdered.

Fleance
Banquo's son or "seed".

Donalbain
Donalbain is Duncan's second son who flees to Ireland once his father is murdered.

Lady Macbeth
The manipulative wife of Macbeth. We never know her name… **She eventually succumbs (m) to madness and kills herself.**

Kills A5.s8 ←

Macduff
The Thane of Fife who did not attend Macbeth's coronation (a). He forms an alliance with Malcolm when the truth comes out and eventually kills Macbeth.

Lady Macduff
She is murdered along with her children when Macbeth cannot find Macduff.

Join forces A4.s3 →

Macduff's Children
Macbeth orders their murder when he cannot find Macduff.

Minor Characters

Lennox
A young Thane of the Scottish kingdom.

Ross
Macbeth's cousin who is initially loyal to the Thane of Glamis.

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KS4 – English - An Inspector Calls

ORMISTON SWB ACADEMY

Act 1:
1. The Birling family are celebrating the engagement of Sheila Birling and Gerald Croft.
2. An Inspector arrives and tells them that a woman named Eva Smith has committed suicide.
3. After Inspector Goole questions Mr Birling, it becomes clear that Mr Birling fired Eva from his factory for asking for higher wages.
4. Inspector Goole then interrogates(I) Sheila and it is revealed that she used her position as a wealthy local person to get Eva fired from her job at Milwards.
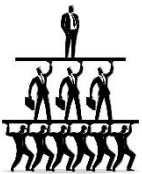
Act 2:
1. The interrogation (I) moves to Gerald; it comes to light that Gerald had an affair with Eva after she was fired from Milwards – Eva had changed her name to Daisy Renton by now – and he had kept her in an apartment for six months before ending their relationship.
2. The Inspector then questions Mrs Birling about when Eva came to her charity for help whilst pregnant. She refused to help her as she believed Eva to be "impertinent"(H) for using the name 'Mrs Birling'.

Act 3:
1. The Inspector then questions Eric as it has become clear that it was Eric who got Eva pregnant. Eric reveals that he forced himself on Eva. He says" 'I was in that state when a chap easily turns nasty." Eric then confesses to stealing money from his father but Eva refused the money.
2. Inspector Goole leaves after delivering his final speech; he warns that there is a lesson to be learnt in "fire and blood and anguish" if we do not start taking responsibility for our actions and start treating everyone in society fairly.
3. Mr Birling calls up the police department who confirm there is no Inspector Goole so the family believe they've been tricked until they receive a phone call to let them know a girl has committed suicide and an Inspector is on his way to question them.

| Act 1 | → | Act 2 | → | Act 3 |

Narrator:
"The dining room is of a fairly large suburban house, belonging to a prosperous manufacturer."

The Inspector:
"A chain of events."

The Inspector:
"A girl died tonight. A pretty, lively sort of girl, who never did anybody any harm. But she died in misery and agony – hating life –. "

Gerald:
"…she told me she'd been happier than she'd ever been before."

Eric:
"I was in that state when a chap easily turns nasty – and I threatened to make a row."

Mr Birling:
"…unsinkable, absolutely unsinkable."

Mr Birling:
"If you don't come down sharply on some of these people, they'd soon be asking for the earth."

Mrs Birling:
"Girls of that class."

The Inspector:
"Public men, Mr Birling, have responsibilities as well as privileges."

The Inspector:
"We don't live alone. We are members of one body. We are responsible for each other."

Mr Birling:
"…as if we were all mixed up together like bees in a hive – community and all that nonsense."

Sheila:
"But these girls aren't cheap labour – they're people."

Sheila:
"No, he's giving us the rope so that we'll hang ourselves."

Mrs Birling:
"As if a girl of that sort would ever refuse money!"

Sheila:
"The point is, you don't seem to have learnt anything."

Key terms	Definition
A Socialism	A political system where people work together for society; where wealth is shared and everyone benefits equally.
B Capitalism	A system of private ownership that allows the rich to get richer; this system allows the lower classes to be exploited (D).
C Dramatic Irony	When the audience has more knowledge of what is happening than a character.
D Exploitation	The action or fact of treating someone unfairly in order to benefit from their work.
E Bourgeoisie	Middle Class
F Proletariat	Working Class
G Patriarchy	A society ruled by males in which women are valued less and often act in a obedient way.
H Impertinent	Rude
I Interrogates	Asks lots of questions
J Morality	Having morals/ good values
K Conservatives	A political party who values more capitalist)b) attitudes.
L Mouthpiece	Someone placed there to speak your own views.
K Credited	Given the praise for.

10

Context

- The play was written in 1945 but set in 1912 – during this period, both world wars had happened
- Priestley fought in WWI and saw the horrors. At the end of the WWII he saw the class, age and gender divides all broken down and fought for the country to keep it like that, rather than go back to Edwardian attitudes of 1912 of patriarchy (g) and rich people ruling without considering the poor.
- After WWII, the Labour Party (a socialist (A) party) won the general election in a landslide victory against Churchill's Conservatives (k). Priestley held socialist (A) beliefs and wanted to encourage others to behave in a socialist (A) way
- In 1912 women did not have the right to vote and were seen as less than men; by 1945 they could vote and had more value in society after the war

Writer's Intentions

- Priestley wrote the morality (J) play, An Inspector Calls, as a warning for people to treat each other more equally otherwise horrible events could follow like World War One and Two.
- He highlighted the divisions that existed in pre-war Britain by setting the play in 1912 and through the characters.
- He wanted his 1945 audience to see how damaged society was and wanted to encourage them to work together and look after each other.
- He believed these socialist (A) values would help the country to avoid another war. He uses the character Inspector Goole as his mouthpiece for his socialist views and he shows his audience that the younger generation (through Eric and Sheila) have the ability to enforce these changes that society need.
- The arrogant and ignorant attitudes of Mr and Mrs Birling, the bourgeoisie (E), are what Priestley wanted society to shy away from and therefore characterises them as foolish and unlikeable.

Characters

Sybil Birling
Arthur's wife of a higher class. An unsympathetic woman who represents the bourgeoise (E) upper class. She is adamant that she is blameless in Eva Smith's suicide.

Eric Birling
Sybil and Arthur's son. He is adolescent in his manner and drinks too much. He forced himself on Eva, got her pregnant, then stole money from his father to support her. He accepts responsibility.

Edna
The maid of the Birling family; used a symbol of their wealth.

Eva Smith
She never appears on stage; she has already committed suicide. She represents the proletariat(F) who are exploited (D) by the upper classes, like the Birlings.

Arthur Birling
Sybil's husband. He represents the capitalist (B) class that controls the wealth and means of production; he is concerned with material gain and conventional attitudes. He is a wealthy factory owner in his mid 50s.

Sheila Birling
Sybil and Arthur's daughter. She's in her early twenties; bright, lively and optimistic. Unlike her parents and fiancé, she expresses deep regret for her role in Eva Smith's suicide.

Gerald Croft
Sheila's fiancé. Gerald Croft represents the aristocracy: the highest class of society, comprised of rich land owners and people who inherit their wealth from their parents. He had an affair with Eva.

Inspector Goole
A mysterious figure. His name evokes the word 'ghoul', meaning spirit or phantom. He appears to have supernatural powers of observation and persuasion. He reflects a socialist (A) point of view.

Winston Churchill
| War Hero | Often voted as one of the top three greatest ever Britons, Winston Churchill was the Conservative (k) Prime Minister who is often credited with being important in winning WWII (1945). | Conservative MP |

Responsibility
| Social Responsibility | Priestley believed in social responsibility and taking care of everyone in society; this is explored through each character's reaction to their role in Eva's death. | Responsibility for our Actions |

Age
| Younger Generation | This theme is explored through the older and younger generation (Mr and Mrs Birling vs Eric and Sheila); their reactions to their part in the "chain of events" demonstrates how the younger generation have more capacity for change. | Older Generation |

Gender
| Inequality | Women were treated as though they were inferior and they were often oppressed by the male characters in the patriarchal (G) society in which the play was set. | Role of Women |

Social Class
| Bourgeoisie | The Birlings and Gerald represent the upper classes who abuse their power and exploit (D) the lower classes who are represented through Eva and the Inspector. | Proletariat (f) |

11

ORMISTON SWB ACADEMY

The poet alludes to/implies/conveys/ signifies/expresses/illustrates…

The poet conjures up an image of…

The reader can infer…

At the start/end of the poem, the poet…

The word '_____' accentuates/evokes…

The poet's attitude becomes apparent…

The theme of _____ is explored…

The writer has employed the use of…

Step-by-step approach for Q1

Step 1: Read the question: what is the steer (a)?

Step 2: Where can you find the steer (a) in the poem?
- Start with the title
- Beginning/middle/end
- ONLY things that link to the steer (a)or focus.

Step 3: Link your methods or ideas
- 1 overarching thesis (d)statement that addresses the steer(a).
- 3 supporting ideas or methods.
- language and structure

Step 4: Explode the effects of these three methods OR ideas in the poem.

Step 5: Structure this in three paragraphs.
- Idea, meaning, method (language and /or structure), connotations (words), effect (on a reader), alternative (b) interpretations (c) and secondary reference.

In 'Give', how does the poet present the speaker's attitude to **generosity**? (24 marks)

Step 1:

Thesis:
The speaker wants people to be kinder to those less fortunate; this kindness is not necessarily monetary.

Give

Of all the public places, dear
to make a scene, I've chosen here.

Of all the doorways in the world
to choose to sleep, I've chosen yours.
I'm on the street, under the stars.

For coppers I can dance or sing.
For silver-swallow swords, eat fire.
For gold-escape from locks and chains.

It's not as if I'm holding out
for frankincense or myrrh, just change.

You give me tea. That's big of you.
I'm on my knees. I beg of you.

Simon Armitage

The direct address (f) used by the speaker makes the reader feel slightly uncomfortable at their own lack of action; the speaker is holding them accountable (g) and reminding them that they also have a social responsibility.

By listing these metals in order of their value and what they would do for each of them, the speaker conveys their desperation for kindness from people. We can conclude that the speaker feels dehumanised (l) from the unkindness they have faced as they are willing to act as a performer rather than a fellow human being.

The ambiguous (h) use of the word 'change' could be a literal (i) interpretation: the speaker seeks something as insignificant (j) as spare change. Or, this could be metaphorical (k): the speaker is hoping for a change in society's attitudes to those less fortunate.

Key terms		Definition
A	Steer	Direction/focus of the question.
B	Alternative	Another option or possibility.
C	Interpretations	Explaining the meaning of something.
D	Thesis	Statement or theory as an argument to be proved.
E	Speaker	The voice or narrator of the poem.
F	Direct Address	The writer communicates a message directly to an individual or group of individuals.
G	Accountable	Required to explain their actions; be responsible for something.
H	Ambiguous	Not having a clear meaning.
I	Literal	Something in its most basic sense; not metaphorical (k).
J	Insignificant	Not important.
K	Metaphorical	When something symbolizes something else (d).
L	Dehumanised	Take away human qualities.
M	Structure	The way something is put together. E.g. Stanzas, chapters, a novel, a play etc.

12

In both 'Give' and 'People Need People' the speakers describe their attitudes **towards how people treat each other.**

What are the similarities/differences between the ways the poets present these attitudes? (8 marks)

Step-by-step approach for Q2

Step 1: Read the question: what is the steer (a)?

Step 2: Where can you find the steer (a) in this poem and the other poem?
- Start with the title
- Beginning/middle/end
- ONLY things that link to the steer (a)or focus.

Step 3: Compare the methods.
- Find examples of how the poets have used language in each poem- are they the same or different?
- Find examples of how the poets have structured the poem – are they the same or different?

Step 4: Explode the effects of these methods in both poems.

Step 5: Structure this in one or two paragraphs.
- Poem A – method and effect
- Similar or different?
- Poem B – method and effect

Step 1: This links to the 'steer' of the question because it's about how people treat each other.

Step 2: The poet has repeated this phrase throughout the poem.

Step 4: This has been done to emphasise how much and how often we need other people.

Step 3: On the other hand, the speaker in 'Give' uses direct address: "I'm on my knees. I beg of you"

Step 4: This also emphasises how much people need others as the speaker has to 'beg' for human affection

People need people,
To walk to
To talk to
To cry and rely on,
People will always need people.
To love and to miss
To hug and to kiss,
It's useful to have other people.
To whom to moan
If you're all alone,
It's so hard to share
When no one is there.
There's not much to do
When there's no one but you.
People will always need people.
To please
To tease
To put you at ease,
People will always need people.
To make life appealing
And give life some meaning,
It's useful to have other people.
It you need a change
To whom will you turn.
If you need a lesson
From whom will you learn.
If you need to play
You'll know why I say
People will always need people.

Comparison Connectives	
Similarly	Contrastingly
In the same way	On the other hand
Also	However
In addition	Whereas
Tentative Phrases	
Could	Maybe
Might	Possibly
May	Perhaps
Appears	Seems to

Things to consider when comparing:
- Ideas
- Themes
- Effect on reader
- Writer's intentions
- Tone
- Mood and atmosphere
- Imagery
- Narrative voice
- Language techniques
- Structural (m) techniques
- Shift of focus
- Beginning
- End

	Keyword	Definition
A	Tyrannical	Being cruel with power.
B	Radical	A person who wants to change society.
C	Oppressed	Being treated harshly, often by rulers.
D	Imperialism	Pushing your country's ideas on others.
E	Displace	Taking over the place or role.
F	Industrial Revolution	The use of machines in factories.
G	Romantic era	Poems about nature and its impact in a changing industrial (f) word.
H	Hierarchy	A system where people or items are ranked by status or power.
I	Terrorists	A person or group who uses violence to achieve their goals to change world.
J	Governor	The person in charge.

Romantic era (g)

Imperialism (d)

Global Conflict

Global Conflict

Global Displacement (e)

1792	→	1854	→	1914-18	→	1939-45	→	1969 onwards
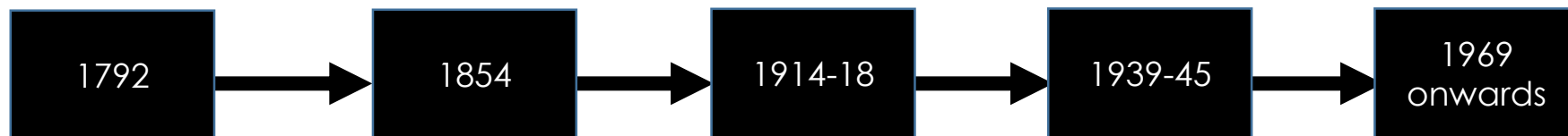
Poems:
1. **London**
2. **Extracts from the Prelude**
3. **Ozymandias**

Key ideas:
- Poems are not about love. Poems are about personal growth and
- appreciating nature during the industrial revolution (f).
- Poets sometimes fought back against what they thought were tyrannical (a) rulers who oppressed (c) normal people.
- This made them considered radical (b).

Poems:
4. **My Last Duchess**
5. **Charge of the Light Brigade**

Key ideas:
- 1 in 5 people in the world called Queen Victoria of Great Britain their governor (j).
- People were very poor.
- People lacked rights.
- The social hierarchy (h) still defined who had power.

Poems:
6. **Exposure**
7. **Bayonet Charge**

Key ideas:
- In the First World War:
- 20 million people died.
- It was fought from trenches (holes in the ground) in Europe.

Poems:
11. **Kamikaze**

Key ideas:
- In the Second World War:
- 75 million people died.
- It was fought across the globe.
- Pearl Harbour in the USA was attacked in December 1941. Japanese pilots were trained to bomb ships by flying into them. This meant they committed suicide for their country.
- Following this, America came into the war on Britain's side, changing which side had the upper hand in the war.

Poems:
8. **Storm on the Island**
9. **War Photographer**
10. **The Emigree**
12. **Tissue**
13 **Checkin' Out Me History**
14. **Remains**
15. **Poppies**

Key ideas
- Wars were often fought against smaller countries to stop tyrants (a) or terrorists (i).
- Locals thought Western countries invaded for oil and other resources.
- Many locals were still loyal to the tyrants (a).

14

War and conflict

Power of nature

Power of the state

7 1957

"He lugged a rifle numb as a smashed arm."

The simile (k) of the rifle being like a broken limb, slowing him down, shows how the army weighs heavily.

9 1985

"A hundred agonies in black and white."

The juxtaposition (n) of agony as a fairly plain image shows the contrast between the victims and speaker.

8 1966

"We are bombarded by the empty air."

The air is personified (l) as being like a bomber plane.

2 1799

"A huge peak, black and huge… upreared its head."

The peak personified (l) as rising its 'huge' head shows how powerful nature appears, scaring the speaker.

1 1792

"I wander through each chartered street."

'Chartered' implies even the street is owned by the state.

13 2005

"Dem tell me wha dem want to tell me."

The repetition (p) of 'dem tell me' shows the control the state has to control what the speaker knows.

5 1854

"…into the jaws of death/ into the mouth of hell."

The personification (l) of death having 'jaws' shows it can kill like wild animals.

6 1917

"Tonight this frost will fasten on this mud and us."

The metaphor (j) 'fasten' shows how the weather has power to hold them down.

10 1993

"There once was a country... I left it as a child."

The war between tyrants (a) has forced the Émigré (q) to leave, making their country in the past tense.

Effects of war

Power of the individual/ authority

14 2008

"…his blood shadow stays on the street."

The imagery (o) of the blood being a shadow could imply it's following him, like his memories.

15 2009

"I traced the inscriptions on the war memorial."

The grieving speaker is visualising how her child could have joined the war-dead with the verb 'traced'.

11 2000s

"A shaven head full of powerful incantations."

The word 'incantations' implies the kamikaze pilot is under a spell and being controlled against their will.

4 1842

"I choose never to stoop."

The personal pronoun (m) 'I' shows how the Duke feels he is always central and most important.

3 1817

"My name is **Ozymandias**, king of kings."

The metaphor (j) 'king of kings' implies the tyrant (a) feels he is more powerful than all other rulers.

Power of humans

12 2000s

"Fine slips from grocery shops… might fly our lives like paper kites."

The simile (k) of 'paper kites' shows how fragile our lives truly are being controlled by outside forces.

Keyword	Definition
J Metaphor	Comparing two unlike things by saying something is something else.
K Simile	Comparing two things by saying something is like something else.
L Personification	Giving non-human things human qualities.
M Personal pronouns	Words which replace names: I, you, he, she, it, we, they, me, him, her, us, and them .
N Juxtaposition	Where two things are placed together solely to compare them.
O Imagery	Descriptive language which helps to create an image for the reader.
P Repetition	Where a word or idea is reused often for a particular meaning.
Q Émigré	A person who has left their country for another. Often, they have been forced out.

Number on context page.

When written

Quote

Analysis of quote

1 2
2000s

"blood shadow stays on the street"

The metaphor (j) 'king of kings' implies the tyrant feels he is above all of rulers.

15

Start of the exam

✓ Use the context box to infer (e) information about what the text is about and make predictions

Top Tips
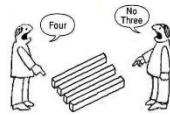
✓ Use the **What/How/Why** paragraph structure,

✓ On questions 2 and 4, **zoom in** on words from text,

✓ Refer to the **steer of the question throughout** and

✓ Keep quotes to 5-10 words long.

1: The '4 things' Question

– List four things from a specific (a) part of the source.

You should: Select appropriate (b) evidence from text in response to the statement.

4 marks

2: The 'Language' Question

How does the writer use language to…? based on a specific part of the source e.g. lines 8-18.

You should: Explain or analyse the effect of language.

8 marks

3 The 'Structure' Question

How has the writer structured the text to…? Based on the whole text.

You should: Explain or analyse the effect or how structure interests the reader.

8 marks

4: The 'Agree' Question

20 marks

To what extent do you agree with the statement provided? Based on a specific part of the source.

You should:

❑ Judge the effect(s) on the reader,
❑ Understand the writer's methods (d),
❑ Use a range of textual references and quotes and
❑ Keep a relevant focus on the question throughout.

Active Verbs (similar to" shows")

- Connotes
- Depicts
- Demonstrates
- Illustrates
- Portrays
- Reflects
- Conveys
- Exhibits
- Emphasises
- Implies
- Presents
- Suggests

The writer _(active verb)___ the…

Question	marks	% of paper	% of GCSE
1	4	10	5
2	8	20	10
3	8	20	10
4	20	50	25

	Key terms	Definition
A	Specific	Clearly identified or marked out
B	Appropriate	Suitable for the focus of the question
C	Structure	The way a text is put together, whether through paragraphs, subheading or flashbacks (f) etc.
D	Methods	The way something has been achieved.
E	Infer	To work out from the information available in the text.

16

AO	marks	% of paper	% of GCSE
5	24	30	15
6	16	20	10

5: The 'Writing for a purpose' question.

Question 5: Writing a narrative or description AO5/AO6
You will produce a story or description based on a picture or a sentence detailing your task.

*Your local newspaper is running a creative writing competition and the best entries will be published. **Either** write a story about time travel as suggested by this picture or write a story entitled 'Stranded'.*

Key skills:
AO5: You should:
Ensure the story or description is **clear.**

AO6: You should:
Use **varied and accurate** sentence structures.

Start of the exam

✓ 5 minute plan with question in mind.

Top Tips

✓ Keep your tone consistent (g) throughout: do not use words which suggest a light and playful atmosphere (b) after you have just spent 15 minutes making the scene sound scary.

✓ Use a variety of structural (e) features: flashbacks (f),

✓ Keep to one or two characters and

✓ 5 minutes' of checking SPaG, including paragraphing.

Punctuation to use

Question Mark	**?**	Exclamation Mark	**!**
Comma	**,**	Full stop	**.**
Semi-Colon	**;**	Speech Marks	**" "**
Colon	**:**	Apostrophe	**'**

Key language devices to use:

Simile
Where you compare two things by saying they're like something else:

"He was as timid as an urban fox."

Metaphor
Where you compare two things by saying something is something else when it clearly is not.

"She was a night owl."

Pathetic fallacy
Where you use the weather to set the atmosphere (b).

"The sky became cloudy and darkness fell."

Sensory Language
Where you use vocabulary to describe the character's five senses.

"I could taste blood streaming from my lip."

Overview of each paragraph

P1: Always begin with the weather and describe the scene or setting– decide if it's positive or negative.

P2: Character focus – introduce character – show but not tell then lead in to a flashback. Use a symbol, item or even to trigger the shift in time.

P3: Come back to present moment, developing the character in more detail. Keep something withheld!

P4: Describe the setting – zoom out to change focus. Include a motif (d).

P5: Cyclical (a) development – back to weather/scene/setting – change from positive to negative or vice versa (c).

Great sentence openers

Connective	Unless, although.
Adverb	Regretfully, sadly.
Simile	Like a mouse…
Metaphor	Brave lions, they…
Feeling	Jealous, she tore up his clothes.
Verb 'ing' clause	Giggling and laughing, they ran to school.

	Key terms	Definition
A	Cyclical	Returning back to a previous point like a cycle.
B	Atmosphere	The tone or mood.
C	Vice versa	The two items can be switched around or reversed.
D	Motif	An object which is repeated and has importance to the events. E.g. a raven for death.
E	Structural	The way a text is put together, whether through paragraphs, subheading or flashbacks (f) etc.
F	Flashback	When the text goes back in time.
G	Consistent	Keeping something the same.

17

Question	marks	% of paper	% of GCSE
1	4	10	5
2	8	20	10
3	12	20	10
4	16	50	25

Start of the exam

✓ Use the context box to infer (e) information about what the text is about and make predictions.

Top Tips

✓ Use the **What/How/Why** paragraph structure.

✓ On questions 3 and 4, **zoom in** on words from text.

✓ Refer to the steer (f) of the question throughout.

✓ Use a range of **comparison connectives.**

✓ Keep quotes to 5-10 words long.

1: The 'True or False' Question

-Choose **four** statements which are true.

Draw a box around the lines to find the information.

Ensure to **shade** the boxes, not tick or cross.

4 marks

2: The 'Summary' Question

-Use details from both sources to write a summary of …

Have 4 small quotes with **clear differences or similarities.**

Write 4 small paragraphs **inferring** (e) how they are different or similar.

Do not explain language devices, c).

8 marks

3 The 'Language' Question

-How does the writer **use language** to…? based on a specific (a) part of the source e.g. lines 8-18.

Explain or analyse the **effect of language.**

12 marks

4: The 'Comparison' Question

16 marks

Find **4-5** differences for the **question focus.**

Find a **quote** from each source for each of the differences.

Find **language or structure devices** in those quotes. Use **connectives** to link paragraphs and connect ideas.

Write 4-5 paragraphs, using **methods** (d)and focusing on the question.

Active Verbs (similar to" shows")

- Connotes
- Depicts
- Demonstrates
- Illustrates
- Portrays
- Reflects
- Conveys
- Exhibits
- Emphasises
- Implies
- Presents
- Suggests

The writer _(active verb)___ the…

	Key terms	Definition
A	Specific	Clearly identified or marked out.
B	Appropriate	Suitable for the focus of the question.
C	Devices	A thing made for a specific purpose.
D	Methods	The ways a writer achieves their aim.
E	Infer	Work out from the information.
F	Steer	What the examiner has asked you to focus on when answering.

18

Section B: Question 5

Start of the exam

- ✓ 5 minute plan with question in mind.
- ✓ Underline the **audience (a), purpose (b) and form (c)** the task/question
- ✓ 35 minute response
- ✓ 5 minute checking SPaG, including paragraphing.

Top Tips

- ✓ Consider the following first: what do you **already know** about the topic?
- ✓ What is your **opinion** on the topic?
- ✓ Do you have any **personal experiences** that could support your ideas?
- ✓ What would others' opinion be?
- ✓ What is the **effect on others or society**?

5: The 'Writing for a purpose' question.

Question 5: Writing to argue   AO5/AO6
You will produce a written text for a specified **audience (a), purpose (b) and form (c)**. You will give your own perspective on the theme introduced in Part A. **Example question:**   *"Cars are dangerous."*

Write a letter to the Minister for Transport arguing your point of view on this statement.

Key skills:
AO5: You should:

Ensure the story or description is **clear.**

AO6: You should:

Use **varied and accurate** sentence structures.

AO	marks	% of paper	% of GCSE
5	24	30	15
6	16	20	10

Letter

Dear Sir/Madam or name • Addresses • Date • Paragraphs • Yours sincerely/faithfully.

Speech

- Clear address to audience • Use rhetorical devices throughout
- A clear sign off, e.g. 'Thank you for listening'.

Article

- Clear/apt/original title
- Introductory paragraph
- Use persuasive techniques to convince reader of your viewpoint.

Leaflet

- Clear/apt/original title
- Organisational devices such as inventive subheadings or boxes
- Bullet points.

Overview of each paragraph

P1: Outline your **main opinion** (big idea) and list your **three reasons** (supportive ideas). You could use a **circular structure (e) (hook)**): either open with a **descriptive hook (i)** 'Imagine a world where..' or a **questioning hook** 'Have you ever thought...' or an **anecdotal hook** 'Meet Dave…' – a made up character that is affected or not affected by the statement.

P2: **First reason** acknowledges **audience (a), purpose (b) and form (c)** and support main idea - back up with anecdotal evidence or a scenario(h).

P3: **Second reason** supports main idea - back up with anecdotal (f) evidence or a scenario.

P4: Use a **counter argument with third reason or how** might this issue impact on society?

P5: **Conclusion** – refer back to the circular structure (e). Comment on how this problem or statement might impact on others or society. **Return to 'hook' (i) from the beginning**. Imagine a world now that.. Answer question from the beginning or return to 'Dave'.

	Key terms	Definition
A	Audience	This is who you are aiming your writing towards.
B	Purpose	This is why you are writing. Is it to inform, persuade, advise etc?
C	Form	This is what your writing will be in the form of i.e. a letter, speech, article, leaflet, blog etc.
D	Hook	A technique that "**hooks**" the reader's attention so that he or she will keep on reading.
E	Circular structure	You start and end using the same idea or message.
F	Anecdote	A short personal story adding meaning or significance to your message.
G	Counter	The opposite point of view.
H	Scenario	An imaginary situation.
I	Hook	Something which catches the reader's attention.

19

Before progressing through this section of work, you may find it useful to look back at **Crossover Unit 52-Direct and Inverse Proportion** knowledge organiser.

Keyword/ Skill	Definition/Tip
Direct Proportion	Two quantities change in the same way. When one increases or decrease, so does the other one.
Inverse Proportion	As one quantity increases the other decreases.
Equation	The value of two expressions is equal. (Shown by =)
Constant of Proportionality	A constant value, written as k, relating to amounts that rise or fall uniformly together.

Reminders:
Direct Proportion
y is directly proportional to x
$y \propto x$

$y = kx$ — k multiplied by x
— k is constant (of proportionality)

Inverse Proportion
y is inversely proportional to x

$y \propto \dfrac{k}{x}$ — k is divided by x

Example 2
y is directly proportional to the square of x.
When x = 6, y = 27. Find y when x = 4.

$y \propto x^2$
$y = k \times x^2$

$27 = k \times 36$

$\dfrac{27}{36} = k$

$0.75 = k$

$y = 0.75 \times 4^2$
$y = 0.75 \times 16$

y = 12

Example 1
y is directly proportional to √x

x	36	a
y	2	5

Work out the value of a
$y = k \times \sqrt{a}$
$2 = k \times \sqrt{36}$
$2 = k \times 6$

$\dfrac{2}{6} = k$

$k = \dfrac{1}{3}$

$5 = \dfrac{1}{3} \times \sqrt{a}$

$15 = \sqrt{a}$

$15^2 = a$

a = 225

Example 3
R is inversely proportional to the square root of F. When R = 32, F = 16. Find F when R = 16

Replace 'inversely proportional' with '= k ÷'

$R = \dfrac{k}{\sqrt{F}}$

$32 = \dfrac{k}{\sqrt{16}}$

$32 = \dfrac{k}{4}$

k = 128

$16 = \dfrac{128}{\sqrt{F}}$

$16 = \dfrac{128}{\sqrt{F}}$

$\sqrt{F} = 8$

F = 8² = 64

Other topics/Units this could appear in:
- A-level
- Pure 1
- Differentiation
- Exponentials and Logarithms
- Pure 2
- Differentiation

Exam Tips
- When you see words, "Inversely Proportional to" replace with "= k ÷" to get you started.
- These questions can range from 2-4 marks.
- You will gain a mark for finding 'k' in each case.

20

Before progressing through this section of work, you may find it useful to look back at **Crossover Unit 46 – Congruence & Similar Shapes** knowledge organiser.

Keyword/ Skill	Definition/tip
Similar	Two shapes are **similar** when one can become the other after a **resize**, flip, slide or turn.
Length	A measure of distance. How far from end to end, or from one end to another.
Scale factor	The ratio by which a length or other measurement is increased or decreased
Ratio	A ratio shows the relative sizes of 2 or more values.
Area	The size of a surface
Volume	The amount of 3D space something takes up. Also called capacity.

DON'T FORGET

Linear scale factor = 3

Area scale factor = 3^2 = 9

Volume scale factor = 3^3 = 27

4cm

12cm

Reminder- Linear Scale Factor
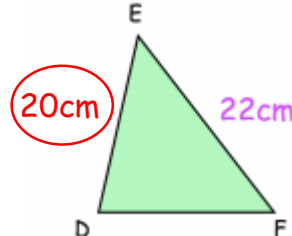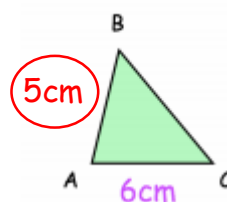
In order to find length DF
Write two of the corresponding sides as a ratio =

AB : DE
5 : 20
1 : 4

With a scale factor of 4

Simplify

This is the scale factor

To find DF- look at the corresponding length AC = 6cm
6 x 4 = **24cm**

Area Scale factor
Example
The 2 supermarket tickets are mathematically similar

2 cm

6 cm

The area of the smaller ticket is 7cm^2.
Calculate the area of the larger tickets.

Corresponding lengths written as a ratio = 2 : 6
1 : 3

Linear Scale factor = 3
Area Scale factor = 3^2 = 9

Area of small ticket x area scale factor =
7 x 9 = **63cm²**

Volume Scale Factor
Example
A child's rugby ball is 10cm long and has a volume of 200cm3.
It is similar in shape to a full size rugby ball. A full size rugby ball is 22cm long. Find the volume of the full size rugby ball.
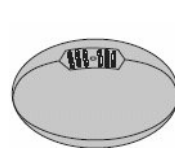
10cm

22cm

Corresponding lengths = 10 : 22
1 : 2.2

Scale factor = 2.2^3
200 x 2.23 = **2129.6cm³**

Other topics/Units this could appear in:
- Congruence
- Geometric Proof

Exam Tips
- To help you start similarity questions you will need to find the scale factor.
- You will gain a mark for recognising and using area and volume scale factor.

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Before progressing through this section of work, you may find it useful to look back at **Crossover Unit 46 – Congruence & Similar Shapes**

Problem Solving with Area Similarity
Example 1:
A model yacht is made to a scale of $\frac{1}{20}$ of the size of the real yacht. The area of the sail of the model is 150cm^2. What is the area of the sail of the real yacht.

$\frac{1}{20}$ can be written as the linear scale factor = 1 : 20

Area scale factor = 20^2 = 400

Area of real sail = 400 x area of model sail
                  = 400 x 150
                  = **60,000cm²**

Take care if you are asked to give your answer in m^2

To convert from cm^2 into m^2 you need to divide by 100^2 = 10,000

60,000 ÷ 10,000 = **6m²**

Problem Solving with Area Similarity
Example 2:

A 20 Euro note is a rectangle 133mm long and 72mm wide.

A 50 Euro note is a rectangle 165mm long and 82mm wide.

Show that the two rectangles are not mathematically similar.

The rectangles will be mathematically similar if the scale factors for the lengths and widths are equal. You need to show that they are different.

Lengths	Widths
133 : 165	72 : 82
1 : 1.240606	1 : 1.1388…

The scale factors are different therefore the rectangles are not mathematically similar.

Problem Solving with Area and Volume Similarity
Example:
Mark has made a clay model. He will now make a clay statue that is mathematically similar to the clay model.

The model has a base area of 6cm^2 . The statue will have a base area of 253.5cm^2
Mark used **2kg** of clay to make the model.
Clay is sold in **10kg** bags.
Mark has to buy all the clay he needs to make the statue.
How many bags of clay will Mark need to buy?

Use the area scale factor to calculate linear scale factor, then the volume scale factor.

Area scale factor = 253.5 ÷ 6 =42.25
Linear scale factor = √42.25 = 6.5
Volume scale factor = 6.5^3 = 274.625

274.625 x 2 =549.25kg of clay needed
549.25 ÷ 10 = 54.925kg clay needed
= **55 bags**

Keyword/ Skill	Definition/tip
Similar	Two shapes are **Similar** when one can become the other after a **resize**, flip, slide or turn.
Length	A measure of distance. How far from end to end, or from one end to another.
Scale Factor	The ratio by which a length or other measurement is increased or decreased.
Ratio	A ratio shows the relative sizes of 2 or more values.
Area	The size of a surface. The amount of space in a 2D surface.
Volume	The amount of 3D space something takes up. Also called capacity.

Other topics/Units this could appear in:
- Congruence
- Geometric Proof

Exam Tips
- To help you start similarity questions you will need to find the scale factor.
- You will gain a mark for recognizing and using area and volume scale factor.

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Before starting work with graphs of trigonometric functions & further trigonometry, you may find it useful to look back at the **Crossover Unit 34 – Pythagoras & Trigonometry** knowledge organiser.

Exam Tip – Make sure if you're asked to draw graphs you use a pencil. Your graphs need to be a smooth curve, no straight lines!

Sine (Sin) Function Graph

$$y = \sin(x)$$
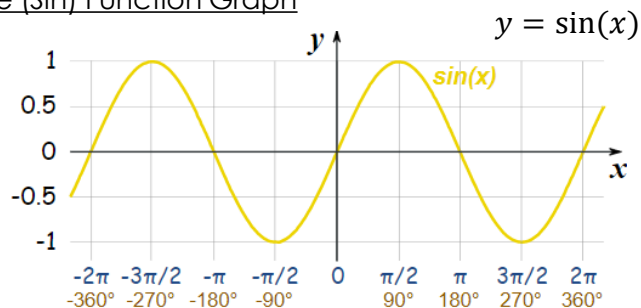
The sine graph repeats every 360° in both directions of the graph.
The graph goes through the origin and has a maximum y-value of 1 and a minimum y-value of -1.

Cosine (Cos) Function Graph

$$y = \cos(x)$$
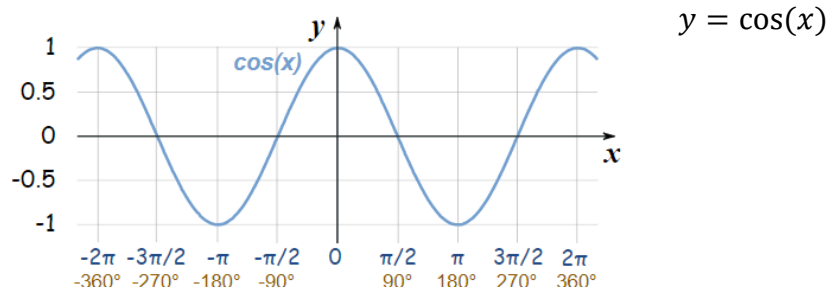
The cosine graph repeats every 360° in both directions of the graph.
The graph cuts the y axis at 1.
It has a maximum y-value of 1 and a minimum y-value of -1.

Tangent (Tan) Function Graph

$$y = \tan(x)$$
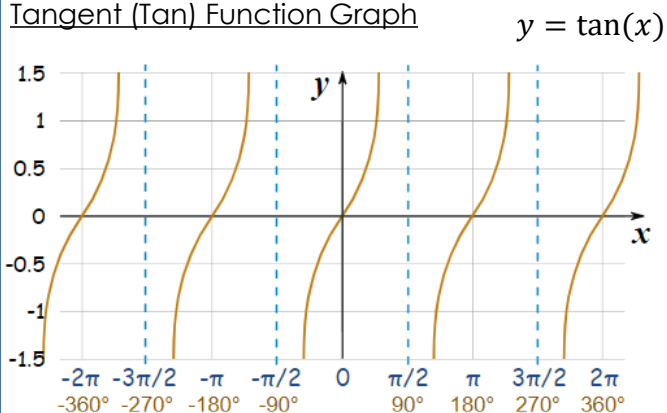
The tan graph goes between positive and negative infinity, crossing the x-axis at 0 every 180°.

The graph goes through the origin.
Every 90° ($\frac{\pi}{2} radians$) and 270° ($\frac{3\pi}{2} radians$) the function is 'undefined'.
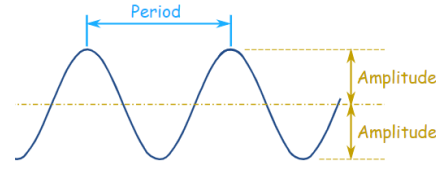
Sin & Cos Graph
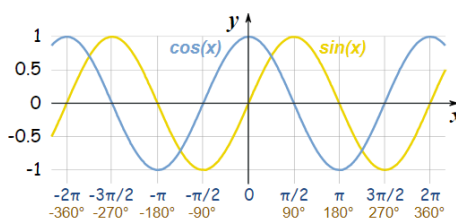
The sin and cos graph are the exact shame shape and are exactly 90° ($\frac{\pi}{2} radians$) apart.

Exact Trig Values

	0°	30°	45°	60°	90°
Sinθ	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1
Cosθ	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0
Tanθ	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	Undefined

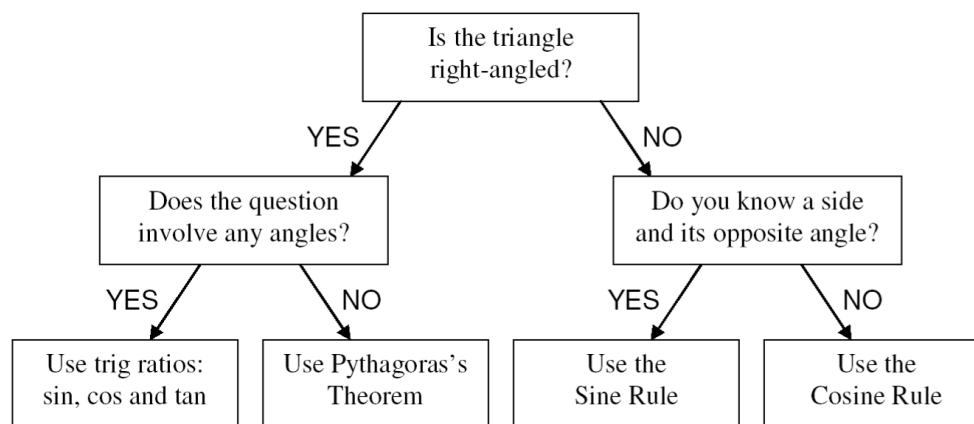| Keyword/Skill	Definition/Tips
Trigonometry	Trigonometry is the study of triangles: their angles, lengths and more.
Hypotenuse	The longest side of a right-angled triangle. It is always opposite the right angle.
Adjacent & Opposite	Adjacent side – Next to the marked angle. Opposite side – Opposite the marked angle
Inverse Trig Functions	You use these when calculating angles: $Sin^{-1}(x)$ $Cos^{-1}(x)$ $Tan^{-1}(x)$
Sin/Sine	The ratio of the length of the **opposite** side to the length of the **hypotenuse**
Cos/Cosine	The ratio of the length of the **adjacent** side to the length of the **hypotenuse**
Tan/Tangent	The ratio of the length of the **opposite** side to the length of the **adjacent** side
Radians	A unit of measure for angles. The angle made by taking the radius and wrapping it round the circle. Radians are measured using π. Degrees-> 180° = π <- Radians
Transformations	A change in position or size
Plane	A flat Surface
Periodic Function	A function (like **Sine** or **Cosine**) that repeats forever
Amplitude	The height of the centre line (x-axis) to the top (or bottom) of a graph

Other Topics/Units this could appear in:

• A-Level Topics – Core Trigonometry

23

The following rules are all used with non-right angled triangles. You label these triangles with 3 letters for the sides and angles. A side needs to match up with the angle opposite it. Example ->
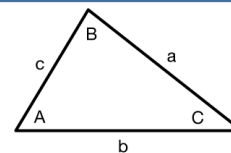
Sine Rule

You use the sine rule when:
- You are looking for a side and have 2 angles and a side.
- You are looking for an angle and have an angle and 2 sides.

Sine Rule: $\frac{a}{Sin(A)} = \frac{b}{Sin(B)} = \frac{c}{Sin(C)}$

Example:
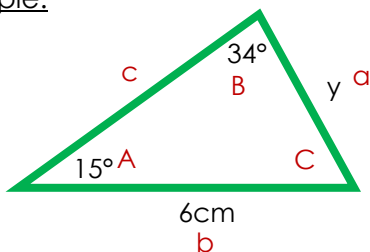
Always label your triangle first

$\frac{y}{Sin(15°)} = \frac{6}{Sin(34°)}$

$y = \frac{6}{Sin(34°)} \times Sin(15°)$

$y = 2.7770626 = 2.8cm\ (1d.p.)$

Cosine Rule

You use the cosine rule when:
- You are looking for an angle and have 3 sides.
- You are looking for a side and have an angle and 2 sides.

Cosine Rule: $\qquad a^2 = b^2 + c^2 - 2bcCos(A)$

(You will sometimes need to rearrange this formula. If you need help with rearranging equations you can look back at **Working Above Unit 2b – Rearranging Equations**)

Example:
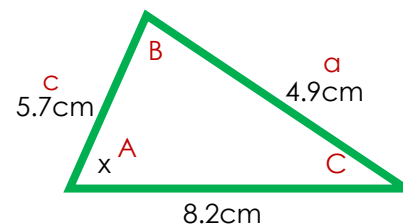
Substitute values into the formula

$4.9^2 = 8.2^2 + 5.7^2 - (2 \times 8.2 \times 5.7 \times Cos(A))$

$24.01 = 99.73 - 93.48 \times Cos(A)$ Then make Cos(A) the subject of the equation

$Cos(A) = \frac{99.73 - 24.01}{93.48} = 0.81\ (2d.p.)$

$Cos^{-1}(0.81) = 35.9° \qquad x = 35.9°$

Area of a Triangle

Area of a triangle: $\frac{1}{2}abSin(C)$
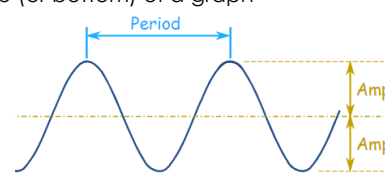
This is used for finding the area of non-right angled triangles.

Area $= \frac{1}{2}abSin(C)$
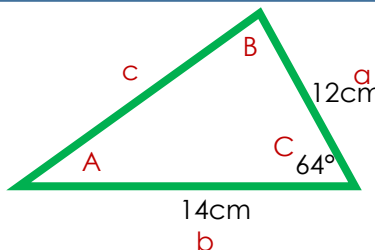
Area $= \frac{1}{2} \times 12 \times 14 \times Sin(64°)$

Area $= 76.13cm^2$

Keyword/Skill	Definition/Tips
Trigonometry	Trigonometry is the study of triangles: their angles, lengths and more.
Hypotenuse	The longest side of a right-angled triangle. It is always opposite the right angle.
Adjacent & Opposite	Adjacent side – Next to the marked angle Opposite side – Opposite the marked angle
Trigonometric Ratios/Functions	The special measurements of a right-angled triangle: **Sin**/Sine **Cos**/Cosine **Tan**/Tangent
Inverse Trig Functions	You use these when calculating angles: $Sin^{-1}(x)$ $Cos^{-1}(x)$ $Tan^{-1}(x)$
Sin/Sine	The ratio of the length of the **opposite** side to the length of the **hypotenuse**
Cos/Cosine	The ratio of the length of the **adjacent** side to the length of the **hypotenuse**
Tan/Tangent	The ratio of the length of the **opposite** side to the length of the **adjacent** side
Transformations	A change in position or size
Plane	A flat Surface
Periodic Function	A function (like **Sine** or **Cosine**) that repeats forever
Amplitude	The height of the centre line (x-axis) to the top (or bottom) of a graph

Other Topics/Units this could appear in:

- A-Level Topics – Core Trigonometry

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Calculator Help

Here are the **trig functions** on your calculator. You use these ones when you are finding a length.

To get the **inverse trig functions** you need to press the SHIFT button first before you press the function you need. You use these ones when you are finding an angle.

Which Rule to use

Is the triangle right-angled?

YES → Does the question involve any angles?

YES → Use trig ratios: sin, cos and tan

NO → Use Pythagoras's Theorem

NO → Do you know a side and its opposite angle?

YES → Use the Sine Rule

NO → Use the Cosine Rule

Exam Tip:
The sin, cos & area of a triangle formulas will sometimes need to be rearranged. You need to be able to decide which rule to use and when you will need to rearrange it. You also need to learn these rules as you will not get them in the exam!

Keyword/Skill	Definition/Tips
Trigonometry	Trigonometry is the study of triangles: their angles, lengths and more.
Hypotenuse	The longest side of a right-angled triangle. It is always opposite the right angle.
Adjacent & Opposite	Adjacent side – Next to the marked angle Opposite side – Opposite the marked angle
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Plane	A flat Surface
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Amplitude	The height of the centre line (x-axis) to the top (or bottom) of a graph

Other Topics/Units this could appear in:

• A-Level Topics – Core Trigonometry

*Before starting work with sampling, you may find it useful to look back at the **Crossover Unit 38 Sampling** knowledge organiser.*

Types of Sampling

Random Sampling

Random Sampling is when every person in the group you are interested in has an equal chance of being chosen.

Names might be placed in a hat and then picked out or names could be chosen randomly by a computer.

Stratified Sampling

Where the group of people, (population) is divided into smaller groups so that the same PROPORTION can be taken.

E.G. if 50 out of 1000 pupils were asked a favourite pop group,,
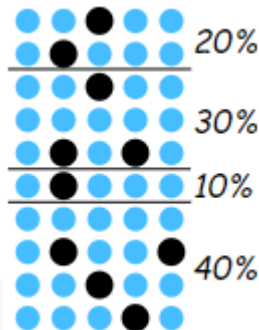
Year Group	No. of Pupils	How to work out pupils in each group.	No of Pupils in Sample
7	180	$\frac{180}{1000}$ X 50 =9	9
8	200	$\frac{200}{1000}$ X 50 =10	10
9	240	$\frac{240}{1000}$ X 50 = 12	12
10	220	$\frac{220}{1000}$ X 50 = 11	11
11	160	$\frac{160}{1000}$ X 50 = 8	8

Check your answers add up to 50
(9+10+12+11+8 = 50).

Systematic Sampling

This follows a system. E.G every fourth person is chosen.

20%
30%
10%
40%
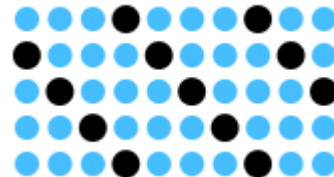
Capture/Recapture

You might recognise this from biology! The method is:
1) Take a sample of the population
2) Mark each item
3) Put the items back into the population and ensure **they are thoroughly mixed**
4) Take a second sample and count how many of your sample are marked
5) The proportion of marked items in your new sample should be the same as the proportion of marked items from the population in your first sample

Example: *10 fish are caught in a lake, marked and released back into the lake. A week later, 20 fish are caught and 4 are found to be marked. Estimate the number of fish in the lake.*

$$\frac{10}{n} = \frac{4}{20}$$

$$n = \frac{10 \times 20}{4}$$

$$n = 50$$

There are approximately 50 fish in the lake

Keyword/Skill	Definition/Tips
Data	Facts that are collected.
Population	The whole group from where the sample is taken, i.e. a whole year group.
Primary Data	Data you collect yourself.
Secondary Data	Data which other people have collected.
Hypothesis	An idea or an assumption that you can test to see of it is true.
Quantitative Data	Data that is given in numbers.
Qualitative Data	Data that is given in words.
Discrete Data	Data that only takes a certain value. E.G. number of people in class. (Only whole numbers)
Continuous Data	Data that has a number of possibilities between two fixed points. E.G. The weight of a new born baby (Can include decimal numbers)
Bias	A built in error that makes the results wrong or "unfair", i.e. a weighted dice so when rolled it lands on 6 more than the rest.

Other Topics/Units this could appear in:

- A Level Statistics - Data Collection

26

*Before starting work with quartiles, you may find it useful to look back at the **Crossover Unit 23 Averages and Unit 24 Averages from a Table** knowledge organisers.*
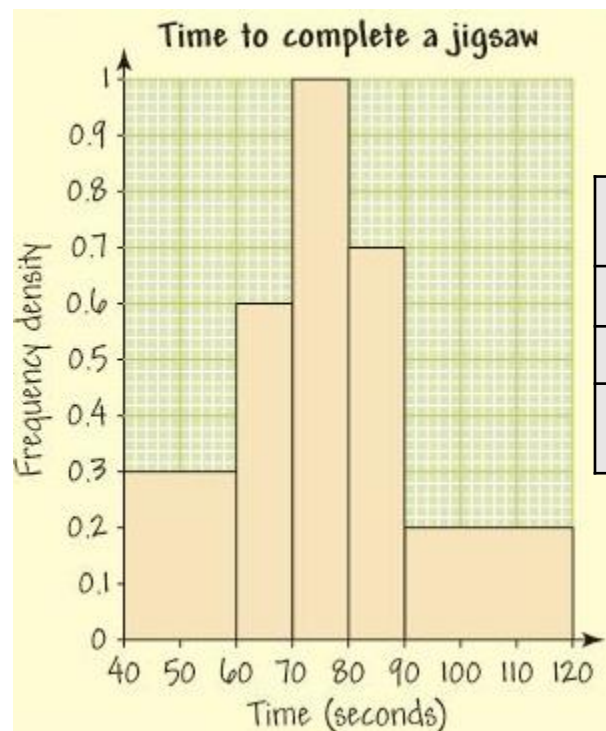
Quartiles

Quartiles are the values that divide a list of numbers into quarters:
- Put the list of numbers **in order**
- Then cut the list into **four equal parts**
- The Quartiles are at the "cuts"

Example: 1, 3, 3, 4, 5, 6, 6, 7, 8, 8
The numbers are already in order, cut the list into quarters:

$$1, \ 3, \ 3, \ 4, \ 5, \ 6, \ 6, \ 7, \ 8, \ 8$$

| Q1 lower quartile | Q2 middle quartile (median) | Q3 upper quartile |
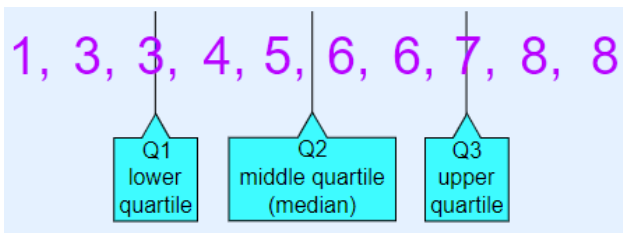
In this case Quartile 2 is half way between 5 and 6:
Q2 = (5+6)/2 = **5.5**

And the result is:
- Quartile 1 (Q1) = **3 (Lower Quartile)**
- Quartile 2 (Q2) = **5.5 (Median)**
- Quartile 3 (Q3) = **7 (Upper Quartile)**

IQR

The IQR "Interquartile Range" is the spread of the middle 50% of data.

As it is only the middle 50% the IQR is **less likely to be affected by outliers**. Whereas the range (which is the spread of all the data) would be affected by outliers.

To calculate it just **subtract Quartile 1 from Quartile 3**.
Using the example from the quartiles:
Q3 = 7
Q1 = 3   So the interquartile range is 4

| | Q1 | Q2 | Q3 | |
| 25% | 25% | 25% | 25% |

Interquartile Range = Q3 - Q1
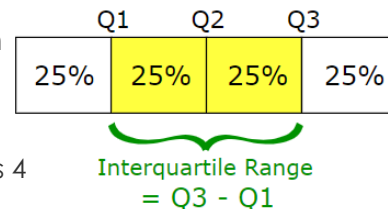
Box Plot

A **box plot** shows a visual representation of the **median** and **quartiles** of a set of **data**.

To draw a box plot, the following information is needed:
- minimum value
- **lower quartile**
- median
- **upper quartile**
- maximum value

Making Comparisons

The box plot summarise the heights of samples of 14 and 14 year old boys and girls

The median is labelled as Q2, use a ruler to read the value

Median height of girls = 1.63m
Median height of boys 1.60m

On average, the girls are taller than boys.

The IQR is the UQ subtract the LQ, read Q3 & Q1 then do Q3 – Q1

IQR for girls = 1.67 – 1.54 = 0.13m
IQR for boys = 1.69 – 1.52 = 0.17m

The IQR for the boys is greater than the girls, the girls heights are more **consistent** than the boys

Keyword/Skill	Definition/Tips
Sample	A group from the population that we are testing .
Population	The whole group from where the sample is taken, i.e. a whole year group.
Discrete	Discrete data can only have a finite or limited number of possible values. (Whole numbers)
Continuous	Continuous data can have an infinite number of possible values within a selected range. (Can include decimal numbers).
Quantitative	Quantitative data that can be counted (discrete), quantitative date that can be measured (continuous)
Mode	The number which appears most often in a set of numbers
Median	Place the numbers in value order and then find the middle number. When there are two numbers in the middle, we find the average them.
Range	The difference between the highest and lowest values.
Outlier	A point that "lies outside" (is much smaller or larger than) most of the other values in the dataset.
IQR (interquartile range)	The spread of the middle 50% of data. A smaller IQR shows that the data is **consistent**.

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*Before starting work with quartiles, you may find it useful to look back at the **Crossover Unit 23 Averages and Unit 24 Averages From a Table** knowledge organisers.*

Cumulative Frequency Graphs

A **cumulative frequency diagram** creates a running total of the amounts within a table.

A cumulative frequency diagram is drawn by plotting the **upper class boundary** with the cumulative frequency.

Position of the median
40 ÷ 2 = 20th

Range = largest length – smallest length = 55 – 30 = 25cm

Median = 42.5cm
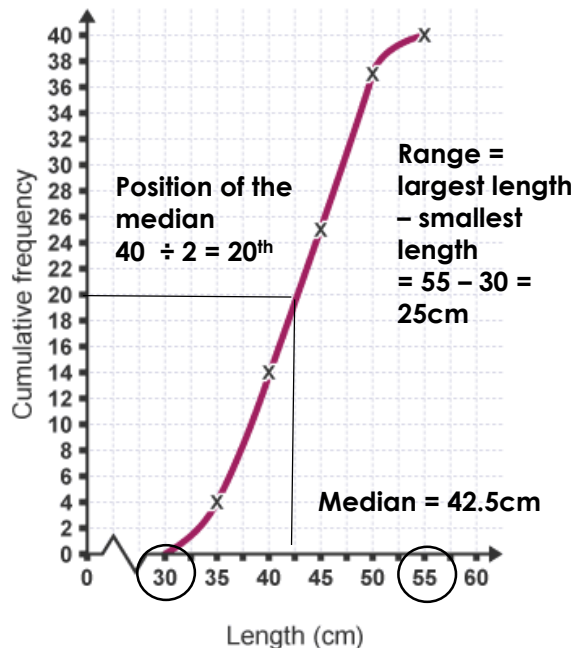
The upper class boundaries for this table are 35, 40, 45, 50 and 55.

Length (cm)	Frequency	Cumulative frequency
30 ≤ l < 35	4	4
35 ≤ l < 40	10	14 (4 + 10 = 14)
40 ≤ l < 45	11	25 (4 + 11 = 25)
45 ≤ l < 50	12	37 (25 + 12 = 37)
50 ≤ l < 55	3	40 (37 + 3 = 40)

Making Comparisons

*When making comparisons use an **average** or **spread** to back up your statement!*

Masses of men and women
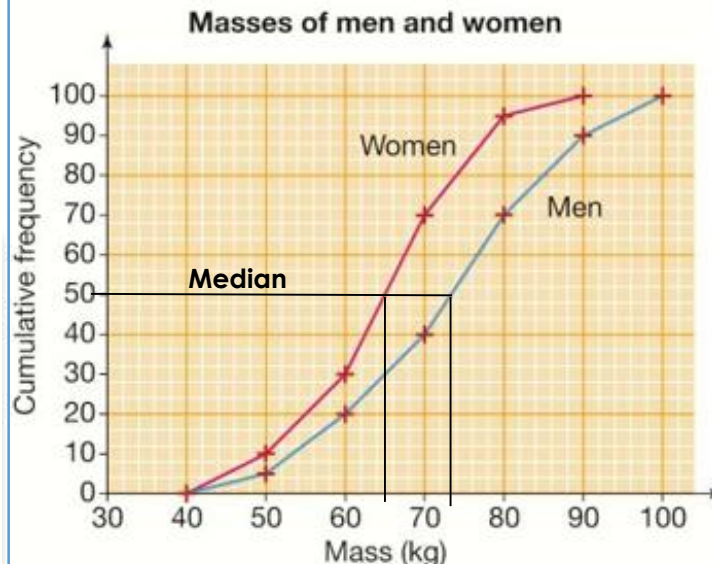
2) *Range of women's masses = 90 – 40 = 50kg*
Range of men's masses = 100 – 40 = 60kg

*The men's masses **vary** more than the women's masses*

These cumulative frequency graphs summarise the masses of samples of 100 men and 100 women.

Finding the median mass for 100 women. Position of the median is 100 ÷ 2 = 50 so find the mass of the 50th person. Read from 50 on the cumulative frequency axis to the value on the mass axis.

1) *Median mass of women = 65kg*
Median mass of men = 73kg

*On **average**, the women are lighter than men*

Range of masses = largest mass (read from the final point) subtract the mass from where the line starts

Exam Tips!

- *Be sure to label the axis "cumulative frequency" not just "frequency"*
- *Note how the graphs don't have to start at origin*
- *Smooth curve going to through all the points – use a pencil!*
- *When making a comparison, write a statement and back it up with evidence from the graph (comparing the medians or IQR in context of the question!)*

| Keyword/Skill	Definition/Tips
Sample	A group from the population that we are testing .
Population	The whole group from where the sample is taken, i.e. a whole year group.
Discrete	Discrete data can only have a finite or limited number of possible values. (Whole numbers)
Continuous	Continuous data can have an infinite number of possible values within a selected range. (Can include decimal numbers).
Quantitative	Quantitative data that can be counted (discrete), quantitative date that can be measured (continuous)
Mode	The number which appears most often in a set of numbers
Median	Place the numbers in value order and then find the middle number. When there are two numbers in the middle, we find the average them.
Range	The difference between the highest and lowest values.
Outlier	A point that "lies outside" (is much smaller or larger than) most of the other values in the dataset.
IQR (interquartile range)	The spread of the middle 50% of data. A smaller IQR shows that the data is **consistent**.

Other Topics/Units this could appear in:

- A Level Statistics- Data Collection

28

Before starting work with quartiles, you may find it useful to look back at the Crossover Unit 23 Averages and Unit 24 Averages from a group table knowledge organiser.

Histograms

$$Frequency\ density = \frac{Frequency}{Class\ width}$$

Key Facts
- The bars in a histogram can have different widths
- The area of each bar represent the frequency
- The height of the bar represents the frequency density

Bar Graph

Gaps

← Categories →
Discrete data

Histogram

No Gaps

← Number Ranges →
Continuous data

Drawing a Histogram

How to draw a histogram
1) Find the class width of each interval
2) Calculate the frequency density
3) Draw a histograms. **There are no gaps between the bars**.

Time to complete a jigsaw
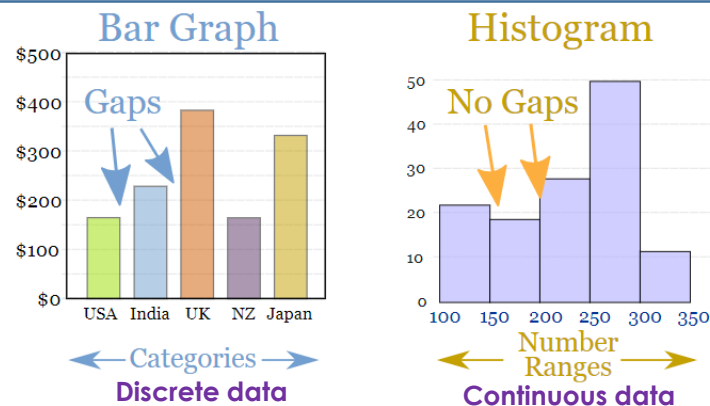
Histogram axis labels
- Y axis is frequency density (you need to calculate this)
- X axis is in context of the question (time)

The table shows the time taken to complete a simple jigsaw

Time, t seconds	40 ≤ t < 60	60 ≤ t < 70	70 ≤ t < 80	80 ≤ t < 90	90 ≤ t < 120
Class Width	20	10	10	10	70
Frequency	6	6	10	7	6
Frequency density	0.3	0.6	1	0.7	0.2

Class Width
Find the size of each class
i.e. 60 – 40 = 20
(Note the class widths do not need to be same)

Frequency Density
The frequency will be given to you and use your calculated class width

$$\frac{Frequency}{Class\ width} \text{ i.e. } \frac{7}{10} = 0.7$$

Keyword/Skill	Definition/Tips
Sample	A group from the population that we are testing
Population	The whole group from where the sample is taken, i.e. a whole year group
Discrete data	Can only take exact values (usually collected by counting), for example the number of students in a class. **Bar graphs represent discrete data.**
Continuous data	Can take any value (collected by measuring), for example the heights of the students in a call – use continuous data. **Histograms represent continuous data.**
Quantitative	Quantitative data that can be counted (discrete), Quantitative date that can be measured (continuous).
Outlier	A point that "lies outside" (is much smaller or larger than) most of the other values in the dataset.
IQR (interquartile range)	The spread of the middle 50% of data. A smaller IQR shows that the data is **consistent**.
Frequency density	$\frac{Frequency}{Class\ width}$ It is labelled as the y axis on a histogram.

Other Topics/Units this could appear in:

- A-Level Statistics - Data Collection

29

Before starting work with quartiles, you may find it useful to look back at the Crossover Unit 23 Averages from a table and U24 Averages from a group table knowledge organiser.

Interpreting Histograms – Finding the median

Sometimes you are given the histogram and you need to interpret it.
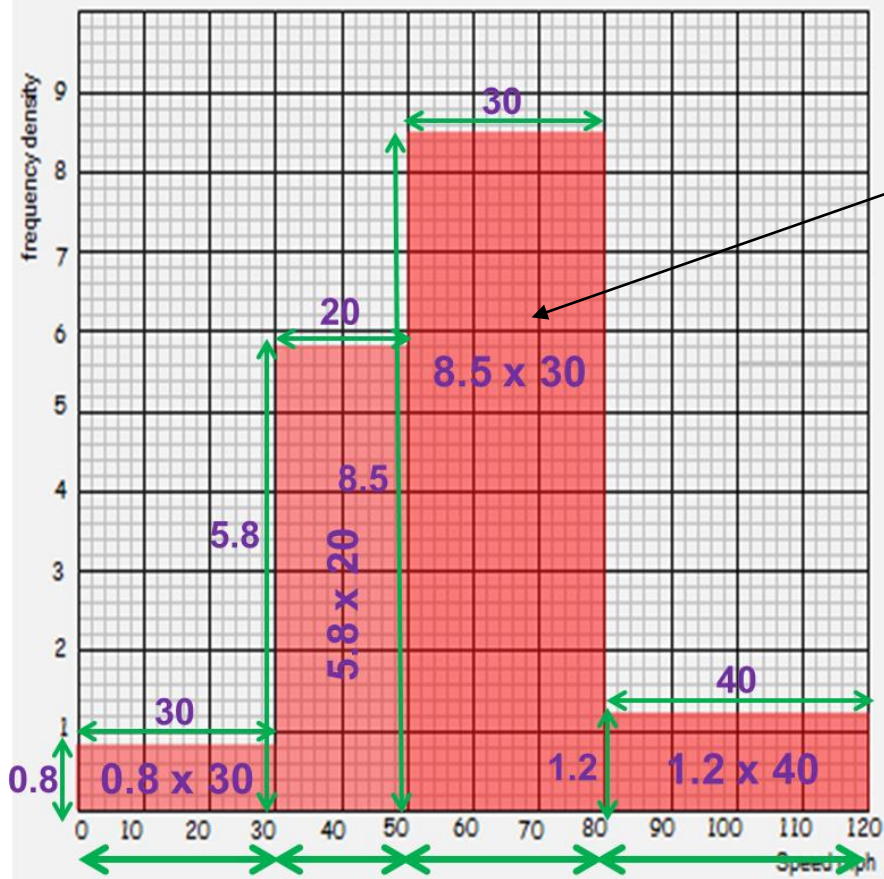
The histogram below gives information on the speed (mph) of cars on a motorway. Find the median class.

Frequency = Frequency Density x Width

The area of each bar is the frequency, height (frequency density) multiplied by the width (class interval)

Speed (mph)	Frequency	CF
0 ≤ x < 30	24	24
30 ≤ x < 50	116	140
50 ≤ x < 80	255	395
80 ≤ x < 120	48	443

Position of the median = $\dfrac{total\ frequency + 1}{2}$

Position of the median = $\dfrac{443 + 1}{2}$

Position of the median = 222nd value

(Find this value by looking at the cumulative frequency column)

Median class =   50 ≤ x < 80

Interpreting Histograms – Estimating the mean

Speed (mph)	Frequency	Mid point	fx
0 ≤ x < 30	24	15	24 x 15 = 360
30 ≤ x < 50	116	40	116 x 40 = 4640
50 ≤ x < 80	255	65	255 x 65 = 16575
80 ≤ x < 120	48	100	48 x 100 = 4800
Totals	443		26375

Estimating the mean from a histogram is the same as estimating the mean from a grouped frequency table.

Estimated mean = $\dfrac{\text{Total fx}}{\text{Total f}}$

= $\dfrac{26375}{443}$ = 59.5 mph (1 d.p)

Find the mid points and calculate a new fx column

Keyword/Skill	Definition/Tips
Sample	A group from the population that we are testing.
Population	The whole group from where the sample is taken, i.e. a whole year group.
Discrete data	Can only take exact values (usually collected by counting), for example the number of students in a class. **Bar graphs represent discrete data.**
Continuous data	Can take any value (collected by measuring), for example the heights of the students in a call – use continuous data. **Histograms represent continuous data.**
Quantitative	Quantitative data that can be counted (discrete). Quantitative date that can be measured (continuous).
Outlier	A point that "lies outside" (is much smaller or larger than) most of the other values in the dataset.
IQR (interquartile range)	The spread of the middle 50% of data. A smaller IQR shows that the data is **consistent**.
Frequency density	$\dfrac{Frequency}{Class\ width}$ It is labelled as the y axis on a histogram.

Other Topics/Units this could appear in:

- A-Level Statistics- Data Collection

Before progressing through this section of work, you may find it useful to refer to **Crossover Unit 30 - Quadratic and Cubic Graphs & Working Above Unit 6 - Quadratics**

Sketching Quadratic Curves

Roots – where y = 0

(-5, 0)

(7, 0)

(0, -35)

(1, -36)

y-intercept – where x = 0
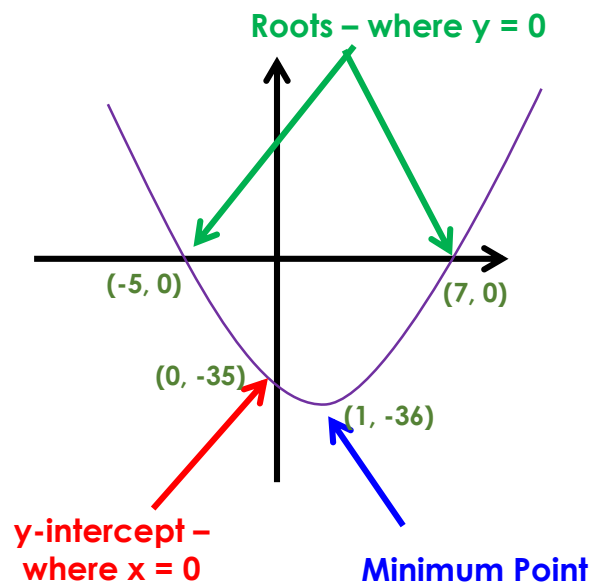
Minimum Point

E.g. Sketch the graph of $y = x^2 – 2x - 35$ clearly stating the roots, the y Intercept and the minimum point of the curve.

Step 1: Find the roots by factorising and the solve the Quadratic
Equation $x^2 – 2x – 35 = 0$
$(x - 7)(x + 5) = 0$
$x = 7$ and $x = -5$ are the two roots

Step 2: Find the y coordinate of the y intercept by putting
$x = 0$ into $x^2 – 2x – 35$ which gives a y intercept of (0, -35)

Step 3: We can find the minimum coordinate of the curve by
'completing the square'
$x^2 – 2x – 35$
$(x - 1)^2 – 35 - 1$
$(x - 1)^2 – 36$
Minimum point at (1 , -36)

Exam Tip: These questions can be worth up to 5/6 marks
Make sure you are familiar with the different
techniques and hey presto, 5/6 marks in the bag.

Sketching Cubic Curves - For GCSE, only the roots (x intercepts) and the y intercept are required for cubic graphs.

(-10, 0)

(0, 0)

(3, 0)
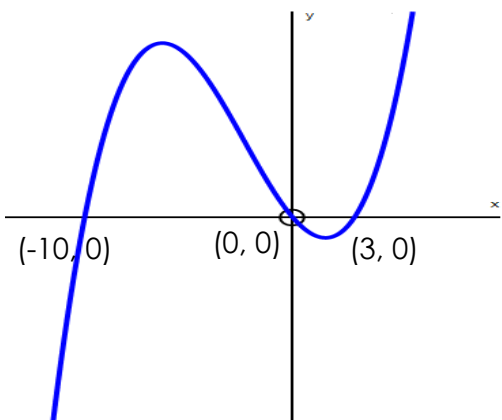
Eg. Sketch the graph of $y = x^3 + 7x^2 - 30x$

Step 1: Factorise and solve the equation $x^3 + 7x^2 - 30x = 0$
$x(x^2 + 7x – 30) = 0$ so immediately we know one root is 0
Now solve the equation $x^2 + 7x – 30 = 0$ for the other(s)
$(x + 10)(x – 3) = 0$
$x = -10$ and $x = 3$
There are 3 roots which are -10, 0 and 3

Step 2:   Find the y coordinate of the y intercept by putting
$x = 0$ into $x^3 + 7x^2 - 30x$ which gives a y intercept of (0, 0)
Note: In this example, the y intercept is also a root. This will not always
be the case.

Keyword/ Skill	Definition/tip
Quadratic	Where the highest power of the variable (usually x) is squared . e.g, x^2, $x^2 + 5x$, $x^2 - 2x – 8$ etc.
Cubic	Where the highest power of the variable (usually x) is cubed. e.g, x^3, $x^3 + 5x$, $x^3 + 2x^2 - 5x + 2$ etc.
Factorise	Write an expression as a product of its factors.
Root	Where a function equals zero.
Y Intercept	The point where a line or a curve crosses the y-axis of a graph.
Function	A mathematical relationship between two variables.

Other topics/Units this could appear in:

- Quadratic and Cubic Graphs
- 'A' Level:
- Core - Differentiation
         - Integration
- Mechanics - Kinematics

31

Area under a Graph - In a Velocity/Time (Speed/Time) graph, the area under a curve is the **distance** travelled.

Find the acceleration of the sledge when t = 6s.

E.g. The velocity of a sledge as it slides down a hill is shown in the graph. Estimate the distance travelled by the sledge. Use as many 4 second intervals as possible in your estimate.
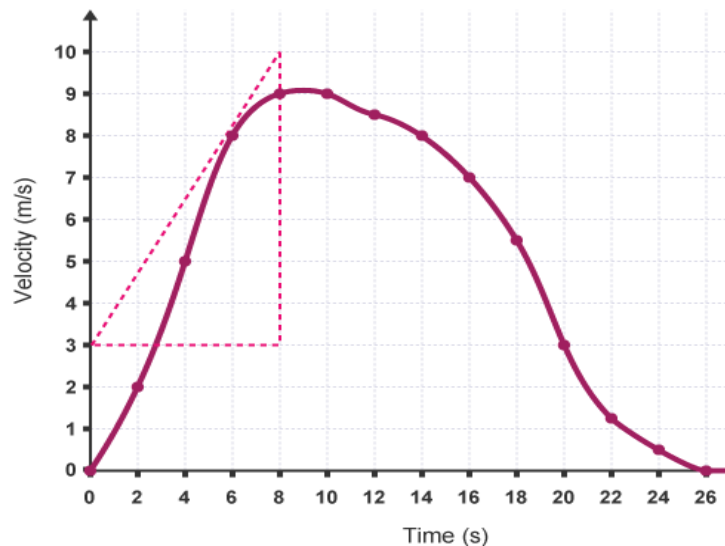
As we are **estimating** the distance travelled,

Area of Triangle $\quad$ A $\dfrac{4 \times 5}{2} = 10$

Area of Trapezium $\quad$ B $\dfrac{4 \times (5 + 9)}{2} = 28$

Area of Trapezium $\quad$ C $\dfrac{4 \times (9 + 8.5)}{2} = 35$

Area of Trapezium $\quad$ D $\dfrac{4 \times (8.5 + 7)}{2} = 31$

Area of Trapezium $\quad$ E $\dfrac{4 \times (7 + 3)}{2} = 20$

Area of Trapezium $\quad$ F $\dfrac{4 \times (3 + 0.5)}{2} = 7$

Area of Triangle $\quad$ G $\dfrac{(0.5 \times 2)}{2} = 0.5$

The estimated area under the graph is
10 + 28 + 35 + 31 + 20 + 7 + 0.5 = 131.5
The sledge travelled is 131.5 metres.

To work out the acceleration or deceleration at a particular point draw a tangent at that point. For instance, the acceleration of the sledge 6 seconds into its journey is:

$$\frac{change\ in\ y}{change\ in\ x} = \frac{7m/s}{8s} = 0.875m/s^2.$$

Keyword/ Skill	Definition/Tip
Velocity	Speed (how fast something is moving) in a particular direction.
Acceleration	How fast velocity changes.
Estimate	To find a value that is close enough to the right answer usually involving a calculation.
Trapezium	A flat shape with 4 straight sides that has one pair of parallel sides. Area is given by $\frac{a+b}{2}$ x h where a and b are the parallel sides and h is the distance between them.
Tangent	A line that just touches a curve at one point.
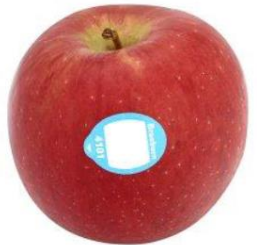
Other topics/Units this could appear in:

- Coordinate Geometry
- Real-Life Graphs

Exam Tip: If the question **does not** specify how many sections to split the graph into, try not to use more than 4 sections of Triangles, Trapeziums and/or Rectangles. When calculating acceleration after drawing the tangent make a right angled triangle as shown to help with the calculation.

32

Best Buys: Work out how much money **one item** costs. The best value is the **cheapest**.

A

B

1.2kg for £3.89

700g for £2.14

Step 1 - For offer A, Convert 1.2kg to grams by multiplying by 1000 so that we have both offers in grams.

Step 2 - If 1200g of Apples costs 389p (or £3.89) we can work out 1g by dividing the grams and the money by 1200.

Step 3 - For offer B, If 700g costs 214p (or £2.14) we can work out 1g by dividing the grams and the money by 700.

Step 4 - See which is the lowest cost per gram and that is the best value.

1.2kg = £3.89
÷ 1200   1200g = 389p   ÷ 1200
  1g = 0.32p

700g = 214p
÷ 700   1g = 0.31p ÷ 700

Note: If you leave the money in £'s, for offer A, 1g = £0.0032 and for offer B, 1g = £0.0031. The answer is still the same. Offer B is cheapest.

Offer B is the best value.

Eg2. Which is better value?

SHAMPOO

TRESCO Supermarket Sells 500ml bottles for £1.60
Special Offer 3 for price of 2

ASDER Supermarket sells 300ml bottles for £1.50
Special offer buy one get one free

TRESCO:
x 3   500ml = £1.60   x 3
÷ 1500   1500ml = £3.20   ÷ 1500
1ml = £0.0021

ASDER:
x 2   300ml = £1.50
÷ 600   600ml = £1.50 ÷ 600
1ml = £0.0025

TRESCO is the best value

Step 1 - At Tresco, the offer is 3 bottles of 500ml for the price of 2 bottles. Therefore 3 x 500ml costs 2 x £1.60

Step 2 – So if 1500ml of Shampoo costs £3.20, we can work out 1ml by dividing the ml and the money by 1500.

Step 3 - At ASDER, the offer is buy 1 and get 1 free. Therefore we get 2 x 300ml for 1 x £1.50

Step 4 - If 600ml costs £1.50 we can work out the cost of 1ml by dividing the ml and the money by 600.

Step 5 – Now see which is the lowest cost per ml of shampoo and that is the best value. – In this example TRESCO is the cheapest/best value.

Keyword/Skill	Definition/Tips
Best Buy	The cheapest price per item/unit OR the highest number of units/price .
Direct Proportion	2 variables change at the same rate
Unitary Method	Finding the cost of a single unit OR finding the amount of units per eg. £1
Exchange Rate	The price of one currency in terms of another currency. Eg. £1 = $1.25 For each pound I have to spend I can buy $1.25
Multiply	Repeated addition.
Divide	To split into equal parts or groups.
Changing Format	If the rate is given in the format (for instance) $1 = £0.85 Divide both numbers by 0.85 to get the exchange rate in the format £1 = $1.18

Other Topics/Units this could appear in:

- Direct and Inverse Proportion
- Similarity
- Mensuration
- Fractions and Percentages

Crossover Unit 6 & 7 – Best Buys & Exchange Rates

Exchange Rates: One currency can be exchanged for another currency by calculations using exchange rates.

Example 1

John went to Paris on holiday. He changed £1450 into Euros at Manchester Airport before his flight to Paris. The exchange rate at the airport was £1 = €1.14. On the holiday he spent €1355. On his return to England he changed his remaining euros back into pounds. Work out how much he returned to England with. Give your answer in pounds to the nearest penny.

£1   =   €1.14

£1450   =   1450 x 1.14 = €1653

€1653 - €1355 = €298

298 ÷ 1.14 = £261.4035......

      = £261.40 (nearest penny)

Step 1 - For EVERY pound John receives he gets €1.14. Therefore, for £2 he gets 2 x €1.14, for £3 he gets 3 x €1.14 etc so for £1450 he gets 1450 x €1.14 = €1653

Step 2 - On holiday in Benidorm he spends € 1355 so the next thing we do is subtract 1355 from 1653 which is €298

Step 3 - When we changed from pounds to euros we used multiplication, so to convert back from euros to pounds we do the inverse of multiplication ie. division.

Therefore the calculation is 298 ÷ 1.14 = £261.4035 which is £261.40 to the nearest penny

Note: When the exchange rate is given as
£1 = "other currency" then

GBP ⟶ Other currency   x   exchange rate
GBP ⟵ Other currency   ÷   exchange rate
Otherwise: Reverse the operations. See eg2.

Example 2

Elaine is going to New York. She wants to change £500 into US Dollars. The exchange rate in the UK is £1 = $1.26 and the exchange rate in New York is $1 = £0.81. In which country is she best changing her money? Explain your answer.

UK : 500 x 1.26 = $630

US (New York) : 500 ÷ 0.81 = $617.28

She should change her money in the UK because she will get more dollars.

Step 1 - If Elaine changes her money in the UK, for every
£1 she gets $1.26
£2 she gets 2 x $1.26
£3 she gets 3 x $1.26 etc

so for £500 she gets 500 x $1.26 = $630

Step 2 - If Elaine changes her money in New York, even though she is changing pounds to dollars the calculation is "divided by the exchange rate" because the exchange rate in New York is given as $1 = £0.81

Exams!
- As you can see, these questions are all about money, so make sure in an exam you use the correct units, e.g £ or $ etc.
- You also need to make sure all of your answers are rounded to 2.d.p, as money is always in this form.

Keyword/Skill	Definition/Tips
Best Buy	The cheapest price per item/unit OR the highest number of units/price .
Direct Proportion	2 variables change at the same rate
Unitary Method	Finding the cost of a single unit OR finding the amount of units per eg. £1
Exchange Rate	The price of one currency in terms of another currency. Eg. £1 = $1.25 For each pound I have to spend I can buy $1.25
Multiply	Repeated addition
Divide	To split into equal parts or groups
Changing Format	If the rate is given in the format (for instance) $1 = £0.85 Divide both numbers by 0.85 to get the exchange rate in the format £1 = $1.18

Other Topics/Units this could appear in:

- Drawing and Interpreting tables and graphs
- Expressions and substitution into simple formulae

34

ORMISTON SWB ACADEMY

1. Percentage of an Amount (without a calculator)

100% = 1 whole ÷2→ **50%** = $\frac{1}{2}$ ÷2→ **25%** = $\frac{1}{4}$

÷10↓

10% = $\frac{1}{10}$
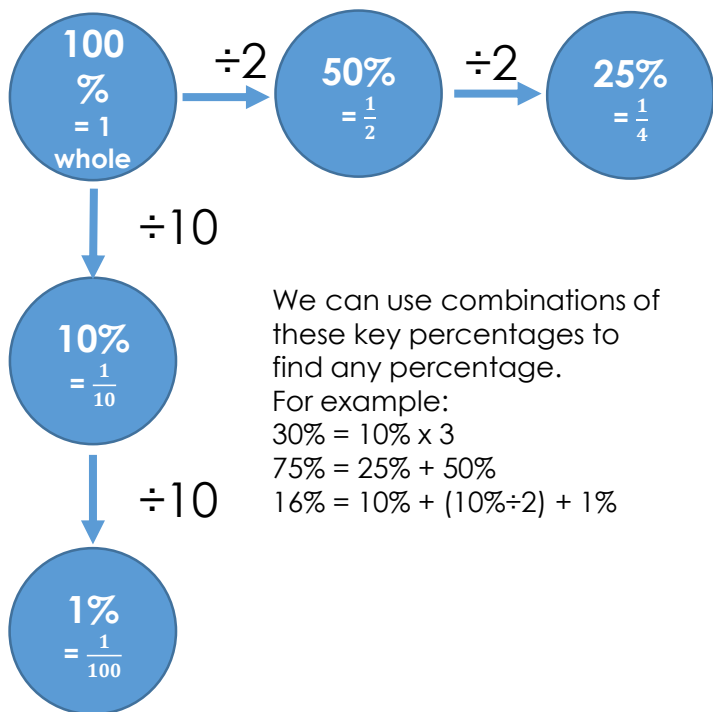
We can use combinations of these key percentages to find any percentage.
For example:
30% = 10% x 3
75% = 25% + 50%
16% = 10% + (10%÷2) + 1%

÷10↓

1% = $\frac{1}{100}$

Example 1:
Find 25% of £120
To find 25% you divide by 2 then divide by 2 again (or ÷ 4)
£120 ÷ 4 = £30
So, 25% of £120 is £30

Example 2:
Find 60% of 300kg
To get 60% we can use 50%+10%
To find 50% you divide by 2
So 50% = 150kg
To find 10% you divide by 10
So 10% = 30kg
Therefore 60% of 300kg = 180kg

2. Percentage increase/decrease (without a calculator)

Firstly, find the percentage of the given amount.
Then you add or subtract this amount depending on whether you are increasing or decreasing.

Example 1
Increase $80 by 50%

50% of $80 = $40
Then **add** this onto the starting amount

$80 + $40 = $120

Example 2
Decrease 500g by 3%

1% of 500g = 5g
3% of 500g = 5g x 3 = 15g
Then **subtract** this from the starting amount

500g – 15g = 485g

3. Percentage of an Amount (with a calculator)

Here we can use **percentage multipliers**.
First of all you need to find the decimal equivalent of the percentage you need.

50%	=	0.5
75%	=	0.75
30%	=	0.3
2%	=	0.02

You need to use these decimals as percentage multipliers.
Example
Find 48% of £250
48% = 0.48 (this is the percentage multiplier)
250 x 0.48 = 120
So, 48% of £250 is £120

4. Percentage Increase/Decrease (with a calculator)

Here we can also use **percentage multipliers.**

Increasing Example
Increase 480 by 16%.
Every amount starts at 100%. If I want to **increase** by 16%, this would go up to 116%.
So I need my multiplier to be the decimal equivalent of 116%
116% = 1.16
So to increase 480 by 16%
480 x 1.16 = 556.8

Decreasing Example
Decrease 725 by 26%.
Every amount starts at 100%. If I want to **decrease** by 26% this would go down to 74%. (100 – 26 = 74)
So I need my multiplier to be the decimal equivalent of 74%.
74% = 0.74
So to **decrease** 725 by 26%
725 x 0.74 = 536.5

Keyword/Skill	Definition/Tips
Percentage	A number out of 100. Symbol %
Fraction	Any part of a group, number or whole. They are written as one number over another.
Decimal	A number with a decimal point in it. It can be positive or negative. 3746.374
Equivalent	Having the same value or amount.
Increase	To get larger in size or number.
Decrease	To get smaller in size or number.
Profit	This occurs when an item is sold for more than it cost to buy. It is the difference between the amount earned and the amount spent.
Loss	This occurs when an item is sold for less than it cost to buy.
Interest	Money paid regularly at a particular rate. Usually on bank accounts or loans.
Percentage multiplier	The number you multiply a quantity by to find a percentage or increase/decrease it by a percentage.
Simple Interest	Interest calculated as a percentage of the original amount.
Compound Interest	Interest paid on the original amount and the accumulated interest.
Decay/ Depreciation	The decrease in the value or amount of something over time. (Car prices are a common example)
Growth/ Appreciation	The increase in the value or amount of something over time. (House prices are a common example)

5. Interest, Growth and Decay

Simple Interest (Growth)	A £200 loan earns 15% **simple** interest over 5 years. How much will be owed at the end of the 5 years? Work out 15% of £200 = £30 £30 x 5 years = £150 £200 + £150 = <u>£350</u>
Compound Interest (Growth)	A £200 loan earns 15% **compound** interest over 5 years. How much will be owed at the end of the 5 years? Here you need to use percentage multipliers. To **increase** by 15% five times (for each of the 5 years) you would multiply by 1.15 five times. A quick way of writing this is by using indices. £200 x 1.15^5 = £402.27
Compound Depreciation (Decay)	A car was brought for £12,000. It depreciates in value by 20% per year. How much will the car be worth after 3 years? Here you need to use percentage multipliers. To **decrease** by 20% three times (for each of the 3 years) you would multiply by 0.8 three times. A quick way of writing this is by using indices. £12,000 x 0.8^3 = £6,144

6. Reverse Percentages

Reverse percentages help us to calculate the **original** price or value of something, when we only know the price or value after the increase or decrease has taken place.

Before we do this, it is important we know that 100% represents the whole amount or the full price of something. So if something is increased by 20%, the amount we have now is worth 120%. If something is reduced by 5%, the amount we have is now worth 95%.

Non – Calculator This could come up on a non-calculator paper, but they will usually give you nice numbers that will divide easily like the example here.	A shop has a 20% off sale. A shirt is now worth £24. What was the original price? So, £24 represents 80% of the value of the shirt 80% + 20% = 100% £24 + £6 = £30
Calculator On a calculator paper, the numbers are likely to be more difficult, so you will need to use percentage multipliers.	Some money has been put into a bank account with an interest rate of 4%. After a year, the total amount of money in the account was £291.20. How much money was invested? £291.20 ÷ 1.04 = £280
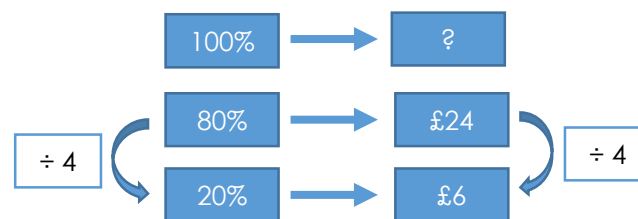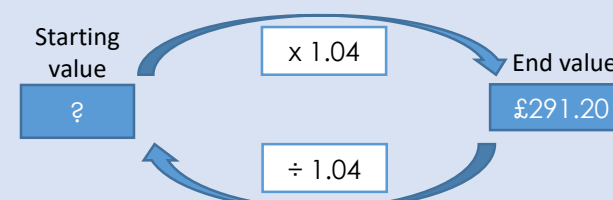
Sometimes, the phrase 'per annum' is used. This means the same as 'per year'. Annum is the Latin word for year.

Exams!
- A lot of these questions will involve money. Remember money should always be rounded to 2d.p.

Other Topics/Units this could appear in:

- Direct and inverse proportion
- Ratio
- A-level Units

36

Keyword/Skill	Definition/Tips
Numerator	How many parts of a whole. The top number in a fraction.
Denominator	How many parts the whole is split into. The bottom number in a fraction.
Improper Fraction	A fraction where the **numerator** is bigger than the **denominator**
Mixed Number	A number made from an integer and a fraction
Reciprocal	One of two numbers that multiply to make 1. e.g. the reciprocal of 2 is $\frac{1}{2}$ because $2 \times \frac{1}{2} = 1$
Multiplicative Inverse	Another way of describing reciprocal
Conversion	To change our fraction into something else (decimal or percentage)
Equivalent Fractions	Two or more fractions that are equal in value
Common Denominator	When two or more fractions have the same denominator

Multiplying Fractions

To multiply fractions together, we simply multiply the numerators and then multiply the denominators.

Don't forget to simplify your answer

$$\frac{2}{3} \times \frac{3}{4} = \frac{6}{12} = \frac{1}{2}$$

Dividing Fractions

$\frac{6}{7} \div \frac{3}{5}$ can be expressed as $\frac{6}{7}$ is $\frac{3}{5}$ of something?

$$\frac{6}{7}$$
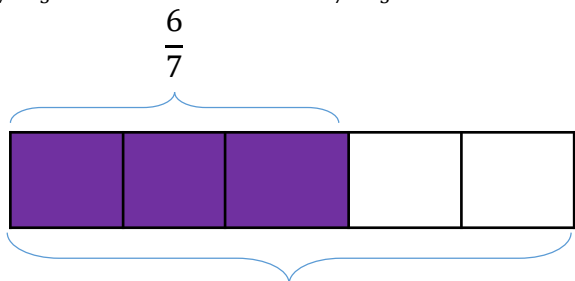
We need to figure out what one part of the bar model is worth. We can do that by doing $\frac{6}{7} \div 3$ which equals $\frac{2}{7}$

This means one part of the bar model is worth $\frac{2}{7}$.

To find the answer to $\frac{6}{7} \div \frac{3}{5}$ we want to know what the whole bar is worth.

$\frac{2}{7}$	$\frac{2}{7}$	$\frac{2}{7}$	$\frac{2}{7}$	$\frac{2}{7}$
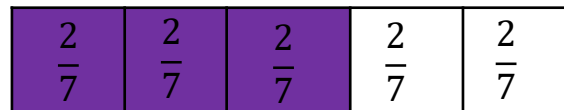
We have 5 lots of $\frac{2}{7}$ which equals $\frac{10}{7}$.

Therefore the answer to $\frac{6}{7} \div \frac{3}{5} = \frac{10}{7}$

Other Topics/Units this could come up in:

- Fraction Calculations
- Recurring Fractions
- Surds including Rationalising

Adding and Subtracting Fractions

To add or subtract fractions we must first make the denominators the same. We do this by using equivalent fractions and common denominators. Once the denominators are equal we simply add or subtract the numerators (keeping the denominators the same)

$\frac{1}{6} + \frac{4}{9}$ The common denominator will be 18

$\frac{5}{7} - \frac{1}{3}$ The common denominator will be 21

$\frac{1}{6} = \frac{3}{18}$ (x3) $\frac{4}{9} = \frac{8}{18}$ (x2)

$\frac{1}{6} + \frac{4}{9} = \frac{3}{18} + \frac{8}{18} = \frac{11}{18}$

$\frac{5}{7} = \frac{15}{21}$ (x3) $\frac{1}{3} = \frac{7}{21}$ (x7)

$\frac{5}{7} - \frac{1}{3} = \frac{15}{21} - \frac{7}{21} = \frac{12}{21}$

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FRACTIONS

Recognising Fractions

Numerator
How many equal parts of a number are needed

$$\frac{3}{8}$$

Denominator
How many equal parts are there altogether

Simplifying Fractions

You will need to simplify your answers after you have added, subtracted, multiplied or divided your fraction. Here's a reminder how:

- To simplify a fraction you need to find a common factor of the **numerator** and the **denominator.**

- Ex: Simplify: $\frac{18}{30}$ A common factor of 18 and 30 would be 6. So I need to divide 18 and 30 by 6

- 18 ÷ 6 = 3 and 30 ÷6 = 5 , therefore my simplified fraction is $\frac{3}{5}$

Keyword/Skill	Definition/Tips
Numerator	How many parts of a whole. The top number in a fraction.
Denominator	How many parts the whole is split into. The bottom number in a fraction.
Improper Fraction	A fraction where the **numerator** is bigger than the **denominator**
Mixed Number	A number made from an integer and a fraction
Reciprocal	One of two numbers that multiply to make 1. e.g. the reciprocal of 2 is $\frac{1}{2}$ because $2 \times \frac{1}{2} = 1$
Multiplicative Inverse	Another way of describing reciprocal
Conversion	To change our fraction into something else (decimal or percentage)
Equivalent Fractions	Two or more fractions that are equal in value
Common Denominator	When two or more fractions have the same denominator

Fractions of Amounts

Zaki's mum buys 20 sweets and gives Zaki $\frac{1}{4}$ of them.
How many sweets does Zaki get?

I am splitting 20 into four parts as it is $\frac{1}{4}$ of the sweets.

20

20 ÷ 4 = 5
That means each part is worth 5

5	5	5	5
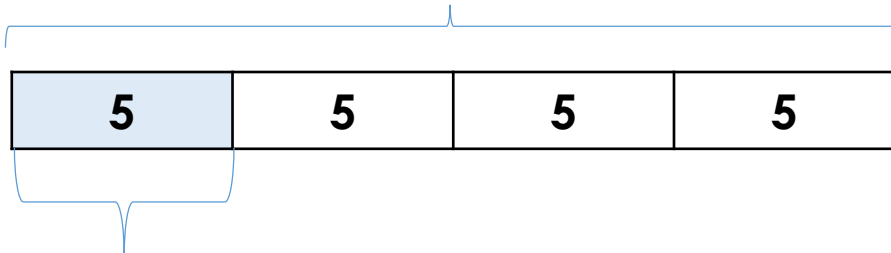
As it is $\frac{1}{4}$ I only need one of these parts

So Zaki gets 5 sweets.

Gurpreet & Mitch share 35 sweets.

Gurpreet gets $\frac{3}{5}$ of them.

I am splitting 35 into five parts.

35

35 ÷ 5 = 7
That means each part is worth 7

7	7	7	7	7
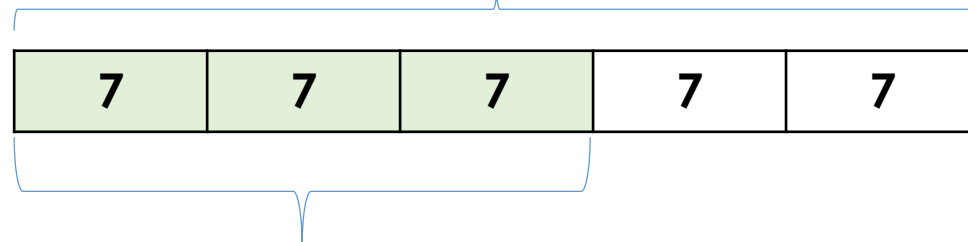
As it is $\frac{3}{5}$ I need three parts so this is 7 x 3 = 21

So Gurpreet gets 21 sweets.

Representing a ratio

"For every 5 boys there are 3 girls".

This is the "whole" – boys and girls together

This represents the 5 boys   This represents the 3 girls

5:3

Double Number Line

This represents the 5 boys

This is the "whole" – boys and girls together

This represents the 3 girls

Units are important:

When using a ratio – all parts should be in the same units

Useful Conversions

mm → ×10 → cm → ×100 → m → ×1000 → km
(÷10, ÷100, ÷1000)

g → ×1000 → kg (÷1000)

ml → ×1000 → L (÷1000)
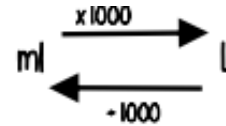
Simplifying a ratio

Cancel down the ratio to its lowest form

"For every 6 days of rain there are 4 days of sun"

6:4

÷ by 2 ↓

3:2

rain   sun
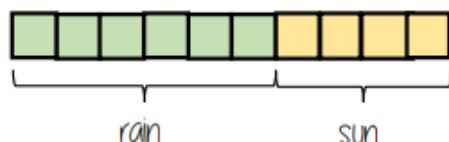
Find the biggest common factor that goes into all parts of the ratio

For **6** and **4** the biggest factor (number that multiples into them is **2**)

"For every 3 days of rain there are 2 days of sun" – when this happens twice the ratio becomes 6:4

Order is Important

"For every dog there are 2 cats"

Dogs: Cats

1:2

The ratio has to be written in the same order as the information is given.

e.g. 2:1 would represent 2 dogs for every 1 cat ✗

Ratio 1:n (or n:1)

This is asking you to cancel down until the part indicated represents 1.

Show the ratio 4:20 in the ratio of 1:n

The question states that **this part has to be 1 unit**
Therefore **Divide by 4**

4 : 20
1 : 5

This side has to be divided by 4 too – to keep in **proportion**

H the n part does not have to be an integer for this type of question

Keyword/Skill	Definition/Tips
Ratio	Ratio compares the size of **one part** to **another part**. Written using the ':' symbol. 3 : 1
Proportion	Proportion compares the size of **one part** to the size of the **whole**. In a class with 13 boys and 9 girls, the proportion of boys is $\frac{13}{22}$ and the proportion of girls is $\frac{9}{22}$
Share	Split or divide.
Parts	One cube in the bar model represents one part
direct proportion	As one amount increases, another amount increases at the same rate
inverse proportion	when one value **decreases** at the same rate that the other increases.
Best Buys	The product which is the best value for money/cheapest

Other Topics/Units this could appear in:

• Direct and inverse proportion

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Sharing a whole into a given ratio

James and Lucy share £350 in the ratio 3:4.
Work out how much each person earns

Model the Question

James: Lucy

$3 : 4$
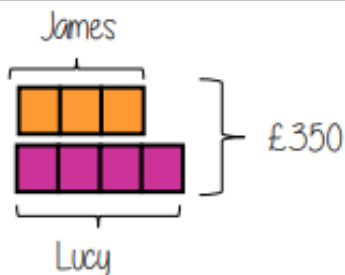
James
Lucy
£350

Find the value of one part

Whole: £350
7 parts to share between
(3 James, 4 Lucy)

£350 ÷ 7 = £50

□ = one part
= £50

Put back into the question

James = 3 x £50 = £150

James: Lucy

$_{x50}$ $3 : 4$ $_{x50}$

£150:£200

50 50 50
50 50 50 50
£350
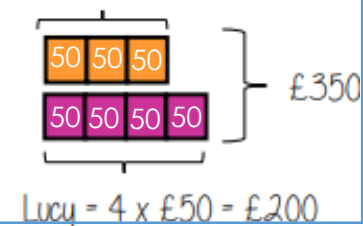
Lucy = 4 x £50 = £200

Other Topics/Units this could appear in:

• Direct and inverse proportion

Finding a value given 1:n (or n:1)

Inside a box are blue and red pens in the ratio 5:1.
If there are 10 red pens how many blue pens are there?

Model the Question

Blue pens
Blue : Red

$5 : 1$

□ = one part
= 10 pens

Red pens
One unit
= 10 pens
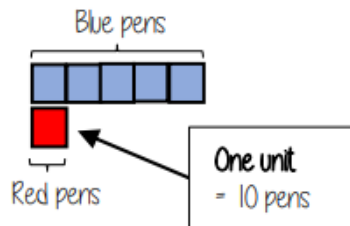
Put back into the question

Blue : Red
$\left(_{x10} \; 5 : 1 \; _{x10} \right)$
50 : 10

Blue pens = 5 x 10 = 50 pens
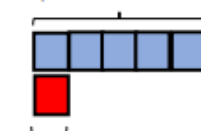
Red pens = 1 x 10 = 10 pens

There are 50 Blue Pens

Ratio as a fraction

Trees: Flowers
$3 : 7$

Trees
Ratio
Flowers
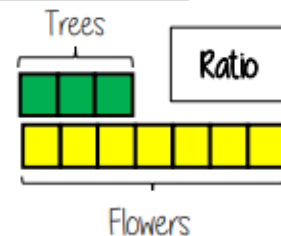
There are **3** parts for trees

Fraction

$$\frac{\text{Number of parts of in group}}{\text{Total number of parts}} = \frac{3}{10}$$

Tree parts **3** + Flower parts **7** = **10**

Proportion – Using Recipes

This is very applicable to real life! It's all about adjusting ingredients in a recipe!

Here are the ingredients needed to make 16 gingerbread men.

Ingredients
to make **16** gingerbread men

160 g flour   80g
40 g ginger   20g
110 g butter   55g
30 g sugar   15g

Find how much of each ingredient he needs for 8 gingerbread men (divide everything by 2!) and add that to your original recipe

Hamish wants to make 24 gingerbread men. Work out how much of each of the ingredients he needs.

$24 = 16 + 8$

80 + 160 = 240 g flour
20 + 40 = 60 g ginger
110 + 55 = 165 g butter
15 + 30 = 45 g sugar

Keyword/Skill	Definition/Tips
Ratio	Ratio compares the size of **one part** to **another part**. Written using the ':' symbol. $3 : 1$
Proportion	Proportion compares the size of **one part** to the size of the **whole**.
Share	Split or divide.
Parts	One cube in the bar model represents one part
Direct proportion	As one amount increases, another amount increases at the same rate
Inverse proportion	When one value **decreases** at the same rate that the other increases.
Best Buys	The product which is the best value for money/cheapest

Crossover Unit 21 & 22– Solving Equations & 'Subject of'

When we are solving equations, you need to figure out the value of the variable in the equation

Variable

$$4x - 7 = 5$$

You need to carry out the inverse operations to find the value of the variable.

Remember whatever operation you do to one side of the equals sign, you must do the same to the other to keep it balanced. Think of it like a set of scales:
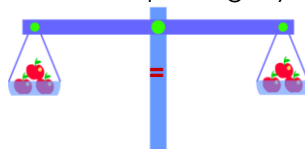
If I remove one apple from the left side, to keep it balanced I must do the same to the right side!
We need to think like this when we solve equations.

Keyword/Skill	Definition/Tips
Expression	One or a group of symbols representing a number or a value. Can contain numbers, variables & operations
Equation	Statement using an equals sign, to show two **expressions** are equal. $$4x - 7 = 5$$ Terms
Variable	A symbol for a number we do not know yet
Operations	The four basic operations in maths: addition, subtraction, multiplication & division
Inverse Operations	The **operation** that reverses the effect of another operation. **Addition & subtraction are inverse operations** **Multiplication & division are inverse operations**
Simplify	To remove unnecessary terms and numbers
Formula	A rule or fact written using mathematical symbols
Solve	To find the answer/value of something
Rearranging Formulae	Use inverse operations on both sides of the formula until you find the expression/equation for the letter you need.
'Subject of'	A certain variable needs to be by itself on one side of the equal sign Example: x = 4y + 10 x is the subject of this formula

One – Step Equations
These are equations where you only need to do one inverse operation to solve the equations:

Ex1

$y + 14 = 20$
   -14 -14
$y \quad\ = 6$

Ex2

$x - 120 = 80$
   +120 +120
$x \qquad\ = 200$

Ex3

$3n = 12$
÷3   ÷3

$n = 4$

Ex4

$\frac{k}{2} = 16$
x2 x2

$k = 32$

Two – Step Equations
These are equations where you need to do two inverse operations to solve the equations:

Ex1

$4x - 3 = 25$
    +3   +3
$4x = 28$
    ÷4   ÷4
$x = 7$

Ex2

$\frac{y}{5} + 6 = 14$
    -6   -6
$\frac{y}{5} = 8$
    x5   x5
$y = 40$

Expanding and Solving Equations
You will also need to use skills you have already learnt to solve some equations. (If you need help expanding brackets look back at the **Crossover Unit 19 – Expand & Simplify** knowledge organiser).

Ex1

$3(x + 4) = 27$
Expand the brackets first
$3x + 12 = 27$
    -12   -12
$3x = 15$
    ÷3   ÷3
$x = 5$

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Crossover Unit 21 & 22– Solving Equations & 'Subject of'

Keyword/Skill	Definition/Tips
Expression	One or a group of symbols representing a number or a value. Can contain numbers, variables & operations
Equation	Statement using an equals sign, to show two **expressions** are equal. $\underbrace{4x - 7}_{} = \underset{}{5}$ *Expression* *Terms*
Function	A mathematical relationship between two values
Operations	The four basic operations in maths: addition, subtraction, multiplication & division
Inverse Operations	The **operation** that reverses the effect of another operation. **Addition & subtraction are inverse operations** **Multiplication & division are inverse operations**
Simplify	To remove unnecessary terms and numbers
Formula	A rule or fact written using mathematical symbols
Solve	To find the answer/value of something
Rearranging Formulae	Use inverse operations on both sides of the formula until you find the expression/equation for the letter you need.
'Subject of'	A certain variable needs to be by itself on one side of the equal sign Example: x = 4y + 10 x is the subject of this formula

Equations With an Unknown Variable on Both Sides

Sometimes equations may have variables on each side of the equals sign. There is one extra step you need to do before you apply the same method for solving two-step equations.

The extra step is whichever side has the smaller unknown variable, subtract that from both sides of the equation. You can then continue with the same method of using the inverse operations to solve the equation

Ex1
$$8x + 12 = 5x + 30$$

Here we will subtract $5x$ from both sides as $5x$ is the smaller variable

$$8x + 12 = 5x + 30$$
$$\quad\quad\;\; \mathbf{-5x} \quad\quad\; \mathbf{-5x}$$

$$3x + 12 = 30$$
$$\quad \mathbf{-12} \quad \mathbf{-12}$$
$$3x = 18$$
$$\quad \mathbf{\div 3} \quad \mathbf{\div 3}$$
$$x = 6$$

Making the 'Subject of' (Rearranging Formulae)

In these types of questions, it will ask you to make a certain variable the 'subject of' the equation or formula. What this means is you need to use the solving equation method to isolate the variable it is asking for:

Ex1 Make y the subject of this formula:
$$y + 81 = x + 100$$
$$\quad \mathbf{-81} \quad\quad \mathbf{-81}$$

Here y is the variable we want to isolate (have by itself on one side of the equals sign).

$$y = x + 19$$

Ex2 Make x the subject of this formula:
$$C = 4x + 5y$$
$$\quad \mathbf{-5y} \quad\quad \mathbf{-5y}$$

$$C - 5y = 4x$$
$$\quad \mathbf{\div 4} \quad\quad \mathbf{\div 4}$$

When you are dividing an expression, just write it as a fraction

$$\frac{C - 5y}{4} = x$$

Other Topics/Units this could appear in:
- Forming and Solving Equations
- Expanding and Factorising
- Simultaneous Equations
- Algebraic Fractions
- Algebraic Proof
- Rearranging Equations

42

Calculating the Mean

The mean is the most commonly used measure of average. The mean is the total amount split evenly.

For example take this data set:

10. 12. 4. 2

I can represent this as a bar model:

10	12	4	2

28
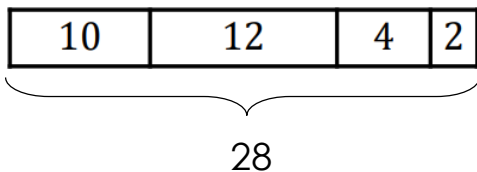
The total is 28. I then want to split this amount evenly into how many values there are. In this case I need to split 28 into 4 even values.

7	7	7	7

28
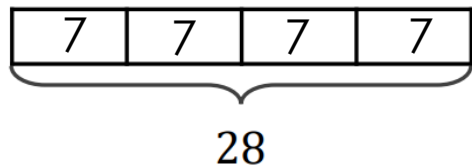
Therefore the mean is 7!

You can also find missing values from data sets when given the mean.

Example:
Three children have a mean of 150cm.
Two children have a height of 155cm and 158 cm.
What is the height of the third child?

I can draw a bar model to help me out:

450cm

150 cm	150 cm	150 cm
155 cm	158 cm	? cm
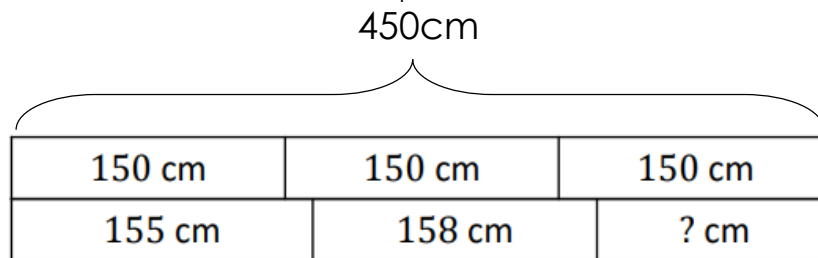
I can see that the total would be 450cm so I can figure out the missing total:

155cm + 158cm = 313cm   450cm – 313cm = **137cm**

Calculating the Median

- If you place a set of numbers in order, the median number is the middle one.

    10 12 13 15 16 23 26

    15 is the middle number so it is the median.

- If there are two middle numbers the median is the mean of this

    10 12 13 15   16 17 23 26

    Here you need to find the number in the middle of 15 and 16:

    15 + 16 = 31   31÷ 2 = 15

    Therefore, 15.5 is the median.

Calculating the mode

- The mode is the value that occurs most often

Example:

1,3,3,4,7,8

The number 3 occurs the most so the mode is 3.

Calculating the Range

The range is the difference between the highest and lowest values in a set of numbers

Find the range of:

23, 27, 40, 18, 25

The largest value is 40 and the smallest value is 23.

40 – 23 = 17

Keyword/Skill	Definition/Tips
Discrete	Discrete data can only have a finite or limited number of possible values
Continuous	Continuous data can have an infinite number of possible values within a selected range
Quantitative	Quantitative data that can be counted (discrete), quantitative date that can be measured (continuous)
Qualitative	Information that describes something
Average	A calculated 'central value' of a set of numbers
Mean	The mean amount is the total amount split evenly
Median	Place the numbers in value order and then find the middle number. When there are two numbers in the middle we average them.
Mode	The number which appears most often in a set of numbers
Range	The difference between the highest and lowest values
Frequency	How often something happens.
Table	Information (such as numbers and descriptions) arranged in rows and columns.
Data	A collection of facts, such as numbers, words, measurements, observations or even just descriptions of things.
Proportion	A part, share, or number considered in comparative relation to a whole.
Univariate Data	Univariate means "one variable" (one type of data).

Other Topics/Units this could appear in:

- Averages
- Averages from Tables
- Sampling
- Histograms

Crossover Unit 24 – Averages From a Table

Finding the mode from a table

- The mode is the value that occurs most often.
- The mode is the only average that can have no value, one value or more than one value.
- When finding the mode, it helps to order the numbers first.

In this frequency table, the mode is the value with the highest frequency:

Shoe size	5	6	7	8	9
Frequency	2	5	11	4	1

The modal size is 7 because more people wear size 7 than any other size.

Finding the modal class from a grouped frequency table

The following table shows the weights of children in a class.

Mass (m) kg	Frequency
$30 \leq m < 40$	7
$40 \leq m < 50$	6
$50 \leq m < 60$	8
$60 \leq m < 70$	4

The modal class is the class that has the highest frequency. In this case the modal class is:

$$50 \leq m < 60$$

Total Frequency

score	frequency
1	19
2	18
3	12
4	19
5	9
6	23

Andy throws a dice in an investigation. How would you work out the total number of times he has thrown the dice?

100

You can work out the **total frequency** by adding up each frequency.

Finding the median from a Table

The table below shows the average number of hours a group of 200 students spend watching TV per week to the nearest hour.

hours	frequency	cumulative frequency
0	8	8
1	16	24
2	33	57
3	75	132
4	44	176
5	8	184
6	16	200

The 105.5th value which is the **median** would be in this category.

To work out the median value, first work out the **cumulative frequency column**.

- There are 200 data items, so **the median** must lie between items 100 and 101

$$\text{Median} = \frac{n+1}{2} \qquad \text{Median} = \frac{200+1}{2} = \frac{201}{2} = 105.5$$

The median value would be the **105.5th value** in the table. Then use this to help you to work out where this data would lie using the **cumulative frequency column**

Keyword/Skill	Definition/Tips
Discrete	Discrete data can only have a finite or limited number of possible values
Continuous	Continuous data can have an infinite number of possible values within a selected range
Quantitative	Quantitative data that can be counted (discrete), quantitative date that can be measured (continuous)
Qualitative	Information that describes something
Average	A calculated 'central value' of a set of numbers
Mean	To calculate the mean, add up all of the numbers and then divide by how many numbers there are
Median	Place the numbers in value order and then find the middle number. When there are two numbers in the middle we average them.
Mode	The number which appears most often in a set of numbers
Range	The difference between the highest and lowest values
Frequency	How often something happens.
Table	Information (such as numbers and descriptions) arranged in rows and columns.
Midpoint	The middle point. The point halfway between.

Calculating the Mean from a Table

- The **mean** is found by adding up all the numbers and dividing by how many numbers there are.

To find the mean in this example, the total number of goals must be found and then divided by the number of games.

Number of Goals (x)	Frequency (f)	fx
0	2	0 x 2 = 0
1	2	1 x 2 = 2
2	5	2 x 5 = 10
3	1	3 x 1 = 3
Total		10	15

Total number of football games

Total number of goals.

- From the table, we can see that for 2 games, no goals were scored. This makes a grand total of zero goals so far.
- The rest of the total amount of goals can be worked out in this way, by multiplying goals **(x)** by the frequency **(f).** Call this column **fx** (f multiplied by x)

The total number of goals is 15. There were 10 football games so
15 ÷ 10 = 1.5
The mean number of goals is 1.5 goals per game.

Remember to divide fx by the total of the frequencies, not by the amount of different items of data – the correct answer here is $\frac{15}{10}$ not $\frac{15}{4}$

Further Example

x	f	fx
1	15	15
2	27	54
3	8	24
4	5	20
TOTALS:	55	113

The table shows the number of parking spaces per house in a street. Work out the **mean number of spaces**

Mean = $\frac{113}{55}$ = **2.05...**

Finding the Range
The **range** is the **difference between the highest and lowest values** in a set of numbers.
<- Using this table as an example:
The highest value is 4 and the lowest value is 1. Range = 4 – 1 = 3

Keyword/Skill	Definition/Tips
Sample	A selection taken from a larger group 'the population' that will let you find out things about a larger group.
Population	The whole group being studied
Stem and Leaf	A plot where each data value is split into a 'leaf' and a 'stem'. 'Stem' values are listed down and 'leaf' values are listed next to them.
Pie Chart	Graph using a divided circle where each section represents part of the total.
Estimate	To make an approximate or rough calculation often based on rounding.
Primary	Primary data is data that is collected by a data researchers from first hand sources.
Secondary	Secondary data is data gathered from studies, surveys or experiments run by other people or for other research.
Interval	An interval is between two points of values. An interval may or may not include start and end points.
Survey	To gather information by individual samples so we can learn about the whole thing.
Sort	To arrange or group in a special way (such as by size, type or alphabetically).

Other Topics/Units this could come up in:

- Averages
- Mode, median, range and mean
- Cumulative frequency

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Inequality Symbols

Equality and Inequality

larger > smaller
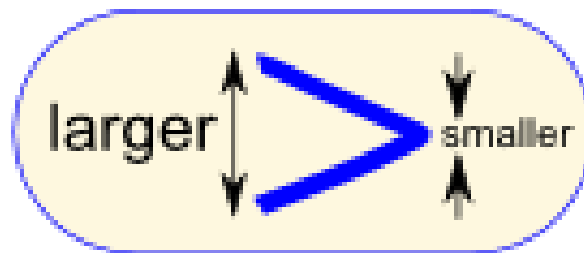
= equal

≠ not equal

> greater than

≥ greater than or equal

< less than

≤ less than or equal

Examples:

x < 5   means x is less than 5

p ≥ 100   means p is greater than or equal to 100

y > -2   means y is greater than -2

Other Topics/Units this could appear in:

- Numbers, powers, roots, decimals and rounding
- Expressions and substituting into a formula
- Expand and simplify
- Solving equations

Keyword/Skill	Definition/Tips
Integer	Whole number including 0 and negative numbers. No fractions or decimals.
Inequality	Compares two values showing if one is less than, greater than or not equal to each other.
Greater than	One number is BIGGER than another number.
Less than	One number is SMALLER than another number.
Equal to	Two things have the SAME value.
Equation	Says that two things are equal. (1 + 1 = 2).
Satisfy	A value that solves an equation. E.g. $2x + 1 = 9$ $x = 4$ so $x=4$ satisfies the equation.
Variable	A symbol for a number we don't know yet, usually a letter.
Coefficient	A number used to multiply a variable. E.g. $6y = 6 \times y$. y is the variable and 6 is the coefficient.
Inverse	Opposite of (i.e. x and ÷, + and -)
Solve	Find all of the values that satisfy the inequality.

46

Inequalities Symbols on a Number Line

Symbol	Circle		Direction of Arrow
<	Open	○	Left
>	Open	○	Right
≤	Closed	●	Left
≥	Closed	●	Right

We use open and/or closed circles to represent inequalities on a number line. A closed circle means that the number **is** included in the represented group of values. An open circle means that the number **is not** included in the represented group of values.

Examples:

Keyword/Skill	Definition/Tips
Integer	Whole number including 0 and negative numbers. No fractions or decimals.
Inequality	Compares two values showing if one is less than, greater than or not equal to each other.
Greater than	One number is BIGGER than another number.
Less than	One number is SMALLER than another number.
Equal to	Two things have the SAME value.
Equation	Says that two things are equal. (1 + 1 = 2).
Satisfy	A value that solves an equation. E.g. 2x + 1 = 9 x =4 so x=4 satisfies the equation.
Variable	A symbol for a number we don't know yet, usually a letter.
Coefficient	A number used to multiply a variable. E.g. 6y = 6 x y . y is the variable and 6 is the coefficient.
Inverse	Opposite of (i.e. x and ÷, + and -)
Solve	Find all of the values that satisfy the inequality.

Solving Inequalities

Solving an inequality means finding the range of values that **satisfy** the inequality.

22

| x | x | x | 7 |

$3x + 7 < 22$

$22 - 7 = 15$

| x | x | x |

$3x < 15$

5

| x |
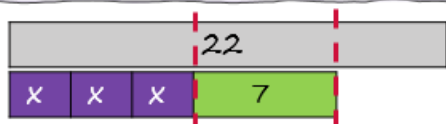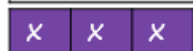
$x < 5$
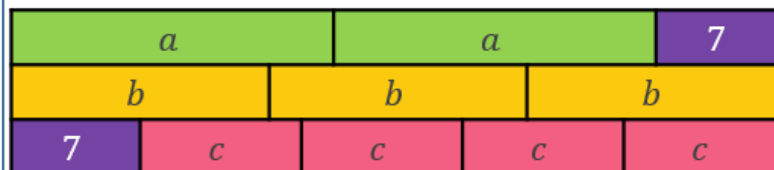
We can also use bar models to form new inequalities.

a	a	7
b	b	b
7	c	c	c	c

e.g.
$$2b < 2a$$
$$4c + 7 = 2a + 7$$
$$3b > 4c$$

17

| x | x | 3 |

$2x + 3 < 17$

$17 - 3 = 14$

| x | x |

$2x < 14$

7

| x |

$x < 7$

| x | 17 |

$2x + 3 < x + 17$

| x | x | 3 |

| x | $17 - 3 = 14$ |

$2x < x + 14$

| x | x |

14

| x |
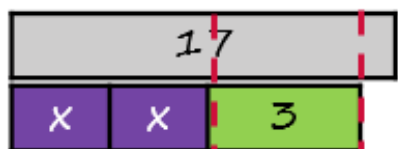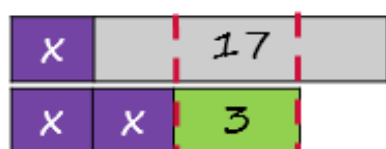
$x < 14$

We can use bar models to represent the size of each side of the inequality. This allows us to see how much bigger/smaller one side is compared to the other. It also allows us to make changes to both sides in order to solve the inequality.

Keyword/Skill	Definition/Tips
Product	Means multiply
Prime number	A number that has exactly two **factors**
Integer	Whole number including 0 and negative numbers. No fractions or decimals.
Inequality	Compares two values showing if one is less than, greater than or not equal to each other.
Greater than	One number is BIGGER than another number.
Less than	One number is SMALLER than another number.
Equal to	Two things have the SAME value.
Equation	Says that two things are equal. (1 + 1 = 2).
Satisfy	A value that solves an equation. E.g. 2x + 1 = 9 x =4 so x=4 satisfies the equation.
Variable	A symbol for a number we don't know yet, usually a letter.
Coefficient	A number used to multiply a variable. E.g. 6y = 6 x y . y is the variable and 6 is the coefficient.
Inverse	Opposite of (i.e. x and ÷, + and -)
Solve	Find all of the values that satisfy the inequality.

Frequency Diagrams

Frequency Diagrams

A **frequency diagram**, often called a line graph or a frequency polygon, shows the frequencies for different groups of data.

Line Graphs (for discrete data)

Example

The table below shows the average temperature in Belfast each day.

	Belfast
Monday	14°C
Tuesday	16°C
Wednesday	15°C
Thursday	10°C
Friday	9°C

The line graph below shows the results of the table.

A point has been plotted at the correct frequency for each day. And the points are joined with straight lines.
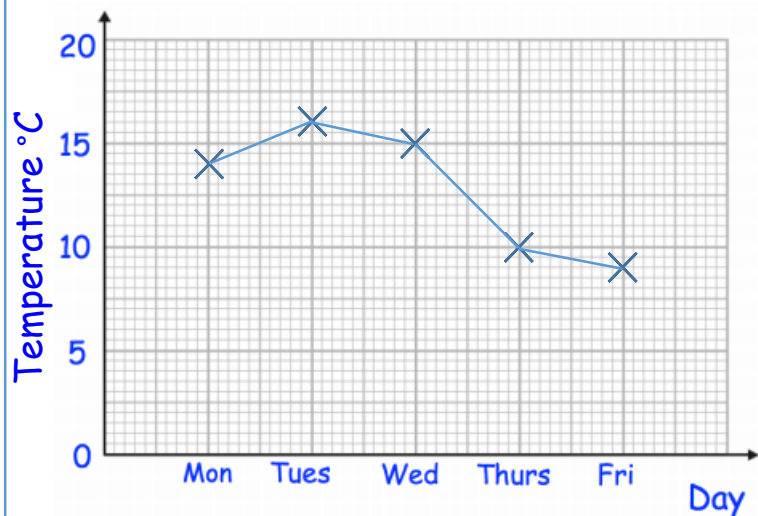
Frequency Polygons (for continuous grouped data)

Example

The table gives information about the distances thrown, in metres, at a school sports day.

Time (seconds)	Frequency
$0 < d \leq 2$	5
$2 < d \leq 4$	10
$4 < d \leq 6$	21
$6 < d \leq 8$	18
$8 < d \leq 10$	1

The line graph below shows the results of the table.

A point has been plotted at the correct frequency for each day, above the **midpoint of each group**. And the points are joined with straight lines.
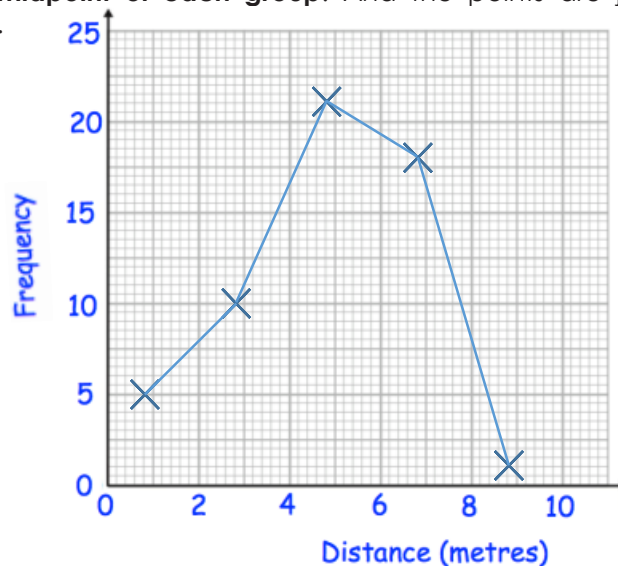
Keyword/Skill	Definition/Tips
Discrete	Discrete data can only have a finite or limited number of possible values.
Continuous	Continuous data can have an infinite number of possible values within a selected range.
Qualitative	Data categories like food, clothes and hobbies.
Quantitative	Data that can be counted or measured.
Data	Collection of information.
Sample	Section of a whole group.
Population	Whole set of individuals, items or data from which a statistical sample is drawn.
Frequency	The number of times an item appears in a set of data.

Exams!
When drawing line graph or frequency polygon you must draw straight lines between the points. Not curved lines.
A polygon is a shape with straight edges, so your graph needs straight edges too.
You **do not** join the first and last point together

Other Topics/Units this could appear in:

- Probability
- Probability Trees
- Cumulative Frequency & Box Plots
- Histograms
- Representations of Data

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Scatter Graph

A scatter graph is a diagram where points are plotted to show the relationship (correlation) between two variables.

The value of one variable is shown along the x-axis and the values of the second variable is shown on the y-axis.

The scatter graph to the right shows the temperature compared with the number of ice-creams sold.
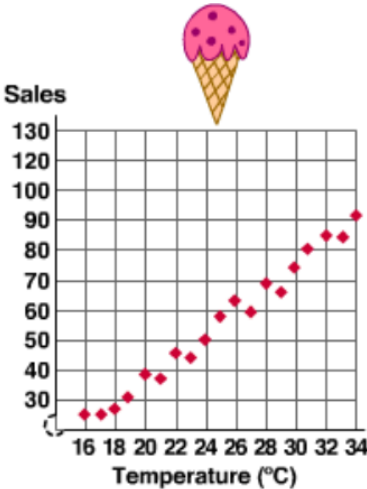
Positive Correlation
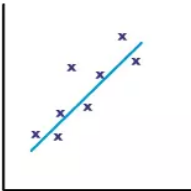
Negative Correlation
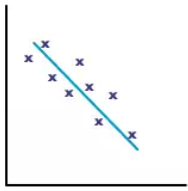
No Correlation
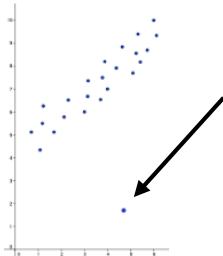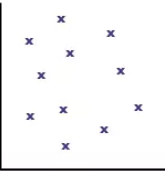
Outlier

Time – series graph

Time series graphs show data fluctuations over time and are used to predict trends, cycles and seasonality.

Example

The time series graph below shows the amount of money invested by a company between 2005 and 2014.
The general trend of the graph is an increase in the amount of money invested over time.
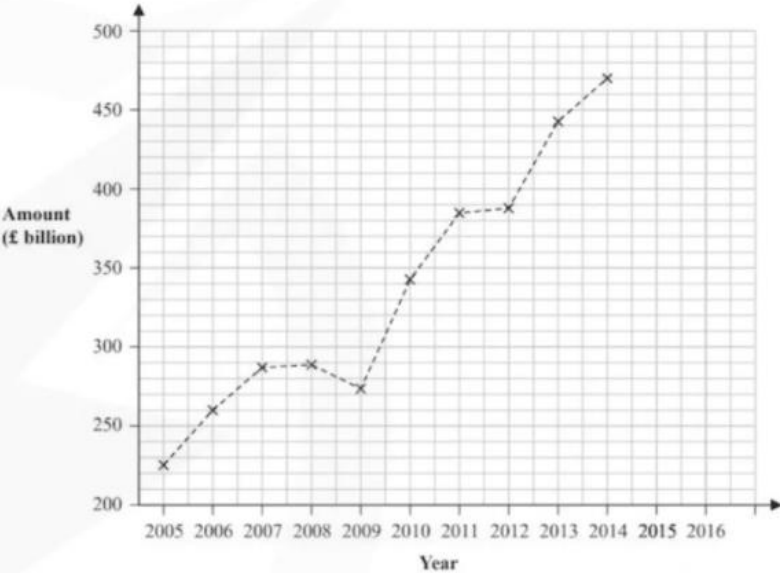
Keyword/Skill	Definition/tip
Scatter graph	A diagram with points plotted to show a relationship between two variables.
Variable	A quantity that can change or vary, taking on different values.
Line of best fit	A straight line that best represents the data on a scatter graph.
Correlation	A relationship between two or more things.
Positive correlation	Both variables increase or both variables decrease.
Negative correlation	One variable increases and the other decreases or vice versa.
No correlation	There is no relationship between the two variables.
Outlier	A value that lies outside most other values.
Time-Series	A line graph of repeated measurements taken over regular time intervals.
Trend	A direction in which something is changing.

Other topics/Units this could appear in:

- Coordinate Geometry
- A-Level Statistics - Correlation

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Exams!
- When interpreting scatter graphs always refer to what the graph is showing. For example "it has positive correlation so the hotter it is the more ice creams that are sold"

Exams!
- Once all points have been plotted, ALWAYS draw a line of best fit. (Scatter graph)
- Use line of best fit to estimate answers.

PYTHAGORAS

Pythagoras' Theorem: $a^2 + b^2 = c^2$ Where c is the hypotenuse.
a and b can be either of the two shorter sides.

$$a^2 + b^2 = c^2$$

c^2

a^2

b^2
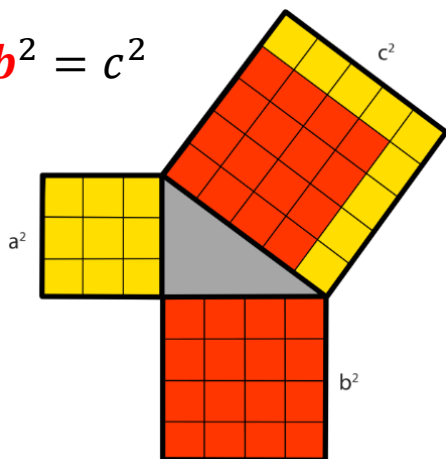
You can use the theorem to calculate the length of the hypotenuse (the longest side)

You can rearrange the theorem to calculate the length of the shorter sides

$3^2 + 4^2 = 5^2$

$9 + 16 = 25$

$$a^2 + b^2 = c^2$$

$$a^2 = c^2 - b^2$$

OR

$$b^2 = c^2 - b^2$$

Keyword/Skill	Definition/Tips
Pythagoras	A Greek mathematician. He is famous for proving a theorem about the right-angle triangle.
Pythagoras' Theorem	In a right-angled triangle the square of the long side (**hypotenuse**) is equal to the sum of the squares of the other two sides.
Hypotenuse	The longest side of a right-angled triangle. It is always opposite the right angle.
Adjacent & Opposite	Adjacent side – Next to the marked angle Opposite side – Opposite the marked angle
Trigonometry	Trigonometry is the study of triangles: their angles, lengths and more.
Trigonometric Ratios/Functions	The special measurements of a right-angled triangle: **Sin**/Sine **Cos**/Cosine **Tan**/Tangent
Inverse Trig Functions	You use these when calculating angles: $Sin^{-1}(x)$ $Cos^{-1}(x)$ $Tan^{-1}(x)$
Sin/Sine	The ratio of the length of the **opposite** side to the length of the **hypotenuse**
Cos/Cosine	The ratio of the length of the **adjacent** side to the length of the **hypotenuse**
Tan/Tangent	The ratio of the length of the **opposite** side to the length of the **adjacent** side

Example of calculating the hypotenuse:

Calculate the value of x:

a
6cm

c
X cm

b
8cm
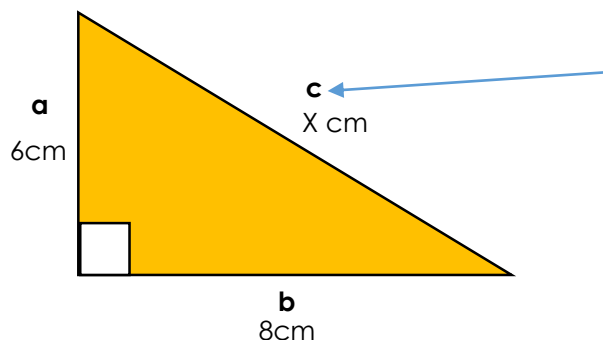
Label the sides of your triangle with a, b and c.
The hypotenuse must be labelled c.
The other sides can be labelled a and b (it doesn't matter which way round these are).

Example of calculating the shorter sides:

Calculate the value of the missing side:

13cm
c

a ?

b
12cm

Substitute the lengths you have into this formula:

$$6^2 + 8^2 = c^2 \qquad a^2 + b^2 = c^2$$

$$36 + 64 = 100$$

$$100 = c^2 \implies \sqrt{100} = c \implies 10cm = c$$

Don't forget, this is c^2. We want to calculate c so we need to square root!
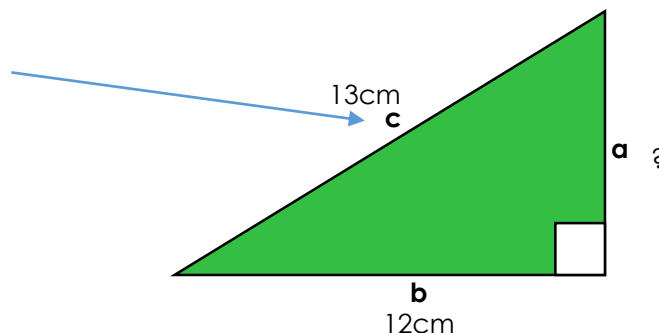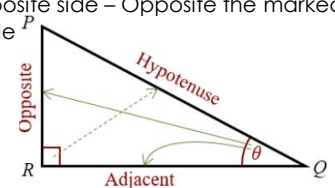
Substitute the lengths you have into this formula:

$$a^2 = 13^2 - 12^2 \qquad a^2 = c^2 - b^2$$

$$a^2 = 169 - 144$$

$$a^2 = 25 \implies a = \sqrt{25} \implies a = 5cm$$

Don't forget, this is a^2. We want to calculate a so we need to square root!

Other Topics/Units this could appear in:
- Graphs of trigonometric functions.
- Further trigonometry.
- Appears throughout A-Level in the Core and Mechanics Units

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Trig Ratios

Sin SOH   **Cos** CAH   **Tan** TOA

$$\sin(\emptyset) = \frac{opposite}{hypotenuse} \qquad \cos(\emptyset) = \frac{adjacent}{hypotenuse} \qquad \tan(\emptyset) = \frac{opposite}{adjacent}$$
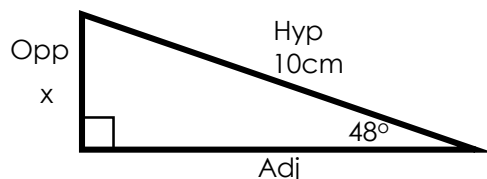
When you are calculating angles it will involve the inverse trig functions:

$$Sin^{-1}(x) \qquad Cos^{-1}(x) \qquad Tan^{-1}(x)$$

TRIGONOMETRY

Your first step in a trigonometry question is to label the triangle's sides.
The three sides are the **hypotenuse, opposite & adjacent** sides.
The **hypotenuse** side is always the longest side.
The **opposite** and the **adjacent** depend on the given angle:

Hypotenuse – HYP – H
Opposite – OPP – O
Adjacent – ADJ – A
θ°

Adjacent – ADJ – A
Hypotenuse – HYP – H
Opposite – OPP – O
θ°

Ex1: Calculate the value of x:

Opp   x
Hyp 10cm
Adj   48°

Remember your first step is label the sides!

I am given an angle and a length. I have the hypotenuse and am looking for the opposite.
This means it involves **SOH**

I then cover the O as I am looking for the opposite side.
This means I need to do:

$$opposite = Sin(x) \times hypotenuse$$

$$opposite = Sin(48°) \times 10 \ = 7.43\text{cm (rounded to 2 d.p.)}$$

Ex2: Calculate the value of x:

Remember your first step is label the sides!

Adj   x
7cm
Hyp
15cm
Opp
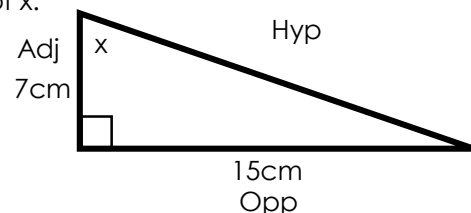
am given two lengths, the opposite and adjacent sides, and need to find an angle. This means it involves **TOA**

I then cover Tan° as I am looking for the angle.
This means I need to do:

$$Tan(x°) = \frac{opposite}{adjacent}$$

$$Tan(x°) = \frac{15}{7}$$

This is what Tan(x°) is equal to. We want just the angle. I need to use Tan^{-1}

$$Tan^{-1}\left(\frac{15}{7}\right) = 64.98° \text{ (rounded to 2 d.p.)}$$

Keyword/Skill	Definition/Tips
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Other Topics/Units this could appear in:
- Graphs of trigonometric functions.
- Further trigonometry.
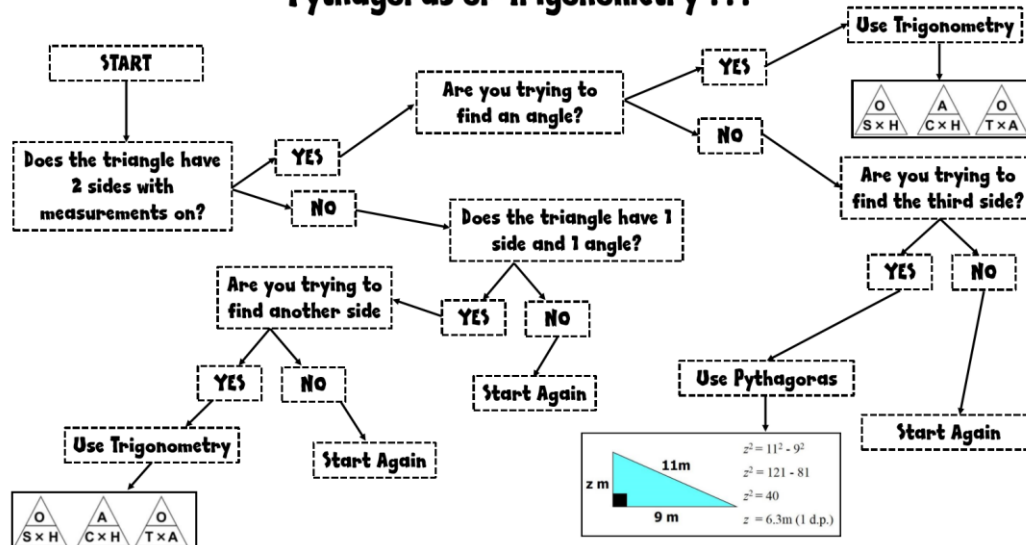- Appears throughout A-Level in the Core and Mechanics Units
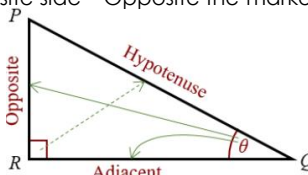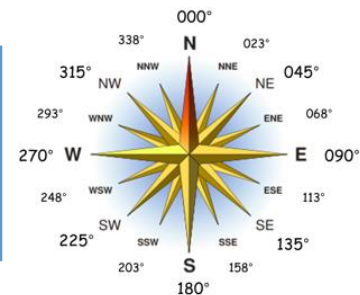
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Calculator Help

Here are the **trig functions** on your calculator. You use these ones when you are finding a length.

To get the **inverse trig functions** you need to press the SHIFT button first before you press the function you need. You use these ones when you are finding an angle.

Keyword/Skill	Definition/Tips
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Tan/Tangent	The ratio of the length of the **opposite** side to the length of the **adjacent** side

Pythagoras or Trigonometry

Pythagoras or Trigonometry ???

Other Topics/Units this could appear in:
- Graphs of trigonometric functions.
- Further trigonometry.
- Appears throughout A-Level in the Core and Mechanics Units

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Bearings are used to specify direction and are used to navigate ships and aeroplanes.
The key point to remember are:
1. Bearings are measured starting from North.
2. Bearings are always measured in a clockwise direction.
3. Bearings are always written in 3 figures (45° becomes 045°).

Matching compass points...

000°		
338°	N	023°
315° NNW	NNE	045° NE
293° WNW		ENE 068°
270° W		E 090°
248° WSW		ESE 113°
225° SW	SSE	135° SE
203°	S	158°
	180°	

Keyword/Skill	Definition/Tips
Bearing	The angle measured in degrees clockwise from North.
Degree	A measure for angles. There are 360 in a full turn.
Perpendicular	A line that is at a right angle, 90° from another rline
North line	A line facing North that all bearings are measured from.
Clockwise	Moving in the direction of the hands of a clock.
Angle	The amount of turn between two lines about their common point.
Bisect	To divide something into two equal parts.
Protractor	An instrument used to draw or measure angles.

Measuring Bearings

Find the bearing of A from B.

75°

075°

- Mark the North line on at B (if there isn't a North line draw one in)
- Measure the angle clockwise from the North line to A
- Give the answer as a three-figure bearing

Find the bearing of A from B.

294°

294°

- Mark the North line on at B (if there isn't a North line draw one in)
- Measure the angle clockwise from the North line to A
- Give the answer as a three-figure bearing

Tip: Measure this bit first (66°).
Then subtract from 360. 360 - 66 = 294°.

Drawing Bearings

Use a compass and ruler to construct the following bearings

Eg1	B is a bearing 120° from A and a distance of 4cm.

120°

Eg2	B is a bearing 225° from A and a distance of 5cm.

135°

360° - 135° = 225°

Calculating Bearings

John runs from A to B and back again.

| a | What is the bearing of his outward run from A to B? | = 057° |

| b | What is the bearing of this return run from B to A? | = 057° + 180° = 237° |

Look at **Crossover U36 - Alternate and Corresponding Angles/Angle Facts** if you need help with the angle facts used here.

57°

57°

57°

180°

Because corresponding angles are equal

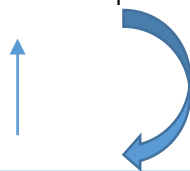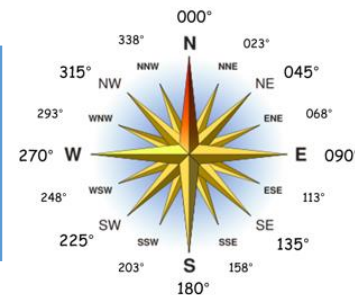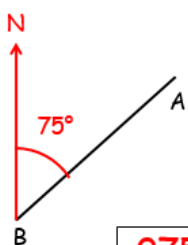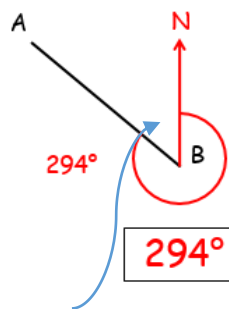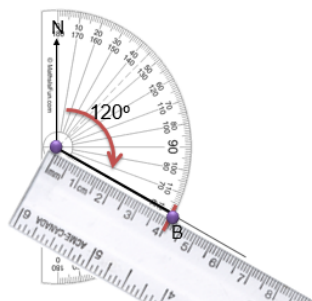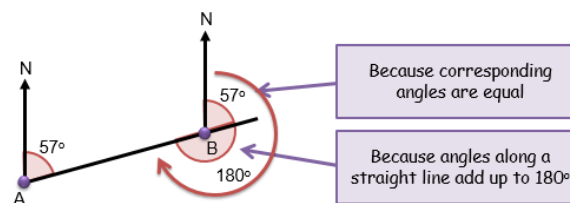Because angles along a straight line add up to 180°

Other Topics/Units this could appear in:

- Properties of shapes
- Simple angle facts
- Mensuration

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Bearings are used to specify direction and are used to navigate ships and aeroplanes.
The key point to remember are:
1. Bearings are measured starting from North.
2. Bearings are always measured in a clockwise direction.
3. Bearings are always written in 3 figures (45° becomes 045°).

Matching compass points...

Keyword/Skill	Definition/Tips
Bearing	The angle measured in degrees clockwise from North.
Degree	A measure for angles. There are 360 in a full turn.
Perpendicular	A line that is at a right angle, 90° from another rline
North line	A line facing North that all bearings are measured from.
Clockwise	Moving in the direction of the hands of a clock.
Angle	The amount of turn between two lines about their common point.
Bisect	To divide something into two equal parts.
Protractor	An instrument used to draw or measure angles.

Measuring Bearings

Find the bearing of A from B.

75°

075°

- Mark the North line on at B (if there isn't a North line draw one in)
- Measure the angle clockwise from the North line to A
- Give the answer as a three-figure bearing

Find the bearing of A from B.

294°

294°

- Mark the North line on at B (if there isn't a North line draw one in)
- Measure the angle clockwise from the North line to A
- Give the answer as a three-figure bearing

Tip: Measure this bit first (66°).
Then subtract from 360. 360 - 66 = 294°.

Drawing Bearings

Use a compass and ruler to construct the following bearings

Eg1	B is a bearing 120° from A and a distance of 4cm.

Eg2	B is a bearing 225° from A and a distance of 5cm.

120°

135°

360° - 135° = 225°

Calculating Bearings

John runs from A to B and back again.

a	What is the bearing of his outward run from A to B?	= 057°

b	What is the bearing of this return run from B to A?	= 057° + 180° = 237°

Look at **Crossover U36 - Alternate and Corresponding Angles/Angle Facts** if you need help with the angle facts used here.

57°

57°

57°

180°

Because corresponding angles are equal

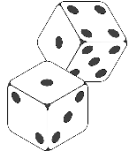Because angles along a straight line add up to 180°

Other Topics/Units this could appear in:

- Properties of shapes
- Simple angle facts
- Mensuration

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Probability

Probability is always between 0 and 1. When a single dice is thrown, there are six possible outcomes: **1, 2, 3, 4, 5, 6**.

The probability of any one of them is $\frac{1}{6}$

Construct sample space diagrams

Sample space diagrams provide a systematic way to display outcomes from events.

The possible outcomes from tossing a coin | The possible outcomes from rolling a dice

	1	2	3	4	5	6
H	1,H	2,H	3,H	4,H	5,H	6,H
T	1,T	2,T	3,T	4,T	5,T	6,T

This is the set notation to list the outcomes S =

In between the { } are all the possible outcomes.

S = { 1H, 2H, 3H, 4H, 5H, 6H, 1T, 2T, 3T, 4T, 5T, 6T}
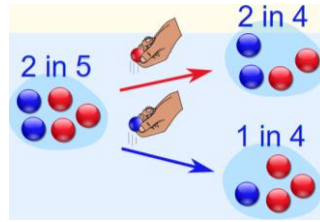
Replacement

The probability of getting a blue in the first bag is $\frac{2}{5}$

But after taking one out the chances change!

If we got a red marble before, then the probability of getting a blue marble from the second bag is $\frac{2}{4}$ or $\frac{1}{2}$

- With replacement the events are independent (the chances do not change)
- Without replacement the events are dependent (the changes change)

Probability from two-way tables

	Car	Bus	Walk	Total
Boys	15	24	14	53
Girls	6	20	21	47
Total	21	44	35	100

P (Girl walk to school) = $\frac{21}{100}$

The event
The total in the set
The total number of items

Probability from sample space

The possible outcomes from tossing a coin | The possible outcomes from rolling a dice

	1	2	3	4	5	6
H	1,H	2,H	3,H	4,H	5,H	6,H
T	1,T	2,T	3,T	4,T	5,T	6,T

This is the set notation that represents the question P

What is the probability that an outcome has an even number and a tails?

P (Even number and Tails) = $\frac{3}{12}$

In between the ( ) is the event asked for

There are three even numbers with tails

Numerator: the event

Denominator: the total number of outcomes

There are twelve possible outcomes

Keyword/Skill	Definition/Tips
Probability	$\dfrac{\text{number of successful outcomes}}{\text{total number of possible outcomes}}$
Dependent event	One outcome affects another. For example – choosing one red card reduces the chance of choosing another red card.
Independent event	One event does not affect the probability of the other.
Mutually exclusive	Two events that cannot happen at the same time, i.e. if you cannot turn left and right at the same time.
Conditional	The probability of something happening, given something else has occurred.
Sample space	The **set of all possible outcomes** of an experiment.
Theoretical	$\dfrac{\text{Number of Favourable Outcomes}}{\text{Total Number of Possible Outcomes}}$
Relative Frequency	$\dfrac{\text{Number of Successful Trials}}{\text{Total Number of Trials}}$
Experimental	An estimated probability based on the results of an experiment. The more trials are performed, the more reliable the results

Other Topics/Units this could appear in:
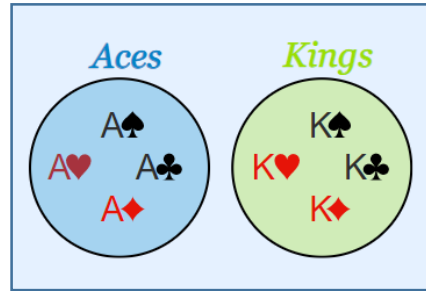
- Conditional probability

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Mutually Exclusive

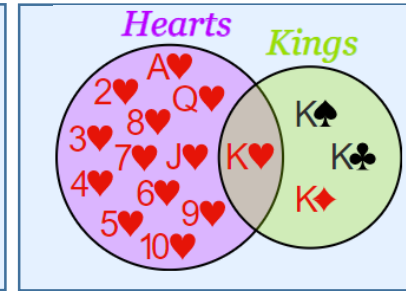When two events (call them "A" and "B") are Mutually Exclusive it is **impossible** for them to happen together:

P(A and B) = 0

"The probability of A and B together equals 0 (impossible)"

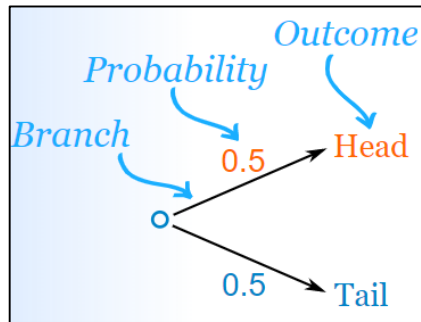Aces and Kings are **Mutually Exclusive** (can't be both)

Hearts and Kings are **not** Mutually Exclusive (can be both)

Probability Trees

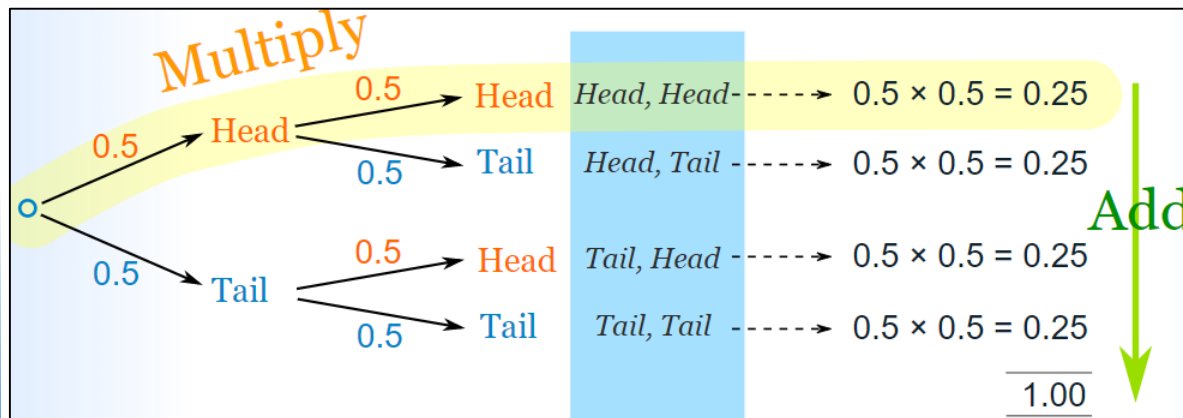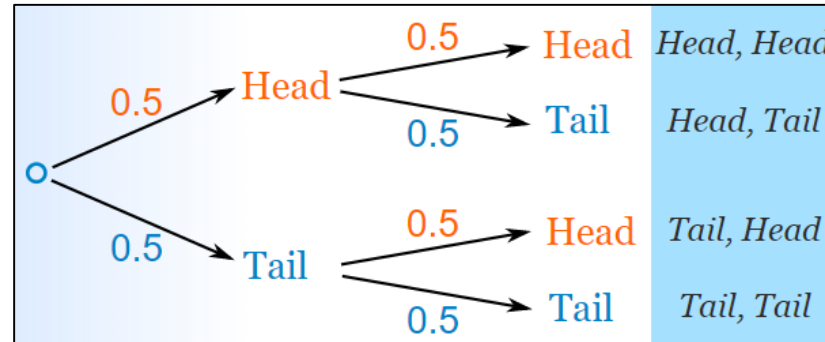Here is a tree diagram for the toss of a coin:

There are two "branches" (Heads and Tails)
- The probability of each outcome is written on the branch
- The outcome is written at the end of the branch

We can extend the tree diagram to two tosses of a coin:

How do we calculate the overall probabilities?
- We **multiply** probabilities **along the branches**
- We **add** probabilities down **columns**

Multiply

0.5 Head
- 0.5 → Head   Head, Head -----→ 0.5 × 0.5 = 0.25
- 0.5 → Tail   Head, Tail -----→ 0.5 × 0.5 = 0.25

0.5 Tail
- 0.5 → Head   Tail, Head -----→ 0.5 × 0.5 = 0.25
- 0.5 → Tail   Tail, Tail -----→ 0.5 × 0.5 = 0.25

Add

1.00

Now we can see such things as:
- The probability of "Head, Head" is 0.5×0.5 = **0.25**
- All probabilities add to **1** (which is always a good check)
- The probability of getting **at least one** Head from two tosses is 0.25+0.25+0.25 = **0.75**

| Keyword/Skill	Definition/Tips
Probability	$\dfrac{\text{number of successful outcomes}}{\text{total number of possible outcomes}}$
Dependent event	One outcome affects another. For example – choosing one red card reduces the chance of choosing another red card.
Independent event	One event does not affect the probability of the other.
Mutually exclusive	Two events that cannot happen at the same time, i.e. if you cannot turn left and right at the same time.
Conditional	The probability of something happening, given something else has occurred.
Sample space	The **set of all possible outcomes** of an experiment.
Theoretical	$\dfrac{\text{Number of Favourable Outcomes}}{\text{Total Number of Possible Outcomes}}$
Relative Frequency	$\dfrac{\text{Number of Successful Trials}}{\text{Total Number of Trials}}$
Experimental	An estimated probability based on the results of an experiment. The more trials are performed, the more reliable the results

Other Topics/Units this could appear in:
- Conditional probability   **57**

Crossover Unit 43 – Constructions

Construction Equipment
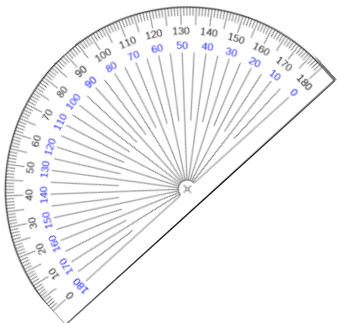
You will need a **ruler**, **protractor**, **eraser**, **sharpened pencil** and **pair of compasses** for your exam.
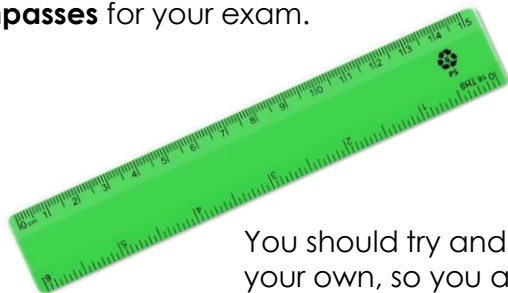
You should try and get your own, so you are used to using them all.

Using Compasses

Make sure your pencil is sharp and your compasses don't wobble.

Tighten the compasses so the points of the pencil and compasses are as close together as possible.

Try to hold only the black part of the compasses when you are drawing so you don't change the gap you have set.

Using a protractor

Always position your protractor with the + over the end of the line and line up the 0 on the scale. Count from 0 on the scale when measuring an angle.

This angle measures 25° and is acute.
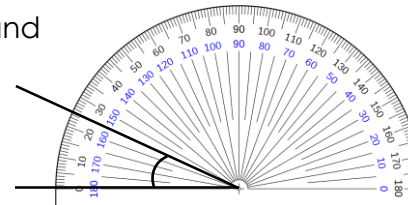
You may also want to look at the knowledge organisers for:

Year 7 Unit 7 - Angles
and
Working Towards Unit 5 - Angle Facts & Shape Properties

Check you can measure these angles correctly.

Measuring and Drawing Angles
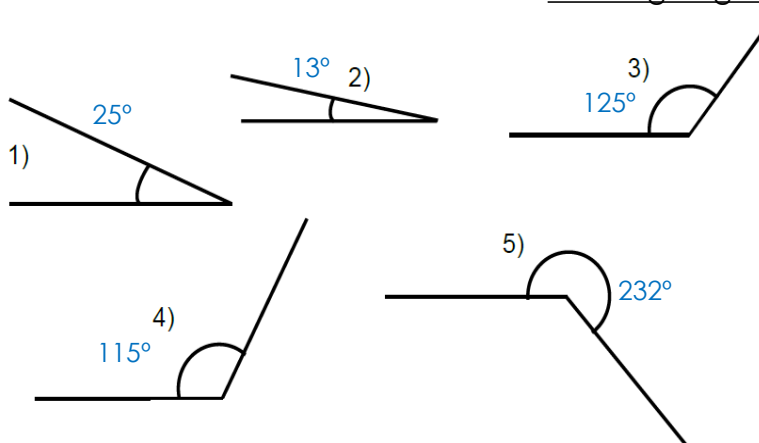
1) 25°
2) 13°
3) 125°
4) 115°
5) 232°

Keyword/Skill	Definition/Tips
Vertex	A corner where two edges meet at a point.
Line segment	A section of a line, usually between two letters, such as AB.
Angle	The corner point of an angle is called the **vertex**. And the two straight sides are called **arms**. The angle is the **amount of turn** between each arm.
Degree	The unit of measurement for turn, shown by the symbol ° 90° = ¼ turn, 180° = ½ turn, 270° = ¾ turn.
Adjacent	Next to one another.
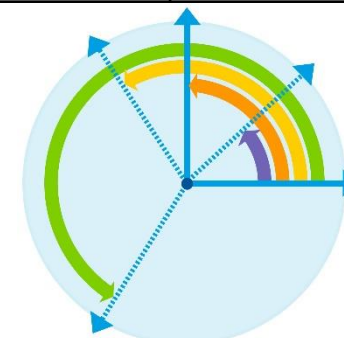
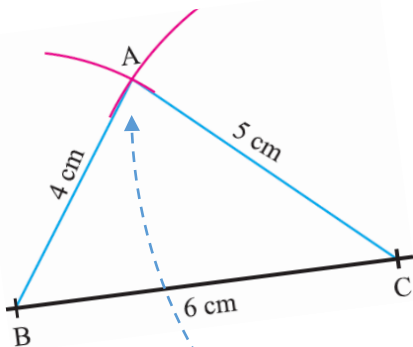## Constructing Triangles – given 3 side lengths

Using **ruler** and **compasses**, you can **construct** any triangle, given its three side lengths.

This triangle has side lengths 6cm, 5cm and 4 cm.

The 6cm line was drawn with a ruler.

Then arcs with radii 5cm and 4cm were constructed at either end of the 6cm line, using compasses.

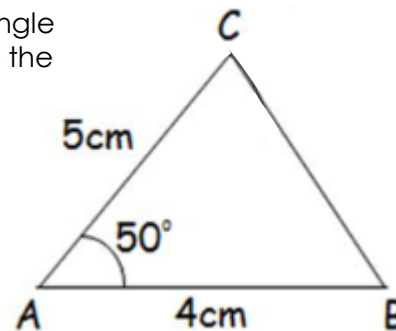The intersection point shows where the other vertex should be.

Constructing Triangles – given 2 sides and 1 angle

Using **ruler** and **protractor**, you can **construct** any triangle, given two of its side lengths and the angle between them.

This triangle has two side lengths 5cm and 4cm with a 50° angle between them.

The 4cm line is drawn first, then an angle of 50° is measured and marked from the end of the line.

A 5cm line is drawn at this angle.

don't rub these construction lines out – the examiner will want to see them!

Using **ruler** and **protractor**, you can **construct** any triangle, given two of its angles.

These triangles both have interior angles of 48° and 25°, but the side lengths are different.

Draw the side in between the two angles first; sometimes this is given to you in the question.

Then measure the angles from each end of the line – make sure the protractor is lined up correctly! Extend your construction lines until they intersect.

The intersection points show where the other vertex (corner) should be.

Constructing Triangles – given 2 angles
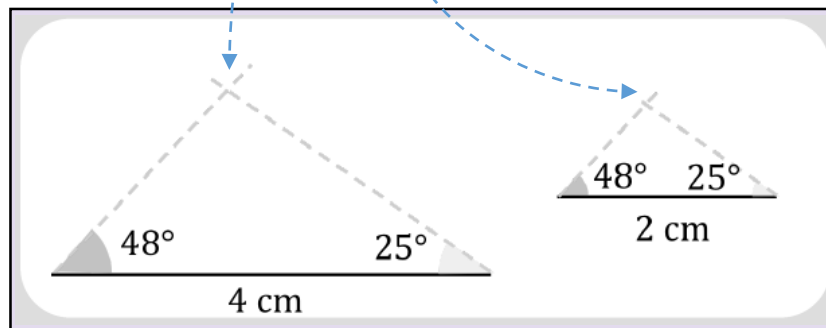
| Keyword/Skill	Definition/Tips
Arc	Part of the circumference of a circle.
Vertex	A corner where two edges meet at a point.
Line segment	A section of a line, usually between two letters, such as AB.
Construct	Use ruler, pencil, protractor and/or compasses to accurately draw a given shape.
Angle	The corner point of an angle is called the **vertex**. And the two straight sides are called **arms**. The angle is the **amount of turn** between each arm.
Degree	The unit of measurement for turn, shown by the symbol ° 90° = ¼ turn, 180° = ½ turn, 270° = ¾ turn.
Adjacent	Next to one another.
Intersect (intersection)	Where two or more line segments cross or meet at a point.

Crossover Unit 43 – Constructions

Using **ruler**, and **compasses**, you can **construct** an angle bisector, which cuts an angle in half.
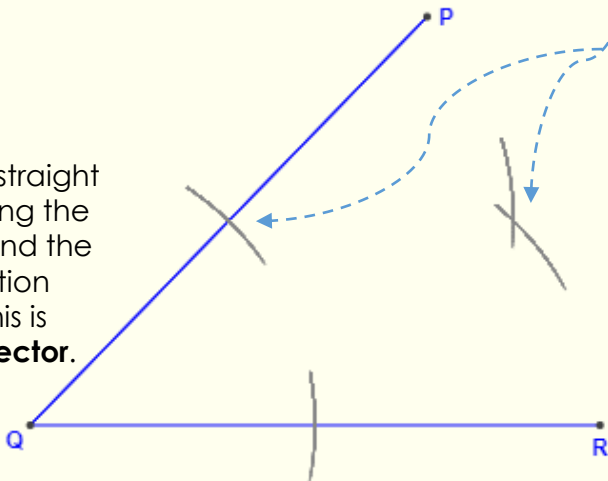
Constructing Angle Bisectors

Keep the gap on your compasses the same for the whole construction.

Draw two short arcs with the compass point placed at the vertex of the angle.

don't rub these construction lines out – the examiner will want to see them!
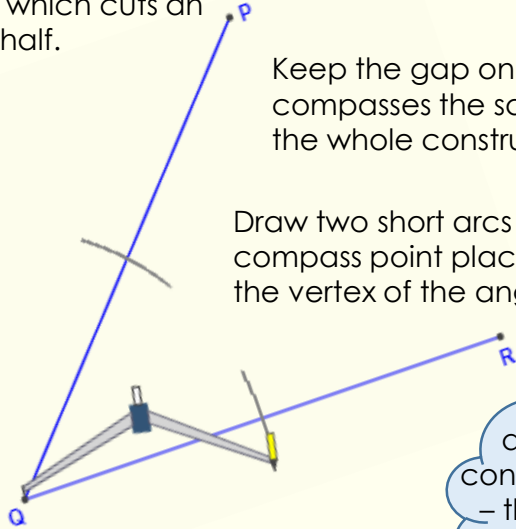
Draw two short arcs with the compass point placed on your first pair of arcs.

Draw a straight line joining the vertex and the intersection point. This is your **bisector**.

Using **ruler**, and **compasses**, you can **construct** a perpendicular bisector, which cuts a line in half at a right angle.
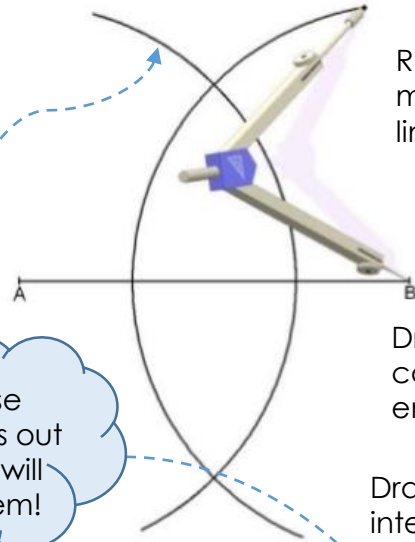
Constructing Perpendicular Bisectors

Remember to open the compasses more than half the length of the line you are bisecting.

Keep the gap on your compasses the same for the whole construction.

Draw two long arcs with the compass point placed at either end of the line you are bisecting.

Draw a straight line joining the two intersection points. This is your **bisector**.

Perpendicular Bisector from a point to a line

When constructing a perpendicular bisector from a point to a line, add this first step, then continue as above.
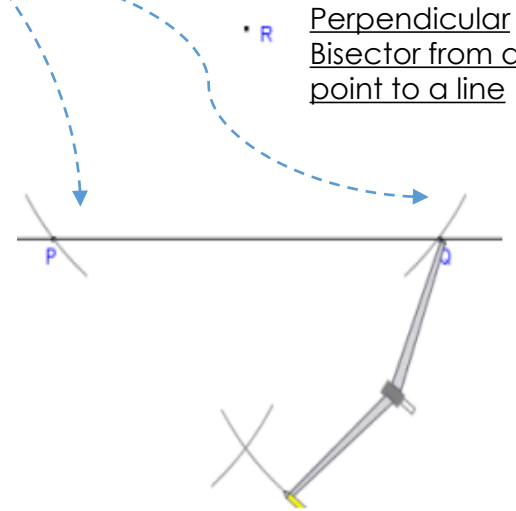
Keyword/Skill	Definition/Tips
Bisect	Cut exactly in half.
Loci/Locus of points	A **locus** is a path formed by a point which moves according to a rule. The plural is **loci**.
Perpendicular	Straight lines which meet or cross at right angles (90°) to one another.
Scale	The scale is the ratio of a distance on the drawing or model to the corresponding distance in real life, eg 1:20 means 1cm on the drawing represents 20 cm in real life.
Region	A specific part of something, usually shown by shading or labelling R.
Plan	A plan is similar to a map, usually showing a small area such as a playground or house.

Exams!

- You can use all these construction skills to construct loci or scale drawings.
- Any correct part of a construction scores a mark, so always have a go, even if you're not sure.

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Diameter and Radius of a Circle
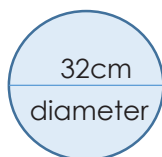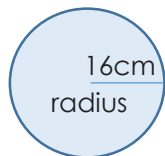
The diameter is double the size of the radius.

Example:

A circle has a radius of 16 cm. What is the diameter?

Radius = 16cm

6cm x 2 = 32cm

Diameter = 32cm

16cm radius

32cm diameter

Circumference of a Circle
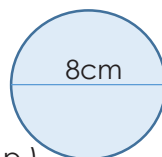
The circumference of a circle is the distance around the circle. It is the correct name for the perimeter of a circle.

Circumference = π x diameter

Example: Find the circumference of this circle

Circumference = π x 8

= 25.13cm (2d.p.)

8cm

You may be given the radius instead of the diameter, so you need to know the relationship between them (this information is stated above).
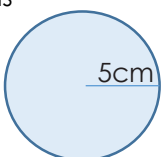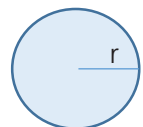
Example:
Radius = 5cm.
Diameter = 5cm x 2 = 10cm

5cm

Circumference = π x 10

= 31.41cm (2d.p.)

Area of a Circle

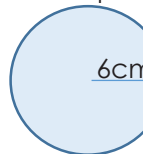**Area = πr^2**

= $\pi \times radius^2$

r

Example: Find the area of the circle.

Radius = 6cm

6cm

Area = πr^2
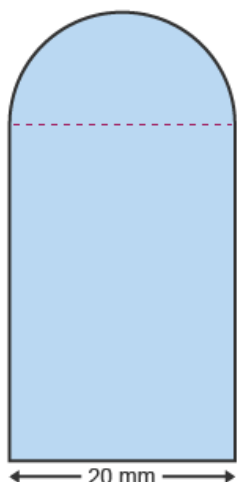
= $\pi \times 6^2$

= 36πcm^2 = 113.1cm^2

Exam!

In an exam it may ask you for your answer in terms of π. This means instead of doing the final calculation you just leave it with π in the answer e.g. 10πcm

The Area of a Compound Shape

This shape is made up of a rectangle and a semicircle.

To find the total area we just find the area of each part and add them together.

Area of rectangle = l x w

= 20×30

= $600mm^2$

Area of circle = πr^2

= $3.14 \times 10 \times 10$

= $314mm^2$

Area of semicircle

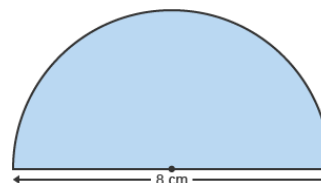= $314 \div 2 = 157mm^2$

$Total\ area = 600 + 157$

= $757mm^2$

30 mm

20 mm

Semicircles

The perimeter of a Semicircle:

Remember that the **perimeter** is the distance round the outside.

A semicircle has two edges. One is half of a circumference and the other is a diameter.

$C = \pi d$

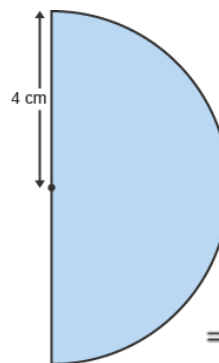= 3.14×8

= $25.12cm$

8 cm

Remember this is the circumference of the whole circle, so now we need to half this answer and remember to add on the other edge.

$25.12 \div 2 = 12.56cm$

Total Perimeter = $12.56 + 8 = 20.56cm$

The Area of a Semicircle:

A semicircle is just half of a circle. To find the **area** of a semicircle we calculate the area of the whole circle and then half the answer.

$A = \pi r^2$

= $3.14 \times 4 \times 4$

= $50.24cm^2$

4 cm

= $50.24 \div 2 = 25.12cm^2$

| Keyword/Skill	Definition/Tips
Area	The size of a surface. The space inside a 2D surface.
Perimeter	The distance around a two-dimensional shape.
Formula	A rule or fact written with mathematic symbols.
Semi-Circle	It is half of a circle
Accuracy	How close a measured value is to the actual (true) value.
Surface Area	The total area of the surface of a three-dimensional object.
Segment	The smallest part of a circle made when it is cut by a line.
Arc	Part of the circumference of a circle or any curve.
Sector	A "pie-slice" part of a circle.
Circumference	The distance around the edge of a circle (or any curvy shape).It is a type of perimeter.
Radius	The distance from the centre to the circumference of a circle. It is half of the circle's diameter.
Diameter	The distance from one point on a circle through the centre to another point on the circle.
Pi	The ratio of a circle's circumference to its diameter. The symbol is π. π = 3.14159265358979323846... (the digits go on forever without repeating)

Other Topics/Units this could appear in:

- Properties of shape and simple angle facts
- Perimeter and Area
- Mensuration
- Similarity in 2D & 3D
- Circle Geometry – Gradients & Tangents
- Circle Theorems
- Coordinate Geometry and Circles

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Crossover Unit 45 – Surface Area & Volume

Volume

Volume Using Unit Cubes

This is a unit cube. It has a volume of $1cm^3$. You may get shapes made from unit cubes and you will need to find the volume of that shape by counting how many cubes there are.
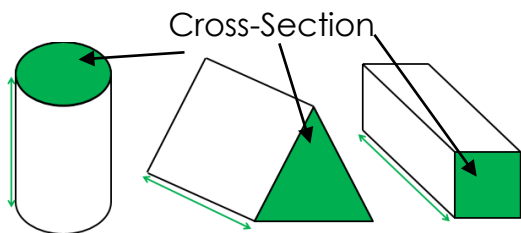
Example:
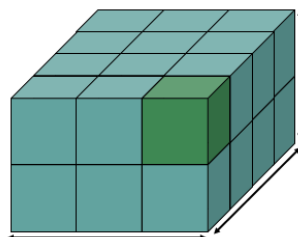
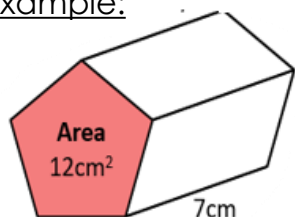The volume of this cuboid would be $24cm^3$ as there are 24 unit cubes altogether.

Volume of Prisms

Cross-Section

A prism has a constant cross-section. To find the volume of it you first need to find the area of the cross section and multiply it by the height/depth of the shape.
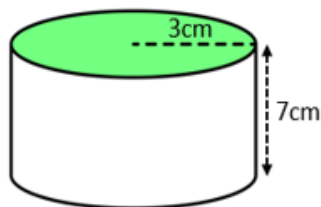
Formula for Volume of Prims: **Area of Cross-Section x Height**

Example:

You are given the area of the cross-section so you need to multiply the area by the depth:

Area 12cm²

7cm

$12cm^2$ x 7 = $84cm^3$

3cm

7cm

Area of cross-section = $\pi \times r^2$
= π x 3^2 = $28.27cm^2$

Volume = Area of Cross-Section x Height
= 28.27 x 7 = $197.89cm^3$
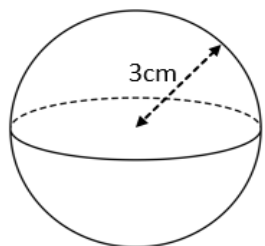
Volume of Spheres

Formula for volume of a Sphere: $\frac{4}{3} \times \pi \times r^3$

3cm

You are given this formula in the exam, you just need to be able to use it!

Example:
Volume = $\frac{4}{3} \times \pi \times 3^3$ = $113.1cm^3$ (1d.p.)

Exam!
Make sure you use the correct units with your answer.
Area uses square units and volume uses cubic units.
Examples:
Area units: cm^2, m^2, mm^2, km^2, etc.
Volume: cm^3, m^3, mm^3, km^3, etc.

Keyword/Skill	Definition/Tips
Prism	A 3D shape that has two identical ends and flat sides.
Cross Section	A view into the inside of something by cutting through it.
Diameter	The distance from one point of a circle to another passing through the centre. It is twice the radius.
Radius	The distance from the centre of the circle to the circumference. It is half the diameter.
Formula/ Formulae	A rule or fact written with mathematical symbols. (V = l x w x h).
Compound Shape	A compound shape is made up of two or more basic shapes.
Face	A flat surface of any object.
Perimeter	The distance around the outside of a shape.
Area	The space inside a 2D shape.
Surface Area	The total area of the outside of a 3D shape.
Volume	The amount of 3-dimensional space something takes up.

Other topics/units this may appear in:
- Perimeter and Area
- 3D forms
- Mensuration

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Crossover Unit 45 – Surface Area & Volume

Cubes and cuboids

Each face has the same area.
Area of one face:
$5 \times 5 = 25cm^2$
Total surface area:
$25 \times 6 = 150cm^2$

5cm
5cm
5cm

4cm
5cm
3cm

B
A
C
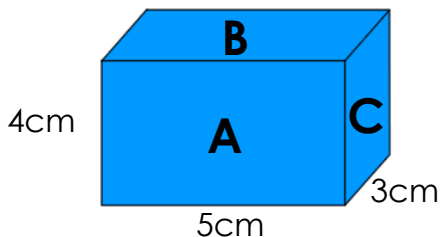
A cuboid will have 3 pairs of equal faces:
$2 \times A = 2 \times (5 \times 4) = 40cm^2$
$2 \times B = 2 \times (5 \times 3) = 30cm^2$
$2 \times C = 2 \times (3 \times 4) = 24cm^2$
Surface Area $= 40 + 30 + 24 = 94cm^2$

Triangular Prisms & Cylinders

Make sure you find the area of each face on a prism. They may not be all the same shape!

8 cm
5 cm
3 cm
4 cm
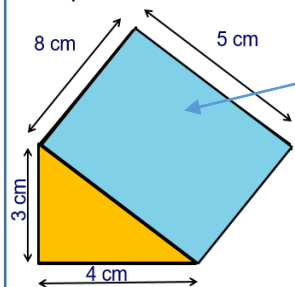
$5 \times 8 = 40cm^2$
$3 \times 8 = 24cm^2$
$4 \times 8 = 32cm^2$
$(3 \times 4) \div 2 = 6cm^2$
$(3 \times 4) \div 2 = 6cm^2$

$40 + 24 + 32 + 6 + 6 = 108cm^2$

A cylinder's surface is made from two circles and a rectangle, you can see this from the net of a cylinder. The dimensions of the rectangle are the height of the cylinder and the circumference of one of the circles.

10cm
3cm
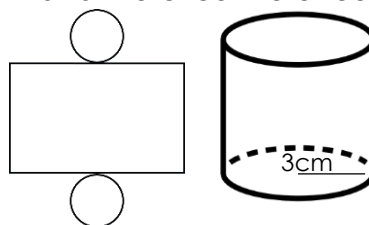
Area of the two circles:
$2 \times (\pi \times 3^2) = 56.6cm^2$ (1d.p.)

Area of the curved surface:
Circumference x Height
$(2 \times \pi \times 3) \times 10 = 188.5cm$ (1d.p.)
Total: $56.6 + 188.5 = 245.1cm^2$

Compound Shape Prisms
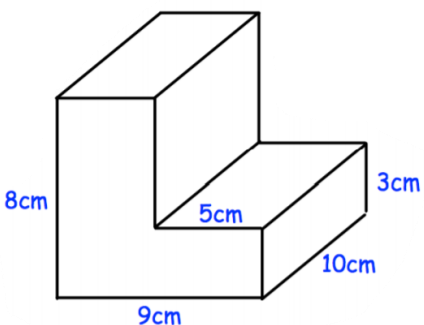
The area of the bottom and the top of the shape will be the same.

The area of the left and right sides of the shape will also be the same.

You then need to split the face of the shape up into shape you can find the area of, in this example it will be two rectangles.

8cm
3cm
5cm
10cm
9cm

9cm – 5cm = 4cm
4cm
8cm
A
5cm
B
9cm
3cm
10cm
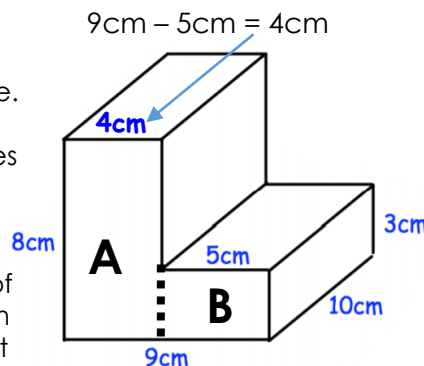
Area of the top and bottom:
$2 \times (9 \times 10) = 180cm^2$
Area of the left and right:
$2 \times (8 \times 10) = 160cm^2$
Area of rectangle A (front & back):
$2 \times (8 \times 4) = 64cm^2$
Area of rectangle B (front & back):
$2 \times (5 \times 3) = 30cm^2$

Total Surface Area:
$180cm^2 + 160cm^2 + 64cm^2 + 30cm^2$
$= 434cm^2$

| Keyword/Skill	Definition/Tips
Prism	A 3D shape that has two identical ends and flat sides.
Cross Section	A view into the inside of something by cutting through it.
Diameter	The distance from one point of a circle to another passing through the centre. It is twice the radius.
Radius	The distance from the centre of the circle to the circumference. It is half the diameter.
Formula/ Formulae	A rule or fact written with mathematical symbols. ($V = l \times w \times h$).
Compound Shape	A compound shape is made up of two or more basic shapes.
Face	A flat surface of any object.
Perimeter	The distance around the outside of a shape.
Area	The space inside a 2D shape.
Surface Area	The total area of the outside of a 3D shape.
Volume	The amount of 3-dimensional space something takes up.

Other topics/units this may appear in:

- Perimeter and Area
- 3D forms
- Mensuration

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Crossover Unit 46- Similarity and Congruence

Before progressing through this section of work, you may find it useful to look back at **Crossover Unit 44 – Constructions** knowledge organiser.

DON'T FORGET

Enlargements make the object bigger or smaller.
Scale factors tell us how much bigger or smaller.

An enlarged shape will ALWAYS produce a **similar** pair of shapes.
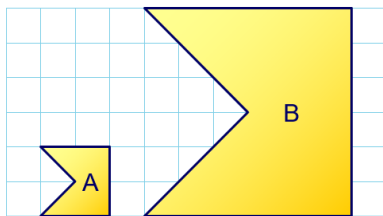
Shape A has been enlarged by a scale factor of 3 (al sides multiplied by 3) but all the angles will remain the same.

Similarity Vs. Congruence

Congruent

Similar
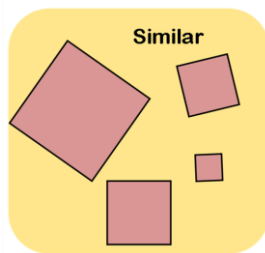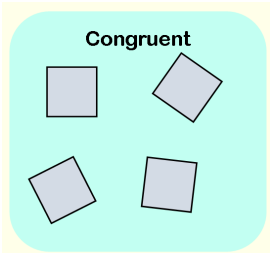
Length, Area & Volume Scale Factor

Linear scale factor = 3

Area scale factor = 3^2 = 9

Volume scale factor = 3^3 = 27

4cm

12cm

Example

Volume = 64cm³   64 x 27   Volume = 1728cm³
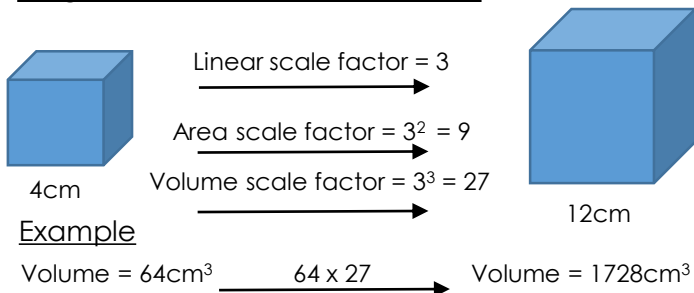
Finding and Using a Scale Factor
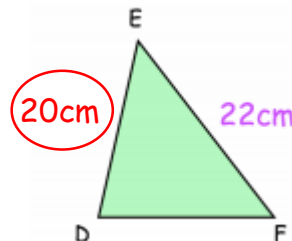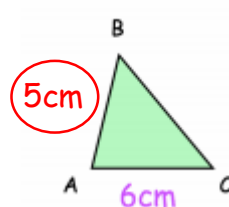
5cm 6cm   20cm 22cm

In order to find length DF
Write two of the corresponding sides as a ratio = AB : DE
5 : 20
1 : 4

With a scale factor of 4

Simplify

This is the scale factor

To find DF- look at the corresponding length AC = 6cm
6 x 4 = **24cm**

Rules for Congruent Triangles
If each of the three identified measurements (in the diagrams below) are equal, then the triangles are congruent.

SSS (Side – Side – Side)
3 sides are respectively equal

SAS (Side – Angle – Side)
2 sides and the included angle are respectively equal

ASA (Angle – Side – Angle)
2 angles and the included side are respectively equal
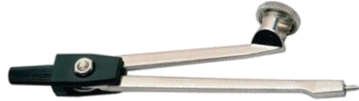
RHS (Right angle – Hypotenuse – Side)
Hypotenuse and one side are respectively equal

Keyword/Skill	Definition/tip
Similar	Two shapes are **similar** when one can become the other after a **resize**, flip, slide or turn.
Congruence	Two shapes are congruent if they are exactly equal in size and shape.
Scale factor	The ratio by which a length or other measurement is increased or decreased.
Ratio	A ratio shows the relative sizes of 2 or more values.
Enlargement	When a shape/length changes size (bigger or smaller) using a scale factor.
Compass	Piece of mathematical equipment
Construction	Use ruler, pencil, protractor and/or compasses to accurately draw a given shape.

Other topics/Units this could appear in:
• Transformation
• Construction

Exam Tips
• To help you start similarity questions you will need to find the scale factor.
• You will gain a mark for recognising and using area and volume scale factor.

64

In order to be able to solve simultaneous equations you will need to be able to **solve linear equations** (see units 2a, 21,22 and 50 for recap)

You also need to be able to use **substitution.** (Unit 2b)

Elimination Method

Example 1

Solve the equation: 6x + y =15 and 4x + y =11

It is useful to label the equations to help with method.

$$6x + y = 15 \quad (1)$$
$$4x + y = 11 \quad (2)$$

The y-term in both equations has the same coefficient. (No need to balance them)

$$6x + y = 15 \quad (1)$$
$$4x + y = 11 \quad (2)$$

Equation (1) minus equation (2)

$$2x = 4$$

$÷ 2$

$$x = 2$$

Substitute x = 2 into one of the original equations. (Usually the one with the smaller numbers)

So substitute x = 2 into: $\quad 4x + y = 11$

$$8 + y = 11$$

Solve

$$y = 3$$

You can then test the solutions by substituting values found back into the original equations

Example 2

$$5x + y = 22 \quad (1)$$
$$2x - y = 6 \quad (2)$$

Both equations have the same y-coefficient but with **DIFFERENT SIGNS**

As the signs are different you ADD the two equations to eliminate the y-terms. [Equation (1) + equation (2)]

$$5x + y = 22 \quad (1)$$
$$2x - y = 6 \quad (2)$$

Add

$$7x = 28$$

$÷ 7$

$$x = 4$$

Substitute x = 4 into one of the original equations, 5x + y = 22 which gives 20 + y = 22

Solve

$$y = 2$$

Sometimes you will have to change both equations to get identical terms.

Example 3

Solve these equations:

$$4x + 3y = 27 \quad (1)$$
$$5x - 2y = 5 \quad (2)$$

Both equations have to be changed to get identical terms in either x or y.

Equation (1) x 2
Equation (2) x 3

Here it will be best to make the y-coefficients the same so that we can add the equations. (Easier than subtracting)

$$8x + 6y = 54 \quad (3)$$
$$15x - 6y = 10 \quad (4)$$

Label new equations (3) and (4)

Eliminate by adding (3) + (4)

$$23x = 69$$

$÷ 23$

$$x = 3$$

Substitute into equation (1)=
$$12 + 3y = 27$$
$$3y = 15$$

Solve

$$y = 5$$

Example 4- Apply to solve problems

Three chews and four bubblies cost 72p. Five chews and two bubblies cost 64p. What would three chews and five bubblies cost?

You need to set up two simultaneous equations in c and b and then solve them.

$$3c + 4b = 72$$
$$5c + 2b = 64$$

Solve the simultaneous equations as in example 1

c = 8
b = 12

Use these answers to calculate 3 chews = 3 x 8 = **24p**
5 bubblies= 5 x 12 = **60p**

Keyword/ Skill	Definition/tip
Simultaneous Equation	A pair of equations with two unknown variables. Both equations need to be solved at the same time (simultaneously)
Eliminate	To remove a variable in order to help solve the equation.
Substitution	When a letter in an equation, expression or formula is replaced by a number, we have substituted the number for the letter.
Variable	A symbol for a number that we don't know yet. Often this is a letter such as x or y.
Coefficient	The number in front of an unknown quantity (the letter) in an algebraic term.

Other topics/Units this could appear in:
- Working above
- Unit 7 – Simultaneous equations
- A-level
- Core – algebra and functions
- Statistics- statistical distributions

Exam Tips
- You will gain 1 mark by correctly starting a process to eliminate a coefficient.

To be able to solve simultaneous equations graphically, you may be asked to draw the line of given equations. In order to do this you may need to look back at **Crossover Unit 29- Straight Line Graphs knowledge organiser.**

Example

Solve the following simultaneous equations graphically

$y = 2x + 1$
$y = y = 3$

Step 1- Draw the line $y = 2x + 1$

Step 2- Draw the line $y = 3$

Step 3 - Your solution is the coordinates where the lines cross

Coordinates = (1, 3)

x = 1
y = 3

Keyword/ Skill	Definition/tip
Simultaneous Equation	A pair of equations with two unknown variables. Both equations need to be solved at the same time (simultaneously)
Eliminate	To remove a variable in order to help solve the equation.
Substitution	When a letter in an equation, expression or formula is replaced by a number, we have substituted the number for the letter.
Variable	A symbol for a number that we don't know yet. Often this is a letter such as x or y.
Coefficient	The number in front of an unknown quantity (the letter) in an algebraic term.

Other topics/Units this could appear in:
• Working above
• Unit 7 – Simultaneous equations
• A-level
• Core – algebra and functions
• Statistics- statistical distributions

Further questions relating to this topic may include solving simultaneous equations graphically when **one equation is linear and the other is quadratic**. As with the example above, you would draw the graph of the equations and look for where your straight line crosses two parts of the quadratic curve.

Exam Tips
• If you need to draw your own straight line graph you will gain marks for that.
• If the graph has been drawn for you LOOK at where the lines cross.

Direct Proportion means as one quantity increases or decreases, so does the other one. Example: The more hours you work, the more you will earn.
A is directly proportional to B is written as:

$A \propto B$
$A = k \times B$
$A = kB$

"k" is the constant of proportionality that links our two numbers. We need to put it into our formula.

Example 1
It takes 3 hours to fill 12 boxes with food. How long does it take to fill 5 boxes?

$A = kB$

Step 1: Write an equation of proportionality.

$12 = k \times 3$
$4 = k$

Step 2: Substitute A and B to find k

Step 3: Rewrite the equation using k and substitute A and B

$A = 4B$
$A = 4 \times 5$
$A = 20$

Example 2
a is directly proportional to b.
a = 27 when b = 9 Find the value of a when b = 5

$a = kb$
$27 = k \times 9$
$3 = k$
$a = 3 \times b$
$a = 3 \times 5$
$a = 15$

Find the value of k first using the steps above.

Rewrite and substitute the value of k into the equation.

Inverse Proportion means as one quantity increases, the other decreases.
Example: If one quantity doubles the other is halved. If it takes 4 people 5 hours to dig a hole, it would take 8 people 2.5 hours.

Example 1
2 cows eat a tonne of food in 6 days. How long would it take 3 cows to eat a tonne of food?

Step 1: Write an equation $y = \dfrac{k}{x}$

Step 2: Substitute x and y to find k $6 = \dfrac{k}{2}$
days   cows

$k = 12$

Step 3: Rewrite the equation using k and substitute x to find y
$y = \dfrac{12}{x}$

$y = \dfrac{12}{3}$ **y = 4 days**
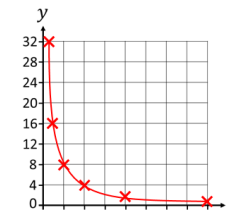
Example 2
y is inversely proportional to x
y = 6 when x = 5. Find the value of y when x = 10

$y = \dfrac{k}{x}$ Use the same steps as above

$6 = \dfrac{k}{5}$

$30 = k$

REWRITE & SUBSTITUTE

$y = \dfrac{30}{x}$

$y = \dfrac{30}{10} = 3$

x	1	2	4	8	16	32
y	32	16	8	4	2	1

1 job takes 32 hours to complete. We can show the inverse relationship on a graph

---

Keyword/Skill	Definition/Tips
Ratio	Shows the relative sizes of two or more values. E.G. 1 boy and 3 girls would be written as 1:3
Inverse	The opposite or the reverse E.g. the inverse of addition is subtraction.
Proportion	Two ratios or fractions that are equal.
Direct Proportion.	Two quantities change in the same way. When one increases or decrease, so does the other one.
Variable	A symbol for a number we don't know yet, often a letter x or y.
Equation	Says that two things are the equal. (1+1=2).
Linear	A graph that has a straight line.
Substitute	Putting values where the letters are.
Constant of Proportionality	A constant value, written as k, relating to amounts that rise or fall uniformly together.

Other topics/units this may appear in:

- Best Value
- Exchange Rates
- Proportion Recipes
- Straight Line Graphs

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Biology Knowledge Organisers

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1. Magnification

Image / Actual X Magnific-ation

2. Plant and animal cells : compare and contrast

3. Enzymes and food tests

Name of large biological molecule	Name of enzyme that digests it	Digested molecule	Food test	Positive result
Carbohydrates – Starch	Carbohydrase	Glucose	Starch – Iodine solution Glucose – Benedict's solution	Blue/black colour Green, yellow, orange, brick red colour
Proteins	Protease	Amino acids	Biuret reagent	Violet colour
Lipids	Lipase	Glycerol and three fatty acids	N/A	N/A
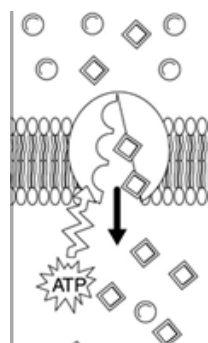
4. Enzyme substrate complex

6. Active transport

5. Osmosis

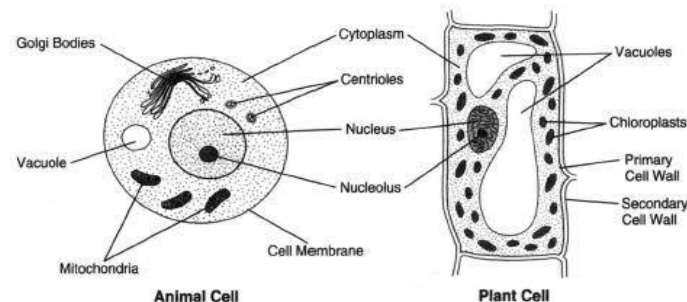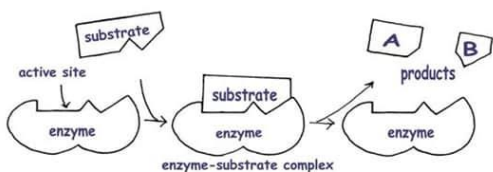| Keyword	Definition
Magnification	The number of times larger an image is than the initial object that produced it
Objective lens	The part of the microscope that is closest to the specimen
Resolution	The smallest change that can be measured by an instrument
Nucleus	The control centre of the "eukaryotic cell"
Eukaryotic	A cell with a nucleus
Microvilli (us)	A tiny fold in the cell surface membrane of a cell, increase the surface area of the cell
Adaptations	The features of something that enable it to do a certain function
Gametes	A haploid cell produced by meiosis used for sexual reproduction
Haploid	A cell or nucleus that has one set of chromosomes. Gametes are haploid
Epithelial cells	A cell found on the surface of internal organs
Chromosomal DNA	The main bulk of DNA found in a cell. In humans, this DNA is found in chromosomes
Prokaryotic	A cell with no nucleus is prokaryotic
Monomers	A small molecule that can join with other molecules like itself to form a polymer
Polymers	A long-chain molecule made by joining many smaller molecules (monomers)
Biuret test	A test that uses copper sulfate solution and potassium hydroxide solution to test for proteins. It turns from blue to purple in the presence of proteins
Benedicts solution	A solution used to detect the presence of reducing sugars (eg. Glucose) in foods
Calorimeter	Apparatus used to measure the energy content of substances by burning them and measuring the temperature increase
Ethanol emulsion test	A test using ethanol to detect lipids (fats) in food
Active site	The space in an enzyme where the substrate fits during an enzyme-catalysed reaction
Denatured	A denatured enzyme is one where the shape of the active site has changed so much that the substrate no longer fits and the reaction can no longer happen
Optimum temperature	The temperature at which an enzymes rate of reaction is greatest, or at which a population of microorganisms grow most rapidly
Osmosis	The movement of water from a high concentration to a low concentration through a partially permeable membrane
Active Transport	The pumping of particles across a cell membrane from a low concentration to high concentration (requires energy)

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B the stages of mitosis

In **prophase** the nucleus starts to break down and **spindle fibres** appear.

By the end of **metaphase**, the chromosomes are lined up on the spindle fibres across the middle of the cell.

The chromosome copies are separated and moved to either end of the cell on the spindle fibres. This is **anaphase**.

In **telophase** a membrane forms around each set of chromosomes to form nuclei.

A cell surface membrane forms to separate the two cells during **cytokinesis**. Cell walls form in plant cells.

B The zones of an onion root tip where cells divide, elongate and differentiate into specialised cells. (Note: colour has been added to help identify different tissues.)

B Percentile growth curves for UK baby boys from 2 weeks to 1 year, for mass. The red line that has been plotted on the curves shows the growth of one baby.

The 50th percentile curve shows the growth of a baby of the median (average) size of the population. Half (50%) of all babies will have a mass above this curve and half equal to or below the curve.

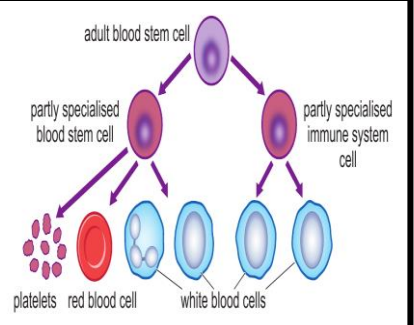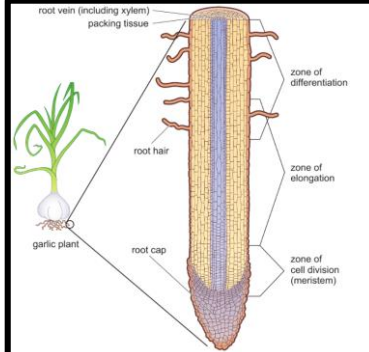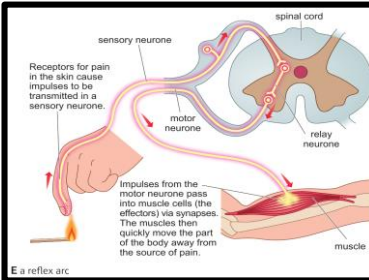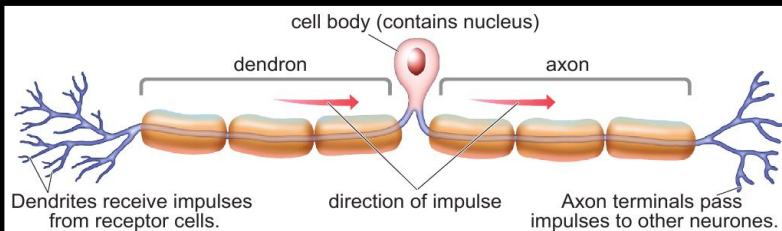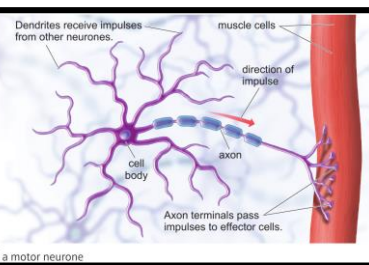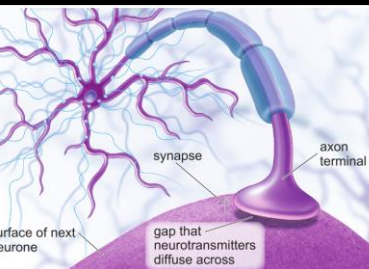C Blood stem cells are found in marrow in the middle of long bones (such as the femur). They continue to divide throughout life to produce new blood cells.

E a reflex arc

Receptors for pain in the skin cause impulses to be transmitted in a sensory neurone.

Impulses from the motor neurone pass into muscle cells (the effectors) via synapses. The muscles then quickly move the part of the body away from the source of pain.

D a sensory neurone

cell body (contains nucleus)

dendron

axon

Dendrites receive impulses from receptor cells.

direction of impulse

Axon terminals pass impulses to other neurones.

C a motor neurone

Dendrites receive impulses from other neurones.

muscle cells

direction of impulse

cell body

axon

Axon terminals pass impulses to effector cells.

Cell differentiation

Although all animals develop from a single cell, not all the cells in their bodies are the same. Cells produced by mitosis are the same as the cell from which they were formed. However, the new cells may then change in different ways, so they become specialised for different functions. The process that changes less specialised cells into more specialised ones is called **differentiation**.

D The gap in a synapse is only about 20 nm (0.00002 mm) wide.

surface of next neurone

synapse

gap that neurotransmitters diffuse across

axon terminal

Keyword	Definition
anaphase	The stage of mitosis in which the separated chromosomes move away from each other.
cancer cell	Cell that divides uncontrollably.
cell cycle	A sequence of growth and division that happens in cells. It includes interphase and mitosis, and leads to the production of two daughter cells that are identical to the parent cell.
clone	Offspring from asexual reproduction. All the cells in a clone are genetically identical to each other and to the parent's cells.
cytokinesis	When the cytoplasm of the cell is separated as the cell membrane is pinched to divide the cell into two daughter cells.
daughter cell	New cell produced by cell division.
diploid	A cell with two sets of chromosomes.
DNA replication	The copying of the DNA within a cell.
haploid	A cell with one set of chromosomes.
interphase	The stage when the cell prepares itself for the process of cell division, and DNA replication takes place. The cell also makes more of its sub-cellular structures.
metaphase	The stage of mitosis when the chromosomes line up across the middle of the cell.
mitosis	The process of cells dividing to produce two daughter cells that are genetically identical to the parent.
prophase	The stage of mitosis in which the nucleus starts to break down and spindle fibres appear.
telophase	The stage of mitosis in which the chromosomes arrive at opposite ends of the cell and the nucleus membrane reforms.
differentiation	When a group of similar things, such as cells, become different in form from each other.
percentile	A $\frac{1}{100}$th division of a group. For example, 10 per cent of the data items are below the 10th percentile and 50 per cent are below the 50th percentile.
elongation	When something gets longer (such as a cell in a plant root or shoot before it differentiates into a specialised cell).
adult stem cell	Stem cell found in specialised tissue that can produce more of the specialised cells in that tissue for growth and repair.
cancer	Disease caused by the uncontrolled division of stem cells in a part of the body.
embryonic stem cell	Stem cell from an early embryo that can produce specialised cells of many different types.
rejection	When the immune system attacks and kills cells and tissue that come from another person, such as blood (after transfusion) or stem cells.
axon	The long extension of a neurone that carries an impulse away from the dendron or dendrites towards other neurones.

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D meiosis (simplified to show just two different types of chromosome)

The gamete-making cell has two sets of chromosomes. It is diploid (2n).

one set of chromosomes — the other set of chromosomes

pair of chromosomes

DNA replication

The chromosomes replicate (and the copies stay stuck to one another).

The cell divides into two and then into two again. Each of the final four daughter cells has a copy of one chromosome from each pair. They are haploid (1n).

A DNA is packaged up tightly with proteins in a chromosome.

chromosomes

The nucleus of a cell contains chromosomes.

A chromosome contains one long DNA molecule that is tightly coiled many times. Proteins hold the shape together.

DNA is a double helix.

B the structure of DNA

sugar (called deoxyribose)

phosphate group   hydrogen bond

one nucleotide — a phosphate group, a sugar and a base

DNA double helix

complementary base pairs join the two strands together

A genetic diagram for sex determination in humans

egg-making cell   sperm-making cell

sex chromosomes

XX   XY

gametes

X   X   X   Y

different possible combinations at fertilisation

different possibilities of zygote

XX   XY   XX   XY

B Punnett square for human sex determination

XY male

possible gametes   X   Y

female   XX

	X	Y
X	XX	XY
X	XX	XY

The boxes show the possible combinations in the offspring.

C Punnett square for parents that are heterozygous for the CF gene

Ff male

possible gametes   F   f

female   Ff

	F	f
F	FF	Ff
f	Ff	ff

Keyword	Definition
chromosome	A structure found in the nuclei of cells. Each chromosome contains one enormously long DNA molecule packed up with proteins.
daughter cell	A cell produced by another cell that has divided.
diploid	A cell or nucleus that has two sets of chromosomes. In humans, almost all cells except the sperm and egg cells are diploid.
DNA	Deoxyribonucleic acid. A polymer made of sugar and phosphate groups joined to bases. One molecule of DNA is found in each chromosome.
fertilisation	Fusing of a male gamete with a female gamete.
gamete	A haploid cell used for sexual reproduction.
gene	Section of the long strand of DNA found in a chromosome, which often contains instructions for a protein.
genome	All the DNA in an organism. Each body cell contains a copy of the genome.
haploid	A cell or nucleus that has one set of chromosomes. Gametes are haploid.
meiosis	A form of cell division in which one parent cell produces four haploid daughter cells.
replicate	When DNA replicates it makes a copy of itself.
zygote	Another term for 'fertilised egg cell'.
base (in DNA)	Four substances that help make up DNA, often shown by the letters A, C, G and T. Pairs of bases form 'links' between two 'spines' formed of phosphate groups and a type of sugar.
chromosome	A structure found in the nuclei of cells. Each chromosome contains one enormously long DNA molecule packed up with proteins.
complementary base pair	Two DNA bases that fit into each other and link by hydrogen bonds. There are two types of complementary base pair: A linking with T, and C linking with G.
double helix	Two helices joined together.
allele	Most genes come in different versions called alleles. So a gene for eye colour may have one version (allele) that can cause dark eyes, and another allele that can cause pale eyes.
phenotype	The characteristics that a certain set of alleles display.
genotype	The alleles for a certain characteristic that are found in an organism. Written in a shorthand using letters to represent the alleles (with the dominant allele having a capital and being written first).
dominant	Allele that will always affect the phenotype (as opposed to a recessive allele, whose effect will not be seen if a dominant allele is present).
recessive	Allele that will only affect the phenotype if the other allele is also recessive. It has no effect if the other allele is dominant.
heterozygous	When both the alleles for a gene are different in an organism.
homozygous	When both the alleles for a gene are the same in an organism.

1. Evidence for human evolution

Ardi (Ardipithecus ramids)	• Human like female fossil • Walked upright • Long arms and short legs • Small skull and brain
Lucy (Australopithecus afarensis)	• More human like female fossil than Ardi • Walked upright better than Ardi • Arm and legs were the length between ape and human • Skull and brain slightly larger than Ardi
Turkana Boy (Homo erectus) discovered by Richard Leakey	• More human like female fossil than Lucy • Walked upright better than Lucy • Arm and legs were human length • Skull and brain larger than Lucy

Evidence for human evolution can also be gained from looking at stone tools, which become more sophisticated overtime

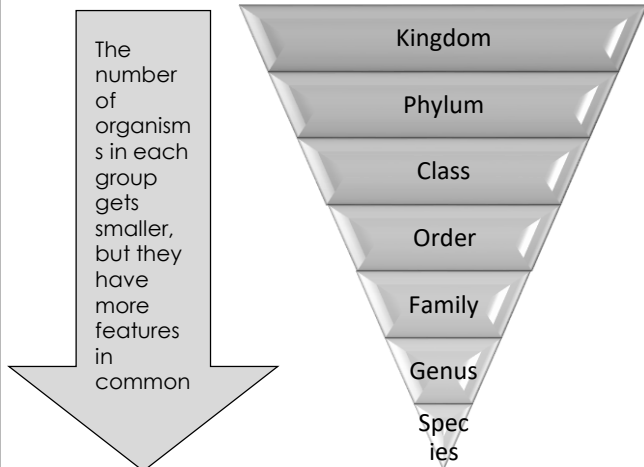
2. Darwin's Theory of Evolution

Evolution is a change in the inherited characteristics of a population over time. This occurs through a process called natural selection.

- The differences in a population gives some
- individuals an advantage.
- This individual is more likely to survive for longer and be able to breed to pass on desirable genes.
- Nature is selecting the individual with the phenotypes most suited to survival ('survival of the fittest'). This is called natural selection.
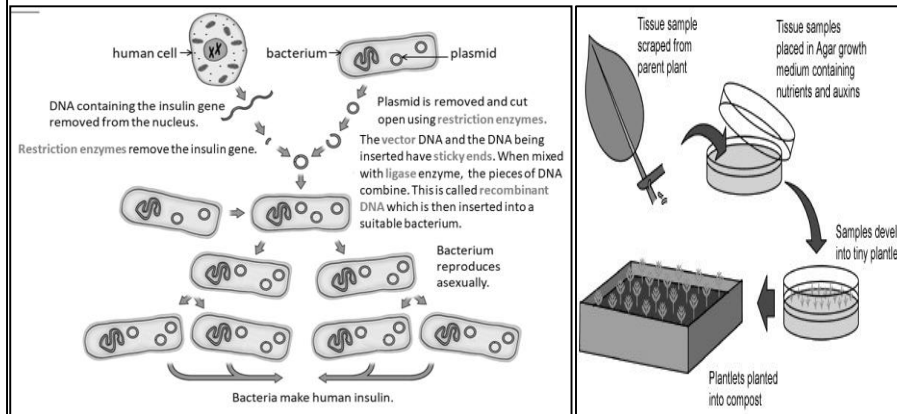
Our understanding of evolution has also been helped by the study of antibiotic resistance in bacteria.

Genetic Mutation Causes Drug Resistance

Non-resistant bacteria exist → Bacteria multiply by the billions → Some mutations make the bacterium drug resistant → Drug resistant bacteria multiply and thrive.

3. Classification

The number of organisms in each group gets smaller, but they have more features in common →

Kingdom
Phylum
Class
Order
Family
Genus
Species

4. Genetic Engineering and Tissue Culture

human cell → bacterium → plasmid
DNA containing the insulin gene removed from the nucleus.
Restriction enzymes remove the insulin gene.
Plasmid is removed and cut open using restriction enzymes.
The vector DNA and the DNA being inserted have sticky ends. When mixed with ligase enzyme, the pieces of DNA combine. This is called recombinant DNA which is then inserted into a suitable bacterium.
Bacterium reproduces asexually.
Bacteria make human insulin.

Tissue sample scraped from parent plant
Tissue samples placed in Agar growth medium containing nutrients and auxins
Samples develop into tiny plantlets
Plantlets planted into compost

In **genetic engineering, genes from** the chromosomes of **humans** and other organisms are **cut out** of the **DNA** using **enzymes**. The **genes** are then **transferred** to the **cells of the organism** to be genetically modified.
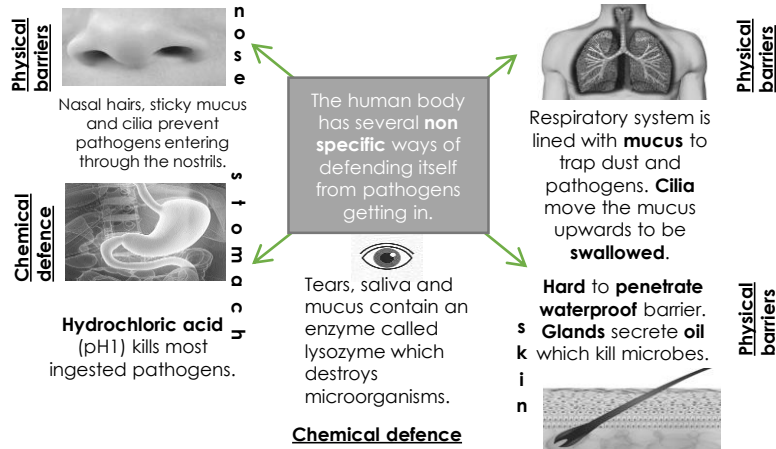
Keyword	Definition
Binomial system	The system of naming organisms using two Latin words
Evolution	A change in one or more characteristic of a population over a long period of time
Genetic variation	Differences between organisms caused by differences in the alleles they inherit from their parents, or differences in genes caused by mutation. Also called inherited variation
Natural selection	A process in which certain organisms are more likely to survive and reproduce than other members of the same species because they possess certain genetic variations
Resistance	When an organism has resistance to something, it is unaffected by it, or not affected very much
Pentadactyl limb	A limb that has five digits (fingers and thumbs). Amphibians, reptiles, birds and mammals share this characteristics
Classification	The process of sorting organisms into groups based on their characteristics
Kingdoms	There are five kingdoms into which organisms are usually divided: plants, animals, fungi, protists and prokaryotes
Selective breeding	When humans choose an organism that has a certain characteristic and breed more of these organisms, making that chosen characteristic more and more obvious
Varieties	Groups of plants of the same species that have characteristics that make them different to other members of the species
Genetic engineering	Altering the genome of an organism, usually by adding genes from another species.
GMOs	An organism that has had its genome genetically altered (genetic modification)
Yield	The amount of useful product that you can get from something
Disease resistance	Unaffected or less affected by a certain disease
Stem cells	An unspecialised cell that continues to divide by mitosis to produce more stem cells and other cells that differentiate into specialised cells
Tissue culture	Growing tiny pieces of tissue, or cells, in the lab
Pests	Animals that cause problems, such as damaging crops
Biological control	Using organisms to kill problem organisms, such as pests or weeds
Insecticides	A substance used to kill insect pests

KS4 Biology - Health, Disease and the Development of Medicine

Transmission of Disease

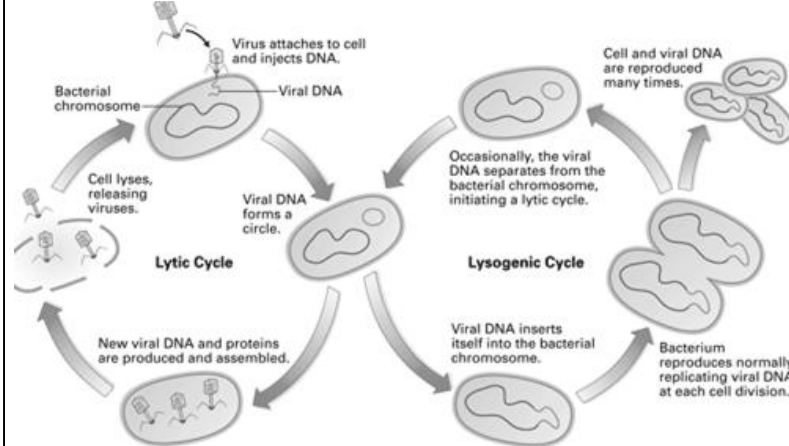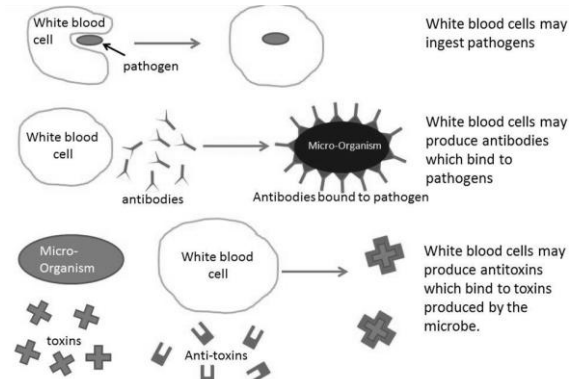| Disease	Symptom	Method of transmission	Control spread of disease by:	Caused by:
Malaria	Recurrent fever	Animal vector	Preventing breeding of mosquitoes or use of a net to prevent being bitten.	Protist
Chalara ash dieback	Leaf loss and bark lesions	Airborne	Remove infected leaf litter. Clean all tools, vehicles and footwear.	Fungus
Cholera	Diarrhoea	Waterborne	Clean drinking water and good hygiene and sanitation.	Bacteria
Tuberculosis	Lung damage	Airborne	Vaccination programme. Treat infection with antibiotics.	Bacteria
HIV	Flu like illness	Sexual contact or bodily fluids. Direct contact.	Use of condoms / clean needles. Treat infection with antiretroviral drugs.	Virus
Ebola	Haemorrhagic fever	Bodily fluid - direct contact	Avoid contact with people infected with Ebola.	Virus

Communicable diseases:	Non-communicable diseases:
Common cold	Diabetes
Influenza	Cancer
STDs	Cardiovascular disease

Lysogenic Vs Lytic Virus Lifecycle

The Immune System

Defence Against Disease

Physical barriers

Nasal hairs, sticky mucus and cilia prevent pathogens entering through the nostrils.

Chemical defence

Hydrochloric acid (pH1) kills most ingested pathogens.

The human body has several **non specific** ways of defending itself from pathogens getting in.

nose

stomach

skin

Tears, saliva and mucus contain an enzyme called lysozyme which destroys microorganisms.

Chemical defence

Physical barriers

Respiratory system is lined with **mucus** to trap dust and pathogens. **Cilia** move the mucus upwards to be **swallowed**.

Physical barriers

Hard to **penetrate waterproof** barrier. **Glands** secrete **oil** which kill microbes.

Cardiovascular Disease

Cardiovascular disease (CVD) is a general term for disease which involve the **heart** or **blood vessels**. **Atherosclerosis** is a cause of **coronary heart disease** where **layers** of **fatty material** build up inside the coronary arteries, **narrowing** them. This **reduces** the flow of blood through the coronary arteries, resulting in a **lack of oxygen** for the **heart muscle**.

Atherosclerosis can be **treated** in two main ways by placing a **stent** in the coronary artery and/or using **lifelong medication** called **statins**. Lifestyle changes such as a healthy diet, exercise and no smoking are also vital in reducing the risk of CVD.
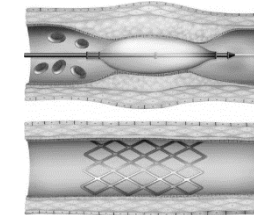
Stents are metal cylinder grids which can be **inserted** into an artery to maintain blood flow by **keeping the artery open** so that the heart continues to receive **enough oxygen** to function effectively.

Statins are drugs that lower harmful **cholesterol** in the blood and stop the **liver** producing too much cholesterol and reduce the rate at which it is deposited. Patients should change their **lifestyle** and have a healthy **diet**. This **reduces** the risk of heart disease.

Obesity

Excess weight (obesity) can make a person at **risk of cardiovascular disease**, a stroke and Type 2 diabetes. A tool called the **Body Mass Indicator** (BMI) can be used to calculate whether a persons weight lies within a healthy range.

$$BMI = \frac{mass\ (kg)}{(height\ (m))^2}$$

The use of **BMI** has **limitations** because it simply shows if a person is carrying too much weight. It does not calculate if this is excess fat, muscle or bone. The **waist to hip ratio** should be considered alongside the BMI figure.
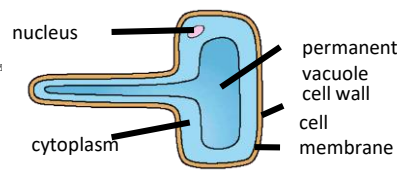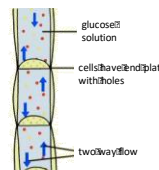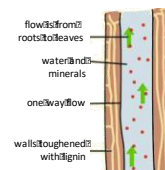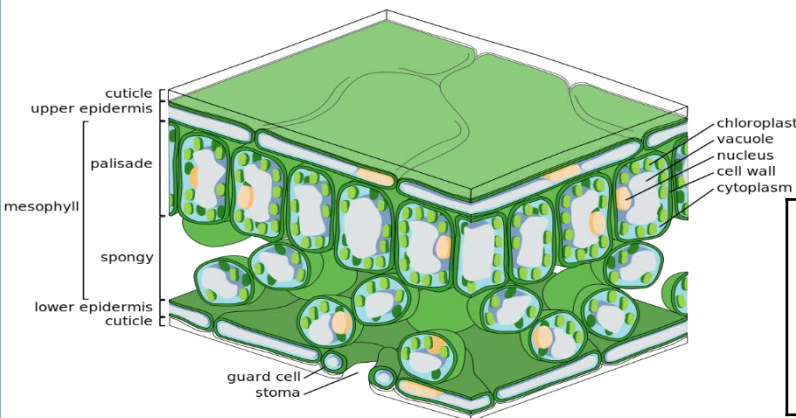
Photosynthesis

Plants make use of light energy from the environment (ENDOTHERMIC) to make food (glucose)

Carbon dioxide + Water → Oxygen + Glucose

$$CO_2 \quad + \quad H_2O \rightarrow O_2 \quad + \quad C_6H_{12}O_6$$

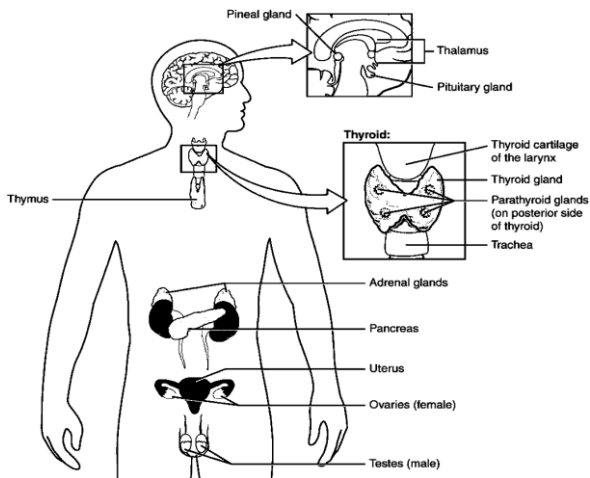|		
Epidermal tissues	Waxy cuticle (top layer of the leaf)	Reduces water loss from the leaf
	Guard cells and stomata	Guard cells open and close the stomata to control water loss and allow for gas exchange (oxygen and carbon dioxide).
Palisade mesophyll	Palisade cells	Cells near the top surface of the leaf that are packed with chloroplasts that contain chlorophyll. Both adaptations maximize photosynthesis.
Spongy mesophyll	Air spaces in the leaf between cells	Increased surface area for gas exchange so that carbon dioxide can diffuse into photosynthesising cells.
xylem	Hollow tubes strengthened by lignified dead cells adapted for the transportation of water and mineral ions through the plant in the transpiration stream	Allows transport of water and mineral ions from the roots to the stem and the leaves.
phloem	Cell sap moves from one phloem cell to the next through pores in the end walls	Transports dissolved sugars from the leaves to the rest of the plant for immediate use or storage (translocation).
Meristem tissue	New cells (roots and shoot tips) are made here including root hair cells	Root hair cells have an increased surface area for the uptake of water by osmosis, and mineral ions by active transport.

Factors affecting the rate of photosynthesis

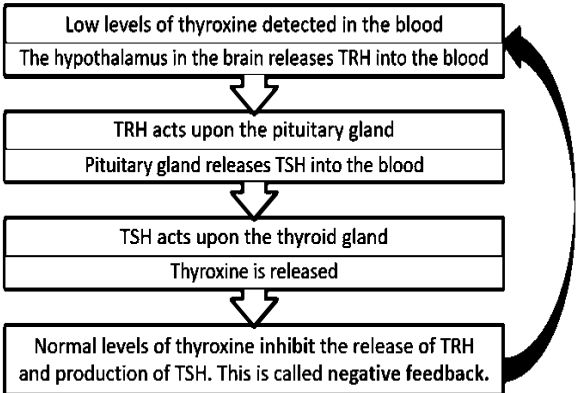| Factor	How the rate is affected	Limiting factors (why the rate stops going up)
Temperature	As the temperature of the environment the plant is in increases rate of photosynthesis increases (up to a point) as there is more energy for the chemical reaction.	Photosynthesis is an enzyme controlled reaction. If the temperature increases too much, then the enzymes become denatured and the rate of reaction will decrease and stop
Light intensity	Light intensity increases as the distance between the plant and the light sources increases. As light intensity increases so does the rate of photosynthesis (up to a point) as more energy is available for the chemical reaction.	At point X another factor is limiting the rate of photosynthesis. This could be carbon dioxide concentration, temperature or the amount of chlorophyll
Carbon dioxide concentration	Carbon dioxide is needed for plants to make glucose. The rate of photosynthesis will increase when a plant is given higher concentrations of carbon dioxide (up to a point).	At point X another factor is limiting the rate of photosynthesis. This could be light intensity, temperature or the amount of chlorophyll

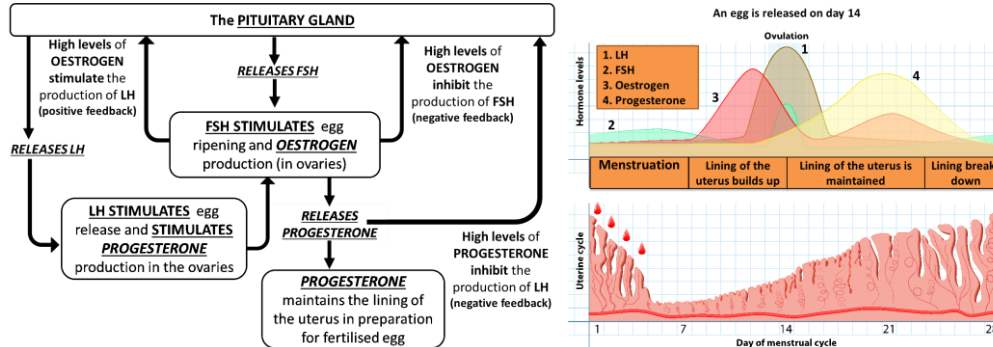| Keyword	Definition
Active Transport	Active transport moves substances from a more dilute solution to a more concentrated solution (against a concentration gradient). The energy is provided by respiration
Xylem	Form hollow tubes made of dead tissue. Long cells with walls toughened by waterproof lignin. Water and minerals flow from the roots towards the leaves in one direction in a process called TRANSPIRATION. Xylem vessels also provide support to the stem of the plant.
Phloem	Form tubes made of living tissue. Cells have end plates with holes in them. Sucrose in solution move from the leaves to growing tips and storage tissues in both directions. This process is called TRANSLOCATION. There are no forces causing translocation to occur and so the sucrose is moved along using active uptake which requires energy.
Stoma	
Guard Cell	Cells either side of the stoma that
Gibberellins	End seed dormancy, promote flowering, increase fruit size.
Ethene	Control ripening of fruit during storage and transport.
Auxins	Weed killers, rooting powders, promoting growth in tissue culture.

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The Human Endocrine System

Anti-diuretic hormone (ADH)	Kidney	Controls water levels in the blood
Thyroid-stimulating hormone (TSH)	Thyroid	Stimulates the thyroid gland to secrete thyroxine
Luteinising hormone (LH)	Ovaries	Stimulates egg release and progesterone production in the ovaries
Follicle-stimulating hormone (FSH)	Ovaries	Stimulates egg ripening and oestrogen production (in ovaries)
Prolactin (PRL)	Breasts	Stimulates the breasts to produce milk
Growth hormone (GH)	All cells in the body	Stimulates growth and repair

Low levels of thyroxine detected in the blood

The hypothalamus in the brain releases TRH into the blood

TRH acts upon the pituitary gland

Pituitary gland releases TSH into the blood

TSH acts upon the thyroid gland

Thyroxine is released

Normal levels of thyroxine inhibit the release of TRH and production of TSH. This is called **negative feedback.**

The Menstrual Cycle

Hormone	Produced in...	Causes...
FSH Follicle stimulating hormone	**Pituitary Gland**	**Stimulates egg ripening and oestrogen production (in ovaries)**
Oestrogen	**Ovaries**	**Lining of the womb to develop. Stimulates pituitary gland to make LH**
LH Luteinising hormone	**Pituitary Gland**	**Stimulates egg release and progesterone production in the ovaries**
Progesterone	**Ovaries**	**Maintains the lining of the womb**
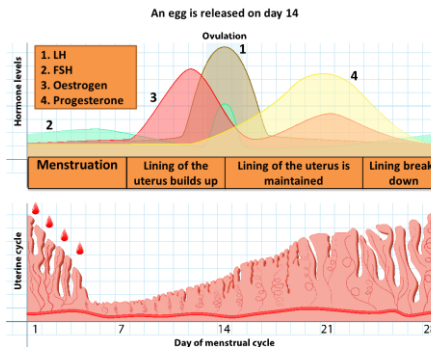
Contraception

The pill - oral contraceptives that contain oestrogen to inhibit FSH production so that no eggs develop and mature. After taking for a while egg development and release will stop completely.

The **mini pill** and **injections** contain progesterone. High levels stimulate the cervix to produce a thick mucus which stops sperm entering the uterus.

Implant or **skin patches** of slow release progesterone inhibit the maturation and release of eggs for a number of months or years.

Spermicidal agents which kill or disable sperm.

Barrier methods such as **condoms and diaphragms** prevent the sperm reaching an egg

The **'coil' or other intrauterine devices** which prevent the implantation of an embryo

Sterilisation or vasectomy - surgical methods of male and female sterilisation.

Keyword	Definition
Endocrine system	Collection of organs/glands in the human body that release hormones
Hormones	Chemical messengers released from endocrine glands that cause a change in bodily responses
Target organ	The organ where a particular hormone is released and effects
Metabolic rate	The rate at which the energy stored is transferred by all the reactions that take place in your body
Glycogen	How glucose is stored as a polymer
Fight or flight response	When the body prepares to fight or run away from a perceived danger. This response is caused by the hormone adrenaline
Menstrual cycle	A roughly 28 day cycle of changes that occurs in the female reproductive system
Menstruation	When the lining of the uterus breaks down and passes out through the vagina, Also known as a period
Ovulation	When an egg is releases from its follicle in the ovary, happens roughly on day 14 of the menstrual cycle
Contraception	A method that prevents fertilisation and therefore pregnancy. Contraception can be hormonal or physical/barrier methods
ART	Assisted reproductive technology that uses hormones and other techniques to increase the chance of pregnancy in infertile women. Clomifene therapy is an example of ART

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Control of Blood Glucose

Blood glucose concentration TOO HIGH

↓

The PANCREAS releases the hormone insulin

↓

Insulin stimulates the movement of GLUCOSE from the blood into cells

↓

Liver and muscle cells convert excess glucose into glycogen

The control of blood glucose concentration is an example of NEGATIVE FEEDBACK. This ensures that, in any control system, changes are reversed and returned back to the set level.

The PANCREAS releases INSULIN

Blood glucose concentration TOO HIGH → LIVER and MUSCLE cells convert excess GLUCOSE into GLYCOGEN

Normal blood GLUCOSE levels

Blood glucose concentration TOO LOW ← LIVER and MUSCLE cells convert GLYCOGEN into GLUCOSE

The PANCREAS releases GLUCAGON
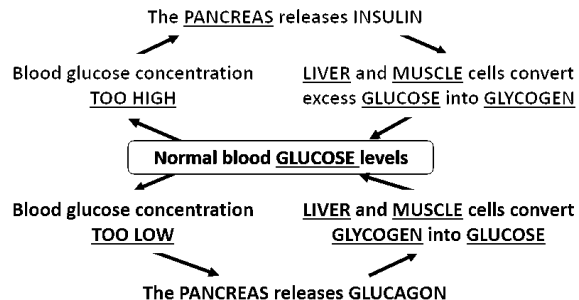
Diabetes- a condition that causes a person's blood sugar level to become too high.

Type 1 diabetes

A disorder in which the pancreas fails to produce enough insulin.

The lack of insulin causes uncontrolled high blood glucose levels.

Type 1 is normally treated with insulin injections.

Type 2 diabetes

A disorder where the body cells no longer respond to insulin produced by the pancreas.

Obesity is a risk factor for Type 2 diabetes.

Type 2 is normally treated by controlling the carbohydrate in the diet and by exercise.

Excess weight (obesity) can make a person have a greater risk of developing type 2 diabetes.

A tool called the **Body Mass Indicator (BMI)** can be used to calculate whether a persons weight lies within a healthy range.

$$BMI = \frac{mass\ (kg)}{(height\ (m))^2}$$

The use of BMI has **limitations** because it simply shows if a person is carrying too much weight. It does not calculate if this is excess fat, muscle or bone.

Very muscular adults and athletes may be classed as overweight or obese even though their body fat is low.
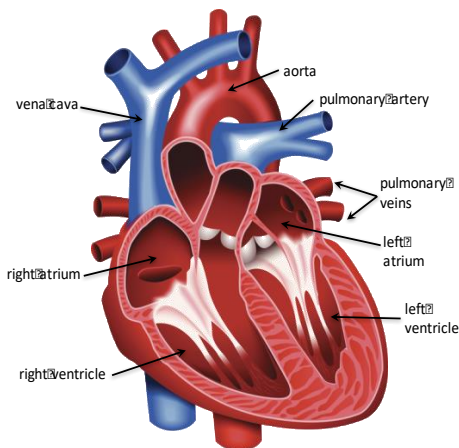
The **waist to hip ratio** should be considered alongside the BMI figure.

Male (waist : hip ratio)	Female (waist : hip ratio)	Health risk based on Waist : hip ratio
0. 95 or below	0.80 or below	Low risk
0.96 to 1.0	0.81 to 0.85	Moderate risk
1.1 or more	0.86 or more	High risk

gas exchange in an alveolus
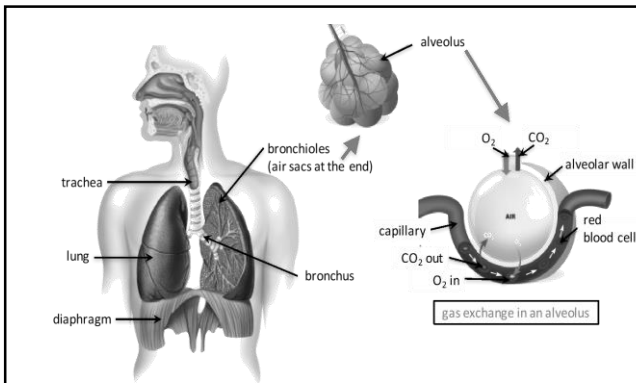
Trachea	Carries air to/from the lungs	Rings of cartilage protect the airway.
Bronchioles	Carries air to/from the air sacs (alveoli)	Splits into multiple pathways to reach all the air sacs.
Alveoli	Site of gas exchange in the lungs	Maximises surface area for efficient gas exchange.
Capillaries	Allows gas exchange between into/out of blood	Oxygen diffuses into the blood and carbon dioxide diffuses out.

Artery	Vein	Capillary
Carry blood away from the heart	Carry blood to the heart	Connects arteries and veins
Thick muscular walls, small lumen, carry blood under high pressure, carry oxygenated blood (except for the pulmonary artery).	Thin walls, large lumen, carry blood under low pressure, have valves to stop flow in the wrong direction, carry deoxygenated blood (except for the pulmonary vein).	One cell thick to allow diffusion, Carry blood under very low pressure.

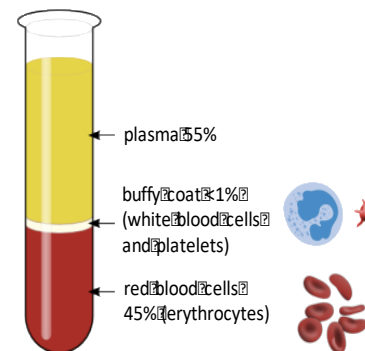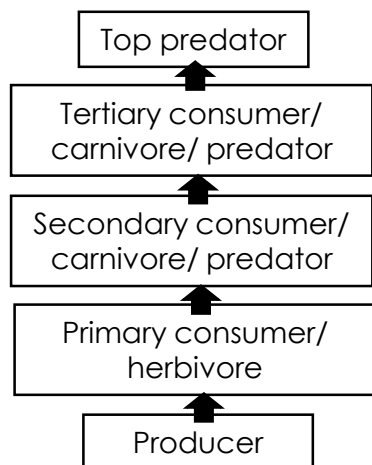| Different structure in the heart have different functions		
Right ventricle	Pumps blood to the lungs where gas exchange takes place.
Left ventricle	Pumps blood around the rest of the body. Thicker cardiac muscle in the wall.
Pacemaker (in the right atrium)	Controls the natural resting heart rate. Artificial electrical pacemakers can be fitted to correct irregularities.
Coronary arteries	Carry oxygenated blood to the cardiac muscle.
Heart valves	Prevent blood in the heart from flowing in the wrong direction.

Aerobic respiration
Respiration with oxygen. Occurs inside the mitochondria continuously
Glucose is oxidised by oxygen to transfer the energy the organism needs to perform it's functions.
Glucose + oxygen → carbon dioxide + water

Anaerobic respiration
Respiration when oxygen is in short supply. Occurs during intensive exercise
During hard exercise, muscle cells are respiring so fast that blood cannot transport enough oxygen to meet their needs. Glucose is partially oxidised to produce lactic acid which builds up in muscle tissue causing them to become painful and fatigued.
Glucose → lactic acid

Factors affecting rate of diffusion (Biology only)		
Surface area	Concentration gradient	Diffusion distance
Increased surface area on exchange surface increases diffusion.	Diffusion is from area of high concentration to low concentration. A large difference in concentration will increase rate f diffusion.	The smaller the diffusion distance to faster the rate of diffusion,

plasma 55%

buffy coat <1% (white blood cells and platelets)

red blood cells 45% (erythrocytes)

Keyword	Definition
Diffusion	The spreading of the particles of a gas or substances in solution, resulting in a net movement of particles from a region where they are of a higher concentration *to an area of* lower concentration
Surface areas to volume ratio	The surface area to volume ratio can be calculated by dividing an object's surface area (SA) by its volume
Cardiac Output	Cardiac output = stroke volume x heart rate
Stroke Volume	Cardiac output is the volume of blood pumped by a ventricle per minute. The units are cm^3 min^{-1}
Heart Rate	Heart rate is the number of beats per minute (bpm)
Stroke Volume	Stroke volume is the volume of blood pumped by one ventricle per contraction (cm^3)

Plasma (55%)	Pale yellow fluid	Transports CO_2, hormones and waste.
Red blood cells (erythrocytes)(45%)	Carries oxygen	Large surface area, no nucleus, full of haemoglobin.
White blood cells (phagocytes and lymphocytes)(<1%)	Part of the immune system	Some produce antibodies, others surround and engulf pathogens.
Platelets (<1%)	Fragments of cells	Clump together to form blood clots.

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A food web shows the feeding relationship between organisms in a community.

Top predator

↑

Tertiary consumer/ carnivore/ predator

↑

Secondary consumer/ carnivore/ predator

↑

Primary consumer/ herbivore

↑

Producer

Separates

Species availability that indicate water pollution

Clean → Stonefly
Some → Shrimp
Moderate → Bloodworm
Very polluted → Sludge worm

Species availability that indicate air pollution

Clean → Bushy lichens and blackspot fungus
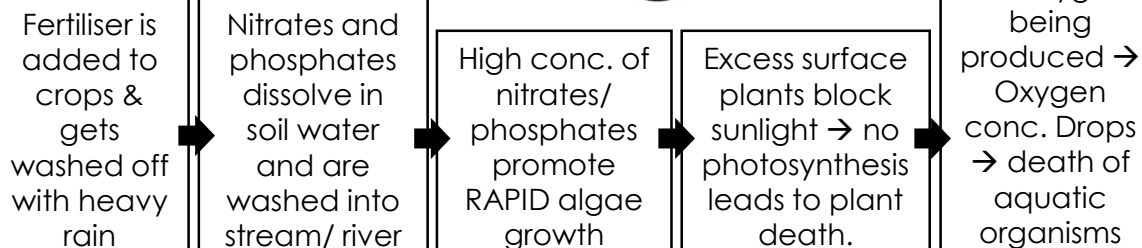Some → Leafy lichens
Very polluted →Crusty lichens

| Examples of abiotic factors	Examples of biotic factors
Extremes of an abiotic factor can reduce the biodiversity of the ecosystem. For example, ecosystems with a very low temperature tend to have low biodiversity **Example: Temperature, light, water and pollutants.**	Biotic factors are the interactions between the living things in an ecosystem. This can include grazing and predation. Animals which graze on the plant species in an ecosystem can influence which species of plants can survive **Example: competition and predation**.

Eutrophication process

Fertiliser is added to crops & gets washed off with heavy rain	Nitrates and phosphates dissolve in soil water and are washed into stream/ river	High conc. of nitrates/ phosphates promote RAPID algae growth	Excess surface plants block sunlight → no photosynthesis leads to plant death.	No oxygen being produced → Oxygen conc. Drops → death of aquatic organisms

Keyword	Definition
Ecosystems	a biological community of interacting organisms and their physical environment.
Biodiversity	the variety of plant and animal life in the world or in a particular habitat
Resources	a substance or object in the environment required by an organism for normal growth, maintenance, and reproduction.
Community	two or more populations of organisms.
Populations	the number of organisms of the same species that live in a particular geographic area at the same time.
Interdependent	this means that all the organisms in an ecosystem are dependent upon each other. If the population of one organism rises or falls, then this can affect the rest of the ecosystem.
Habitats	the place where an organism lives.
Biomass	the total dry mass of one animal or plant species in a food chain or food web
Abiotic	non-living chemical and physical factors in the environment which affect ecosystems.
Adaptations	the biological mechanism by which organisms adjust to new environments or to changes in their current environment.
Eutrophication	the gradual increase in the concentration of phosphorus, nitrogen, and other plant nutrients in an aging aquatic ecosystem such as a lake.
Indigenous	a species can be indigenous to a given region or ecosystem if its presence in that region is the result of only natural processes, with no human intervention.
Preservation	The act or process of keeping the environment safe from harmful effects of human activity.
Parasitism	relationship between two species of plants or animals in which one benefits at the expense of the other, sometimes without killing the host organism. Examples include tapeworms and fleas.
Mutualism	The interaction between two or more different species in an environment where each species has a net benefit. Example includes an oxpecker bird landing on the back of zebra eating ticks. The oxpecker gets fed and the zebra gets pest control.

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Quadrats are square frames of wire usually 0.25 m². These are placed on the ground to look at the plants or slow-moving animals within them. Throwing these randomly in the area we can obtain the following information:

Count

Don't count
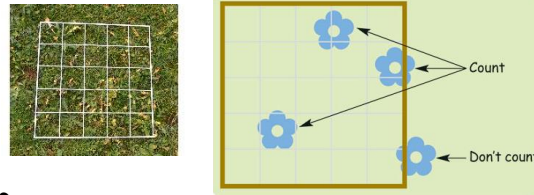
- **The number of individuals in one species**.
- **Species richness:** the number of different plant or animal species
- **Percentage cover**: the percentage of the quadrat area that is covered by one species (e.g grass). This is easier to estimate if a quadrat has wires making smaller sections. Percentage cover rather than number of individuals is used when estimating plant frequencies if it is difficult to identify individual plants, such as grasses or moss.

Abundance is the measure of how common something is in its area (example population size)

Population size = no. of organisms in all quadrats x $\dfrac{\text{Total size of area}}{\text{Total area of quadrats}}$

Separates

Efficiency of energy transfer = $\dfrac{\text{Energy transferred to biomass}}{\text{Total energy supplied to organisms}}$
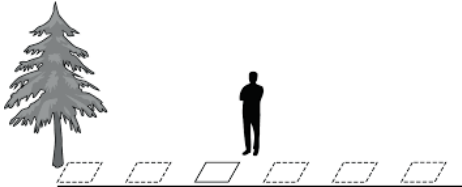
% biomass transfer from producers to primary consumers = $\dfrac{\text{Primary consumers}}{\text{Producers}}$ x 100%

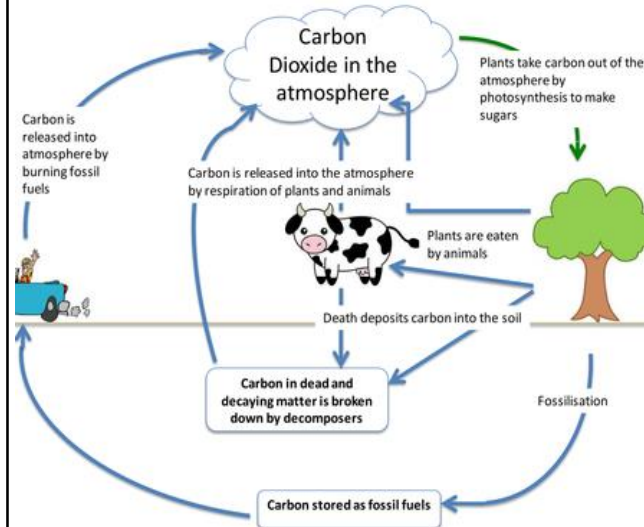Rate of decomposition = $\dfrac{\text{Mass lost}}{\text{No. of days}}$

Belt transect: used when there is a gradual change from one side of a habitat to another.
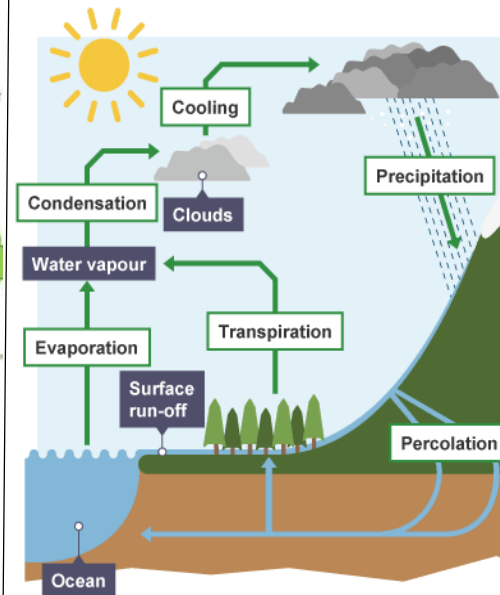
1. Extend a measuring tape from one side of the habitat to another.
2. Place a quadrat at 0m on the tape.
3. Count the numbers/estimate percentage cover of each species.
4. Use a key to identify each species.
5. Record results in a table.
6. Move the quadrat along the measuring tape.
7. Repeat step 3-5 at regular intervals along the measuring tape.
8. Continue until the full length of the measuring tape has been sampled.
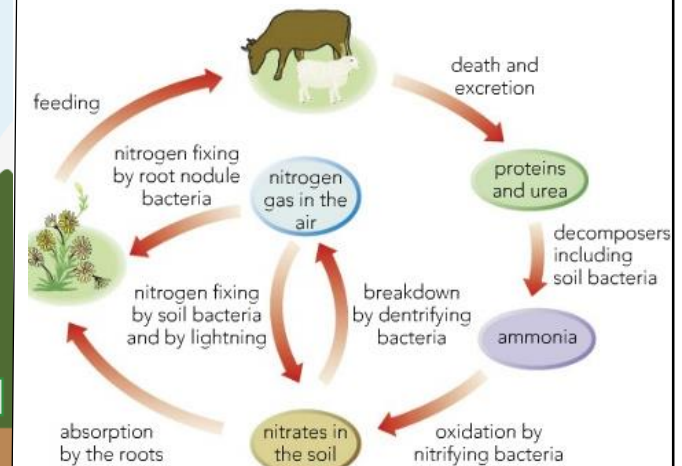9. Calculate the average of each species.
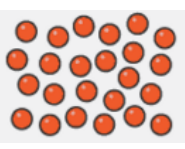
The Carbon Cycle

The Water Cycle

The Nitrogen Cycle

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Chemistry Knowledge Organisers
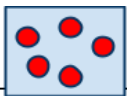
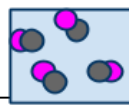|	Solids	Liquids	Gases
Arrangement	Particles are close together, next to each other. Particles are in rows . Regular arrangement.	Particles touch each other and are next to each other. Particles are not in a regular pattern.	Particles are not in a regular arrangement. The particles are spaced out.
Movement	Very little movement, particles vibrate in their fixed positions. They do not move from one place to another.	Particles have some movement. The particles are able to rollover each other.	Particles in gases have lots of movement and move in all directions.
Challenge – energy and attraction of particles	Particles have very little energy. The particles are attracted to each other.	Particles have some energy. The particles are attracted to each other.	Particles have lots of energy and there is no or very little attraction between the particles.

Chromatogram	The end product in chromatography (paper with separated components).
Solute	The solid that dissolves.
Solvent	The liquid that dissolves the solute.
Solution	Formed when a solvent dissolves a solute.
Dissolve	The act in which a solution is made (forming a solution).
Saturated	When no more solute can be dissolved in a solvent.
Unsaturated	When more solute can be dissolved in a solvent.
Atom	Smallest component of an element.
Molecule	A group of atoms chemically bonded together.
Compound	Two or more different atoms chemically bonded together.
Evaporation	Change of state where a liquid turns to a gas.
Condensation	Change of state where a gas turns to a liquid.
Filtration	Separation technique where insoluble particles are separated from soluble particles and liquid.
Crystallisation	Separation technique where the solvent in a solution is left to evaporate, leaving the solute behind.
Distillation	Separation technique where liquid mixtures or soluble solutions can be separated based on their boiling points.
Soluble	Can dissolve in water.
Insoluble	Cannot dissolve in water.
Baseline	The pencil line drawn at the base of the chromatography paper during chromatography.
Mixture	Two or more different atoms not chemically bonded together.
Boiling point	The temperature that a liquid turns into a gas.

Physical change (Reversible)	Chemical change (Irreversible)
For example – melting chocolate Freezing water into ice	For example – frying an egg - rusting
No new substances or products formed. There has just been a change of state (solid, liquid, gas)	One or more new substances has been formed.

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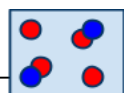**A pure substance contains atoms of one single element only.**
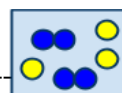
pure substance - 1 element

pure substance - 1 compound

An impure substance is 2 or more different elements and/or compounds together that are not chemically bonded. AKA, a mixture.

mixture - 1 element & 1 compound

mixture - 2 elements

Solutions

Solvent + Solute → Solution

Unsaturated solution   Saturated solution

Making a saturated solution
1. Add solute to a solvent and stir.
2. Continue to add the solute until it no longer dissolves.

Filtration
➤ Filtration separates insoluble from soluble.
➤ Soluble substances and liquid are allowed through the small holes in the filter paper and form filtrate.
➤ Insoluble particles cannot fit through the small holes and are kept in the filter papers as the residue.
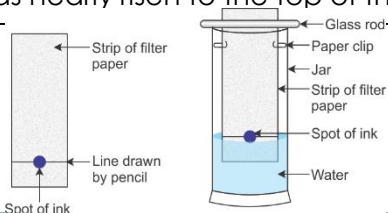
Filter — Filter paper

Residue — Conical Flask

Filtrate
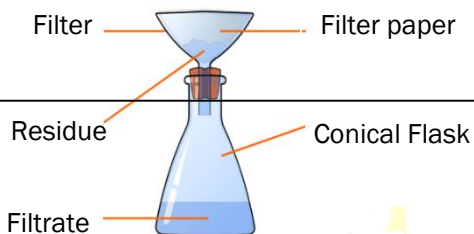
Crystallisation
➤ Heat the solution.
➤ Evaporate off the solvent, leaving the solute behind.
➤ Crystallisation forms crystals of different sizes.
➤ If the solvent takes longer to evaporate, the crystals have more time to form an order and therefore larger.
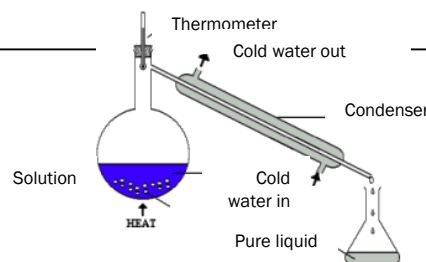
Evaporating basin — Gauze

Tripod — Bunsen Burner

Heat proof mat
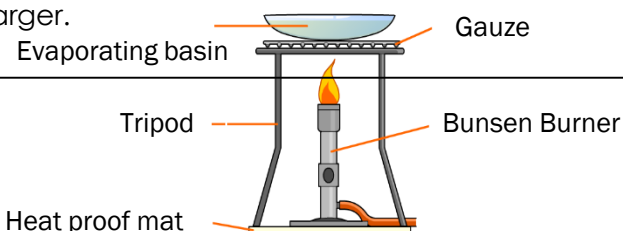
Chromatography
➤ Draw a horizontal line, using pencil and ruler, 2cm up from the bottom filter paper (pencil is insoluble).
➤ Add a dot of ink mixture to each 'x' mark evenly spaced on the baseline.
➤ Measure 1cm depth of water (or other solvent) in a beaker.
➤ Stand the filter paper up in the water, making sure the waterline is UNDER the baseline (to ensure the solvent moves up the stationary phase).
➤ Take out the chromatogram when the mobile phase has nearly risen to the top of the paper.

Strip of filter paper

Line drawn by pencil

Spot of ink

Glass rod
Paper clip
Jar
Strip of filter paper
Spot of ink
Water

Distillation
➤ Heat the mixture until one solution evaporates to become a gas (one with the lowest boiling point).
➤ The evaporated liquid will rise up as a gas.
➤ The gas will enter the condenser.
➤ In the condenser delivery tube, energy will be taken from the solution by the circulating water outside.
➤ The gas will turn to a liquid- condensation.
➤ The pure liquid will fall into a separate beaker.
➤ The other liquid in the mixture will be left in the round-bottom flask.
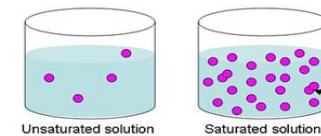
Thermometer
Cold water out
Condenser
Solution
Cold water in
HEAT
Pure liquid

Making drinking water potable

Water in   Pump   Storage tank

Screen | Coarse filter | Sedimentation tank | Fine filter | Chlorine added | To homes and factories
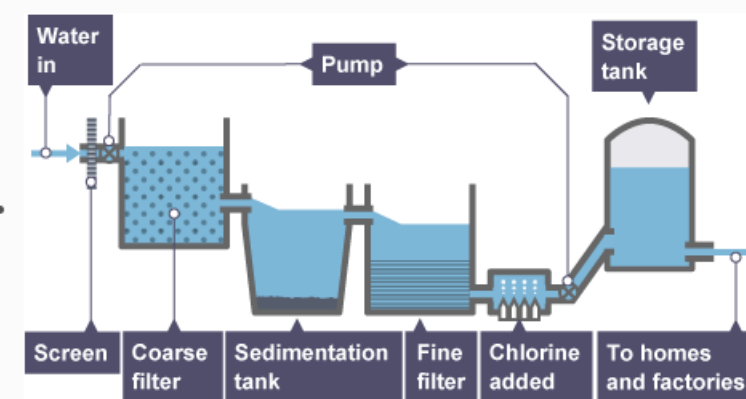
Water is essential for life. Water that is safe for humans to drink is called potable water. Potable water is not pure water because it almost always contains dissolved impurities.

For water to be potable, it must have sufficiently low levels of dissolved salts and microbes. This is because:

dissolved salts can sometimes be harmful for humans microbes can cause illnesses

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Atomic Structure

Dalton's atomic model

Proton
Electron
Neutron
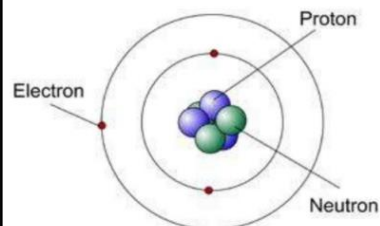
Isotopes

- Versions of an element with same atomic number but different atomic mass.
- Number of protons is the same, but number of neutrons is different.
- Relative Atomic Mass is average of the masses of the isotopes, weighted by their **relative abundance**
- For example, Neon has three isotopes

Neon Isotope Mass	Relative Abundance (%)
20	90.5
21	0.3
22	9.2

- Relative atomic mass of Neon =
$$\frac{20 \times 90.5 + 21 \times 0.3 + 22 \times 9.2}{90.5 + 0.3 + 9.2} = 20.2$$

- This is why some atoms have a relative atomic mass with a decimal point.

Sub-atomic particles

Atoms are made from smaller particles called subatomic particles. There are three type:

| Particle	Relative mass	Relative charge	Found?
Proton	1	Positive, +1	In nucleus
Neutron	1	Neutral, 0	In nucleus
Electron	Neglible $(\frac{1}{1840})$	Negative, -1	In shells orbiting nucleus

$_1^1H$ Hydrogen $_1^2H$ Deuterium $_1^3H$ Tritium
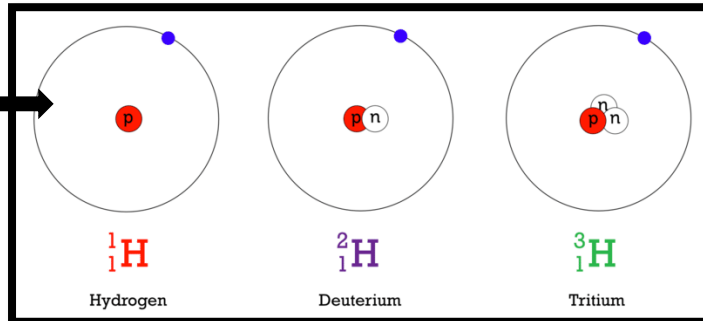
- For example, two isotopes of carbon:

mass number is different

atomic number is the same
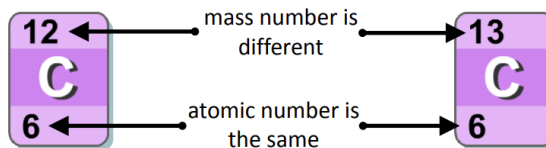
- The existence of isotopes results in relative atomic masses not being whole numbers

Reading the Periodic Table

19
F
fluorine
9

Relative Atomic Mass
(aka nucleon number):
The total number of protons and neutrons added together.

Atomic number (aka proton number):
The number of protons or electrons.

Note: on some periodic tables, they are the wrong way up, just remember that the smaller number is the proton number.

What's in my atom?

Protons = atomic number
Electrons = atomic number
Neutrons = relative atomic mass subtract atomic no.

19
F
fluorine
9

Atomic number = 9
Relative Atomic mass = 19

Protons = 9
Electrons = 9
Neutrons = 19-9 = 10

32
S
sulfur
16

Atomic number = 16
Relative Atomic mass = 32

Protons = 16
Electrons = 16
Neutrons = 32-16 = 16

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Mendeleev

- Arranged elements by increasing atomic mass <u>but</u>….
- He broke this rule and left some gaps if an element's properties weren't similar to the one above it.
- He thought the gaps were for elements that hadn't been discovered yet and predicted their properties.
- When they were discovered, the properties matched the predictions

Electron Configuration
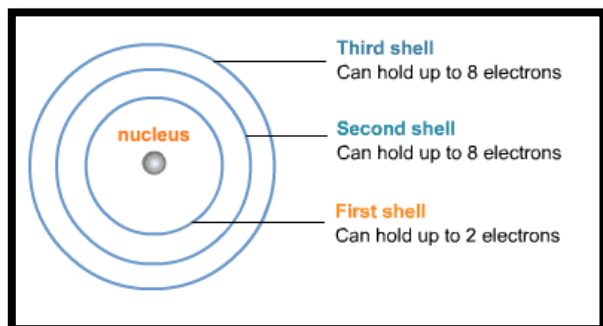
- Electrons orbit the nucleus in **shells.**

- **First** shell holds up to two electrons
- **Second** shell can hold up to 8 electrons
- **Third** shell can also hold up to 8 electrons

Third shell
Can hold up to 8 electrons

Second shell
Can hold up to 8 electrons

First shell
Can hold up to 2 electrons

nucleus

Group 4

Silicon: 2.8.**4**

1ˢᵗ shell   2ⁿᵈ shell   3ʳᵈ shell

3 shells used = so the element is in the 3ʳᵈ period

PERIODS….increasing atomic mass, differing properties

GROUPS…..similar properties

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.
The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

Example: Silicon
Atomic number is 14, so it has 14 electrons.

You build up electrons from the first shell outwards, so in this case:
  - First shell has 2
  - Second shell has 8
  - Third shell has 4
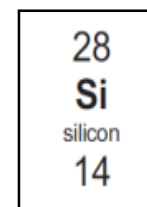
This can be written as: **2.8.4**; or drawn as:

28
Si
silicon
14
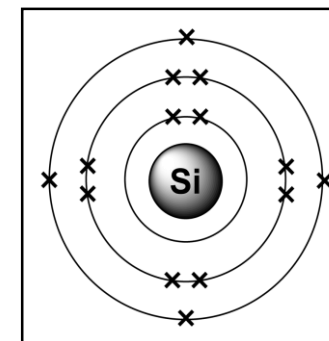
<u>**Electron configuration and how it links to the Periodic Table:**</u>
Group number: shows the number of electrons in the outer electron shell
Period number: shows the number of electron shells
In the above example, we can see Silicon belongs to group 4, and is in period 3.

Ionic	Particles are oppositely charged ions	Occurs in compounds formed from metals combined with non metals.
Covalent	Particles are atoms that share pairs of electrons	Occurs in most non metallic elements and in compounds of non metals.
Metallic	Particles are atoms which share delocalised electrons	Occurs in metallic elements and alloys.

| Keyword	Definition
Ionic bond	A strong electrostatic force of attraction between oppositely charged ions.
Covalent bond	The bond formed when a pair of electrons is shared between two atoms.
Metallic bond	The type of bonding found in metals. Positively charged ions in a 'sea' of negatively charged electrons.
Lattice Structure	An arrangement of many particles that are bonded together in a fixed, regular, grid-like pattern
Melting point	The temperature at which a substance changed fro the solid state to the liquid state when heated, or from the liquid state to solid state when cooled.
Boiling point	The temperature at which a substance changed from a liquid to a gas.
Charge	Also known as electric charge, is a characteristic of a unit of matter that expresses the extent to which it has more or fewer electrons than protons.
Electrical conductivity	Allowing electricity to pass through.
Aqueous solution	A mixture that is formed when a substance is dissolved in water.
Molten	A substance that has been liquefied by heat.
Electron pair	Two electrons occupying the same orbital in an atom or molecule, especially forming a nonpolar covalent bond between atoms.

Keyword	Definition
Ion	An atom with an electric charge, caused by the loss or gain of electrons.
Cation	A positively charged ion.
Anion	A negatively charged ion.
Electrostatic force	The attractive or repulsive force between two electrically charged objects.
Attraction	The electric force that acts between oppositely charged bodies, tending to draw them together.
Intermolecular force	Forces of attraction which act between molecules.
Atom	The smallest unit into which matter can be divided without the release of electrically charged particles.
Element	An element is a substance whose atoms all have the same number of protons.
Compound	A substance formed when two or more chemical elements are chemically bonded together.
Transfer	Movement of a particle from one place to another.
Share	Two bodies having equal portions distributed between the two.
Delocalised electron	An electron that is not associated with a particular atom within a shell, or held in a covalent bond.
Proton	A particle found in the nucleus of an atom, having a positive charge and the same mass as a neutron.
Neutron	A particle found in the nucleus of an atom having zero charge and a mass of 1.
Electron	A tiny particle with a negative charge and very little mass.
Shell	Area around a nucleus that can be occupied by electrons and usually drawn as circles.
Nucleus	The central part of an atom or ion.

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Metallic bonding

Giant structure of atoms arranged in a regular pattern	Electrons in the outer shell of metal atoms are delocalised and free to move through the whole structure. This sharing of electrons leads to strong metallic bonds.

Delocalised electrons   Metal ions
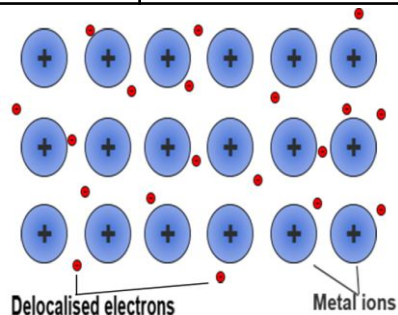
High melting and boiling points	This is due to the strong metallic bonds.
Pure metals can be bent and shaped	Atoms are arranged in layers that can slide over each other.
Good conductors of electricity and heat	Delocalised electrons transfer energy.

Ionic bonding

High melting and boiling points	Large amounts of energy needed to break the bonds.
Do not conduct electricity when solid	Ions are held in a fixed position in the lattice and cannot move.
Do conduct electricity when molten or dissolved	Lattice breaks apart and the ions are free to move.

Dot and cross diagram		
Giant structure		

Electrons are transferred so that all atoms have a noble gas configuration (full outer shells).	*Metal atoms lose electrons and become positively charged ions*	Group 1 metals form +1 ions Group 2 metals form +2 ions
	Non metals atoms gain electrons to become negatively charged ions	Group 6 non metals form -2 ions Group 7 non metals form -1 ions

Structure	• Lattices consist of a regular arrangement of atoms • Held together by strong electrostatic forces of attraction between oppositely charged ions • Forces act in all directions in the lattice
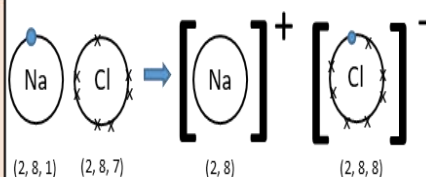
-ide	If a compound name ends in –ide, it usually contains only two elements.	For example: calcium + oxygen → calcium oxide
-ate	If a compound name ends in -ate, it usually contains three or more elements one of which is always oxygen.	For example: Calcium + carbon + oxygen → calcium carbonate

Covalent bonding

Simple molecular compounds

Low melting and boiling points	Small amounts of energy needed to overcome the intermolecular forces.
Poor conductors of electricity	No free electrons to transfer energy.

Size of atoms and molecules	Simple molecular structures consist of atoms joined by strong covalent bonds. This means that atoms are smaller than simple molecules.

Atoms share pairs of electrons	Can be small molecules e.g. ammonia		Dot and cross : + Show which atom the electrons in the bonds come from - All electrons are identical 2D with bonds: + Show which atoms are bonded together - It shows the H-C-H bond incorrectly at 90° 3D ball and stick model: + Attempts to show the H-C-H bond angle is 109.5°
	Can be giant covalent structures e.g. polymers		Simple polymers consist of large chains of hydrocarbons.

Giant covalent structures

Diamond

Each carbon atom is bonded to four others		Very hard.	Rigid structure.
		Very high melting point.	Strong covalent bonds.
		Does not conduct electricity.	No delocalised electrons.

Used for cutting tools due to being very hard.

Graphite

Each carbon atom is bonded to three others forming layers of hexagonal rings with no covalent bonds between the layers		Slippery.	Layers can slide over each other.
		Very high melting point.	Strong covalent bonds.
		Does conduct electricity.	Delocalised electrons between layers.

Used for electrodes as is inert.

Graphene and fullerenes

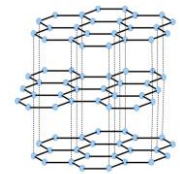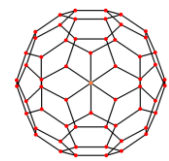| Graphene		Excellent conductor.	Contains delocalised electrons.
	Single layer of graphite one atom thick	Very strong.	Contains strong covalent bonds.

Fullerenes		Buckminsterfullerene, C_{60} First fullerene to be discovered.	Hexagonal rings of carbon atoms with hollow shapes. Can also have rings of five (pentagonal) or seven (heptagonal) carbon atoms.

Diamond, graphite, silicon dioxide	Very high melting points	Lots of energy needed to break strong, covalent bonds.

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KS4 Chemistry – Acids and Alkalis (part 1)

pH scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 — acidic, neutral, alkaline

The pH scale and indicators
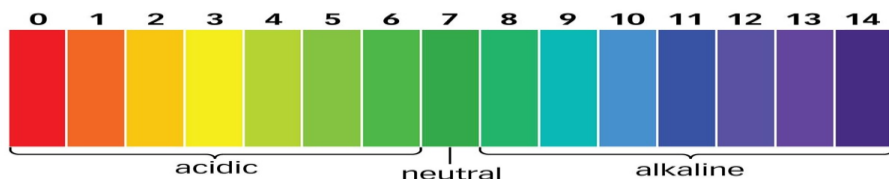
Acids	Acids produce hydrogen ions (H^+) in aqueous solutions.
Alkalis	Aqueous solutions of alkalis contain hydroxide ions (OH^-).
Base	A base is any substance that reacts with an acid to form a salt and water only
Examples of soluble bases	Alkalis e.g. sodium hydroxide, potassium hydroxide

Universal indicator	Red in acid, green in neutral and blue in alkali
Litmus	Red in acid, purple in neutral and blue in alkali
Methyl orange	Red in acid, yellow in neutral and yellow in alkali
Phenolphthalein	Colourless in acid and in neutral and pink in alkali
A neutralisation reaction is between an acid and a base	In neutralisation reactions, hydrogen ions react with hydroxide ions to produce water: $H^+ + OH^- \rightarrow H_2O$

Reactions with acids

Metals	Metal + acid → metal salt + hydrogen	Magnesium + hydrochloric acid → magnesium chloride + hydrogen
Metal oxides	Metal oxide + acid → metal salt + water	Copper oxide + sulfuric acid → copper sulfate + water
Metal hydroxides	Metal hydroxide + acid → metal salt + water	Sodium hydroxide + nitric acid → sodium nitrate + water
Metal carbonates	Metal carbonates + acid → metal salt + carbon dioxide + water	Calcium carbonate + sulfuric acid → calcium sulfate + carbon dioxide + water

Gas	Test	Positive result
Hydrogen	Burning splint	'squeaky pop' sound.
Carbon dioxide	Limewater	Goes cloudy (as a solid calcium carbonate forms).

Keyword	Definition
H^+ ion	A positively charged hydrogen ion
OH^- ion	A negatively charged, diatomic hydroxide ion.
Aqueous solution	*A mixture that is formed when a substance is dissolved in water.*
Acid	*A solution that reacts with alkalis, turns litmus red and has a pH of less that 7.*
Alkali	*A solution which contains an excess of OH^- ions, turns litmus blue and has a pH greater than 7.*
Base	*A substance that will react with an acid to form only a salt and water.*
pH scale	*A scale going up to 14 showing acidity or alkalinity.*
Indicator	*A substance which can change colour depending on the pH of a solution.*
Concentration	*The amount of a solute dissolved in a certain volume of solvent.*
Concentrated	*Containing a large amount of solute dissolved in a small volume of solvent.*
Dilute	*A low concentration of solute in a solution.*
Strong acid	*An acidic solute that dissolves completely into ions when it dissolves.*
Weak acid	*An acidic solute that does not dissociate completely into ions when it dissolves.*
Salt	*A compound formed by neutralisation of an acid by a base.*
Filtration	*Using a filter to separate insoluble substances from a liquid.*
Crystallisation	*Separating the solute from a solution by evaporating the solvent.*
Soluble	*A substance that can be dissolved in a certain liquid.*
Insoluble	*A substance that cannot be dissolved in a certain liquid.*
Solute	*Describes a substance that dissolves in a liquid to make a solution.*
Solvent	*Describes the liquid in which a substance dissolves to make a solution.*
Solution	*Formed when a substance has dissolved in a liquid.*
Burette	*A piece of apparatus used to accurately measure the volume of solution that has been added during a titration.*
Pipette	*A piece of apparatus used in a titration to accurately measure a set volume of a solution.*
End-point	*When just enough solution has been added from the burette to react with all the solution in the flask in a titration experiment.*
Ionic equation	*A balanced equation that only shows the ions that react together. The spectator ions are not included.*
Half equation	*A chemical equation written to describe an oxidation or reduction half-reaction.*
Spectator ion	*These are ions that do not change within a reaction.*

Making pure, dry insoluble salts

Step 1	Add insoluble reactant (e.g. metal oxide) to acid	Add until there is an excess of insoluble reactant.
Step 2	Filter the solution	Collect the filtrate in a conical flask and dispose of the residue.
Step 3	Crystallisation	Heat the filtrate using a Bunsen burner to evaporate the water from the solution.
Step 4	Evaporation	Leave the evaporating basin with the heated filtrate to evaporate any remaining water and make pure, dry insoluble salts.

Titrations are used to work out the precise volumes of acid and alkali solutions that react with each other to form salt and water.

Step 1	Use the pipette to add 25 cm^3 of alkali to a conical flask and add a few drops of indicator.
Step 2	Fill the burette with acid and note the starting volume. Slowly add the acid from the burette to the alkali in the conical flask, swirling to mix.
Step 3	Stop adding the acid when the end-point is reached (the appropriate colour change in the indicator happens). Note the final volume reading. Repeat steps 1 to 3 until you get consistent readings.

State Symbol	Meaning
s	Solid
l	Liquid
g	Gas
aq	Aqueous solution

Producing salts from soluble reactants

Soluble salts	Soluble salts can be made from reacting acids with solid insoluble substances (e.g. metals, metal oxides, hydroxides and carbonates).
Production of soluble salts	Add the solid to the acid until no more dissolves. Filter off excess solid and then crystallise to produce solid salts.

Solubility

Sodium, potassium and ammonium	All common sodium, potassium and ammonium salts are soluble e.g. sodium chloride and potassium fluoride.
Nitrates	All nitrates are soluble e.g. potassium nitrate.
Sulfates	Common chlorides (e.g. sodium chloride) are soluble, expect those of silver and lead.
Carbonates and hydroxides	Common carbonates and hydroxides are insoluble except those of sodium, potassium and ammonium.

Strong and weak acids (HT ONLY)

Concentrated	High mass of substance in a given volume of solution
Dilute	Low mass of substance in a given volume of solution
Strong acids	Completely ionised in aqueous solutions e.g. hydrochloric, nitric and sulfuric acids.
Weak acids	Only partially ionised in aqueous solutions e.g. ethanoic acid, citric acid.
Hydrogen ion concentration	As the pH decreases by one unit (becoming a stronger acid), the hydrogen ion concentration increases by a factor of 10.

KS4 Chemistry – Calculations involving masses

1. How to find an empirical formula:

Example: 10.0g of calcium reacts with 17.8g of chlorine. Find the empirical formula of the product that is formed.

1. Symbol	Ca	Cl
2. Mass (g)	10.0	17.8
3. A_r	40.0	35.5
4. Divide mass by A_r	$\frac{10.0}{0.25} = 40$	$\frac{17.8}{35.5} = 0.50$
5. Divide answers by smallest number	$\frac{0.25}{0.25} = 1$	$\frac{0.50}{0.25} = 2$
6. Empirical formula	$CaCl_2$	

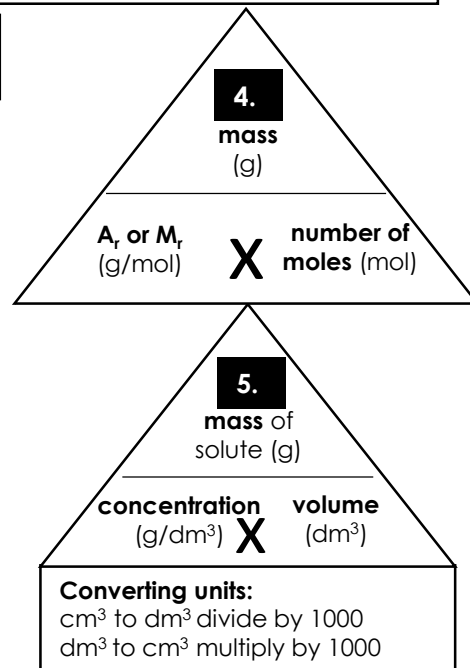## 2. How to deduce the molecular formula from the empirical formula and relative formula mass:

Example: The empirical formula for glucose is CH_2O and its relative formula mass is 180. Deduce the molecular formula for glucose.

1. Find the empirical formula mass by adding up the relative atomic masses of all of the atoms	C + H + H + O 12 + 1 + 1 + 16 = 30
2. Divide the relative formula mass by the empirical formula mass	$\frac{180}{30} = 6$
3. Multiply the numbers in the empirical formula to get the molecular formula	• CH_2O x 6 • So $C_6H_{12}O_6$

3. How to calculate the masses of reactants or products:

*Example: Calculate the mass of chlorine needed to make **53.4g** of aluminium chloride.*

1. Write the balanced equation	$2Al + 3Cl_2 \rightarrow 2AlCl_3$
2. Calculate M_r of substances in the question	• $M_r\,Cl_2 = 2 \times 35.5 = 71$ • $M_r\,AlCl_3 = 27 + (3 \times 35.5) = 133.5$
3. Calculate the ratio of masses	• $3Cl_2$ makes $2AlCl_3$ • $(3 \times 71)\,Cl_2$ makes $(2 \times 133.5)AlCl_3$ • $213g\,Cl_2$ makes **267**g $AlCl_3$
4. Divide to work out the mass for 1g of product	• $\frac{213g\,Cl_2}{267}$ makes $\frac{267g\,AlCl_3}{267}$ • $0.798g\,Cl_2$ makes 1g $AlCl_3$
5. Multiply to scale up	• $(0.798g \times$ **53.4**$)\,Cl_2$ makes $(1g \times$ **53.4**$)\,AlCl_3$ • $42.6g\,Cl_2$ makes 53.4g $AlCl_3$

4.

$$\frac{\text{mass (g)}}{A_r \text{ or } M_r \text{ (g/mol)} \quad \textbf{X} \quad \text{number of moles (mol)}}$$

5.

$$\frac{\text{mass of solute (g)}}{\text{concentration (g/dm}^3) \quad \textbf{X} \quad \text{volume (dm}^3)}$$

Converting units:
cm^3 to dm^3 divide by 1000
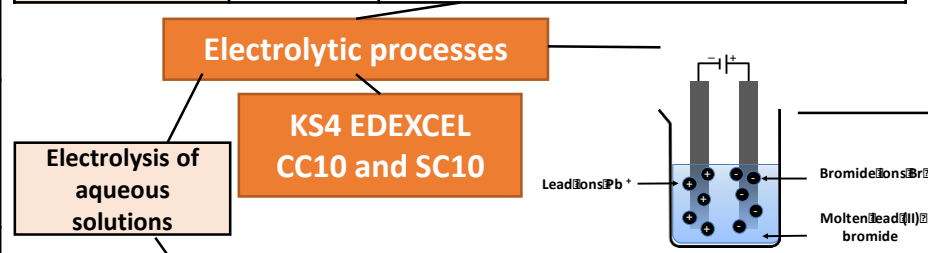dm^3 to cm^3 multiply by 1000

6. Keyword	7. Definition
atom	The smallest neutral part of an element that can take place in chemical reactions.
Avogadro constant*	The number of particles in one mole of a substance (6.02 x 10²³ atoms, molecules, formulae or ions).
closed system	Substances cannot enter or leave such as a precipitation reaction in a stoppered flask.
concentration	The amount of solute dissolved in a stated volume of a solution. Units include g/dm3.
conservation of mass	During a chemical reaction, the overall mass of substances does not change so the total mass of reactants is equal to the total mass of products.
empirical formula	The simplest whole number ratio of atoms or ions of each element in a substance.
excess reactant	There is more of this reactant present than is needed so it is not completely used up in a reaction.
limiting reactant	There is less of this reactant present than is needed so it is completely used up in a reaction. The mass of product formed is controlled by this reactant.
mole*	One mole of particles of a substance is defined as: a) the Avogadro constant number of particles (6.02 x 10²³ atoms, molecules, formulae or ions) of that substance b) a mass of 'relative particle mass' g. The SI unit symbol is mol.
molecular formula	This represents the actual number of atoms of each element in one molecule.
molecule	A particle consisting of two or more atoms joined together by bonds.
open system	Substances can enter or leave such as a reaction in an open flask that takes in or gives out a gas.
precipitate	An insoluble substance that is formed when two soluble substances react together in solution.
precipitation	A reaction in which a precipitate is formed.
product	A substance formed in a reaction.
reactant	A substance used up in a reaction.
reaction	A process in which reactants are converted to different substances called products.
relative atomic mass	(A_r) The mean mass of an atom relative to the mass of an atom of C-12 which is assigned a mass of 12. Unit is g/mol.
relative formula mass	(M_r) The sum of the relative atomic masses of all the atoms or ions in its formula. Unit is g/mol.
stoichiometry*	The ratio of moles of each substance in a reaction.
volume	The amount of space hat a liquid takes up. Units include cm³ and dm³.

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Oxidation Is Loss, Reduction Is Gain

Key Word	Definition
Electrolysis	Decomposition/break down of a compound using electrical energy.
Ions	Charged particle.
Cations	Positively charged ions, formed by losing electrons. Usually metal form cations.
Anions	Negatively charged ions, formed by gaining electrons. Usually non-metal form anions.
Electrodes	A rod made of metal or carbon which carries the current in the electrolyte.
Cathode	An electrode that is negatively charged.
Anode	An electrode that is positively charged.
Electrolyte	Ionic liquid where moving ions carry the current during electrolysis
Reduction	When a positive ion gains electrons.
Oxidation	When a negative ion loses electrons.
Discharged	When ions convert to elements due to transfer of electrons during electrolysis.
(H) Half equations	Ionic equation showing transfer of electrons in oxidation and reduction.

Process of electrolysis	*Splitting up using electricity*	When an ionic compound is melted or dissolved in water, the ions are free to move. These are then able to conduct electricity and are called electrolytes. Passing an electric current though electrolytes causes the ions to move to the electrodes.
Electrode	*Anode Cathode*	The positive electrode is called the anode. The negative electrode is called the cathode.
Where do the ions go?	*Cations Anions*	Cations are positive ions and they move to the negative cathode. Anions are negative ions and they move to the positive anode.

Extracting metals using electrolysis

Metals can be extracted from molten compounds using electrolysis.

This process is used when the metal is too reactive to be extracted by reduction with carbon.

The process is expensive due to large amounts of energy needed to produce the electrical current.
Example: aluminium is extracted in this way.

Electrolytic processes

KS4 EDEXCEL CC10 and SC10

Lead ions Pb $^+$

Bromide ions Br $^-$

Molten lead (II) bromide

Higher tier: You can display what is happening at each electrode using half-equations:
At the cathode: $Pb^{2+} + 2e^- \rightarrow Pb$
At the anode: $2Br^- \rightarrow Br_2 + 2e^-$

Electrolysis of aqueous solutions

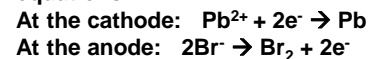| At the negative electrode	Metal will be produced on the electrode if it is less reactive than hydrogen. Hydrogen will be produced if the metal is more reactive than hydrogen.
At the positive electrode	Oxygen is formed at positive electrode. If you have a halide ion (Cl⁻, I⁻, Br⁻) then you will get chlorine, bromine or iodine formed at that electrode.

The ions discharged when an aqueous solution is electrolysed using inert electrodes depend on the relative reactivity of the elements involved.

Using copper	*Copper is a very good electrical conductor*	Much of the copper available isn't pure enough for this use so it is purified using electrolysis.
Copper sulfate solution	*The anode is made of impure copper and the cathode is made of pure copper*	Both electrodes are placed in copper sulfate solution. Copper ions (Cu^{2+}) leave the anode and are attracted to the cathode.
Electrodes	*The cathode of pure copper builds up*	The anode decreases in size. The impurities left behind form a sludge.

potassium	most reactive	K
sodium		Na
calcium		Ca
magnesium		Mg
aluminium		Al
carbon		C
zinc		Zn
iron		Fe
tin		Sn
lead		Pb
hydrogen		H
copper		Cu
silver		Ag
gold		Au
platinum	least reactive	Pt

negative ion in solution	element given off at positive electrode
chloride, Cl⁻	chlorine, Cl_2
bromide, Br⁻	bromine, Br_2
iodide, I⁻	iodine, I_2
sulfate, SO_4^{2-}	oxygen, O_2

Oxidation Is Loss (of electrons) Reduction Is Gain (of electrons)

HT ONLY: Reactions between metals and acids are redox reactions as the metal donates electrons to the hydrogen ions. This displaces hydrogen as a gas while the metal ions are left in the solution.

increasing reactivity

potassium
sodium
calcium
magnesium
aluminium
(carbon)
zinc
iron
lead
(hydrogen)
copper
silver
gold
platinum

Metals above carbon in the reactivity series must be extracted using **electrolysis because they need a more powerful method of extraction**.

Metals less reactive than carbon can be extracted from their ores by **reduction**.

Copper, silver, gold and platinum can occur **native** and do not need to be extracted. Sometimes copper needs to be extracted from an ore.

Extraction using carbon

Metals less reactive than carbon can be extracted from their oxides by reduction.	For example: **zinc oxide + carbon → zinc + carbon dioxide**

Unreactive metals, such as gold, are found in the Earth as the metal itself. They can be mined from the ground. More reactive metals are obtained by displacement or electrolysis.

Extraction of metals and reduction

	Reactions with water	**Reactions with acid**
Group 1 metals	*Reactions get more vigorous as you go down the group*	*Reactions get more vigorous as you go down the group*
Group 2 metals	*Do not react with water*	*Observable reactions include fizzing and temperature increases*
Zinc, iron and copper	*Do not react with water*	*Zinc and iron react slowly with acid. Copper does not react with acid.*

Obtaining and Using Metals CC11 and SC11

Reactions of acids and metals

Reactions with acids	*metal + acid → metal salt + hydrogen*
magnesium + hydrochloric acid → magnesium chloride + hydrogen	
zinc + sulfuric acid → zinc sulfate + hydrogen	

Acids react with some metals to produce salts and hydrogen.

The reactivity series

Please send Charlie's monkeys and zebras in lead cages securely guarded!

Metal	Reaction with water	Reaction with dilute acids	Reactivity
Potassium	Violent with cold water	Violent	Most reactive
Sodium			
Calcium	Slow with cold water Rapid with steam	Rapid	
Magnesium			
Aluminium	Usually no reaction		
Zinc		Slow	
Iron	Rusts slowly		
(Hydrogen)			
Copper	No reaction	No reaction	
Silver			
Gold			Least reactive

Metals form positive ions when they react	*The reactivity of a metal is related to its tendency to form positive ions*	The reactivity series arranges metals in order of their reactivity (their tendency to form positive ions).
Carbon and hydrogen	*Carbon and hydrogen are non-metals but are included in the reactivity series*	These two non-metals are included in the reactivity series as they can be used to extract some metals from their ores, depending on their reactivity.
Displacement	*A more reactive metal can displace a less reactive metal from a compound.*	Silver nitrate + Sodium chloride → Sodium nitrate + Silver chloride

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Biological methods of metal extraction

Metals ores	*These resources are limited*	Copper ores especially are becoming sparse. New ways of extracting copper from low-grade ores are being developed.
Phytomining	*Plants absorb metal compounds*	These plants are then harvested and burned; their ash contains the metal compounds.
Bioleaching	*Bacteria is used to produce leachate solutions that contain metal compounds*	The metal compounds can be processed to obtain the metal from it e.g. copper can be obtained from its compounds by displacement or electrolysis.

Oxidation and reduction in terms of electrons (HT ONLY)

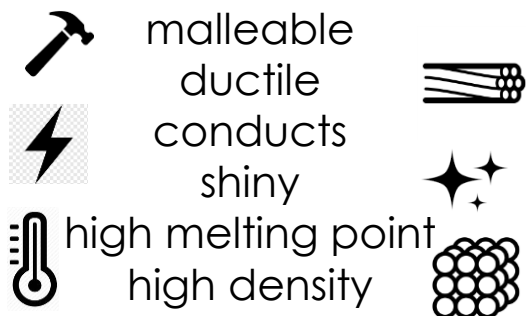|		
Metals and oxygen	*Metals react with oxygen to form metal oxides*	magnesium + oxygen → magnesium oxide $2Mg + O_2 → 2MgO$
Reduction	*This is when oxygen is removed from a compound during a reaction*	e.g. metal oxides reacting with hydrogen, extracting low reactivity metals
Oxidation	*This is when oxygen is gained by a compound during a reaction*	e.g. metals reacting with oxygen, rusting of iron

Ionic half equations (HT only)

For displace - ment reactions	*Ionic half equations show what happens to each of the reactants during reactions*	For example: The ionic equation for the reaction between iron and copper (II) ions is: **$Fe + Cu^{2+} → Fe^{2+} + Cu$** The half-equation for iron (II) is: **$Fe → Fe^{2+} + 2e^-$** The half-equation for copper (II) ions is: **$Cu^{2+} + 2e^- → Cu$**

Ways of reducing the use of resources

Reduce, reuse and recycle	*This strategy reduces the use of limited resources*	This, therefore, reduces energy sources being used, reduces waste (landfill) and reduces environmental impacts.
Limited raw materials	*Used for metals, glass, building materials, plastics and clay ceramics*	Most of the energy required for these processes comes from limited resources. Obtaining raw materials from the Earth by quarrying and mining causes environmental impacts.
Reusing and recycling	*Metals can be recycled by melting and recasting/reforming*	Glass bottles can be reused. They are crushed and melted to make different glass products. Products that cannot be reused are recycled.

Life cycle assessment

LCAS	*Life cycle assessments are carried out to assess the environmental impact of products*	They are assessed at these stages: - Extraction and processing raw materials - Manufacturing and packaging - Use and operation during lifetime - Disposal
Values	*Allocating numerical values to pollutant effects is difficult*	Value judgments are allocated to the effects of pollutants so LCA is not a purely objective process.

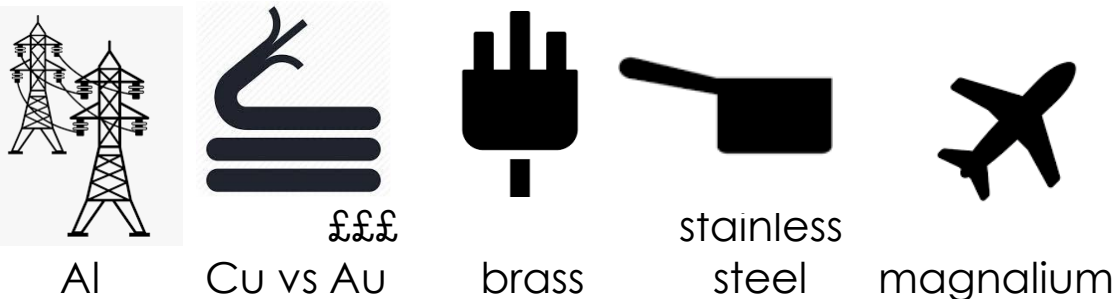| Word	Definition
Reactivity series	List of metals in the order of reactivity
Cations	Positive ions
Displacement reactions	When a reactive metal replaces a less reactive metal
Extraction	Taking a metal out of a compound
Native state	Unreactive metals found naturally
Electrolysis	Passing electricity through molten ionic compound to decompose it into it's elements
Oxidation	Gain of oxygen by a substance
Reduction	Loss of oxygen by a substance
Redox	Reactions in which oxidation and reduction occurs
Corrosion	When a metal reacts with oxygen and sometimes with water

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KS4 – Chemistry – Transition Metals

1. Physical properties

malleable
ductile
conducts
shiny
high melting point
high density

2. Chemical properties

coloured compounds
catalysts

3. Corrosion

iron + oxygen -> hydrated
+ water   iron(III) oxide

4. Electroplating

silver (anode)
Voltage source
Ag⁺
Ag⁺
Spoon (cathode)
$AgNO_3(aq)$

5. Alloying

alloy   pure

6. Uses

Al   Cu vs Au   brass   stainless steel   magnalium

£££

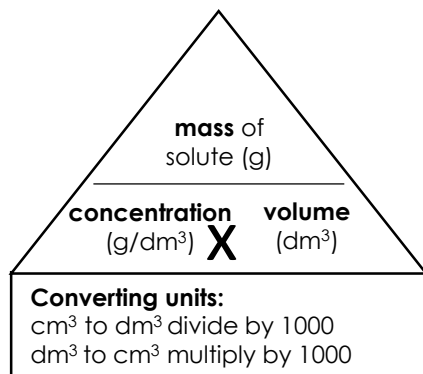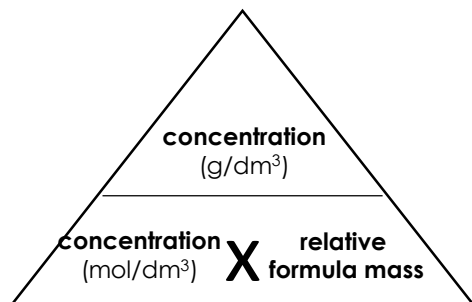| 7. Keyword	8. Definition
alloy	A metal with one or more other metals added to improve its properties.
alloy steel	Iron with other elements added to it. eg high strength steel – has a high carbon content (strong, hard) eg mild steel – has a low carbon content (strong, malleable) eg stainless steel – contains chromium (oxidises to resist rusting) eg tool steel – contains tungsten and molybdenum (string, tough)
anode	Positive electrode.
catalyst	A substance that speeds up the rate of a reaction without being used up itself.
cathode	Negative electrode.
corrosion	The gradual deterioration of a substance when it reacts with substances in the environment – eg when a metal oxidises.
ductile	A substance that can be stretched out to make a thin wire.
electrolyte	An ionic compound that is molten or dissolved in water.
electroplating	Using electricity to coat one metal with a thin layer of another metal.
galvanising	Coating iron or steel with a thin layer of zinc to improve its resistance to rusting.
malleable	A substance that can be rolled or hammered into shape without shattering.
oxidise	To combine a substance chemically with oxygen.
pure metal	A metal that has a fixed composition with nothing else mixed with it.
rusting	The corrosion of iron or steel – water and oxygen must be present.
sacrificial protection	Using a more reactive metal to protect iron from rusting.
tarnish	A thin layer that forms on a metal due to oxidation.
tin plating	Electroplating steel with tin to protect it from rusting.

1. Percentage yield

- **percentage yield =** $\dfrac{\text{actual yield}}{\text{theoretical yield}}$ x 100
- **Less than 100%** due to:
    - an incomplete reaction
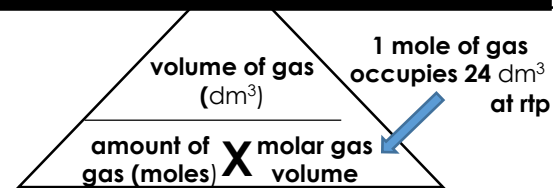   - side reactions
    - loss of product

2. Atom economy

- **atom economy =** $\dfrac{\text{relative formula masses of the useful product}}{\text{sum of relative formula masses of all reactants}}$ x 100
- We want it to be as high as possible
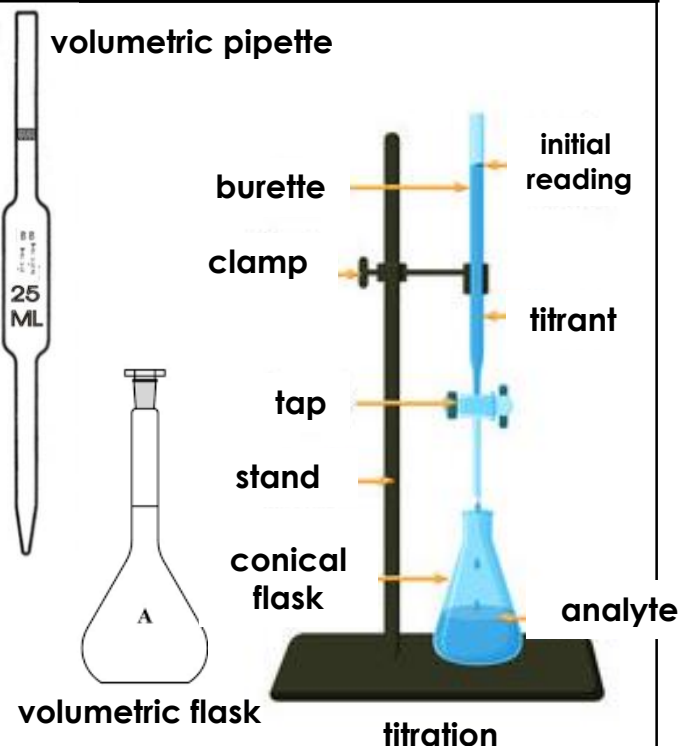- It can be increased by finding a different way to make the product
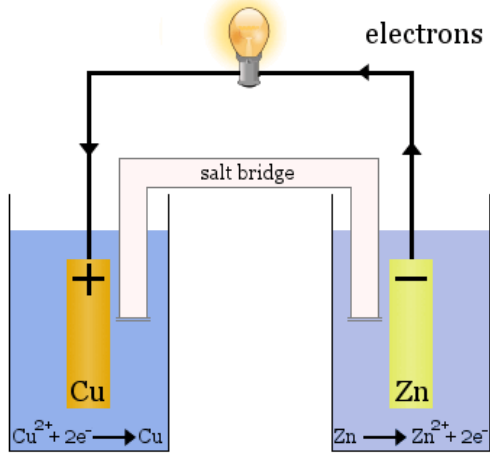
3. Concentration

concentration (g/dm³)

concentration (mol/dm³) **X** relative formula mass

mass of solute (g)

concentration (g/dm³) **X** volume (dm³)

Converting units:
cm³ to dm³ divide by 1000
dm³ to cm³ multiply by 1000

4. Titrations

volumetric pipette

burette

clamp

titrant

tap

stand

conical flask

initial reading

analyte

volumetric flask

titration

5. Molar volume of gases

volume of gas (dm³)

amount of gas (moles) **X** molar gas volume

1 mole of gas occupies 24 dm³ at rtp
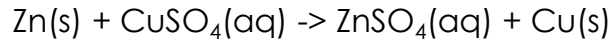
6. Keyword	7. Definition
actual yield	The actual amount of product obtained from a chemical reaction.
atom economy	The percentage, by mass, of reactants that are converted into useful products.
Avogadro's law	If the temperature and pressure are the same, equal volumes of different gases contain an equal number of molecules.
burette	A piece of apparatus used to accurately measure the volume of solution that has been added during a titration.
by-product	Substance produced in a chemical reaction in addition to the desired product.
calibrated	Marked with a scale for accurate readings.
concentration	The amount of solute dissolved in a certain volume of solvent.
concordant	Readings that have been taken several times and are identical, or close to each other.
end-point	When just enough solution has been added from the burette to react with all the solution in the flask.
indicator	A substance which changes colour depending on the pH.
molar gas volume	The volume occupied by one mole of any gas. It is 24dm³ at rtp.
side reactions	A reaction which takes place at the same time as another main reaction.
theoretical yield	The maximum calculated amount of a product that could be formed from a given amount of reactants.
titration	A technique in volumetric analysis that is used to find the exact volumes of solutions which react with each other.
volumetric flask	A flask which is accurately calibrated to hold a given volume of solution.
volumetric pipette	This piece of equipment is calibrated to allow extremely accurate measurement of the volume of a solution.

95

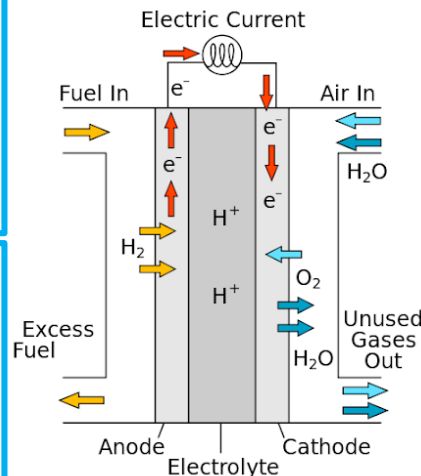| Keyword	Definition
by-product	A substance that is made in addition to the desired product.
chemical cell	A device that produces a voltage due to reactions between the reactants stored inside it, until one of the reactants gets used up (cell goes 'flat').
electrode	A rod made of metal or graphite that carries the current into or out of the electrolyte.
fuel	A substance that releases thermal energy when burned.
fuel cell	A device that produces a voltage due to reactions involving a fuel and oxygen.
greenhouse gas	A gas that helps to trap 'heat' in the atmosphere (eg carbon dioxide, methane, water vapour).
oxidation	A reaction in which oxygen reacts with a chemically joins to a substance. Involves the loss of electrons
reduction	A reaction in which oxygen is removed from a substance. Involves the gain of electrons

Chemical cells

electrons

salt bridge

Cu

$Cu^{2+} + 2e^- \longrightarrow Cu$

Zn

$Zn \longrightarrow Zn^{2+} + 2e^-$

- 2 **different metals.**
- Each metal is in a **solution of its salt.**
- A **salt bridge** to allow ions to move between solutions.
- The further apart the metals are in the **reactivity series**, the bigger the voltage made.
- An e**xothermic reaction** which mainly transfers energy as **electricity**.
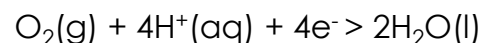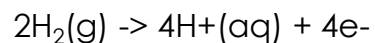
$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$

Fuel Cells – example hydrogen-oxygen cell

- Produces a voltage (electrical energy) by reacting hydrogen with oxygen
- hydrogen + oxygen -> water
- $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$
- Hydrogen is oxidised
- Oxygen is reduced

- Need non renewable natural gas to make hydrogen
- Making hydrogen produces carbon dioxide as a by-product
- Hydrogen has to be stored safely (explosive, takes up space)

Electric Current

Fuel In   e⁻   Air In

H_2

H^+

H^+

H_2O

O_2

Excess Fuel

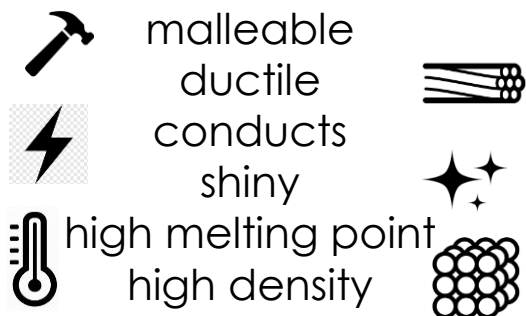Unused Gases Out

H_2O

Anode   Cathode

Electrolyte

- More efficient than power stations or cells as:
1. less stages so less heat loss.
2. no moving parts so no energy lost as friction.
- No need for turbines, generators etc as electricity is generated directly from the reaction.
- Quieter than a petrol or diesel engine.
- Don't produce CO_2, NO, SO_2, CO.
- Only by-products are water and heat.

$2H_2(g) \rightarrow 4H+(aq) + 4e-$

$O_2(g) + 4H^+(aq) + 4e^- > 2H_2O(l)$

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KS4 – Chemistry – Transition Metals

1. Physical properties

malleable
ductile
conducts
shiny
high melting point
high density

2. Chemical properties

coloured compounds
catalysts

3. Corrosion

iron + oxygen -> hydrated
+ water   iron(III) oxide

4. Electroplating

5. Alloying

alloy   pure

6. Uses

Al   Cu vs Au   brass   stainless steel   magnalium

£££

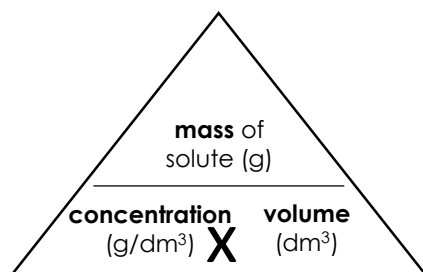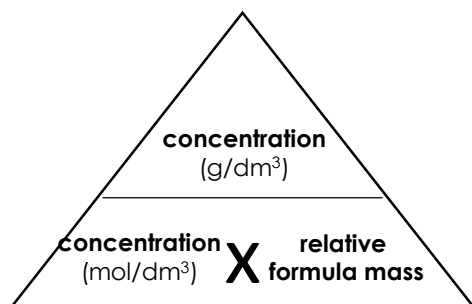| 7. Keyword	8. Definition
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1. Percentage yield

- **percentage yield = actual yield** $\times$ 100
  theoretical yield
- **Less than 100%** due to:
  - an incomplete reaction
  - side reactions
  - loss of product

2. Atom economy

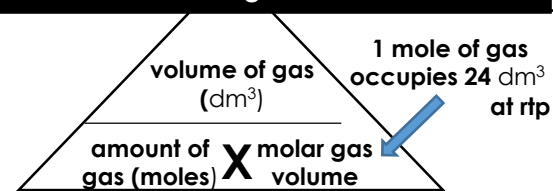- **atom economy = relative formula masses of the useful product** x 100
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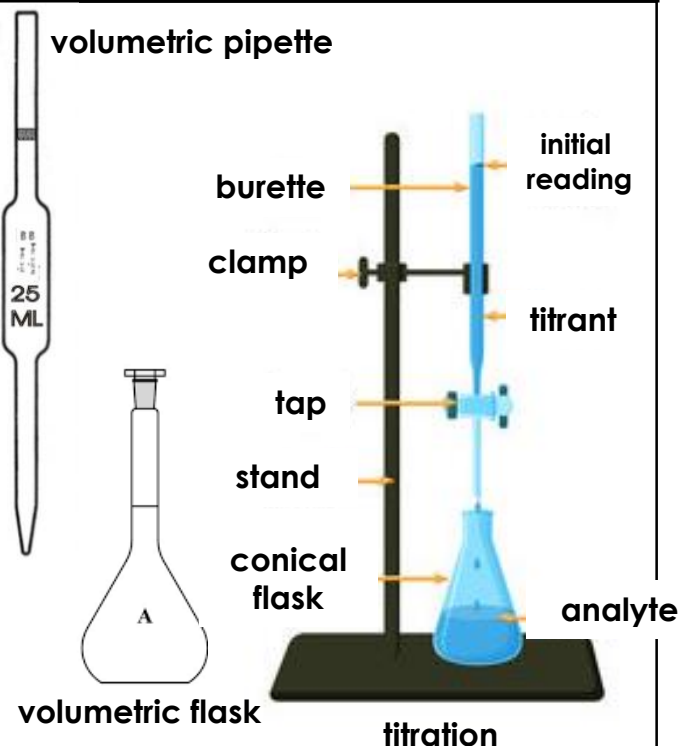- It can be increased by finding a different way to make the product

3. Concentration

concentration
(g/dm³)

concentration
(mol/dm³) **X** relative
formula mass

mass of
solute (g)

concentration
(g/dm³) **X** volume
(dm³)

Converting units:
cm³ to dm³ divide by 1000
dm³ to cm³ multiply by 1000

4. Titrations

volumetric pipette

25
ML

burette → initial reading

clamp

titrant

tap

stand

conical flask

analyte

A

volumetric flask

titration

5. Molar volume of gases

volume of gas
(dm³)

1 mole of gas
occupies 24 dm³
at rtp

amount of **X** molar gas
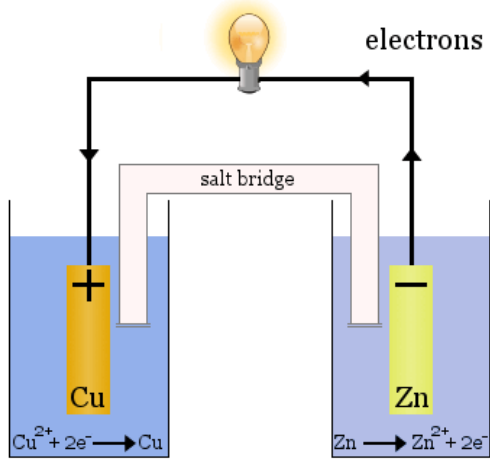gas (moles) volume
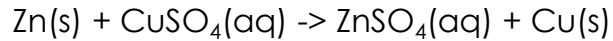
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KS4 – Chemistry – Chemical and Fuel Cells

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chemical cell	A device that produces a voltage due to reactions between the reactants stored inside it, until one of the reactants gets used up (cell goes 'flat').
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fuel	A substance that releases thermal energy when burned.
fuel cell	A device that produces a voltage due to reactions involving a fuel and oxygen.
greenhouse gas	A gas that helps to trap 'heat' in the atmosphere (eg carbon dioxide, methane, water vapour).
oxidation	A reaction in which oxygen reacts with a chemically joins to a substance. Involves the loss of electrons
reduction	A reaction in which oxygen is removed from a substance. Involves the gain of electrons

Chemical cells

- 2 **different metals.**
- Each metal is in a **solution of its salt.**
- A **salt bridge** to allow ions to move between solutions.
- The further apart the metals are in the **reactivity series**, the bigger the voltage made.
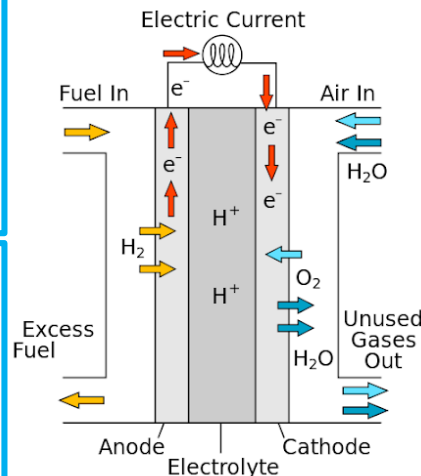- An e**xothermic reaction** which mainly transfers energy as **electricity**.
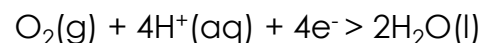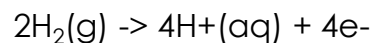
$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$

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- Oxygen is reduced

- Need non renewable natural gas to make hydrogen
- Making hydrogen produces carbon dioxide as a by-product
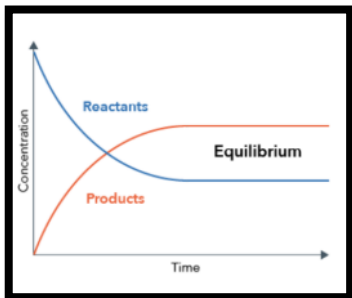- Hydrogen has to be stored safely (explosive, takes up space)

- More efficient than power stations or cells as:
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2. no moving parts so no energy lost as friction.
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- Quieter than a petrol or diesel engine.
- Don't produce CO_2, NO, SO_2, CO.
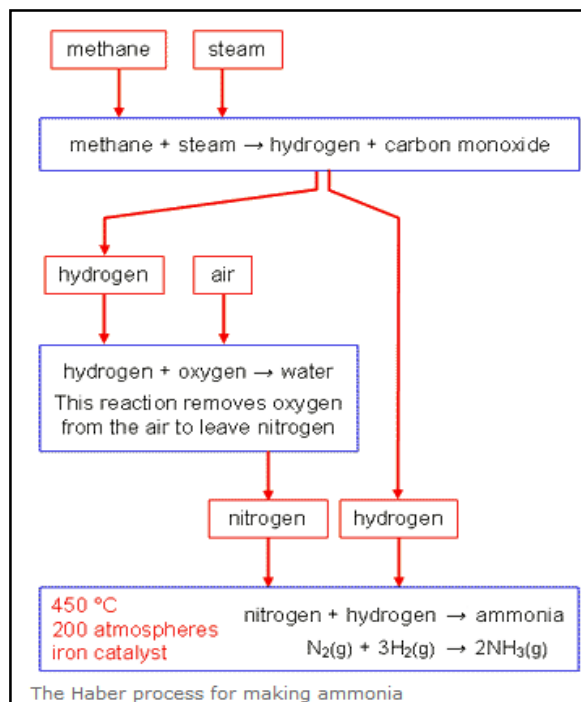- Only by-products are water and heat.

$2H_2(g) \rightarrow 4H+(aq) + 4e-$

$O_2(g) + 4H^+(aq) + 4e^- > 2H_2O(l)$

Keyword	Definition
Le Chatelier's Principles	States that when a system experiences a disturbance (change in condition), it will respond to restore a new equilibrium state.
Changing concentration	If the concentration of a reactant is increased, more products will be formed . If the concentration of a product is decreased, more reactants will react.
Changing temperature	If the temperature of a system at equilibrium is increased: - Exothermic reaction = products decrease - Endothermic reaction = products increase
Changing pressure (gaseous reactions)	For a gaseous system at equilibrium: - Pressure increase = equilibrium position shifts to side of equation with smaller number of molecules. - Pressure decrease = equilibrium position shifts to side of equation with larger number of molecules.
Equilibrium in reversible reactions	When a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur exactly at the same rate.
Equilibrium in reversible reactions	When a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur exactly at the same rate.
The Haber Process	This process uses nitrogen from the air and hydrogen from natural gas to form ammonia. The reaction is reversible and uses optimum conditions and a catalyst in order to reach dynamic equilibrium.
NPK fertilisers	Formulations of various salts containing appropriate percentages of the elements.

Reversible Reactions and Equilibria

Reversible reactions	In some chemical reactions, the products can react again to re-form the reactants.
Representing reversible reactions	A + B ⇌ C + D
The direction	The direction of reversible reactions can be changed by changing conditions: heat A + B ⇌ C + D cool

Changing concentration	If the concentration of a reactant is increased, more products will be formed . If the concentration of a product is decreased, more reactants will react.
Changing temperature	If the temperature of a system at equilibrium is increased: - Exothermic reaction = products decrease - Endothermic reaction = products increase
Changing pressure (gaseous reactions)	For a gaseous system at equilibrium: - Pressure increase = equilibrium position shifts to side of equation with smaller number of molecules. - Pressure decrease = equilibrium position shifts to side of equation with larger number of molecules.

Graph sketch shows in a reversible reaction, the backward reaction gets faster with time, and the forward reaction gets lower with time. When they are occurring at the same rate, dynamic equilibrium has been reached.

The Haber process	This process uses nitrogen from the air and hydrogen from natural gas to form ammonia. The reaction is reversible and uses optimum conditions and a catalyst in order to reach dynamic equilibrium.
Optimum temperature	The optimum temperature for the Haber process is 450ºC.
Optimum pressure	The optimum pressure for the Haber process is 200 atmospheres.
Optimum conditions	The optimum temperature for the Haber process is 450ºC and optimum pressure is 200 atmospheres. These are economically viable conditions as they produce the best yield to cost ratio.
The use of a catalyst	The Haber process uses an iron catalyst. This does not alter the position of the equilibrium but it does increase the rate of the reaction.

methane + steam → hydrogen + carbon monoxide

hydrogen + oxygen → water
This reaction removes oxygen from the air to leave nitrogen

450 °C
200 atmospheres
iron catalyst

nitrogen + hydrogen → ammonia
$N_2(g) + 3H_2(g) → 2NH_3(g)$

The Haber process for making ammonia

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KS4 Chemistry Groups in the Periodic Table

Alkali metals

Transition metals

Halogens

Noble gases

1	2											3	4	5	6	7	0
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	?	?	?						

Elements arranged in order of atomic number	Elements with similar properties are in columns called groups	Elements in the same group have the same number of outer shell electrons and elements in the same period (row) have the same number of electron shells.

Group 0

Noble gases	Unreactive, do not form molecules	This is due to having full outer shells of electrons.
	Boiling points increase down the group	Increasing atomic number.

Helium	Used in balloons	Due to being less dense than air, which means balloons will float.
Neon	Used in signs	Glows when electricity flows through it.
Argon	Used in filament light bulbs	Stops the heated filament reacting with oxygen. Bulbs filled with unreactive argon instead.

Group 1

Metal	Reaction with water	Word equation
Lithium	Fizzing	Lithium + water → lithium hydroxide + hydrogen
Sodium	Fizzing more vigorously than lithium	Sodium + water → sodium hydroxide + hydrogen
Potassium	Fizzes and burns with a lilac flame	Potassium + water → potassium hydroxide + hydrogen

Alkali metals	Soft and easily cut	Low melting and boiling points.
	Very reactive with oxygen, water and chlorine	Only have one electron in their outer shell. Form +1 ions.
	Reactivity increases down the group	Negative outer electron is further away from the positive nucleus so is more easily lost.

Group 7

Halogens	Consist of molecules made of a pair of atoms	Have seven electrons in their outer shell. Form -1 ions.
	Melting and boiling points increase down the group (gas → liquid → solid)	Increasing atomic mass number.
	Reactivity decreases down the group	Increasing proton number means an electron is less easily gained as outer shell is further away from nucleus, therefore the attraction force is weaker.

With metals	Forms a metal halide	Metal + halogen → metal halide e.g. Sodium + chlorine → sodium chloride	e.g. NaCl metal atom loses outer shell electrons and halogen gains an outer shell electron
With hydrogen	Forms a hydrogen halide	Hydrogen + halogen → hydrogen halide e.g. Hydrogen + bromine → hydrogen bromide	Dissolve in water to form acidic solutions.
With aqueous solution of a halide salt	A more reactive halogen will displace the less reactive halogen from the salt	Chlorine + potassium bromide → potassium chloride + bromine	(HT) These are redox reactions. The halogen gains electrons and the halide ion from the compound loses electrons.

| Keyword	Definition
Reactivity of group 1	The atoms get larger as you go down, so the single electron in the outermost shell (highest energy level) is attracted less strongly to the positive nucleus. The electrostatic attraction with the nucleus gets weaker because the distance between the outer electron and the nucleus increases. Also the outer electron experiences a shielding effect from the inner electrons, reducing the attraction between the oppositely charged outer electron and the nucleus.
Reactivity of group 7	When Group 7 elements react, the atoms gain an electron in their outermost shell. Going down the group, the outermost shell's electrons get further away from the attractive force of the nucleus, so it is harder to attract and gain an extra electron. The outer shell will also be shielded by more inner shells of electrons, again reducing the electrostatic attraction of the nucleus for an incoming electron.
Reactivity of group 0	Elements in Group 0 of the periodic table are called the noble gases. They are unreactive because their atoms have stable arrangements of electrons. The atoms have eight electrons in their outermost shell, apart from helium which has just two but still has a complete outer shell. The stable electronic structure explains why they exist as single atoms; they have no tendency to react to form molecules. The boiling points of the noble gases get higher going down the group. For example, helium boils at -269 °C and radon boils at -62°C.

Rates of Reaction

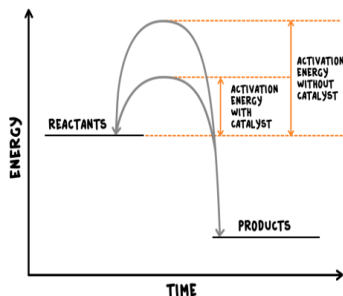| Rate of chemical reaction	This can be calculated by measuring the quantity of reactant used or product formed in a given time.	Rate = quantity of reactant used / time taken
		Rate = quantity of product formed / time taken

Factors affecting the rate of reaction

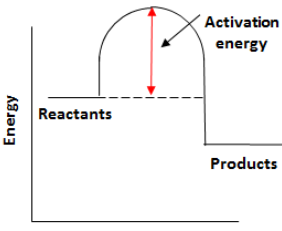| Temperature	The higher the temperature, the quicker the rate of reaction.
Concentration	The higher the concentration, the quicker the rate of reaction.
Surface area	The larger the surface area of a reactant solid, the quicker the rate of reaction.
Pressure (of gases)	When gases react, the higher the pressure upon them, the quicker the rate of reaction.
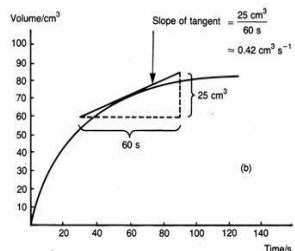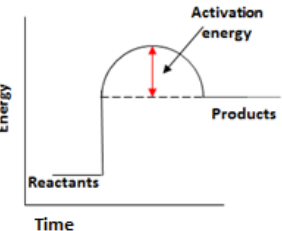
Quantity	Unit
Mass	Grams (g)
Volume	cm^3
Rate of reaction	Grams per cm^3 (g/cm^3) HT: moles per second (mol/s)

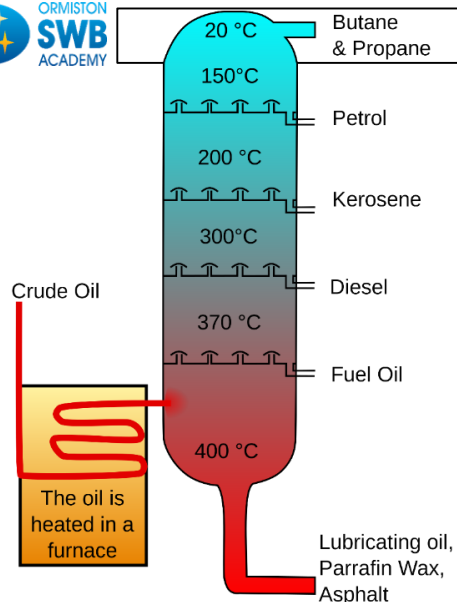| Catalyst	A catalyst changes the rate of a chemical reaction but is not used in the reaction.
Enzymes	These are biological catalysts.
How do they work?	Catalysts provide a different reaction pathway where reactants do not require as much energy to react when they collide.

Energy Changes

Endothermic

Products are at a higher energy level than the reactants. As the reactants form products, energy is transferred from the surroundings to the reaction mixture. The temperature of the surroundings decreases because energy is taken in during the reaction.

Exothermic

Products are at a lower energy level than the reactants. When the reactants form products, energy is transferred to the surroundings. The temperature of the surroundings increases because energy is released during the reaction.
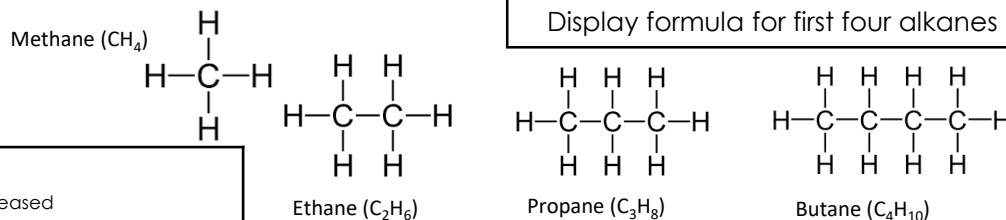
Bond energy calculation

Calculate the overall energy change for the forward reaction

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

Bond energies (in kJ/mol): H-H 436, H-N 391, N≡N 945

Bond breaking: 945 + (3 x 436) = 945 + 1308 = 2253 kJ/mol

Bond making: 6 x 391 = 2346 kJ/mol

Overall energy change = 2253 - 2346 = -93kJ/mol

Therefore reaction is exothermic overall.

Keyword	Definition
Collision theory	Chemical reactions can only occur when reacting particles collide with each other with sufficient energy.
Activation energy	This is the minimum amount of energy colliding particles in a reaction need in order to react.
Heat energy changes	Occur in the following: - Salts dissolving in water - Neutralisation reactions - Displacement reactions - Precipitation reactions
Exothermic reactions	Heat energy is given out as bonds are being formed.
Endothermic reactions	Heat energy is taken in as bonds are being broken.

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Fractional Distillation Column

20 °C — Butane & Propane

150°C

Petrol

200 °C

Kerosene

300°C

Diesel

370 °C

Fuel Oil

400 °C

Crude Oil

The oil is heated in a furnace

Lubricating oil, Parrafin Wax, Asphalt

What happens as the hydrocarbon chain length increases?

	What happens as the hydrocarbon chain length increases?
Boiling point (temperature at which liquid boils)	↑
Viscosity (how easily it flows)	↑
Flammability (how easily it burns)	↓

Display formula for first four alkanes

Methane (CH_4)

Ethane (C_2H_6)

Propane (C_3H_8)

Butane (C_4H_{10})

1. Hydrogen fuel	Hydrogen reacts with oxygen in the engine to power the vehicle	✓ Water is the product ✓ No greenhouse gases released ✓ Renewable X Expensive to buy X Difficult to re-fuel
2. Fossil fuels	Crude oil, natural gas and coal	Petrol, kerosene and diesel oil are non-renewable. Methane is found in natural gas and is also non-renewable.
3. Sulfur dioxide	Released from burning hydrocarbons with sulfur impurities in	Sulfur dioxide dissolves in rain water to form acid rain. This damages plant life and can make water habitats acidic. Acid rain can also erode limestone and sandstone structures.
4. Oxides of nitrogen	Oxygen and nitrogen react under high temperatures to form these.	As pollutants, oxides of nitrogen can damage the ozone layer and are also classified as greenhouse gases. Can cause respiratory problems.
5. Incomplete combustion issues	1. Carbon monoxide is an odourless, toxic gas that can kill	2. Soot (carbon) is also produced that builds up in the atmosphere and can cause global dimming. This reduces the amount of sunlight that reaches the Earth and can alter rainfall patterns.

Complete combustion of methane:

Methane + oxygen → carbon dioxide + water + energy

$$CH_4 (g) + 2O_2 (g) \rightarrow CO_2 (g) + 2 H_2O (l)$$

Complete Combustion
- The carbon and hydrogen in the fuels are **oxidised**.
- **Carbon dioxide, water and energy** are released.

Incomplete combustion
- There is **not enough oxygen** available for complete combustion.
- The products of the reaction are **carbon monoxide, carbon and water**.

Keyword	Definition
Crude oil	A finite resource. Consisting mainly of plankton that was buried in the mud, crude oil is the remains of ancient biomass.
Hydrocarbons	• make up the majority of the compounds in crude oil • made up of **hydrogen and carbon only.**
General formula for alkanes	C_nH_{2n+2} for example: C_2H_6 or C_6H_{14}
Cracking	• The **breaking down** of long chain hydrocarbons into **smaller, more useful** chains. • Helps **supply** meet **demand.** • Can be done by various methods including **catalytic cracking and steam cracking**.
Fractions	• The hydrocarbons in crude oil can be split into fractions. • Each fraction contains molecules with a similar number of carbon atoms in them. • The process used to do this is called fractional distillation.
Using fractions	• Fractions can be processed to produce **fuels and feedstock** for petrochemical industry. • We depend on many of these fuels; **petrol, diesel and kerosene**. • Many useful materials are made by the petrochemical industry; **solvents, lubricants and polymers**.

Gas	Percentage
Nitrogen	78%
Oxygen	21%
Argon	0.9%
Carbon dioxide	0.04%

Volcano activity 1st Billion years	Billions of years ago there was intense volcanic activity	This released gases (mainly CO_2) that formed to early atmosphere and water vapour that condensed to form the oceans.
Other gases	Released from volcanic eruptions	Nitrogen was also released, gradually building up in the atmosphere. Small proportions of ammonia and methane also produced.
Reducing carbon dioxide in the atmosphere	When the water vapour condensed, the oceans formed and the carbon dioxide dissolved into it	This formed carbonate precipitates, forming sediments. This reduced the levels of carbon dioxide in the atmosphere.

Effects of climate change

Effects of climate change
Rising sea levels
Extreme weather events such as severe storms
Change in amount and distribution of rainfall
Changes to distribution of wildlife species with some becoming extinct

How oxygen increased

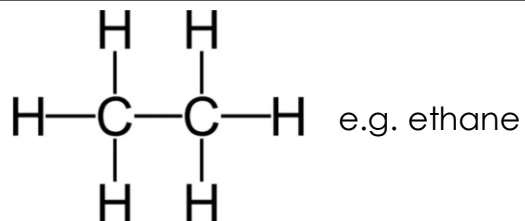| Algae and plants	These produced the oxygen that is now in the atmosphere, through photosynthesis.	carbon dioxide + water → glucose + oxygen $6CO_2 + 6H_2O → C_6H_{12}O_6 + 6O_2$
Oxygen in the atmosphere	First produced by algae 2.7 billion years ago.	Over the next billion years plants evolved to gradually produce more oxygen. This gradually increased to a level that enabled animals to evolve.

How carbon dioxide decreased

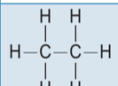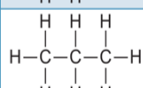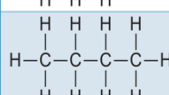| Reducing carbon dioxide in the atmosphere	Algae and plants	These gradually reduced the carbon dioxide levels in the atmosphere by absorbing it for photosynthesis.
Formation of sedimentary rocks and fossil fuels	These are made out of the remains of biological matter, formed over millions of years	Remains of biological matter falls to the bottom of oceans. Over millions of years layers of sediment settled on top of them and the huge pressures turned them into coal, oil, natural gas and sedimentary rocks. The sedimentary rocks contain carbon dioxide from the biological matter.

Human activities and greenhouse gases

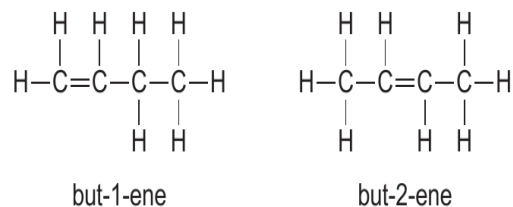| Carbon dioxide	Human activities that increase carbon dioxide levels include burning fossil fuels and deforestation.
Methane	Human activities that increase methane levels include raising livestock (for food) and using landfills (the decay of organic matter released methane).
Climate change	There is evidence to suggest that human activities will cause the Earth's atmospheric temperature to increase and cause climate change.
Carbon dioxide, water vapour and methane	Examples of greenhouse gases that maintain temperatures on Earth in order to support life
The greenhouse effect	Radiation from the Sun enters the Earth's atmosphere and reflects off of the Earth. Some of this radiation is re-radiated back by the atmosphere (including carbon dioxide, methane and water vapour) to the Earth, warming up the global temperature.

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Alkane

e.g. ethane

- General formula: C_nH_{2n+2}
- Saturated molecule

Number of carbons in the chain	Prefix	Alkane	Molecular formula	Structural formula
1	meth-	methane	CH_4	
2	eth-	ethane	C_2H_6	
3	prop-	propane	C_3H_8	
4	but-	butane	C_4H_{10}	

B the first four members of the alkane homologous series

Isomers

but-1-ene   but-2-ene

Alkene

e.g. ethene

- General formula: C_nH_{2n}
- Unsaturated molecule
- C=C functional group

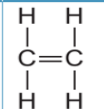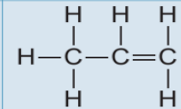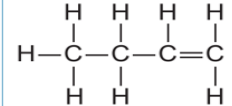| Name	Molecular formula	Structural formula
ethene	C_2H_4	
propene	C_3H_6	
butene	C_4H_8	

C the first three members of the alkene homologous series

D The numbers in the butene isomer names show the position of the double bond. The 1 shows that the C=C bond starts at the end of the molecule on the first carbon, the 2 shows that it is in the middle. Carbon atoms are numbered starting from the end closest to the double bond.

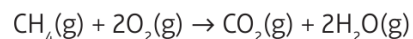| Keyword	Definition
Alkane	A hydrocarbon in which all the bonds between the carbon atoms are double bonds.
Alkene	A hydrocarbon in which there are one or more double bonds between carbon atoms.
Homologous series	A family of compounds that have the same general formula and similar properties, but have different numbers of carbon atoms.
Carbon monoxide	A poisonous gas produced from carbon burning without enough oxygen.
Carbon dioxide	A colourless, odourless gas with the molecular formula CO_2.
Saturated	A molecule that contains only single bonds between the carbon atoms in a chain.
Unsaturated	A molecule that contains one or more double bonds between carbon atoms in a chain.
Complete Combustion	Combustion of hydrocarbons with enough oxygen present to convert all the fuel into carbon dioxide and water.
Incomplete Combustion	When a substance reacts only partially with oxygen, such as when carbon burins in air producing carbon monoxide and soot (unburnt carbon).
Isomer	Molecules with the same molecular formula but different arrangements of atoms.
Addition reaction	A reaction in which reactants combine to form one larger product and no other products.
Functional group	An atom or group of atoms in a molecule that is mainly responsible for the molecule's chemical reactions and properties.

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Combustion

Complete	Incomplete

Complete

- Plentiful supply of oxygen
- Products:
  - ➢ Carbon dioxide
  - ➢ Water
- Blue flame on Bunsen burner
- Example:

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

Incomplete

- Poor supply of oxygen
- Products:
  - ➢ Carbon monoxide
  - ➢ Carbon (soot)
- Yellow flame on Bunsen burner

Bromine Water Test

alkane + bromine water
The product retains the colour from the bromine solution.

BROMINE WATER

alkene + bromine water
The product is colourless.

Bromine water is a dilute solution of bromine in water, Br_2 (aq).
It has an orange-brown colour.

- Alkenes – react with Br_2
- Alkanes – do not react with Br_2

The C=C double bond reacts with the bromine to form a colourless product. The bromine is therefore removed from the solution, which loses its colour.
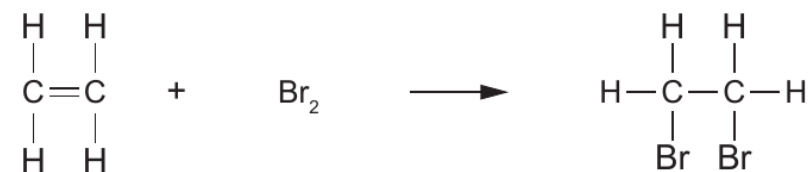
Addition Reactions

Two reactant molecules add to one another to form just one product molecule.

A reaction in which reactants combine to form one larger product molecule and no other products.
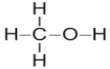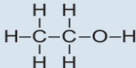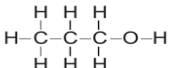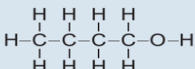
Example:

ethene   +   bromine   ⟶   1,2-dibromoethane

**D** Ethene reacts with bromine to form 1,2-dibromoethane.

Alcohols

General formula: $C_nH_{2n+1}OH$

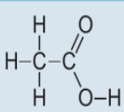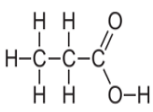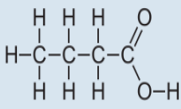| Name	Molecular formula	Structural formula
methanol	CH_3OH	
ethanol	C_2H_5OH	
propanol	C_3H_7OH	
butanol	C_4H_9OH	

B The naming of compounds uses a set of rules produced by the International Union of Pure and Applied Chemistry (IUPAC).

- -OH functional group
- Combustion of alcohols:
  alcohol + oxygen → carbon dioxide + water
- Oxidised to form carboxylic acids
- React with reactive metals to form hydrogen gas

methanol   ethanol   propanol
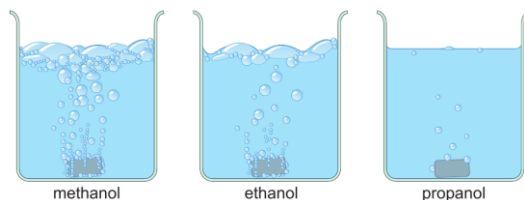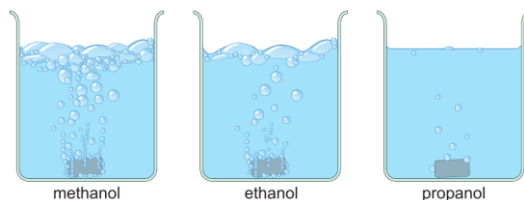
C Alcohols react with sodium metal but their reactivity depends on carbon chain length.

Carboxylic Acids

Name	Molecular formula	Structural formula
methanoic acid	HCOOH	
ethanoic acid	CH_3COOH	
propanoic acid	C_2H_5COOH	
butanoic acid	C_3H_7COOH	

C the first four carboxylic acids

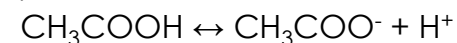The carboxylic acids have similar chemical properties. They all:

- form solutions with a pH less than 7 (if soluble)
- react with metals to form a salt and hydrogen
- react with bases to form a salt and water
- react with carbonates to form a salt, water and carbon dioxide.

oxygen

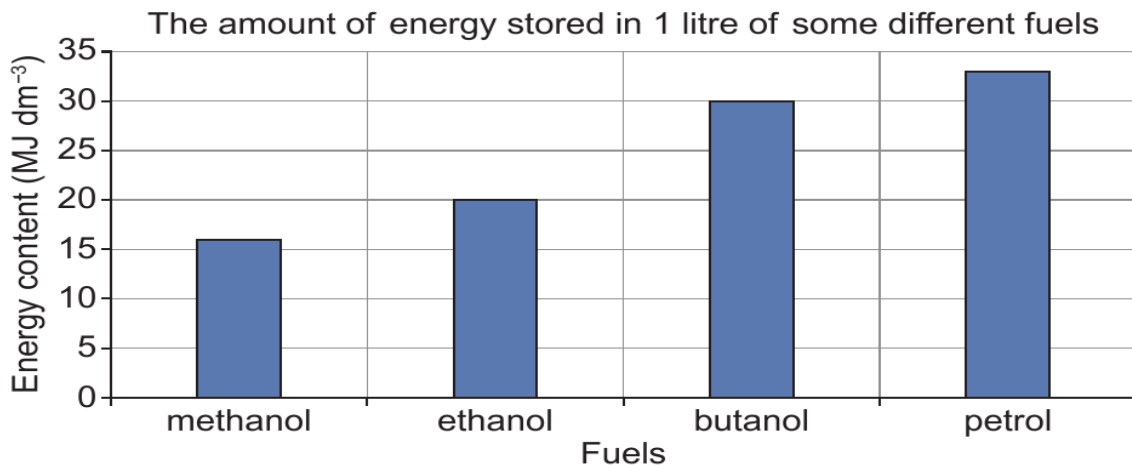An oxygen molecule collides with the functional group of an ethanol molecule and two hydrogen atoms are removed.

ethanol

The hydrogen atoms from the ethanol combine with an oxygen atom to form a water molecule.

The carbon atom that has lost the hydrogens forms a double bond with an oxygen atom.

water   +   ethanoic acid

A oxidising ethanol

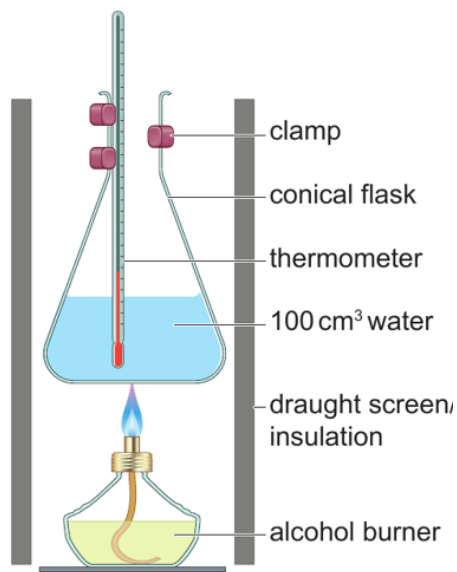| Keyword	Definition
Alcohol	An homologous series of compounds that contain the –OH functional group.
Fractional distillation	In fractional distillation a mixture of several substances, such as crude oil, is distilled and the evaporated components are collected as they condense at different temperatures.
Fraction	In fractional distillation, such as that of crude oil, the different parts of the original mixture are called fractions. The substances in each fraction have similar boiling points to each other.
Organic compound	Chemical compounds that contain carbon. Atoms such as hydrogen, oxygen, nitrogen or chlorine are also common in organic compounds.
Distillate	A distillate will contain the compound that boils at the lowest temperature
Renewable	Energy sources that are replenished and not exhausted, eg solar power.
Homologous series	A family of compounds that have the same general formula and similar properties, but have different numbers of carbon atoms.
Carboxylic acid	An homologous series of compounds that contain the –COOH functional group.
Oxidation	Oxidation occurs when an atom, molecule, or ion loses one or more electrons in a chemical reaction
Oxidising agent	A substance that can oxidise other substances in chemical reactions.
Fermentation	Anaerobic respiration occurring in microorganisms.
Functional group	An atom or group of atoms in a molecule that is mainly responsible for the molecule's chemical reactions and properties.
Sugar	Basic unit of carbohydrates.
Carbohydrates	Food belonging to the food group consisting of sugars, starch and cellulose.
Respiration	Process in living organisms involving the transfer of energy, typically with the intake of oxygen and the release of carbon dioxide from the oxidation of glucose.
Anaerobic	Without oxygen.
Enzymes	A protein which catalyses or speeds up a chemical reaction.

- In solution:
  $$CH_3COOH \leftrightarrow CH_3COO^- + H^+$$
- Carboxylic acid + metal → salt + hydrogen
- Carboxylic acid + base → salt + water

Combustion of alcohols

The amount of energy stored in 1 litre of some different fuels

D Butanol has some advantages over some other alcohols used as fuels.

B investigating energy in fuels

Method

Wear eye protection. Do not refill the alcohol burner if there are any naked flames nearby.

A Measure the mass of an alcohol burner and cap. Record the mass and the name of the alcohol.

B Place the alcohol burner in the centre of a heat-resistant mat.

C Use a measuring cylinder to add 100 cm³ of cold water to a conical flask.

D Measure and record the initial temperature of the water and clamp the flask above the alcohol burner.

E Light the wick of the burner and allow the water to heat up by about 40 °C.

F Replace the cap on the burner and measure and record the final temperature of the water.

G Measure the mass of the alcohol burner and cap again and record the mass.

H Calculate the mass of the alcohol burned to produce a 1 °C rise in temperature.

I Repeat steps A to H using fresh, cold water and a different alcohol.

Ethanol Production (C_2H_5OH)

- Sugars mixed with water and yeast
- Fermentation - enzymes in the yeast turn the sugars into ethanol and carbon dioxide
- Temperature and pH must be carefully controlled
- Yeast undergo anaerobic respiration (occurs in absence of oxygen)

Example:

$$glucose \rightarrow ethanol + carbon\ dioxide$$

- Fermentation produces alcohol concentrations <15%
- Fractional distillation used to form more concentrated alcohol solutions
- Yeast undergo anaerobic respiration (occurs in absence of oxygen)

D fractional distillation of an ethanol solution

108

SC24
Separate Chemistry – Polymers
(Knowledge Organiser)

Polymers are made from polymers.

Polymers have a high RMM.

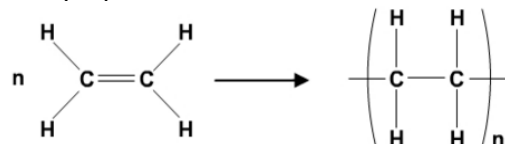**Polymers:** Alkenes can be used to make polymers. Polymers are very large molecules made when many smaller molecules join together, end-to-end. The smaller molecules are called **monomers**.

Addition polymer – poly(ethene) from ethene monomers
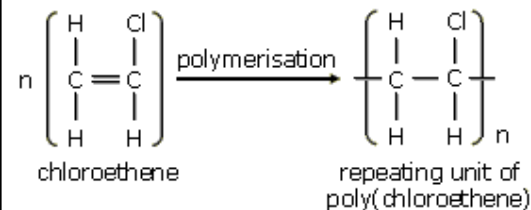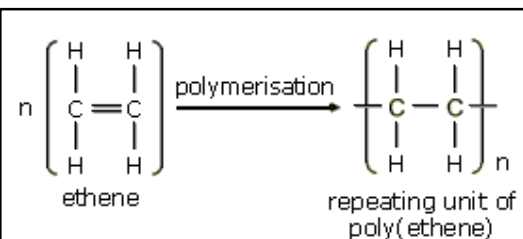

n = a big number of monomers

Displayed formulas of polymers
Polymer molecules are very large compared with most other molecules, so the idea of a repeating unit is used when drawing a displayed formula. When drawing one, starting with the monomer:
change the double bond in the monomer to a single bond in the repeating unit add a bond to each end of the repeating unit.

Addition polymeristion – when a double bond in a monomer opens and another monomer molecule is added on.

ethene → repeating unit of poly(ethene)

chloroethene → repeating unit of poly(chloroethene)

Synthetic polymers – man made. Manufactured in the laboratory. E.g. poly(ethene)

Natural polymers – DNA, starch, proteins. DNA – made from 4 different monomers called nucleotides. Starch is made from a sugar called glucose. Proteins are polymers made from amino acids.

Key word	Definition
Addition polymerisation	When a double bond in a monomer opens and another monomer molecule is added on.
Biodegradable	Microbes can feed on these types of materials, and break them down.
Condensation polymerisation	Monomers join together, and eliminate a small molecule of water.
Ester links	Functional group in polymers formed when an acid has reacted with an alcohol.
Functional group	Atom or group of atoms that is responsible for the properties and reactions of the compound.
Monomers	Small molecules with a double bond, that can open to form polymers
Non-biodegradable	Microbes cannot feed on these types of materials, and cannot break them down.
Polyester	Polymer made by condensation from a carboxylic acid and an alcohol. Synthetic polymers.
Polymerisation	Monomers (small molecules) join together to form polymers (large molecules)
Polymers	Large molecules made from lots of small molecules, called monomers.
Repeating unit	Shows how the monomer has changed and how it repeats in a polymer.
Synthetic polymers	Man made polymers (plastics)

SC24
Separate Chemistry – Polymers
(Knowledge Organiser)

Polymer (and common name)	Properties	Uses
poly(ethene) polythene or polyethylene	flexible, cheap, good insulator	plastic bags, plastic bottles, cling film, insulation for electrical wires
poly(propene) polypropene or polypropylene	flexible, shatterproof, high softening point	buckets and bowls
poly(chloroethene) **PVC**	tough, cheap, long-lasting, good insulator	window frames, gutters, pipes, insulation for electrical wires
poly(tetrafluoroethene) **PTFE** or **Teflon®**	tough, slippery, resistant to corrosion, good insulator	non-stick coatings for saucepans, bearings and skis, containers for corrosive substances, stain-proofing carpets, insulation for electrical wires

H Condensation Polymers:
Condensation polymerisation is a process whereby many small monomer molecules join together to form one large polymer, with water, or some other small molecule formed at the same time. The monomers have more than one functional group.

H Polyesters: You can use reaction of alcohols and carboxylic acids to make long chain esters which contain thousands of individual ester molecules joined together,

This is a polyester. The long-chain molecules can be made into fibres, which can be woven into fabrics.

Esters are made when carboxylic acids (like ethanoic acid) react with alcohols (like ethanol):

ethanoic acid (acid) + ethanol (alcohol) → ethyl ethanoate (ester) + water
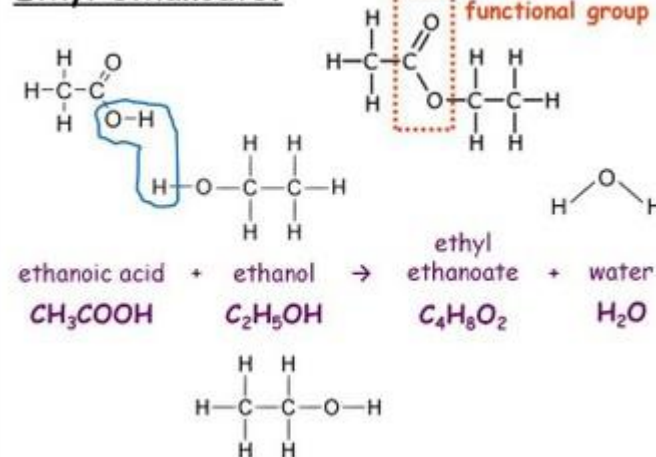
Problems with polymers:
- They are non-biodegradable, causing problems in landfill sites.
- When incinerated, the energy released can be used to generate electricity. However toxic gases are formed.
- Difficult to recycle polymers, as they need to be sorted into different types before they can be made into new objects.3

Ethyl ethanoate.

ethanoic acid + ethanol → ethyl ethanoate + water
CH_3COOH C_2H_5OH $C_4H_8O_2$ H_2O

Recycling symbols on polymers:

1 PETE 2 HDPE 3 V 4 LDPE 5 PP 6 PS 7 OTHER

Diacid + Diol ⇒ Polyester

Ester link + H_2O

Polyester (e.g. Terylene)

SC25
Separate Chemistry – Qualitative Analysis (Knowledge Organiser)

Types of chemical analysis

Qualitative analysis – investigates the type of substance present in a sample.
Quantitative analysis – investigates the amount of substance present in a sample.

Ionic Compounds

...are made up of cations and anions. Cations are positively charge ions formed by the loss of electrons. Anions are negatively charged ions formed by the gain of electrons.
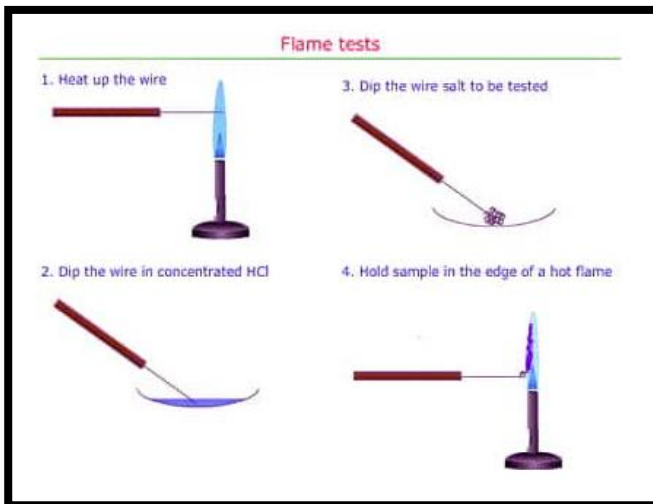

Flame tests

1. Heat up the wire
2. Dip the wire in concentrated HCl
3. Dip the wire salt to be tested
4. Hold sample in the edge of a hot flame

Key word	Definition
Anions	A negatively charged ion formed from an atom that has gained electrons.
Cations	A positively charged ion formed from an atom that has lost electrons.
Confirmatory test	A chemical test carried out to check the conclusion from the results of another test.
Flame photometer	A machine used to identify metal ions in solution and to determine their concentration.
Halides	A compound formed between a halogen and another element such as a metal or hydrogen.
Halide ions	A negatively-charged ion formed from one of the Group 7 elements.
Standard solutions	A solution containing a known substance.
Precipitates	An insoluble substance that is formed when two soluble substances react together in solution.

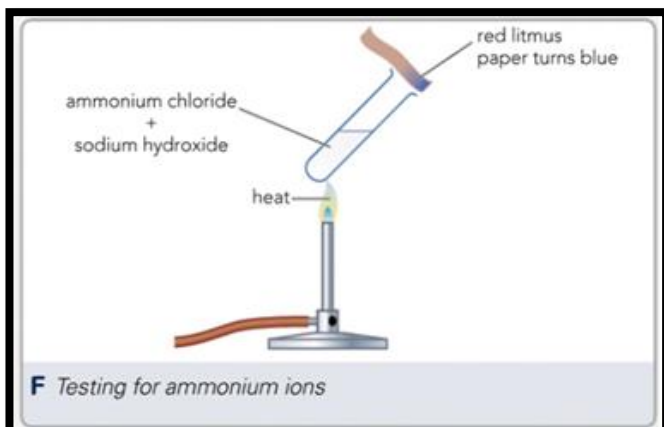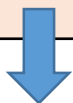| Element	Colour flames
Lithium	*Red*
Sodium	*Yellow*
Potassium	*Lilac*
Calcium	*Orange-red*
Copper	*Blue-green*

To carry out a flame test on an ionic substance:
- Clean a metal loop in dilute hydrochloric acid.
- Dip it into the sample solution or solid.
- Hold the loop at the edge of a Bunsen burner flame.
- Observe the colour of the flame and use this to determine which metal ion is present.

Flame photo metry	*An instrumental method used to analyse metal ions*	Analyses the concentration of ions in a dilute solution using a calibration curve. The user compares the results to known data in order to identify the metal ions and their concentration.
Using scientific instruments may improve: sensitivity (detect much smaller amounts), accuracy (give values closer to the true value and speed.		

SC25
Separate Chemistry – Qualitative Analysis (Knowledge Organiser)
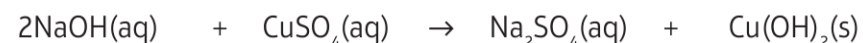
Sodium hydroxide	*Is added to solutions to identify metal ions. These are precipitation reactions.*
White precipitates	*Aluminium, calcium and magnesium ions form this with sodium hydroxide solution.*
Coloured precipitates	*Copper (II) = blue-green* *Iron (II) = green* *Iron (III) = brown*

Testing for ammonia	*Damp red litmus paper*	Will turn blue in the presence of ammonia. Can also be identified by its characteristic smell.

F *Testing for ammonium ions*

Carbonates	*React with dilute acids to form carbon dioxide.*
Halide ions	*When in a solution, they produce precipitates with silver nitrate solution in the presence of nitric acid.*
Sulfate ions	*When in a solutions they produce a white precipitate with barium chloride solutions in the presence of hydrochloric acid.*

Halide ion testing
Halide ions can be identified by using silver nitrate solution acidified with nitric acid.

Halide ion	Precipitate with silver ions
chloride (Cl^-)	white
bromide (Br^-)	cream
iodide (I^-)	yellow

Test carried out using …	Ions identified
flame test	Na^+, K^+, Ca^{2+}, Cu^{2+}
dilute acid and lime water	CO_3^{2-}
dilute hydrochloric acid and barium chloride solution	SO_4^{2-}
silver nitrate solution and dilute nitric acid	Cl^-, Br^-, I^-
sodium hydroxide solution and heat	Al^{3+}, Ca^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, NH_4^+

E *Some of the tests that a forensic chemist might perform on unknown substances.*

For example, sodium hydroxide solution reacts with copper sulfate solution to form a blue precipitate:

sodium hydroxide + copper sulfate → sodium sulfate + copper hydroxide

$$2NaOH(aq) + CuSO_4(aq) \rightarrow Na_2SO_4(aq) + Cu(OH)_2(s)$$

These precipitation reactions can also be modelled using balanced ionic equations. For example, aqueous iron(III) ions react with aqueous hydroxide ions to form solid iron(III) hydroxide:

$$Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$$

Glass and clay ceramics

Ceramics are a range of durable compounds that change very little when heated. They are chemically unreactive, hard and stiff but brittle. They are also poor electrical and thermal conductors, and have high melting points. Ceramic materials consist of giant structures with many strong bonds (covalent or ionic), giving them their typical properties.

Brick, porcelain and china are **clay ceramics**. They are made from clay moulded into the desired shape. When the clay is heated to a very high temperature, tiny crystals form and join together. Bricks are usually decorated by adding a coloured substance to the clay before heating. A pattern may also be moulded into surfaces that will be visible in a finished wall. Porcelain and china are dipped in a 'glaze' and heated strongly again. The glaze forms the hard, waterproof, smooth surface you see on tiles, washbasins and toilet bowls.

Glass is made by melting sand, then allowing it to cool and solidify. Glass and clay ceramics have similar properties because they both have giant structures. However, the atoms in glass are not arranged in a regular way to form crystals, so glass is **transparent** rather than **opaque**.

Polymers

Polymers are substances with high average relative formula masses. They are made from **monomers** – smaller molecules that join together to form repeating units. For example, poly(ethene) is made from ethene, and poly(chloroethene) or PVC, is made from chloroethene (see *SC24 Polymers*).

Polymers can be moulded into complex shapes. The properties of a polymer depend on its structure and chemical composition, but polymers are usually strong and chemically unreactive. They are also poor electrical and thermal conductors. Rigid PVC is useful for underground pipes and window frames. PVC can be made softer by including substances called **plasticisers** in its manufacture. Flexible PVC is useful for indoor water pipes and waterproof flooring.

A **composite material** is a mixture of two or more materials, combined to produce a material with improved properties. The individual materials often have contrasting properties. The individual materials are also usually visible in the composite material, and can often be separated out by physical separation methods. Pykrete consists of ice and about 14% wood pulp. Tiny pieces of wood can be seen in pykrete, and they separate out when the ice melts.

Reinforcement and matrix

Concrete is made by mixing cement, sand, aggregate (small stones and gravel) and water together. As the concrete sets hard, chemical reactions happen that bond the solid components together. The sand and aggregate form the **reinforcement** of the concrete. The reinforcement is bonded together by cement, which forms the **matrix**.
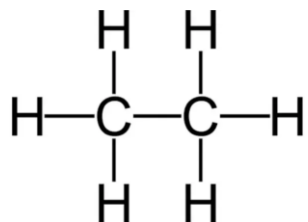
Laminates

Wood is a natural composite material consisting of cellulose fibres in a matrix of a polymer called lignin. It is stronger along its grain than it is across its grain. Plywood typically consists of odd numbers of thin sheets of wood, each glued at right angles to the sheet below (see diagram E).

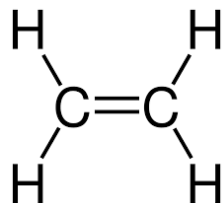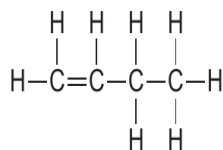| Keyword	Definition
Alloy	An alloy is a mixture of two or more elements, at least one of which is a metal
Brittle	If something is brittle it is easily broken
Composite material	Material made from two or more different materials with contrasting properties
Compressive strength	A measure of how well a material resists being crushed when a force is applied
Density	A measure of compactness and the ratio of mass to volume. It is usually measured in kilograms per metre cubed (kg/m^3) or grams per centimetre cubed (g/cm^3)
Ductile	A ductile material is capable of being drawn into thin sheets or wires without breaking
Malleable	Capable of being hammered or pressed into a new shape without being likely to break or return to the original shape
Matrix	The substance that binds the reinforcement together in a composite material
Nanoparticles	Tiny particles which are between 1 and 100 nanometres (nm) in size
Nanoparticulate materials	Useful substances containing nanoparticles
Polymer	A large molecule formed from many identical smaller molecules known as monomers
Reinforcement	Fibres or other material that make up the bulk of a composite material
Resin	Raw plastic, especially when in semi-liquid form
Tensile Strength	The tension a material can withstand without breaking
Tension	Pulling force exerted by each end of an object such as a string or rope

Alkane

e.g. ethane

- General formula: C_nH_{2n+2}
- Saturated molecule

Number of carbons in the chain	Prefix	Alkane	Molecular formula	Structural formula
1	meth-	methane	CH_4	
2	eth-	ethane	C_2H_6	
3	prop-	propane	C_3H_8	
4	but-	butane	C_4H_{10}	

B the first four members of the alkane homologous series

Alkene

e.g. ethene

- General formula: C_nH_{2n}
- Unsaturated molecule
- C=C functional group

Name	Molecular formula	Structural formula
ethene	C_2H_4	
propene	C_3H_6	
butene	C_4H_8	

C the first three members of the alkene homologous series

Isomers

but-1-ene   but-2-ene

D The numbers in the butene isomer names show the position of the double bond. The 1 shows that the C=C bond starts at the end of the molecule on the first carbon, the 2 shows that it is in the middle. Carbon atoms are numbered starting from the end closest to the double bond.

Keyword	Definition
Alkane	A hydrocarbon in which all the bonds between the carbon atoms are double bonds.
Alkene	A hydrocarbon in which there are one or more double bonds between carbon atoms.
Homologous series	A family of compounds that have the same general formula and similar properties, but have different numbers of carbon atoms.
Carbon monoxide	A poisonous gas produced from carbon burning without enough oxygen.
Carbon dioxide	A colourless, odourless gas with the molecular formula CO_2.
Saturated	A molecule that contains only single bonds between the carbon atoms in a chain.
Unsaturated	A molecule that contains one or more double bonds between carbon atoms in a chain.
Complete Combustion	Combustion of hydrocarbons with enough oxygen present to convert all the fuel into carbon dioxide and water.
Incomplete Combustion	When a substance reacts only partially with oxygen, such as when carbon burins in air producing carbon monoxide and soot (unburnt carbon).
Isomer	Molecules with the same molecular formula but different arrangements of atoms.
Addition reaction	A reaction in which reactants combine to form one larger product and no other products.
Functional group	An atom or group of atoms in a molecule that is mainly responsible for the molecule's chemical reactions and properties.

Combustion

Complete	Incomplete

- Plentiful supply of oxygen
- Products:
  - ➢ Carbon dioxide
  - ➢ Water
- Blue flame on Bunsen burner
- Example:

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

- Poor supply of oxygen
- Products:
  - ➢ Carbon monoxide
  - ➢ Carbon (soot)
- Yellow flame on Bunsen burner

Bromine Water Test

alkane + bromine water
The product retains the colour from the bromine solution.

BROMINE WATER

alkene + bromine water
The product is colourless.

Bromine water is a dilute solution of bromine in water, Br_2 (aq).
It has an orange-brown colour.

- Alkenes – react with Br_2
- Alkanes – do not react with Br_2

The C=C double bond reacts with the bromine to form a colourless product. The bromine is therefore removed from the solution, which loses its colour.

Addition Reactions

Two reactant molecules add to one another to form just one product molecule.

A reaction in which reactants combine to form one larger product molecule and no other products.

Example:

ethene   +   bromine   ⟶   1,2-dibromoethane

D Ethene reacts with bromine to form 1,2-dibromoethane.
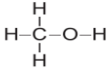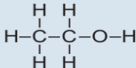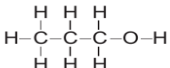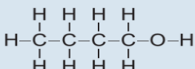
KS4 – Science – Alcohols and Carboxylic Acids

Alcohols

General formula: $C_nH_{2n+1}OH$

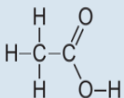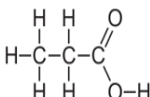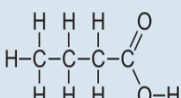| Name	Molecular formula	Structural formula
methanol	CH_3OH	H H–C–O–H H
ethanol	C_2H_5OH	H H H–C–C–O–H H H
propanol	C_3H_7OH	H H H H–C–C–C–O–H H H H
butanol	C_4H_9OH	H H H H H–C–C–C–C–O–H H H H H

B The naming of compounds uses a set of rules produced by the International Union of Pure and Applied Chemistry (IUPAC).

- -OH functional group
- Combustion of alcohols:
  alcohol + oxygen → carbon dioxide + water
- Oxidised to form carboxylic acids
- React with reactive metals to form hydrogen gas

methanol   ethanol   propanol

C Alcohols react with sodium metal but their reactivity depends on carbon chain length.

Carboxylic Acids

Name	Molecular formula	Structural formula
methanoic acid	HCOOH	O H–C O–H
ethanoic acid	CH_3COOH	H O H–C–C H O–H
propanoic acid	C_2H_5COOH	H H O H–C–C–C H H O–H
butanoic acid	C_3H_7COOH	H H H O H–C–C–C–C H H H O–H

C the first four carboxylic acids

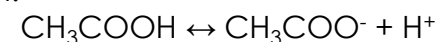The carboxylic acids have similar chemical properties. They all:

- form solutions with a pH less than 7 (if soluble)
- react with metals to form a salt and hydrogen
- react with bases to form a salt and water
- react with carbonates to form a salt, water and carbon dioxide.

oxygen

An oxygen molecule collides with the functional group of an ethanol molecule and two hydrogen atoms are removed.

ethanol

The carbon atom that has lost the hydrogens forms a double bond with an oxygen atom.

The hydrogen atoms from the ethanol combine with an oxygen atom to form a water molecule.

water   +   ethanoic acid

A oxidising ethanol

Keyword	Definition
Alcohol	An homologous series of compounds that contain the –OH functional group.
Fractional distillation	In fractional distillation a mixture of several substances, such as crude oil, is distilled and the evaporated components are collected as they condense at different temperatures.
Fraction	In fractional distillation, such as that of crude oil, the different parts of the original mixture are called fractions. The substances in each fraction have similar boiling points to each other.
Organic compound	Chemical compounds that contain carbon. Atoms such as hydrogen, oxygen, nitrogen or chlorine are also common in organic compounds.
Distillate	A distillate will contain the compound that boils at the lowest temperature
Renewable	Energy sources that are replenished and not exhausted, eg solar power.
Homologous series	A family of compounds that have the same general formula and similar properties, but have different numbers of carbon atoms.
Carboxylic acid	An homologous series of compounds that contain the –COOH functional group.
Oxidation	Oxidation occurs when an atom, molecule, or ion loses one or more electrons in a chemical reaction
Oxidising agent	A substance that can oxidise other substances in chemical reactions.
Fermentation	Anaerobic respiration occurring in microorganisms.
Functional group	An atom or group of atoms in a molecule that is mainly responsible for the molecule's chemical reactions and properties.
Sugar	Basic unit of carbohydrates.
Carbohydrates	Food belonging to the food group consisting of sugars, starch and cellulose.
Respiration	Process in living organisms involving the transfer of energy, typically with the intake of oxygen and the release of carbon dioxide from the oxidation of glucose.
Anaerobic	Without oxygen.
Enzymes	A protein which catalyses or speeds up a chemical reaction.

- In solution:
$$CH_3COOH \leftrightarrow CH_3COO^- + H^+$$
- Carboxylic acid + metal → salt + hydrogen
- Carboxylic acid + base → salt + water

Combustion of alcohols

The amount of energy stored in 1 litre of some different fuels

D Butanol has some advantages over some other alcohols used as fuels.

B investigating energy in fuels

Method

Wear eye protection. Do not refill the alcohol burner if there are any naked flames nearby.

A Measure the mass of an alcohol burner and cap. Record the mass and the name of the alcohol.

B Place the alcohol burner in the centre of a heat-resistant mat.

C Use a measuring cylinder to add 100 cm³ of cold water to a conical flask.

D Measure and record the initial temperature of the water and clamp the flask above the alcohol burner.

E Light the wick of the burner and allow the water to heat up by about 40 °C.

F Replace the cap on the burner and measure and record the final temperature of the water.

G Measure the mass of the alcohol burner and cap again and record the mass.

H Calculate the mass of the alcohol burned to produce a 1 °C rise in temperature.

I Repeat steps A to H using fresh, cold water and a different alcohol.

Ethanol Production (C_2H_5OH)

- Sugars mixed with water and yeast
- Fermentation - enzymes in the yeast turn the sugars into ethanol and carbon dioxide
- Temperature and pH must be carefully controlled
- Yeast undergo anaerobic respiration (occurs in absence of oxygen)

Example:

glucose → ethanol + carbon dioxide

- Fermentation produces alcohol concentrations <15%
- Fractional distillation used to form more concentrated alcohol solutions
- Yeast undergo anaerobic respiration (occurs in absence of oxygen)

D fractional distillation of an ethanol solution

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Polymers are made from polymers.

Polymers have a high RMM.

Polymers: Alkenes can be used to make polymers. Polymers are very large molecules made when many smaller molecules join together, end-to-end. The smaller molecules are called **monomers**.

Addition polymer – poly(ethene) from ethene monomers

n = a big number of monomers

Displayed formulas of polymers
Polymer molecules are very large compared with most other molecules, so the idea of a repeating unit is used when drawing a displayed formula. When drawing one, starting with the monomer:
change the double bond in the monomer to a single bond in the repeating unit add a bond to each end of the repeating unit.

Addition polymeristion – when a double bond in a monomer opens and another monomer molecule is added on.

ethene → repeating unit of poly(ethene)

chloroethene → repeating unit of poly(chloroethene)

Synthetic polymers – man made. Manufactured in the laboratory. E.g. poly(ethene)

Natural polymers – DNA, starch, proteins. DNA – made from 4 different monomers called nucleotides. Starch is made from a sugar called glucose. Proteins are polymers made from amino acids.

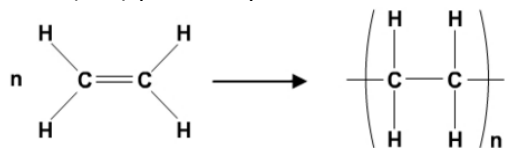| Key word	Definition
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Biodegradable	Microbes can feed on these types of materials, and break them down.
Condensation polymerisation	Monomers join together, and eliminate a small molecule of water.
Ester links	Functional group in polymers formed when an acid has reacted with an alcohol.
Functional group	Atom or group of atoms that is responsible for the properties and reactions of the compound.
Monomers	Small molecules with a double bond, that can open to form polymers
Non-biodegradable	Microbes cannot feed on these types of materials, and cannot break them down.
Polyester	Polymer made by condensation from a carboxylic acid and an alcohol. Synthetic polymers.
Polymerisation	Monomers (small molecules) join together to form polymers (large molecules)
Polymers	Large molecules made from lots of small molecules, called monomers.
Repeating unit	Shows how the monomer has changed and how it repeats in a polymer.
Synthetic polymers	Man made polymers (plastics)

H Condensation Polymers:
Condensation polymerisation is a process whereby many small monomer molecules join together to form one large polymer, with water, or some other small molecule formed at the same time. The monomers have more than one functional group.

H Polyesters: You can use reaction of alcohols and carboxylic acids to make long chain esters which contain thousands of individual ester molecules joined together,

This is a polyester. The long-chain molecules can be made into fibres, which can be woven into fabrics.

Problems with polymers:
- They are non-biodegradable, causing problems in landfill sites.
- When incinerated, the energy released can be used to generate electricity. However toxic gases are formed.
- Difficult to recycle polymers, as they need to be sorted into different types before they can be made into new objects.3

Recycling symbols on polymers:

Polymer (and common name)	Properties	Uses
poly(ethene) polythene or polyethylene	flexible, cheap, good insulator	plastic bags, plastic bottles, cling film, insulation for electrical wires
poly(propene) polypropene or polypropylene	flexible, shatterproof, high softening point	buckets and bowls
poly(chloroethene) **PVC**	tough, cheap, long-lasting, good insulator	window frames, gutters, pipes, insulation for electrical wires
poly(tetrafluoroethene) **PTFE** or **Teflon**®	tough, slippery, resistant to corrosion, good insulator	non-stick coatings for saucepans, bearings and skis, containers for corrosive substances, stain-proofing carpets, insulation for electrical wires

Esters are made when carboxylic acids (like ethanoic acid) react with alcohols (like ethanol):

ethanoic acid (acid) + ethanol (alcohol) → ethyl ethanoate (ester) + water

Ethyl ethanoate.

ethanoic acid + ethanol → ethyl ethanoate + water
CH_3COOH C_2H_5OH $C_4H_8O_2$ H_2O

Diacid + Diol ⇒ Polyester

Diacid + Diol

Ester link + H_2O

Polyester (e.g. Terylene)

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Types of chemical analysis

Qualitative analysis – investigates the type of substance present in a sample.
Quantitative analysis – investigates the amount of substance present in a sample.

Ionic Compounds

...are made up of cations and anions. Cations are positively charge ions formed by the loss of electrons. Anions are negatively charged ions formed by the gain of electrons.

Flame tests

1. Heat up the wire
2. Dip the wire in concentrated HCl
3. Dip the wire salt to be tested
4. Hold sample in the edge of a hot flame

Element	Colour flames
Lithium	*Red*
Sodium	*Yellow*
Potassium	*Lilac*
Calcium	*Orange-red*
Copper	*Blue-green*

To carry out a flame test on an ionic substance:
- Clean a metal loop in dilute hydrochloric acid.
- Dip it into the sample solution or solid.
- Hold the loop at the edge of a Bunsen burner flame.
- Observe the colour of the flame and use this to determine which metal ion is present.

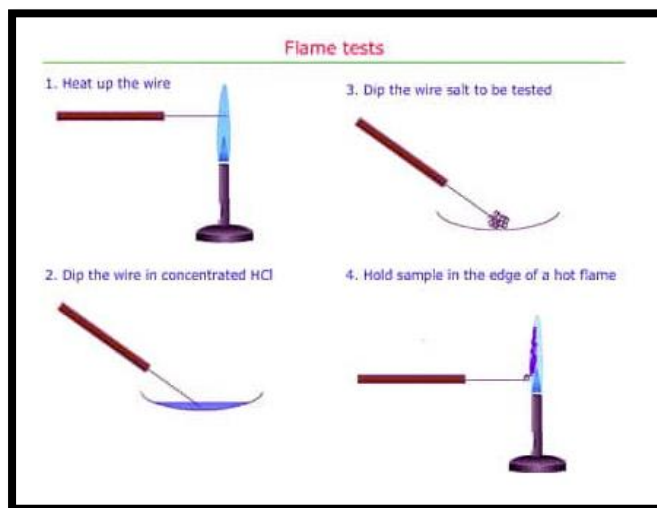| Key word	Definition
Anions	A negatively charged ion formed from an atom that has gained electrons.
Cations	A positively charged ion formed from an atom that has lost electrons.
Confirmatory test	A chemical test carried out to check the conclusion from the results of another test.
Flame photometer	A machine used to identify metal ions in solution and to determine their concentration.
Halides	A compound formed between a halogen and another element such as a metal or hydrogen.
Halide ions	A negatively-charged ion formed from one of the Group 7 elements.
Standard solutions	A solution containing a known substance.
Precipitates	An insoluble substance that is formed when two soluble substances react together in solution.

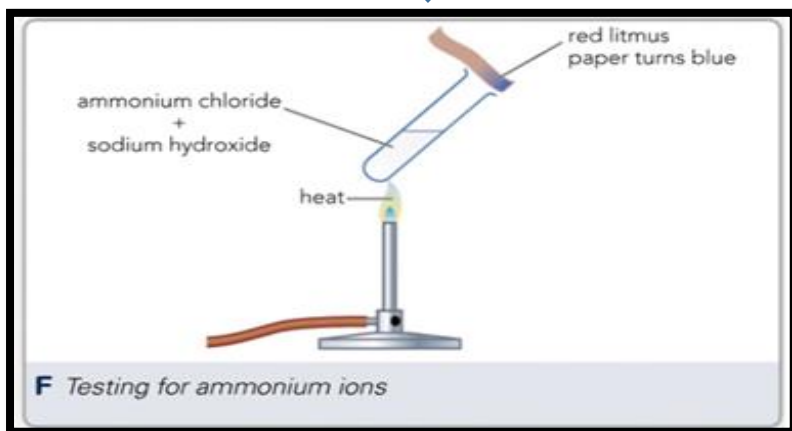| Flame photo metry	*An instrumental method used to analyse metal ions*	Analyses the concentration of ions in a dilute solution using a calibration curve. The user compares the results to known data in order to identify the metal ions and their concentration.
Using scientific instruments may improve: sensitivity (detect much smaller amounts), accuracy (give values closer to the true value and speed.		

Testing for ammonia	*Damp red litmus paper*	Will turn blue in the presence of ammonia. Can also be identified by its characteristic smell.

red litmus paper turns blue

ammonium chloride + sodium hydroxide

heat

F *Testing for ammonium ions*

Test carried out using ...	Ions identified
flame test	Na^+, K^+, Ca^{2+}, Cu^{2+}
dilute acid and lime water	CO_3^{2-}
dilute hydrochloric acid and barium chloride solution	SO_4^{2-}
silver nitrate solution and dilute nitric acid	Cl^-, Br^-, I^-
sodium hydroxide solution and heat	Al^{3+}, Ca^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, NH_4^+

E *Some of the tests that a forensic chemist might perform on unknown substances.*

Sodium hydroxide	*Is added to solutions to identify metal ions. These are precipitation reactions.*
White precipitates	*Aluminium, calcium and magnesium ions form this with sodium hydroxide solution.*
Coloured precipitates	*Copper (II) = blue-green* *Iron (II) = green* *Iron (III) = brown*

Carbonates	*React with dilute acids to form carbon dioxide.*
Halide ions	*When in a solution, they produce precipitates with silver nitrate solution in the presence of nitric acid.*
Sulfate ions	*When in a solutions they produce a white precipitate with barium chloride solutions in the presence of hydrochloric acid.*

Halide ion testing
Halide ions can be identified by using silver nitrate solution acidified with nitric acid.

Halide ion	Precipitate with silver ions
chloride (Cl^-)	white
bromide (Br^-)	cream
iodide (I^-)	yellow

For example, sodium hydroxide solution reacts with copper sulfate solution to form a blue precipitate:

sodium hydroxide + copper sulfate → sodium sulfate + copper hydroxide

$$2NaOH(aq) + CuSO_4(aq) \rightarrow Na_2SO_4(aq) + Cu(OH)_2(s)$$

These precipitation reactions can also be modelled using balanced ionic equations. For example, aqueous iron(III) ions react with aqueous hydroxide ions to form solid iron(III) hydroxide:

$$Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$$

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Glass and clay ceramics

Ceramics are a range of durable compounds that change very little when heated. They are chemically unreactive, hard and stiff but brittle. They are also poor electrical and thermal conductors, and have high melting points. Ceramic materials consist of giant structures with many strong bonds (covalent or ionic), giving them their typical properties.

Brick, porcelain and china are **clay ceramics**. They are made from clay moulded into the desired shape. When the clay is heated to a very high temperature, tiny crystals form and join together. Bricks are usually decorated by adding a coloured substance to the clay before heating. A pattern may also be moulded into surfaces that will be visible in a finished wall. Porcelain and china are dipped in a 'glaze' and heated strongly again. The glaze forms the hard, waterproof, smooth surface you see on tiles, washbasins and toilet bowls.

Glass is made by melting sand, then allowing it to cool and solidify. Glass and clay ceramics have similar properties because they both have giant structures. However, the atoms in glass are not arranged in a regular way to form crystals, so glass is **transparent** rather than **opaque**.

Polymers

Polymers are substances with high average relative formula masses. They are made from **monomers** – smaller molecules that join together to form repeating units. For example, poly(ethene) is made from ethene, and poly(chloroethene) or PVC, is made from chloroethene (see *SC24 Polymers*).

Polymers can be moulded into complex shapes. The properties of a polymer depend on its structure and chemical composition, but polymers are usually strong and chemically unreactive. They are also poor electrical and thermal conductors. Rigid PVC is useful for underground pipes and window frames. PVC can be made softer by including substances called **plasticisers** in its manufacture. Flexible PVC is useful for indoor water pipes and waterproof flooring.

A **composite material** is a mixture of two or more materials, combined to produce a material with improved properties. The individual materials often have contrasting properties. The individual materials are also usually visible in the composite material, and can often be separated out by physical separation methods. Pykrete consists of ice and about 14% wood pulp. Tiny pieces of wood can be seen in pykrete, and they separate out when the ice melts.

Reinforcement and matrix

Concrete is made by mixing cement, sand, aggregate (small stones and gravel) and water together. As the concrete sets hard, chemical reactions happen that bond the solid components together. The sand and aggregate form the **reinforcement** of the concrete. The reinforcement is bonded together by cement, which forms the **matrix**.

Laminates

Wood is a natural composite material consisting of cellulose fibres in a matrix of a polymer called lignin. It is stronger along its grain than it is across its grain. Plywood typically consists of odd numbers of thin sheets of wood, each glued at right angles to the sheet below (see diagram E).

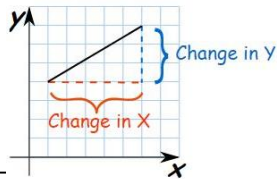| Keyword	Definition
Alloy	An alloy is a mixture of two or more elements, at least one of which is a metal
Brittle	If something is brittle it is easily broken
Composite material	Material made from two or more different materials with contrasting properties
Compressive strength	A measure of how well a material resists being crushed when a force is applied
Density	A measure of compactness and the ratio of mass to volume. It is usually measured in kilograms per metre cubed (kg/m^3) or grams per centimetre cubed (g/cm^3)
Ductile	A ductile material is capable of being drawn into thin sheets or wires without breaking
Malleable	Capable of being hammered or pressed into a new shape without being likely to break or return to the original shape
Matrix	The substance that binds the reinforcement together in a composite material
Nanoparticles	Tiny particles which are between 1 and 100 nanometres (nm) in size
Nanoparticulate materials	Useful substances containing nanoparticles
Polymer	A large molecule formed from many identical smaller molecules known as monomers
Reinforcement	Fibres or other material that make up the bulk of a composite material
Resin	Raw plastic, especially when in semi-liquid form
Tensile Strength	The tension a material can withstand without breaking
Tension	Pulling force exerted by each end of an object such as a string or rope

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Physics Knowledge Organisers

Motion

Scalar / Vector

Scalar	Vector
Distance	Displacement
Speed	Velocity
Power	Momentum
Mass	Acceleration
Volume	Weight
Temperature	
Force	
Pressure	

Calculating speed/velocity

Speed *(m/s)* = **distance** *(m)* ÷ **time** *(s)*

How to remember the equation?
"Don't Step on Turtles"

$$D = S \times T$$
$$S = D \div T$$
$$T = D \div S$$

Calculating a gradient

Gradient = $\frac{Change\ in\ y}{Change\ in\ x}$

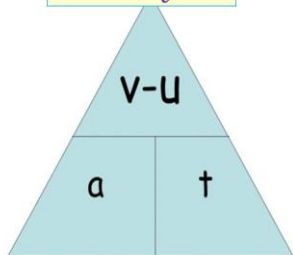## Calculating acceleration

Acceleration is the <u>rate of change</u> of <u>velocity</u>

Acceleration (m/s/s) = $\frac{Change\ in\ velocity\ (m/s)}{time\ taken\ (s)}$

$$a = \frac{v - u}{t}$$

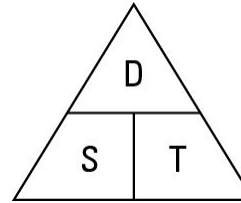a= acceleration
v= final velocity
u= initial velocity
t= time

V – U
a   t

Distance-time graph
Key features:

fast, steady speed.
getting faster
steady speed
stationary
returning to start
DISTANCE
TIME
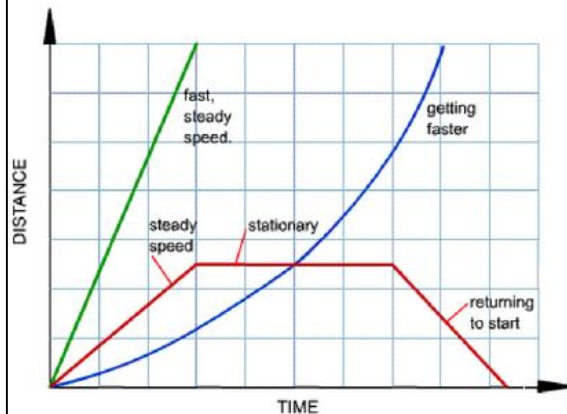
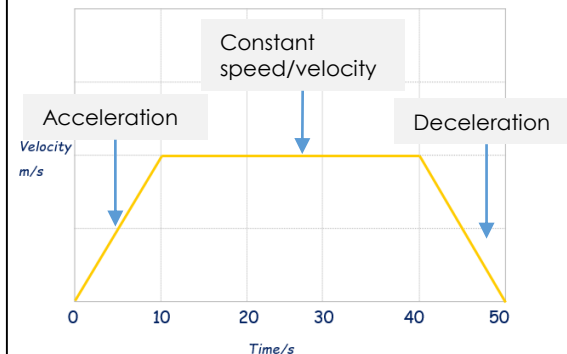*You can calculate speed from this distance-time graph.*

Steeper gradient= faster speed.

Velocity-time graph
Key features:

Constant speed/velocity
Acceleration
Deceleration
Velocity m/s
0 10 20 30 40 50
Time/s

You can calculate acceleration from this velocity-time graph.

*Calculating the **area beneath the lines**, is the same as the **overall distance travelled***

Steeper gradient= faster acceleration.

Glossary

Term	Definition
Speed	*Scalar measurement that shows how fast an object is moving. Measure in m/s (meters per second).*
Velocity	*Vector measurement that shows how fast an object is moving in a specific direction. Measured in m/s (meters per second).*
Distance	*Measurement of how far an object is moving/has moved. Measured in m (meters).*
Time	*Measurement of time. Measured in s (seconds).*
Acceleration	*When an objects speed increases over time.*
Conversion	*Changing a measurement to another form.*
Deceleration	*When an objects speed decreases over time.*
Scalar	*A measurement that shows magnitude only.*
Vector	*A measurement that shows magnitude and direction.*
Plateau	*A straight horizontal line on a graph.*
Gradient	*Difference between two values, shown by a incline or decline on a line graph.*
Constant	*When something does not change. Shown by a straight line on a line graph.*
Magnitude	*Another term used for size.*
Direction	*The course which an object is moving. We show North, West, East, South or a combination of two.*
Initial	*The beginning.*
Final	*The end.*
Displacement	*A vector measurement to show the shortest distance to the final place an object ends up.*

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10 000 N lift from the wings

2500 N drag

3000 N thrust from the propeller

10 000 N weight

0.5 seconds after jumping, speed = 5 m/s

3 seconds after jumping, speed = 25 m/s

12 seconds after jumping, speed = 55 m/s

Air resistance increases with speed, so just after jumping the air resistance is much smaller than her weight. The large resultant force makes her accelerate downwards.

Her air resistance is larger but her weight stays the same. The resultant force is smaller, so she is still accelerating, but not as much.

She is moving so fast that the air resistance balances her weight. She continues to fall at the same speed.

Keyword	Definition
acceleration	A measure of how quickly the velocity of something is changing. It can be positive if the object is speeding up or negative if it is slowing down.
balanced forces	When the forces in opposite directions on an object are the same size so that there is a zero resultant force.
resultant force	The total force that results from two or more forces acting upon a single object. It is found by adding together the forces, taking into account their directions.
scalar quantity	A quantity that has a magnitude (size) but not a direction. Examples include mass, distance, energy and speed.
speed	How fast something is moving. Often measured in metres per second (m/s), miles per hour (mph) or kilometres per hour (km/h).
unbalanced forces	When the forces in opposite directions on an object do not cancel out, to there is a non-zero resultant force.
vector quantity	A quantity that has both a size and a direction. Examples include force, velocity, displacement, momentum and acceleration.
velocity	The speed of an object in a particular direction. Usually measured in metres per second (m/s).
centripetal force	A force that causes objects to follow a circular path. The force acts towards the centre of the circle.
mass	A measure of the amount of material there is in an object. The units are kilograms (kg).
weight	The force pulling an object downwards. It depends upon the mass of the object and the gravitational field strength. The units are newtons (N).
gravitational field strength	A measure of how strong the force of gravity is somewhere. It is the force on a 1 kilogram mass, so the units are newtons per kilogram (N/kg).
inertial mass	The mass of an object found from the ratio of force divided by acceleration. The value is the same as the mass calculated from the weight of an object and gravitational field strength.
action–reaction forces	Pairs of forces on interacting objects. Action–reaction forces are always the same size, in opposite directions, and acting on different objects. They are not the same as balanced forces.
balanced forces	Forces acting on the same object. Balanced forces are always equal, in opposite directions, and always act on the same object. They do not have to be the same type of force An object acted on by balanced forces will not change the way it is moving..
equilibrium	When a situation is not changing because all the things affecting it balance out.
conservation of momentum	The total momentum of moving objects before a collision is the same as the total momentum afterwards, as long as no external forces are acting.
momentum	The mass of an object multiplied by its velocity. Momentum is a vector quantity, with units kilogram metres per second (kg m/s).
kinetic energy	A name used to describe energy when it is stored in moving things. The amount of energy stored depends on the mass of the object and on its speed (or velocity) squared.
work done	The energy transferred when a force acts through a distance to move an object or change its speed. It is calculated using the size of the force and the distance moved in the direction of the force. The unit for work done is the joule (J).
acceleration	A measure of how quickly the velocity of something is changing. It can be positive if the object is speeding up or negative if it is slowing down.

Newton's First Law of motion can be written as:

- a moving object will continue to move at the same speed and direction unless an external force acts on it
- a stationary object will remain at rest unless an external force acts on it.

The acceleration of an object is a measure of how much its velocity changes in a certain time. Sir Isaac Newton's Second Law of Motion describes the factors that affect the acceleration of an object.

The acceleration in the direction of a resultant force depends on:

- the size of the force (for the same mass, the bigger the force the bigger the acceleration)
- the mass of the object (for the same force, the more massive the object the smaller the acceleration).

Newton's Third Law is about the forces on two different objects when they interact with each other. This interaction can happen:

- when objects touch, such as when you sit on a chair
- at a distance, such as the gravitational attraction between the Earth and the Moon.

On Earth the **gravitational field strength** has a value of about 10 newtons per kilogram (N/kg). This means that each kilogram is pulled down with a force of 10 N. The gravitational field strength is different on other planets and moons.

The weight of an object can be calculated using the following equation:

weight = mass × gravitational field strength
(N)   (kg)   (N/kg)

This is often written as: $W = m \times g$

Momentum is calculated using this equation:

momentum = mass × velocity
(kg m/s)   (kg)   (m/s)

This can also be written as $p = m \times v$, where p stands for momentum.

Momentum and acceleration

Table C shows two equations involving acceleration. These can be combined to give:

$$\text{force} = \frac{\text{mass} \times \text{change in velocity}}{\text{time}} \quad \text{or} \quad \frac{m(v - u)}{t}$$

where v is the final velocity and u is the starting velocity.

As mass × velocity is the momentum of an object, this equation can also be written as:

$$\text{force} = \frac{\text{change in momentum}}{\text{time}} \quad \text{or} \quad \frac{mv - mu}{t}$$

H Momentum and collisions

When moving objects collide the total momentum of both objects is the same before the collision as it is after the collision, as long as there are no external forces acting. This is known as **conservation of momentum**. Remember, momentum is a vector so you need to consider direction when you add the quantities together. If two objects are moving in opposite directions, we give the momentum of one object a positive sign and the other a negative sign.
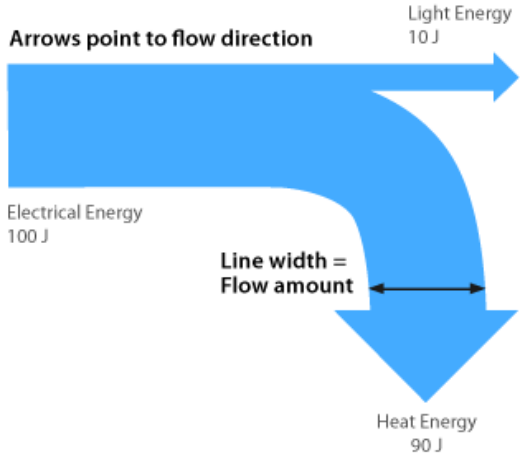

before collision

after collision
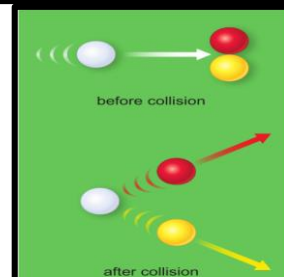
D The total momentum of the two coloured balls will be the same as the momentum of the white ball that hit them.

Conservation of Energy

Energy Type	Example
Light Energy	Sun, light bulb, torch
Thermal Energy (heat)	Oven, electric fire
Sound Energy	Radio, speakers, TV
Electrical Energy	Electric car, laptop
Nuclear Energy	Nuclear power station, nuclear bomb
Chemical Energy	Food, batteries, coal
Gravitational Potential Energy	Book on a shelf, boulder on a cliff
Elastic Potential Energy	Bow, wind-up toy, stretch spring
Kinetic Energy (movement)	Person running, rolling ball

Arrows point to flow direction
Light Energy 10 J
Electrical Energy 100 J
Line width = Flow amount
Heat Energy 90 J

heating	Put more jumpers on and turn off central heating
Hot water	Take showers, only boil the amount of water you need
Electrical appliances	Turn off devices that are on standby
Washing clothes	Air dry clothes, wash on a lower temperature
Heat lost from home	Install insulation – double glazing, loft/floor insulation

Energy Efficiency = Useful energy/total energy input

|		
Renewable Energy	Quickly replenishes its energy used. Infinite	Wind power, solar power, hydroelectric power, tidal power, geothermal power, biomass
Non-renewable Energy	Is finite (will run out). Does not quickly replace energy used	Fossil fuels – coal, oil and natural gas Nuclear power

Energy Source	Advantages	Disadvantages
Fossil Fuels	Cheap to set up, power stations already present	Limited (will run out), causes pollution – greenhouse gases and gases that make acid rain, running costs
Nuclear power	Does not produce carbon dioxide or sulphur dioxide	Finite (will run out) danger from radioactive material
Wind power	Infinite, cheap to run, no pollution, cheap to run	Costly to build, only works when windy, noisy and ugly
Tidal power	Good for islands, potential to generate lots of energy, reliable – tide will always go in and out, doesn't release pollution	Costs a lot to build, hard to find suitable locations, could damage environment
Solar power	Infinite, building can have their own power supply, doesn't release pollution, cheap to run	Expensive to set up, only works when sunny
Geothermal power	Doesn't create any pollution, potentially infinite	Expensive to set up, only works in volcanic areas, volcanic activity may stop making station useless
Hydroelectric power	Doesn't create pollution, creates water reserves	Costly to build, can cause flooding, can have major ecological impacts
Biomass	Cheap, if replaced can be sustainable	Burning releases atmospheric pollution, replanting required

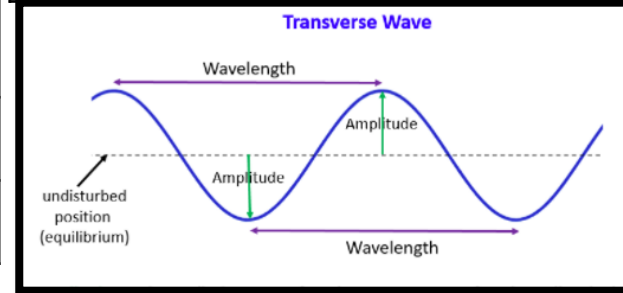| Keyword	Definition
Chemical	Energy store that is emptied during chemical reactions when energy is transferred to the surroundings.
Conduction	The transfer of heat by passing on energy (or electrical charge) to nearby particles.
Convection	The process by which heat travels through fluids (gases and liquids).
Elastic potential	An energy store that is filled when a material is stretched or compressed.
Electrical	Energy store resulting from the movement of electrical charge (electrons).
Energy	This is the ability to make something happen when it is transferred.
Gravitational potential	Energy store that is filled when an object is raised.
Joule	Unit of energy, represented by the symbol J.
Kinetic	An energy store filled when a moving object speeds up.
Light	A form of radiation that can transfer energy in a wave.
Non-renewable	An energy resource that will be used up, and not replenished in our lifetime.
Nuclear	An energy store associated with nuclear interactions.
Radiation	Radiation is the transfer of internal energy in the form of electromagnetic waves. This radiation lies in the infrared region of the electromagnetic spectrum. It does not require particles to move, it can travel through a vacuum.
Renewable	An energy resource that can be readily replenished in our lifetime.
Sound	A form of energy transferred by sound waves.
Thermal	An energy store that is filled when an object is heated.
Transformation	Energy transformation is the process of changing one form of energy to another.

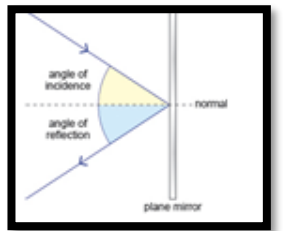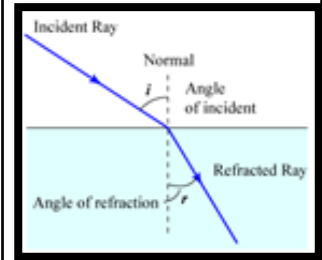|	
Wave	Vibrations that transfer energy from place to place.
Transverse	A wave where the vibrations are at right angles to the direction in which the wave is travelling.
Longitudinal	A wave where the vibrations are parallel to the direction in which the wave is travelling.
Frequency	The number of vibrations (or the number of waves) per second, measured in hertz.
Period	The time taken for one complete wave to pass a point. It is measured in seconds.
Wavelength	The distance between a point on one wave and the same point on the next wave.
Amplitude	The size of vibrations or the maximum distance a particle moves away from it resting position when a waves passes.
Refraction	The change in direction when a wave goes from one medium to another.
Normal	An imaginary line drawn at right angles to the surface of a mirror or lens where a ray of light hits it.

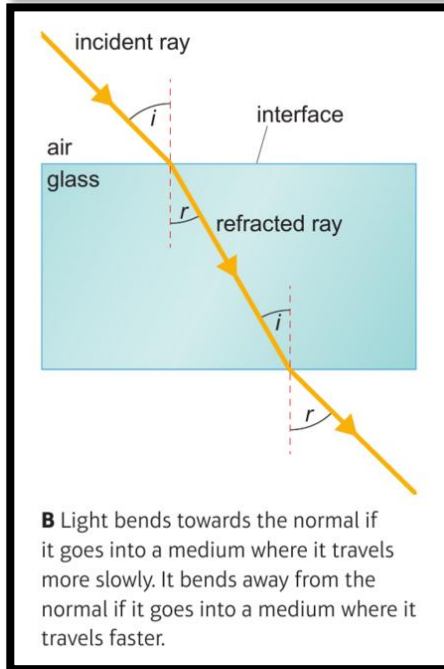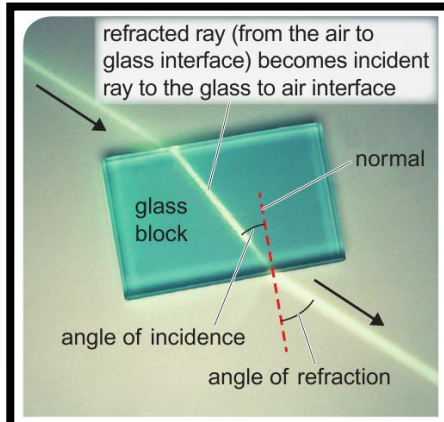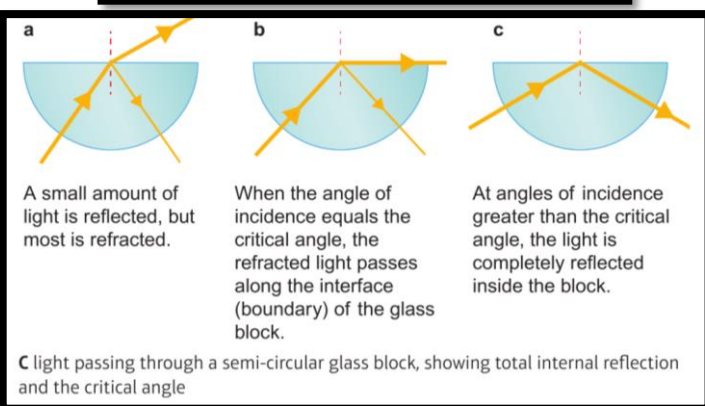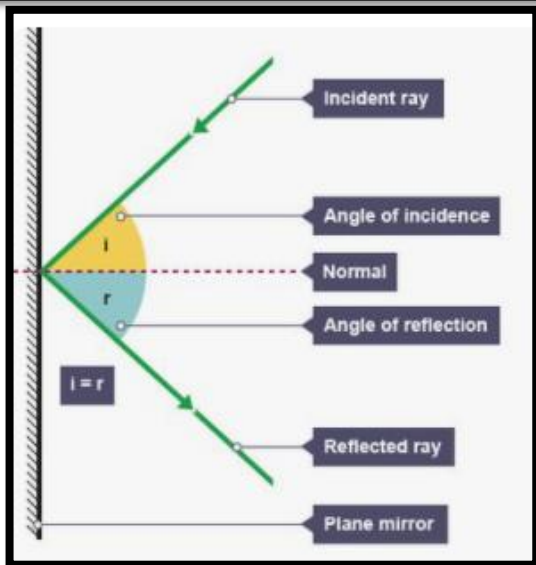| Frequency	The number of waves pass a point in a second.	Higher frequency = more energy transferred	Increasing frequency = higher pitch
Amplitude	Maximum disturbance from its undisturbed position.	Increasing amplitude increases energy transferred	Increasing amplitude = increase in volume
Wavelength	The distance between a point on one wave and the same point on the next wave.	Increasing wavelength = decrease energy transferred	

Longitudinal Wave vs. Transverse Wave
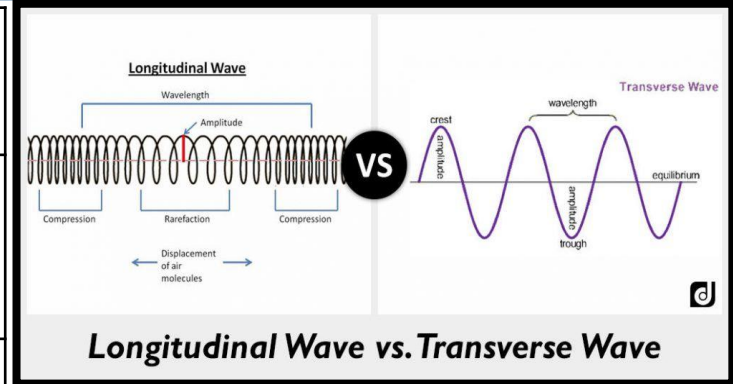
Longitudinal	Transverse
Particles oscillate (vibrate) in the direction of the wave's movement	Particles oscillate (vibrate) at right angles to the direction of the wave movement
Sound waves, ultrasound	Electromagnetic waves (light), water waves

Transverse Wave

	Description	Diagram
Reflection = light bouncing off a surface	Light waves reflect from surfaces. When waves reflect, they obey the law of reflection: the angle of incidence equals the angle of reflection.	
Refraction = light bends	Waves change speed when they pass across the boundary between two substances with different densities, such as air and glass. This causes them to change direction and this effect is called refraction.	

Wave Formula

Wave speed = wavelength x frequency

Wave speed is measured in meters per second (m/s)	Wavelength is measured in meters (m)	Frequency is measured in Hertz (Hz)

Example

Dylan is standing on the end of a pier. He measures the water waves going past him. The wavelength of each wave is 1.3m. He counts 2 waves every second. Find the wave speed

Wave speed = frequency x wavelength

Wave speed = 2 x 1.3

= 2.6 m/s

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Peak | Amplitude | Wavelength
Rest position | Trough | Wavelength | Wavelength

refracted ray (from the air to glass interface) becomes incident ray to the glass to air interface

normal

glass block

angle of incidence

angle of refraction

Incident ray
Angle of incidence
Normal
Angle of reflection
i = r
Reflected ray
Plane mirror

incident ray

interface

air
glass

refracted ray

B Light bends towards the normal if it goes into a medium where it travels more slowly. It bends away from the normal if it goes into a medium where it travels faster.

a | b | c

A small amount of light is reflected, but most is refracted.

When the angle of incidence equals the critical angle, the refracted light passes along the interface (boundary) of the glass block.

At angles of incidence greater than the critical angle, the light is completely reflected inside the block.

C light passing through a semi-circular glass block, showing total internal reflection and the critical angle

Separates only. Total internal reflection and critical angle.
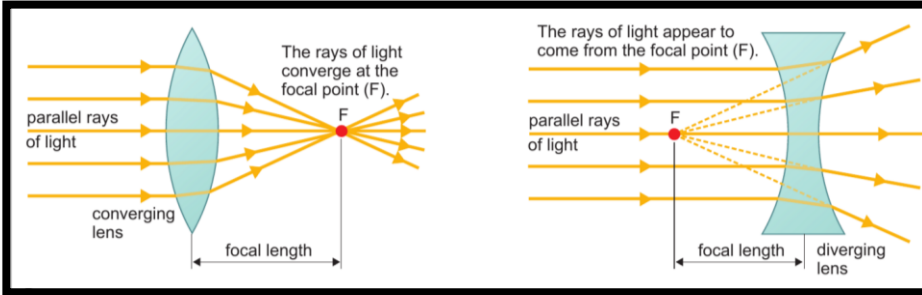
Angle of incidence (i)	The angle between incidence ray and the normal.
Angle of refraction (r)	The angle between normal and the refracted ray.
Separates only - Critical angle	The angle at which total internal reflection happens. In a glass block this is 42°.
Separates only - Diffuse reflection	Reflected light scattered in all directions
Electromagnetic radiation	Form of energy transfer including radio waves, microwaves, infrared, visible light, ultraviolet, x-rays and gamma rays.
Electromagnetic spectrum	The entire frequency range of electromagnetic waves.
Electromagnetic waves	A group of waves that all travel at the same speed in a vacuum, and all are transverse.
Incident ray	The light ray approaching the interface (mirror edge, or edge of a perspex block)
(H) Oscillations	Movement backward and forward
Radiotherapy	Medical technique to kill cancer cells using gamma rays.
Ray diagram	A diagram that models what happens when light is reflected or refracted.
Refracted ray	The light ray that leaves a material like a glass Perspex block. This ray has changed direction.
Separates only - Specular reflection	Light is evenly reflected from smooth surfaces such as a mirror surface.
Separates only – Total internal refection	When a ray of light is shone into a curved glass block and when the angle (critical angle) has been achieved to allow all the light to be completely reflected inside the glass.
Transverse waves	Vibrations are at right angles to the direction in which the wave is travelling

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KS4 Physics – Light and EM Spectrum (part 2)

Specular reflection

Diffuse reflection

shortest wavelength
highest frequency

longest wavelength
lowest frequency

10^{-12} m 10^{-9} m 10^{-6} m 10^{-3} m   1 m 10^3 m

gamma rays   X-rays   ultra violet   infrared   micro-waves   radio waves

visible light

wavelengths within the spectrum are put into groups

B the electromagnetic spectrum (not to scale)
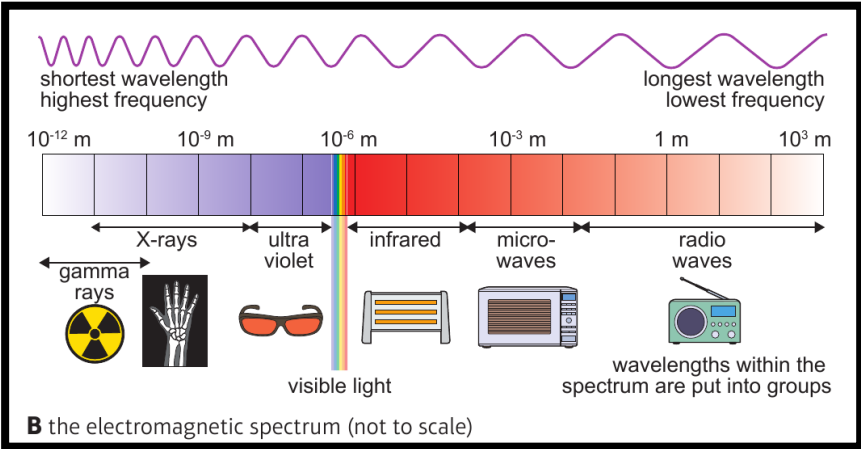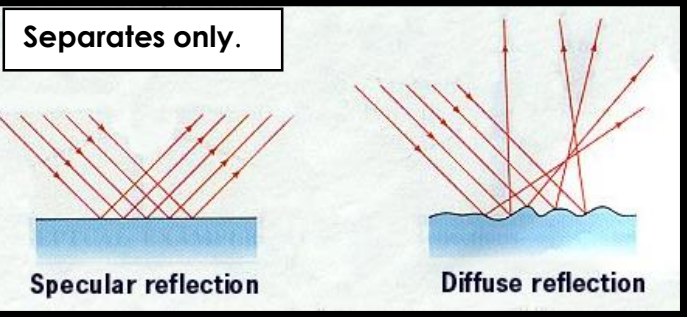
A **converging lens** is fatter in the middle than at the edges. It makes parallel rays of light converge (come together) at the **focal point**. The **focal length** is the distance between the focal point and the centre of the lens. A **diverging lens** is thinner in the middle than at the edges. The focal point is the point from which the rays seem to be coming after passing through the lens.

The rays of light converge at the focal point (F).

parallel rays of light

converging lens

focal length

The rays of light appear to come from the focal point (F).

parallel rays of light

focal length   diverging lens

Long wavelength, low frequency	Uses	Dangers
Visible light	Light bulbs, our eyes detect it	From a laser can damage the retina in the eye
Infrared	Communication – TV remote, grills, toasters	Felt as heat, and can cause skin to burn
Microwaves	Communications, mobile phones, microwave for food	Can cause internal heating of body tissue
Radio waves	Radio broadcast, communications	Very large doses can cause cancer

Short wavelength, high frequency	Uses	Dangers
Ultraviolet	Used to kill microorganisms in water, detecting forge bank notes	Too much exposure can lead to skin cancer
X-rays	Hospitals – to check for broken bones	High frequency, transfer a lot of energy and can penetrate the body. Excessive exposure may cause DNA mutation, possibly leading to cancer.
Gamma rays	Cancer treatment, sterilising hospital equipment	High frequency, transfer a lot of energy and can penetrate the body. Excessive exposure may cause DNA mutation, possibly leading to cancer.

Heat transfer by radiation - Heat can be transferred by infrared radiation. Unlike conduction and **convection** - which need the vibration or movement of **particles** - **infrared radiation** is a type of electromagnetic radiation. When infrared radiation is absorbed by an object it is heated and its temperature rises.
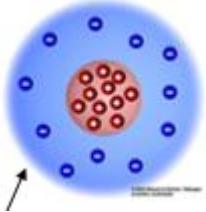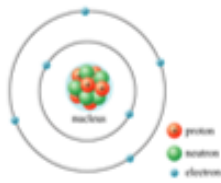
•Dark matt surfaces are better at absorbing heat energy than light shiny surfaces.
•Dark matt surfaces are better at radiating heat energy than light shiny surfaces.

Surface	Absorption	Emission
Dull, matt or rough	Good absorber of heat radiation	Good emitter of heat radiation
Shiny	Poor absorber of heat radiation	Poor emitter of heat radiation

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Dalton's model	Plum Pudding - Thomson	Rutherford	Bohr/Chadswick
John Dalton thought that all matter was made of tiny particles called atoms, which he imagined as tiny spheres that could not be divided.	Thomson carried out experiments and discovered the electron. This led him to suggest the plum pudding model of the atom. In this model, the atom is a ball of positive charge with negative electrons embedded in it.	Rutherford suggested a new model for the atom, called the nuclear model. In the nuclear model: the mass of an atom is concentrated at its centre, the nucleus the nucleus is positively charged	Bohr did calculations that led him to suggest that electrons orbit the nucleus in shells. The shells are at certain distances from the nucleus. Chadwick found evidence that the nucleus contains no charged particles called the neutron.

Term	Definition
Atomic number (also called proton number)	Number of protons in an atom
Background radiation	Naturally radioactive substances in the environment that produce radiation.
Becquerels (Bq)	Unit to measure radioactivity. One Bq is one nuclear decay each second.
Count rate	Number of clicks on a GM tube when radiation is detected. It is the amount of radiation per second or minute.
Elements	Substances that contain the same type of atoms
Geiger-Muller (GM) tube	An instrument to measure radioactivity.
Half-life	Time taken for half the unstable nuclei in a sample of a radioactive isotope to decay.
Isotopes	Atoms of a single element that have different numbers of neutrons, but same number of protons.
Kinetic theory	Model that helps explains the properties of solids, liquids and gases.
Mass number (also called nucleon number)	Total number of protons and neutrons.
Nucleons	Smaller particles that make up the nucleus.
Neutrons	Sub-atomic particle found in the nucleus, with no charge.
Particle theory	Model that helps explains the properties of solids, liquids and gases.
Protons	Positively charged sub-atomic particle found in the nucleus.
Subatomic particles	Particles smaller than atom, and make up an atom. Protons, neutrons and electrons.

Atomic Mass - The number of protons & neutrons in the nucleus.

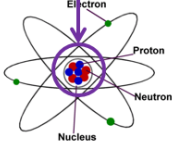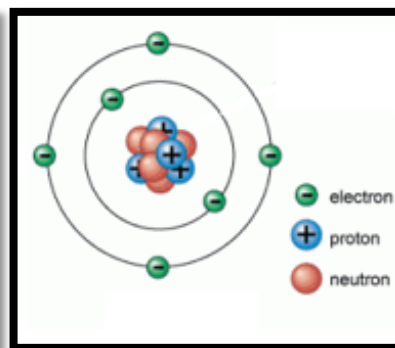**Atomic Number** - The number of just protons in the nucleus.

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The number of particles in the nucleus

C

Carbon
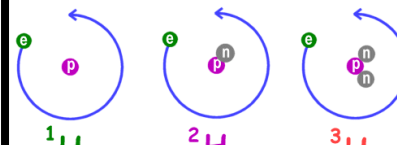
6

Number of protons = number of electrons

Atomic structure – protons and neutrons found in the nucleus. Electrons orbit the nucleus on electron shells.

	relative charge	relative mass
proton	+1	1
neutron	0 neutral	1
electron	-1	1 / 1840

Atoms of a single element that have different numbers of neutrons, but same number of protons.
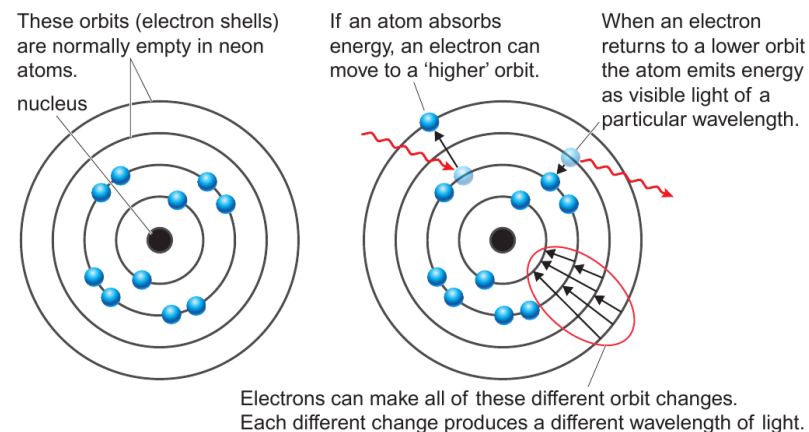

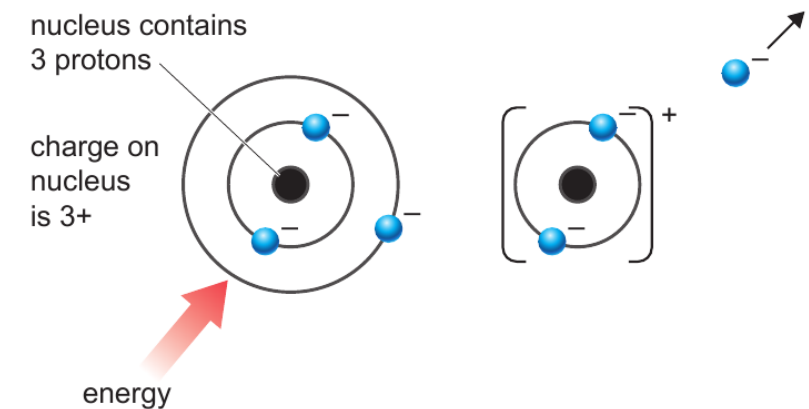Three Isotopes of Hydrogen

^1H Protium ^2H Deuterium ^3H Tritium

These orbits (electron shells) are normally empty in neon atoms.

nucleus

If an atom absorbs energy, an electron can move to a 'higher' orbit.

When an electron returns to a lower orbit the atom emits energy as visible light of a particular wavelength.

Electrons can make all of these different orbit changes. Each different change produces a different wavelength of light.

B electronic configuration and energy level changes for neon

nucleus contains 3 protons

charge on nucleus is 3+

energy

D ionisation of a lithium atom

Ionisation

Sometimes an atom gains so much energy that one or more of the electrons can escape from the atom altogether. An atom that has lost or gained electrons is called an **ion**. Radiation that causes electrons to escape is called **ionising radiation**.

Type of nuclear radiation

Property	Alpha	Beta	Gamma
What is it?	Nucleus of a helium atom	electron	EM waves
Charge	+2	-1	None
Mass	Relative 4	Relative 0 (1/1840)	None
Range in air	3-5cm	15cm	Long range
Penetration ability	Low, stopped by paper	Increased, stopped by aluminium or lead	Great slowed by concrete, lead
Ionising ability	Highly ionisinig	Fairly	Least ionising
Effects of a magnetic field	Deflected	Deflected	Unaffected
Effects of an electric field	Attracted to negative electrode	Attracted to positive electrode	Unaffected

Particle	Symbol	
Alpha	α	^4_2He
Beta	B⁻	$^0_{-1}e$
Positron	β⁺	$^0_{+1}e$
neutron		n

Dangers of radioactivity – can damage the DNA inside a cell. This damage is called mutation. Gene mutation that occur in gametes can be passed on to the next generation. Some mutations can cause cancer.
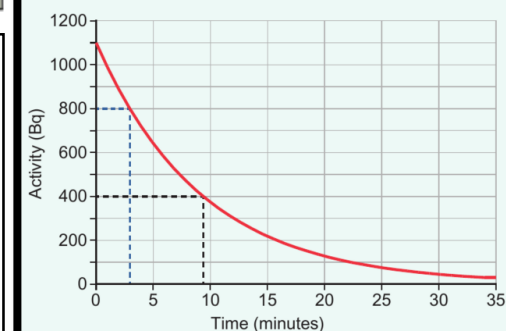
The penetration power of the three types of radiation.

α

β

γ

Skin or paper stops ALPHA

Thin aluminum stops BETA

Thick lead reduces GAMMA
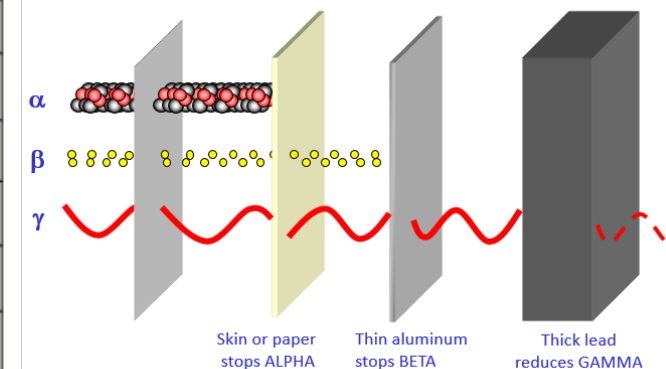
Worked example

In figure D, the activity at 3 minutes is 800 counts per second. After one half-life the count rate will have decreased to 400 counts per second.

This occurs at 9.5 minutes, so the half-life is 9.5 – 3 = 6.5 minutes.

**D** graph of activity against time for a radioactive substance

[Separates] Using radioactivity
- Killing microorganisms
- Radioactive detecting
- Diagnosing cancer - tracers
- Treating cancer
- Checking thickness of paper
- Smoke alarms – contains a source of alpha particles

[Separates] Radioactivity in medicine
- Radioactive materials are used to diagnose medical conditions without having to cut into a patient's body.
- Tracers that emit positrons – used to detect medical problems.
- - Treating cancer – external radioactivity which uses a beams of gamma rays, x-rays or protons directed at the tumour.

Life Cycle of Stars:
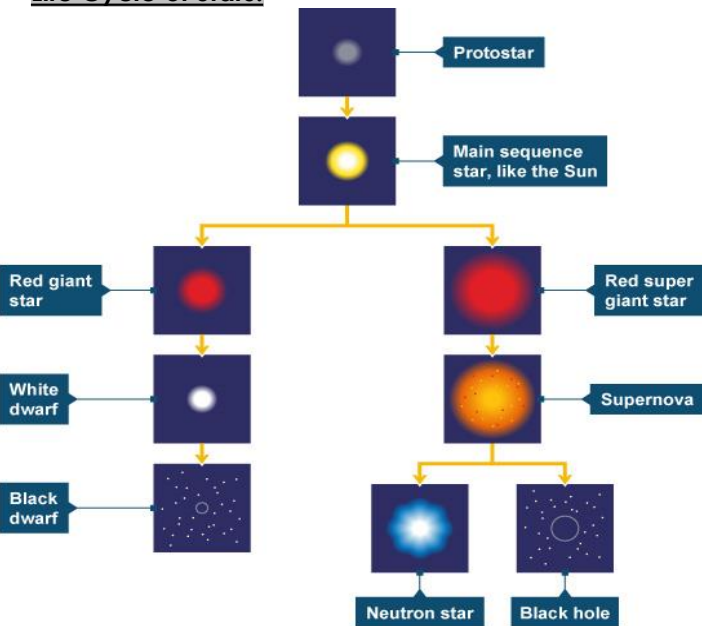
**Nebula:** Cloud of dust and gas from which stars are made.

Gravity and Thermal Pressure: The two forces that determine whether a star is stable (balanced), shrinking or growing.

Nuclear Fusion:
- process of nuclei combining that releases energy in a star
- in the main sequence Hydrogen fuses to make Helium
- requires huge pressure from gravity

Which path does a star evolves along?
- depends on mass
- stars like our sun become **Red Giants**
- **more massive** stars become
Red Super Giants.
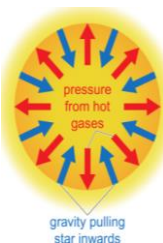
| Keyword	Definition
Solar System	Contains Sun, 8 planets, dwarf planets, comets, asteroids and meteors.
Protostar	A very young star that is still accumulating mass from its main molecular cloud.
Main Sequence Star	A star that merges hydrogen into its core/nucleus and has a stable balance of the external pressure of central nuclear fusion and the gravitational forces that push inward.
Red Giant	A dying star in the later stages of stellar evolution.
White Dwarf	They mark the evolutionary end point of mass stars from low to intermediate like our Sun.
Black Dwarf	All that remains after a white dwarf star burns all its heat but retains its mass.
Red Super Giants	A huge giant star that has consumed its core hydrogen reserve. Helium has accumulated in the nucleus and hydrogen is undergoing nuclear fusion in the outer layers.
Super Nova	The explosion of a star, the largest explosion that takes place in space.
Neutron Star	Created when giant stars die in supernovae, their nucleus collapses, and protons and electrons fuse together to form neutrons.
comet	Balls of ice and dust in elliptical orbits around the Sun.
asteroid	Made of rock and metal in orbit around the Sun between Mars and Jupiter.

The Solar System and Orbits:
Dwarf Planet: too small to be a planet
Orbit: A path of one object around another.
Satellite: Any object which orbits another.
Planetary orbits:
- occur because of **gravity** (acts on an object towards the centre of the more massive object).

not to scale
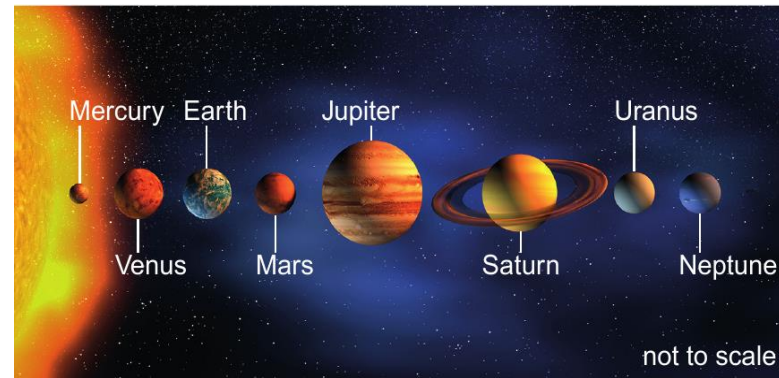
Weight and gravity:
- Your weight is a force of gravity acting on you.
- It depends on your mass and the **gravitational field strength** (g) of the earth. (g = 9.81 N/Kg)
- Weight (N) = mass (kg) x gfs (N/kg)

Models of Solar System:
1. Geocentric model:
- The earth is at the center of everything.

2. Heliocentric model:
- **Copernicus.**
- The sun at the center of universe.
- Evidence from **Galileo** using **telescopes** to observe **Jupiter's moons.**

3. Elliptical orbit:
- Most bodies in the solar system are in elliptical orbits.
- This is the current model.

Redshift:
- Suggests that the Universe is expanding.
- If a wave source is **moving** relative to an observer, there will be a change in the observed **frequency and wavelength**
- There is an increase in the wavelength of light coming from the galaxies.
- The **further away** the galaxy, the **more redshift,** the **faster** it is moving away.
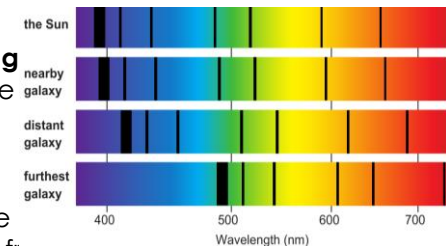
Creation of Universe Theories
1. Steady State
- The Universe has always existed, and is expanding
- As the universe expands, new matter is being constantly created.
Evidence:
- **Red shift** because galaxies are moving away from us.

2. The Big Bang Theory – accepted theory as there is **more evidence**
- the Universe began as a very tiny point of concentrated energy.
- The expansion is still going on.
Evidence:
- **Cosmic Microwave Background Radiation**: Left over radiation from the beginning of the Universe.
- **Redshift** because galaxies are moving away from us due to the continual expansion.

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Keyword	Definition	Units of measurement
Work done	The energy transferred by a force	Joules (J)

Keyword	Definition	Units of measurement
Power	The rate at which energy is transferred	**Watts (W)** or **Joules per second (J/s)**

work done = force × distance moved in the direction of the force
   (J)   (N)   (m)

This can be written as:

$E = F \times d$

where *E* represents work done

F represents force

d represents distance.

$$\frac{E}{F \times d}$$

B

$$power (W) = \frac{work\ done\ (J)}{time\ taken\ (s)}$$

This can be written as:

$$P = \frac{E}{t}$$

where *E* represents work done

P represents power

t represents time.

$$\frac{E}{P \times t}$$

E

Worked Example

Danny is moving a box weighing 200N. He pulls it 12m along a sloping floor using a force of 150N. Calculate the work done by Danny.

E = F x d

   = 150N x 12m

   = 1800J

> The force must be in the direction of movement

Crane A lifts a weight of 1000N a distance of 6m in 10second

Crane B lifts the exact same weight the exact same distance, but in **4 seconds**.

We can say that crane B is more powerful as it has done the same amount of work (lifted a force a certain distance), but has done so in less time.

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Forces can be placed into two groups. There are forces that act on contact and there are forces that act at a distance.

Contact Forces	Non-Contact Forces
Air Resistance	Gravity
Friction	Magnetism
Tension	Electrical Force
Normal Force	Nuclear Force

Force	A vector quantity	. A push or a pull on an object.
Contact forces	Two objects have to touch for the force to act. Interact at zero distance.	Caused by objects interacting. E.G. Friction, man pushing a wall, a book on a table, Upthrust of water on a boat.
Non-contact forces	Two objects do not have to touch for the force to act. Can interact at a distance.	Caused by interacting fields. E.G. Magnetic forces, electrostatic forces, gravitational forces.

When two children are on a see-saw the see-saw may be balanced and the children will not move. In this case the clockwise moment is balanced by the anti-clockwise moment – so the two moments are equal.

As both the clockwise moment and anti-clockwise moment are balanced:

$$F_c \, x_c = F_a \, x_a$$

Where the subscript denotes the direction (clockwise or anti-clockwise).

Free body force diagrams	A diagram showing all the forces acting on an isolated object or a system	The size and direction of the pairs of forces acting upon an object or system.
Resultant force	Forces acting along the same line	Add together the forces acting in the same direction. Subtract the forces acting in opposite directions.
Vector diagrams	A diagram where forces do not act in the same line. Use scale diagrams to find the resultant force	Draw all the forces acting upon an object. Make sure they are to scale and in the right directions. Draw a joining line rom the start of the first force and the end of the last force.

Moments: A force or a system of forces may cause an object to rotate.

Everyday examples of force causing a rotation motion include door handles, steering wheels and see-saws.

The turning effect of a force is called the moment of the force. The size of the moment is determined by the equation:

moment of a force (Nm) = force (N) × distance (m)

M = F x x

The distance, x, is normal to the direction of the force

Levers are used to increase the force applied to an object, usually to lift it up from a surface. Levers must have a pivot to rotate around and will work on the principle of moments.

A gear is a wheel that has teeth on it (also known as a cog), as shown in the diagram opposite. For gears to do work you need at least two gears. Gears are used to transmit rotational forces from one place to another
.

When two cogs are in contact with their teeth interlocking, the driven cog will rotate in the opposite direction to the drive cog. If the drive cog in a gear spins clockwise then the driven cog will spin anti-clockwise.

When a large cog is driving a small cog, then the small cog will rotate faster than the large cog. Halving the number of teeth on the small cog will double the speed of the small cog. Going from a large cog to a smaller cog will increase the speed of rotation.
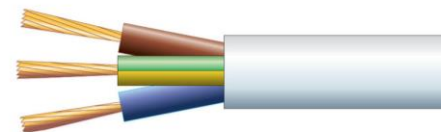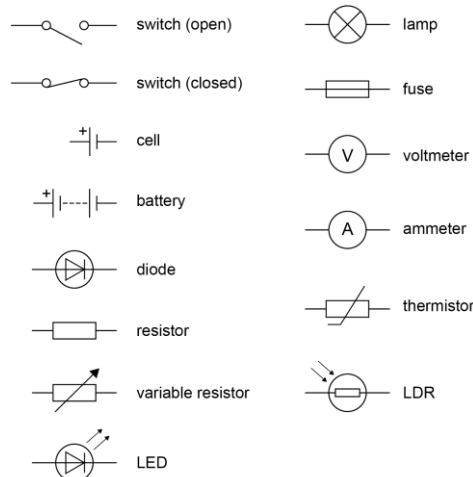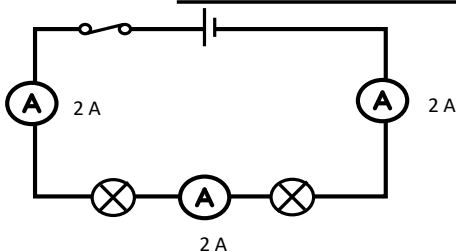
SPEED 1
SPEED 2

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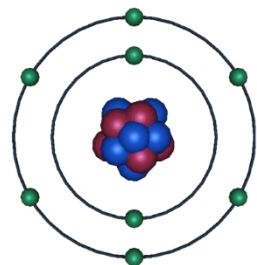
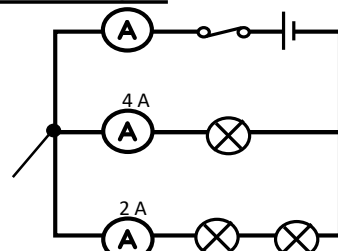|	Mass	Charge	Location
Proton	1	+ (positive)	nucleus
Neutron	1	no charge	nucleus
Electron	1/1835 negligible	- (negative)	shells

Useful formulas

- energy transferred (J) = charge moved (C) x potential difference (V) $E = Q \times V$
- charge (C) = current (A) × time (s) $Q = I\,t$
- potential difference = current × resistance
- energy transferred = current × potential difference × time $E = I \times V \times t$
- electrical power (W)= potential difference (V) x current (A) $P = V\,I$
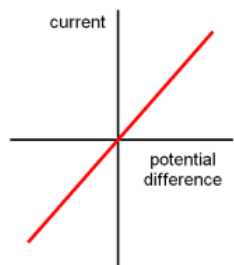- power = current squared x resistance $P = I^2\,R$
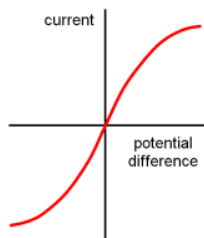
Current in series and parallel circuits

At the junction:
current in = current out
6 A = 4 A + 2A

Circuit symbols:
- switch (open)
- switch (closed)
- cell
- battery
- diode
- resistor
- variable resistor
- LED
- lamp
- fuse
- voltmeter
- ammeter
- thermistor
- LDR

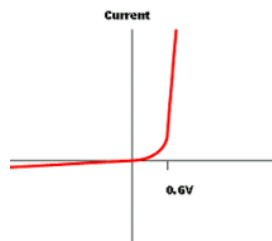| Name	Colour	Function
live	brown	Carries alternating potential difference from the supply.
neutral	blue	Completes the circuit.
earth	yellow/green	Safety wire to stop appliance becoming live.

Ohmic Conductor

Non-Ohmic Conductors: Filament Lamp

Non-Ohmic Conductors: Diodes

Non-Ohmic Conductors: Thermistors and LDRs

Keyword	Definition
Current	The rate of flow of charge in a circuit.
Potential Difference	Also called voltage. The difference in potential between two points of a circuit. Causes a current to flow.
Charge	Charge is the amount of electricity travelling through a circuit.
Resistance	Anything that slows the flow of charge around a circuit. Resistance is usually caused by electrons colliding with ions in a material.
Series Circuit	A circuit with a single loop of wire.
Parallel Circuit	A circuit with two or more loops (branches) of wire.
Variable resisitor	A variable resistor is a component where the resisitance changes as you slide the connector along it. It can be used to investigate how the resisitance of the lamp changes as you change the resisitance.
Ohm's Law	the current through an ohmic conductor (at a constant temperature) is directly proportional to the potential difference across the resistor
Ohmic Conductors	Ohmic conductors will produce a straight line I – V graph that goes through the origin.
Non-Ohmic Conductors	The resistance of components such as lamps, diodes, thermistors and LDRs is not constant. It changes with the current through the component.

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Example of Static Electricity

1. The balloon has a negative charge.
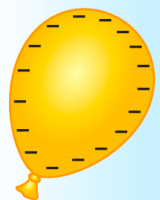
wall
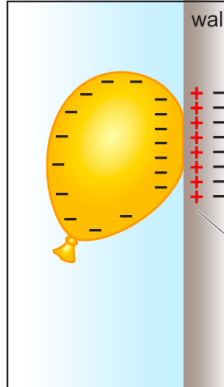
2. As the balloon is brought towards the wall, the electrons in the wall are repelled and move away.

wall

3. The positive charge left behind (the induced charge) attracts the negative charge on the balloon.

Electric fields – a charged object has a force field around it called an electric field (or electrostatic field)
Field lines 1. Never cross, 2. show where the field is strongest (lines are closest), 3. Show the direction of the force on a charge in the field. 4. Go from positive to negative – if only 1 object they keep going and become more widely dispersed.

positive

electric field

charged plates

negative

x y z
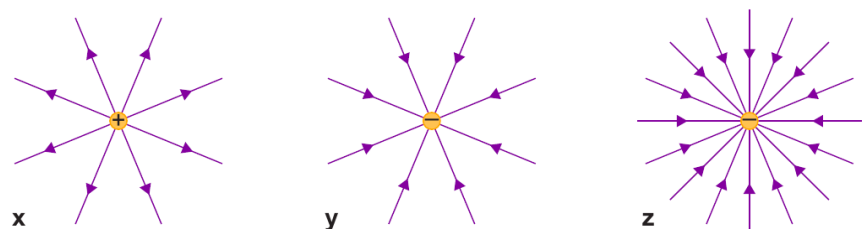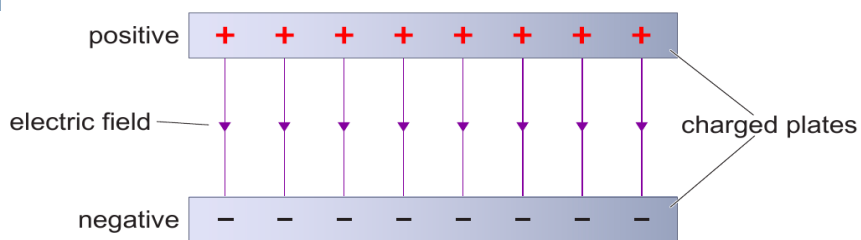
A an electric field around positive and negative point charges **Separate only**

Dangers of static electricity
Risk of discharge/sparks. Could lead to fire. Solution and to prevent sparks – earth wire is used to disperse electricity into the ground.

Sparks are a problem when refueling an aircraft, which often becomes charged when flying through the air.

connect to earth

bonding line

Uses of Static Electricity
Electrostatic spraying makes use of static electricity. Use of charged particles for painting, applying pesticides. Particles spread out due to repulsion, and are then attracted to a surface via induction.
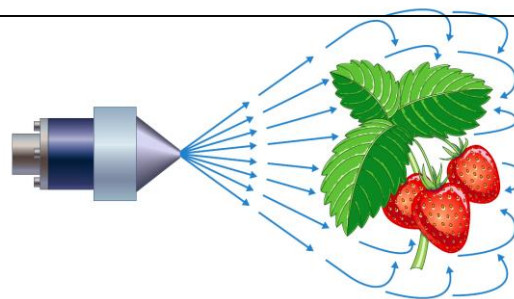
Keyword	Definition
Static Electricity	Electric charge on insulating materials
Conductor	Material that does conduct electricity.
Insulator	Material that does not conduct electricity.
Electric Charge	Electric charge is a fundamental property of a material that causes a force to be experience when in a magnetic field
Acetate	An insulator that can be used to build up a static charge by friction.
Induction	To create, for example build up of a current in a wire in a magnetic field.
Discharge	Is the release of electricity, commonly via a spark.
Electrostatic	A force of attraction between oppositely charged particles and repulsion between like charges.
Force field	The space around something where a non-contact force affects things, e.g magnetic and gravitational fields.
Field line	The field lines are perpendicular to the surface of the charge. The magnitude of charge and the number of field lines, both are proportional to each other.

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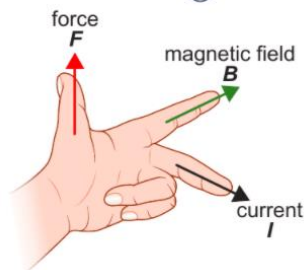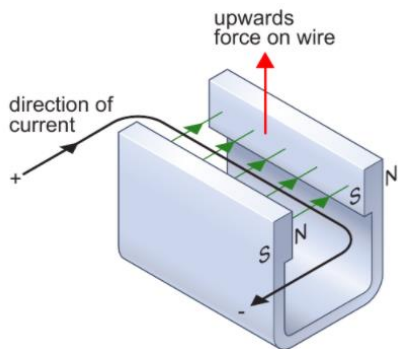| Keyword	Definition
Magnet	An object that has its own magnetic field around it.
Magnetic field	The area around a magnet where it can affect magnetic materials or induce a current.
Permanent magnet	A magnet that is always a magnet such as a bar magnet.
Solenoid	A coil of wire with electricity flowing in it. Also called an electromagnet.
Motor Effect	The force experienced by a wire carrying a current that is placed in a magnetic field.
Magnetic flux density	A way of describing the strength of a magnetic field. Measured in Teslas (T).
Split ring commutator (HT)	This reverses the direction of the current in the coil each half turn. This allows the motor coil to rotate continuously in one direction.

Maxwell's Right Hand Grip rule
A circular magnetic field forms around a current carrying wire. If you point your right thumb in the direction of the current (+ to -), the magnetic field goes in the direction your fingers are pointing.

direction of magnetic field

direction of current
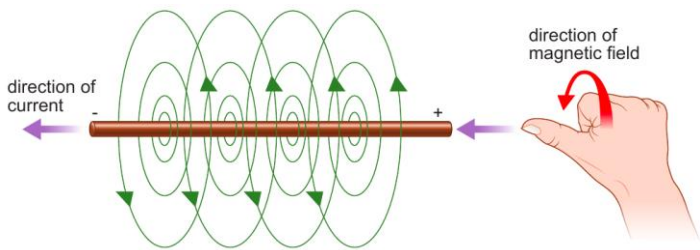
A current flowing through a wire causes a magnetic field. Electric motors and other devices depend on the magnetic effect of electric currents.

Fleming's Left Hand Rule (HT)
The motor effect describes the force that acts on a current carrying wire in a magnetic field.

upwards force on wire

direction of current

force F

magnetic field B

current I

Earth's magnetic field
A plotting compass can also show the Earth's magnetic field.

The behaviour of compasses is evidence that the Earth has a magnetic field, which is similar in shape to the magnetic field of a bar magnet.

magnetic pole

outer core

North Pole

South Pole

magnetic pole

Magnetic field diagrams (HT)
Magnetic field flows from north to south. Also around a current carrying wire.

force on wire
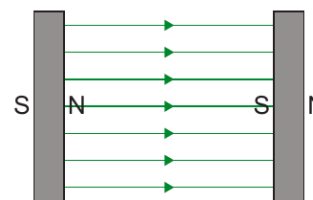
Two flat magnets produce a uniform magnetic field between them.
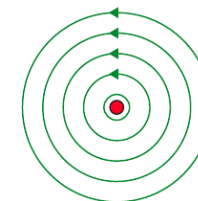
A magnetic field goes around a wire carrying a current.
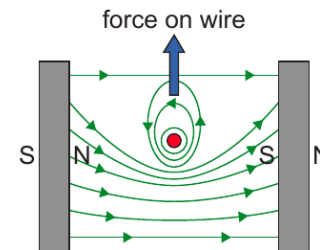
When the wire carrying a current is put between the magnets, the two fields interact to produce a force.

KS4 Physics Electromagnetic Induction

Inducing a potential difference
A potential difference can be induced (created) in a **conductor** when there is movement between the conductor and a magnetic field. This can occur in two different ways:
- a coil of wire is moved in a magnetic field
- a magnet is moved into a coil of wire

This is called **electromagnetic induction** and is often referred to as the **generator effect**.

The direction of the induced potential difference or induced current depends on the direction of movement. The current is reversed when:
- The magnet is moved out of the coil
- The other pole of the magnet is moved into the coil

An induced potential difference or induced current will increase if:
- The speed of movement is increased
- The magnetic field strength is increased
- The number of turns on the coil is increased

Transformers and how they work

ac input   ac output

Primary coil   Magnetic field in core   Secondary coil
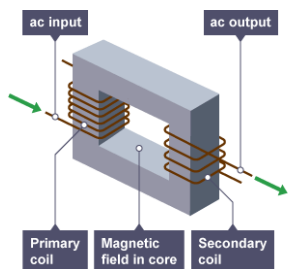
1. A primary voltage drives an **alternating current** through the primary coil.
2. The primary coil current produces a magnetic field, which changes as the current changes.
3. The iron core increases the strength of the magnetic field.
4. The magnetic field passes through (or cuts) the secondary coil.
5. The changing magnetic field induces a changing potential difference in the secondary coil.
6. The induced potential difference produces an alternating current in the external circuit.

Transformer Calculations

The primary coil of a transformer has a current of 0.5 A with a potential difference of 100 V. The current in the secondary coil is 25 A. What is the potential difference across the secondary coil? Use $V_p \times I_p = V_s \times I_s$

$100\,V \times 0.5\,A = V_s \times 25\,A$

$50 = V_s \times 25$

$V_s = \dfrac{50}{25} = 2\,V$

A radio runs off the 230 V mains supply but only needs 23 V. Its transformer has 100 turns of wire in the primary coil. How many turns are needed in the secondary coil?

$\dfrac{V_p}{V_s} = \dfrac{N_p}{N_s}$

$\dfrac{230\,V}{23\,V} = \dfrac{100}{N_p}$

$10 = \dfrac{100}{N_p}$

$10 \times N_p = 100$

$N_p = \dfrac{100}{10} = 10$

So the secondary coil must have 10 turns.

Keyword	Definition
A.C	Alternating current, current that flow in both directions
Alternator	An electrical generator which produces alternating current
Conductor	Electrical conductors are materials that have low resistance and allow current to pass through them easily
Dynamo	An electrical generator which produces direct current
Electromagnetic Induction	The production of potential difference (voltage) when a conductor e.g. wire moves through a magnetic field. If the conductor is part an electric current, an induced current will flow
Generator	Device that converts kinetic energy into electrical energy
Generator Effect	When motion between a conductor and a magnetic field creates electricity, i.e. a magnet is moved into a coil of wire.
Magnetic Field	Area surrounding a magnet that can exert a force on magnetic materials
National Grid	The network that connects all of the power stations in the country to make sure that everywhere has access to electricity.
Potential Difference	The potential difference (or voltage) of a supply is a measure of the energy given to the charge carriers in a circuit. Units = volts (V). This is the voltage between two points that makes an electric current flow between them.
Power	The energy transferred each second, measured in watts (W). Power = work done ÷ time taken.
Transformer	An electrical device that increases, or decreases, the potential difference (voltage) of an alternating current.

Solid — Melting / Freezing or solidifying — Liquid — Evaporating or boiling / Condensing — Gas
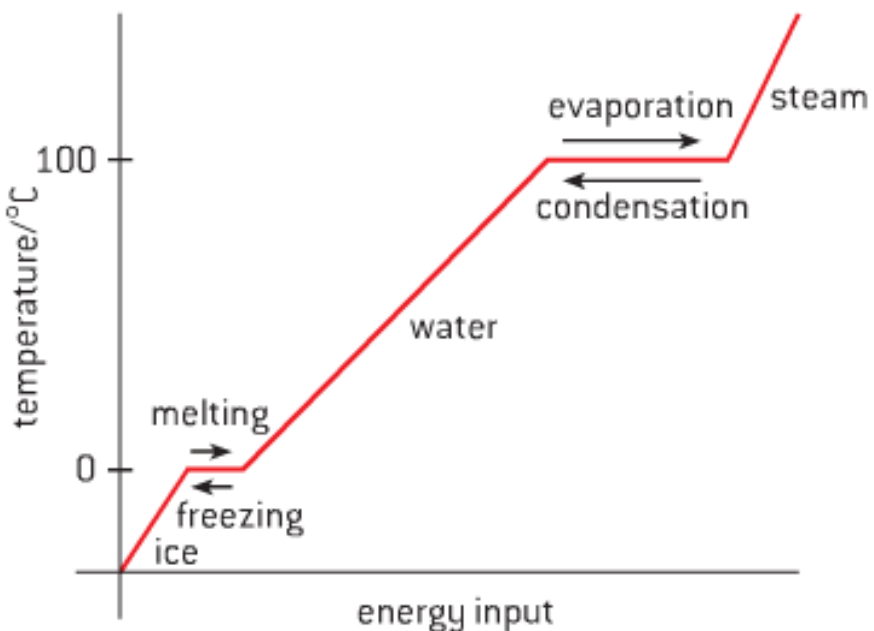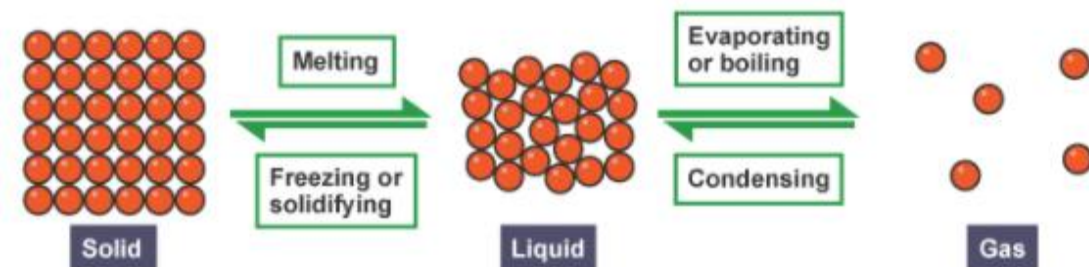
Particles and pressure:
The pressure of a gas is due to the forces on the walls of the container, caused by the moving particles hitting the walls. The faster the particles are moving, the more frequent the collisions will be and the more force they will exert when they collide.
The faster the average speed of the particles in a gas, the higher the temperature of the gas.
The higher the temperature, the higher the pressure.

Worked example

What is the boiling point of water in kelvin?

boiling point = 100 °C + 273 = 373 K

To convert from kelvin to degrees Celsius, subtract 273.

To convert from degrees Celsius to kelvin, add 273.

When a substance undergoes a **change of state** the particles end up in a different arrangement. There are the same number of particles so the mass stays the same (mass is **conserved**). This is a **physical change**, because no new substances are formed and the substance recovers its original properties if the change is reversed. Mass is also conserved in **chemical changes**, but the change in the substances often cannot be reversed.

| Key word	Definiton
Sublimation	When a solid turns straight into a gas without becoming a liquid first
State of matter	One of three different forms a substance can have: solid, liquid, gas
Change of state	Adding or removing energy to change the arrangment of particles in a material
Physical change	A reversible change in a substance
Chemical change	An irreversible change in a substance
Density	The mass of a certain volume of a substance
Specific heat capacity	The amount of energy it takes to make 1kg of a substance by 1°C
Specific latent heat	The amount of energy it takes to make 1kg of substanc change state
kinetic theory	The model that explains the properties of different states of matter in terms of movement of particles
Conserved	A quantity that is kept the same throughout
Joule (J)	A unit for measuring energy
Kelvin (K)	The unit in the Kelvin temperature scale. One kelvin is the same temperature interval as 1° C
Pascals (Pa)	The units for pressure

ρ = m / v

Density (g/cm^3) = $\frac{mass\ (g)}{volume\ (cm^3)}$

ΔQ = m × c × $\Delta\theta$

change in thermal energy (J) = mass (kg) × specific heat capacity (J/kg°C) × change in temperature (°C)

Q = m × L

thermal energy for a change of state (J) = mass (kg) × specific latent heat (J/kg)

Core Practical: Investigate the densities of solids and liquids
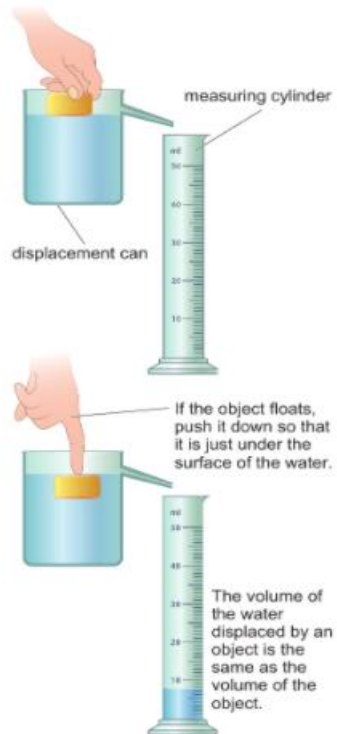
Method

Liquids

A Put an empty beaker on a balance, and set the balance to zero.

B Use a measuring cylinder to measure 50 cm³ of a liquid and then pour it into the beaker. Write down the reading on the balance. This is the mass of 50 cm³ of the liquid.

Solids

C Find the mass of the solid and write it down.

Diagram B shows how to find the volume of an irregular shape:

D Stand a displacement can on the bench with its spout over a bowl. Fill it with water until the water just starts to come out of the spout.

E Hold a measuring cylinder under the spout and carefully drop your object into the can. If your object floats, carefully push it down until all of it is under the water. Your finger should not be in the water.

F Stand the measuring cylinder on the bench and read the volume of water you have collected. This is the same as the volume of your object. Write it down.

Core Practical: Investigate the properties of water by determining the specific heat capacity of water

Method

Melting ice

Wear eye protection.

A Put a boiling tube full of crushed ice into a Pyrex [or heatproof] beaker. Put a thermometer in the ice and note the temperature.

B Put the beaker onto a tripod and gauze. Pour hot water from a kettle into the beaker, and keep it warm using a Bunsen burner.

C Measure the temperature of the ice every minute and record your results in a table. Stop taking readings three minutes after all the ice has melted.

D Note the times at which the ice starts to melt and when it appears to be completely melted.

Specific heat capacity

E Put a polystyrene cup in a beaker onto a battery-powered balance and zero the balance. Then fill the cup almost to the top with water and write down the mass of the water. Carefully remove the cup from the balance.

F Put a thermometer in the water and support it as shown in photo B. Put a 12 V electric immersion heater into the water, making sure the heating element is completely below the water level. Connect the immersion heater to a joulemeter.

G Record the temperature of the water, and then switch the immersion heater on. Stir the water in the cup gently using the thermometer.

H After five minutes record the temperature of the water again and write down the reading on the joulemeter.

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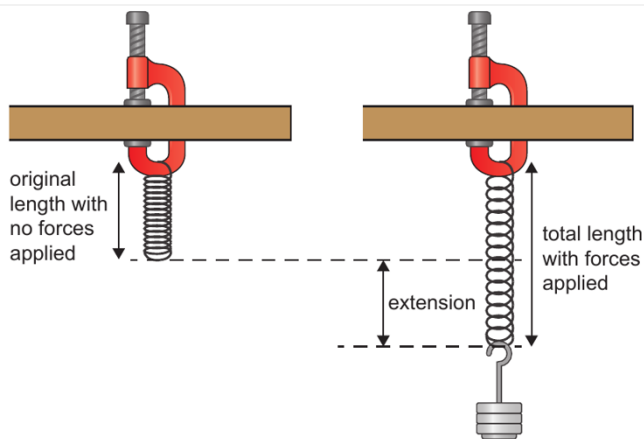
C The *extension* of a spring is not the same as its length.
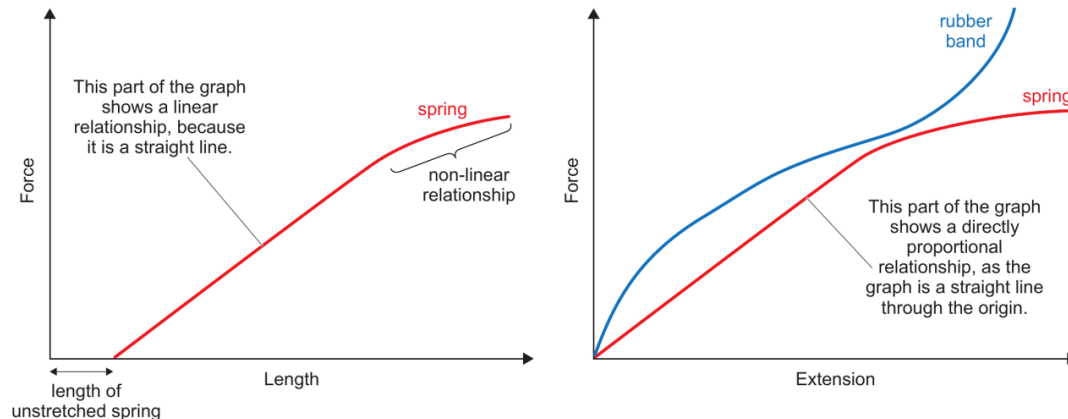
D force and extension relationships for springs and rubber bands

The force needed to extend a spring by 1 metre is called the spring constant. The stiffer the spring, the larger the spring constant.

The spring constant is calculated using the following equation:

spring constant = force / extension
(N/m)   (N)   (m)

The work done to stretch a spring is calculated using the following equation:

energy transferred in stretching = ½ × spring constant × (extension)²
(J)   (N/m)   (m)²

This graph shows that the force, F, is proportional to the extension, x, for both springs.
$F \propto x$

The gradient of the line on the graph is the spring constant.
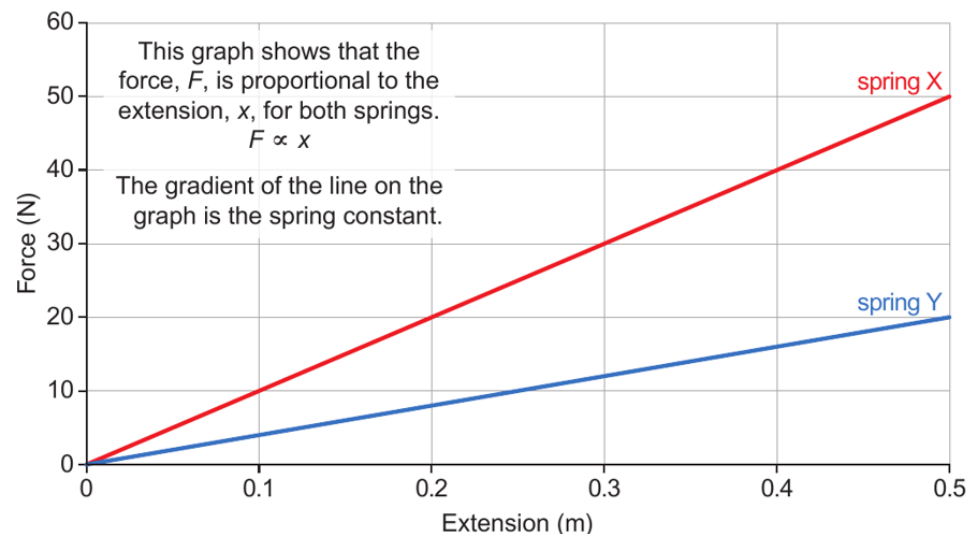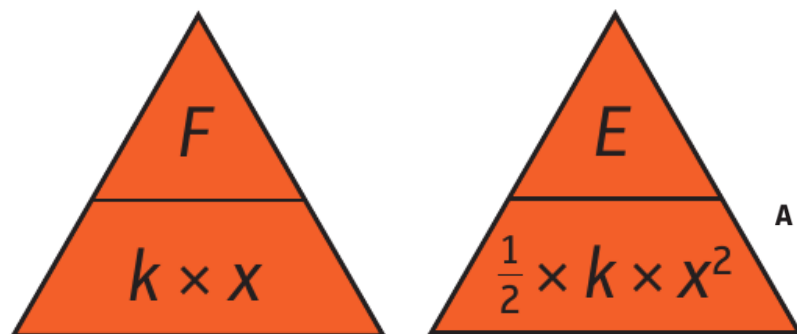
A Force-extension graph for two springs. The ∝ symbol means 'directly proportional to'.

Key word	Definiton
Elastic	An object that can return to its original shape, after forces are removed
Inelastic	An object that cannot return to its original shape, so keeps its new shape, even after forces are removed
Extension	The change in length of an object after forces have been applied
Linear relationship	The graph shows a straight line
Non-linear relationship	The graph does not show a straight line (curve)
Directly proportional	If the value of one variable increase, the other variable also increase by the same percentage
Spring constant	The force needed to produce an extension of 1 metre in a spring
Work done	The energy transferred when a force moves through a distance

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ORMISTON SWB ACADEMY

AO1 DEVELOP
DEVELOP ideas through investigations informed by **ARTISTS** and other sources, showing analytical and cultural **UNDERSTANDING**

AO2 EXPERIMENT
REFINE ideas through **EXPERIMENTING** and **SELECTING** appropriate resources, media, techniques and processes

AO3 RECORD
RECORD ideas, observation and insights **RELEVANT** to your **INTENTIONS**

AO4 PRESENT
Present a **PERSONAL** response, showing analytical understanding and realising **INTENTIONS** for your project, making connections in your work

How do I identify the formal elements of my major project; Cakes, Biscuits & Sweets?
- Artist's information/Inspiration
- What specific theme/genre are you going to study.
- Name a well known artist to take influence from within your chosen genre.
- Define Form/shape/pattern/experiment.
- Apply numerous techniques during development.

How do I create a response to chosen Artists work?
- Use the ideas behind an artists work to inspire your own designs.
- Watch a demonstration by your teacher.
- Use decorative/dyeing/printing/experimental Textiles techniques with skill and control.
- Create a response to your chosen artists work using influence from their work.

What needs to be included to ensure a successful final piece?
- Commit to design throughout project.
- Use shape, scale and proportion accurately.
- Make your work as detailed as possible using the Textiles techniques explored.
- Take inspiration from your chosen artist and show clear development in response to their work.
- Create a mock-up of a final product.
- Create final product signifying the conclusion to the journey you have created throughout your sketchbook.

Digital Art — Ps, P

Artist Response
Responding to the work of other **artists** is a great way to generate ideas. ... Starting with a direct **response** showing their understanding of the ideas and aesthetic of an **artist**.

Keyword	Definition
Observation	The action or process of closely observing or monitoring something or someone.
Silk Printing	A design is cut out of paper or another thin, strong material and then printed by rubbing, rolling, or spraying paint or ink through the cut out areas.
Fabric Manipulation	Experimenting with the **fabric** to change its appearance, drape or shape.
Influence	Something or someone that influences a person or thing, then, has an influence on that person or thing.
Moodboard	An arrangement of images, materials, pieces of text, etc. intended to evoke or project a particular style or concept.
Batik	A method (originally used in Java) of producing coloured designs on textiles by dyeing them, having first applied wax to the parts to be left undyed.
Applique	Layering pieces of fabric that are sewn or stuck on to a larger piece to form a picture or pattern.
Toile	An early version of a finished garment made up in cheap material so that the design can be tested and perfected.

ORMISTON SWB ACADEMY

Asking Artistic questions?
Practice the use of these words by asking the following questions about your artwork or the work of others:

Composition: How is the space used? Does the image fill the canvas/paper?

Light: Highlighted areas? Shadows? Time of day? Natural light or artificial? Harsh or soft? Reflected or direct? Abstract?

Line: Are there any lines that are prominent? Are they straight, curvy? Thin or thick? Do the lines create direction? Do they outline? Do the lines show movement or energy?

Repetition: Are there any objects, shapes or lines which repeat and create pattern?

Shape: Do you see geometric or organic shapes? What are they?

Space: Positive or negative? Is there a depth to the work?

Texture: Smooth or rough? Does the work give the impression of texture?

Tone: Is there a range of tones from dark to light? Where is the darkest? Where is the lightest?

Colour: Are the colours primary? Secondary? Tertiary? Complementary? Harmonious?

Watch and learn.

BBC Bitesize

https://www.bbc.com/bitesize/subjects/z6hs34j
https://www.studentartguide.com

Pinterest is a great way to collect the work of individual artists, themes or cultures. These images can motivate you and help formulate the kinds of imagery and art that you enjoy and are inspired by.
Task: Create your own Pinterest boards on your favourite artists, cultures and inspirations.

Keyword	Definition
Brushwork	Refers to the way paint is applied in a painting, describing texture of the paint surface applied with a brush.
Colour wash	A term used to describe the transparent layers of colour in a watercolour.
Complementary colour	Red and green, yellow and purple, blue and orange. These colours lie opposite each other on the colour wheel.
Composition	The arrangement of elements within an artwork.
Contrast	The difference in colour found between the light and dark parts of an image.
Contextual	Connections made to the work of other artists from different and similar times, places and cultures.
Style	The visual appearance of a work of art. Could also link to art movements – for example 'expressive style.'
Develop	Bring out potential.
Explore	Try out the qualities of materials, techniques or processes through practical investigation.
Imaginative	Develop ideas and concepts in new, engaging and inventive ways.
Refine	Improve initial work taking into account feedback and aims.

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Elements of the Promotional Mix

- **Learning Aim A** : Promotion

What is promotion?
Promotion is any method of communication that tries to encourage current and potential customers to buy products. Examples include adverts on television and money-off coupons in magazines.

The purpose of promotion
Promotion can be used to:
- Create a positive image of the enterprise in the minds of current and potential customers
- Encourage current and potential customers to buy products

Promotional mix
There are many different methods of promotion used to get current and potential customers to buy products.

Enterprises will choose a combination of methods depending on their product and their suitability for the **size of the enterprise.** This is known as the promotional mix.

The use of advertising to persuade and inform. The two basic aspects of advertising are:

The message	What the communication needs to say about the product. ▪ Low price ▪ Quality ▪ Useful
The medium	How to get the message across by choosing the correct method of advertising to reach current and potential customers.

Methods of Promotion	Explanation
Sales Promotion	is the process of **persuading a potential customer** to buy the product
Advertising	is defined as any **"paid-for method of promotion".** Advertising is the main form of "above the line promotion".
Public Relations	where a business manages its relationships with different parts of the public, e.g. customers, the media, local communities and others
Direct Marketing	describes a range of promotional activities that are aimed directly at the customer, so bringing the promotional message straight to the target audience.
Personal Selling	is where businesses use people (the "**sales force**") to sell the product after meeting **face-to-face** with the customer.
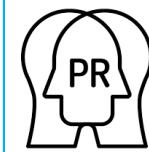
The promotional mix is a part of the marketing mix but it is not the same as the marketing mix. The marketing mix includes all of the 4 P's where as 'promotion' is one of the '4P'.

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- **Learning Aim A** : Promotion

Methods of advertising	Where advertising appears	Benefits
Moving image	- Television - Cinemas - Video sites - Promotional DVDs	✓ Enables products with moving parts of a practical use to be seen in action and where/how they can be used
Print	- Local and national newspapers - Magazines - Leaflets - Billboards	✓ Likely to be seen by large numbers of people, either in a specific location (local newspaper, billboards and leaflets) or over a wide geographical area (national newspapers and magazines).
Ambient	Public places, such as bus stops and shopping centres	✓ Outdoor advertising aims to catch the attention of passers-by
Digital	- Company websites - Social media [Pinterest, Instagram]	✓ Enables large and small businesses to connect with large numbers of people instantly
Audio	Local and national radio	✓ Allows businesses to speak directly to their target market

Factors which influence the choice of advertising	Benefits
Potential sales	These can result from the advert. An enterprise will want to get financial return from it's investment in advertising
Costs	Some methods, such as television advertising, can be very expensive and may only be suitable for large businesses. Other methods such as leaflets offer better value for smaller enterprises and budgets.
Characteristics of target market	Factors such as income, gender, age and lifestyle will influence the method used to attract customers
Types of product	How best to promote a products features.

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- **Learning Aim A** : Promotion

Purpose of sales promotion
Enterprises use sales promotion for different reasons.
- To entice people into a shop where they may buy the product but other products also
- To boost sales figures
- To attract first time buyers
- To sell off older or less-fashionable goods to make space for new items
- To maintain customer loyalty

Method and features	Benefits/Limitations
Coupons Money-off voucher	👍 may encourage purchases 👎 impacts profit if doesn't cover cost
Free sample Often given with coupon	👍 potential repeat sales 👎 could impact profit
Competitions Prize draws	👍 builds up marketing – thrill means more entrants 👎 impacts on profits
Money off discount Percentage reduction	👍 encourages purchases 👎 profit affected if sales are low
Loyalty incentive Points towards other product or free items	👍 long term customer relationships established 👎 impacts on profit if too few sales generated
Buy-One-Get-One-Free Free product on purchase of a full price product	👍 encourages additional purchases 👎 profit impacted if sales are low

Personal selling
This is where a representative of an enterprise contacts potential customers directly. There are 4 main methods of personal selling:

1. Face to face
The sales person is in direct personal contact with the customer

2. Telephone
The sales person makes phone calls to the customer [usually from a call centre]

3. Email
The sales person communicates electronically with the customer.

4. Video or Web conferencing
The sales person communicates with the customer through a webcam.

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- **Learning Aim A** : Promotion

An enterprises public image is an essential aspect of its success. A poor reputation may lead to reduced sales and a fall in profits. A positive image can maintain or even increase sales. Public relations (PR) involves building and maintaining an enterprises reputation – its image – through the media.

The purpose of public relations
PR may be used to promote products. Its purpose is to:
- Encourage positive views
- Encourage positive publicity through media
- Protect the brand image

Public relations

Telemarketing
Sales representatives make phone calls to inform customers of offers or new products (cold calling)

Email marketing and text messaging
Both may include links to the enterprises website.

Magazines
Enterprises own magazines including features and news of its latest products, or specialist magazines targeting a specific market

Direct Marketing

Mail order catalogues
Include photos and descriptions of products and information on how to order. Used by enterprises selling a wide range of products.

Direct mail [junk mail]
Leaflets, letters and brochures about new products. Suitable for a small enterprise such as a local restaurant or service.

Direct marketing is when an enterprise communicates with a customer directly to try to sell them something, either by phone or written communication

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- **Learning Aim A** : Promotion

Markets can be sorted into different sections, known as segments. Each segment is made up of consumers with shared characteristics, needs and interests. Enterprises segment their markets for various reasons.
Enterprises decide on the most suitable promotional mix based on whether they are targeting a business-to-business (B2B) market or a business-to-consumer (B2C) market.

B2B

An enterprise sells its goods to another enterprise. The goods may be raw materials, equipment, consumables (items that are used up and replaced) or items for resale. This type of market is known as Business to Business (B2B).
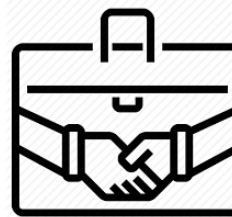
B2C

An enterprise sells its products – goods and services – directly to individuals for their own use. Such individuals are known as consumers, and the type of market is known as Business to Consumer (B2C).
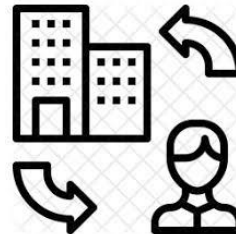
Market segmentation
This is the process of breaking down a large market into much smaller groups of consumers.
Enterprises analyse the market, and divide it into segments, each containing consumers with similar characteristics.

Why enterprises segment the market:
✓ To better understand the characteristics, needs and interests of current and potential customers
✓ To develop products for a particular market segment
✓ To develop products that suit the needs of different market segments
✓ To choose promotional methods that are better suited to the target market.

Markets can be segmented in different ways. Enterprises may target one or more segments. They may also target different categories within each segment. The segments include:
Demographic: Characteristics of consumers
Geographic: where consumers live
Behavioural: how customers behave (spending choices, frequency)
Psychographic: social class, attitudes, lifestyle etc.

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Age: Markets are often segmented by age ranges to identify specific needs
Gender: Genders have different tastes and have differing needs
Income: Differing incomes determine whether individuals can afford luxury or basic items
Education level: Higher education can sometimes mean higher earnings

Socio-Economic group: Social class is based on income and type of occupation
Ethnicity, religious and cultural beliefs: May influence choices such as food and clothing.
Family size: Larger families usually buy in larger quantities.

Demographic

Market segments

Geographic

Where people live influences the products they buy.
For example:
▪ People living in cold, hot or damp climates will need different types of clothing and transport
▪ Regional tastes in cuisines means different demands for food
▪ Customs and cultural characteristics of a country or region affect peoples choices
▪ The general standard of living in an area will affect how much consumers have to spend

Behavioural

Behavioural segmentation looks at how customers relate to products through:
Spending and consumption
▪ Usage
▪ Loyalty
▪ Desired benefits

Psychographic

Consumers are segmented by personality, likes and dislikes, values, lifestyle, interests and attitudes.

Using psychographic segmentation
✓ Cinemas may offer two-for-one deals, discounts and annual passes to attract regular movie goers and encourage customer loyalty.
✓ Products made of recyclable materials may be promoted to meet the needs of environmentally conscious consumers.

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- **Learning Aim A** : Promotion

Large enterprises

These are likely to:

- Have a large promotional budget
- Use all of the promotional methods you have revised
- Employ specialist staff to plan and manage promotional methods
- Employ a team of sales staff to promote products
- Hire public relations specialist and agencies to promote the brand

Smaller enterprises

These are likely to have:

- A limited promotional budget
- A narrower range of promotional methods as some would be too costly

They are unlikely to employ specialist staff. Promotions mat only run at certain times to keep costs down.

These may be linked to the skills of the owner and employees, the type of products, the size of the market and the budget.

Enterprises need to choose methods that are appropriate for the product based on its size and audience.

The promotional budget

Both large and small enterprises set aside money to run promotional activities.

Budget size is based on:

- Size of the enterprise
- How much competition there is – the more competition the higher the spend may be
- Sales revenue – the money received from sales

Budgetary constraints

- Promotional methods may be limited in scope for smaller enterprises with smaller budgets
- Decisions on spending may be influenced by product lifecycle. For example, new products may require a bugger budget than a product with steady sales
- Poorly performing enterprises may have to restrict promotional activities to those that generate most sales
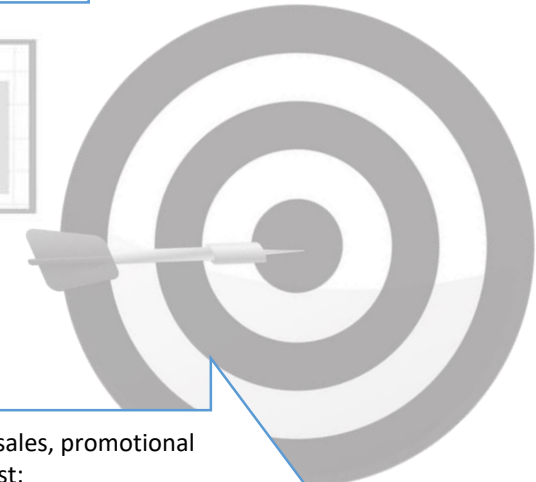
To have positive impacts on sales, promotional methods must:

1. Reach the target market
2. Be based on their habits and wants to appeal to them [Reading? Hobby? Lifestyle?]

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- **Learning Aim B** : Financial records

Enterprise use a range of financial documents throughout the buying and selling process to record the sale and purchase of goods and services.

Purchase order → Delivery note → Invoice → Receipt → Credit note → Statement of account

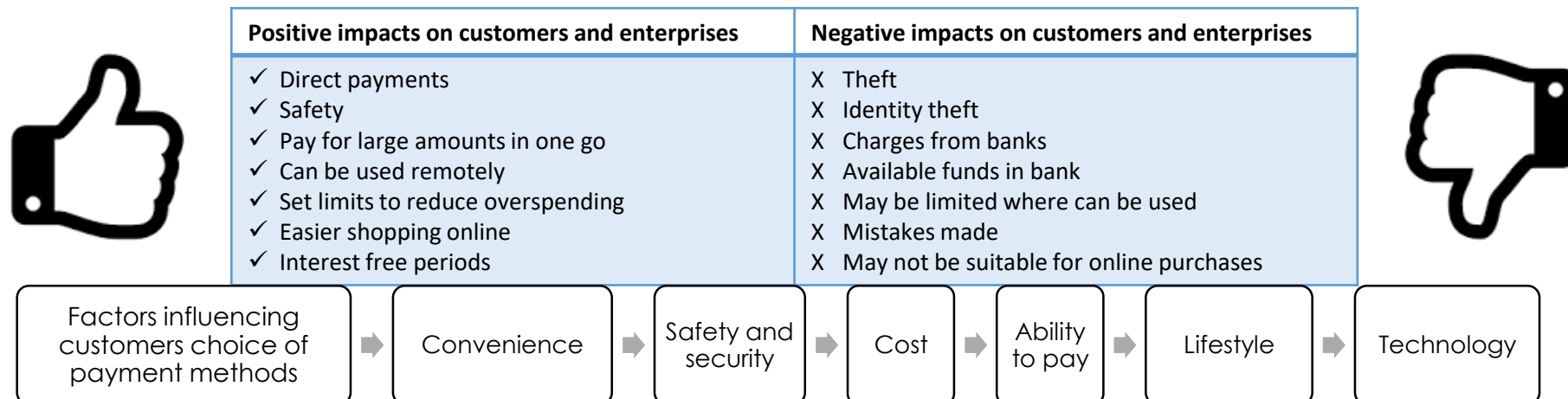| Document	Description	Document	Description
Purchase order	• Completed by buyer (the customer) • A legal offer to buy goods from the supplier • List items required, including price agreed and quantity • Sent to the supplier requesting products	Receipt	• Completed by supplier and sent to the customer • A record of payment made by the customer • Rarely used when enterprises sell goods on credit (see statement of account)
Delivery note	• Completed by supplier • Sent to customer when goods delivered • Lists details about the order, including contents of delivery • Lists any goods not supplied, with reasons for non-delivery • Used by the customer to check that goods delivered match goods requested on the purchase order	Credit note	• Completed by supplier and sent to the customer • Lists any goods that may have been returned by the customer • Confirms money refunded to the customer or may be used against the purchase of other goods by the customer in the future
Invoice	• Completed by supplier • A request for payment – sent to customer, either on receipt of goods or shortly after • List price of goods delivered, delivery charges and amounts owed to supplier • States date by which money must be paid • Explains how to pay, for example by bank transfer	Statement of account	• Completed by supplier and sent to customer • A financial summary of the goods ordered, purchased or returned by the customer over a period of time, usually a month • Some enterprises pay their invoiced only after receiving the statement

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- **Learning Aim B** : Financial records

Payment methods

There are many different ways for enterprises and their customers to pay for goods and services. Depending on the type of financial transaction, some methods are more suitable than others.

Debit card

Issued by banks to their customers (account holders); card is linked directly to the bank account.

Payment technologies

This could be such as PayPal which allows individuals to transfer money safely between buyers and sellers. Money is added/ withdrawn from the individuals bank account.

Credit card

Issues by banks and financially companies. Allows you to spend to your limit and pay back at the end of the month

Cash [notes and coins]

Accepted in most places as a form of payment. Money can be withdrawn from a bank account with the use of a debit card. Some shops only accept cash if they do not have the technology available.

Direct debit

An instruction to a bank authorising a third part, such as enterprise, to transfer money of various accounts to its own bank on an agreed date. This is such as a phone contract that is taken on the same day every month.

Cheque

A written order to pay a sum of money from a bank account to the payee. This is a declining method of payment.

Positive impacts on customers and enterprises	Negative impacts on customers and enterprises
✓ Direct payments ✓ Safety ✓ Pay for large amounts in one go ✓ Can be used remotely ✓ Set limits to reduce overspending ✓ Easier shopping online ✓ Interest free periods	X Theft X Identity theft X Charges from banks X Available funds in bank X May be limited where can be used X Mistakes made X May not be suitable for online purchases

Factors influencing customers choice of payment methods ➡ Convenience ➡ Safety and security ➡ Cost ➡ Ability to pay ➡ Lifestyle ➡ Technology

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- **Learning Aim B** : Financial records

Income from sales

This is the most common form of income. Income from sales is known as revenue or turnover

- Cash sales from over the counter
- Credit sales from methods of credit such as a credit card
- Commission received from sales the business has supported
- Repairs of products previously purchased
- Maintenance contracts to regularly service a product and keep it in working order

Income from assets

An asset is something owned by an enterprise, such as property or equipment. An asset can be sold to generate income for the enterprise. There are many ways to generate income from assets:

- Lease or hire out equipment
- Invest in another enterprise to receive a share of its profits
- Put spare cash into an account that pays interest
- Sell assets such as property or equipment to raise money
- Rent out part of the premises to another enterprise.

Start up costs
Before trading these help to set up the enterprise

Start-up costs will be influenced by the type of enterprise. For example:
- A clothing manufacturer will require an industrial premises, machinery and materials to produce goods.
- A high street retailer will require shop premises, shop fittings and items to sell.

To pay for these the enterprise needs to source the start-up capital. This could be from owners own money, money loaned from family and friends, business loan or an investor

Running costs
There are two types of running costs

fixed costs

Fixed costs
These are costs that the enterprise has to pay n mater how well it is doing.
- Heating and lighting charges
- Rent
- Insurance
- Business rates

Variable costs
These costs are directly linked with the number of items produced or sold. For example:
- The more orders a clothing manufacturer receives for t-shirts the more material it will need to produce them
- The more vehicles a car mechanic repairs and services, the more replacement parts would be required.
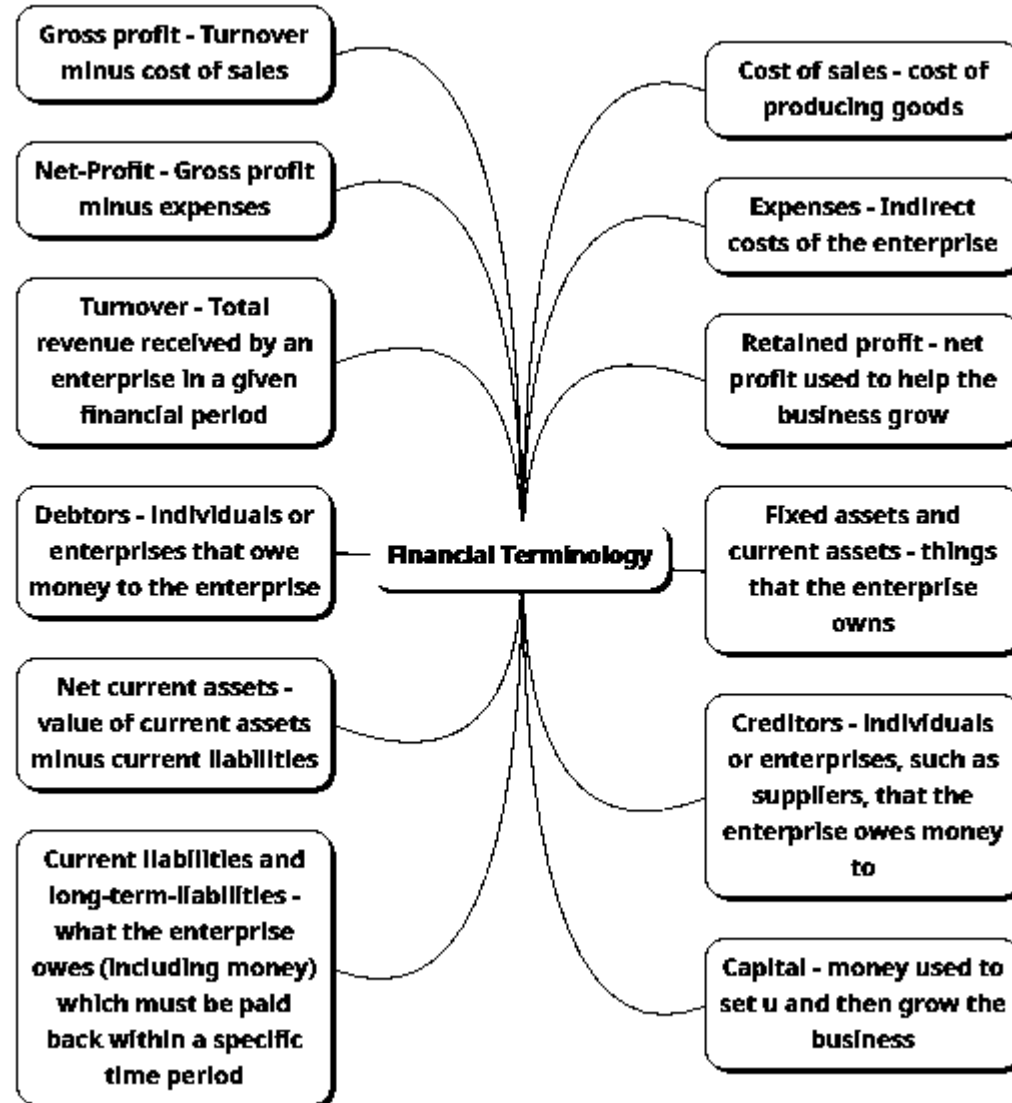
Total running costs
Fixed costs + variable costs

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- **Learning Aim B** : Financial records

Gross profit - Turnover minus cost of sales

Net-Profit - Gross profit minus expenses

Turnover - Total revenue received by an enterprise in a given financial period

Debtors - Individuals or enterprises that owe money to the enterprise

Net current assets - value of current assets minus current liabilities

Current liabilities and long-term-liabilities - what the enterprise owes (including money) which must be paid back within a specific time period

Financial Terminology

Cost of sales - cost of producing goods

Expenses - Indirect costs of the enterprise

Retained profit - net profit used to help the business grow

Fixed assets and current assets - things that the enterprise owns

Creditors - Individuals or enterprises, such as suppliers, that the enterprise owes money to

Capital - money used to set u and then grow the business

Understanding terminology

You may come across the terms below by different names elsewhere.

The different terminology is shown in brackets – they mean the same thing:
- Debtors (trade receivables)
- Creditors (trade payables)
- Fixed assets (non-current assets)
- Long term liabilities (non-current liabilities)

Financial terminology often appearing in financial statements	
Statement of comprehensive income	Statement of financial position
Turnover, Cost of sales, gross profit, expenses, net profit, retained profit	Fixed assets, current assets, owners capital, current liabilities, long term liabilities (non-current liabilities), debtors (trade receivables), creditors (trade payables)

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Statement of comprehensive income

- **Learning Aim B** : Financial records

A statement of comprehensive income is a summary of the enterprises activities over a specific period of time, usually a year. It is used by several interested groups of people to understand how well the enterprise is performing.

	£	£
Sales revenue		15 400
Cost of sales		5 200
Gross profit		**10 200**
Less expenses		
Wages	2 800	
Rent	1 200	
Marketing	500	
Transport	1 800	
	6 300	
Net Profit		**3 900**

In financial statements if figures are shown in (brackets) they are **negative**. The minus sign is not used

Sales revenue – This is the revenue received by the business from selling its products. It is also referred to as simply **sales** or **turnover** (net sales) because it takes into account any price discounts or goods returned by the customer

Cost of sales – this includes the cost of making the products.

Gross profit = turnover – cost of sales

Expenses – These are the indirect costs incurred when running a business. Expenses are listed separately in the statement of comprehensive income.

This is the total of the individual expenses.

Net profit – Once sales, cost of sales and expenses are identified, the net profit or loss can be calculated: Net profit = Gross profit - Expenses

Interested groups
Several groups of people will be interested in the comprehensive statement of account as they will want to know if the enterprise is being well run.
- Managers
- Employees
- Shareholders
- Suppliers
- Customers
- Tax authorities

Purpose of comprehensive statement of income
The financial statement shows:
- How much revenue the enterprise has received from sales of goods and services
- How much the enterprise has sent
- Where the money was spent

Profit
On the example above both gross profit and net profit were positive figures, which means the enterprise made a profit.

Loss
If total costs (cost of sales + expenses) are greater than the revenue, the enterprise will make a loss, as shown in the example.

- **Learning Aim B** : Financial records

	£	£
Fixed assets		
Computer	500	
Vehicle	2 000	
		2 500
Current assets		
Inventory	4 000	
Debtors	600	
Cash in bank	2 000	
		6 600
Current liabilities		
Creditors	700	
Overdraft	300	
		1 000
Net current assets		5 600
Total assets less current liabilities		8 100
Financed by		
Owners capital	5 000	
Retained profit	3 100	
		8 100

This column identifies the *value* of individual items

This column identifies the *total value* of individual items

The total fixed assets are 500 + 2000 = 2500

Total of current assets

Total of current liabilities

Net current assets = current assets – current liabilities
6600 – 1000 = 5600

Owners funds
= owners capital + net profit for the year
= 5000 + 3100 = 8100

This figure will be reduced if the owner takes money out of the business to pay themselves a salary. It would be shown as 'drawings'

A statement of financial position is a financial snapshot of the assets and liabilities of an enterprise on a particular day, usually the last day of the enterprises financial year.

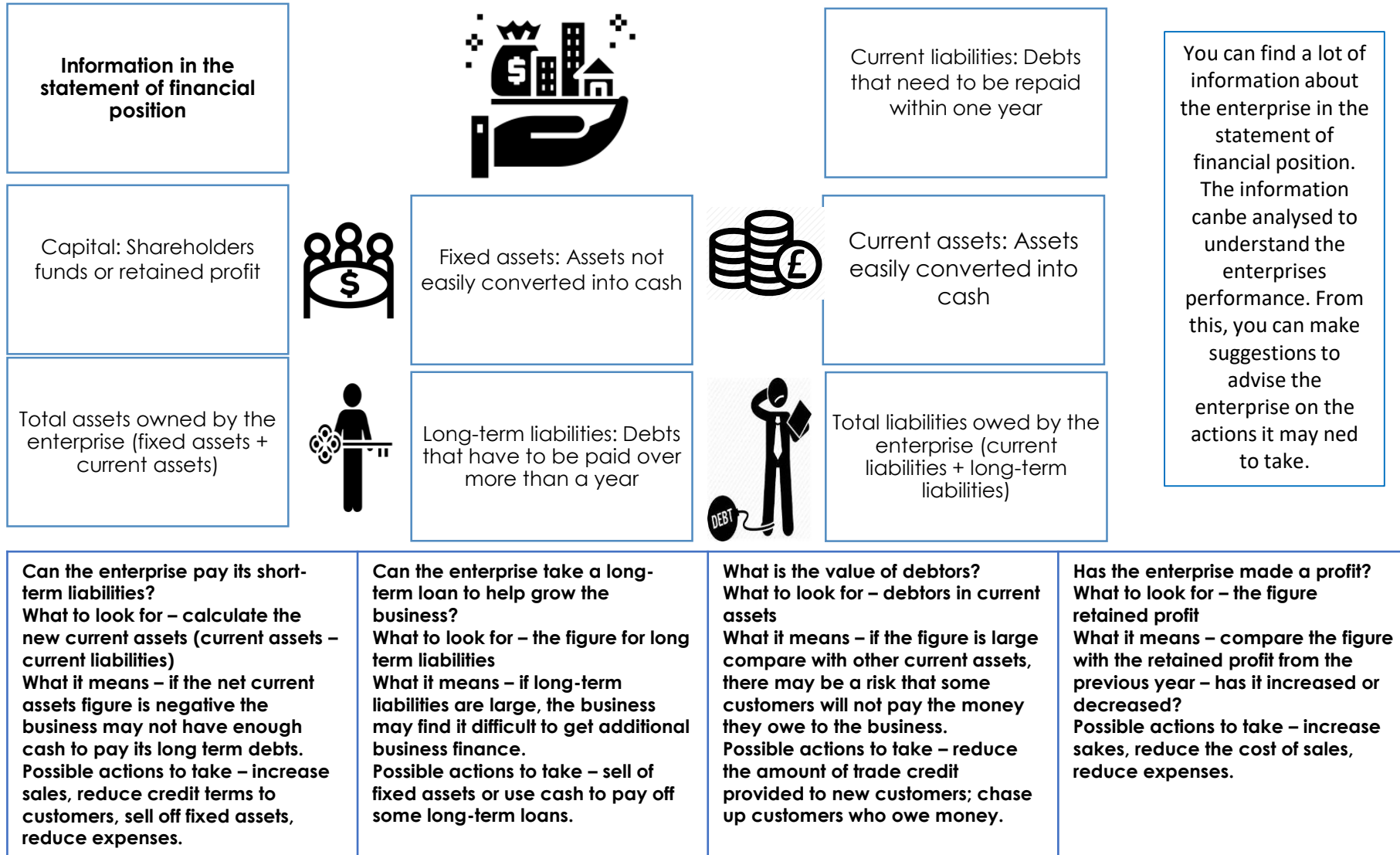**Purpose of a financial statement of position**
This shows:
- The value of all the enterprises assets and liabilities
- The source of capital used by the enterprise to finance its operations

Preparing a statement of financial position
To prepare a statement of financial position correctly, you first need to categorise the enterprises assets into fixed and current assets and liabilities into current and long-term liabilities.

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- **Learning Aim B** : Financial records

Information in the statement of financial position

Capital: Shareholders funds or retained profit

Total assets owned by the enterprise (fixed assets + current assets)

Fixed assets: Assets not easily converted into cash

Long-term liabilities: Debts that have to be paid over more than a year

Current liabilities: Debts that need to be repaid within one year

Current assets: Assets easily converted into cash

Total liabilities owed by the enterprise (current liabilities + long-term liabilities)

You can find a lot of information about the enterprise in the statement of financial position. The information canbe analysed to understand the enterprises performance. From this, you can make suggestions to advise the enterprise on the actions it may ned to take.

Can the enterprise pay its short-term liabilities?
What to look for – calculate the new current assets (current assets – current liabilities)
What it means – if the net current assets figure is negative the business may not have enough cash to pay its long term debts.
Possible actions to take – increase sales, reduce credit terms to customers, sell off fixed assets, reduce expenses.

Can the enterprise take a long-term loan to help grow the business?
What to look for – the figure for long term liabilities
What it means – if long-term liabilities are large, the business may find it difficult to get additional business finance.
Possible actions to take – sell of fixed assets or use cash to pay off some long-term loans.

What is the value of debtors?
What to look for – debtors in current assets
What it means – if the figure is large compare with other current assets, there may be a risk that some customers will not pay the money they owe to the business.
Possible actions to take – reduce the amount of trade credit provided to new customers; chase up customers who owe money.

Has the enterprise made a profit?
What to look for – the figure retained profit
What it means – compare the figure with the retained profit from the previous year – has it increased or decreased?
Possible actions to take – increase sakes, reduce the cost of sales, reduce expenses.

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- **Learning Aim B** : Financial records

What is profitability?
Profitability is the ability of an enterprise to turn revenue into profit. This is know as its **profit margin.** It is the amount of profit generated from each £1 generated in saes revenue. So, a profit margin of 20% means the enterprise is generating £0.20 from each £1 of sales revenue.

Increasing profitability
An enterprise can increase its profitability by raising prices without demand falling or lower its costs without a noticeable change to the product or service.

Sales revenue and gross profit are the two items needed to calculate gross profit margin.

	£	£
Sales revenue		17 800
Cost of sales		7 120
Gross profit		10 680
Less expenses		
Wages	3 420	
Rent	1 400	
Marketing	600	
Insurance	1 700	
	7120	
Net profit		3 560

The value for sales revenue (17,800) minus the cost of these sales (7,120) will enable the business to calculate its gross profit.

The value for gross profit (10,680) minus total expenses (7,120) will enable the business to calculate its new profit (3,560).

f (x)
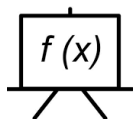
Gross profit margin
To calculate gross profit margin, you will need to extract figures from the enterprises statement of comprehensive income.

Net profit margin
To calculate net profit margin, you will need to extract figures from the enterprises statement of comprehensive income.

Formula
Gross profit margin = (gross profit ÷ sales revenue) x 100
The answer will be shown as a percentage

Formula
Net profit margin = (net profit ÷ sales revenue) x 100
The answer will be shown as a percentage

f (x)

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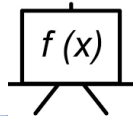
- **Learning Aim B** : Financial records

Current ratio and liquid capital ratio
To understand the liquidity of an enterprise two ratios are calculated – one which *includes* the inventory (stock) and another which *excludes* it.

Liquidity ratios

Current ratio
This is the ratio of total current assets and liabilities. It includes both cash and inventory (stock). It is a useful measure of the enterprise's ability to pay its debts, but may be misleading if current assets largely consist of inventory.

Liquidity ratios
If an enterprise needs to pay debts in the near future, such as wages, it will need to have cash. The liquid capital ratio is a more accurate measure of the enterprises liquidity, as it removes inventory (stock) from the calculation, since stock may be difficult to turn into cash quickly.

Current ratio formula

Current ratio =
current assets ÷ Current liabilities

Liquid capital ratio formula

Liquid capital ratio =
(current assets – inventory) ÷ current liabilities

Interpreting current and liquid capital ratios
Current assets must be higher than current liabilities. Most enterprises will accept 1.5:2.1 for the current ratio as it includes inventory. If either ratio falls below 1.1, the enterprise will struggle to pay its debts because it has insufficient cash. It would be advised to reduce the quantity of its inventory and increase its cash levels.

Liquidity is the ability of an enterprise to pay its debts
An enterprise with good (positive) liquidity will have sufficient net current assets to pay its creditors. It means the enterprise is **solvent** – can pay its debts.
An enterprise with poor (negative) liquidity may not be able to pay its debts. The enterprise may become insolvent and have to cease trading.

Liquidity and cash
If an enterprise needs to pay its debts in the near future – such as wages and heating and lighting – it will need to have access to cash.

The ability of an enterprise to convert its assets into cash is known as liquidity. For example, if a business has to pay its suppliers £5000 in 10 days' time but only has £2000 in cash, it could sell one of its fixed assets, such as a company vehicle it no longer requires, or sell some of its inventory (stock) at reduced prices.

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- **Learning aim C :** Financial planning and forecasting

Enterprises collect cash flow data and use it to produce **cash flow statements** and **cash flow forecasts.** They use this information to monitor and control cash flow.

Cash flow statement

This records the enterprise's actual cash inflows and outflows over the previous 12 months. It is used by the enterprise to monitor the flow of cash. Analysis of the previous year's cash flow statement may be used to produce the enterprise's cash flow forecast.

Cash flow forecast

This predicts the enterprise's likely cash inflows from sales, and outflows (purchases) each month over a period of time. The forecast allows the enterprise to calculate net cash flow and ensure it has sufficient cash to cover its running costs. It is also used to determine net current asset requirements – the working capital needed to operate the business – and to make business decisions.

The total receipts row shows the **cash inflows** (sales) for each month. In January, total receipts = £1000 + £250 = £1250

The total payments row shows the **cash outflows** (purchases) for each month. In January, total payments = £750 + £200 + £150 + £300 = £1400

This is a *negative* net cash flow (shown in brackets) where total payments are greater than total receipts.

The closing balance at the end of the month is calculated by adding together the net cash flow and the opening balance.

The **net inflow/outflow –** the **net cash flow** – figure is calculated as total receipts (cash inflows) less total payments (cash outflows). In February, there is a net cash flow figure of £1575 (£3250-£1675).

The **closing balance** in one month is the money available to the enterprise at the end of the month. The closing balance is carried forward to the next month and becomes the **opening balance**. At the end of February, the closing balance was £3675. this was carried forward to become the opening balance in March.

2019	Jan (£)	Feb (£)	March (£)
Cash inflows			
Sandwich sales	1 000	2 500	3 000
Soft drinks	250	750	1 000
Business loan			2 000
Total receipts	1250	3250	6 000
Cash outflows			
Bread and Rolls	750	900	1 120
Fillings	200	250	300
Soft drinks	150	225	400
Rent	300	300	300
Total payments	1 400	1 675	2 120
Net inflow/ outflow	(150)	1 575	3 880
Opening balance	2 500	2 100	3 675
Closing balance	2 100	3 675	7 555

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- **Learning aim C :** Financial planning and forecasting

Analysis of cash flow information
The differences between forecast and actual cash flow can alert an enterprise to cash flow problems. Cash flow information can be analysed to find out where there is a problem – in inflows or outflows. The size of the closing balance will indicate to the enterprise that it mat need to take action to improve cash flow.

Total receipts (cash inflows) show a large increase between February and march, mainly due to the £2000 bank loan.

The closing balance forecast for April is only £230 as a result of the impact of the net cash outflow. If there is another cash outflow in May, Colin will need to take steps to improve cash flow.

Analysing the cash flow for Colins Bike Repair Shop:

2019	Jan (£)	Feb (£)	March (£)
Cash inflows			
Repairs	2 500	3 000	3 500
Spare part sales	950	1 000	1 300
Bank loan		2 000	
Total receipts	**3 450**	**6 000**	**4 800**
Cash outflows			
Cycle frames	1 900	2 120	2 400
Bike chains	750	1 900	2 200
Tyres	225	800	1 000
Rent	300	300	1 000
Loan repayment			75
Total payments	**3 175**	**5 120**	**6 675**
Net inflow/ outflow	**275**	**880**	**(1 425)**
Opening balance	**500**	**775**	**1 655**
Closing balance	**775**	**1 655**	**230**

Rent increased in April from £300 to £1000 per month. The enterprise may have moved to larger premises.

Monthly loan repayments start in April because the enterprise borrowed the money in March.

There is a negative net cash outflow in April of £1425. a move to larger premises (the big increase in rent) may mean the enterprise needs additional inventory (stock). Colin must ensure that cash inflows in future months increase, otherwise the business may face financial difficulties.

- **Learning aim C :** Financial planning and forecasting

Costs/Revenue

An example of a break-even chart

Revenue

Break-even point

Profit

Total Costs

Margin of Safety

Loss

Output

You must remember the formulas as these are not given in the exam!!

DON'T FORGET!
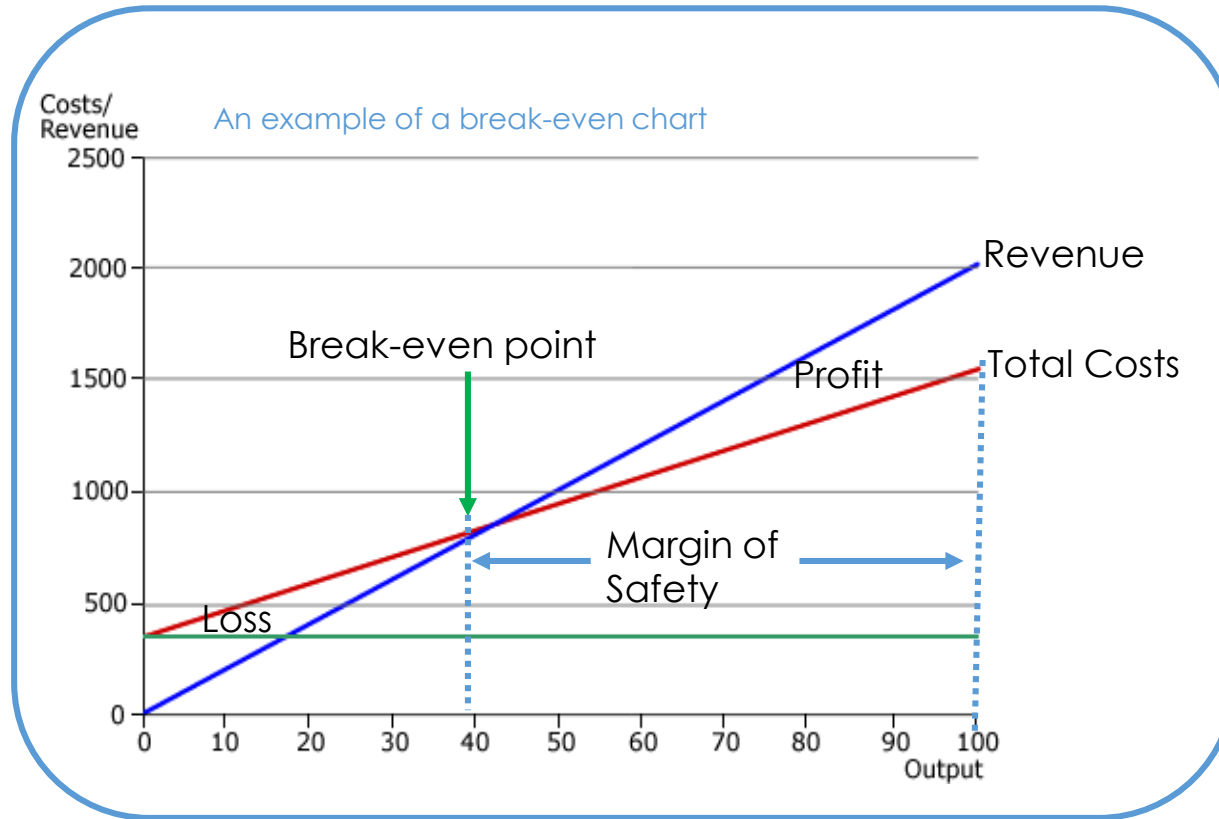
Information for a break even chart:
Before drawing a break-even chart, you will need the following information about the product:
- Fixed costs
- Variable costs
- Total revenue (sales)
- Selling price per unit

How to draw a break even chart
1. Draw the **fixed costs** line
2. Draw the **total costs** line (variable + fixed costs)
3. Draw the **total revenue** line
4. Mark on the **break-even** point – where total costs and total revenue lines cross.

Remember to:
- Give the chart a title
- Label the axes, lines and break-even point

Key Facts
Break Even helps a business by showing how many units it needs to sell to cover its costs. It shows when it will start to make a profit and the lowest amount they can sell so they don't make a loss. It can show the margin of safety and if costs or selling price change how that will affect the profit or loss

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- **Learning aim C :** Financial planning and forecasting

	Costs	Selling price	Sales (revenue)
👍	**Costs fall** Lowers break-even point. The enterprise makes more profit. The lower the break-even point, the fewer the sales are required to break-even.	**Increase in selling price** Break-even point lowers. Fewer sales required to break-even.	**Sales increase** Lowers break-even point. The margin of safety increases, revenue increases and the enterprise makes more profit.
👎	**Costs increase** Break-even point rises. The enterprise makes less profit. *Action to take:* the enterprise may need to sell more items to break-even. It may try to reduce costs. It may raise the selling price.	**Decrease in selling price** Break-even point rises. *Action to take:* The enterprise will need to make more sales to break even or reduce its variable costs.	**Sales fall** Break-even point rises. The margin of safety decreases. *Action to take:* The enterprise may try to improve sales by lowering the selling price. This increases the number of goods needed to be sold to break even. It may also reduce its variable costs.

Increasing the selling price.

A change in the selling price can have the opposite effect to the one hoped for by the enterprise – to lower the break-even point. Customer may not be prepared to pay the increased price and switch to a rival, cheaper brand.

Falling sales

An enterprise may lower the price for a short time only to boost sales and attract new customers.

Cost and revenue (£)

Output

Loss

Breakeven point

Profit

Total costs (Fixed costs plus variable costs)

Revenue

Fixed costs

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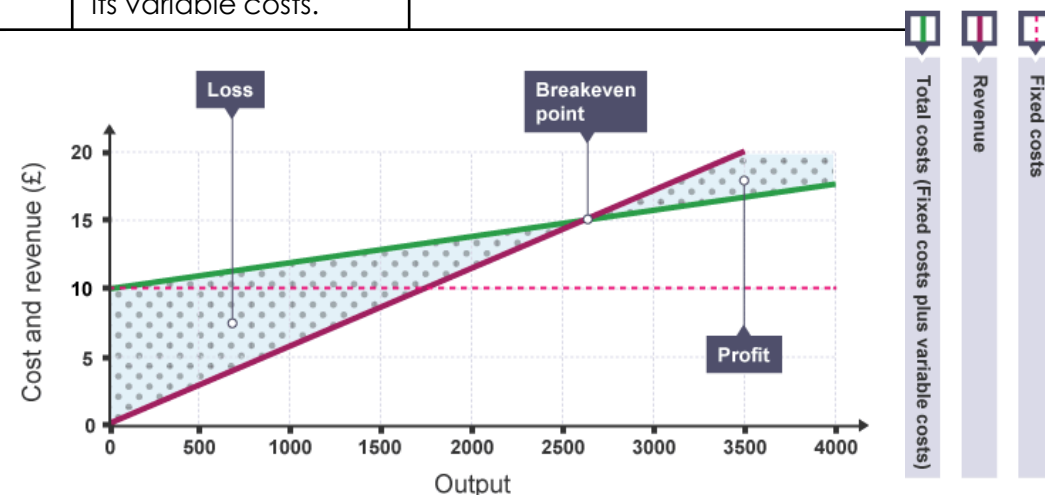
Target Audience:

You need to know your target audience. Who are they? What kind of things do they do? What are their likes and dislikes? What are they interested in? Getting an understanding of these individuals helps you create with ease and make something you know will relate to them.

Planning:

Create a work plan which lists all of the tasks involved in the whole project. Estimate how long each task will take and create a chart or diary to record how long they REALLY take to complete. Build in some contingency time in case things go wrong!

Create a site map to show the pages of the website and how they will be linked together with navigation features.

Create a visualisation diagram to plan the content and layout of the individual web pages.

Test Plans:

There are a range of elements that all need work to produce a successful product. Create a test plan to check these functions:

- Navigation
- Links to take the user to the correct page
- Display of images and content
- Playback of video and audio

Asset Table:

Create an asset table to show the range of audio, video and images you will be using. This will include listing where you got the assets from and describing any legal issues with using them.

Methods of internet connection:
- Wired broadband
- Wi-Fi
- 3G, 4G and 5G wireless broadband

Year 11– iMedia(ICT) – R085

Devices used to access webpages:
- Laptops and personal computers
- Tablets
- Mobile devices and smartphones
- Game consoles and digital television
- Smart Speaker
- Smart Watch

Purposes of websites:

- Education
- Online retail
- Information
- Services
- Advertising
- Promotion
- Entertainment

Features of websites:
House style
Navigation features
Hyperlinks
Search facility
Website footer
Images/image gallery
Ordering forms
Downloadable content
Logo/Title
Page Titles
Email links
Links to social media
Internal links
Shopping basket

Interactive features
- Rollovers
- Animations
- Adverts
- Surveys
- Forums
- Quizzes
- Comment boxes
- Audio/video files

How does the appearance of websites differ on different devices?
The screen resolution used can change the look of a site
Operating system used can change the look of a site
Fewer images may be used on mobile versions
The web browser may change things
The orientation can change

Client Requirements:

Your client is the person you will be working for. They will tell you what to plan, design or create for them. The client will set out requirements that they want you to follow when you plan the project.

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What are the different purposes of websites?

- To entertain
- To promote
- To inform
- To communicate
- To advertise
- To Educate
- To sell
- To help

What are the different devices used to access websites?

- Mobile Phone
- Smart watch
- Tablet
- Laptop / PC
- Smart speaker
- Smart TV
- Games Console

Which different ways can be used to connect to the Internet?

1. ADSL Broadband over existing phone lines.
2. Cable Broadband -.through cables shared by the TV service
3. Fibre Broadband.- High speed fibre optic cables
4. Ethernet - a cable running from a router / network point
5. Wi-fi - wireless signal from a wireless router
6. Mobile Data 3G and 4G

How does the appearance of websites change on different devices?

1. The screen resolution you are using can change the look of a site.
2. The operating system used can change the look of a site.
3. Fewer images may be used on mobile versions.
4. The web browser used may change things.
5. The orientation can change.

Advantages and disadvantages of using the Internet

Advantages	Disadvantages
1. Easy communication across the world	1. Viruses
2. 24/7 access to information	2. Cyber-bullying / Trolling
3. Entertainment	3. Viruses
4. Online Banking	4. Exposure to inappropriate material
5. Online Shopping	5. Identity theft
6. Learning Resources and information availability	6. Leakage of private information

What are the common features of websites?

- Banner
- Navigation Bar
- Logo / Title
- Shopping basket
- Search bar
- Multimedia
- Images
- Page Titles
- Text
- Internal Links / Buttons
- Social Media
- Web Links
- Email links
- Copyright information
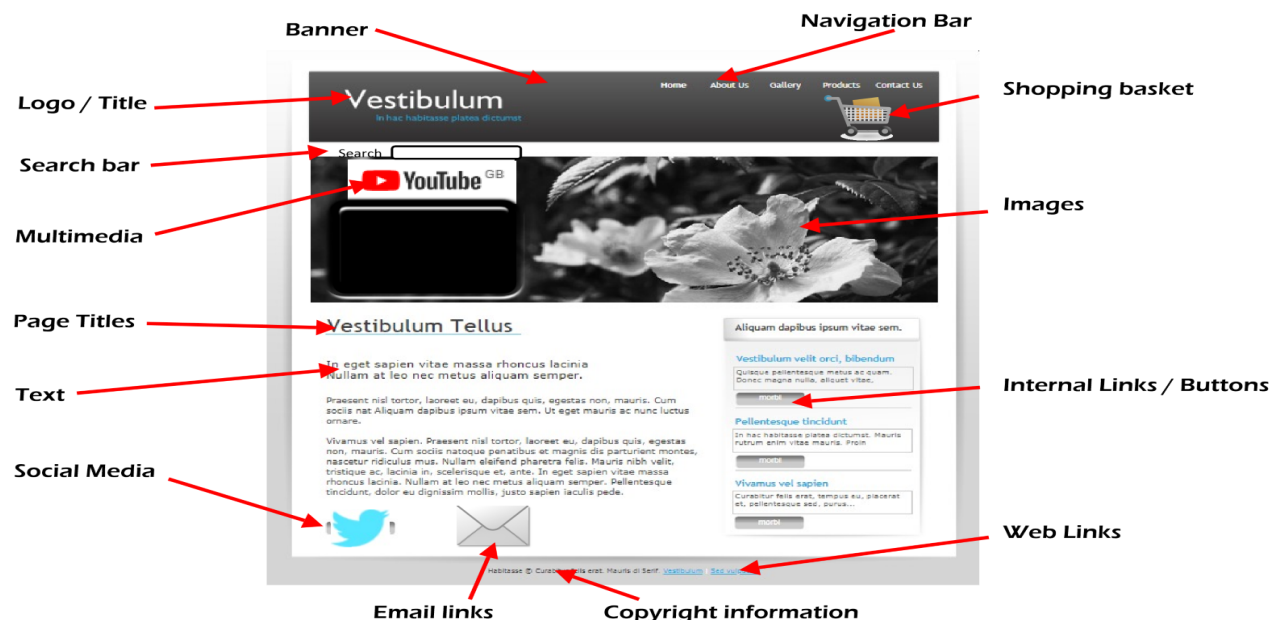
Interactive elements: e.g. rollovers, animations, games, adverts, surveys, forums, quizzes, comment boxes, audio files

Year 11– iMedia(ICT) – R085

Research	Plan	Create	Review
Þ **Refer to client specification** Þ **Target** **Audience** Þ **Identify** **existing** **solutions.** Þ **Is** **the project** **achievable** Þ **Target** **audience** Þ**Technology needed to complete the project**	Þ Layout Þ Colours Þ Fonts Þ Media Þ Content Þ User needs Þ House Style Þ Charts Þ Equipment	Þ Assets Þ Templates Þ Images Þ Logos Þ Text Þ Media Þ Hyperlinks Þ Forms Þ Testing plan	Quality Þ Testing Þ Fix errors Þ Obtain feedback Þ Check fit for purpose Þ Improvement Þ Meets client requirements Þ Use target audience and client feedback

Keywords

Word	Meaning/Description
Website	A collection of web pages linked together.
Webpage	A document which can be displayed in a web browser such as Firefox, Google Chrome, Microsoft Internet Explorer or Edge, or Apple's Safari.
Navigation Bar	A navigation bar is a user interface element within a webpage that contains links to other sections of the website.
Rollover Image	Allows you to have two images and when the pointer hovers over one, it changes to another image.
Hyperlink	A button, text or image that allows you to move around a website.
Hotspots	An area on a computer screen which can be clicked to activate a function, especially an image or piece of text acting as a hyperlink.

Required Evidence	Examples of evidence
Written and presentation files	• Electronic files/evidence • Written report/presentation
Client requirements	• Written report, presentation, audio commentary
Planning Documents	• Work plan, asset table, visualisation diagram and test plan
Finished product	• An website product.
Review	• Written report, presentation or recording

Year 11– iMedia(ICT) – R085

Using the planning techniques should enable you to be able to produce a visualisation diagram or sitemap of the website that is in your client brief.
It should represent the full consideration of the client brief.
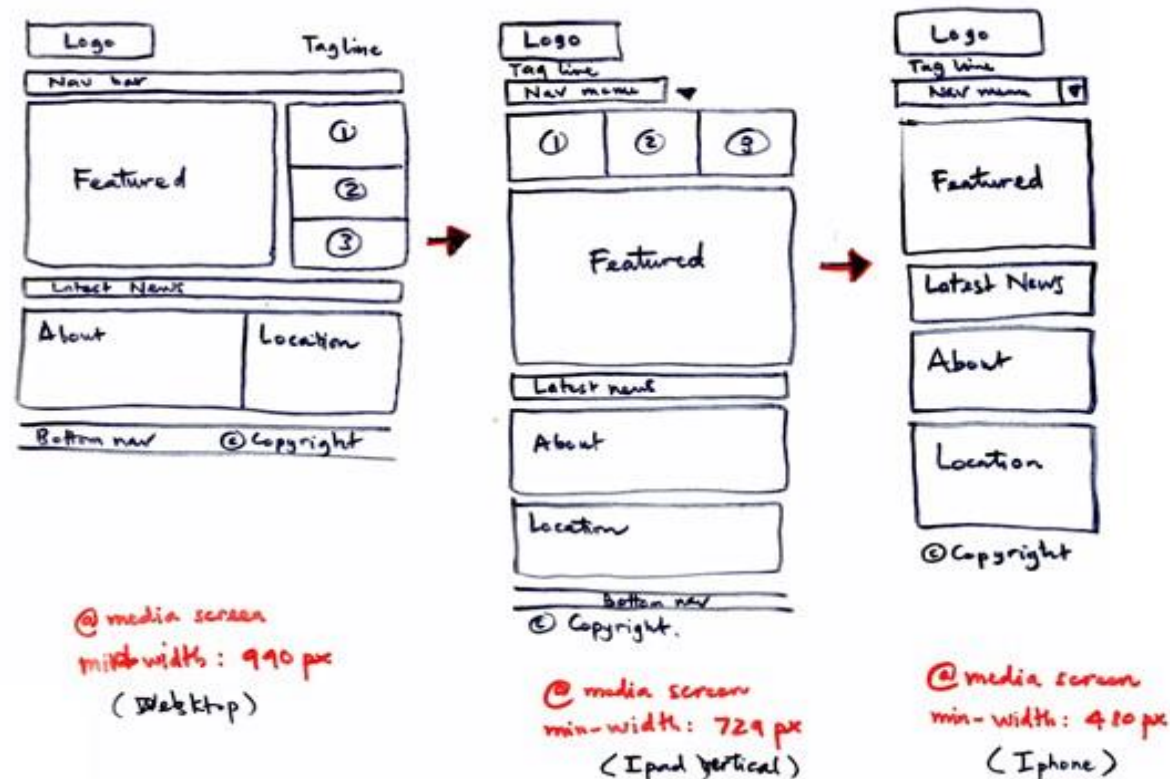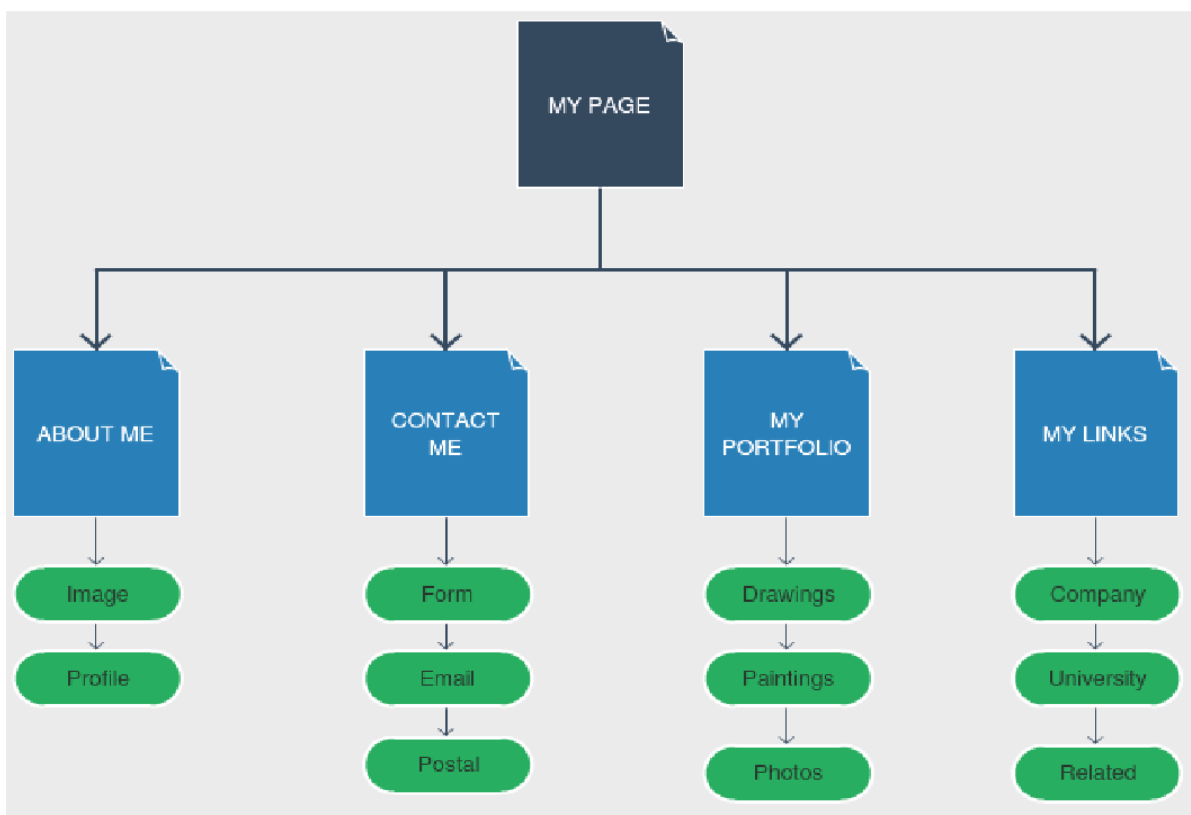
Visualisation diagrams and storyboards are always produced prior to creating the multimedia project.
They assist in the development of the project ensuring that all the client's requirements have been fulfilled before the expressive task of creating the media begins.
Sitemaps and visualisation diagrams are never edited once the multimedia product has been completed, so some differences are expected to be seen.

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What is a test plan and where will I use it?

Example of a test plan

Test	Pass/Fail	Comments	Re-test	Result

What are you testing?.

Did it work or not?
Did it pass or fail?

Add comment on why it pass/fail

If it failed the first time and you've made changes, did it pass the second time?

What was the final result of all the testing done?

All the links work correctly

It is suitable for the target audience and purpose

It is free from errors

It looks professional

Interesting and relevant images used

It is interesting to read

Think about the following when you test your product :
- Checking   if all links work correctly.
- Checking for errors.
- Whether interesting and relevant images were used.
- Whether it looks professional.
- If it suits their target audience.

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Copyright Protection

- Copyright protection starts as soon as a work is created .
- Once your copyright has expired, anyone can use or copy your work .
- The length of copyright depends on the type of work .

Type of Work	How long Copyright Lasts
Written, dramatic, musical and artistic work	70 years from when it's first published
Films	70 years after the death of the director, screenplay author and composer
Broadcasts	50 years from when it's first broadcast
Layout of published editions of written, dramatic or musical works	25 years from when it's first published

Copyright Infringement

Copyright is infringed when any of the following acts are done **without permission** , whether directly or indirectly and whether the whole or a substantial part of a work is used:

- copying the work in any way
- issuing copies of the work to the public
- renting or lending copies of the work to the public
- performing, showing or playing the work in public
- broadcasting the work or other communication to the public by electronic transmission
- making an adaptation of the work .

- Conviction in the magistrates' court the maximum term of incarceration in the UK for copyright infringement is 6 months and/or a fine of up to £50,000.
- Conviction in the Crown Court the maximum term of incarceration in the UK for copyright infringement is 10 years and/or an "unlimited" fine .

Creative Commons Marks

Some creators **Creative Commons** to release and enable free distribution of work that would otherwise be regarded as eligible for copyright protection.

There are sometimes conditions (additional logos) associated with the creative commons licences (see table.)

Icon	Right	Description
	Attribution (BY)	You may copy, distribute, display and perform the work and make derivative works and remixes based on it only if they give the author or licensor the credits (attributio n).
	Share -alike (SA)	You may distribute derivative works only if it is not modified.
	Non -commercial (NC)	You may copy, distribute, display, and perform the work and make derivative works and remixes based on it only for non -commercial purposes.
	No Derivative Works (ND)	Your may copy, distribute, display and perform only verbatim copies of the work, not derivative works and remixes based on it.

Creative Commons Marks

Creative commons **Zero Mark** is a way to release as many copyright restrictions possible to anyone internationally.

The creative commons **Public Domain Mark** indicates works that is already released for public use and is free of any known copyright restrictions.

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What types of sources/assets can be collected to use in website design?.

Example of an assets table – this is how you can keep a record of all the assets you have collected or created to use while creating your website.

Asset	Properties	Source	Legal issues	Use

Name of the assets That you have Used/Created.

Tell the moderator a Bit more about the Properties of the Assets. This can Include size, type, Format etc

This can either be a Primary source or a Secondary source. Primary source is Something you have Created or took Yourself. Secondary Is when this is a Source that belongs To someone else e.g News article, video Or logo.

For secondary Sources, is it Copyright protected? Do you have? Permission to use This asset?

Where have you Used this asset? Example is "Animated banned Used on all web Pages" or "image of Street food used on The Culture" Webpage.

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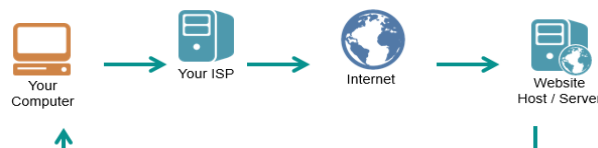
Possible Careers:

- Web designer
- Data Analyst
- Programmer

The Internet

The Internet also known as WWW which stands for **World Wide Web** is a network of online content formatted in a code called HTML. These are interlinked HTML pages that can be accessed over the Internet.

It provides space for a wide range of information like documents, content and videos

(1) When connecting a computer to a website, the user needs to have an internet service provider which is also known as an ISP.
(2) The ISPs are responsible for making sure you can access the Internet, routing Internet traffic, resolving domain names, and maintaining the network infrastructure.
(3) The website host server stores the webpages for individuals and organisations. Websites are **hosted**, or stored, on special computers called **servers**

Hyperlinks

A **hyperlink**, or simply a link, is a link from a document to another document or part of the document that the user can follow by clicking or tapping on.

Keywords	Definition
Tag/s	are the hidden keywords within a web page that define how your web browser must be formatted and displayed e.g. **\<title>**
Html	Stands for **Hypertext Markup Language** is the standard markup language for documents designed to be displayed in a web browser
Http	transfers web pages from web servers to the client. All web page addresses start with http
Code	Is the set of instructions forming a computer program which is executed by a computer
CSS	**Cascading style sheets** are used to format the layout of Web pages
Webpage	are HTML documents that present images, sound and text accessed through a web browser

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```
<!DOCTYPE html>
<html>
<head>
<title>My First Webpage</title>
</head>
<body>
<h1>My First Heading</h1>
<p>My first paragraph.</p>
</body>
</html>
```

My First Heading

My first paragraph.

HTML TAG	Definition – What does it do?
<html>	Root of a HTML document
<boy>	Content of the page
<head>	Information about a page
<title>	Tab title/ defines title
<h1>, <h2>, <h3>	Headings
<p>	Paragraphs
<img>	Image
<a>	Anchor (used in hyperlinks with href)
/	Ordered/unordered list
	List item
<table>	Creates and defines tables
<tr>	Table row
<td>	Table data
<div>	Divider

CSS Script	Definition – What does it do?
Colour	Font colour
Text-align	Horizontal alignment
Background – Colour	Changes background colour
Background – Image	Change background image
Background - Repeat	Changes the background to stay in place or move when scrolled

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Learning Aim A: Investigating individual circumstances that may impact learning and development

	Key Terminology		
Restricted gross motor skills	A child is unable to control the large muscles in their bodies compared to other children their age	Care/educational providers	Settings that provide formal care or education for children
Restricted fine motor skills	A child is unable to control the small muscles in their hands and fingers compared to other children their age	Family structure	The way in which a family is organised
Delayed gross motor skills	The large movements of a child's body are not progressing as quickly as other children their age	Expected milestones	Development that is expected at a particular age
Delayed fine motor skills	The small movements of a child's hands are not progressing as quickly as other children their age	Initiate play	To start play
Poor concentration levels	When children find it difficult to focus on what they are doing	Navigate	Move with planned direction
Delayed literacy skills	When a child's reading and writing skills are not progressing as quickly as other children the same age	Preferences	Things that children prefer to do
EAL	English as an additional language	Lack of responsiveness	Not responding to people
Negative role model	Someone who does not set a good example	Emotional resilience	A person's ability to adapt to stressful situations
Social norms and values	Attitudes and behaviours that are considered normal in society	Positive relationships	A relationship between two people that makes them happy
Disruptive behaviour	Unwanted behaviour that disturbs and interrupts activities	Expression	The action of making known ones thoughts and feelings
Transition	A change in a child's life	Routine	A sequence of actions that is regularly followed

Circumstances that may impact on a child's learning			How they may affect learning
Physical circumstances		These may include sensory impairments, restricted fine and gross motor skills, and delayed gross and fine motor skills.	A child may not be able to access learning at varying levels, grasp and manipulate small objects and to navigate play areas. Children may also tire easily and not be able to sustain involvement in activities,
Cognitive circumstances		These may include poor concentration levels and delayed literacy skills	A child may not be able to understand the rules of play,
Communication and language circumstances		These may include English as an additional language and a child who has a language and communication delay	A child may have difficulty communicating preferences and choices, and play with others may be limited due to lack of responsiveness
Social and emotional circumstances		These may include negative role models, difficulty forming friendships with other children, disruptive behavior and transitions such as death of a loved one, birth of a new sibling and moving house.	A child may have poor emotional resilience, may isolate themselves, refuse to join in play with others and may have low self-esteem. A child may also have limited expression of thoughts and feelings and find it difficult to build positive relationships with others.

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Learning Aim B: Creating safe environments to support play, learning and development in children aged 0 – 5 years

Key Terminology

Risk	Likelihood of an environment, activity or resource causing harm
Hazard	Potential for an environment, activity or resource to cause harm
Risk assessment	A process of evaluating what might cause harm to people and making sure things are in place to manage the risk
Positive risk taking	Balancing the potential risk of harm against the benefit of children participating in activities
Adult to child ratio	The number of adults to the number of children
Stimulation	Giving something interest, enthusiasm or excitement
Role model	A person looked to by others as an example to be imitated
Intrusive	Causing disruption or annoyance through being unwelcome
Smart device	Allows us to connect different devices or networks
Parental controls	Software and tools that can be installed on internet enabled devices
Personal information	Private details about someone e.g. date of birth, full name, address
Inappropriate content	Information online that could upset a child, including violence and bad language
Trip hazard	Objects on the floor that cause someone to trip and fall
Toileting needs	The need to use the toilet
Accessibility	How easy it is for an area to be reached

Health and safety considerations of inside environments

Layout of furniture	Width of doorways and corridors
Types of flooring and floor coverings	Layout of furniture
How resources are organised	Use of specific areas for play

Ensuring Children are safe

Manage risks and hazards		An adult must consider the hazards and risks when planning an activity. Children should also be taught how to explore and take risks in a positive way, learning how to judge risks for themselves. Adults should use safety features such as the BSI kite mark, age advice symbols and the CE mark to ensure the suitability of resources.
The role for the adult		Adults have a responsibility to plan play activities, ensure the correct adult to child ratio and model appropriate behaviours. Adults must be available but not intrusive and ensure the play is age appropriate.
Internet enabled technology		Adults need to teach children how to be safe online, including not sharing personal information or befriending strangers. Controls must be put in place by adults, and also talk to children about internet safety.

Health and safety considerations of outside environments

Appropriate clothing	Planning ahead for hunger, thirst, toilet breaks etc.	
Accessibility – how children may enter and exit buildings	Choice of outdoor play resources	Noisy or quiet play spaces – use of signs and maps

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Learning Aim C: Adapt Play to promote inclusive learning and development

Key Terminology

Inclusive	Including everyone
Right to learn	A moral or legal entitlement to have an education and learn
Desired behaviours	The way in which we want children to behave
Additional needs	A term used to indicate that a child requires extra support or services to enable them to participate fully in activities
Positive behaviours	Behaviours that are good and desired
Communication methods	The different ways in which we can **communicate** with each other
Sensory needs	Difficulty seeing or hearing
Contrasting colour schemes	The change of appearance of a colours surrounded by another colour
Social inclusion	The process of joining in with others
Alternative communication	Forms of communication used instead of or along with talking
Picture exchange communication system (PECS)	A form of alternative communication which allows children with little or no communication abilities to communicate using pictures
Makaton	A language programme using signs and symbols to help children to communicate
Identification of words	To establish what words mean

Adapting activities/resources to support a child with physical needs

Make adjustments to the environment	Choose age appropriate resources
Select resources that ALL children can hold and grasp	Secure moveable objects with tape etc..
Adjust the level of desks and chairs etc	Provide materials for sensory needs e.g. contrasting colours

Adapting activities/resources to support a child with cognitive/intellectual or communication and language needs

Allow children to play together and share ideas and promote social inclusion	Shorten activities to suit a child's concentration span	Use Makaton or PECS
Use peers or other adults to model activities	Break tasks down into smaller steps	Label equipment with pictures
Modify toys to suit needs e.g. less parts etc.	Use digital resources where appropriate	Display routines as pictures

Adapting activities/resources to support a child with social and emotional and language needs

Promote self resilience	Provide a structured approach to activities
Choose activities that focus on a child's interests	Promote choice to allow the child control over resources to complete an activity
Allow expression of thought	Promote group activities to build confidence

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HEALTH & WELLBEING IMPROVEMENT PLANS

Health Improvement Plans	When creating improvement plans follow these steps:
- Health Improvement plans should be based on the individuals physiological and lifestyle indicators. - Should be person centered and include goals, actions, targets and identify support **Person Centered Approach** -Puts the individual at the heart of their health improvement plan. Takes into account the individual's **needs, circumstance and wishes** **Needs** = PIES **Wishes** = Likes, dislikes, choices, desires **Circumstances** = Illnesses, accesses to facilities, time, commitments, experience	1. Identify the health issue & goal 2. Recommended actions to take 3. Set Targets for health improvement 4. Identify support needed 5. Identify possible obstacles and ways to overcome

Sections of an Improvement Plan	Definitions	Improvement Plan Examples		
Goals	From the case study you will be about to **identify goals** for health improvement	Reduced BMI	Stop smoking	Improve mobility
Recommended Actions	For each goal you need to suggest an **action**	Eat a healthier diet and exercise more	Use nicotine substitutes	Start an exercise routine
Targets	Challenges to help a person complete the action. SMART Targets are more likely to be successful. These are: Specific = an exact goal, clearly explained Measurable = so that progress can be assessed Achievable = possible for the person Realistic = suitable for the needs and circumstances Time-related = has a deadline **Short Term Targets** = less than 6 months **Long Term Targets** = 6 months to a year	**Short Term** = Within 6 weeks exercise twice a week and stop snacking in-between meals **Long Term** = Within 6 months exercise 3 times a week and eat less than 1800 calories a day.	**Short Term** = Cuts down to 5 cigarettes a day within 1 month **Long Term** = Shorts completely within 10 months.	**Short Term** = Within 6 weeks walk for 20 mins every other day. **Long Term** = Join a gym and attend regularly within 6 months

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Formal Support

Provided by health professional who are paid and trained. Either primary, secondary or tertiary

Primary care	**Healthcare provided in the community for all individuals. The individual makes the initial approach to a medical professional.**
Health centre	• Measures & interprets BMI, pulse, blood pressure & peak flow • Advises on lifestyle risks – ie smoking, alcohol and drugs • Works with people to produce health improvement plans & monitor health • Prescribes treatment • Refers to other health professions
Dental Surgery	Run daily clinics to diagnose and treat dental issues. Tasks include: advice, clean teeth, perform minor surgeries.
Opticians	Examine eyes for vision problems, diagnose and treat eye disease, prescribing glass & lens if needed.
Pharmacy	Give advice on minor conditions, recommend medication and dispense prescriptions. Provide aids such as nicotine replacement therapies and blood pressure monitors
Secondary	**Primary care professional refers you to a specialist, you are then in secondary care.**
Cardiologist	Specialises in diagnosing and treating diseases of the heart. they may carry out tests, and they may some do procedures and surgeries.
Psychologist	Assess, diagnose and treat individuals suffering from mental distress and mental illness
Physiotherapist	Treats people who have mobility, breathing and neurological problems
Orthopaedics	Specialise in disorders of eye movements and diagnostic procedures related to disorders of the eye and visual system.
Tertiary Care	**Patient needs higher level of care within the hospital. Tertiary care requires highly specialised equipment and expertise.**
Dermatology	Dermatologist specialises in treating skin, nail and hair disorders.
Psychiatry,	They make a diagnosis and work with you to develop a management plan for your treatment and recovery for mental illnesses.
Allied Professionals	**Professionals who may not be medically trained but use their knowledge to support peoples health.**
Podiatrist	Provides essential foot care for individuals with diabetes, circulatory and nerve damage.
Art therapist,	Helps people who have behavioural and emotional problems by using drawing, painting and other art.
Dietician,	Uses their expert knowledge about the science of food to advise and support individuals in their dietary needs.
Social worker	Provide advice, support and resources to individuals and families to help them solve their problem
Youth Worker	Personal and social development. Support for young people between 11-25.

Informal Support

Provided by people who are not paid to provide help

Partners Family Friend Neighbours Work Colleagues	They can: o Follow same health plan o Reassure o Praise progress o Help overcome barriers

Types of formal support & organisation

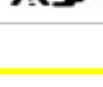- **Physiological measuring aids** – blood pressure, weighing scales etc...
- **Medication**
- **Practical support** – DVDs, healthy menu plans and routine advice
- **Advice and leaflets**
- **Emotional Support**
- **Support Groups:**
  - **Alcohol:** Alcoholics Anonymous
  - **Diet:** Weight Watchers
  - **Diet & Exercise:** Change4Life
  - **Smoking:** QUIT
  - **Drugs: Talk to Frank,** Action on Addiction
  - **Social Isolation of elderly :** Age UK

Potential Obstacles

Emotional	Low self-esteem, lack of motivation, acceptance of current health situation
Time constraints	Lack of time because of work or family
Resources	Lack of financial resources, equipment or opportunities
Lack of Support	Lack of informal or formal support. Not able to access services
Access to services	Geography, culture or language means you cannot get to/access services
Individual specific	Factors specific to the individual, such as age, gender, disability, illness or addiction

SERVICES

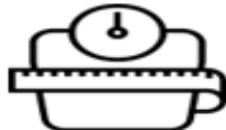|	
Primary care	**Healthcare provided in the community for all individuals. The individual makes the initial approach to a medical professional.**
General Practitioners (GP)	Treat all common medical conditions and refer patients to hospitals and other medical services for urgent and specialist treatment
Nurse	Practice nurses provide nursing and health care support, duties include vaccinations, new patient assessments and monitoring patients with long term conditions
Dentist	Dentists run daily clinics to diagnose and treat dental issues. Tasks include: advice, clean teeth, perform minor surgeries.
Optician	Examine eyes for vision problems, diagnose and treat eye disease, prescribing glass & lens if needed.
Pharmacist	Give advice on minor conditions, recommend medication and dispense prescriptions.
Walk in Centres	Provide routine and urgent treatment for minor injuries. No appointment needed.
Secondary care	**Primary care professional refers you to a specialist, you are then in secondary care.**
Cardiologist	Specialises in diagnosing and treating diseases of the heart. they may carry out tests, and they may some do procedures and surgeries.
Psychologist	Assess, diagnose and treat individuals suffering from mental distress and mental illness
Physiotherapist	Treats people who have mobility, breathing and neurological problems
Orthopaedics	Specialise in disorders of eye movements and diagnostic procedures related to disorders of the eye and visual system.
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Social worker	Provide advice, support and resources to individuals and families to help them solve their problem
Youth Worker	Personal and social development support for young people between 11-25.

ILLNESSES

Asthma		Your **airways are sensitive** and become inflamed and tighten when they breathe if anything irritates them. This ca cause **tightness** and **wheezing** and make it hard to breathe
Diabetes Type 2		A condition that causes **high levels of glucose** in your blood because you have a problem with producing insulin. This means the glucose stays in the blood stream and can't be used to give you energy.
Dementia		**Memory loss** can be a problem. Risk increases with age
High Blood Pressure		When your **blood pressure**, the force of your **blood** pushing against the walls of your **blood** vessels, is consistently too **high**.
Autism		A disorder affecting brain development. It may affect the way a person relates to their environment. Some people find interacting more difficult than others.
Hearing Impairment		Is a **partial or total inability to hear**
Speech Impairment		A condition in which the ability to produce **speech** sounds that are necessary to communicate with others is **impaired**.
Mobility		**Mobility** refers to whether you can move an injured body part, like a joint or a limb.
Skin Conditions		Acne, **eczema**, seborrheic dermatitis, skin cancer and psoriasis are the five most common skin disorder
Gum Disease		**Swelling** of the soft tissue and abnormal loss of bone that surrounds the teeth and holds them in place.
Incontinent		Any **accidental or involuntary loss of urine** from the bladder or bowel motion, faeces or wind from the bowel.

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Physical Barriers

Physical barriers are the structural difficulties that may limit service users' access. Includes- doors not being wide enough, uneven surfaces, lifts not working, no ramps etc.

Overcome - planning access before travel, amendments made to building to support equal access, consideration and careful planning of the services which need to be accessed.

Sensory Barriers

Sensory barriers are when an individual has an impairment which impacts their senses. Includes vision loss or hearing loss which may make process more difficult for them and cause them distress.

Overcome - by amending environments to support them or providing them with adaptive equipment to make their access easier.

Social, cultural and psychological barriers

Social Barriers - linked to stigmas within the community; this could be stereotypes, addiction or opening hours of services.
Cultural barriers- may be limitations linked with their traditions, religion or beliefs. This may include: Gender of professionals or belief in treatments being offered.
Psychological barrier- may be fear, anxiety, mental illness, self-diagnosis or negative experiences that limit access.
Overcome - taking individual's preference's into consideration when offering services, making reasonable adjustments and, having a wider variety of professionals available to support.

Language barriers

Language barriers are when verbal communication struggles to be corresponded between two people or a group. This may be due to not speaking the native language, learning difficulty which impacts speech, use of improper English etc.

Overcome - by having translators in place to support the transition to a common language, use of alternative communication methods such as images and interpreters.

Geographical Barriers

Geographical barriers are when services cannot be effectively utilised due to their location. This may be due to fuel prices, public transport, and distance to the service.

Overcome - by voluntary services supporting with transport, having mobile units to provide treatment, or refunding fuel and car parking charges for long term health patients.

Intellectual Barriers

People with intellectual disabilities may be due to genetic conditions, childhood illnesses, or they may be uneducated and struggle to learn.

Overcome - breaking down information to the ability of the service user and reiterate key points, avoid noisy areas so information is clear, involve a family member or advocate as someone who can also be aware to repeat the information when required.

Resource Barriers

Resource barriers are when services struggle to provide adequate equipment, treatments and building to support the growing needs of service users. Also, having a lack of staff can affect how the services are provided and the quality of care people receive.

Overcome - government can redistribute funding to meet the needs of all, organising skills and equipment to make the most of what is available, reducing waste and amending ideas to stretch the availability of resources.

Financial Barriers

Financial barriers links to the use of money. This may be travel expenses, paying for services, or not having any disposable income to pay for preventative services.

Overcome - by the NHS having financial exemptions for vulnerable people, having services free at point of contact and also to refund expenses to ensure that services users are not missing out services due to their income.

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Health Indicators to discuss			What?	Abnormal Reading?	Risks	Causes
Physiological		BLOOD PRESSURE	Pressure exerted by the blood against the artery walls.	High Blood Pressure is 140/90 mm Hg Low Blood Pressure is 90/60 mm Hg or lower A Blood pressure chart is used to interpret measurements	Hypertension Heart Disease Stroke Kidney Disease Dementia	Lifestyle Diet Genetic Lack of Exercise Stress Overweight
		BODY MASS INDEX	• A way of measuring the amount of body fat. • Based on height and weight and can be found on a published chart. • Normal Reading 18.5-24.9	Underweight = <18.5 Overweight = 25-29.9 Obese = 30-34.9 Severely Obese= 35>	Underweight – Anaemia, Weak immune system, osteoporosis Overweight – Heart Disease, stroke, diabetes, arthritis	Poor diet (too many calories, too much fat) Lack of exercise Alcohol intake
		PEAK FLOW	• Measures the speed a person can expel air from their lungs • Assesses health of lungs	• Low readings could indicate problems • People readings will depend on sex and height and you need to use a peak flow chart to assess	• Asthma • Emphysema • Bronchitis • Cystic Fibrosis • Lung Cancers	Any lung condition that decreases air flow will result in abnormal readings.
		PULSE RATE	Measures how fast the heart beats per minute (bpm) Indicates the level of a person's health & physical fitness.	Average is between 60-100bpm for an adult High than 100bpm at rest is abnormal	Dizziness Heart Attack Stroke High Blood Pressure	Lack of exercise Overweight High stress levels Smoking
Lifestyle	SMOKING		ALCOHOL INTAKE	DIET		LEVEL OF EXERCISE

Need to be able to use these charts to understand people's current physical health

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BMI Chart

Blood pressure chart — Systolic (top number) vs Diastolic (bottom number): High blood pressure, Pre-high blood pressure, Ideal blood pressure, Low

PEF (L/min) vs Age chart

Resting Heart Rate Chart

Men (beats per minute)

Age	18 - 25	26 - 35	36 - 45	46 - 55	56 - 65	65 +
Athlete	49 - 55	49 - 54	50 - 56	50 - 57	51 - 56	50 - 55
Excellent	56 - 61	55 - 61	57 - 62	57 - 63	57 - 61	56 - 61
Great	62 - 65	62 - 65	63 - 66	64 - 67	62 - 67	62 - 65
Good	66 - 69	66 - 70	67 - 70	68 - 71	68 - 71	66 - 69
Average	70 - 73	71 - 74	71 - 75	72 - 76	72 - 75	70 - 73
Below Average	74 - 81	75 - 81	76 - 82	77 - 83	76 - 81	74 - 79
Poor	82 +	82 +	83 +	84 +	82 +	80 +

Women (beats per minute)

Age	18 - 25	26 - 35	36 - 45	46 - 55	56 - 65	65 +
Athlete	54 - 60	54 - 59	54 - 59	54 - 60	54 - 59	54 - 59
Excellent	61 - 65	60 - 64	60 - 64	61 - 65	60 - 64	60 - 64
Great	66 - 69	65 - 68	65 - 69	66 - 69	65 - 68	65 - 68
Good	70 - 73	69 - 72	70 - 73	70 - 73	69 - 73	69 - 72
Average	74 - 78	73 - 76	74 - 78	74 - 77	74 - 77	73 - 76
Below Average	79 - 84	77 - 82	79 - 84	78 - 83	78 - 83	77 - 84
Poor	85 +	83 +	85 +	84 +	84 +	85 +

agelessinvesting.com

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BTEC Performing Arts – Component 1 – Exploring the Performing Arts- Learning Aim A

Practitioner	Style	Key Stylistic Features
Bertolt Brecht	Epic Theatre	**Alienation:** Using sing, placards, pitch and pace to make the audience distance from the action on stage. **Gestus:** To give a character a clear and over exaggerated gesture they must use when they come on stage **Political themes:** Brecht wanted the audience to think about the corruption of the world they live in.
Frantic Assembly	Physical theatre	**Chair Duets:** Using two chairs create a continuous string of movements. Add emotion. Add pace to speed up or slow down sections. **Hymn Hands:** Use hands to mirror what your partner is doing– or grab the hands or shoulders for effect. **Round-by-through:** Moving around the body. Go through another actors' arms to create a spiral effect.
Jerome Robbins	Book Musical	**Allegory for Romeo and Juliet:** based on this story- however focusses on the love of a Jew and a Catholic **Theme of Love:** The love Tony felt for Maria and Romeo for Juliet made them defy their families, their friends and their social world. Their love is strong and forceful, so much so that it made them revolt against the very world they revolved in and, sometimes, even against themselves **Theme of Society:** **Racial inequality** Jets Vs Sharks= Jews vs Catholics **Gender Roles** in the song "America" we see how men and women view America very differently.

Keyword	Definition
Book Musical	A musical where the music, lyrics and script follow a well thought out narrative.
Creative Intentions	The theme, issues within a play or the style. Why did the director choose each of these?
Epic Theatre	A form of didactic theatre where the scenes are episodic and follow no narrative. Often political.
Focus	Not laughing while you are on stage and staying in character.
Genre	The style of a theatre.
Physical Theatre	a form of theatre which emphasizes the use of physical movement, as in dance and mime, for expression.
Practitioner	A person who pioneered a style of theatre.
Purpose	The reason a piece of theatre exists. Example: to put across a political message.

Keyword	Definition
Responsibilities	What someone in the theatre is required to do. Director- have a vision and tell the actors what to do on stage.
Role	A job role within theatre: director, actor, stage manager, lighting designer etc.

Director

To have a vision for the production.
To be in charge of telling actors where to go and what to do
To tell the other role holder on the production what they need to do to bring your vision to life.

Choreographer

To design the movement for the show.
To teach the movement to the actors/ dancers
To the liaise with the director about their vision

Costume designer

To design the costumes for the actors.
To take accurate measurements or the actors.
To liaise with the director and ensure that costumes are in line with the setting and time of the production.

Set designer

To design the set for the show.
To build and paint any set required.
To liaise with the director about the context and vision of the show.

BTEC Performing Arts – Component 2 – Developing Skills and Techniques in the Performing Arts

Steps to a good monologue or duologue.

Choose your monologue.
Can I play this character?
Can I use **characterisation**?
Is it 3-5 minutes?

Choose a style to perform in.
Naturalism, Epic, Physical Theatre

Take notes in workshop lessons to add specific techniques to your performance.

Use **Line Memory Recall** to learn your lines

Take on feedback from teachers and keep a verbal feedback log to help with this.

Practice performing to peers and family.

Steps to use Line Memory Recall.

Start with the first line. While looking at it, repeat it ten times.

Cover up the line and attempt to say it without looking. If correct, move to next step. If wrong, start again.

Then add the second line. Say it ten times while looking at it.

Cover up the line and attempt to say it without looking. If correct, move to next step. If wrong, start again.

Repeat until all lines are memorised.

Keyword	Definition
Articulation	Pronouncing the consonants and vowels in your words clearly so you can be understood.
Characterisation	Creating a believable character on stage. Becoming the character.
Facial Expression	Showing your emotion through your face.
Focus	Not laughing while you are on stage and staying in character.
Gesture	Using your hands to show the audience where to look through pointing, waving etc.
Line Memory Recall	A technique used to remember lines. Repeat one line with the rest covered up.
Mannerism	A movement which your character would do without thinking. Example: A twitch or playing with hair.
Pace	The speed at which you say something or do a movement to convey the emotion of your character.
Pause	To use your breath to create suspense within a line or a key moment.
Pitch	How high or low your voice is to convey emotion.
Projection	Using a loud volume to make sure you are heard.
Reaction	What did they say? How would your character respond?
Vocal Tone	Showing emotion through your voice.

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BTEC Performing Arts – Component 3 – Responding to brief

Milestone 1- Ideas Log:

1. What is the concept and style of your performance?

2. What is your target audience and why did you decide on this?

3. What resources do you think you will need to develop and perform your performance?

4. How do your ideas for the performance meet the brief ?

5. How has the work of Pantomime, Stanislavski, Frantic Assembly or any other practitioners influenced your performance?

6. What ideas have you contributed to the performance plan? Were these successful? Why?

7. How did you come up with the ideas you have

Milestone 2- Skills Log:

1. What was your role in the group? (director, performer etc)

2. Which style did you choose? Why?

3. Which techniques and skills did you choose? Why did you choose them?

4. What work have you done individually to help the group? (research, rehearsal leading, choreographing movement etc)

5. How did the resources you chose aid your performance?

6. What would you change or improve?

Milestone 3- Workshop Performance:

- You must present your group workshop performance or pitch/presentation to an invited audience.

- The group workshop performance must be between 10 and 15 minutes long.

- You will need to perform as part of a group and work well together.

- You will be assessed on your individual skills and techniques, collaboration with others and communication of creative ideas to the audience through your role.

Milestone 4- Evaluation Report:

1. How did the result of your performance meet the brief?

2. How did you process and ideas develop through this project?

3. Was the outcome of the performance what you wanted? What did the audience learn?

4. What were the key strengths of your group's performance?

5. What were the key strengths in your individual performance?

6. What would you improve upon given the chance again? Why would you change this? How would that help your performance meet the brief?

Keyword	Definition
Articulation	Pronouncing the consonants and vowels in your words clearly so you can be understood.
Characterisation	Creating a believable character on stage. Becoming the character.
Facial Expression	Showing your emotion through your face.
Focus	Not laughing while you are on stage and staying in character.
Gesture	Using your hands to show the audience where to look through pointing, waving etc.
Line Memory Recall	A technique used to remember lines. Repeat one line with the rest covered up.
Mannerism	A movement which your character would do without thinking. Example: A twitch or playing with hair.
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Projection	Using a loud volume to make sure you are heard.
Reaction	What did they say? How would your character respond?
Vocal Tone	Showing emotion through your voice.

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ORMISTON
SWB ACADEMY

Final Design:
- Drawn Isometric from more than one view
  - Exploded component or section

Initial Ideas: use existing products and your specification to inspire ideas.

THE DESIGNER

Assess and Evaluate ideas:
- How does it meet the spec and user needs?
  - How can it be improved further?

Modelling:
1. Model some of your developed ideas in 3D to see proportions more clearly
2. Model ideas virtually using CAD software to manufacture prototype parts

Developed drawings: choose an initial idea and then apply the improvements.

Assess and Evaluate ideas:
- How does it meet the spec and user needs?
- How can it be improved further?

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ORMISTON SWB ACADEMY

Final Design

Environment: MDF is more sustainable that Pine and Oak due to its readily availability being a regulable material. Also means it will not harm the environment.

Aesthetics: tesselated shape that follows a step down pattern.

Size: product no bigger than 600mm in length, 300mm in height and 150mm in width.

Cost: Manufactured from MDF, cheaper than Pine due to being recycled before and after its life cycle.

Customer: My target audience for the product will be young adults. This is so it will be attractive to a higher number of people and suite their organisational needs.

Safety: product uses housing & finger joints, these are strong so product will not break or collapse when on wall.

Function: the product is to be placed on the wall and act like an ornament but also a storage unit too. It has numerous sections to store items inside and out of product body.

Material: MDF; recyclable, strong for a recycled wood, apply finish with no preparation.

A - Aesthetics (meaning appearance)
C - Cost (meaning a price range)
C - Customer (meaning the person who wants to buy it)
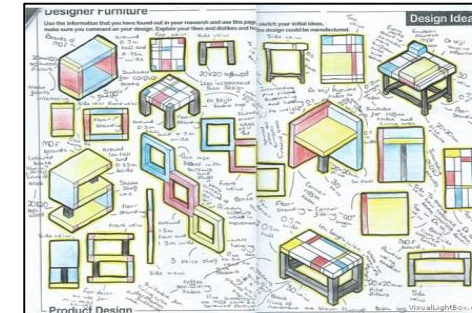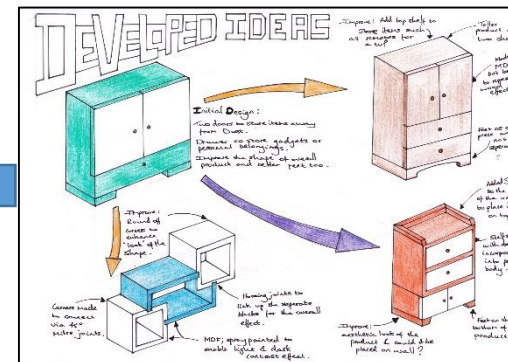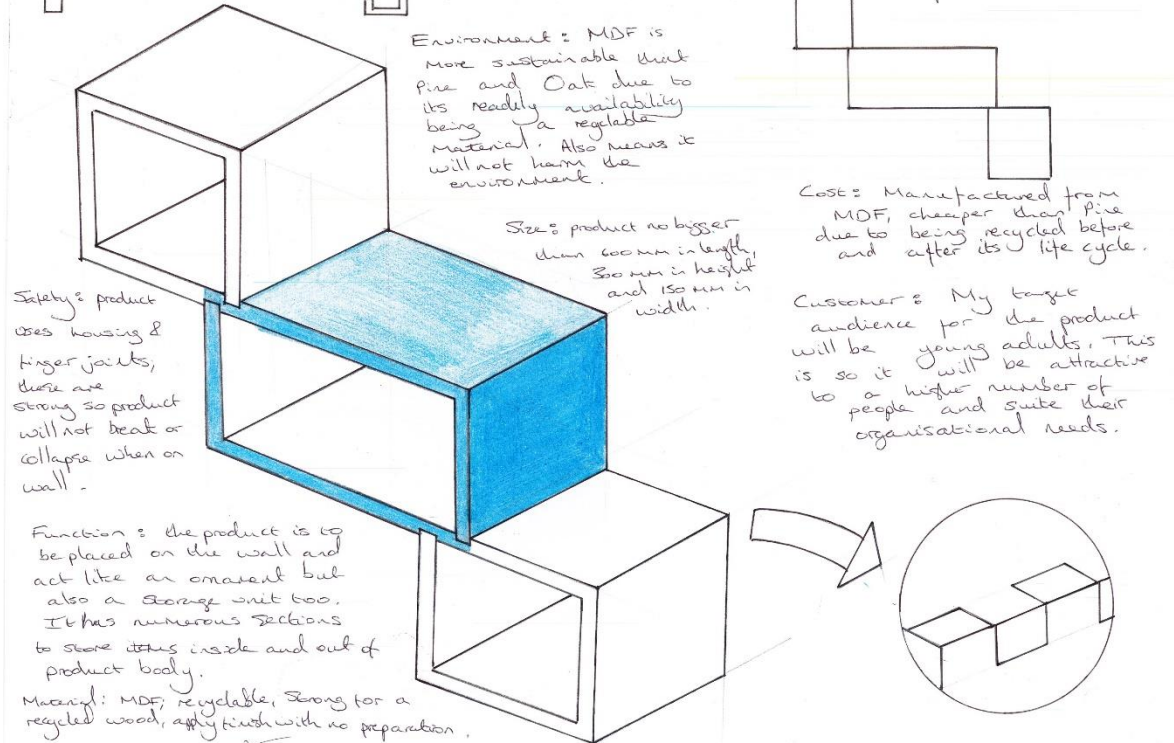**E** - Environment (meaning where it is used and how eco-friendly it is)
S - Safety (meaning how safe it is)
S - Size (meaning how big it is)
F - Function (meaning what job it does)
M - Materials (meaning what materials would you need to make it)

When annotating and analysing your final idea use these hints to assess how good the design is in relation to your brief, specification and user needs.

Final Design Criteria

To achieve a successful final design for your coursework, you need to make sure it contains the following key features:

1) Draw your final design in 3d so all the different views are visible for your teacher and examiner to see.

2) Use the ACCESS FM criteria to analyse the final design, choose a question from each of the key headings and make sure you explain your choice with reasons!

3) Identify a key feature and draw a zoomed in view, the example shown has a zoomed in view of the main joint used for the product frame, a finger joint is shown here.

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Awareness of risks and hazards for making processes
Your health and safety is the most important thing there is.

▪ **Things to consider**

▪ Preparation of work area before you start.
▪ Tidying of work area when you finish.
▪ Follow all health and safety procedures.
▪ Be alert to moving parts.
▪ Ensure machine guards are in place.
▪ Know where the emergency stop buttons are.
▪ Know how to isolate machines after use.
▪ Wear the correct PPE.
▪ Remove swarf, clean spills, put tools away.
▪ Remove burrs and sharp edges.
▪ Complete the risk assessment.
▪ Always leave the workshop as you would expect to find it

Being safe in a workshop does not just mean using tools and processes correctly.
It is important to work in a safe way throughout: when preparing, working and finishing any engineering work.

Making skills
▪ Practice the making skills you are going to need to make your product.
▪ Ensure that you use the correct tools. Make sure they are sharp and ground correctly.

Set-up of work area
▪ No trip hazards or obstructions.
▪ Tools and equipment available.
▪ Clean and tidy work surfaces and general area.

Set-up of machines
▪ Machine in good condition, serviced and maintained properly.
▪ You have the training and required skills.
▪ Correct safety equipment such as fume extraction or ear and eye protection.

Choosing suitable tools

Using the wrong tool will not only ruin your work, but can also be extremely dangerous.

Tools for milling

There are two basic types of milling machine, vertical and horizontal. The milling machine is extremely versatile and can perform many engineering processes using a variety of tools.

▪ Face mill
▪ End mill
▪ Slot drills
▪ Slotting cutters
▪ Slitting saws
▪ Profile cutters
▪ Twist drills

Tools for drilling

You may be familiar with the drilling machine in the workshop, but you may be surprised by the wide range of tools associated with this machine!

▪ Drill bit
▪ Centre drill
▪ Flat bottomed drill
▪ Counterboring tool
▪ Countersinking tool
▪ Reamer (used after the drilling process)
▪ Tap (used after the drilling process)

Lathe tools

The lathe is an extremely useful machine with a huge range of tools available for many different processes.

▪ Turning tool
▪ Facing tool
▪ Form tool
▪ Parting off tool
▪ Single point threading
▪ Boring bar
▪ Recessing tool
▪ Centre drill, twist drill, reamer
▪ Tap and die
▪ Knurling tool

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A **production plan** is a document that sets out the necessary information about all stages of the production process. This helps to ensure that every component is made to the same standards of accuracy and quality.

Developing a production plan

Operations/ processes	Tools and equipment	Materials	Health and safety	Inspection, testing and quality standards	Comments

A production plan includes the following features.

- Operations and processes you will use.
- A list of equipment and tools you will use.
- A list of materials and components you will use.
- Health and safety in the work space you will work in.
- Inspections, testing and quality standards.
- Other comments such as the quantity of engineered product you will be making (for example, one-off, batch or mass production).

Adaptation according to inspected outcomes

- When you check and inspect a component, you may find that it is not quite as it should be, and you will need to make a decision whether or not to **adapt** what you have done, or to start again.
- When a product has been completed in the workshop, it then needs to be **inspected** to see if it fully matches the original specification.
- A customer will not accept a product that is not what they asked for.
- A product that is not safe, or is not capable of correctly doing the job it was designed to do, is also unacceptable.

Skills in observing and recording techniques

Examining an engineered product is a very important step in the engineering design process, because it forms the basis of **quality control**.

When the product you have made has been completed, you will then be required to check every aspect of it, to make sure it is within the **tolerances** allowed in the **original brief and specification**.

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AC 1.1 – Functions of Nutrients	AC 1.3 – Nutritional Deficiencies (-)	AC 1.3 Nutritional Excesses (+)
Carbohydrates provides the body with energy. There are two main types, complex and simple. Complex carbohydrates give long lasting energy. These are found in foods such as bread, pasta and cereals. Simple carbohydrates make blood sugar levels go up very quickly. This provides a short burst of energy. These are found in sugary; foods such as cakes, jams and sweets.	❖ Lack of energy/ tiredness ❖ Weight loss ❖ Severe weakness	❖ Tooth decay (simple sugars) ❖ Raised blood sugar levels ❖ Weight gain
Protein is needed for growth and to repair cells. Protein is made up of amino acids. Proteins that are high in essential amino acids are called high biological value (HBV) proteins. These are found in milk, cheese, fish, eggs, meat and soya beans. Proteins that are low in amino acids are called low biological value (LBV) proteins. These are found in nuts, cereals and pulses.	❖ Weak nails ❖ Hair loss ❖ Weakened immune system ❖ Poor growth (children) ❖ Food is nor digested properly	❖ Weight gain ❖ Strain on kidneys and liver
Fats are used by the body for energy. Fat also forms an insulating layer under your skin to keep us warm and protect our organs, such as our kidneys. There are two main types of fat, saturated and unsaturated. Foods such as meat, cheese and butter are high in saturated fats. Foods such as seeds, fish and vegetable oils are high in unsaturated fats. We should eat less saturated fats.	❖ Weight loss ❖ Bruising of the bones ❖ Lack of vitamin A, D, E and K	❖ Weight gain ❖ Type 2 diabetes ❖ High blood pressure (adults) ❖ High cholesterol (adults) ❖ Heart disease (adults) ❖ Organ failure
Fibre helps food to move through our bowels and prevent constipation. Foods such as vegetables, wholemeal bread and beans are high in fibre.	❖ Constipation ❖ Bowel cancer	❖ Children feel full and so miss out on other nutrients
Water is needed for lots of reasons, keeping our body at the right temperature, digesting food, lubricating our bones and keeping us hydrated. Water is found in drinks, fruits and vegetables.	❖ Dehydration ❖ Headaches ❖ Kidney stones	❖ Water intoxication
Vitamin A good vision, especially when it is dark. **B group vitamins** releasing energy from carbohydrates. **Vitamin C** Fighting diseases and helping the body to absorb iron. **Vitamin D** along with calcium, it helps our body make strong bones and teeth.	**Vit A** infected mucus membranes. **Vit B1** beriberi. **Vit B2** sores. **Vit B3** pellagra, dementia, dermatitis. **Vit B9** megaloblastic anaemia. **Vit B12** pernicious anaemia. **Vit C** scurvy. **Vit D** rickets (children), osteomalacia (adults)	**Vit A** night blindness. **Vit D** kidney damage
Iron to make red blood cells to carry oxygen around the body. **Calcium** Along with vitamin D, calcium helps make strong bones and teeth.	❖ **Iron** deficiency anaemia ❖ **Calcium** same as **Vit D**	**Iron** nausea, stomach pain. **191**

AC 1.4 – Cooking Methods
Boiling – A liquid is heated to 100°C to cook foods like pasta, rice and potatoes. A quick and simple method of cooking that does not require any fat. Boiling makes the texture of food soft, over boiling really soft. If boiling vegetables, B vitamins and vitamin C is lost during boiling. .
Steaming – Food is cooked from the steam of boiling water. Steaming food such as vegetables, fish and rice helps to preserve colour, texture and water soluble vitamins.
Baking – Food is cooked using the dry hot air of the oven. Foods that are baked such as cakes, pastries and biscuits cause the outer layers to turn brown and crisp.
Grilling – Dry heat is used to cook food at a very high temperature, it is fairly healthy because no fat is added, and fat drips out of the food as it cooks. Because the heat is so high the food cooks quickly and browns the outside.
Stir-fry – Food is cooked in a wok with very little oil. This is a healthy method as food cooks quickly due to very small pieces of meat and vegetables, leading to crunchy and colourful vegetables that have limited vitamin loss.
Roasting – Food is also cooked using dry heat in a hot oven. Fat is added to the outside of roasted food, causing the outside to go brown and crisp, while the inside stays moist.
Poaching – Food is cooked very gently in liquid that is below boiling point. Delicate foods such as meat, fish and eggs.

- ✓ Use seasonal ingredients
- ✓ Use ingredients from local farmers and markets
- ✓ Use ingredients from rooftop garden
- ✓ Use less plastic

- ✓ Cover pans
- ✓ Use the correct size hob and pan
- ✓ Cook different foods together
- ✓ Don't boil more water than you need
- ✓ Use water carefully – bowls to wash

- ✓ Order in bulk to reduce packaging
- ✓ use FIFO to rotate stock
- ✓ Prepare the correct amount of ingredients
- ✓ Use accurate portion control

AC 2.2 – Environmental Policy

An establishment requires an environmental policy because :
1. It is the law
2. Saves the establishment money
3. Builds a good reputation
4. It saves energy, water and reduces waste
5. Reduced the harm to the environment

- ✓ Fully load dishwashers
- ✓ Fully load washing machines
- ✓ Carry out maintenance checks
- ✓ Turn equipment off
- ✓ Use energy efficient equipment

- ✓ Recycle materials using recycling bins
- ✓ Use biodegradable packaging for taking away food
- ✓ Give foods to charities
- ✓ Weigh ingredients accurately

- ✓ Reuse glass bottles and plastic containers
- ✓ Reuse leftover food for stock, compost or animal feed
- ✓ Use cardboard for wet floors

Keyword	Definition
Biodegradable	Decomposes naturally in the ground
Food miles	The distance food has travelled from field to plate

Keyword	Definition
Recycle	Product is broken down and made into something new
FIFO	First In First Out

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The UK's Population
- Is increasing. 2020: 67m. 2050: 77m people.

This increase will put pressure on resources:
- More housing means more greenfield sites are needed to be built on.
- More food will mean natural habitats are destroyed to make space for farms.
- More energy might mean more greenhouse gases if fossil fuels are burnt.
- Increase in flooding as there is an increase in impermeable surfaces and houses built on flood plains.

To solve these problems:
- Use brownfield sites for building.
- Encourage people to limit their food intake and have a healthy lifestyle.
- Use sustainable, renewable energy sources for electricity.

Transport in the UK
- Global transport emits huge amounts of greenhouse gases.

The UK is trying to reduce greenhouse gases:
- Improve public transport so people leave their cars at home.
- London has created cycle routes and Boris bikes for people to rent for the day or longer.
- Congestion charges: charging people for driving through city centers has reduced traffic and pollution.

Greenfield Sites
Advantages:
- Cheaper and quicker to build on.
- Environment is usually cleaner and more pleasant to look at.

Disadvantages:
- Valuable farms or open spaces are lost.
- Agriculture production is lost
- Animal habitats are destroyed.

Brownfield Sites
Advantages:
- Less countryside is lost and utilities already in place
- Old dis – used urban areas are cleaned up.

Disadvantages:
- Often more expensive because old buildings need to be destroyed/rebuilt.
- Higher levels of pollution in these areas.

The UK's Economy
The 2 speed economy: London and the south east's economy grows faster than the north of England.

Why is this?
- More government money is invested in the south to attract more businesses.
- The big businesses in London attract the brightest people from the north of England. These people move south to work.

How is the government trying to stop the north Vs south divide?
- A high speed railway (HS2) is being built from London to northern cities. This will create jobs in the north.
- Airports in the north are improving to encourage travel and businesses to set up in the north.

Migration
- Immigrants: mainly from India + China.
- Emigrants: mainly leave to Australia.
- Reasons for migration: better jobs, better education, family reasons or to retire.

Advantages of migration nationally:
- Brings more workers so more taxes are paid.
- Different cultures bring different music and food.

Disadvantages of migration locally:
- More people means we need more hospitals, schools and doctors. This costs money.
- Some people think migrants take jobs from British people.

Keyword	Definition
Boris bikes	Bikes that can be rented by the day in London. Boris Johnson, now the Prime Minister, introduced them when he was the Mayor of London
Brownfield	Land that has been built on before
Congestion	Heavy traffic
Culture	People's way of life, the music they listen to or the food they eat or the activities they enjoy
Economy	The jobs and money in an area
Emigrants	People that move out of a country. E.g.: Jack has emigrated to Australia
Greenfield	Land that has not been built on before
Greenhouse gases	Gases that damage the environment and cause global warming
Immigrants	People that move into a country. E.g.: Jack has immigrated into the UK
National Park	An area of protected by the state for the enjoyment of the general public or the preservation of wildlife.
Urban	Cities and built up areas

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UK's Landscape Challenges
How can we protect national parks?
- Employ young people to work in the park so they grow up seeing its importance.
- Encourage public transport into the national park.
- Cycle hire is promoted within National Parks to reduce carbon emissions.
- Building restrictions are in place to help conserve the natural area (e.g. promoting the conversion of older farm buildings).
- Using greener energy to help reduce carbon emissions and pollution.

The UK is at risk from river flooding because:
- The population is increasing so more people have to live nearer rivers.
- More urban areas means more impermeable surfaces.
- More extreme rainfall because of climate change.

The UK government is planning to:
- Reduce the number of buildings near rivers.
- Build flood defences – hard/soft engineering.
- Help people prepare through warnings.

Specific example: Somerset floods, 2013/14.
- Heavy rainfall flooded 600 homes.
- Flood defences failed to protect people.
- Rivers were blocked with silt which meant rivers couldn't hold much water.

The UK is at risk from coastal flooding because:
- Storm surges cause severe flooding because of the wave height and wind power.
- Storm surges can destroy some coastal defences.

Reducing coastal flooding in the UK:
- Build sea walls to reduce flooding and erosion.
- Use managed retreat in certain areas.

Specific example: 2013, across east England.
- The Thames flood barrier protected London from flooding.
- Flood barriers were quickly built in Norfolk.
- Advice was passed out through social media which meant that 800,000 homes were protected.

UK's Climate Change Challenges
The UK will become:
- Warmer in winter and summer by 3 – 5 degrees.
- 30% wetter in winter, 30% drier in summer.
- Extreme rainfall will be more severe and often.

Climate change will impact the UK:
- More flooding near rivers and the coast.
- More drought and less water in rivers may affect animal habitats and numbers of species.
- More heatwaves could mean more illnesses like heatstroke. This puts pressure on the NHS.

Responding to climate change
Individual people can:
- Walk or cycle to reduce greenhouse emissions.
- Recycle waste to reduce resource consumption.
- Build solar panels and insulate homes to conserve heat.

Governments can:
- Place limits on carbon emissions from businesses.
- Create adverts which encourage recycling.
- Sign agreements like the Paris agreement to work with other governments.

Problems governments face:
- Encouraging economic growth and development usually means using more resources.
- Reducing climate change can damage economic growth.

Keyword	Definition
Drought	Little or no rainfall for a long time, usually months or years
Economic growth	An increase in the number of jobs in an area and an increase in the number of money spent in an area
Emissions	When gases are released into the atmosphere (air)
Extreme rainfall	Very heavy rain
Flood defences	Things that aim to try and stop rivers from flooding
Greenhouse gases	Gases that damage the environment and cause global warming
Heatwaves	Very hot weather for a few days or possibly weeks
Heatstroke	An illness that makes the body weak. Is caused by being in hot temperatures for too long without drinking enough water
Impermeable surfaces	Building materials that don't allow water to pass through them. E.g. concrete, tarmac
Insulate	Keep warm
Managed retreat	Allowing certain parts of the land to become flooded
National parks	Parks that cannot be built on. They are protected by laws
Severe	Very dangerous
Storm surge	This is when the wind 'picks up' the waves and makes them higher. About 6 feet higher than usual
Thames flood barrier	A barrier on the Thames river that protects London from flooding

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<u>Crime, punishment and law enforcement in Anglo Saxon England</u>

- Anglo Saxon kings ruled the unified Kingdoms of England. They wrote codes of law and enforced those laws

- The king was supported by nobles who maintained the law

- Anglo Saxon society aimed to keep the peace through community law enforcement

- Physical punishments and maiming were used as a deterrent

- The wergild system of fines was introduced as an alternative to blood feuds

- Some serious crimes were punished by death

- The church was also powerful, it was responsible for trials by ordeal

<u>Crime, punishment and law enforcement in Norman England</u>

- William I's harsh response to the Anglo Saxon rebellion and the building of castles strengthened his power

- The Normans introduced the murdrum fine which gave Normans a higher position in society than Anglo Saxons

- The Forest Laws bought most of the land under the Kings control and made hunting and gathering wood illegal there

- Norman punishment included physical punishment, fines and execution.

- Trial by combat was introduced

- It was the community's responsibility to deal with crime through the use of the hue and cry and tithings

<u>Crime, punishment and law enforcement in the later Middle Ages</u>

- Henry II centralised the legal system

- Towns grew, which meant a need for a better way to police them

- The Statute of Labourers showed a desire for new laws but also to maintain old order

- New punishments were introduced for heresy and treason

- These included being hanged drawn and quartered and being burnt at the stake

- These were introduced to deter criminals from challenging the king and church's power

<u>Case study: the influence of the Church on crime and punishment</u>

- The Church was extremely powerful and so had a large influence over how crime and punishment worked

- The Church courts provided alternative trials and punishments

- Sanctuary and trial by ordeal demonstrate that medieval justice relied on God as a judge

- Changes in Church law sometimes directly affected the countries laws – for example the end of trial by ordeal and the use of juries

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Key Word	Definition
Crime	An action that breaks the law.
Punishment	A consequence given out to a person who has committed a crime.
Progress	When things get better
Turning point	When a significant change happens
Factors	These are the things that affect/cause change e.g. poverty, wealth, attitudes, institutions (e.g. the church, government), individuals, science and technology, travel and towns.
Law Enforcement	Methods of policing and upholding the law
Retribution	A punishment where someone takes revenge on the criminal
Deter	A punishment to stop other crimes being committed
Reparation	A punishment that means to repay or 'make good' the damage caused by a criminal.
Capital Punishment	The death penalty.
Corporal Punishment	Physical harm caused to a criminal, e.g. cutting off a hand
Treason	Crime against the King
Kings Peace	King's duty to take care of law and order
Trial by Ordeal	A trial held in/near a church. The accused person is set a difficult/ dangerous task. God would decide whether they passed.
Murdrum Fine	The whole community pays a heavy fine if a Norman was murdered there.
Stocks and pillories	Stocks attached ankles while the pillory secured the arms and neck.
Heresy	Questioning/disagreeing with the Church
Sanctuary	Safe places/protection from the law

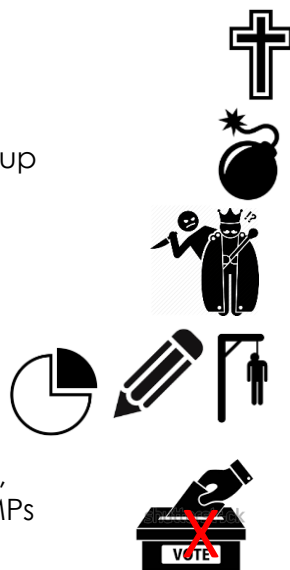**196**

Changing definitions of crime 1500-1700

- Religious change led to a change in definitions of crimes as each rulers imposed their own religions

- Increasing wealth in some areas of society led to new crimes

- Economic changes led to more vagrants in the 16th and 17th century. People became scared of the unemployed and poor

- The Game of Law 1671 made it illegal for poor people to hunt. The public did not take this seriously and it was hard to enforce

- Cromwell bought in many new moral crimes during the 1650s

- In the 17th century, the government introduced import taxes on some goods – this led to smuggling

Law enforcement and punishments 1500-1700

- Law enforcement in 1500-1700 was similar to the medieval period

- Community policing was still widely used

- Growth of towns meant that more co-ordination in law enforcement was needed

- The earliest prisons were built in the 16th century and after 1601 more 'houses of correction' were established

- The usual punishments at this time were fines, corporal punishment and execution

- During the reign of James I, transportation to America was introduced as an alternative to execution

Case Study: The crimes and punishments of the Gunpowder plotters 1605

- English Catholics were persecuted in various ways and were not free to worship as they chose

- The Gunpowder Plot, led by Robert Catesby, aimed to blow up the king and those close to in 1605

- The plot was uncovered and the conspirators found guilty of treason

- They were sentenced to death to be hanged drawn and quartered

- Following the plot, Catholics experienced more persecution , and were excluded by the law from voting and becoming MPs

Witchcraft and the law 1500-1700

- People greatly feared the idea of witchcraft

- James I's interest in witches, attitudes towards women and uncertainty caused by Civil Wars all increased fear of witchcraft

- In 1645, Matthew Hopkins, a 'Witchfinder General' began hunting down witches in Essex and East Anglia

Key Word	Definition
Crime	An action that breaks the law.
Punishment	A consequence given out to a person who has committed a crime.
Progress	When things get better
Turning point	When a significant change happens
Factors	These are the things that affect/cause change e.g. poverty, wealth, attitudes, institutions (e.g. the church, government), individuals, science and technology, travel and towns.
Law Enforcement	Methods of policing and upholding the law
Retribution	A punishment that intends to take revenge on the criminal
Deter	A punishment that intends to stop other crimes being committed
Reparation	A punishment that intends to repay or 'make good' the damage caused by a criminal.
Capital Punishment	The death penalty.
Corporal Punishment	Physical harm caused to a criminal, e.g. cutting off a hand
Vagabond	A homeless, unemployed person
Transportation	Sending criminals to North America and, later, Australia
The Bloody Code	The death penalty passed for minor crimes
Witchcraft	The crime of practising magic and worshipping the devil
Stocks and pillories	Stocks secured ankles while the pillory secured the arms and neck.
Smuggling	Bringing goods into country without paying import tax
Sanctuary	Safe places/protection from the law

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Changing definitions of crime 1700-1900

- Smuggling increased in the 18th century whilst there were profits to be made

- It then decreased in the 19th century when it became less profitable

- Highway robbery became less common as new patrols clamped down on robbers

- Harsh laws and unpopular laws were passed against poaching – but were later repealed in the 1820s

- The case of the Tolpuddle martyrs shows how attitudes were changing over what was considered a crime
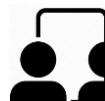
Changing attitudes to punishments 1700-1900

- People began to question the Bloody Code and wanted punishments to match the severity of the crime committed

- Transportation to Australia was seen as a serious punishment and worked as a deterrent

- Reformers like Charles Dickens led campaigns against public executions – he thought they were not an effective deterrent

- The growth of the prison system meant there was an alternative to transportation

Law Enforcement 1700-1900

- In the early 18th century methods of law enforcement were similar to the early modern period

- The Bow Street Runners were established in 1748 which showed a development in policing

- In 1829, the Metropolitan Police was set up by Robert Peel in London

- The 1856 Police Act meant that all areas had to have a professional police force that was controlled by the government

- In 1878 the Criminal Investigations Department (CID) was set up

Case Studies: Pentonville Prison and Robert Peel

Pentonville

- It was a model prison

- The plan was to keep prisoners as separate as possible

- The government made conditions harsh to deter criminals

- In the late 19th century the punishments became harsher at Pentonville

- The 1856 Prison Act focused on strict punishment – not reform

Robert Peel

- Robert Peel became Home Secretary in 1822

- During the 1820s he bought in many changes to law enforcement

- He wanted to use the law more effectively and introduce a new penal code

- In 1829 he introduced the Metropolitan police which was nor popular at first

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Key Word	Definition
Transportation	The punishment of being sent to another country to serve a period of hard labour
Smuggling	Bring goods into the country illegally
Highway Robbery	Highway men stopping a stagecoach and robbing its passengers, often violently
Decriminalisation	When something stops being a crime
Tolpuddle Martyrs	Farm workers who demanded a wage rise after it was cut. Created a union but were accused of making secret oaths and sentenced to 7 years' transportation to Australia. Later pardoned.
Trade union	A system set up to protect workers rights
Bow Street Runners	Thief takers patrolling London
Separate System	Prisoners kept apart as much as possible (in separate cells for up to 23 hours)
Penal reforms	Improvements/changes to punishments
Profitable	When you are likely to make a profit (more money that you are spending)
Pentonville Prison	One of first modern prison built in 1840
Reformer	Someone who wanted to change things for the better
Repeal	Undo/take back something – usually a law

Crime and definitions of crime 1900-present

- Changing attitudes made some things that were previously legal become a crime

- The 1968 Race Relations Act made it illegal to refuse jobs, housing or public services to anyone based on race

- During the 20th century there were big changes to laws on violence and intimidation between people in a relationship or who have been

- New technology and changing attitudes led to changes on how driving offences were viewed and dealt with

- Digital technology has enabled criminals to carry out old crimes in new ways e.g. fraud/theft
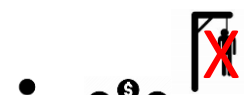
Law enforcement 1900-present

- Technology and science have improved the ability to catch criminals

- A focus on crime prevention has also helped reduce crime

- Co-ordination and co-operation at a local and national level has increased

- In the 20th century there was an increase in specialisation, with special division set up and better training

- There was a focus on crime prevention including Neighbourhood watch schemes

Changes in punishment 1900-present

- At the start of the 20th century, the death penalty was still used, almost always for murder

- In 1965, the death penalty was abolished

- The 1940s Labour government introduced many radical welfare and social reforms including some on youth justice

- During the 20th century there were many new ideas about the purpose of prison, and the way prisoners should be treated

- Changing attitudes meant that courts could use alternative punishments to prison for less serious crimes

Case Studies: Conscientious objectors in WW1 and WW2 and Derek Bentley

Conscientious objectors

- Some men refused to fight as it was against their beliefs

- By 1916, they were viewed as criminals

- The Military Service Act included a section called the 'conscience clause' which allowed men to refuse to fight but was very rarely accepted

- Prison was the most common punishment for COs in WW1

- Government attitudes to COs were less harsh during WW2 but people's opinions did not change

Derek Bentley

- Derek Bentley was arrested for murdering a policeman

- The case was controversial and led to questions about the death penalty

- Many MPs believed it was wrong to hang Bentley

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Key Word	Definition
Hate crime	Crime committed against a person because of their race, gender, disability or sexuality.
Extortion	Using threats to make someone pay money
Neighbourhood watch	Local group of people who raise awareness about crime and encourage local community to keep an eye on each others' property
Borstals	Specialist prison for young boys only
Conscientious objectors	People who refuse to take part in war or conflict for moral reasons.
Bentley Case	Young man executed for murder. Prompted mass protest. Was pardon after he died
Cyber crime	Crimes committed using technology (usually computer, mobile phones and the internet)
Abolish	To get rid of something
Reform	A change for the better
Tribunal	Like a court case where someone puts an argument across to be considered
Prevention	Stopping something before it happens

Context: Policing the nation

- Unlike other forces, the Metropolitan police were controlled by the government

- Following a series of scandal and accusations of incompetence, the CID was set up in 1878

- Useful sources for investigating policing include: police station reports, records of court cases, memoirs and local and national newspapers

- There are positive and negative aspects of all these sources – especially police station reports and newspapers
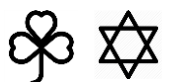
The local context of Whitechapel

- Poor housing, overcrowding and unemployment were common in Whitechapel

- Attempts to improve conditions included building new houses and providing orphanages e.g. Barnados

- These existed alongside the traditional responses to poverty such as workhouses

Tensions in Whitechapel

- By the early 1880s there had been major waves of immigration into Whitechapel – Irish and Eastern European

- In both cases people were scared they had brought dangerous political views with them

- Immigration seemed to be a threat out local people for housing and work

- Immigrant groups were stereotyped as criminals

Police organisation in Whitechapel

- Police were seen as the government in uniform – this made them unpopular

- Prostitution, alcohol and the layout of streets gave the police problems

- There were too few policemen to deal with crime – some areas had no patrols

- Many believed the police focused too little on serious crimes

Investigative policing in Whitechapel

- Failure to catch Jack the Ripper led to criticism of H Division, the Metropolitan police, CID and Scotland Yard

- Police methods were not good enough but often criticism was unfair and did not recognise the problems with solving crimes at this time

- Some of lines of enquiry in 1888 by CID were ahead of their time and effective

- The Metropolitan police were slow to learn from their mistakes in the Ripper case and improvements did not appear until 1900

- There were considerable changes in housing, lighting and health as a result of fear over the serial killer

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Key Word	Definition
Anti-Semitic	Hatred and prejudice against Jews.
Beat Constable	The lowest rank of police officer whose main duty was to walk 'the beat'/ patrol
CID (Criminal Investigation Department)	Created 1878 to detect crime led by Howard Vincent
Commissioner	Head of MET police, reported to the Home Secretary.
Fenians	Irish Nationalist who wanted an Ireland free from British rule. They protested using force & exploded bombs in London.
H Divison	Policed the area of Whitechapel.
Jack the Ripper	A serial killer who murdered five women in Whitechapel in 1888. Police didn't catch him damaging public confidence in them
Peabody Estate	Peabody Trust built flats in an old slum area, designed to be affordable rents and surrounded by a yard to improve ventilation.
Sensational stories	Press dramatized stories to excite readers & sell more copies of newspapers.
Socialism	Political and economic system in which property and resources are owned or controlled by the state and wealth shared by people
Workhouse	Accommodation that gave food and shelter to poor. Conditions were bad to make it a last resort. Inmates were typically the old, sick, disabled, orphans and unmarried mothers
Protection racket	Taking money from people in exchange for agreeing not to hurt them. Gangs ran protection rackets which threatened the owners of Jewish businesses.

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The situation of Elizabeth's accession

- It was considered unnatural for women to rule

- Elizabeth was highly educated, charismatic but sometimes indecisive

- She was head of the government and made the decisions

- She needed the privy council, parliament, lord lieutenants and JPs to rule effectively

- She faced threats from Scotland, France and Spain

- Catholic wanted Mary Queen of Scots to rule England

- The monarch decided the religion of England

The 'settlement' of religion

- Elizabeth was a Protestant queen but England was a not an entirely Protestant country

- More Protestant areas were London, the South East and East Anglia whereas Catholicism was strong in the North of England

- The religious settlement came in 3 parts – the Act of Supremacy, the Act of Uniformity and the Royal Injunctions

- In some places the changing of the religious settlement was slow

- There was some monitoring of religion but Elizabeth did not want it to be too harsh

- Elizabeth wanted a middle ground for religion

Challenges to the religious settlement

- Challenges came from home and abroad

- The Catholic threat was limited until 1569

- Puritans challenged the use of crucifixes and vestments

- Elizabeth sent troops and money to support Protestants in Scotland (1560) and France (1562) but not the Dutch (1566)

- Relations with Spain became worse after the Dutch Revolt

- The Dutch Revolt caused concern as Spain sent the army to crush the rebellion

- Elizabeth ordered the plundering of Spanish ships to make it hard for them to remain in the Netherlands

The problem of Mary Queen of Scots

- Mary Queen of Scots (second cousin) is **not** Mary I (Elizabeth's sister)

- Mary Queen of Scots was a Catholic

- Mary Queen of Scots arrival in England was a huge problem

- Mary had a strong claim to the throne after Elizabeth

- Mary became the focus at court due to a plot to marry the Duke of Norfolk in 1569

- This plot was developed into a rebellion by English earls

- Elizabeth did not want to take action against Mary

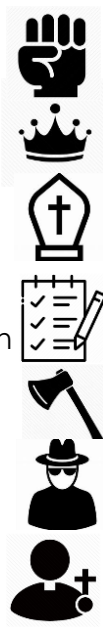- From 1568 Mary was kept in captivity

205

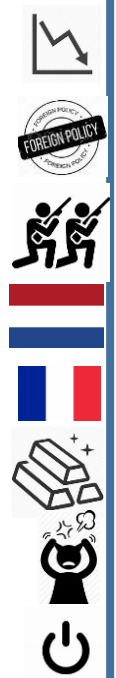| Key Word	Definition
Catholic	The Pope was in charge of the Catholic Church. It had lots of colour and decoration inside, clergy were not allowed to marry, they had the mass and Bible in Latin
Protestant	Elizabeth I was in charge of the Protestant church. Churches were plainer, priests' clothes (vestments) were plainer, they had services/ Communion and the bible in English
Puritan	Extreme Protestants who wanted to purify the protestant church of anything Catholic that remained and make a simpler church.
Act of Uniformity	Said what Prayer Book had to be used in church each week, that everyone must go to church and punishments and fines for not attending.
Mass	Most important catholic service. The priest performed a miracle and turned bread and wine into the blood and body of Jesus
Protestant Reformation	Changed the church from Catholic with the Pope to Protestant with the Monarch in charge.
Holy Communion	Protestant service /version of Mass where bread and wine are shared with those in church.
Act of Supremacy	Elizabeth is the head of the Church of England as well as the head of State
Nobles	Wealthy and powerful people, with lots of influence and help the monarch run the country.
Gentry	Land owners who were important in running local areas.
Merchants	Normally rich Businessmen in towns.
Yeoman	Farmers who owned land
Crucifix	A cross with a figure of Jesus on it, popular with Catholics
Legitimacy	Being recognised as a royal by being born when the mother and father were married

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Plots and revolts at home

- The Revolt of the Northern Earls in 1569 was a serious rebellion focused on overthrowing Elizabeth by the Catholics

- Elizabeth was excommunicated in 1570. This caused Catholics to have a divided loyalty between Elizabeth and the Pope

- Plots against Elizabeth were encouraged by the Pope

- There were 3 major plots: Ridolfi (1571), Throckmorton (1583) and Babington (1586) to put Mary Queen of Scots on the throne

- Mary Queen of Scots was executed in 1587

- Plots against Elizabeth failed because of Walsingham's spy network

- Catholic priests were smuggled into England to support Catholics

Relations with Spain

- Relations with Spain worsened between 1569 and 1585

- Elizabeth's foreign policy was defensive – she wanted to avoid war

- The Dutch Revolt led to Spanish armies being sent to the Netherlands. This was seen as a threat to England

- England's support to the Dutch rebels was limited until 1585

- Elizabeth I used her friendship with France and mercenaries to help the Dutch

- Sir Francis Drake angered Spain by making gains in the New World

- Elizabeth frustrated her Privy Council by her hesitation to go war

- In 1584, Elizabeth control meant she could intervene in the Netherlands

The outbreak of war

- Elizabeth promised to help the Dutch and signed the Treaty of Nonsuch in 1585

- England's intervention in the Netherlands was not very successful

- The Earl of Leicester did not have a good relationship with the Dutch nor enough men or resources

- Elizabeth sent Sir Francis Drake to raid the Spanish New World Settlements in 1585

- In 1587, Drake delayed the launching of the Armada (known as the singeing of the King of Spain's beard)

The Armada

- The Armada was the Spanish fleet sent to invade England in 1588

- The English fleet set out from Plymouth and followed to Armada to Calais

- The Armada had problems with supplies and communication

- The English had faster ships that could fire more cannon balls from a greater distance

- The Battle of Gravelines did substantial damage to the Armada

- After Gravelines, the Armada headed North and lost thousands of men in shipwrecks

- The defeat of the Armada boosted Elizabeth and England's profile and Protestantism in Europe

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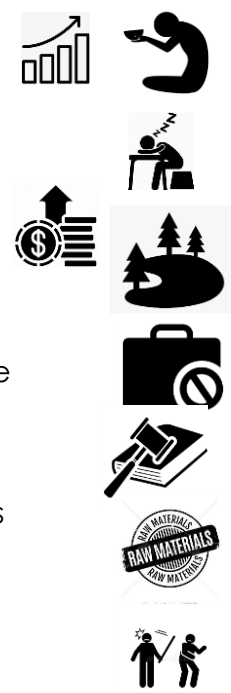| Key Word	Definition
Armada	A large fleet of ships from Spain
Excommunicate	Expelling someone from the Roman Catholic Church
Jesuit	A type of priest that came from abroad to convert the English to Catholicism
The Pope	Head of the Catholic Church – lives in Rome
Propaganda	Spreading a one sided message as widely as possible
Recusancy	Deliberate non attendance at Church in Elizabeth's time
Seminary	A type of priest who came from abroad to support English Catholics
Plunder	Attack and steal valuable items from enemy ships
The New World	America and the East – people were beginning to discover these areas
Foreign Policy	Laws that affect relations with other countries
Dutch Revolt	Where the Spanish attack the Netherlands for being Protestant and rebelling against the king
Privy Council	The small group of Elizabeth's most trusted advisors
The Treaty of Nonsuch	A treaty where England promised financial aid to Netherlands to help their rebellion
The Battle of Gravelines	The battle where the English sailed fire ships into the Armada

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Education and Leisure

- Education expanded during Elizabeth I's reign – however it was mostly boys who received an education

- Most people in the Elizabethan times were illiterate

- There was not much difference in the classroom education of girls and boys but boys were more active outside of the classroom

- Every town had a grammar school by 1577

- Elizabethan past times were similar to modern ones but sport was more violent

- The theatre was very popular and appealed to all classes of people – many new theatres were built

- Protestantism led to many new plays being written

The problem of the poor

- Poverty and vagabondage were seen as a growing problem in Elizabethan England

- The poor were divided into 'idle', 'deserving' and 'impotent'

- Population increase, laws about land (enclosure), disruption to trade and inflation made the issue of poverty worse

- Attitudes changed when unemployment was seen as a genuine issue

- Elizabeth I passed laws to help the poor

- One involved giving people raw materials so they could make goods and sell them

- Vagabonds faced harsh punishment but these were rarely enforced

- There were local initiatives to help the poor too – e.g. Ipswich

Exploration and voyages of discovery

- Trade was the driving force behind exploration

- Another reason was to challenge Spain's position in the New World

- New technology made it possible to undertake longer journeys and increase accuracy of maps and navigation

- The printing press enabled the reproduction of maps, navigation manuals and accounts of exploration

- Drake's circumnavigation of the globe started as a mission to attack Spain and eventually led people to invest in exploration

- Nova Albion encouraged the English to attempt further colonisation of North America

Raleigh and Virginia

- Walter Raleigh attempted to set up a colony in Virginia twice

- These attempts were a failure due to inexperience, the suitability of the colonists and the relationship with the Native Indians

- Conditions in Virginia were harsher than colonists expected

- Many of the 1585 colonists did not co-operate with each other

- The English were very dependant on the Native Indians in Virginia in order to survive

- The local chief – Wingina did not trust the English and became hostile

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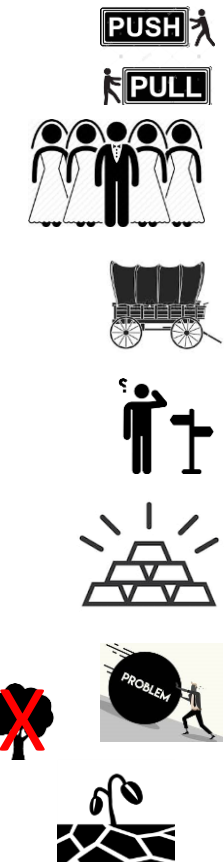| Key Word	Definition
Colony	Area of land owned by another country where people live
Settlement	Living and establishing a community where people haven't typically lived before
Exploration	Finding and discovering new areas
Vagabondage	Vagrancy, homelessness and wandering without purpose
Bear Baiting	Fight between a chained Bear and dogs
Illiterate	Unable to read or write
Protestantism	The religion of the Church of England that Elizabeth was in charge of
Poverty	The state of being extremely poor
Impotent Poor	Helpless, unable to work
Idle Poor	Those seen as able to work but chose not to
Deserving Poor	Those whose poverty was not their fault and wanted to work
Circumnavigation	The process of sailing all around something – usually the world
Colonist	Someone who lives in a colony

The Plains Indians: Their beliefs and way of life

- The Plains Indians were made up of different tribes and nations – some with very different customs

- Each tribe had one or more chiefs who negotiated with the government or other tribes

- The Plains Indians ideas about land, nature, warfare and property were very different from the white American settlers

- The buffalo was extremely important to the Plains Indians – they used all parts of it

- The Plains Indians believed land was sacred and farming hurt it

- The US government supported the idea of Westward expansion

- Firstly, tribes were moved from the East behind a Permanent Indian Frontier

- Then, the tribes were put into reservations to keep them separate from the white settlers

Migration and early settlement

- Different factors encouraged migration to the West – some 'pulled' people West and others 'pushed' them

- The Mormons moved West (1846-47) due to persecution and set up home in Salt Lake City

- The Oregon trail made migration to the West possible but it was not easy

- The Donner Party showed how disastrous it could be – even with planning

- The Gold Rush of 1849 encouraged settlers to move to California to find their fortune. It also attracted immigrants from all over the world

- Early settlers on the Plains had a hard life due to the conditions there

- Farming was hard due to lack of rainfall, few trees and extreme weather conditions

Conflict and tension

- The growing number of people moving to the Plains caused tensions between the settlers and the Plains Indians

- The Fort Laramie Treaty (1851) involved promises being made to the Plains Indians and the settlers

- Law and order was difficult to enforce in the early towns and settlements

- A lack of government help meant local communities took it upon themselves to tackle lawlessness

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Key Word	Definition
Ecological	Something that tries not to cause lasting harm to land or animal and plant life
Homesteaders	People who settled on the Plains
Immigration	The arrival of people from one place in another where they hope to stay and live
Indigenous	Something or someone whose origins are deeply rooted in a place e.g. Native Americans in America
Manifest Destiny	The belief in a God-given right to take over the whole of America
Mormon	Followers of the teachings of Joseph Smith and the book of Mormon
The Plains	The area of land between the Mississippi riber and the Rocky mountains
Reservation	Areas of land set aside for Indian settlement
The Oregon Trail	A route across the middle of the USA from the Missouri to Oregon, some 3,000 km long
Persecution	Being treated badly because of race, religion, politics or gender
Permanent Indian Frontier	Land given especially to the Indians when they move West
Donner Party	A group of people who made the journey West but took a 'short cut' that led to major delays
Gold Rush	When gold was found in California and people migrated there on masse to find their share

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The development of settlement in the West

- The Homestead Act was passed in 1862 and encouraged more people to move West

- The Pacific Railroad Act of 1862 allowed companies to start building railroads on the Plains to connect the East and West

- The new wave of settlers started to benefit from new methods of farming the Plains such as barbed wire, sulky ploughs and steel blades

- The Timber Culture Act was passed in 1873 and allowed homesteaders to purchase an extra 160 acres of land if they promised to plant trees on ¼ of it.

- The large amounts of settlers and building of the railways led to an increase in lawlessness

- New towns build near the railroads were called Hell on Wheels

Ranching and the cattle industry

- 1862-1876 saw the rapid growth of the cattle industry

- Ranching became common on the Plains

- Goodnight, Illiff and McCoy came up with new ways to meet the demand for beef in the East and West

- Abilene was the first cow town to be created.

- Cowboys drove the cattle to the railroads. This was called the long drive

- Homesteaders started to claim public land which caused tensions with the cowboys and ranchers
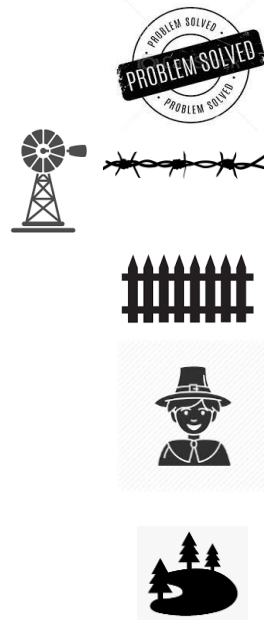
Changes in the way of life of the Indians

- White settler's invasion of the Plains Indians land put pressure on the Indians

- As the number of cattle increased, the number of buffalo decreased as they ate the same food - grass

- Corrupt management of reservation food supplies caused desperation and conflict

- The Indian Appropriation Act came into place in 1871 and meant Indians were no longer treated as citizens of the USA and it was easy to take their land

- Government policy focused on moving the Indians to the reservations

- 3 major conflicts broke out due to the poor treatment of the Indians – Little Crows War (1862), The Sand Creek Massacre (1864) and Red Clouds War (1866-68)

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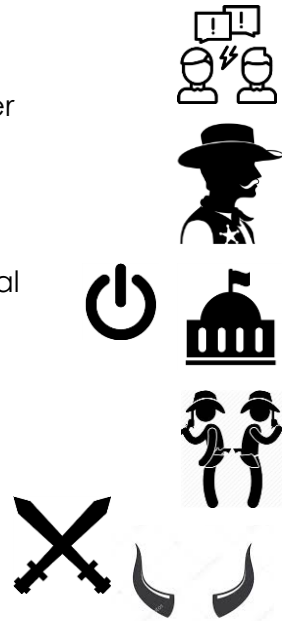| Key Word	Definition
Homestead Act 1861	Allowed people to claim 160 acres of land if lived & farmed there for 5 years.
Pacific Railroad Act 1861	Central Pacific Railroad built a train line from East, while the Union Pacific Railroad would build a from the West
Windmills	Used the wind to pump water from underground to water crops.
Dry Farming	Farmers ploughed their land straight after it rained to trap the water in the soil
Cattle Industry	The buying and selling of cows.
Ranching	Cows grazing on a range where cowboys would work to look after them.
Open Range	Originally cattle would graze and live on unfenced land/ranches.
Cattle Drives	Moving of cattle from Texas in the South to cow towns/railroads in the North. Cowboys would lead the cattle drives.
Grant's Peace Policy 1868	USA stopped policy of extermination against the Plains Indians. Instead he swapped to a non-violent policy
Indian Appropriations Act 1871	Cancelled former treaties with Plain Indians & US Government. Plain Indians would be treated as an individuals
Red Cloud's War	When gold was discovered in the Rocky Mountains, Plain Indians attacked settlers who entered their lands to get it.
Sand Creek Massacre	The US army attacked Black Kettle's camp killing 150 men, women and children despite the camp showing a white flag
Little Crows War	1861-62 Sioux starving on reservations killed settlers and soldiers. **214**

The development of settlement in the West

- Changes in farming solved most of the early problems the homesteaders faced

- New methods included dry farming, barbed wire and wind pumps

- The end of the 'open range' meant new, smaller ranches, fenced with barbed wire

- The Exoduster movement bought black American settlers to the Plains

- The Oklahoma Land Rush opened up land to settlers from previously protected Indian territory
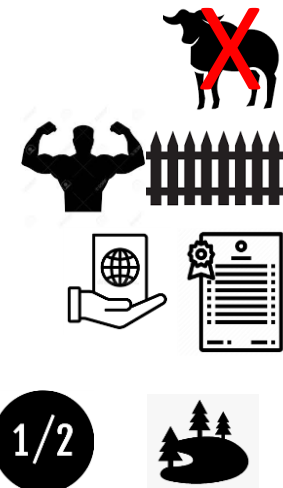
Conflict and tension

- Conflicts over land continued to cause problems of law and order

- This was especially common between cattle ranchers and other land users as well as outlaws such as Billy the Kid

- In most parts of the West the government had more power to deal with crime and disorder

- The Johnson County War was a range war that made vigilante justice more common – many members of the public were unhappy about this

- The shock caused by the defeat at Little Bighorn meant the government were determined to prevent Indian resistance ever again

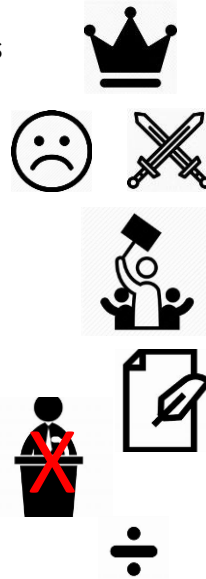## The destruction of the Plains Indians way of life

- The destruction of the buffalo led to Indians staying off the white Americans land

- Reservation life was extremely tough and some believed it would mean the end of the Indians

- The Dawes Act of 1887 failed to encourage Indians to become American citizens and homesteaders

- By 1890, Plains Indians had lost over half the land they originally owned in 1887

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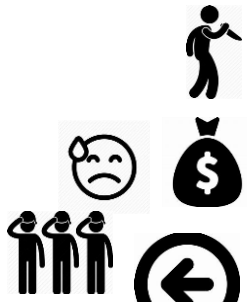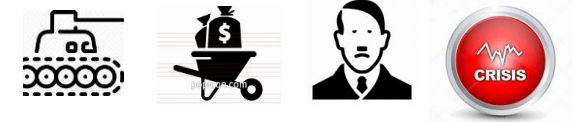| Key Word	Definition
The Great Die Up	The horrible winter of 1886-7 was icy cold causing thousands of Cattle to die
Exoduster movement	The mass movement of African Americans to states like Kansas in 1879
Indians Appropriation Act	Saw two million acres of fertile Plain Indian land opened for settlement in the West by Homesteaders. It prompted a huge surge of settlers to the area.
Dawes Act 1887	Allowed shared reservation lands to be split up into individual plots of land. (160 acres). Plain Indians could each receive one plot. Remaining land was then put up for sale.
Johnsons County War	Conflict between settlers and powerful cattle ranchers in Wyoming in 1892. 1889 saw Jim Averill and Ella Watson killed by local cattle barons after they complained about the cattle barons grabbing land. No-one was prosecuted for the crimes and killings escalated leaving some small rancher holders dead. Cattle Barons responded by organising an invasion of Johnson County in 1892. The local governor knew about it and even provided extra guns for the invasion. Johnson County fought back and the President had to order US military in to resolve the conflict. Despite the public condemning them for their actions the Cattle Barons were never found guilty of any crimes.
Indian agents	Government officials in charge of a reservation. Some Plains Indians joined them to help keep the order on reservations.
Ghost dance	A special dance that would allow White people to disappear and for dead Buffalo and Plains Indians to return.
Wounded knee	US Cavalry shot at Plain Indians at Wounded Knee killing 146 Plains Indians including elderly, women, children and babies as well as adult males. The massacre was seen as the last battle in the Plain Indian wars.
Vigilante	Someone who takes it upon themselves to deal with law enforcement without legal authority
Oklahoma Land Rush 1889	US government opened up the middle section of Oklahoma for white settlers to claim land

The origins of the republic 1918-1919

- The Kaiser abdicated on 9th November 1918, the war ended 2 days later

- War had not been kind to Germany – the SPD (social democratic party) had to work hard to establish order

- Despite revolts and riots, Ebert and the SPD established a new government

- The National Assembly met in Weimar and created a constitution for the Weimar Republic

- The structure meant no single party could hold all the power

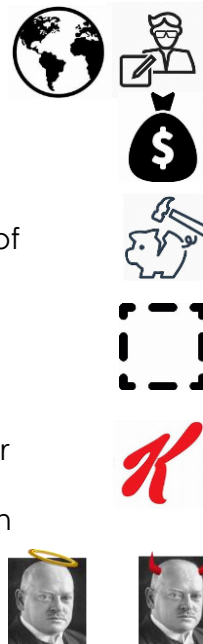- But it also made making decisions hard and divided people

Early challenges to the republic 1919-1923

- The Treaty of Versailles (1919) and the 'stab in the back' myth made the Weimar Republic unpopular

- The T of V included terms such as: a reduced army, reparations, war guilt and a loss of land

- From 1919 to 1923 the Weimar Republic suffered opposition from the extreme Left (Spartacist Uprising and the Communists) and extreme Right (Kapp Putsch and the Freikorps)

- 1923 was a crisis year for 3 reasons: hyperinflation, the occupation of the Ruhr and the Munich Putsch

The recovery of the republic 1923-1924

- Gustav Stresemann was appointed Foreign Secretary in 1923

- He introduced a new currency (the Rentenmark) in 1923 which ended hyperinflation

- The Dawes Plan (1924) and Young Plan (1929) reduced the strain of reparations

- The Locarno Treaties (1925) secured Germany's Western borders

- The Kellogg Briand Pact (1928) and Germany's joining of the League of Nations (1926) helped Germany's reputation to recover

- Not all economic problems were solved by 1929 when Stresemann died

Changes in society 1924-1929

- Some improvements in the standard of living improved in areas such as unemployment, wages, housing and women

- There were some improvements in the position of women in politics, work and leisure – not everyone was happy about this!

- Dramatic changes occurred in culture – particularly art, cinema and architecture – this also did not please some Germans

Key Word	Definition
Coalition government	Two or more parties because neither party has a majority in Parliament
Social Democratic Party (SDP)	The main left-wing party, supported mainly by the working class
Constitution	Ideas for how a country is governed
Proportional Representation	Parties gain seats in proportion to the number of votes cast for them
Spartacist Uprising 1919	Left wing revolt by radical SDLP members, believed in communist ideas and tried to overthrow the Weimar government in 1919.
Treaty of Versailles 1919	Document signed by the countries involved in WWI. It imposed certain conditions on Germany such as the Reparations.
Kapp Putsch 1920	Right wing uprising. to seize Berlin and try to set up a new right-wing government. The plan failed.
Reparations	Money to be paid by Germany agreed by the Treaty of Versailles for war damage
War Guilt	Germany having to accept full responsibility for the war
Occupation of the Ruhr	France sent troops in the Ruhr (border between the two countries), which was the main industrial area of Germany.
Hyperinflation	Very extreme high inflation which makes money and currency worth less
Kellogg Briand Pact 1928	Germany and 64 other nations signed this deal to agree that their armies would be used for 'self-defence' and that international disputes would be sorted peacefully.
Locarno Pact 1925	Signed between Germany, Britain, France, Belgium and Italy. Agreed to keep the existing borders between Germany and France/Belgium to help both countries feel secure.
Dawes Plan 1924	New financial deal to help Germany. It promised American loans and lowered the amount of Reparations being paid
The Young Plan 1929	A new agreement that reduced the amount of reparations Germany had to pay and agreed that they could pay them over a longer period of time.

Early development of the Nazi Party 1920-1922

- Hitler joined the German Workers Party (DAP) in September 1919

- Between 1919 and 1923, Hitler took control of the DAP

- Hitler took over by controlling party policy, using his personal appeal, controlling party organisation, winning leadership and using the SA

- Hitler changed the DAP to the NSDAP and introduced new features such as the swastika symbol and the straight armed salute
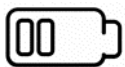
The Munich Putsch and lean years 1923-1929

- Hitler launched the Munich Putsch in November 1923 to try and take control of Germany

- The Putsch failed but the Nazis and Hitler benefitted in some ways

- Hitler went to prison where he wrote Mein Kampf

- Hitler relaunched the Nazi Party in 1925 based on the ideas in his book

- Hitler reorganised the party centrally and nationally

- Hitler strengthened his control over the party and the SA

- However, by 1928 the Nazi Party had little power in the Reichstag

Growth in Nazi support 1929-1932

- By the start of 1929, the Nazi Party had little political power in Germany

- However, by 1932 they had 230 seats in the Reichstag

- A key factor was the Wall Street Crash in 1929

- The economic crisis caused a banking collapse, a fall in industrial output, rising unemployment and a decrease in wages

- The Weimar government failed to solve these problems

- People turned to extreme parties who promised to make a difference

- Support for the Nazis came from several different sections of society – they appealed to many groups
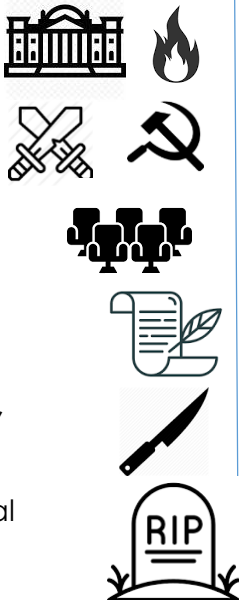
How Hitler became Chancellor 1932-1933

- By 1932, Hitler still had little political power

- However, In January 1933 he was made Chancellor of Germany

- One reason was Hitler's success in the Presidential elections of 1932

- Another was the success of the NSDAP in the Reichstag elections of 1932

- Von Schleicher and von Papen plotted to get rid of Bruning and reduce the power of the Reichstag

- Both von Papen and von Schleicher thought they could control Hitler
- There was a fear a civil war would occur if a strong government was not put in place

- Reluctantly, Hindenburg made Hitler Chancellor with von Papen as vice chancellor

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Key Word	Definition
Mein Kampf	Hitler's autobiography that he wrote while in prison. 'My Struggles'.
25 point programme	1920, Hitler and Drexler wrote a list of their (Nazi) ideas and policies.
Fuhrerprinzip	Leadership principle, the idea that the Nazis should have one leader with absolute power and total control.
The SA	The Sturmabteilung, were often called Brownshirts and were protection squads or private army of the Nazi party
Munich Putsch 1923	Hitler & Nazis tried to overthrow the regional government in Munich.
Wall Street Crash 1929	Financial crisis when the USA stock market collapsed in October 1929
Election	Opportunity to vote, often for a government leader
Charisma	How charming/compelling a person is.
Political Instability	Significant government changes and problems causing unrest. It risks the sudden changes of leaders in government.
Reichstag	The government/government building similar to Parliament in the UK
Industrial Output	The amount of industrial good produced and sold
Chancellor	Underneath the President in terms of power
Proportional Representation	Parties gain seats in proportion to the number of votes cast for them
Civil War	A war between two sides of the same country

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The creation of a dictatorship 1933-1934

- The Reichstag Fire (February 1933) gave Hitler the opportunity to form a dictatorship

- After the fire, there were attacks on Communists

- The Nazi party gained more seats in the Reichstag

- The Enabling Act (March 1933) gave more power to Hitler – he could pass laws without the support of the Reichstag

- The Night of the Long Knives (July 1934) saw many of the SA killed, enabled Hitler to eliminate threats and strengthen his power

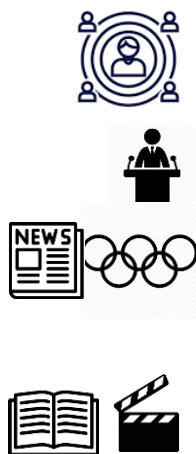- After Hindenburg's death in August 1934, Hitler became the official leader of Germany

The police state

- Nazi Germany was a police state controlled by the SS, SD and Gestapo

- From 1933 concentration camps were used to deal with 'undesirables' such as political opponents to Nazism

- The legal system was Nazified – law courts and judges were placed under Nazi control

- Religion was closely controlled although both Catholics and Protestants resisted this

Controlling and influencing attitudes

- In Nazi Germany, propaganda and censorship were used to influence peoples opinions

- Joseph Goebbels was the head of the Ministry of People's Enlightenment and Propaganda and organised propaganda

- Nazi control and influence was exerted using the media, rallies and sport including the Olympic Games of 1935

- The Nazis also exerted control over the Arts, including literature, art and film

Opposition, resistance and conformity

- Most Germans supported or at least conformed to Nazi practices and beliefs

- Resistance was limited due to propaganda and the police state

- Also, the Nazis had improved foreign policy and employment

- Opposition came from youth groups, the church, trade unions, the army and political opposition groups

- Some young people set up alternative youth groups to those approved by the Nazis

- Very few people were brave enough to openly oppose the Nazis and many just grumbled privately about their views

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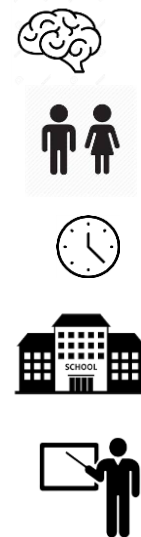| Key Word	Definition
SD	Security Service, set up in 1931 to gather intelligence of potential enemies
Police State	A dictatorship that has absolute control by secretly monitoring the belief and activities of its people and taking act
Concentration Camp	Prison for political prisoners and Nazi enemies, placed there without trial. The first one was opened in 1933.
The SA	The Sturmabteilung, often called Brownshirts. Were protection squads/private Nazi party army
Gestapo	Nazi official secret police
Enabling Act	1933 Reichstag law gave Hitler and his government full power. He would have more powers than the president under the law.
Night of the Long Knives	This was where Hitler's political and military rivals in the SA were removed on 30th June 1934.
SS	(Schutzstaffel). Hitler's personal bodyguard
Decree for Protection of People and State	Law passed after the Reichstag Fire, due to state of emergency. It stopped basic civil rights
Concordat	Nazi agreement with the Pope. The Pope agreed to stay out of politics if Hitler agreed to stay out of the Catholic Church.
Propaganda	Spreading of false or exaggerated information normally by a government to increase support for them
The Edelweiss Pirates	Often young working class opposition. Listened to banned swing music, did anti-Nazi graffiti, created no go Hitler Youth areas
Swing Youth	Middle class opposition. They listened to swing music, men grew their hair long, women wore make up in protest at Nazi
Totalitarian State	Country where government controls all areas.
indoctrinate	To teach a person to accept a set of beliefs without questioning them
Aryan	'Pure' Germans, with no Jewish family.
Rallies	Large meetings of people, usually to show support for Hitler and the Nazis.
Censorship	Not including information that may make someone/something seem unpopular and only allowing a certain viewpoint to be shared

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Nazi policies towards women

- The Nazis believed women should adopt a traditional appearance, leave professional jobs to men and get married and have children

- The Nazis used propaganda to convince women of this

- Nazis laws included the Law for the Encouragement of Marriage, changes to divorce laws, Lebensborn and the Mothers Cross

- Women were banned from certain jobs and discouraged from going to University

- Nazi policies towards women had some impact but not as much as they had hoped

Nazi policies towards the young

- The Nazis believed the youth should be brought up to be useful to Germany and support Nazi ideas

- They believed boys and girls should be brought up differently

- The Hitler Youth (boys) and the League of German Maidens (girls) were set up to reinforce Nazi ideas in young people's 'free time'

- Schools in Nazi Germany were organised to create useful German adults and Nazi supporters

- The Nazis shaped the development of young Germans by controlling teachers and the curriculum

Employment and living standards

- Reducing unemployment was a priority for Hitler and the Nazis

- The Nazis used a range of strategies to do this: The National Labour Service, building autobahns and rearmament

- As well as official unemployment levels, Nazi Germany also had 'invisible unemployment'

- People experienced many changes under the Nazis, these included: unemployment, wages, prices and the use of luxuries

- The Labour Front, including Strength through Joy and the Beauty of Labour also affected living standards

The persecution of minorities

- Treatment of minority groups was shaped by eugenics, racial hygiene and anti-Semitism

- The Slavs, gypsies, homosexuals and people with disabilities were all mistreated

- Nazi persecution began in 1933 , became worse in 1935 with the Nuremburg Laws and became worse still in 1939 after the events of Kristallnacht

- The Final solution was not enforced until 1942, when Germany was involved in WW2

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Key Word	Definition
Lebensborn	'Fountain of life' programme. unmarried pure women could donate a baby to the Fuhrer by becoming pregnant by a SS man.
Law for the Encouragement of Marriage 1933	Law gave couples a loan when they married if the wife quit work. Could keep more of loan if had more kids
The Mothers Cross	An award given to mom's for the amount of children they had
Anti-Semitism	Hatred & persecution of the Jews
Reich Labour Service (RAD)	Scheme to give jobs/manual labour to young unemployed men Rearmament: Providing the German armed forces with weapons and military equipment
Volksgemeinschaft	Creating of a people's community where the strongest races e.g. Aryan would dominate the weakest races in Germany.
Strength through Joy	Aim was to improve Germans leisure time by organising leisure/cultural activities for cheap
Labour Front (DAF)	DAF was set up to replace Trade Unions and control German workers
Nuremburg Laws 1935	Racial laws. Consisted of Reich Citizenship Law & Law for the Protection of German Blood and Honour
Kristallnacht 1938	The smashing of Jewish windows: businesses, homes and synagogues
Concentration Camps	Prison for political prisoners, Nazi enemies and 'undesirables' like Jews placed there without trial.
Ghetto	A slum part of a city where a particular group of people live.
Master Race/Ubermenschen	'Pure' Germans. Pure race (often blue eyed, blonde, tall and athletic)
Subhuman/Untermenschen	All non-pure German groups. They were treated as second class citizens who had 'contaminated' the master race. Jews were an example.

The Nature of God: The Mool Mantra

- Opening words of the Guru Granth Sahib (GGS 1a)
- 'Mool Mantra' means 'Main Chant'.
- Sikhs believe the words were the first teachings of Guru Nanak after he became enlightened
- Most important part of the Guru Granth Sahib (GGS) and most important statement for Sikhs
- Said daily in Sikh prayers and recited in worship.

One Universal Creator God (Ik Onkar)
The Name is Truth
Creative Being Personified
No Fear, No Hatred
Image of the Undying
Beyond Birth
Self Existent
By Guru's Grace

God as Creator

- God (Waheguru) created everything.
- There are no creation stories in Sikhism, and Sikhs accept scientific views about how the universe came to be here, but nothing would have happened without it being God's will (hukam).
- Sikhs believe God is both separate from and part of His creation: *'He possesses all qualities; He transcends all qualities'*

God as separate from the Universe	God shown in and through the Universe
- God is transcendent – beyond human understanding - He does not have a physical form, is timeless and spaceless, and has no limits - God is without gender (Sikhs use 'He' to have a simple way to talk about God) and has no beginning or end. - 'Nirgun' – without qualities or form. - *'He is the Perfect Transcendent Lord, from the very beginning and through the ages'*	- God is present within creation and within human beings, as a soul or Divine Spirit - There are ways that God can be understood by humans, e.g. through the Mool Mantra, the teachings of the Gurus, other parts of the GGS or through his creation. - 'Sargun' – with qualities or form - *The Lord is seen to be manifest and present'* - *He Himself is the water… He Himself abides in each and every heart'*

The Virtues

- God has given people an opportunity to reunite with Him (Mukti)
- To achieve this, Sikhs must build good karma in the hope of being released from the cycle of birth, death and rebirth
- One way to build good karma is to live a good life, developing certain positive characteristics known as **virtues**.

Virtue	Description
Truth and Truthful Living	Telling the truth, living an honest life. Includes promoting justice and not discriminating. *'Truth is higher than everything; but higher still is truthful living'*
Compassion and Patience	Being kind and aware of the needs of others. Being able to accept/put up with delays/problems with a calm mind and attitude. *'Show kindness and mercy to all life'.*
Contentment	Not being greedy, being satisfied with what you have, maintaining detachment from material things.
Humility	To be humble, not proud. Not full of your own importance.
Love	To show a loving attitude to everyone, to show kindness, respect and forgiveness (just as God would do for them)
Wisdom	Having experience, knowledge and good judgement – understanding all of the virtues and being able to put them into practice.
Courage	Being brave. Many Sikhs throughout history have shown bravery in remaining true to their faith, even if they have suffered for it.
Temperance/ Self-Control	Showing self-control and moderation, can include not partaking of alcohol or drugs. Being able to control one's temper and behaviour.
Justice	Working to make all things fair, or to bring equality.

Gurmukh and Manmukh

- **Gurmukh**: **God centered**. Someone who prays, worships, follows the virtues etc and keeps God in mind at all times. '*The Gurmukh acts in harmony with God's will; the Gurmukh finds perfection'*
- **Manmukh**: **Man centered**. Someone who is selfish, thinks they are above God and others, succumbs to the evils. *'The foolish, self-willed manmukh is blind in the world'.*

Beliefs about Life After Death

Rebirth	- **Reincarnation**: when a human dies, their soul is reborn into another body - This rebirth is part of a cycle of being born, dying and reborn, known as **samsara**. - The cycle will repeat until the soul is freed/ liberated and becomes united with God - All animals, including humans, have souls, so a human may be reborn as an animal. - *'They die and die, over and over again, only to be reborn, over and over again'*
Karma	- Sum total of a person's actions and words which determines their afterlife - Reincarnation is based on the good or bad karma they built in a previous life. - A human is the best being you can be reborn into as it gives you the best chance to build good karma and be liberated from samsara. - Good actions = good karma = a good reincarnation/ liberation from samsara - Bad action = bad karma = a lower reincarnation e.g. animal. - *'The body is the field of karma in this age; whatever you plant, you shall harvest'*
Mukti	- Liberation, freedom and release from the cycle of samsara - The final goal for Sikhs - individual soul reunites with God - Negative aspects: To achieve mukti, a person must rid themselves of all that stands in the way of getting close to God. This can be challenging. - Positive aspects: the soul is free to unite with God. This is indescribable and can only be experienced. - *'Through selfless service, eternal peace is obtained'*

Exam Terminology

Influence: The capacity to have an effect on people's character, behaviour or actions
Contrasting: To show a difference
Contemporary: Occurring in the present time
Sacred Writings: Writing that is believed to contain words of God e.g. The Guru Granth Sahib
Evaluate: Consideration of different viewpoints before arriving at a final judgement
Justified Conclusion: A final decision which is based upon a range of evidence.

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Key Beliefs Continued

The Stages of Liberation: The 5 Khands

- Stages a human being must pass thorough on the way to mukti.
- Usually will not all happen in one lifetime

1) Piety	- The opportunity for devotion to God, awareness of God.
2) Knowledge	- Knowing about God; learning about and experiencing God
3) Effort	- Devoting oneself to tuning in with God e.g. through prayer, worship, meditation
4) Grace	- Spiritual blessing given by God (as we can only go so far in developing ourselves)
5) Truth	- Finding God, the realisation of God. Can only be experienced, not described.

The Barriers to Mukti

- - Sikhs must avoid those things which will stop them from achieving mukti. There are 5 evils (below) bt Sikhs should also guard against:
- **Haumai** (pride and ego)
- Illusion (inability to see the truth; focus on material things)
- Self-centredness (ego, selfishness)

Anger		- An emotion causing someone to act without balance
Lust		- Sexual desire – sex outside of marriage leads people away from God: *'Sexual desire and anger are broken, like a jar of poison'*
Greed		- A desire to possess more than you need
Worldly Attachment		- Placing too much emphasis on material possessions and worldly relationships
Pride		- False pride – being proud of things that were given rather than achieved: *'Why do you take pride in trivial matters?'*

The Oneness of Humanity

- Guru Nanak, the founder of Sikhism, had an experience where he disappeared into a river for 3 days. During that time, he said he met with God.
- Following this experience, he taught that there was not only one way to God; there is no need to convert others to Sikhism because we can all follow our own path to God.
- Everyone has a divine spark within them which unites us all, and this is known as the **oneness of humanity.**
- *God is neither Hindu nor Muslim and the path I follow is God's'*
- *'We are all sons of the one God; there is no Hindu and no Muslim'*
- *'The Divine Light is within all'*
- This also means that everyone is equal – this was one of Guru Nanak's most important teachings.

The Equality of All
Equality is shown in Sikhism in the following ways:

The life of Guru Nanak
- Had both Hindu and Muslim friends. His best friend was a Muslim man called Mardana
- Emphasised equality between men and women: *'From her, kings are born… without woman, there would be no one at all'*
- Taught: *'There is no Hindu and no Muslim'*
- Introduced the practice of the langar: *'No discrimination… must be made while making people sit in rows for eating'*

The life of Guru Gobind Singh
- Started the Khalsa – both men and women can join.
- When the first 5 members joined, they wore identical coloured robes to show equality.
- One key role of the Khalsa is to stand up against inequality
- Introduced surnames Singh (Lion) and Kaur (princess) to remove inequality shown by the caste system

The Guru Granth Sahib
- The GGS is a collection of hymns and writings from many teachers and saints e.g. the Gurus.
- Writers also included Hindus and Muslims, showing the inclusivity of Sikhism.
- Guru Gobind Singh declared the GGS 'The Living Guru' and is the 11th and final teacher for Sikhs. It contains many teachings about equality: *'All beings and creatures are His; He belongs to all'. 'All are made of the same clay'.*

Sikhism Today
- The Langer: free kitchen where everyone is welcome. All sit on the floor together to show all are equal. Food is vegetarian so everyone can eat it.
- Both men and women take part in worship, reading GGS in the Gurdwara, cooking or serving food etc.

Sewa: Selfless Service

- Sewa is a duty Sikhs have to help others without expecting anything in return
- It will build good karma and help a Sikh on the path to achieving mukti
- *'Through selfless service, eternal peace is obtained'*
- It helps Sikhs to show many of the virtues whilst avoiding the 5 evils.

Tan (Physical Sewa)	**Man (Mental Sewa)**
Using the body to help others e.g. serving in the langar, cleaning shoes or floors	Using the mind and mental skills e.g. reading the GGS, teaching others, inspiring others

Dhan (Material Sewa)
Using material wealth to help others e.g. giving a tenth of their income to the sangat or to charities. This 10% is known as Dasvandh

The Sangat: Sikh Religious Community

- The company of Sikhs meeting in the presence of the Guru Granth Sahib
- 'Sat Sangat' means 'True Congregation'
- *'Join the Sat Sangat, the True Congregation, and find the Lord'*
- Sikhs may gather together to learn, pray, hold a ceremony, read the GGS etc
- Importance: provides opportunities for sewa, gives the chance to learn from other Sikhs, builds a supportive community to strengthen faith, helps to develop religious understanding.
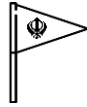
Amritdhari and Sahajdhari Sikhs

- Amritdhari Sikhs are those who have been initiated into the Khalsa.
- They are expected to offer daily prayers, wear the 5Ks, take the name Singh and Kaur, practise the virtues, be vegetarian and obey the code of conduct (which includes rules such as no smoking, drinking or adultery)
- 5 Ks: **Kara** (steel bracelet), **Kirpan** (ceremonial sword), **Kachera** (cotton underwear), **Kanga** (wooden comb), **Kesh** (uncut hair). Amritdhari Sikhs must wear all of the 5 Ks. Sahajdhari Sikhs may choose to wear some.
- Sahajdhari Sikhs have not been initiated into the Khalsa whilst they believe in Waheguru and the Gurus, they do not have to follow the strict rules.

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The Gurdwara: Religious Features

- The gurdwara is the Sikh place of worship. Translates to 'Door of the Guru'
- Technically a gurdwara is any place in which the Guru Granth Sahib is installed and treated with proper respect
- The gurdwara is open to all, no matter their age, race, religion etc.

Outside the Gurdwara:
- Many have a dome and decorations on the outside
- All will have a flag outside – the Nishan Sahib. This is usually yellow with the Khanda symbol in blue.

Prayer Hall: Darbar Sahib	Large space with a throne at one end. Men and women sit separately so they are not distracted by one another, and all sit on the floor so they are lower than the GGS
Takht	Throne: represents the GGS being treated like royalty/ a human guru. Seat covered in fine cloth, often surrounded by flowers, space for money and food offerings, and a bowl containing karah parshad (a sweet food which is seen as a blessing)
Palki	Domed structure used to cover the raised area where the GGS is placed. Canopy at the top may be engraved with the word 'Waheguru' or with scripture.
Manji	A small bed on which the GGS is placed during the day.
Chanani	Large canopy made of decorated cloth which is placed over the palki.
Langar Hall	The area of the gurdwara where free food is served. All are welcome, everyone sits together on the floor to represent equality.

Worship in the Gurdwara

- Worship can include meditating, listening, singing, reciting, working and serving people – is it true worship as long as God is kept in mind.
- *'Worship and adore Him, and you shall be at peace forever'.*
- Worship in the gurdwara may last up to 5 hours but people may come and go.
- Shoes are removed, heads are covered, hands/ feet washed, before bowing and touching the floor in front of the GGS.
- Worship services start and end with the Ardas Prayer
- Kirtan – singing of hymns which nourishes the soul
- Ragis – musicians who sing or play accomoniment for kirtan
- Karah Parshad – given out at the beginning and end of the service, from the same bowl to show equality. Sweet like God's blessings.

The Role of Prayer in the Home

- Sikhs are expected to remember God at all times which includes reciting daily prayers at home.
- Some Sikhs have a copy of the GGS at home but many have a gutka instead, a prayer book, which is treated with as much respect as the GGS (ideally has its own room, or section of a room, and is kept in a clean cloth).
- GGS 305, written by Guru Ram Das, outline how Sikhs should pray:
- *'One who calls himself a Sikh of the Guru, the True Guru, shall rise in the early morning and meditate on the Lord's Name'.*
- Prayer routine includes waking early, bathing, repeating the japji (a prayer given by Guru Nanak), and repeating other prayers at different points of the day.

Nam Japna: Meditating on the Name of God

- One key responsibility of Sikhs is to meditate on the name of God, known as Nam Japna.
- This keeps God in mind at all times and helps them to act well in their life.
- It may involve quietly reciting God's name to oneself, or by saying it out loud in a community recitation.
- It is the community recitation that is usually known as Nam Japna.
- *'Those who have the treasure of the Lord's Name deep within their hearts – the Lord resolves their affairs'*

The Role of the Gurdwara in the Sikh Community

Management and Role
- There are very few paid roles as most Sikhs volunteer as part of sewa.
- A granthi (or management team) manage and maintain the gurdwara.
- Many gurdwaras are open 24/7 and all are welcome
- Besides prayer and worship, other roles for the gurdwara include langar, meeting/ education rooms to teach Punjabi and Gurmukhi, committee meetings, youth clubs etc.

Granthi:
- A male or female Sikh, who has been initiated into the Khalsa, who reads the Guru Granth Sahib.
- They are expected to be of good character and live life according to the Sikh code of conduct
- They do not have a higher status than other Sikhs but they are highly respected.
- Granthis arrange and conduct religious services, maintain the gurdwara, leads kirtan (singing hymns), lead an akhand path etc.
- Most importantly, granthis take care of the Guru Granth Sahib, organizing the ceremony to bring it to and from the rest room each day.

The Role and Importance of the Akhand Path

What	A continuous reading of the Guru Granth Sahib from start to finish – all 1430 pages. Takes approx. 48 hours – male and female Sikhs take shifts to complete it. Karah Parshad is given out at the beginning and the end as a blessing
When/ why	Usually takes place at the start of a festival. Times of joy and sorrow e.g. wedding, funeral, birth of a baby, death of a family member. GGS may be taken to a new home or new business as a blessing
Importance	Seen as a great blessing to have the Living Guru recited at an important event – it should not be taken lightly. If it is to bless a new home or business, the family are expected to listen and take part at some point during the 48 hours to show respect

Showing Respect to the Guru Granth Sahib

- GGS is known as the Living Guru (as declared by the 10th and final human guru, Guru Gobind Singh) and is treated with as much respect as a human guru would be.
- Sikhs show respect to the GGS in a number of ways, e.g.:
- All printed copies have 1430 pages to show they are identical and the words do not change
- Sikhs sit on the floor to worship so they are lower than the GGS
- They do not point their feet towards it
- They bow before it
- They cover it with a rumalla, a decorated cloth (often made of silk)
- They wave a chauri over it – a fan made from yak's hair whch would have been waved over honoured teachers to keep them cool and keep flies away
- At the end of each day it is wrapped in clean cloth and carried in a procession to its rest room, where it is effectively put to bed overnight. The room is called Sach Chand.

Langar as an expression of Sewa

- Started by Guru Nanak to promote equality in a time of the Caste System
- Shows equality: all are welcome, all sit on the floor so they are on the same level, food is vegetarian so everyone can eat it.
- Excellent way for Sikhs to carry out Tan – physical sewa – by cooking, serving, cleaning. Can also show Dhan – material sewa – by donating produce.
- Both men and women take equal roles in helping in the langar.
- Many langars run in times of crisis, and to help those in poverty. **227**
- *Guru Gobind Singh: 'Keep the langar ever open'.*

Festivals: Vaisakhi

- Originally a harvest festival where farmers would show thanks to God for a good harvest
- Usually celebrated on 13th or 14th April

Vaisakhi in 1699
- Guru Gobind Singh started the Khalsa – he asked who would be willing to die for their faith and 5 men stepped forward. They became the Panj Piare, the first 5 members of the Khalsa. The practice of the surnames Singh and Kaur began here.

Vaisakhi in 1919
- During celebrations at Jallianwala Bagh, Amritsar, many Sikhs were shot and killed by a British general who was acting on the orders of the Lieutenant Governor of the Punjab. Sikhs remember sad occasions such as this at Vaisakhi and it's a reminder to stand up for people's human rights to practise religion freely.

Celebrations at Vaisakhi
- Akhand Path
- Act of worship including Ardas Prayer and kirtan
- Community meals – langar
- Many Sikhs choose to join the Khalsa at Vaisakhi
- New clothes, especially for children
- Sending Vaisakhi cards
- Processions through the streets – floats, singing, dancing etc
- Nishan Sahib – a new flag replaces the old flag. Flagpole washed in yogurt and milk then rinsed with water as a symbol of purity.

Festivals: Divali

- Name means 'a row of lights' so Divali is often known as the festival of lights.
- Held in October/ early November
- Celebration of freedom, and the victory of good over evil.
- It's a time for Sikhs to remember those who have stood strong in their faith and who have been brave in times of persecution.
- Sikhs are encouraged to follow the example of Sikhs who have promoted and protected people's freedom

Guru Hargobind and the 52 princes
- Guru Hargobind (6th Guru) and 52 princes were arrested and imprisoned for political reasons.
- The emperor believed the charges were false and demanded Guru Hagobind be released, but he refused to leave unless the princes were released as well.
- The emperor said as many princes as could hold on to the Guru's clothes as he walked out of the gate could be released.
- The Guru's cloak had 52 long tassels – all could hold on and all were freed.
- Became known as 'prisoner release day' and is celebrated at Divali.

Celebrations at Divali
- Akhand Path
- Street Processions, firework displays and langars
- Homes are spring-cleaned and decorated with oil lamps and lights
- New clothes and presents given to children
- Huge celebrations at the Golden Temple – pool and buildings decorated with thousands of lights.

Festivals: The Gurpurbs

- Take place at anniversaries – usually the birth or death of a guru.
- 4 most widely celebrated gurpurbs: Guru Nanak's birthday, Guru Gobind Singh's birthday, martyrdom of Guru Arjan and Guru Tegh Bahadur.
- **Importance**: remind Sikhs of their religion's history, strengthen their faith as they join together to celebrate, enable Sikh children to learn about the gurus, gives Sikhs chance to share their faith and perform acts of sewa.

General Celebrations	Guru Nanak's Birthday
- Akhand Path - Guru Granth Sahib carried in processions - Kirtan - Langars	- October/ November - Most important gurpurb - Processions, candles lit, firework displays, new clothes for children, holiday from school (in India)

Different Celebrations in Great Britain and India

Great Britain	India
Celebrated on nearest Sunday Takes place at weekend so no schools closed Quieter and more local celebrations, focused around gurdwara.	Celebrated on actual day School often closed Much bigger celebrations – colourful processions, firework displays, fairs.

Pilgrimage: Visiting the Golden Temple

Pilgrimage: a religious journey
- Many Sikhs travel to the Golden Temple (Harimandir Sahib) in Amritsar in the Punjab.

Features:
- Surrounded by a pool of fresh, clear water
- 4 entrances to represent that everyone around the world is welcome
- The upper storey is covered with gold leaf
- The original Adi Granth, the first version of the holy book, is installed on a takht inside the temple

Akal Takht
- Political building
- Houses the rest room for the GGS – it is carried in procession every morning and evening.

Visiting/ Importance
- Pilgrims may bathe in the sacred water, thought to have heling properties
- They visit the gurdwara, listen to kirtan, hear readings from GGS, meditate etc
- Langar feeds thousands of pilgrims
- Pilgrimage is not compulsory but Sikhs may choose to as it can strengthen and deepen their faith
- It teaches pilgrims more about the history of their faith and is a time for Sikhs, and non-Sikhs, to gather together
- Rituals such as pilgrimage, or bathing in the sacred pools, are less important than a person's inner faith – bathing would do nothing if they are not clean inside.

Naming Ceremony

What happens?	- Takes place around 2 weeks after a baby is born - Baby is given a spoonful of amrit (sugar and water) and the amrit is stirred with a khanda by the granthi. - Granthi dips the sword into amrit and lightly touches the baby's head and tongue with the tip of the sword. - Mother drinks the rest of the amrit - Karah Parshad is given out.
Naming the baby	- First name: Granthi opens the GGS at a random page. First letter of the first word of the first hymn on left hand page decides the first letter of baby's name. - Surname: Many Sikhs use Guru Gobind Singh's tradition of Singh (lion) or Kaur (princess)
Importance	- A human is the greatest thing to be reincarnated into as it offers the best chance of achieving mukti, so the birth of a baby is a time to celebrate and give thanks to God.

Amrit Sanskar: Initiation Ceremony

What is it?	A ceremony where those who are prepared to be a fully committed Sikh are initiated into the Khalsa
What happens?	Person being initiated must wash their hair, cover their head and wear clean clothes and the 5Ks. 6 other amritdhari Sikhs present – 5 to represent the Panj Piare, plus the granthi. They drink amrit from the bowl 5 times. Amrit is sprinkled on their eyes and hair 5 times. The remaining amrit is then shared between those being initiated, drinking from the same bowl. Karah Parshad is shared out.
What changes?	Initiated Sikhs are known as amritdhari Sikhs. They will follow the Sikh code of conduct (Rehat Maryada) and keep rules such as: no smoking, alcohol or drugs, no eating meat, wearing the 5Ks, no stealing or gambling. They will also take the surname Singh or Kaur, if they didn't have this already.

Exam Terminology
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Evaluate: Consideration of different viewpoints before arriving at a final judgement
Justified Conclusion: A final decision which is based upon a range of evidence.

Key Words

Monotheistic: A religion which believes in one God
Holy: Separate and set apart for a special purpose by God
Omnipotent: All powerful, Almighty
Omnibenevolent: all-loving
Just: Fair
Trinity: One God has 3 parts; God the Father, Son and Holy Spirit
Holy Spirit: God's presence in the world
God the Son: Jesus – enables humans to have a special relationship with God
Creation: God bringing the universe into being
The Word: Jesus – as described in the book of John
Genesis: The first book in the Bible which has the creation story in it
Incarnation: God in human form – Jesus.
Resurrection: coming back from the dead
Blasphemy: saying or doing something which goes against God
Crucifixion: Roman method of execution where a person is nailed to a cross
Ascension: 40 days after the resurrection when Jesus returned to God in heaven
Afterlife: What happens when you die
Day of Judgement: God will judge all souls at the end of time
Heaven: Eternal happiness, being in the presence of God
Hell: Eternal suffering, absence of God
Purgatory: Catholic belief in which souls are cleansed in order to enter heaven
Sin: Any action against God
Original Sin: First sin in the world committed by Adam and Eve which means all humans are born with this in them
Salvation: saving the soul from sin and going to heaven thanks to Jesus' sacrifice
Grace: A quality of God which shows to humans that God loves them, which they don't need to earn
Forgiveness: pardoning someone for their wrong doing
Atonement: restoring the relationship between people and God through the life, death and resurrection of Jesus

God as omnipotent, loving and just

- Christians believe **God is omnipotent: all-powerful**. *'Nothing is impossible with God'*
- **God is omnibenevolent: all-loving.** Guidelines are given for us to live the best lives we can. Christians should love each other treating everyone with care and respect. *'God so loved the world he gave his one and only Son…'*
- God has unlimited power and authority, together with complete love, and therefore gives **justice** in a fair way. Christians should try and bring about fairness in the world.

The Problem of Evil and Suffering: The Inconsistent Triad

- Christians believe God is omnipotent (all-powerful) and omnibenevolent (all-loving).
- However, why is there evil and suffering?
- If God was all powerful, he would be able to stop evil and suffering.
- If he was all loving, he would care enough to stop it. So he would stop it.
- But he doesn't! So God cannot exist, or is at least not omnipotent or omnibenevolent.
- A Christian defence: God is transcendent (beyond our understanding) and therefore we can trust God to know best – there is a reason for this inconsistency, even if we can't understand it.

Different Christian Beliefs about Creation

Genesis 1 v 1-3	- God created the world in 6 days and rested on day 7. *'In the beginning God created the heavens and the earth'.* God created the perfect world in the beginning: *'It was good'* - Not all Christians believe this story is literally true, but rather believe it is a story which represents the idea that God created life. - A further quote from Genesis: *'The Spirit of God hovered over the waters'* indicates that the Holy Spirit was present at creation.	Combined, these ideas suggest that all 3 parts of the Trinity were present at creation.
John 1 v 1-3	- *'In the beginning was the Word, and the Word was with God, and the Word was God….through him all things were made…'.* - 'The Word' refers to Jesus and therefore he was present at the beginning of the world and involved in the creation of the world	

The Oneness of God and the Trinity

- The Holy Trinity: God the Father, the Son and the Holy Spirit.
- God is three in one. There are not three Gods, but different forms of the same thing. Each part is fully God, but also these parts of the Trinity are not the same.

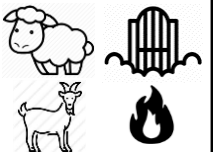| God the Father	God the Son	God the Holy Spirit
- First person of the Trinity. - Creator - Omnipotent, omnibenevolent, omniscient (all-knowing) and omnipresent (everywhere).	- Second person of the Trinity. - Jesus, who became God in human flesh (known as the Incarnation). - Performed miracles, healed the sick and showed kindness to outcasts.	- Third person of the Trinity. - God sent the Holy Spirit to influence, guide and sustain all life on earth after Jesus ascended. - The unseen power of God.

Different Christian Beliefs about the Afterlife

- Based on God's judgement Christians believe that people will go to heaven or hell.
- Judgement will happen at death or at the day of judgement (Christians vary on their understanding of this)
- *The Parable of the Sheep and the Goats* shows how people will be judged by God. The sheep represent those who did good actions (therefore going to heaven) and the goats represent those who did bad actions (therefore going to hell)
- Jesus also said, *"I am the way the truth and the life, no-one comes to the Father except through me."*
- *So,* treating others well *and* believing in God is important to guarantee a good afterlife.
- Heaven is seen as being with God and eternal happiness where there is no suffering. Hell is seen as eternal torment or suffering and being absent from God, and where the Devil is.
- Some Christians believe that Heaven is a literal, real place you will go. Other Christians believe it is just being with God, in the same way hell may not be actually real but an absence of God.
- The Bible teaches that there will be a resurrection of the body for all people who go to heaven, though the details of this are debated.
- In the book of Revelation it mentions that people who go to hell will burn in a lake of fire.
- Roman Catholics believe in a place called purgatory in which your soul goes to be cleansed as not everyone is ready yet to go to heaven.
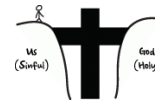
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Jesus' Life: Key Events

Event	Key Details	Importance/ Influence on Christians
Incarnation: Jesus is God in human form	- 'Incarnate' mean 'In the flesh' – Jesus was God in the flesh. - Jesus' birth is explained in the Christmas story: the Nativity. - Humble birth (in a manger) shows Jesus was fully human, but he was born through the immaculate conception (Mary was a virgin), so he was fully God - This means Jesus does not have Original Sin because he was not conceived through sexual relations. - *'Before they came together, she was found to be pregnant through the Holy Spirit'.* - *'The Word became flesh and made his dwelling among us'. '*	- Encourages them to celebrate Christmas for its true meaning - Helps them in difficult times as they know their role model was human too - Allows them to have a personal relationship with God through Jesus
Crucifixion: Jesus' death on the cross	- Crucifixion is remembered on Good Friday. - Jesus was arrested (having been betrayed by Judas) and put to death by Pontius Pilate. He was crucified alongside two criminals. - As Jesus was fully human he suffered pain as an ordinary human did. *'Father, into your hands I command my spirit'* - On the cross Jesus said *'Father forgive them, for they know not what they do'.*	- By accepting Jesus' sacrifice they can be forgiven for sin and go to heaven. - Encourages them to follow Jesus' example and forgive others - Reminds them to be thankful and remember Jesus (especially on Good Friday) - Reminds them that suffering is a part of life and God can understand what it I like for someone to suffer.
Resurrection: Jesus rose from the dead	- Jesus was buried in a tomb and left there until Sunday. Due to it being the Sabbath (on the Saturday), no-one could touch the body until after this. - Mary Magdalene returned to the tomb - it was open and empty. - An angel appeared and said Jesus had risen from the dead. - Evidence of resurrection: he appeared to people including disciples, they saw him eat, Thomas was encouraged to tough Jesus' palms to prove he was not a ghost.	- Shows Jesus was divine and not just a human so it may strengthen faith - Shows the power of good over evil - Encourages them to not fear death
Ascension: Jesus went back up to heaven to be with God	- Happened 40 days after the resurrection - Jesus ascended to heaven. - He gave the disciples the Great Commission: *'Go and make disciples of all nations, baptizing them in the name of the Father, the Son and the Holy Spirit'.* - The Holy Spirit was left to guide and comfort people.	- Will encourage them to call on the Holy Spirit for guidance and comfort - Will encourage them to spread the message of Christianity (evangelise)

Sin and Salvation

- Sin: anything that goes against God's laws. Separates humans from God.
- Salvation means to be saved from sin (therefore being able to go to heaven)
- Humans are not perfect – impossible not to sin
- All humans are born with Original Sin – passed down from Adam and Eve.
- This action separated humans from God and brought about death into the world. They were tempted by the serpent (devil) and Christians believe that Christians are tempted in life to do bad things.
- **Salvation through Law**: humans have free will but should use this to make the right choices using God and Jesus' teachings to guide them, e.g. 10 Commandments.
- **Salvation through Grace**: being saved by accepting the sacrifice Jesus made on the cross – this showed God's grace: *'For by grace you have been saved through faith'*
- **Salvation through Spirit**: having the Holy Spirit as a guide to accept God's Grace and follow his Law.

The Role of Christ in Salvation: Atonement

- Salvation is offered through Jesus, *"For the wages of sin is death, but the gift of God is eternal life in Christ Jesus".*
- Jesus' death makes up for Original Sin. Humans can receive forgiveness for their sins because of Jesus' death and then receive eternal life.
- His sacrifice provides atonement, which means our relationship with God is restored. This removes the effects of sin and allows humans to get back to God. *"He is the atoning sacrifice for our sins and for the sins of the whole world".*
- Jesus paid the price for the sin of all mankind through his death and Christians believe if you put your trust in him you can receive eternal life with God.
- Links with Salvation through Grace: salvation is a gift people must choose through belief in Jesus atoning for their sins

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Worship and Festivals

Practice and Key Words	Details/ Contrasting Views		Importance and Quotations
Worship: Act of religious honour or devotion	**Liturgical** - Takes place in a church and is led by a priest - **Formal**, **set prayers** are read out, and the worship follows a **set pattern and structure** - A more **traditional**, and formal form of worship - E.g. Eucharist in the Catholic Church	**Non-Liturgical** - Also takes place in a church but **less formal** - No set prayers, instead people take turns to preach and read from the **Bible** - Can be modern and appealing to young people - Service is usually focused around a Bible reading - E.g. Methodist or Baptist services	- Shows gratitude, love and respect to God - Could be a way of asking for forgiveness or asking for help - Brings comfort and strength - Gives time for reflection - *'Sing to the Lord, for he has done glorious things; let this be known to all the world'.*
	Informal - Spontaneous prayers or sharing of thoughts - Community or house churches might meet to eat together and share their faith - Pentecostal Church – 'charismatic' worship. Led by the Holy Spirit and may involve dancing, clapping, calling out, speaking in tongues.	**Private** - Spending time with God alone or with close friends/ family - May involve prayer, meditation, studying the Bible.	
Prayer: Communicating with God	**Informal** - Prayers that are made up by the individual using **his or her own words**.	**Set Prayers** - Prayers which have been written down and said many times by many people - E.g. **The Lord's Prayer**: The prayer that Jesus taught the disciples to pray, which includes thanks, asking for forgiveness and asking for guidance. *"Our father who art in heaven….".*	- Set prayers can bring a sense of unity - Prayer brings comfort and builds relationship with God - *'Call on me and come and pray to me, and I will listen to you'.*
Sacraments: An outward sign of inward grace. **Eucharist/ Holy Communion**	**Roman Catholic Church (Mass)** - Readings from the Bible - Offering of bread and wine **brought to the alter** - Priest says the words of Jesus at the Last Supper, says the Lord's Prayer and **gives a sign of peace** - **Congregation come to the alter** to receive the communion	**Orthodox Church (Divine Liturgy)** - Hymns, prayers, readings from Bible. - Priest comes through **Royal Doors** to chant the gospel. - Lord's Prayer said, behind Royal Doors words of Jesus said. - **Bread divided into four** – three consecrated as body and blood and fourth broken into small pieces. **Priest gives bread and wine together on a spoon.**	- Jesus started the tradition at The Last Supper (which took place the day before he died) - Christians now remember Jesus' death – reminds them of Jesus' sacrifice, and reminds them to forgive others. - *"This is my body which is for you, do this in remembrance of me"*
Sacraments: An outward sign of inward grace **Baptism**	**Infant Baptism** - Everyone is a descendent of Adam and Eve and therefore carries **Original Sin**. Baptism washes this away. - It also **welcomes them to the church community**. - Infant wears white, Godparents are chosen, font holds the water - E.g. Catholic, Orthodox	**Believer's Baptism (Adult Baptism)** - Some Christians think children are too young to understand the meaning and therefore don't baptise infants. - The person is old enough to understand the meaning behind what they are doing. - This includes a **full immersion** in a pool to wash away sin and start a new life in Jesus. - This is known as being **'born again'** - E.g. Baptist and Pentecostal churches	- Brings a person into the Christian family/ community - Water symbolises the washing away of sins - Jesus was baptised, setting an example for others to follow - Jesus also encouraged baptism in the Great Commission: . *"Therefore go and make disciples of many nations, baptising them in the name of the father, son and Holy Spirit".*
Pilgrimage: A special religious journey to a holy site.	**Lourdes (France)** - Dedicated to Mary as Bernadette believed to have seen visions of Mary in the 19th Century. - A spring of water was discovered which had **healing powers**. Now millions of people have been to drink from the spring of water in the hope of being healed.	**Iona (Island off west coast of Scotland)** - Small community set up by St. Columba, an Irish missionary in the 6th Century - Pilgrimages happen there in dedication to the virgin Mary. - The community in Iona hold **daily services in the Church leading a seven mile hike** to holy spots – it is a physical and spiritual challenge	- Pilgrimage shows commitment to God and strengthens faith - People may go on pilgrimage for healing - It brings a sense of community
Festivals: Celebrations for religious reasons	**Christmas** - Remembers the birth of Jesus – **his incarnation**. - It is celebrated on the 25th December. - Trees and homes are decorated **with nativity scenes**. Lights remember Jesus is the light of the world. **Carol services** happen in Churches with readings from the Bible. Children act out nativity plays and **midnight mass** takes place on Christmas Eve.	**Easter** - Most important festival which celebrates Jesus' resurrection from the dead leading up from holy week. - Jesus was crucified on **Good Friday and rose on Easter Sunday**. - Special services take place and processions led by someone carrying a cross. - On Easter Sunday, **sunrise services** take place with hymns which celebrate the resurrection. **Easter Eggs** are used as a reminder of new life. **Paschal candle** is lit.	- Festivals celebrate the most important events of Jesus' life – his birth, death and resurrection. - They are a time for believers to come together and celebrate their faith. - *"I bring you glad tidings that today a king is born"* - *'Christ is risen from the dead'.*

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Key Words

Church: The holy people of God, the body of Christ or a building where Christians worship

Agape: compassionate love

Mission: A calling where an individual or group go out and spread the word of God.

The Great Commission: Jesus instruction to his followers to go and spread his message *"Go and make disciples of many nations"*

Missionary: A person sent on a religious mission to promote Christianity in a different country through preaching or charity work

Evangelism: Spreading the Christian message through preaching the Christian gospels

Alpha course: An example of evangelism –trying to tell others about Christianity

Convert: Someone who has decided to become committed to a religion and change his or her religious belief.

Reconciliation: A sacrament in the Catholic faith, also making up after an argument or disagreement

Persecution: hostility or ill-treatment, because of race or religious or political beliefs.

Poverty: When people live without having basic human rights such as having enough food, water or shelter

The Role of the Church in the Local Community

Food Banks	- Provide **free food** (usually non-perishable items) to those in need, usually through donations - Some food banks also offer support in seeking employment - Example: The Trussell Trust	The work of food banks and street pastors supports the key Christian message to show love to all. Key words and quotes to support: *Agape – compassionate love* *'Love your neighbour as you love yourself'* *'Faith, if not accompanied by action, is dead'* *'For I was hungry and you gave me something to eat' (Parable of the Sheep and the Goats)*
Street Pastors	- Volunteers who patrol streets in urban areas - Do not actively preach but **show their faith through their actions** - Give out flip flops, lollipops and water on nights out, help people to get home safely, offer reassurance and support	

Church Growth

Church Growth	- Estimated to be 2.5 billion Christians in the world - Christians are taught **to help to grow the church** by sharing testimonies (how God has changed their lives), inviting people to meetings, prayer, social events etc.	- *The Great Commission 'Go and make disciples of all nations, baptising them in the name of the Father, the Son and the Holy Spirit' (Jesus' words before he ascended to heaven).* - *Example: The Alpha Course. Anyone is welcome to join in with a meal and conversation about the 'Big Questions' of Christianity.*
Mission and Evangelism	- Evangelism means to **spread the message of Christianity** through preaching the Gospel (which means 'Good News') - Some do this through Mission work, which means evangelism overseas - The aim is to tell people that Jesus is the saviour of the world, in the hope of **converting them** to Christianity.	

The Role of the Worldwide Church: Reconciliation and Persecution

Working for Reconciliation	- Jesus came to earth to restore the relationship between humans and God, so Christians believe they have a responsibility **to restore the relationship between themselves and others.** - Lots of examples of arguing between faiths, even within Christianity e.g. **Catholics and Protestants**. Irish Churches Peace Project set up to reconcile these denominations - **Coventry Cathedral** – bombed during WW2. Cathedral has now become a centre for reconciliation as Christians wanted to respond with forgiveness, not revenge.	*'Therefore, if you are offering your gift at the altar and there remember that your brother or sister has something against you, leave your gift there in front of the altar. First go and be reconciled to them; then come and offer your gift'.* *'Blessed are the persecuted because of righteousness, for theirs is the Kingdom of Heaven'.* *'If one part suffers, every part suffers with it' (St Paul, likening members of the Church to different parts of the body)* *'Love your neighbour as you love yourself'* *Agape: Compassionate Love*
Responding to Persecution	- Persecution (ill-treatment) happens all over the world – Christians are tortured or even killed for their faith - Christians have a **responsibility to help those who are persecuted** - They might pray for them, donate to charity or get involved with charities who work abroad. - **The Barnabus Fund**: send financial support, raise awareness for those persecuted, send spiritual and material support.	

The Role of the Worldwide Church: World Poverty

Responding to World Poverty	- Jesus emphasised helping the poor so Christians follow his example - **Jesus told a rich man to sell everything he had** and give it to the poor. - **Christian Aid**: They aim to stop poverty, encourage sustainable development and provide emergency relief in areas such as Africa and the Middle East. - Their slogan is 'We believe in life before death' - They provide emergency food, shelter, water, sanitation and run a **Christian Aid Week** to fundraise every year.	- *'If anyone has material possessions and see a brother or sister in need but has no pity on them, how can the love of God be in that person?'* - *Parable of the Sheep and the Goats* - *'Go, sell everything you have and give to the poor, and you will have treasure in heaven. Then come, follow me.'*

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Reasons for Crime

Cause of Crime	Explanation/ Examples	Christian Responses	Sikh Responses
Poverty and Upbringing	Some people may commit a crime as they do not have the money for what they need e.g. they may steal to feed their family. Or, they may have been brought up in an environment where crime is normalised or even expected of them.	- Christians may be more sympathetic to those who have committed crimes for these reasons and show compassion: **'Love your neighbour as you love yourself'/ Agape, 'Blessed are the merciful'** - They would also feel a responsibility to help those in need so that they had no need to steal: **'Faith without actions is dead', 'I was hungry and you gave me something to eat'.** - However, the crime itself is still wrong: **'Do not steal' (10 Commandments)**	- Sikhs would also show some compassion and understanding: **'Show kindness and mercy to all life'** - Sikhs would also feel a responsibility to help, which is why the service of the **langar, an example of sewa**, is so important. There should be no need for people to steal food as the langar is always open.: **'Keep the langar ever open'** - Sikhs emphasise the importance of a strong family network in order to raise children in the right way.
Mental Illness	Mental illnesses can cause crime; kleptomania is a condition which leads people to steal. Mental illness can lead to anger issues which result in crimes such as assault, and some people feel driven to murder because of their illness.	- Christians would be compassionate towards those with a mental illness as it is not their fault and they are not always consciously committing crimes: **'Love your neighbour as you love yourself'/ Agape 'Blessed are the merciful'** - However, justice for the victim is still important, so Christians would support an appropriate punishment coupled with medical support.	- Sikhs would also show compassion as the criminal was not in full control of their actions: **'Show kindness and mercy to all life'.** - They would support the criminal getting support and treatment, as well as showing compassion for the victim/ their family.
Addiction	Addiction means the body cannot cope without a substance e.g. alcohol or drugs. This can lead to crime if the person is not in control e.g. they are drunk. They may behave in ways they wouldn't usually, or they may drive while intoxicated and cause an accident. They may also steal to fund their habit.	- Whilst illegal drugs are unacceptable, most Christians do not forbid drinking alcohol (Quakers do not drink at all). However, drunkenness is not encouraged, and it is a sin in Catholicism. - Addicts would be encouraged to seek support: **'Love your neighbour as you love yourself'/ Agape**	- Sikh teachings forbid the use of alcohol/ illegal drugs as they take the mind away from God, and a person is not able to worship. - Addicts would be encouraged to seek support: **'Show kindness and mercy to all life'**
Greed	Greed can lead to crime e.g. stealing because you want more money/ possessions	Christians would not at all accept crime for this reason. One of the 10 Commandments says: **'Do not covet'** which means do not be jealous. In the Bible it says: **'you cannot serve both God and money'** and **'The love of money is the root of all evil',** showing the problems with focusing on material wealth.	Sikhs are encouraged to be **Gurmukh** – God-centered, and to focus their minds on God and not on money/ possessions. **Worldly Attachment** is one of the 5 evils/ barriers to mukti, so crime for this reason is totally unacceptable.
Hate	Hatred is a negative feeling which can lead to violence/ aggression. It might be based on a prejudice e.g. racism.	This is a totally unacceptable reason for crime as **'Human beings were made in God's image'** so everyone has the right to be treated fairly.	This is a totally unacceptable reason for crime as **'All are made of the same clay'** so all humans should be treated with love and respect.
Opposition to an unjust law	There are times in history where people have broken the law as they felt the law was unfair, e.g. Rosa Parks refusing to give up her seat in 1950s America. In Britain today, our laws are generally fair but in some countries this is not the case.	- In general, Christians are taught to obey the law: **'Those who refuse to obey the law of the land refuse to obey God'.** - However, if the law was in opposition to Christian beliefs they would perhaps campaign for it to be changed, ideally without breaking the law themselves.	Sikhs have historically protested against laws they felt were unfair or in opposition to their beliefs, e.g. the law on motorcycle helmets. However, they would ideally protest to get the law changed rather than break it.

Types of Crime

Type of Crime	Christian Responses	Sikh Responses
Murder: Deliberately ending someone's life	**'Do not commit murder' Sanctity of Life: 'Human beings were made in God's image'**	**Sanctity of Life: 'The Divine Light is within all'**
Theft: Stealing something that does not belong to you	**'Do not steal'**	**Rehat Maryada: (code of conduct) 'No Sikh should gamble or commit theft'**
Hate Crime: Committing a crime based on prejudice e.g. race, age, sexuality	**'Human beings were made in God's image'., 'There is no Jew nor gentile… male nor female, for you are all one in Christ Jesus'**	**'All are made of the same clay', 'We are all sons of the one God, there is no Hindu and no Muslim'.**

Good and Evil Intentions and Action

Christian Views:
- The Bible warns Christians against having evil thoughts which lead to evil actions. Avoiding sin and temptation steers Christians away from crime.
- Christians would be more willing to treat an offender who had good intentions with more mercy than one who acted out of evil intentions.
- Christians do not believe that people are evil but that people can be tempted to do wrong and break the law.
- Many Christians believe that we are born with **'Original Sin'** due to the actions of Adam and Eve, so we are inclined to be tempted and should resist this.

Sikh Views:
- There is no such thing as an evil person but humans do all make mistakes.
- Having good intentions and obeying the law etc helps Sikhs to build bad karma; those who commit evil actions with evil intentions should face justice in this life but will also face punishment in the next life.

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Aims of Punishment

Aim	Explanation/ Examples	Christian and Sikh responses
Reformation	Supports the criminal in **changing their behaviour** for the better. May involve therapy, education, training.	Preferred aim of punishment for Christians and Sikhs: Christian: **'Love your neighbour as you love yourself'**/ Agape. **'Do not take revenge but leave room for God's punishment… do not be overcome by evil but overcome evil with good'.** Sikh: **'Show kindness and mercy to all life',**
Retribution	Seeking **justice or revenge**. The idea that 'you committed a crime, so you deserve to be punished'.	The Old Testament teaches **'An eye for an eye'**, but this really meant that a punishment should be proportionate to the crime. Christians do NOT agree with revenge. Jesus taught to **'Turn the other cheek'** meaning do not retaliate. Sikhs do NOT agree with revenge either: **'If someone hits you, do not hit him back. Go home after kissing his feet'.**
Deterrence	**Putting people off from committing a crime** – either putting the criminal off from re-offending, or putting society off crime as they see the harsh punishments they could get.	Christians and Sikhs would want criminals to be deterred (put off) from committing crime but NOT in a way that violates their sanctity of life e.g. corporal or capital punishment. Christian: **'Human beings were made in God's image'** Sikh: **'All are made of the same clay'.**

Treatment of Criminals

Type of Punishment	Explanation/ Examples	Strengths and Weaknesses	Christian and Sikh responses
Prison	A secure building where offenders are kept for a period of time set by a judge	+ Protects society, usually gives opportunity for reformation e.g. counselling, good deterrent - Can lead to poor mental health, many people re-offend as they learn poor behaviour or become comfortable in prison.	Christian: Focus should be on reformation: **'Love your neighbour as you love yourself'/ Agape** Sikh: Focus should be on reformation: **'Show kindness and mercy to all life'.**
Community Service	An offender contributes to society as a punishment e.g. doing unpaid work in the community	+ Benefits the community, encourages reformation - Some see it as a soft punishment	Christian: Good punishment for minor offences as reformation is encouraged. Encourages **stewardship.** Sikh: Good punishment for minor offences; will build good **karma** and could lead to future acts of **sewa.**
Corporal Punishment	Punishment of an offender by causing them physical pain e.g. whipping, cutting hands off. Illegal in the UK.	+ Good deterrent, brings justice for the victim/ their family (retribution) - Violates human rights, does not encourage reformation, promotes an attitude of revenge rather than compassion and forgiveness.	Christian: Disagree – violates sanctity of life and is a revenge-seeking punishment: **'Human beings were made in God's image', 'Do not take revenge but leave room for God's punishment'** Sikh: Disagree for same reasons: **'All are made of the same clay', 'If someone hits you, do not hit him back. Go home after kissing his feet'.**
Capital Punishment/ The Death Penalty	Punishment where an offender is put to death for their crimes e.g. electric chair, hanging, firing squad. Illegal in the UK since the 1960s.	+ Good deterrent, brings justice e.g. if you kill, you deserve to lose your life. Supports **principle of utility**; if it benefits society for one person to lose their life, perhaps it is acceptable. - No going back if you get the wrong person, hypocritical, no chance for reformation, violates human rights.	Christian: Disagree – violates sanctity of life. Does not allow for reformation: **'Human beings were made in God's image', Agape etc.** Sikh: Disagree for same reasons: **'All are made of the same clay', 'Show kindness and mercy to all life', 'If someone hits you…' etc.**

Forgiveness: To show grace and mercy, and pardoning someone for what they have done wrong.

Christian Views	Sikh Views
- Forgiveness is at the heart of Jesus' teaching. - Christians would still agree with justly punishing the criminal, but forgiveness is a key teaching within Christianity. - On the cross, Jesus said **'Father forgive them, for they know not what they do'.** - In his life Jesus was also asked how many times people should forgive. He replied: **'Not seven times, but seventy-seven times'**, meaning always forgive. - **'Love your neighbour as you love yourself'/ Agape** - Gee Walker gives Christians a modern role model on the importance of forgiveness.	- Forgiveness is a key teaching of Sikhism, closely linked with equality. - Guru Granth Sahib: **'Where there is forgiveness, there is God'.** - Forgiveness is not a replacement for punishment; fair punishment is still important but forgiveness can also be given. - The focus of punishment should always be reformation, which is closely linked with forgiveness.

Exam Terminology

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Human Sexuality

Heterosexual relationship: a sexual relationship with a member of the opposite sex
Homosexual relationship: a sexual relationship with a member of the same sex
Homosexual couples can now marry, or convert civil partnerships into marriage (as of 2014)

Christian Views	- Catholic Church: homosexual people are not sinful, but the sexual act is. - Therefore they should not have sex, because the Bible recognises it as a sin: - *'Do not have sexual relations with a man as one does with a woman; that is detestable'.* - Church of England: welcomes homosexuals who live in a faithful, committed relationship, but they cannot get married in church. - Liberal Christians: Loving, faithful homosexual relationships are just as holy as heterosexual relationships
Sikh Views	- The Guru Granth Sahib does not mention homosexuality. Some Sikhs may interpret this to mean that the only marriage that should occur is between a man and a woman, as this is the only type of marriage mentioned in the GGS. - Other Sikhs would not view homosexuality as a particular issue of concern. - Either way, Sikhs would not discriminate and would ensure homosexuals were treated fairly, in line with their teaches on equality: *'All are made of the same clay', 'Show kindness and mercy to all life'.*

Sex Before Marriage

- In British society, sex before marriage is no longer considered as unacceptable, however some religious views on the issue remain traditional.

Christian Views	- Many Christians believe that the intimacy of sex requires the commitment of marriage – it should not be a casual, temporary pleasure. - In the Bible, St Paul wrote: *'Flee from sexual immorality… whoever sins sexually, sins against his own body… your body is a temple of the Holy Spirit'.* - Catholic and Anglican church teaches that unmarried people should not have sex. This would therefore make cohabitation (living together) wrong before marriage as well. - Liberal Christians accept that for some people, sex is a valid expression of love. Sex before marriage/ living together before marriage could be seen as acceptable.
Sikh Views	- Sex before marriage is not allowed within Sikhism; the Sikh code of conduct (Rehat Maryada) says that anyone who has sexual relations before marriage is not a true Sikh. - *'For a moment of sexual pleasure, you shall suffer in pain for millions of days' (GGS)* - Anything that might lead to **lust**, one of the **5 evils**, should be avoided. - This would also make cohabitation before marriage wrong.

Sex Outside of Marriage: Adultery

Adultery: Having sexual relations with someone who is not your husband or wife
Regardless of religion, most people in contemporary society view adultery as wrong because it breaks trust, involves secrecy and lies, can affect children and causes pain to all concerned.

Christian Views	- Adultery breaks the promises Christian couples make before God during their wedding. - One of the **10 Commandments** is *'Do not commit adultery'*. - Jesus taught that lust, which could lead to adultery, is also wrong: *'I tell you that anyone who looks at a woman lustfully has already committed adultery with her in his heart'*.
Sikh Views	- Adultery is seen as a very serious sin – Sikh marriage is a sacred bond and adultery break that bond, betrays trust and brings shame on the family. - It is one of the **4 misdeeds (kurahat)** that members of the Khalsa must not commit. - The **Kachera** (cotton underwear) is one of the 5 Ks as a reminder to keep the body pure. - *'The blind fool abandons the wife of his own home, and has an affair with another woman'.*

Marriage

Marriage: A legal union between a man and a woman (or in some countries such as the UK, two people of the same sex), as partners in a relationship.

Christian Views	- Marriage was one of God's gifts at creation. The Bible teaches: *'A man shall leave his mother and father and be united with his wife, and the two will become one flesh'.* - Marriage represents a covenant (promise) before God – it is a spiritual bond of trust. - *'Husbands, love your wives, just as Christ loved the Church'.* - The purpose of marriage is to provide a stable, secure environment for family life.
Sikh Views	- Marriage is a spiritual act; an opportunity to become one spirit within two bodies. - The ceremony is called 'Anand Karaj' which means 'blissful union'. - Marriage is a union witnessed by God, shown by the presence of the GGS at the wedding ceremony. - The purpose of marriage is companionship and the spiritual development of both partners. - *They alone are called husband and wife, who have one light in two bodies' GGS.*

Divorce and Remarriage

Divorce: Legal ending of a marriage
Remarriage: When someone marries again while their former spouse (husband or wife) is still alive.
Annulment: A Catholic Church ruling that a marriage was never valid

Christian Views	- Many churches offer courses to prepare couples for marriage, in the hope of avoiding divorce later. - Jesus taught: *'Anyone who divorces his wife and marries another woman commits adultery against her'* - Christians must balance the need to respect the sanctity of marriage with showing compassion for those in difficult situation e.g. domestic violence. - Catholic Church: a civil divorce cannot dissolve a marriage between two baptised people. Catholics can separate but they cannot marry someone else in a Catholic church while their partner is still alive. - Catholics can obtain an annulment in certain circumstances if it was never a true marriage. - Other Christians see divorce as the lesser of two evils - Methodists: accept civil divorce and allow remarriage in a church, as long as the couple take the vows seriously.
Sikh Views	- Marriage should be for life as the couple are 'one spirit in two bodies' (Guru Amae Das). - The Rehat Maryada teaches that in general, no Sikh should marry a second time if their first spouse is still alive. - If divorce was looking likely, the Sikh community and the couple's family would support in helping the couple to work through their problems. - However, Sikhs reluctantly allow civil divorce – grounds for divorce include adultery, cruelty, desertion, insanity and change of religion. - Widowed Sikhs who wish to marry again are encouraged to do so in the gurdwara. - *Rehat Maryada: 'If a woman's husband has died, she may, if she so wishes, finding a match suitable for her, remarry. For a Sikh man… similar ordinance obtains'.*

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Part 1 Continued: Contraception and Family Planning

Contraception: the methods used to prevent a pregnancy from taking place. Natural forms include the rhythm method.
Artificial forms include: the pill, condom, diaphragm, coil, morning after pill.
Family Planning: The practice of controlling how many children couples have and when they have them.

Christian Views	- All Christian churches agree that having children is God's greatest gift to a married couple. - They also agree that there may be some circumstances where it is not appropriate to bring children into the world e.g. economic, environmental, physical or psychological reasons. - However, churches disagree on how pregnancy should be prevented. - **Catholics:** Artificial contraception goes against God's plans as the purpose of sex is to express love and make new life. These purposes should not be separated. - For Catholics, Only the **rhythm method** is suitable for family planning (having sex at times during a woman's cycle where conception is less likely). - The Church of England **support use of artificial contraception** so that couples can plan their families in a healthy and sensible way. - Many Christians do not support using the morning after pill because here, the egg may have already been fertilised. Since many Christians believe **life begins at conception**, preventing a fertilised egg from developing is seen as sinful as it is already a life.
Sikh Views	- Sensible family planning is accepted by the Sikh community as morally responsible behaviour, since this would only be relevant to a married couple. - Sikh scriptures give **no specific guidance on contraception** so Sikh couples choose their own methods. - Contraception should not be used to prevent having children altogether, or to cover up an adulterous affair. - Some Sikhs would not agree with the morning after pill (reasons as above) and some would also view excessive sex, without allowing children to be conceived, is **lust.**

The Purpose of Families

Procreation: bringing babies into the world
Stability: safety and security, being able to live peacefully
Educating children in a faith: bringing up children according to the religious beliefs of the parents.

Christian Views	- The idea of family is ingrained within the Christian faith – God reveals himself as a Father, with Jesus as his son, and humankind as his children. - Christian parents are expected to be good role models for their children and to teach them moral values. - Many Christians make prayer part of the family's daily routine, and some send their children to faith schools or groups run by the church. - Parents and children all have responsibilities to each other: - *'Listen to your father who gave you life, and do not despise your mother when she is old' Proverbs.* - *'Children are a heritage from the Lord, offspring a reward from him'*
Sikh Views	- Family life is the highest path to spirituality - The Sikh community itself is also a family as humans beings are sons and daughters of the same universal father (God). - Guru Arjan describes the ideal family where the mother is central to its happiness: - *'She is the most noble of all the family. She counsels and advises her hope and desire'* - Raising a child in the Sikhs faith is very important, according to the Sikh code of conduct: - *'It is a Sikh's duty to get his children educated in Sikhism'* Rehat Maryada - Grandparents would play a large role in a child's upbringing – a married couple often move in with the groom's parents after marriage, and most Sikhs would also not consider putting their elderly parents in a care home, as it would be an honour to look after them themselves.

The Nature of Families

Family: A group of people who are related by blood, marriage or adoption
Nuclear Family: A couple and their children regarded as a basic social unit
Stepfamily: A family that is formed on the remarriage of a divorced or widowed person and that includes a child or children
Extended Family: A family that extends beyond just parents and their children, by including grandparents and other relatives as well
Polygamy: The practice or custom of having more than one wife at the same time
Bigamy: The offence of marrying someone while already married to another person (illegal in UK).
Same-sex parents: People of the same sex who are raising children together

Christian Views	- Christian parents want their children to grow up with values such as respect for all life, generosity, compassion, loyalty and the ability to form loving relationships. - Christians are commanded to love one another, so they place very high value on family life. - The book of Timothy teachers: *'Anyone who does not provide for their relatives… has denied the faith and is worse than an unbeliever'.* - 10 commandments: *'Honour your mother and father'.* The importance of family, helping elderly relatives, supporting extended family etc is still crucial today. - Though there are examples in the Bible of people who practised polygamy, St Paul made it clear that each man should have his own wife and each woman her own husband to avoid sexual immorality. - Whilst some Christians disagree with same-sex parents, believing the ideal is for children to have a male and female role model, other Christians believe the most important thing is for a child to be in a loving household.
Sikh Views	- Family is the **essential social unit** in Sikh society. - Guru Nanak preached that the life of the householder was the **highest path to spirituality**. - The family is where children are trained in **sewa** (selfless service) and where religious traditions are passed down. Learning the values of the family are needed for prosperity and world peace: *'Gazing upon his family, he blossoms forth like the lotus flower'.* - Sikhs believe in monogamy; having only one husband or wife). - Within Sikh families, men and women are equal but may have different role e.g. the mother usually takes the main role with children for the first few year while the father takes on household duties. - Amritdhari (baptised) Sikhs and many non-baptised Sikhs would not cut their children's hair. - When the children are older, Sikh parents would often support their child in finding a suitable marriage partner, and grown up children would support their elderly parents. - Sikhs do not generally approve of same-sex parenting, although more liberal Sikhs may support it.

Gender Equality

Gender equality: the idea that people should be given the same rights and opportunities regardless of whether they are male or female
Gender prejudice: Unfairly judging/ holding biased opinions about an individual or group based on their gender
Sexual stereotyping: Having a fixed general idea or image of how men and women will behave
Gender discrimination: To act against someone on the bases of their gender

Christian Views	- All people have been created equal in the image of God: *'Human beings were made in God's image'* - Jesus treated women with respect, and the key teaching of *'Love your neighbour'* shows that discrimination is wrong. - Some traditional Christians believe that men are the head of the family and that women should mainly stay at home and care for children. This may stem from literal interpretation of Bible texts that reflect the time in which they were written: *'Your desire will be for your husband, and he will rule over you'* - Most Christians today see marriage as an equal partnership where the different gifts of men and women strengthen family life.
Sikh Views	- Guru Nanak spoke up on behalf of women which was unusual at that time. - The Gurus changed Indian society as more women began to take part in social, religious and political matters. - Within Sikhism, all are treated equally and judged on their actions, not their caste, gender or race. - Amritdhari Sikhs use the name 'Kaur' which frees them from having to take their husband's name when marrying. - Many Sikh women are well educated and encouraged to pursue professional careers. - Some Sikh women feel that traditional Indian culture, rather than Skhism itself, has limited their chance for education etc, but Sikhism itself fully promotes equality. - *'Without woman, there would be no one at all'.*

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Religion and Life Part 1: The Origins and Value of the Universe

The Origins of the Universe

Christian Views	- Creation story found in first book of the Bible: Genesis - Christians believe the world originated from a specific act of God and not by chance - Genesis 1 v 1: *'In the beginning God created the Heavens and the Earth*	- **Fundamentalist Christians**: take the creation story literally – God created the world in 6 days and rested on the 7th. Also known as Literalists as they believe the Bible is the exact, literal word of God. *'God said 'Let there be light', and there was light'.* - **Liberal Christians**: believe God did create the world but the Bible can be taken metaphorically, so it did not happen exactly as the Genesis story says (also known as non-literalists)	**Can religion and science co-exist?** - Fundamentalist views on creation are NOT compatible with science – creation story vs Big Bang - Both Liberal and Sikh views on creation could co-exist with science, however the key conflicting point is that the religious views argue the universe was a deliberate creation by God, whereas science would argue it was random.
Sikh Views	- The universe was not an accident, but was a deliberate act of God (Waheguru) - Waheguru spoke and his word created everything - He willed the whole of creation into existence - *'As he commands, so they exist'*		
Scientific Views	- Big Bang Theory: Suggests around 13.8 billion years ago thee was a massive expansion of space - All the matter that formed the universe kept expanding and cooling, forming the stars and galaxies - This was random, not a deliberate act		

The Value of the World and the Duty of Humans to Protect it

Christian Views	- The world has value because God made it. - Christians would view the world with a sense of **awe and wonder** – amazement at God's wonderful creation. - Christians have a duty to protect the world – **stewardship**: *'The Lord took the man and put him in the Garden of Eden to work it and take care of it'* - However, the Bible also states that 'Human beings were made in God's image' (Imago Dei), suggesting humans are set apart from God's other creations and have authority over the world – **dominion** - *'They may rule over the fish of the sea and the birds of the air'*
Sikh Views	- The world has value because God made it. - Sikhs would feel a sense of awe and wonder: *'Beholding His wonders, I am wonder-struck'* - Sikhs support **stewardship** - they must live in harmony with all of God's creation and take care of the earth: *'The sky, the earth, the trees and the water – all are the Creation of the Lord'* - There is a **divine spark** in all living things that is part of God, and this spark or soul is taken back to God when released from the cycle of rebirth. - For this reason, Sikhs do NOT support the idea of dominion, and do not believe they are superior creations.

Use and Abuse of the Environment

How do we damage the natural world?	**Christian and Sikh Responses**
- Use of natural resources: overuse of oil, gas and other non-renewable resources, deforestation. Pollution: gas emissions, industrial waste etc.	- Both religions would encourage stewardship – taking care of the environment by recycling, generating less pollution by walking more etc, saving electricity, encouraging sustainable development, voting for people who support environmental issues, supporting charities such as Greenpeace or World Wildlife Fund and praying to God.

Use and Abuse of Animals: Animal Experimentation

What are the issues?	**Christian Responses**
- Animals used to be tested on for cosmetics e.g. makeup but this is less common today - Animals are still tested on for medicinal purposes, to advance science/research and benefit humans	- Testing for cosmetics is **not essential** and does not show good **stewardship**, so would not be supported. - Testing to **benefit human life** may be supported as humans have **dominion**, and ultimately human life is sacred. - Whilst it is not ideal (due to stewardship), many would see it as acceptable for the **greater good** to humans.
	Sikh Responses - Sikhs would not encourage animal testing of any kind because animals have a **soul** too. - **Stewardship** is important and humans should not abuse their power. It will also have a negative effect on someone's **karma**. - However, a Sikh may not actively protest against testing for research/medicine if it is done as humanely as possible, and with the right **intention**.

Use and Abuse of Animals: Food

What are the issues?	**Christian Responses**
- Many people choose not to eat meat, perhaps for ethical, environmental or religious reasons. - Vegetarian: does not eat meat - Vegan: does not eat animals products	- There are no dietary requirements within Christianity – individual choice. - The Bible states that *'Everything that lives and moves about will be food for you'* which suggests animals can be consumed however, Christians would not promote the cruel conditions some animals face for the production of food.
	Sikh Responses - Most Sikhs would be vegetarian, especially if they have joined the Khalsa - Animals have souls, and the Guru Granth Sahib forbids killing living beings. - Food served in the langar is always vegetarian - *'Show kindness and mercy to all life'*

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The Origins of Human Life

Christian Views: Summary
- Day 6 of creation: story of Adam and Eve found in first book of the Bible: Genesis
- Adam was created from the dust of the earth, then Eve from one of Adam's ribs.
- God 'breathed life' into Adam's nostrils
- *'Human beings were made in God's image':* 'Imago Dei'.

Contrasting Christian Views
- **Fundamentalist Christians**: take the creation of Adam and Eve to be literally true. Also known as Literalists as they believe the Bible is the exact, literal word of God.
- This view cannot co-exist with science - Adam and Eve vs Evolution
- **Liberal Christians**: believe God was the creator but the theory of evolution explain *how* it happened, whereas the Bible addresses *why*. Evolution is the way God designed life to advance and evolve. (Also known as non-literalists)
- This view can co-exist with science, other thn the idea that evolution was by chance.

Sikh Views
- The 'how' and 'when' humans came to exist is not as important as the 'why'.
- Sikhs do not oppose evolution, but nothing would happen if it wasn't for hukam (Waheguru's Divine Will)
- Waheguru oversees the natural process of evolution – it isn't left to random chance
- *'Without God, there is nothing at all… He is woven into His creation'*

Scientific Views
- Charles Darwin published 'The Origin of Species..' in 1859 and outlined the theory of evolution.
- Single-celled creatures appeared in the sea which eventually evolved into other species.
- Humans evolved over millions of years from other animals on land.

Sanctity of Life vs Quality of Life
- Sanctity of Life is the concept that life is sacred and given by God; both Christians and Sikhs believe in this.
- **For Christians.** Sanctity of Life only applies to human life and not the life of animals. Sikhs see animals as more valuable as they believe they have a soul too.
- *'God breathed life into Adam'* supports the Christian view that human life is sacred and symbolises that a part of God lives within all of us – for Christians this is our soul
- **The quality of life** refers to the **general wellbeing** of a person e.g. their health and happiness.
- When faced with matters of life and death Christians have to consider the quality of a person's life and this can often conflict with the **Sanctity of Life Christians and Sikhs would largely view the sanctity of life as more important than the quality of life.**

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Justified Conclusion: A final decision which is based upon a range of evidence

Attitudes Towards Abortion

- Deliberate ending of a pregnancy.
- England: can take place before 24 weeks and 2 doctors have to agree.
- Reasons may include: physical or emotional wellbeing of the mother, or potential wellbeing of the foetus or existing children.
- After 24 weeks: can only take place if there is a serious risk of disability or illness, or if the mother's life is at risk.
- Pro-life arguments: Against abortion, due to respecting the life of the foetus
- Pro-choice arguments: May support abortion due to respecting the choice of the mother

Christian Views	- Sanctity of Life – many Christians do not support abortion as the foetus' life is sacred from conception: *'Before I formed you in the womb, I knew you'* - Roman Catholics – do not support abortion at all (only perhaps if the mother's life was as risk): *'Do not commit murder'* - Liberal Christians – generally oppose it, but it's acceptable in some circumstances e.g. mother's life at risk, rape, child would have severe disability (arguments relating to **quality of life**): *Agape, 'Love your neighbour as you love yourself', 'Blessed are the merciful'.*
Sikh Views	- Sanctity of Life – Sikhs do not generally support abortion because it interferes with God's creative work: *'You were cast into the womb by the Lord's command'.* - It is still not acceptable even if the child may have a disability – **sanctity of life is more important than quality of life.** - Only acceptable circumstances might be rape or if the mother's life is at risk.

Attitudes Towards Euthanasia

- Euthanasia is assisting with the ending of life for a person who is terminally ill or has a degenerative illness.
- **Active euthanasia:** life is ended at the request of the patient via lethal injection or poison (assisted suicide). This is also known as **voluntary euthanasia**.
- **Passive euthanasia** : whatever is keeping the patient alive is taken away e.g. life support, medication. Their illness is then what kills them. This might be **non-voluntary euthanasia**, as they may not be able to give consent.
- Active euthanasia is illegal in UK. It is allowed in some countries e.g. Switzerland

Christian Views	- Sanctity of Life – many Christians do not support euthanasia as life is still sacred, even if its quality is poor: *'Human beings were made in God's image'* - Roman Catholics – do not support euthanasia at all; only God has the right to end life: *'Do not commit murder'* - However, if large doses of painkillers are used to help a person's suffering, and as a result, the person dies, this is OK in the yes of the Catholic Church and is called the **Doctrine of double effect** - The Bible teaches that *'There is a time to be born and a time to die'* and therefore people shouldn't meddle in God's plans. - Some Christians might argue that humans have been given freewill to make their own choices. - Liberal Christians – whilst euthanasia would not be encouraged, it may be acceptable if it will relieve unbearable suffering (arguments for **quality of life**): *Agape, 'Love your neighbour as you love yourself', 'Blessed are the merciful'.*
Sikh Views	- Sanctity of Life – Sikhs do not support euthanasia because only God has the right to take life; he created everyone so their life is sacred: *'He created the creation and watches over it'.* - Suffering in this life may be a result of bad karma from a previous life, so escaping this suffering with euthanasia would only lead to more suffering in the next life. - Helping those who are ill and suffering is a good opportunity for sewa (selfless service): *'Through selfless service, eternal peace is obtained'.* - A Sikh would most likely support withdrawing medical provision e.g. life support if there is no chance of recovery.

Death and the Afterlife

Christian Views	- Death is not the end – God judges whether people go to heaven or hell - Our eternal life is more significant than our temporary life on earth. Heaven is a place where God can be found ; indescribably wonderful. *'God will wipe every tear from their eyes'* - Hell is a place of torment, where God is not present: *'Throw them into the burning furnace'* - Christians vary on whether heaven and hell are literal or spiritual places.
Sikh Views	- Death is not the end – good or bad karma in this life dictates what our afterlife will be like - We are all in a cycle of samsara – birth. death and re-birth - Those who have built bad karma will stay in the cycle, and be reincarnated into lower beings. - Those who have built good karma will be reincarnated into a higher being or, eventually, reach mukti (union with God). - Each life is, therefore, a preparation for the next and should be used wisely. - *'They die, over and over again, only to be reborn, over and over again'.*

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ORMISTON SWB ACADEMY

AQA

The Design Argument (Teleological)

Basic Premise and Evidence	Criticisms
- The universe is an intricate, complex design which is too complicated to have come about by chance - Therefore, a great design needs a great designer: God. - Telos = 'purpose' – the universe has been designed by God with a clear purpose in mind. **William Paley's analogy of the Pocketwatch** - If we found a watch, we would look at its intricacies and realise it has not come about by chance but had a watchmaker who had a clear purpose in mind. The same is true of the natural world – trees, the human eye, birds' wings and fish gills… they must have been designed by God. **Isaac Newton and the Thumb** - Newton argued that the fact that every single human being has a different thumbprint, and the fact that we have opposable thumbs, was enough evidence for God's existence: *'In the absence of any other proof, the thumb alone would convince me of God's existence'.*	- Perhaps the complexities in the world e.g. the human eye, birds' wings, are the result of evolution, not God - If God deigned such a perfect world, why is there so much suffering? Yes, humans can be blamed for moral evil, but what about natural disasters e.g. earthquakes? Surely this shows the 'design' of the world is flawed.

The First Cause Argument (Cosmological)

Basic Premise and Evidence	Criticisms
- Everything that exists has a cause (everything is contingent – relies on something else for its existence) - The universe must, therefore, have a cause too. - At some point, there needs to be something eternal, which requires no cause, in order to start the process off - This eternal, 'uncaused cause' needs to be an omnipotent being: God. Therefore, God exists. - The Bible supports the argument: *'In the beginning God created the heavens and the earth'* - The Big Bang could still be true – but God caused it! **Dominoes** - The argument can be compared to dominoes – one falls because the previous one fell. At some point, someone had to push the first domino. This can be compared to the need for an uncaused cause to the universe: God. **St Thomas Aquinas** - An infinite sequence of cause and effect is impossible; there needed to be a starting point - We can clearly see that the universe exists so it needed a creator to begin with: God.	- Atheists say the argument contradicts itself; if everything needs a cause, then what caused God? - If you say that God is eternal and has always existed, why can't the universe just always have existed too? - The Big Bang was a random, spontaneous event, not an action caused by God

The Argument from Miracles

Basic Premise and Evidence	Criticisms
- There are 2 types of miracles: 1) Events which break the laws of nature and cannot be explained by science e.g. Jesus turning water into wine 2) Events which are happy coincidences which occur at just the right time for a positive outcome e.g. 16 people survived in Stairwell B during the September 11th terrorist attacks. - This argument says that if there is no scientific explanation for an event, it must be supernatural i.e. caused someone/something who is outside of nature. - Only God is outside of nature, therefore, God exists. **Examples:** - Incarnation and resurrection are the most important miracles of the Christian faith - Jesus performed many miracles – turning water into wine, healing the sick, feeding the 5000 etc. - Lourdes – many miracles have been recorded here which have been investigated by the church.	- Atheists would argue that 'miracles' are just lucky coincidences - There may be a scientific explanation which we just don't know about yet. - Miracle healings may be the result of mind over matter, or a misdiagnosis by doctors. - Some 'miracles' are fake or exaggerated by people wanting fame or money. - Even if miracles do prove that God exits, they show God to be unfair and as having favourites – why doesn't everyone who needs a miracle get one? **David Hume** - Argued that witnesses to miracles are primitive and uneducated, so the evidence is unreliable. (He was writing in the 18th century).

Arguments against God: Evil and Suffering

- Atheists point to the existence of evil and suffering in the world as proof that God does not exist.
- The argument is that Christians believe God to be all powerful, all knowing, all loving etc. Therefore God should be able to stop evil, would be aware of it and would care enough to stop it. But he doesn't, so he must not exist.

Christian Defence
- Christians may defend God and say that evil and suffering is the result of human free will – Adam and Eve's disobedience brought evil and suffering into God's perfect world. However, this may explain moral evil (human action) but it does not necessarily explain natural evil e.g. earthquakes
- Christians also defend God with arguments such as: without evil we wouldn't appreciate good. Perhaps suffering is a test of faith. Perhaps suffering is an opportunity to show compassion, learn from mistakes and make the choice to do good over evil.

Arguments Against God: Science

- Some atheists and humanists use the developments in scientific knowledge to challenge belief in God.
- In the past, the origins of the universe and life on earth could not be explained, so people assumed it was God. Natural disasters etc were thought to be God's punishment.
- Now, science can explain things that people couldn't previously understand, so people no longer look to religion for answers. Atheists argue that there is no need to 'invent' a God to fill the gaps of what we do not understand.

Christian Defence
- Many Christians see no conflict between science and religion; many Christians do not take the creation stories literally, so the Big Bang/ Evolution can explain the universe and life on earth, but God was the force behind it happening as it did. (Fundamentalist Christians would have an issue, though, as they believe the creation story to be literally true).
- Pope Francis said: *'The Big Bang does not contradict the divine act of creation; rather it requires it… When we read the creation story in Genesis we run the risk of imagining that God was a magician, with a magic wand… but it is not so. He created beings and let them develop…'*

Exam Terminology

Influence: The capacity to have an effect on people's character, behaviour or actions
Contrasting: To show a difference
Contemporary: Occurring in the present time
Sacred Writings: Writing that is believed to contain words of God e.g. The Bible
Evaluate: Consideration of different viewpoints before arriving at a final judgement
Religious Traditions: Viewpoints from either a religion or religious denomination
Justified Conclusion: A final decision which is based upon a range of evidence

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Key Words

Divine: God, Gods or Ultimate Reality

Enlightenment: A state of spiritual awakening and the gaining of a deeper understanding of reality. E.g. Buddhists are seeking how to end suffering and achieve happiness.

General revelation: Indirect revelation; the idea of being able to see something of God through nature and scriptures which are readily available in everyday experience.

Immanent: A characteristic of God; the belief that God is present and involved in the world, (eg through special revelations/miracles).

Impersonal: A characteristic of God; the belief that God is beyond human understanding.

Omniscient: All-knowing; believed by theists to be an attribute of God.

Omnipotent: All-powerful; believed by theists to be an attribute of God.

Personal: A characteristic of God; belief that humans can build relationships with God.

Revelation: When God is revealed to humans; can be special or general.

Special revelation: Direct revelation; God being revealed directly to an individual or group through experiences such as visions.

Transcendent: A characteristic of God; belief that God is outside space and time.

Ultimate reality: Belief in a supreme and fundamental power in the universe. In Christianity, this ultimate reality is a personal being: one God in three persons. In Hinduism, Brahman is often referred to as the ultimate reality and supreme cosmic power.

Vision: An experience of seeing/experiencing something in the imagination or through a dream.

The Divine/ Knowledge of God – An Introduction

- Every religion accepts that there is an ultimate reality that is eternal and unchanging.
- For Christians, their ultimate reality is a personal being, God, who makes himself known in 3 persons: the Father, the Son and the Holy Spirit.
- Some theists say God cannot be known because God is transcendent: beyond human understanding. God cannot be described using the limits of human language.
- Most Christians do accept this, but do think that God can be known through revelations – when God chooses to reveal himself to people.
- There are 2 types of revelation: special revelation and general revelation.
- Some experiences can be both general and special revelation.

Special Revelation: Visions

Basic Premise and Evidence	Criticisms
- When people experience God directly in a particular event or direct personal experience. - Could be a dream, a vision, a prophecy, a miracle or 'hearing God's call'. - Could be experienced alone or with a group of people. - The experiences usually have a huge, life-changing impact on people e.g. Nicky Cruz (gang leader turned Christian minister). - They are rare, and many believers never experience such events. **Visions** - A form of special revelation which comes in a picture or image form. - People may see holy people, angels or hear messages from God - Example from the Bible: Saul on the Damascus Road - Saul had sworn to wipe out the Christian church. He was travelling with others on the Damascus road to arrest any follower of Jesus. - On the way, they were struck by a blinding light, and Saul had a vision of Jesus who spoke to him. - Saul's life was changed – he changed his name to Paul (now known as St Paul) and spent the rest of his life committed to Christianity.	- Special Revelations e.g. visions are subjective, open to interpretation and not open to scientific testing. - Many religions have conflicting revelations so some could argue this invalidates them. - Visions could be brought about by alcohol or drugs, or it could be wishful thinking so someone convinces themselves. - It could be a mental or physical illness, or the mind playing tricks. - People could also be lying to gain wealth or power, or they may have just been mistaken.

General Revelation: Nature and Scripture

Basic Premise and Evidence	Criticisms
- Ordinary, every day human experiences that reveal truths about God, - General revelation comes to people through nature, a person's reason, their conscience (inner sense of right and wrong), reading scriptures, through worship etc. - The experiences are available to everyone, but they do not convince everyone that God is real because they depend on people's interpretation. **Nature as a way of understanding the Divine** - Links with the Design Argument: the beauty and order of the natural world gives theists a sense of awe. - Just as a painting gives insight into the artist, nature gives an insight into God. - God is shown through nature to be creative, artistic, clever, powerful and awesome. - *'The heavens declare the glory of God; the skies proclaim the work of his hands'* **Scripture as a way of understanding the Divine.** - Religious scriptures tell believers what God is like, how God acted in the past and how God wants people to live. - E.g. the Bible tells the story of God's covenant with the Jews (Old Testament) and the life and teaching of Jesus (New Testament). - All Christians believe the Bible is inspired by God but they may interpret it differently e.g. some take t literally and others take a more liberal approach. - When Christians read the Bible, they hope to get a better understanding of the teachings of Christianity and receive spiritual strength from God's words.	**Nature** - Humanists – the works of nature are not a divine revelation but are special because they can lead to a grater understanding of the world through human observation and science. - When a theist and an atheist look at a beautiful landscape, one just sees nature and the other sees God's creation – open to interpretation. **Scripture** - Some argue scriptures cannot reveal anything about God because they are merely their author's opinions and these could be wrong. - Even Christians do not all agree on how scripture should be interpreted,

Different ideas about the Divine: God's Nature

- It is difficult to describe the unseen, infinite God within the limits of human language.
- However, God is seen to have a number of characteristics:
- Omnipotent (all powerful) omniscient (all-knowing) and omnibenevolent (all-loving).

Religious thinkers also use the following words to describe different ideas about God:
- **Immanent:** God is present in the universe and involved with life on earth. God acts in history and influences people.
- **Transcendent:** God is beyond and outside life on earth and is not limited by the world, time or space. God does not act in the world or intervene in people's lives.
- **Personal:** God has human characteristics e.g. merciful, compassionate. God loves and cares for every individual and can be communicated with through prayer.
- **Impersonal:** God does not have human characteristics. God is more like a force or an idea. God is an absolute being who is only understood in terms of itself.

Can God be immanent, transcendent, personal and impersonal?
- Many religious believers think that they can experience God and have a personal relationship with him (immanent and personal) but that at the same time, God is the eternal, unlimited creator of the universe (transcendent and impersonal).
- Some religions emphasise one description more than another but others say all descriptions are true, even if they seem contradictory.
- This is because God is a mystery and beyond human understanding.

Christian interpretation:
- God's immanence is revealed in Jesus who was God in human form, and in the Holy Spirit who works through Christians today.
- God is also transcendent as he is the creator of the universe, without whom nothing would exist.
- Christians regard God as personal, a Father who cares for his children and with whom they can have a relationship through prayer.
- *'You know when I sit and when I rise; you perceive my thoughts from afar'*

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LEARNING OUTCOMES AND EVIDENCE REQUIRED

15-week assessment period, response to a set brief

A - Develop ideas in response to a brief	**Activity 1: Ideas Log** (2 hours, 15 marks) ❑ Research to support idea generation ❑ Ideas log: Initial idea, target audience, influences, content of idea
B - Develop planning materials in response to a brief	**Activity 2: Planning Material** (3 hours +prep time 15 marks) ❑ Annotated flat plan design including headlines, positioning of copy, images, assets, design notes
C - Apply media production skills to the creation of a media product	**Activity 3: Final Media Product.** (4 hours + prep time, 30 marks) ❑ Use ideas and planning to create media product in response to brief. ❑ Assessed on skills and techniques used and how follow brief

PRODUCTION PROCESS

Pre-production: Planning and research

Production: Creation of content such as article/ images/ graphics

Post production: Editing and putting together considering space and layout choices

PRINT MEDIUM POSSIBILITIES

AUDIENCE KEY TERMS RECAP

Primary audience	The audience that the media producer has in mind for consuming the text. This is the audience they intend to target.
VALS profiles	These define an audience by how they think and by considering their values, attitudes and lifestyle (VALs). People can be classed as 1 of the following: The Aspirer -seeks status The Explorer - seeks discovery The Mainstreamers -seeks security The Reformer - seeks enlightenment The Resigned - seeks to survive The Struggler - seeks to escape The Succeeder - seeks control
Socio Demographic groups	Group Description and examples. **A** Higher managerial, Professional e.g. Chief executive, senior civil servant, **B** Intermediate managerial, professional e.g. bank manager, teacher **C1** Supervisory, junior managerial e.g. shop floor supervisor, sales person **C2** Skilled manual workers e.g. electrician **D** Semi-skilled and unskilled manual workers e.g. assembly line worker, refuse collector **E** Casual labourers, pensioners, unemployed e.g. pensioners without private pensions and anyone living on benefits

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Activity 3: PHOTOSHOP TOOLS

Activity 2: Planning Material. Consider…

House style	
Typography fonts	
Typography styles	
Leading to…	
Sketches/ thumbnails	

Activity 1

Primary research:

Secondary research:

PHOTO SHOT TYPES

Extreme Close-Up (ECU)   Big Close-Up (BCU)

Close-Up (CU)   Medium Close-Up (MCU)

Medium Shot (MS)   Medium Long Shot (MLS)

Long Shot (LS)   Very Long Shot (VLS)

Photoshop tools:
- Marquee Tool — Move tool
- Lasso Tool — Quick Selection Tool
- Crop & Slice Tool — Eyedropper Tool
- Brush & patch Tool — Brush & Pencil Tool
- Stamp Tool — History Brush Tool
- Eraser Tool — Gradient & Paint Bucket Tool
- Blur, Sharpen & Smudge — Dodge, Burn & Sponge Tool
- Pen & Point Tool — Type/text Tool
- Path & Diract Selection — Shape Tool
- Hand & rotate Tool — Zoom Tool
- Foreground Color
- Background Color
- Editing Mode — Screen Mode

PURPOSE

Depending on the brief, will your product promote, raise awareness or create profit?

NARRATIVE

What story does your product tell? Connotations for the audience?

GENRE

Steve Neale: "Genres are instances of repetition and difference… difference is absolutely essential to the economy of genre': mere repetition would not attract an audience."

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A. Quel est ton emploi idéal ? (What is your ideal job?)

Quant à moi (As for me) Je crois que (I believe that) Pour moi (For me) Il faut que je sois honnête (I must be honest)	mon emploi idéal serait (my ideal job would be) je voudrais devenir (I would like to become)	agriculteur/rice (famer) architecte (architect) avocat/e (lawyer) boucher/ère (butcher) cassier/ère (cashier) comptable (accountant) créateur/rice de mode (fashion designer) facteur/rice (post man/woman) fonctionnaire (civil servant) infirmer/ère (nurse) instituteur/rice (primary school teacher) médecin (doctor) pompier/ère (fire fighter) vendeur/euse (sales assistant) vétérinaire (vet)	car (because) parce que (because)	je préfèrerais travailler (I would prefer to work)	avec des adultes (with adults) avec des enfants (with children) avec des ordis (with computers) dans une grande entreprise (in a big organisation) à l'extérieur (outside) chez moi (at home) à l'étranger (abroad)

B. Tu préfères travailler… ou…? (Would you prefer to work… or…?)

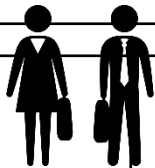|					
À l'avenir (In the future) Dans le futur (In the future) Dans… ans (In… years) Quand je serai vieux (When I am older) Quand j'aurai… ans (When I am… years old)	je préfèrerais (I would prefer) je voudrais (I would like)	travailler (to work)	seul (alone) en équipe (in a team) dans un bureau (in an office) dans un magasin (in a shop) en plein air (outdoors) à l'intérieur (inside)	car je suis (because I am)	motivé(e) (motivated) organisé(e) (organised) intelligent(e) (intelligent) fort(e) en… (good at…) ambitieux/euse (ambitious) sérieux/euse (serious) courageux/euse (brave) travailleur/euse (hardworking) créatif/ive (creative)
	j'aimerais (I would like)	un métier (a job)	créatif (creative) manuel (physical) à responsabilité (in leadership)		

C. Quel est le plus important pour toi dans un métier ? (What is the most important thing for you about a job?)

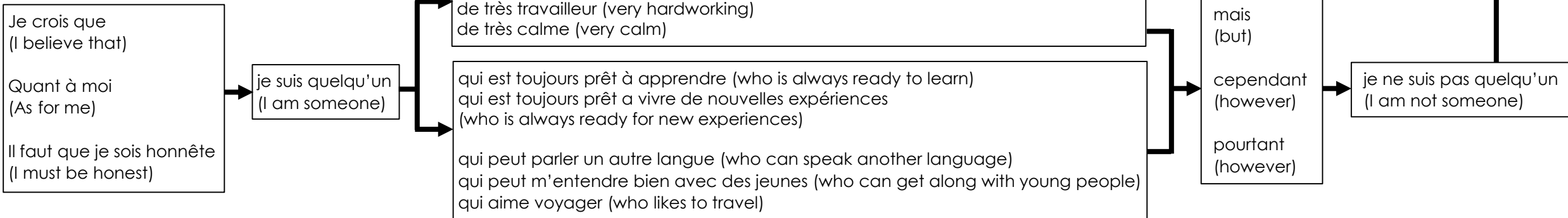|				
Il faut que je sois honnête (I must be honest) Il faut que je sois réaliste (I must be realistic) Je crois que (I believe that) Quant à moi (As for me)	l'important pour moi est (the important thing for me is) le plus important est (the most important is) c'est plus important (it is more important) c'est moins important (it is less important) c'est aussi important (it is as important)	d'avoir un métier bien payé (to have a well paid job) d'avoir un métier qui me plaît (to have a job which I enjoy) de faire quelque chose (to do something)	de satisfaisant (satisfying) de stimulant (stimulating) de gratifiant (rewarding) d'intéressant (interesting) pour améliorer la société (to improve society) pour aider les autres (to help others)	mais (but) cependant (however) le salaire a moins d'importance. (the pay is less important.)

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D. Quelles sont tes qualités personnelles ? (What are you personal qualities?)

Je crois que
(I believe that)

Quant à moi
(As for me)

Il faut que je sois honnête
(I must be honest)

je suis quelqu'un
(I am someone)

de bien organisé (well organised)
de très motivé (very motivated)
de très travailleur (very hardworking)
de très calme (very calm)

qui est toujours prêt à apprendre (who is always ready to learn)
qui est toujours prêt a vivre de nouvelles expériences
(who is always ready for new experiences)

qui peut parler un autre langue (who can speak another language)
qui peut m'entendre bien avec des jeunes (who can get along with young people)
qui aime voyager (who likes to travel)

mais
(but)

cependant
(however)

pourtant
(however)

je ne suis pas quelqu'un
(I am not someone)

E. A part le travail quels sont tes projets pour l'avenir ? (Apart from work what are your plans for the future?)

Avant de continuer mes études (Before continuing my studies) Après avoir terminé mes examens (After finishing my exams) Après avoir quitté le collège (After leaving school) Plus tard (Later) A l'avenir (In the future) Dans le futur (In the future) Dans… ans (In… years) Quand je serai vieux (When I am older) Quand j'aurai… ans (When I am,,, years old)	il faut que je sois honnête (I must be honest) il faut que je sois réaliste (I must be realistic) il faut que je sois heureux (I must be happy)	donc (therefore)	j'ai l'intention de/d' (I intend to) je vais (I'm going to)	faire du bénévolat (do some voluntary work) faire le tour du monde (travel around the world) aller à l'université (go to university) avoir des enfants (have children) fonder une famille (start a family) commencer un apprentissage (start an apprenticeship) prendre une année sabbatique (take a gap year) me marier (get married) m'installer avec mon copain (move in with my friend)

F. Quel travail est-ce que tu voulais faire quand tu étais petit ? (What job did you want when you were little?)

Quand j'étais petit/e (When I was little) Quand j'étais plus jeune (When I was younger) Quand j'avais… ans (When I was… years old) Avant (Before) A l'école primaire (At primary school)	je voulais travailler (I wanted to work) ça m'intéressait de trouver un poste (I was interested in a position)	dans l'audiovisuel (in audiovisual media) dans les médias (in media) dans l'informatique (in ICT) dans l'hôtellerie et la restauration (in catering) dans les arts et la culture (in arts and culture) dans le commerce (in business) dans le sport et les loisirs (in sport and leisure) dans la médecine et la santé (in medecine and health) dans les sciences et les technologies (in science and technology)

N'oubliez pas!

Par exemple (For example)
Comme (Like)
Bien que je sache que
(Although I know)
Ce n'est pas facile (It's not easy)
Je suis sans voix! (I'm speechless!)

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A. Quelle est ta matière préférée ? (What is your favourite subject?)

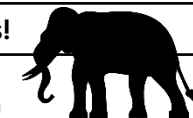|			
J'adore (I love) Je déteste (I hate) Ma matière préférée est (My favourite subject is) J'étudie (I study) Je peux étudier (I can study) Je dois étudier (I must study) Je n'étudie pas (I don't study)	le commerce (business studies) la sociologie (sociology) l'étudie de médias (media studies) l'économie (economics) les sciences (science) les langues (languages) les matières obligatoires (core subjects) les matières facultatives (option subjects) les arts ménagers (home economics)	car (because) puisque (because) pourtant (however)	je suis fort/e en… (I am good at…) je suis faible (I am not good at it) je ne suis pas doué (I'm not very talented) le prof est impatient (the teacher is impatient) le prof nous fait rire (the teacher makes us laugh) le prof nous critique (the teacher criticises us) c'est facile (it's easy) c'est utile (it's useful) il y a trop de devoirs (there's too much homework)

B. Qu'est-ce que tu faisais à l'école primaire ? (What did you do at primary school?)

Quand j'étais petit(e), (when I was younger,) Quand j'étais à l'école primaire (When I was at primary school)	j'étudiais (I studied) je devais étudier (I had to study) j'adorais (I loved) je détestais (I hated)	le français (French) le dessin (art) la géographie (geography) l'histoire (history) l'anglais (English) l'EPS (PE) l'éducation religieuse (RE) les sciences (science) les maths (maths)	c'était (it was)	assez (quite) un peu (a little) très (very) trop (too) super (super) vraiment (really)

(with descriptors: cool (cool), amusant (fun), intéressant (interesting), difficile (difficult), utile (useful), facile (easy), génial (great), nul (rubbish), ennuyeux (boring))

C. Fais-moi une description de ton collège. (Give me a description of your school.)

Mon collège s'appelle…	My school is called…	Mon collège est moderne/ vieux/ bien aménagé.	My school is modern/old/well equipped.
C'est un collège mixte/un internat/ un pensionnat.	It is a mixed gender school/a boarding school.	Mon collège n'est pas moderne/ vieux/ bien aménagé.	My school is not modern/old/ well equipped.
Il y a __ élèves et __ profs.	There are __ students and __ teachers.	Les bâtiments sont modernes/vieux.	The buildings are modern/old.
Les cours commencent à ___ heures et finissent à _____ heures.	Lessons start at ___ and finish at___.	Il y a une salle de sport/ une bibliothèque/ des labos.	There is/There are a sport hall/ a library/ labs.

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N'oubliez pas!

Par exemple (for example)
Comme (like)
Tu rigoles ! (You're joking!)
Quel cauchemar ! (What a nightmare!)

D. Parle-moi d'une journée typique. (Talk about a typical day.)

Lundi (Monday) Mardi (Tuesday) Mercredi (Wednesday) Jeudi (Thursday) Vendredi (Friday)	à __ heures (at __ o'clock)	les cours commencent (lessons start) les cours finissent (lessons finish) J'étudie… (I study…) c'est la recrée (it's break time) c'est le déjeuner (it's lunch time) il y a des clubs (there are afterschool clubs)

E. Comment est le règlement dans ton collège ? (What are the rules like in your school?)
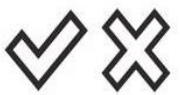
Dans mon collège (In my school)	il faut être à l'heure (you must arrive on time) il faut faire ses devoirs (you must do your homework) il faut porter l'uniforme scolaire (you must wear your uniform) il ne faut pas manquer les cours (you must not skip lessons) il ne faut pas tricher pendant un contrôle (you must not cheat in a test) il est interdit de porter des bijoux ou de maquillage (you must not wear jewellery or make-up) il est interdit d'utiliser son portable en classe (it is forbidden to use your mobile in class) il est interdit de harceler d'autres élèves (it is forbidden to harrass other students) il est interdit de sortir de l'école pendant le déjeuner (it is forbidden to leave school at lunch)	et je trouve ça (and I find it)	assez (quite) un peu (a little) très (very) trop (too) super (super) vraiment (really) raisonnable (reasonable) logique (logical) juste (fair) ridicule (ridiculous) frustrant (fristrating) trop strict (too strict) injuste (unfair) une perte de temps (a waste of time)

F. Quelles sont les différences entre les collèges en Angleterre et en France ? (What are the differences between school in Eng. and France?)

Les élèves ne font pas de cours de religion (students don't study RE) Les élèves portent leurs propres vêtements (students wear their own clthes) Les cours commencent avant 8h30 (lessons start before 8.30) Les grandes vacances durent 2 mois (the summer holidays last 2 months) Les élèves qui ne font pas assez de progrès redoublent (students who don't makre progress retake the year) Les élèves achètent tous les équipements (students buy all their equipment) Avant de quitter le collège les élèves passent le brevet (before leaving school they take their exams) Certains élèves doivent aller au collège le samedi (some students must go to school on Saturdays)	donc, je préfère le système français (so I prefer the French system) donc, je préfère le système britannique (so I prefer the British system)

G. Parle-moi un peu d'une visite scolaire. (Talk to me about a school trip.)

L'année dernière (last year) Récemment (recently)	je suis allé (I went to…) on est allé (we went to…)	et (and)	on s'est fait des nouveaux amis (we made some new friends) on a amélioré ses compétences en langues (we improved our language skills) on a habité chez une famille d'une culture différente (we lived with a family from a different culture) on a visité un nouveau pays (we visited a new country) on a apprécié nos différences/similarités (we appreciated our differences/similarities) on a voyagé en… (we travelled by…) on a acheté des souvenirs (we bought souvenirs)

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Unit 3: Learning Aim A Design a Personal Fitness Training Programme
Personal information
- Personal goals (SMARTER)
- Aims
- Objectives
- Lifestyle
- Physical Activity Questionnaire
- Medical History questionnaire
- Attitude and Motivation towards Exercise

Unit 3: Learning Aim A Design a Personal Fitness Training Programme
Programme Design
- Use of personal information
- Selection of appropriate training method/activity
- Safe and creative design
- Application of FITT
- Application of SPIRRAV
- Include warm-up/cool-down
- Discuss HR training zones
- Include RPE

Unit 3: Learning Aim B Musculoskeletal and cardiorespiratory training systems and the effects on the body when training
- Location of the major muscles and bones
- Structure and function of the 4 synovial joints
- Short term effects of training on these systems
- Structures of the cardiovascular and respiratory systems.

Unit 3: Learning Aim C Implement (do) a Personal Fitness Training Programme
Safely implement the programme
- Take part in the training programme to the best of your ability.
- Wear the correct training gear.
- Conduct the training programme safely
- Complete and record your outcomes for every session accurately.

Unit 3: Learning Aim C Implement (do) a Personal Fitness Training Programme
Session training diary
- Include date/time/duration/ location of training
- Aims/objectives met?
- Type of training done
- How FITT was adapted from last time
- Log achievements and progress
- List resources used
- How progressive overload was used
- HR and RPE recorded

Unit 3: Learning Aim C Implement (do) a Personal Fitness Training Programme
Measures for success
- Intrinsic/extrinsic motivation
- Benefits of motivation/self-confidence
- Motivation for training and feedback on how the sessions felt
- Adaptations
- Achievements against aims/ objectives/goals/targets

Keyword	Definition
SMARTER Targets/Goals	Specific, Measureable, Achievable, Realistic, Time-related, Exciting, Recorded
Training Methods	Flexibility training (static/ballistic/PNF) Strength, muscular endurance and power training (Circuit training, Free weights, plyometrics) Aerobic endurance training (Continuous, Fartlek, Interval, Circuit) Speed training (Hollow, Acceleration, Interval)
FITT	Frequency, Intensity, Time, Type
SPIRRAV	Specificity, Progressive overload, Individual needs, Rest and recovery, Reversibility, Adaptation, Variation
Borg RPE	Rate of Perceived exertion
Musculoskeletal system	The muscular and skeletal systems combined.
Cardiorespiratory system	The cardiovascular and respiratory systems combined.
Progressive overload	In order to progress, training needs to be demanding enough to cause the body to adapt, improving performance.
Intrinsic motivation	Motivation that comes from yourself: enjoyment, fun, feeling good.
Extrinsic motivation	Motivation that comes from external factors: rewards, money, medals.
Adaptations	Changes
Psychological	To do with your thoughts, feelings, beliefs and values

Unit 3: Learning Aim D Review your Personal Fitness Training Programme
Review Programme
Discuss short term psychological effects
- After every session
- Evidence of your adaptations
- Strengths
- Areas for Development
- Recommendations for improving future training and performance

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Unit 6: Learning Aim A Successful Sports leaders and their attributes

Types of sports leaders:
- Coaches
- Fitness instructors
- School/college coaches
- National/international coaches
- Amateur coaches

Attributes
- Skills
    - Communication
    - Organisation of equipment
    - Knowledge
- Advanced skills
    - Activity structure
    - Target setting
    - Use of language
    - Evaluation
- Qualities
    - Appearance
    - Enthusiasm
    - Confidence
- Additional qualities
    - Leadership style
    - Motivation
    - Humour
    - Personality

Responsibilities
- Core responsibilities
    - Professional conduct
    - Health and safety
    - Equality
- Wider responsibilities
    - Insurance
    - Child protection
    - Legal obligations
    - Ethics and values
    - Rules and regulations

Unit 6: Learning Aim B The planning of sports activities

Select your sport/activity
- Individual sports
- Team sports
- Fitness session

Considerations for planning
- Participants
- Aims and objectives
- Resources
- Warm up
    - Pulse raiser
    - Mobilise
    - Stretch
- Main component of activity
- Safe activities
- Cool down
    - Pulse lower
    - Stretch
- Health and safety guidelines
- Risk assessment

Unit 6: Learning Aim B The leading of sports activities

Lead
- Demonstration of attributes
- Completion of core and wider responsibilities

Measures of success
- Coverage of planned components
- Meeting set aims and objectives
- Is it organised and safe?

Keyword	Definition
Attributes	A quality or feature of a person's character
Qualities	A distinctive attribute or characteristic displayed by someone
Leadership style	The manner and approach you take when leading
Responsibilities	The things that are required when taking on a role
Equality	The right to be equal, in terms of rights and opportunities
Insurance	Something that provides protection against accident or injury
Child Protection	Protecting children from violence, abuse, neglect and exploitation
Legal obligations	Things you have to do by law
Ethics and values	Your beliefs and values
Mobilise	Activities to mobilise the joints such as knees, elbows, hips and shoulders

Unit 6: Learning Aim C Review the planning and leading of sports activities

Review
- Feedback for review
- Methods
- Strengths and areas for improvement

Targets for Development
- SMARTER targets
- Development plan
    - Aims and objectives
    - Goals
    - SMARTER targets
    - Activities and opportunities
    - Barriers

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Year 11 – Sports Science – R042 Fitness Training

Principles of Training

Basic: Frequency, Intensity, Time, Type, Adherence
Advanced: Variation, Progressive Overload, Specificity, Reversibility, Moderation.

Components of Fitness

COMPONENT	WHAT IT MEANS	HOW TO TEST IT	TRAINING METHOD
Strength	The maximum force a muscle can generate	Squat Test	Resistance Machines, Circuits, Free Weights
Power	The speed at which a muscle can generate force	Vertical Jump	Plyometric, free weights
Agility	How quickly a player can change direction	Illinois Agility Run	Agility Ladders & hurdles
Balance	How well a player can maintain centre of mass over base of support	Standing Stork	Balance Board, Exercise Ball
Flexibility	The range of motion available at a joint	Sit and Reach	Stretching (active/ passive, static/ dynamic)
Muscular Endurance	The ability of a muscle to repeatedly contract	1 Min Press up	Free weights, circuits, interval training
Cardiovascular Endurance	The ability of the cardiorespiratory system to continue to perform over long periods of time	Bleep Test	Interval training, circuits, continuous, fartlek.

Keyword	Definition
Frequency	How often you train
Intensity	How hard you train
Progressive Overload	The gradual increase in training as the body adapts to previous exercise
Reversibility	The loss of fitness or muscle due to a halt in training
Moderation	Taking into account the individual needs when designing a training programme
Cardiorespiratory System	The cardio vascular system combined with the
Cardiovascular system	The heart, blood and veins
Respiratory system	The lungs and airways
Endurance	Performing something for a long period of time

Training for Sport
Training should always be made relevant for the sport you are competing in. For example a weight lifter must focus on weight training primarily. Invasion sports can differ based on the position you play. E.g. a defender in football would train differently to a goalkeeper or an attacker.

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Unit 1: Learning Aim A Understand the UK Travel & Tourism Sector and it's importance to the UK economy
- Types of tourism
  - Domestic
  - Outbound
  - Inbound
- Types of travel
  - Leisure travel: day trips, short breaks, holidays, visiting friends & relatives (VFR), staycations, special events.
  - Business Travel: MICE Meetings, Incentives, Conferences, Events
  - Specialist Travel: adventure, health, education, cultural heritage, dark tourism, voluntary work, conservation, eco-tourism.
- Principles of sustainable tourism
  - Definition
  - Principles: tourism attempting to make a low impact on the environment and local culture, whilst helping to generate future employment for local people
  - Benefits: Environmental protection, reduced energy consumption, reduced waste, links with the local community, competitive edge, image, cost savings.
- The importance of the T&T industry on the economy
  - Employment: direct and indirect
- Gross Domestic Product (GDP)
  - a measure of all goods and services over a specific time, tourist numbers and the value of tourism spend:
    - Inbound tourism – the number of inbound tourists, type of trip, length of stay, overnight trips, type of accommodation, and their associated spend
    - Domestic tourism – the number of domestic tourist, type of trip, length of stay, overnight trips, type of accommodation and their associated spend
    - Understanding the economic contribution of tourism in different regions of the UK
    - identifying visitor expenditure, number of trips taken.
- Economic Multiplier Effect
- Infrastructure Development – tourism growth/decline.

Key Terms	Definition
Domestic tourism	Taking holidays and trips in your own country.
Outbound tourism	Travelling to a different country for a holiday or visit.
Inbound tourism	Visitors from overseas coming into the country for a holiday.
Sustainable tourism	Meeting the needs of present tourists and local communities while protecting the natural, historical and cultural environment for the future.
Direct employment	These are jobs created directly by the T&T industry. Examples may include pilots and travel agents.
Indirect employment	These are jobs that are created to support the T&T industry. Examples may include hotel builders and cleaners of hotels.
GDP	This stands for Gross Domestic Product. It is the value of a country's economy.
Economic Multiplier Effect	This is the direct spending by tourists, circulated throughout the economy on indirect products and services. It also has to be considered that the total value of goods and services (GDP) and the way in which growth/investment in one area tends to lead to growth and new jobs in another (the multiplier effect).
Infrastructure	The basic physical and organisation structure of facilities e.g. buildings, roads, power supplies
Serviced accommodation	These are places to stay that have full furniture and facilities.
Non-serviced accommodation	These are places to stay where the tourist provides their own towels, cutlery and other basic materials.
Ancillary Organisations	These are companies that offer services that help the T&T industry but aren't directly involved. E.g. a cleaner in a hotel.
Common Ownership	This is where the same company owns lots of different businesses.
Vertical integration	This is where a business at one point of the chain of distribution purchases or acquires a business at a higher or lower level in the chain
Horizontal integration	This is where businesses at the same level in the chain of distribution merge together or are purchased by another business

Unit 1: Learning Aim B Know about the industries, and key organisations, within the travel and tourism sector, their roles and interrelationships

- Tour operators:
    - types – domestic, outbound, inbound
    - role – to assemble and operate component parts of holidays as a package for retail travel agents or direct sales
    - products and services provided – package holidays, accommodation, travel, transfers, excursions, other services.
- Travel agents:
    - types – multiples, independent, online
    - role – to provide expert advice and guidance, arranging and booking trips, excursions and package holidays or individual components
    - products and/or services provided – information; foreign exchange; sales and booking service for packaged holidays, accommodation, flights, transfers and ground transport, excursions, tickets, insurance, ancillary services.
- Online Travel Services
- Passenger transport
    - types – road, rail, air, sea, regional, national, global
    - role – to provide transport from one location to selected destination, safety
    - products and/or services provided – transport, hospitality, entertainment, information and advice.
- Accommodation
    - types – hotels, motels, guest houses/bed and breakfast, apartments, youth hostels, caravans, chalets, camping, holiday cottages, holiday parks)
    - role – to provide a range of accommodation options, services and facilities
    - products and/or services:
        - serviced (room, concierge, restaurant, bar, housekeeping, leisure, conferences)
        - non-serviced (room, self-catering facilities)
        - youth hostels (dormitory/shared rooms, private rooms, self-catering facilities, information and advice, social areas, meals)
        - camping, caravan sites, holiday parks (tent and mobile caravan pitches, static caravan hire, lodge and chalet accommodation, entertainment and hospitality, sports and recreation)
    - location (rural, urban).
- Visitor attractions:
    - type – natural, purpose-built, heritage
    - role – to provide entertainment, education, recreation, fun, hospitality, other visitor facilities
    - products and/or services – information and interpretation, rides, exhibits, events, tours and guides, educational talks, hospitality and catering, souvenirs.
- Arts and entertainment:
    - types – special events, festivals, theatre
    - role – to entertain, inform
    - products and/or services – live entertainment, music and dance, hospitality and catering, merchandise.
- Tourism development and promotion:
    - types – national and regional tourism agencies, tourist and visitor information centres, national and local government departments
    - role – encourage visitors, increase tourism revenue, promote special events, market and promote the UK, its regions and destinations, provide information, advice and guidance
    - products and/or services – information, literature, souvenirs and merchandise, visitor centres, industry representation.

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Unit 1: Learning Aim B Know about the industries, and key organisations, within the travel and tourism sector, their roles and interrelationships

- Trade and professional bodies:
    - types – Civil Aviation Authority (CAA), Office of Rail Regulation (ORR), the Association of British Travel Agents (ABTA), the Association of Independent Tour Operators (AITO), Ukinbound
    - role – regulation and protection, member representation, liaison with government
    - products and/or services – dealing with consumer complaints/arbitration, advice and support, representation, insurance, repatriation, licensing.
- Ancillary organisations:
    - types – car hire, travel insurance, airport services, event booking, product comparison providers
    - role – supporting services for tourists and travellers
    - products and/or services – car hire, insurance, parking, lounges, information and advice.
- Private:
    - characteristics – organisations owned or controlled by private individuals or shareholders
    - functions – sales of goods and services to make a profit, maximise sales revenue, increase market share, support members.
- Public:
    - characteristics – funded and sometimes owned by central and local government
    - functions – to provide a service, regulation, to educate, promote and/or inform.
- Voluntary:
    - characteristics – independent organisations; funded by membership, donations, grants, sales of products and services
    - functions – to provide a service, provide/sell products, support members, promote a particular cause, educate and inform.
- Common ownership,
    - corporate groups (vertical integration – where a business at one point of the chain of distribution purchases or acquires a business at a higher or lower level of the chain of distribution/horizontal integration – where businesses at the same level in the chain of distribution merge together or are purchased by another business)
- Commercial partnerships (separate organisations working together for a common venture).
- Advantages/Disadvantages for organisations of corporate groups/common ownership/commercial partnerships including:
    - marketing and promotion
    - increase sales and income
    - provide good customer care
    - economies of scale
    - shared resources
    - wider customer base.

    - size of operation
    - less customer choice
    - loss of personalised customer care
    - inflexibility

Unit 1: Learning Aim C Understand the role of consumer technology in the travel and tourism industry

- Airports (self-service check-in, security)
- Visitor attractions (multi-media, interpretation, online bookings)
- Accommodation (entertainment, communication, online bookings)
- Mobile applications (communication of information, booking, comparison)
- Electronic and mobile ticketing (e-tickets, m-tickets)
- Websites (reviews, booking, virtual tours).