United Learning
The best in everyone™

Irlam and Cadishead Academy
2022 - 2023

Knowledge Organiser 1

Name:	.....
Tutor Group:	.....
Tutor & Room:	.....

"If you are not willing to learn, no one can help you.
If you are determined to learn, no one can stop you."

Contents

Contents

Knowledge Organiser – A Handy Guide

Research indicates that for homework to be most effective, it should be carefully organised and monitored. To help structure this important aspect of their learning, all students at Irlam and Cadishead are issued with a Knowledge Organiser. The purpose of this is to set well-structured and challenging homework that strengthens their understanding of key information, concepts and subject specific terminology directly related to the syllabuses that inform their GCSE exams. This guide will help you and your child to use their Knowledge Organiser efficiently.

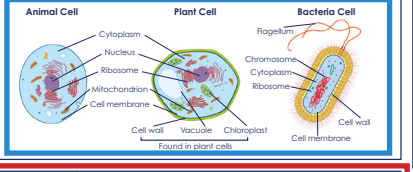
Diagrams
These diagrams act as ***anchors*** for key information that students learn during the unit. In order to make the most of these, students need to be able to ***annotate*** the diagrams correctly, and use them to ***recall*** key information and links in learning.

Content
This is the ***key*** learning that students need for any particular unit. Again, this will ***not*** be the ***only*** learning that students will have for the unit, it is merely the ***foundations*** that deeper learning will sit on. Students will need to have a strong grasp of these fundamentals to build up further, more complex understanding over time.

Science *5 of 13* **Cells, Tissues and Organs**

1. Cell Structure

Unicellular organisms are made of one cell (e.g. bacteria).
Multicellular organisms are made of many cells (e.g. plants and humans).



Organelle	Function
Nucleus	Contains genetic material which controls the cell's activities
Cell Membrane	Controls the movement of substances in and out of the cell
Cytoplasm	Where chemical reactions happen
Mitochondria	Where energy is released in respiration
Ribosome	Where protein synthesis happens
Cell Wall	Provides strength and support
Chloroplast	Absorbs energy for photosynthesis (contains **chlorophyll**)
Vacuole	Filled with cell sap

2. Specialised Cells

Specialised cells - cells that are adapted to do a specific job.

Sperm cell
Streamlined - Swim fast
Lots of mitochondria that release energy for swimming

Palisade cell
Lots of chloroplasts that absorb sunlight for photosynthesis

Root hair cell
Large vacuole for storing cell sap
Large surface area to absorb water and minerals more efficiently

3. Parts Of The Microscope

- Put the slide on the stage;
- Always start on the lowest magnification as it gives you the widest field of vision;
- Use the focus to see your object;
- Then increase the magnification.

Science *6 of 13* **Cells, Tissues and Organs**

4. Organisation

Cell → Tissue → Organ → Organ System

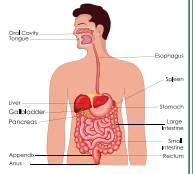
Cell	The smallest structural unit of all organisms.
Tissue	Made from a group of cells with a similar structure and function, which all work together to do a particular job.
Organ	Made from a group of different tissues, which all work together to do a particular job.
Organ System	Made from a group of different organs, which all work together to do a particular job.

5. Digestive System

Role: to break down large food molecules into smaller molecules that can be absorbed.

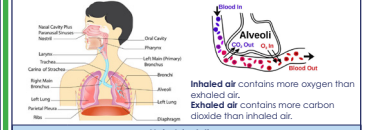
Adaptations

- The intestine is a highly folded structure, which increases surface area to speed up diffusion;
- The intestine is covered in many villi which are further covered by microvilli = large surface area → faster rate of diffusion;
- Thin membranes → shorter distance to diffuse → faster rate of diffusion;
- Covered in blood vessels → keeps blood moving to maintain concentration differences → faster rate of diffusion.



6. Respiratory System

Respiratory system takes in oxygen for respiration and removes carbon dioxide.



Inhaled air contains more oxygen than exhaled air.
Exhaled air contains more carbon dioxide than inhaled air.

Main Adaptations	
Trachea	Contains C ring cartilage which keeps the airway open leaving a clear passage for air to travel in and out of the lungs.
Alveoli	**Thin membranes** → reduced diffusion distance **Good blood supply** → maintains concentration gradients **Highly folded membrane** → increased surface area All of the above adaptations ensure that **gas exchange**, by **diffusion**, happens efficiently.

Image size = magnification x actual size

Key Words
This is organised to help self-quizzing. The students can ***hide*** either the key word or the definition, the try to remember the hidden part. Note – these are ***not*** the only terms or concepts students will learn. These will build up over time.

Equations
Some subjects, such as maths and science, will have ***equations*** that students will need to ***memorise*** and be able to recall.

Knowledge Organiser – A Handy Guide

Look, Cover, Write, Repeat

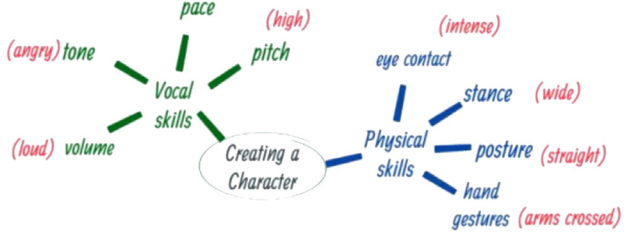
Simple, good to use with spellings, defining keywords and remembering facts:

- Look at the Knowledge Organiser.
- Say the knowledge.
- Cover up the knowledge.
- Write down all that you can remember.
- Correct any mistakes.
- Repeat until there are no mistakes.

Mind Maps

Mind Maps help you to organise and link your learning.

- Start by writing the key idea from your Knowledge Organiser in the centre of your page.
- Choose a colour, and start adding the key ideas from one section of your organiser.
- Choose a different colour to add information from another part of the organiser.
- Use another colour to link ideas or add examples or extra information. Finally, check your Knowledge Organiser to see if you missed out any information.



Flash Cards

Flashcards are great for learning definitions!

- Make your flashcards by writing the key word on one side and the definition on the other.
- Once you have all your flashcards ready, lay them out in rows on a table with the keyword facing you.
- Starting with the first word in the first row, try and remember the definition without looking.
- If you get it right, you can move onto the next one.
- Keep going until you get one wrong. When you do, go back to the start.
- Repeat until there are no mistakes.
- To make sure you fully remember all of the definitions, do it again with the keywords in a different order.

Word Up

This helps with learning specific vocabulary and key definitions.

- Read through the page in your Knowledge Organiser carefully.
- Cover up your Knowledge Organiser and write down as many subject specific words as you can remember down the page.
- For each word you have written, either write the definition or put it into a sentence.
- If you are unsure about a word, look it up in a dictionary.
- Finally, use your Knowledge Organiser to check and correct what you have written.

ICA is an Academy of Standards and Character

All ICA Students READ, They Are:

Respectful – to all students and adults in the classroom. They listen when someone else is speaking and use manners at all times.

Enthusiastic – they take part in all aspects of learning by answering questions, tracking the speaker and taking part in discussions.

Ambitious – they stretch and challenge themselves, completing all work to the best of their ability and are always seeking for the next step.

Determined – even when things are difficult, they work hard to solve problems and learn.

Students who follow these rules will be rewarded!

If you do not follow these rules, the following will happen:

1. **REMIND** – you will be given a clear warning about your behaviour
2. **REPRIMAND** – you will be given a final warning and a 60-minute detention
3. **REMOVE** – you will be removed from the lesson and must work in RFI and complete a 60-minute detention

Learning Habits

Successful students have positive learning habits. It takes hard work but the end results are worth it!

- Homework is completed on time and to an excellent standard.
- Students must be on task during lessons at all times.
- Students follow the academy routines at all times.
- Students are punctual and have outstanding attendance.
- Students wear their uniform perfectly, taking pride in their appearance.
- Students are well equipped with several pens, pencils, a ruler, calculator, Knowledge Organisers, a whiteboard pen and a reading book.
- Students have additional equipment when needed, such as cooking ingredients and correct PE kits.

ICA Promise

I promise that I will try my best

To consider others with thought and ***respect***

To guide my ***enthusiasm***

Towards ***ambition***

And meet every challenge with ***determination***

Today and ***tomorrow***

No trouble nor ***sorrow***

For that is our way

The ICA way

Uniform Summary

This summary is intended for use as a quick reference document and the dress policy should be consulted for guidance.

- ICA Blazer, jumper and tie
- Black trousers or ICA school pattern skirt worn to the knee
- Long black socks or tights with skirt
- Short black socks with trousers
- No makeup – this includes fake eyelashes and acrylic nails
- One stud in the earlobe (where necessary)
- A backpack not a handbag or other style bag
- No electronic devices visible between 8.25am–2.50pm
- No outdoor wear in the building – hoodies are not allowed
- Flat black shoes, not trainer style shoes – see photos below

Oxford Pattern

A plain leather shoe with a toecap

Plain Toe Oxford Pattern

A plain leather shoe without a separate toecap

Flat Shoe With Velcro

Similar to the plain toe Oxford but with Velcro fastening

Mary Jane Pattern

A plain leather shoe with an ankle strap

Plain Toe Oxford Pattern

A plain leather shoe without a separate toecap

Flat Shoe with Velcro

A plain flat shoe that may be secured with Velcro

Attendance Matters

What do your attendance figures actually mean?

95% =	**47 lessons missed each year** 8 days in total or 1 week and 3 days
90% =	**95 lessons missed each year** 16 days in total or 3 weeks and 1 day
85% =	**142 lessons missed each year** 24 days in total or 4 weeks and 4 days
80% =	**190 lessons missed each year** 32 days in total or 6 weeks and 2 days

Did you know that for every two weeks of school that you miss your GCSE grades will lower by one grade!

BE SMART BE THERE!

Percentages based on 190 academic days

What Is Your Attendance?		
	Attendance %	R A G
HT1		
HT2		
HT3		
HT4		
HT5		
HT6		

Attendance Matters

The Periodic Table of Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4		Key: relative atomic mass; **atomic symbol**; name; atomic (proton) number									11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	[285] **Cn** copernicium 112	[286] **Nh** nihonium 113	[289] **Fl** flerovium 114	[289] **Mc** moscovium 115	[293] **Lv** livermorium 116	[294] **Ts** tennessine 117	[294] **Og** oganesson 118

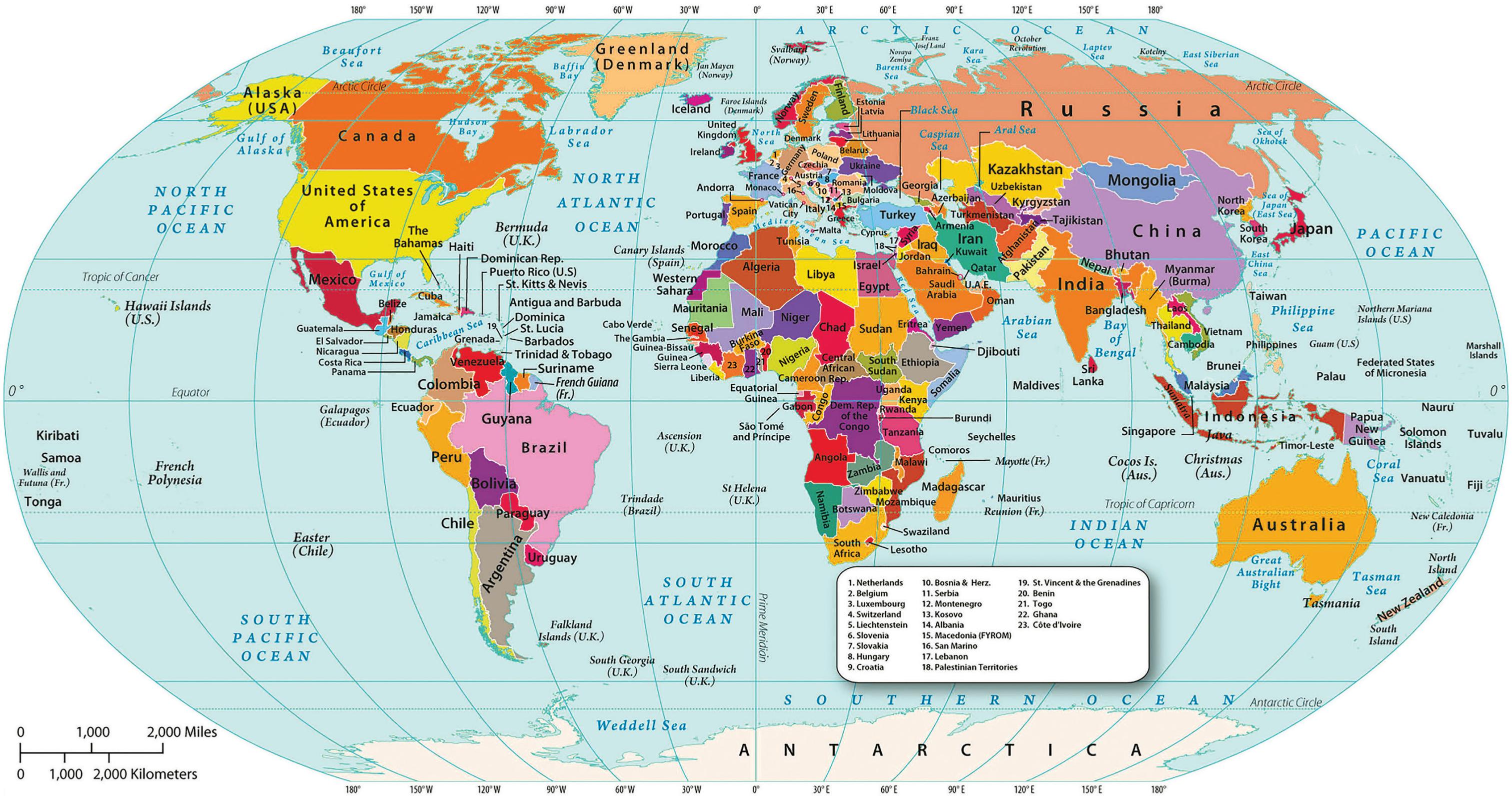
* The Lanthanides (atomic numbers 58 – 71) and the Actinides (atomic numbers 90 – 103) have been omitted.

Relative atomic masses for **Cu** and **Cl** have not been rounded to the nearest whole number.

Multiplication Square

×	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	109
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

World Map



180° 150° W 120° W 90° W 60° W 30° W 0° 30° E 60° E 90° E 120° E 150° E 180°
A R C T I C O C E A N
Beaufort Sea
Greenland (Denmark)
Baffin Bay
Jan Mayen (Norway)
Svalbard (Norway)
Franz Josef Land
Novaya Zemlya
Barents Sea
Kara Sea
October Revolution
Laptev Sea
Kotelny
East Siberian Sea
Arctic Circle
Alaska (USA)
Canada
Hudson Bay
Labrador Sea
Gulf of Alaska
Iceland
Faroe Islands (Denmark)
Norway
Sweden
Finland
Estonia
Latvia
Lithuania
Russia
Black Sea
Caspian Sea
Aral Sea
Sea of Okhotsk
United Kingdom
North Sea
Denmark
Ireland
Belarus
Poland
Germany
Czechia
Ukraine
France
Austria
Monaco
Romania
Moldova
Andorra
Bulgaria
Georgia
Kazakhstan
Mongolia
Uzbekistan
Kyrgyzstan
Azerbaijan
Turkmenistan
Tajikistan
Armenia
Spain
Vatican City
Italy
Greece
Turkey
Portugal
Malta
Cyprus
Syria
Iran
Afghanistan
North Korea
Sea of Japan (East Sea)
South Korea
Japan
China
NORTH PACIFIC OCEAN
United States of America
NORTH ATLANTIC OCEAN
Bermuda (U.K.)
Canary Islands (Spain)
Morocco
Tunisia
Mediterranean Sea
Iraq
Kuwait
Jordan
Israel
Bahrain
Qatar
Pakistan
Nepal
Bhutan
PACIFIC OCEAN
East China Sea
Tropic of Cancer
Mexico
Gulf of Mexico
The Bahamas
Haiti
Dominican Rep.
Puerto Rico (U.S)
St. Kitts & Nevis
Antigua and Barbuda
Dominica
St. Lucia
Barbados
Grenada
Trinidad & Tobago
Cuba
Jamaica
Belize
Guatemala
Honduras
El Salvador
Nicaragua
Costa Rica
Panama
Caribbean Sea
Western Sahara
Algeria
Libya
Egypt
Saudi Arabia
U.A.E.
Oman
India
Myanmar (Burma)
Taiwan
Hawaii Islands (U.S.)
Mauritania
Mali
Niger
Chad
Sudan
Eritrea
Yemen
Arabian Sea
Bangladesh
Laos
Thailand
Vietnam
Philippine Sea
Northern Mariana Islands (U.S)
Cabo Verde
Senegal
The Gambia
Guinea-Bissau
Guinea
Sierra Leone
Liberia
Burkina Faso
Nigeria
Central African Rep.
South Sudan
Ethiopia
Djibouti
Somalia
Bay of Bengal
Cambodia
Philippines
Guam (U.S)
Marshall Islands
Venezuela
Suriname
French Guiana (Fr.)
Colombia
Cameroon
Equatorial Guinea
Gabon
Congo
Uganda
Kenya
Sri Lanka
Maldives
Brunei
Malaysia
Palau
Federated States of Micronesia
0°
Equator
Galapagos (Ecuador)
Ecuador
Guyana
Dem. Rep. of the Congo
Rwanda
Burundi
Tanzania
Seychelles
Sumatra
Indonesia
Singapore
Java
Papua New Guinea
Nauru
Kiribati
Samoa
Wallis and Futuna (Fr.)
Tonga
French Polynesia
Peru
Brazil
Ascension (U.K.)
São Tomé and Príncipe
Angola
Zambia
Malawi
Comoros
Mayotte (Fr.)
Cocos Is. (Aus.)
Christmas (Aus.)
Timor-Leste
Solomon Islands
Tuvalu
Bolivia
Paraguay
Trindade (Brazil)
St Helena (U.K.)
Namibia
Zimbabwe
Mozambique
Botswana
Madagascar
Mauritius
Reunion (Fr.)
Tropic of Capricorn
Coral Sea
Vanuatu
Fiji
Chile
Swaziland
South Africa
Lesotho
INDIAN OCEAN
Australia
New Caledonia (Fr.)
Easter (Chile)
Argentina
Uruguay
SOUTH ATLANTIC OCEAN
Prime Meridian
Great Australian Bight
Tasman Sea
North Island
New Zealand
South Island
Tasmania
SOUTH PACIFIC OCEAN
Falkland Islands (U.K.)
South Georgia (U.K.)
South Sandwich (U.K.)
1. Netherlands
2. Belgium
3. Luxembourg
4. Switzerland
5. Liechtenstein
6. Slovenia
7. Slovakia
8. Hungary
9. Croatia
10. Bosnia & Herz.
11. Serbia
12. Montenegro
13. Kosovo
14. Albania
15. Macedonia (FYROM)
16. San Marino
17. Lebanon
18. Palestinian Territories
19. St. Vincent & the Grenadines
20. Benin
21. Togo
22. Ghana
23. Côte d'Ivoire
S O U T H E R N O C E A N
Antarctic Circle
Weddell Sea
A N T A R C T I C A
0 1,000 2,000 Miles
0 1,000 2,000 Kilometers

Literacy Fundamentals
1 of 2

Can I Write In Paragraphs?

The **TIPTOP** rule

You move onto a new paragraph when you change **Ti**me, **P**lace, **To**pic or **P**erson.

1. I always start an essay with **an introduction** which addresses the question.
2. I finish an essay with **a conclusion** to summarise the main points of my argument and to address the question again.
3. I use **connectives** in each paragraph to link my ideas and to put them in a logical order.

Furthermore Whereas Nevertheless Alternatively Consequently	But Since Yet Therefore Besides	Meanwhile Nonetheless However Although Moreover

Have I Used the Correct Grammar?

I am aware that I must use language that is appropriate to my reader.

- **No slang** that lesson was ~~bangin'~~
- **No informal language** I'm ~~gonna~~ do my homework now

Other things to consider:

- ✓ I am clear about the **purpose** of this piece of writing
- ✓ I know who my **audience** is
- ✓ I will use a suitable **layout** and **text type**

I Am Proud of My Work Because...

- I have written clearly so that my reader can understand my writing easily.
- I have checked my spelling and corrected any errors.
- I have used full sentences with a subject and a verb.
- I have used correct punctuation and grammar.
- I have paragraphed my work using TIPTOP.
- My writing is suitable for the person I am writing for.

Can I spell familiar words accurately?

Common contractions

We must use an apostrophe to replace any letter(s) we have left out.

11 o'clock	How's	They'd	Where'll
Aren't	I'd	They'll	Where's
Can't	I'll	They're	Who'd
Couldn't	I'm	Wasn't	Who'll
Didn't	Isn't	We'd	Who's
Doesn't	It'd	We'll	Why'd
Don't	It'll	We're	Why'll
Hadn't	It's	Weren't	Why's
Hasn't	Mightn't	What'd	Won't
Haven't	Mustn't	What'll	Wouldn't
He'd	Shan't	What's	You'd
He'll	She'd	When'd	You'll
He's	She'll	When'll	You're
How'd	She's	When's	
How'll	Shouldn't	Where'd	

Can I Use Different Sentence Types?

Simple sentences: Contains a subject and a verb and can contain an object.

- **Sarah likes to read in the library.**
- **Tom enjoys reading at home.**

Compound sentences: Joins two simple sentences using the connectives: *for, and, nor, but, or, yet, so*.

- **Sarah likes to read in the library but Tom prefers to read at home.**

Complex sentences: A complex sentence contains a conjunction such as *because, since, after, although*, or *when*.

- **Because Robert felt tired, he only studied for an hour.**
- **Although the rain had stopped, the pitch was still water-logged.**
- **Paul enjoys Music, however, he is more proficient in Art.**

Homophones

I have checked that I have not mixed up my homophones.

Affect/effect	One/won
Bare/bear	Passed/past
Brake/break	Peace/piece
Buy/by	Practice (n)/practise (v)
For/four	Read/red
Flour/flower	Sea/see
Grate/great	Sight/site
Hair/hare	Son/sun
Hole/whole	To/too/two
Hour/our	Wait/weight
Knight/night	Weak/week
Know/no	Wear/where
Meat/meet	

Literacy Fundamentals
2 of 2

Basics:

- Every sentence must start with a capital letter.
- Every sentence must finish with some form of punctuation: .?!
- Proper nouns need capital letters. These are **unique** people, places or things *e.g. there are many cities so 'city' doesn't take a capital letter. However there is only one London, therefore it takes a capital letter.*
- When writing titles of works such as books, films or plays:
  - Capitalise the first word
  - Capitalise any main/important words
  - Don't capitalise minor words such as 'and', 'of' or 'the' e.g. The Sound of Music, The Wizard of Oz, Harry Potter and the Goblet of Fire
- When writing speech:
  - ✓ Go to a new line when a different person speaks e.g. *"Good morning," said the Headteacher. "It's the afternoon!" replied the student.*
  - ✓ Each person's speech is marked with speech marks e.g. *"Walk on the left," said Mr Mathews.*

Can I Spell Accurately?

1. Sound out the word
2. Think about how it looks
3. Think about a similar word
4. Is there a memory sentence for this word? (E.g. big elephants cannot always use small exits)
5. Find the word in a list –
   - Key words list
   - Frequently used words list
   - Your own word bank
6. Look it up in a dictionary/ spell-checker
7. Ask a friend or teacher
8. To learn it: look, cover, write, check
9. Once you've solved it, add the correct spelling to your own word bank.

Can I Use Punctuation?

The Apostrophe

I always aim to use apostrophes correctly.

There are two main reasons why we use apostrophes: for possession and to replace a letter or letters

***Note:* Apostrophes are NEVER used to denote plurals**

Full Stop	.	Indicates that a sentence has finished
Comma	,	Indicates a slight pause in a sentence, separates clauses in a complex sentence and items in a list
Question Mark	?	Goes at the end of a question
Exclamation Mark	!	Goes at the end of a dramatic sentence to show surprise or shock
Apostrophe	'	Shows that letter(s) have been left out or indicates possession
Speech Marks	""	Indicate direct speech, the exact words spoken or being quoted
Colon	:	Introduces a list, a statement or a quote in a sentence
Semicolon	;	Separates two sentences that are related and of equal importance
Dash/Hyphen	-	Separates extra information from the main clause by holding words apart
Brackets	()	Can be used like dashes, they separate off extra information from the main clause
Ellipsis	...	To show a passage of time, to hook the reader in and create suspense

Apostrophe for Possession

(To show that something belongs to another)

If a single thing/person owns anything, add an apostrophe + 's'.

- The dog's bone
- The boy's homework
- Jones's bakery
- Yesterday's lesson

However, if it is plural (more than one), an apostrophe comes after the 's'.

- The dogs' bones
- The boys' homework
- Joneses' bakeries (lots of Jones families)
- Many websites' content is educational

There/their/they're

Note: special care must be taken over the use of there, their and they're as they sound the same but are used quite differently:

- **There** shows position *Your seat is over there*
- **Their** shows that **'they'** own something ***Their blazers are navy blue***
- **They're** is short for **they are** as in *They're revising every day*

Its

Note: its, which shows that something owns something (like our, his etc.), **does not** take an apostrophe: the dog ate its bone and we ate our dinner.

Your/you're

Note: special care must be taken over the use of **your** and **you're** as they sound the same but are used quite differently:

- **Your** is possessive as in *This is your pen*
- **You're** is short for **you are** as in *You're coming over to my house*

A Christmas Carol Topic Sheet

Context

Author: Charles Dickens
Published: December, 1843
Era: Victorian
Genre: Allegorical; a ghost story.
Set: Victorian London
Structure: Five stave novella

The Malthusian Catastrophe: Robert Malthus was a controversial economist who warned that the Industrial Revolution would lead to population growth; this population growth could then lead only to starvation and disease as there would not be enough resource for everyone. This concept was named the 'Malthusian Catastrophe'. Malthus therefore opposed the poor laws as they aimed to get people into factories to increase productivity. **Dickens highlights the Malthusian Catastrophe** when Scrooge refers to the workhouses as a logical solution for the poor.

The Supernatural: Victorian society was fascinated by the supernatural, including mediums, ghosts, and spiritualism. However, this belief in the supernatural was also heavily influenced by the church, with the long standing belief that ghosts were souls who were trapped in purgatory.

Dickens' construction of secular Christmas values: Until the mid-1800s, Christmas was solely a religious festival. Dickens helped to popularise many of the cultural elements that we now associate with Christmas. This **imagery** (food, decorations, music) is used throughout the novella. This has contributed to a more **secular** (non-religious) Christmas, based on the values of goodwill, benevolence and forgiveness

London and inequality: The frequent and abrupt jumping between scenes of middle class comfort (Fred) and grinding poverty (The Cratchits, Beetling shop) emphasises the close proximity and **contrast** of the different classes, and highlights the Christian concept of 'love thy neighbour'. The **urban setting** allows Dickens to exercise his fondness for **hyperbole**, with the exaggerated extremes of poverty adding to the effect of the 'plight of the poor'.

The New Poor Law, 1834: In order to deter poor people from claiming financial help, the government made claimants live in workhouses: essentially, prisons for the poor. Dickens hated this law. He spent 1843 touring factories and mines in England and wished to highlight the situation facing poor people. A Christmas Carol was published soon after – in December 1843.

Victorian Childhoods: Children from wealthy families had access to education and opportunity. Children born into poverty would be expected to work from as young as 4, and bring an income into the household. Education was not compulsory, and children often could not read or write. The jobs they were employed to do were dangerous and life limiting.

Key Characters

Ebenezer Scrooge: The protagonist initially dismisses the goodwill and generosity associated with Christmas. After being forced to transform, he becomes a symbol of Christmas spirit in Stave Five. He is a dynamic character (a character who changes). A man who seems to embody everything about relentlessly striving capitalist spirit of the time.

Bob Cratchit: Bob is Scrooge's downtrodden but loyal employee. His family are a symbol of Victorian poverty, cheerfulness in adversity, togetherness and Christmas Spirit. Bob shows pity for Scrooge, and provides a contrast to Scrooge's isolation and meanness. Tiny Tim is an emblem for noble poverty; he accepts his disability without complaint.

Fred: Fred epitomises the concept of goodwill and forgiveness, refusing to be discouraged by his uncle's misery. People (such as the Cratchits) speak highly of Fred and his generosity, in contrast to how they speak of Scrooge. Fred shows that Scrooge has chosen isolation and shows forgiveness to Scrooge, welcoming him in Stave Five.

Marley's Ghost: Marley's ghost is the spiritual representation of Scrooge's potential fate. The chains that drag him down symbolize the guilt caused by his failure to help people in need. Marley's ghost warns Scrooge that he too will experience the same guilt if he continues to deny people help.

The Ghosts: The Ghost of Christmas Past is a symbol of childhood, truth and enlightenment.
The Ghost of Christmas Present represents goodwill, plenty and the festival of Christmas.
The Ghost of Christmas Yet to Come symbolises a catastrophic future for mankind.

Key Vocabulary

Malthusian	Population growth with out strip agricultural growth, leading to economic disaster.
Purgatory	A place or state of suffering inhabited by the souls of sinners.
Misanthropic	Having or showing a dislike of other people; unsociable.
Philanthropic	Seeking to promote the welfare of others; generous and benevolent.
Avaricious	Having or showing an extreme greed for wealth or material gain.
Benevolent	Well meaning and kindly.
Solitude	The state or situation of being alone.
Resolute	Admirably purposeful, determined, and unwavering.
Remorse	Deep regret or guilt for a wrong committed.
Redemption	Being saved or saving someone from evil, sin or suffering.
Capitalism	An economic, political, and social system in which property, business, and industry are privately owned. The system is directed towards making the greatest possible profits for the owners of production.
Inequality	The difference in social status, wealth, or opportunity between people or groups.
Injustice	A situation in which there is no fairness, justice, or equality in the treatment of a person or persons.

A Christmas Carol Topic Sheet

Key Terminology	
Stave	Chapters in the novella, but we normally associate staves with music, as if the **book** is a Christmas carol, and each chapter is part of the song.
Symbolism	The use of symbols to represent ideas or qualities.
Intrusive Narrator	A narrator who interrupts the story to provide a commentary to the reader on some aspect of the story or on a more general topic.
Circular Structure	Circular narratives cycle through the story one event at a time to end back where the story originated.
Allegory	A story that can be interpreted to reveal a hidden meaning, typically a moral or political one.
Allegorical Figures	An **allegorical** figure is a **character** that serves two purposes: first, they are an important person in the story in their own right, and, second, they represent abstract meanings or ideas.
Foreshadowing	Foreshadowing is a literary device in which a writer gives an advance hint of what is to come later in the story.
Didactic	A type of literature that is written to inform or instruct the reader, especially in moral or political lessons.
Polemic	A strong verbal or written attack on someone or something.

The Big Ideas	Notes	The Methods	Notes
Dickens conveys the message that everybody is capable of redemption.		Dickens uses the spirits to propel Scrooge's redemption.	
Dickens emphasises the need for social responsibility and charity.		Dickens uses contrasts and juxtapositions to highlight social inequality and the redemption of Scrooge.	
Dicken highlights the importance of family and friendship.		The intrusive, **omniscient narrator** provides the reader with social commentary.	

An Inspector Calls Topic Sheet

Context

Playwright: John Boynton Priestley (1894–1984)
Dates: Written in 1945
First performed: In Moscow, Russia, in 1945
Era: Edwardian
Genre: Drama
Set: Fictional town Brumley 'an industrial city in the north Midlands' in 1912
Structure: Three Act Play

Biography of Priestley
- Born in Yorkshire in 1894.
- Fought in the First World War and became politicised by the suffering of it
- Became concerned with the effects of social inequality in Britain in 1930s
- Set up a new political party in 1942, The Commonwealth Party. It merged with the Labour Party and was integral in developing the welfare state

Pre and Post War: Before the First World War there was deemed to be a general air of complacency regarding the prospect of any war taking pace. There were strong distinctions between upper and lower classes, society was deeply patriarchal. After the Second World War ended in 1945, class distinctions had been greatly reduced by the two wars and women had earned a more valued place in society. After 1945 there was a desire for more sweeping social change.

Socialism: Socialism is an approach to economic and social systems that is characterised by social ownership, democratic control and high levels of equality. Socialism is generally concerned with ensuring that disparities between wealth and social status are erased from society. After the two World Wars British society was far more open to socialist ideas. In *An Inspector Calls*, the Inspector harbors socialist attitudes.

Social and Moral Responsibility: Attitudes towards social and moral responsibility changed rapidly in the tine between when the play was set (1912) and the time the play was written (1945). In 1912 the general attitude of those with social status and wealth was towards looking after one's own. By the mid-1940s however, the Labour party under Attlee won a landslide election reflecting a wave of enthusiasm towards communal responsibility for everyone in society.

The Titanic: RMS Titanic was a British passenger liner that sank in the North Atlantic ocean in the morning hours of 15th April 1912, killing around 1500. The Titanic was designed to be the pinnacle of both safety and comfort, and due to its enormous size and quality was frequently labeled 'unsinkable'. In *An Inspector Calls* Birling claims this, thus immediately losing the respect of the audience. It can serve as a symbol of the hubris and arrogance of man.

FORM: The play fits into three possible forms:

Well-Made Play
- A popular type of drama from the 19th century
- The events build to a climax
- Primarily concerned with events that happened before the play
- Plot is intricate and complex

Morality Play
- Most popular during 15th and 16th centuries
- They taught the audience lessons that focused on the seven deadly sins
- Characters who committed those sins were punished

Crime Thriller
- Involves a gripping tale based around a crime
- The audience receives clues and must guess what has happened before the end
- All is revealed by the climax

Key Characters

Inspector Goole: An enigmatic (mysterious) figure who serves as Priestley's mouthpiece and advocates social justice. He serves as the Birling's conscience and exposes their sins.

Mr Arthur Birling: A capitalist and business owner who opposes social change and greater equality. He is a self-made man and lacks the refined manners of the upper classes. Made a fool by Priestley to highlight the arrogance and absurdity of his views.

Mrs Sybil Birling: Her husband's social superior, Mrs Birling is involved in charity work but contradictorily believes in personal responsibility and looking after one's self. Fails to understand her own children.

Shelia Birling: Young and initially enthusiastic, Sheila grows and changes throughout the play, embracing the views of the Inspector and challenging the social indifference of her parents. She becomes wiser and more cautious in her relationship with Gerald.

Eric Birling: In his early twenties, he drinks too much and forces himself upon Eva Smith. Whilst she is pregnant with his child, he steals from his father to attempt to support her. Grows and changes, realises his own wrongs along with everyone else's. Critical of parents.

Gerald Croft: A businessman engaged to Sheila, has a relationship with Daisy Renton (Eva Smith). Even though he sits between he two generations he is politically closest to Birling and fails to embrace the Inspector's message, instead seeking to prove he wasn't real.

Eva Smith: Doesn't appear in the play, but her suffering and abuse represents that of all the working classes. She also calls herself both Daisy Renton and Mrs Birling. The older characters begin to question whether she really is one person.

Central Themes

Social Responsibility	Priestley advocates a socialist message of collective responsibility for one another. The Inspector serves as his voice in conveying this ideology, but the younger generation also come to embrace it. The suffering of Eva Smith highlights the powerlessness of the working classes and the need for a society that protects is most vulnerable.
Age and the Generational Divide	Priestley presents a view that there is hope for change and that it lies with the younger generation. Both Sheila and Eric change for the better, maturing and becoming more empathetic as they come to embrace the Inspector's message. They also become vocal critics of their parents' indifference to Eva's suffering.
Class and Power	Priestley highlights the immense power that business owners wielded over their workers and presents them as arrogant and lacking in empathy. He demonstrates Edwardian society's preoccupation with wealth and status at the cost of the individual as a way of promoting change in post-WW2 Britain.
Gender	At the time the play was first performed, women had just played a pivotal role in World War 2 and were empowered by the freedom work provided them. In the 1912 setting, we see Sheila's growing independence vs her mother. However, the play still highlights the awful vulnerability of women and the outdated stereotyping of them.

An Inspector Calls Topic Sheet

Key Vocabulary

Capitalist	Believing in private wealth and business aimed at making profit for business owners. Independent and self-reliant.
Socialist	Believing in shared ownership, collective responsibility for one another and social equality for all.
Ideology	A political viewpoint or set of beliefs, for example socialism.
Responsibility	Being accountable or to blame for something, or having a duty to deal with something.
Hierarchy	A ranking of status or power e.g. the strict class hierarchy of Edwardian England.
Patriarchy	A society in which power lies with men.
Prejudice	An opposition to or opinion about something/someone based upon what they are e.g. working class, female etc.
Morality	The belief that some behaviour is right and some is wrong.
Proletariat	The working class.
Bourgeoisie	The capitalist class in possession of the means of acquiring wealth.
Aristocracy	The highest class in society and often holding titles passed from father to son, for example Lord and Lady Croft.
Façade	A false front or surface-level illusion, for example the façade of family happiness in the opening scene of the play.
Catalyst	Someone or something that speeds up or triggers an event.
Antithesis	When something is the opposite of something else.

Key Terminology, Symbols and Devices

Dramatic Irony	When the audience is aware of something that a character is not aware of, for example Birling believing war won't happen.
Plot Twist	When a story suddenly departs from its expected path and something very unexpected happens. The final phone call.
Cliffhanger	Each act ends on a particularly dramatic, revealing moment that creates a sense of tension and anticipation.
Stage Directions	When the playwright instructs actors/director to perform in a particular way. Priestley's are unusually detailed.
Entrances/ Exits	Characters frequently leave or enter the stage at dramatic moments. Some characters miss important events.
Lighting	Priestley uses stage directions to indicate how the stage should be lit. Changes to 'brighter and harder' for Inspector.
Props	Physical objects used in the play. The photograph plays a key role in identifying Eva. The doorbell interrupts Birling.
Contrast and Juxtaposition	Deliberately placing two very different things along side one another to draw comparisons e.g. Birling and the Inspector.

The Big Ideas	Notes	The Methods	Notes
Priestley promotes a socialist ideology in which he **argues for collective social responsibility.**		1. Priestley uses **contrasts** in character, setting and language to emphasise the different conflicts at work in society.	
Priestley suggests that change is possible, and that **hope lies with the younger generation.**		2. Priestley uses the **characterisation** of the Inspector and the family as a means of highlighting his view of different groups in society.	
Priestley **challenges existing social hierarchies** of class and gender.		3. Priestley uses **entrances, exits, beginnings and endings** as a means of building and maintaining dramatic tension.	

Macbeth Topic Sheet

Context

Playwright: Shakespeare (April 23rd 1564–April 23rd1616)
Dates: written around 1606
Published: in 'the First Folio, 1623
Era: Jacobean
Genre: Tragedy = A play ending with the suffering and death of the main character.
Set: Scotland,
Structure: Five Act Play

Macbeth. The plot is partly based on fact. Macbeth was a real 11th Century king who reigned Scotland from 1040–1057. Shakespeare's version of the story originates from the Chronicles of Holinshed (a well known historian). The play was most likely written in 1606 – the year after the Gunpowder Plot of 1605 – and reflects the insecurities of Jacobean politics.

The Divine Right of Kings says that a monarch is not subject to earthly authority and that they have the right to rule directly from the will of God. It implies that only God can judge an unjust king and that any attempt to depose, dethrone or restrict his powers runs contrary to the will of God and may constitute a sacrilegious act. The action of killing a king is called regicide and is considered a terrible crime.

King James I of England (and VI of Scotland) came to the throne in 1603 following the death of Queen Elizabeth I. The play pays homage to the king's Scottish lineage. The witches' prophecy that Banquo will found a line of kings is a clear nod to James' family's claim to have descended from the historical Banquo. James was convinced about the reality of witchcraft and its great danger to him leading to witch trials. The play is probably not written simply to please James, but certainly looks at relevant ideas.

Shakespearean Tragedy. Macbeth is one of Shakespeare's tragedies and follows specific conventions. The climax must end in a tremendous catastrophe involving the death of the main character; the character's death is caused by their own flaw(s) (hamartia) yet the character has something the audience can identify with.

The Great Chain of Being was a belief in a strict religious hierarchy (see key vocabulary) of all things which was believed to have been decreed by God. This idea was important in Elizabethan and Jacobean beliefs. The chain starts from God and progresses downward to angels, demons (fallen/renegade angels), stars, moon, kings, princes, nobles, commoners, wild animals, domesticated animals, trees, other plants, precious stones, precious metals, and other minerals.

Conventions of a Shakespearean Tragedy

A **tragic hero** who falls from greatness through a flaw of their own character.	**Hamartia** – the flaw in the tragic hero that destroys them.	A **hero of status** – the central characters are people of importance, with power and status to lose.
External conflict – his tragedies feature conflict between characters, and always lead to death.	**Internal conflict** – there are frequent moments of self-doubt or internal torment.	**Supernatural elements** – Many of Shakespeare's tragedies feature supernatural influences.

Key Characters

Macbeth: The eponymous protagonist is the tragic hero of this play. He is both ambitious and ruthless. He falls from loyal and respected warrior to a paranoid, tyrannical king, before dying in battle in Act V.

Lady Macbeth: A strong, ambitious and manipulative woman who exerts pressure on Macbeth to pursue him ambition of becoming king by murdering Duncan. Unable to deal with the guilt of these actions and is driven to madness and suicide.

The Witches / Weird Sisters: Supernatural and manipulative beings who seem to be able to predict the future. They are unearthly and omniscient.

Banquo: Macbeth's close friend and ally is astute and loyal. Macbeth sees him as a threat. He is virtuous, admired by audiences, and mistrustful of the supernatural witches.

Duncan: King of Scotland at the beginning of the play. He is a virtuous, strong and respected leader, held up as the model of good kingship by others in the play. He is murdered by Macbeth in Act 2.

Macduff: A soldier who is loyal to Duncan and is suspicious of Macbeth. His family is murdered by Macbeth's soldiers and he eventually exacts revenge by killing Macbeth. He was born by caesarian section and therefore was "not of woman born".

Malcolm: Duncan's son and next in line to the throne. He is described as a good man in the play.

Central Themes

Ambition	The play is about the corrupting power of ambition. Both Lady Macbeth and Macbeth are urged to action by the prophecies of the witches, but they still commit their crimes themselves because they want greater power. Their ambition leads them to violence and death.
Kingship and Tyranny	The play contrasts the kind and wise rule of Duncan, who is described as a virtuous (good) king, with the brutal rule of Macbeth, who quickly becomes called a tyrant. The play shows how Macbeth has no divine right to rule and upsets the natural order by killing Duncan.
Order and Disorder	The play subverts the natural order of the world. Macbeth's actions are based on a supernatural belief in a prophecy. It depicts an anarchic world: Macbeth inverts the order of royal succession; his wife inverts the patriarchal hierarchy; the unnatural world disrupts the natural. The disruption underpins the conflict that is not only external and violent but internal as Macbeth and his wife come to terms with what they've done.
Appearance and Reality	Characters in the play are often not what they seem. Lady Macbeth and Macbeth are duplicitous towards Duncan, the witches equivocate (not say what they really mean) and cannot be trusted, Lady Macbeth seeks to manipulate Macbeth.

Macbeth Topic Sheet

Key Vocabulary	
Ambition	A desire to achieve something e.g. Macbeth and kingship
Hubris	Having excessive pride or self-confidence
Tyrant	A ruler who rules through fear and violence
Corrupt	Acting dishonestly OR being in a state of decay
Patriarchal	A society where power is in the hands of men
Duplicitous	Lying and being false. Two-faced. Deceitful
Façade	A false front, mask or illusion. Hiding one's true feelings
Prescient	Having knowledge of things before they happen – the witches
Nihilistic	The belief that everything is meaningless
Courageous	Being very brave
Supernatural	Things that are not a part of the natural world
Fate	Events being already decided and out of a person's control
Treachery	Betraying someone's trust
Regicide	The killing of a King

Key Terminology, Symbols and Devices	
Motif	A recurring image or idea that has symbolic importance. The best example in Macbeth would be blood.
Soliloquy	When a character is alone on stage and speaks their thoughts aloud to themselves.
Iambic Pentameter	A line of a play or poem that has ten syllables organised into five pairs of syllables, where the second in each pair is emphasised. e.g. "When you durst do it then you were a man"
Foreshadowing	When a hint or warning is given about a later event.
Dramatic Irony	When a character is unaware of something that the audience is aware of, so they don't know the full significance of their words.
Symbolism	When something symbolises a set of ideas e.g. "The raven himself is hoarse" – raven symbolic of death, supernatural.
Aside	When a character pauses in a conversation to speak only to the audience or another character, unheard by the rest.

The Big Ideas	Notes	The Methods	Notes
1. Shakespeare uses the play to demonstrate the terrible consequences of disrupting the **natural order**. His rule is unnatural and brings only disorder and sickness. His death restores balance.		1. Shakespeare **uses blood as a metaphor for guilt** through the play. As the guilt increases, the volume of blood increases.	
2. Shakespeare uses the play to demonstrate the consequences of engaging with **the supernatural**.		2. Shakespeare uses **apparitions** to present the consequences of ungodly behaviour and is ambiguous about whether they are real or imagined.	
3. Shakespeare uses Macbeth's role as a tragic hero to highlight how vulnerable people are to the destructive **temptation of power**.		3. Shakespeare's **characterisation of Macbeth and Lady Macbeth** establishes the idea that ungodly deeds do not go unpunished.	

Power and Conflict Poetry

Remains by Simon Armitage

Themes: Conflict, Suffering, Reality of War

Tones: Tragic, Haunting, Anecdotal

Content, Meaning and Purpose
- Written to coincide with a TV documentary about those returning from war with PTSD. Based on Guardsman Tromans, who fought in Iraq in 2003.
- Speaker describes shooting a looter dead in Iraq and how it has affected him.
- To show the reader that mental suffering can persist long after physical conflict is over.

Context
- "These are poems of survivors – the damaged, exhausted men who return from war in body but never, wholly, in mind." Simon Armitage
- Poem coincided with increased awareness of PTSD amongst the military, and aroused sympathy amongst The public – many of whom were opposed to the war.

Language
- "**Remains**" – the images and suffering remain.
- "**Legs it up the road**" – colloquial language = authentic voice
- "**Then he's carted off in the back of a lorry**" – reduction of humanity to waste or cattle
- "**he's here in my head when I close my eyes / dug in behind enemy lines**" – metaphor for a war in his head; the PTSD is entrenched.
- "**his bloody life in my bloody hands**" – alludes to Macbeth: Macbeth the warrior with PTSD and Lady Macbeth's bloody hands and guilt.

Form and Structure
- Monologue, told in the present tense to convey a flashback (a symptom of PTSD).
- First four stanzas are set in Iraq; last three are at home, showing the aftermath.
- Enjambment between lines and stanzas conveys his conversational tone and gives it a fast pace, especially when conveying the horror of the killing
- Repetition of 'Probably armed, Possibly not" conveys guilt and bitterness.

Exposure by Wilfred Owen

Themes: Conflict, Suffering, Nature, Reality of War, Patriotism

Tones: Tragic, Haunting, Dreamy

Content, Meaning and Purpose
- Speaker describes war as a battle against the weather and conditions.
- Imagery of cold and warm reflect the delusional mind of a man dying from hypothermia.
- Owen wanted to draw attention to the suffering, monotony and futility of war.

Context
- Written in 1917 before Owen went on to win the Military Cross for bravery, and was then killed in battle in 1918: the poem has authenticity as it is written by an actual soldier.
- Of his work, Owen said: "My theme is war and the pity of war".
- Despite highlighting the tragedy of war and mistakes of senior commanders, he had a deep sense of duty: "**not loath, we lie out here**" shows that he was not bitter about his suffering.

Language
- "**Our brains ache**" physical (cold) suffering and mental (PTSD or shell shock) suffering.
- Semantic field of weather: weather is the enemy.
- "**the merciless iced east winds that knive us…**" – personification (cruel and murderous wind); sibilance (cutting/slicing sound of wind); ellipsis (never-ending).
- Repetition of pronouns **'we' and 'our'** – conveys togetherness and collective suffering of soldiers.
- '**mad gusts tugging on the wire**' – personification

Form and Structure
- Contrast of Cold>Warm>Cold imagery coveys Suffering>Delusions>Death of the hypothermic soldier.
- Repetition of "**but nothing happens**" creates circular structure implying never ending suffering
- Rhyme scheme ABBA and hexameter gives the poem structure and emphasises the monotony.
- Pararhymes (half rhymes) ("**nervous / knife** us") only barely hold the poem together, like the men.

Poppies by Jane Weir

Themes: Bravery, Reality of War, Suffering, Childhood

Tones: Tender, Tragic, Dreamy, Bitter

Content, Meaning and Purpose
- A modern poem that offers an alternative interpretation of bravery in conflict: it does not focus on a soldier in battle but on the mother who is left behind and must cope with his death.
- The narration covers her visit to a war memorial, interspersed with images of the soldier's childhood and his departure for war.

Context
- Set around the time of the Iraq and Afghan wars, but the conflict is deliberately ambiguous to give the poem a timeless relevance to all mothers and families.
- There are hints of a critical tone; about how soldiers can become intoxicated by the glamour or the military: "a blockade of yellow bias" and "intoxicated".

Language
- Contrasting semantic fields of home/childhood ("cat hairs", "play at being Eskimos", "bedroom") with war/injury ("blockade", bandaged", "reinforcements")
- Aural (sound) imagery: "All my words flattened, rolled, turned into felt" shows pain and inability to speak, and "I listened, hoping to hear your playground voice catching on the wind" shows longing for dead son.
- "I was brave, as I walked with you, to the front door": different perspective of bravery in conflict.

Form and Structure
- This is an Elegy, a poem of mourning.
- Strong sense of form despite the free verse, stream of consciousness addressing her son directly – poignant
- No rhyme scheme makes it melancholic
- Enjambment gives it an anecdotal tone.
- Nearly half the lines have caesura – she is trying to hold it together, but can't speak fluently as she is breaking inside.
- Rich texture of time shifts, and visual, aural and touch imagery.

Power and Conflict Poetry

Charge of the Light Brigade by Alfred, Lord Tennyson

Themes: Conflict, Suffering, Reality of War, Patriotism

Tones: Energetic, Tragic, Haunting

Content, Meaning and Purpose
- Published six weeks after a disastrous battle against the Russians in the (unpopular) Crimean War
- Describes a cavalry charge against Russians who shoot at the lightly armed British with cannon from three sides of a long valley.
- Of the 600 hundred who started the charge, over half were killed, injured or taken prisoner.
- It is a celebration of the men's courage and devotion to their country, symbols of the might of the British Empire.

Context
- As Poet Laureate, he had a responsibility to inspire the nation and portray the war in a positive light: propaganda.
- Although Tennyson glorifies the soldiers who took part, he also draws attention to the fact that a commander had made a mistake: "**Someone had blunder'd**".
- This was a controversial point to make in Victorian times when blind devotion to power was expected.

Language
- "**Into the valley of Death**": this Biblical imagery portrays war as a supremely powerful, or even spiritual, experience.
- "**jaws of Death**" and "**mouth of Hell**": presents war as an animal that consumes its victims.
- "**Honour the Light Brigade/Noble six hundred**": language glorifies the soldiers, even in death. The 'six hundred' become a celebrated and prestigious group.
- "**shot and shell**": sibilance creates whooshing sounds of battle.

Form and Structure
- This is a ballad, a form of poetry to remember historical events – we should remember their courage.
- 6 verses, each representing 100 men who took part.
- First stanza tightly structured, mirroring the cavalry formation. Structure becomes awkward to reflect the chaos of battle and the fewer men returning alive.
- Dactylic dimeter (**HALF-a leaugue / DUM-de-de**) mirrors the sound of horses galloping and increases the poem's pace.
- Repetition of '**the six hundred**' at the end of each stanza (epistrophe) emphasises huge loss.

Bayonet Charge by Ted Hughes

Themes: Conflict, Suffering, Nature, Reality of War, Patriotism

Tones: Tragic, Haunting, Dreamy

Content, Meaning and Purpose
- Describes the terrifying experience of 'going over the top': fixing bayonets (long knives) to the end of rifles and leaving a trench to charge directly at the enemy.
- Steps inside the body and mind of the speaker to show how this act transforms a soldier from a living thinking person into a dangerous weapon of war.
- Hughes dramatises the struggle between a man's thoughts and actions.

Context
- Published in 1957, but most likely set in World War 1.
- Hughes' father had survived the battle of Gallipoli in World War 1, and so he may have wished to draw attention to the hardships of trench warfare.
- He draws a contrast between the idealism of patriotism and the reality of fighting and killing. ("**King, honour, human dignity, etcetera**")

Language
- "The patriotic tear that brimmed in his eye Sweating like molten iron": his sense of duty (tear) has now turned into the hot sweat of fear and pain.
- "Cold clockwork of the stars and nations": the soldiers are part of a cold and uncaring machine of war.
- "His foot hung like statuary in midstride.": he is frozen with fear/bewilderment. The caesura (full stop) jolts him back to reality.
- "A yellow hare that rolled like a flame And crawled in a threshing circle": impact of war on nature – the hare is distressed, just like the soldiers

Form and Structure
- The poem starts 'in medias res': in the middle of the action, to convey shock and pace.
- Enjambment maintains the momentum of the charge.
- Time stands still in the second stanza to convey the soldier's bewilderment and reflective thoughts.
- Contrasts the visual and aural imagery of battle with the internal thoughts of the soldier = adds to the confusion.

War Photographer by Carol Ann Duffy

Themes: Conflict, Suffering, Reality of War

Tones: Painful, Detached, Angry

Content, Meaning and Purpose
- Tells the story of a war photographer developing photos at home in England: as a photo develops he begins to remember the horrors of war – painting a contrast to the safety of his dark room.
- He appears to be returning to a warzone at the end of the poem.
- Duffy conveys both the brutality of war and the indifference of those who might view the photos in newspapers and magazines: those who live in comfort and are unaffected by war.

Context
- Like Tennyson and Ted Hughes, Duffy was the Poet Laureate.
- Duffy was inspired to write this poem by her friendship with a war photographer. She was intrigued by the challenge faced by these people whose job requires them to record terrible, horrific events without being able to directly help their subjects.
- The location is ambiguous and therefore universal: ("**Belfast. Beirut. Phnom Penh.**")

Language
- "**All flesh is grass**": Biblical reference that means all human life is temporary – we all die eventually.
- "**He has a job to do**": like a soldier, the photographer has a sense of duty.
- "**Running children in a nightmare heat**": emotive imagery with connotations of hell.
- "**Blood stained into a foreign dust**": lasting impact of war – links to Remains and 'blood shadow'.
- "**He earns a living and they do not care**": 'they' is ambiguous – it could refer to readers or the wider world.

Form and Structure
- Enjambment – reinforces the sense that the world is out of order and confused.
- Rhyme reinforces the idea that he is trying to bring order to a chaotic world – to create an understanding.
- Contrasts: imagery of rural England and nightmare war zones.
- Third stanza: A specific image – and a memory – appears before him.

Power and Conflict Poetry

Kamikaze by Beatrice Garland

Themes: Conflict, Power, Patriotism, Shame, Nature, Childhood

Tones: Sorrowful, Pitiful

Content, Meaning and Purpose
- In World War 2, Japanese Kamikaze pilots would fly manned missiles into targets such as ships.
- This poem explores a kamikaze pilot's journey towards battle, his decision to return, and how he is shunned when he returns home.
- As he looks down at the sea, the beauty of nature and memories of childhood make him decide to turn back.

Context
- Cowardice or surrender was a great shame in wartime Japan.
- To surrender meant shame for you and your family, and rejection by society: "he must have wondered which had been the better way to die".

Language
- The Japanese word 'kamikaze' means 'divine wind' or 'heavenly wind', and has its origin in a heaven-sent storm that scattered an invading fleet in 1250.
- "Dark shoals of fish flashing silver": image links to a Samurai sword – conveys the conflict between his love for nature/life and his sense of duty. Also has sibilance.
- "They treated him as though he no longer existed": cruel irony – he chose to live but now must live as though he is dead.
- "Was no longer the father we loved": the pilot was forever affected by his decision.

Form and Structure
- Narrative and speaker is third person, representing the distance between her and her father, and his rejection by society.
- The first five stanzas are ordered (whilst he is flying on his set mission).
- Only full stop is at the end of Stanza Five: he has made his decision to turn back.
- The final two are in italics and have longer line to represent the fallout of his decision: his life has shifted and will no longer be the same.
- Direct speech ("My mother never spoke again") gives the poem a personal tone.

The Emigree by Carol Rumens

Themes: Conflict, Power, Identity, Protest, Bravery, Childhood

Tones: Mournful, Defiant, Nostalgic

Content, Meaning and Purpose
- 'Emigree' – a female who is forced to leave their county for political or social reasons.
- The speaker describes her memories of a home city that she was forced to flee. The city is now "**sick with tyrants**".
- Despite the city's problems, her positive memories of the place cannot be extinguished.

Context
- Emigree was published in 1993. The home country of the speaker is not revealed – this ambiguity gives the poem a timeless relevance.
- Increasingly relevant to many people in current world climate

Language
- **"I left it as a child"**: ambiguous meaning – either she left when she was a child or the city was a child (it was vulnerable and she feels a responsibility towards it).
- **"I am branded by an impression of sunlight"**: imagery of light – it will stay with her forever.
- Personification of the city: **"I comb its hair and love its shining eyes"** (she has a maternal love for the city) and "My city takes me dancing" (it is romantic and passionate lover)
- **"My city hides behind me"**: it is vulnerable and – despite the fact that she had to flee – she is strong.
- Semantic field of conflict: **"Tyrant, tanks, frontiers"**

Form and Structure
- First person.
- The last line of each stanza is the same (epistrophe): **"sunlight"**: reinforces the overriding positivity of the city and of the poem.
- The first two stanzas have lots of enjambment – conveys freedom. The final stanza has lots of full-stops – conveys that fact that she is now trapped.

Checking Out Me History by John Agard

Themes: Power, Protest, Identity, Childhood

Tones: Defiant, Angry, Rebellious, Cynical

Content, Meaning and Purpose
- Represents the voice of a black man who is frustrated by the Eurocentric history curriculum in the UK – which pays little attention to the black history.
- Black history is quoted to emphasise its separateness and to stress its importance.

Context
- John Agard was born in the Caribbean in 1949 and moved to the UK in the 1970s.
- His poetry challenge racism and prejudice.
- This poem may, to some extent, have achieved its purpose: in 2016, a statue was erected in London in honour of Mary Seacole, one of the subjects of the poem.

Language
- Imagery of fire and light used in all three stanzas regarding black historic figures: **"Toussaint de beacon", "Fire-woman", "yellow sunrise"**.
- Uses non-standard phonetic spelling **"Dem tell me wha dem want"**, to represent his own powerful accent and mixes Caribbean Creole dialect with standard English.
- **"I carving out me identity"**: metaphor for the painful struggle to be heard, and to find his identity.

Form and Structure
- Dramatic monologue, with a dual structure.
- Stanzas concerning Eurocentric history (normal font) are interspersed with stanzas on black history (in italics to represent separateness and rebellion).
- Black history sections arranged as serious lessons to be learned; traditional history as nursery rhymes, mixed with fairytales (mocking of traditional history).
- The lack of punctuation, the stanzas in free verse, the irregular rhyme scheme and the use of Creole could represent the narrator's rejection of the rules.
- Repetition of "**Dem tell me**": frustration.

Power and Conflict Poetry

Ozymandias by Percy Bysshe Shelley

Themes: Power of Nature, Decay, Pride

Tones: Ironic, Rebellious

Content, Meaning and Purpose
- The narrator meets a traveller who tells him about a decayed stature that he saw in a desert.
- The statue was of a long forgotten ancient King: the arrogant Ozymandias, '**king of kings**.'
- The poem is ironic and one big metaphor: Human power is only temporary – the statue now lays crumbled in the sand, and even the most powerful human creations cannot resist the power of nature.

Context
- Shelley was a poet of the 'Romantic period' (late 1700s and early 1800s). Romantic poets were interested in emotion and the power of nature.
- Shelley also disliked the concept of a monarchy and the oppression of ordinary people.
- He had been inspired by the French revolution – when the French monarchy was overthrown.

Language
- '**sneer of cold command**': the king was arrogant, this has been recognised by the sculptor, the traveller and then the narrator.
- '**Look on my works, ye Mighty, and despair.**': 'Look' = imperative, stressed syllable highlights commanding tone; ironic – he is telling other 'mighty' kings to admire the size of his statue and 'despair', however they should really despair because power is only temporary.
- '**The lone and level sands stretch far away**.': the desert is vast, lonely, and lasts far longer than a statue.

Form and Structure
- A sonnet (14 lines) but with an unconventional structure… the structure is normal until a turning point (a volta) at Line 9 (..these words appear). This reflects how human structures can be destroyed or decay.
- The iambic pentameter rhyme scheme is also disrupted or decayed.
- First eight lines (the octave) of the sonnet: the statue is described in parts to show its destruction.
- Final two lines: the huge and immortal desert is described to emphasise the insignificance of human power and pride.

My Last Duchess by Robert Browning

Themes: Power, Pride, Control, Jealousy, Status

Tones: Sinister, Bitter, Angry

Content, Meaning and Purpose
- The Duke is showing a visitor around his large art collection and proudly points out a portrait of his last wife, who is now dead. He reveals that he was annoyed by her over-friendly and flirtatious behaviour.
- He can finally control her by objectifying her and showing her portrait to visitors when he chooses.
- He is now alone as a result of his need for control.
- The visitor has come to arrange the Duke's next marriage, and the Duke's story is a subtle warning about how he expects his next wife to behave.

Context
- Browning was a British poet, and lived in Italy. The poem was published in 1842.
- Browning may have been inspired by the story of an Italian Duke (Duke of Ferrara): his wife died in suspicious circumstances and it was rumoured that she had been poisoned.

Language
- '**Looking as if she was alive**': sets a sinister tone.
- '**Will't please you sit and look at her?**' rhetorical question to his visitor shows obsession with power.
- '**she liked whate'er / She looked on, and her looks went everywhere.**': hints that his wife was a flirt.
- '**as if she ranked / My gift of a nine hundred-yearsold name / With anybody's gift**': she was beneath him in status, and yet dared to rebel against his authority.
- '**I gave commands; Then all smiles stopped together**': euphemism for his wife's murder.
- '**Notice Neptune, though / Taming a sea-horse**': he points out another painting, also about control.

Form and Structure
- Dramatic Monologue, in iambic pentameter.
- It is a speech, pretending to be a conversation – he doesn't allow the other person to speak!
- Enjambment: rambling tone, he's getting carried away with his anger. He is a little unstable.
- Heavy use of caesura (commas and dashes): stuttering effect shows his frustration and anger: '**She thanked men, – good! but thanked / Somehow – I know not how**'
- Dramatic Irony: the reader can read between the lines and see that the Duke's comments have a much more sinister undertone.

Tissue by Imtiaz Dharker

Themes: Power of Nature, Control, Identity

Tones: Painful, Detached, Angry

Content, Meaning and Purpose
- Two different meanings of 'Tissue' (homonyms) are explored: firstly, the various pieces of paper that control our lives (holy books, maps, grocery receipts); secondly, the tissue of a human body.
- The poet explores the paradox that although paper is fragile, temporary and ultimately not important, we allow it to control our lives.
- Also, although human life is much more precious, it is also fragile and temporary.

Context
- Imtiaz Dharker was born in Pakistan and grew up in Glasgow. 'Tissue' is taken from a 2006 collection of poems entitles 'The Terrorist at My Table': the collection questions how well we know people around us.
- This particular poem also questions how well we understand ourselves and the fragility of humanity.

Language
- Semantic field of light: ('**Paper that lets light shine through**', '**The sun shines through their borderlines**',
- '**Let the daylight break through capitals and monoliths**') emphasises that light is central to life, a positive and powerful force that can break through 'tissue' and even monoliths (stone statues).
- '**Pages smoothed and stroked and turned**': gentle verbs convey how important documents such as the Koran are treated with respect.
- '**Fine slips […] might fly our lives like paper kites**': this simile suggests that we allow ourselves to be controlled by paper.

Form and Structure
- The short stanzas create many layers, which is a key theme of the poem (layers of paper and the creation of human life through layers)
- The lack of rhythm or rhyme creates an effect of freedom and openness.
- All stanzas have four lines, except the final stanza which has one line ('**turned into your skin**'): this line focuses on humans, and addresses the reader directly to remind us that we are all fragile and temporary.
- Enjambment between lines and stanzas creates an effect of freedom and flowing movement.

Power and Conflict Poetry

Extract from The Prelude: Stealing the Boat by William Wordsworth

Themes: Power of Nature, Fear, Childhood

Tones: Confident > Dark / Fearful > Reflective

Content, Meaning and Purpose
- The story of a boy's love of nature and a night-time adventure in a rowing boat that instils a deeper and fearful respect for the power of nature.
- At first, the boy is calm and confident, but the sight of a huge mountain that comes into view scares the boy and he flees back to the shore.
- He is now in awe of the mountain and now fearful of the power of nature which are described as '**huge and mighty forms, that do not live like living men**.'
- We should respect nature and not take it for granted.

Context
- Published shortly after his death, The Prelude was a very long poem (14 books) that told the story of William Wordsworth's life.
- This extract is the first part of a book entitled 'Introduction – Childhood and School-Time'.
- Like Percy Shelley, Wordsworth was a romantic poet and so his poetry explores themes of nature, human emotion and how humans are shaped by their interaction with nature.

Language
- '**One summer evening (led by her)**'; '**her**' might be nature personified – this shows his love for nature.
- '**An act of stealth / And troubled pleasure**': confident, but the oxymoron suggests he knows it's wrong; forebodes the troubling events that follow.
- '**Nothing but the stars and grey sky**': emptiness of sky.
- '**The horizon's bound, a huge peak, black and huge**': the image of the mountain is more shocking (contrast).
- '**Upreared its head' and 'measured motion like a living thing**': the mountain is personified as a powerful beast, but calm – contrasts with his own inferior panic.
- '**There hung a darkness**': lasting effects of mountain.

Form and Structure
- First person narrative – creates a sense that it is a personal poem.
- The regular rhythm and enjambment add to the effect of natural speech and a personal voice.
- The extract can be split into three sections, each with a different tone to reflect his shifting mood:
  - Lines 1–20: (rowing) carefree and confident
  - Lines 21–31: (the mountain appears) dark and fearful
  - Lines 32–44: (following days) reflective and troubled
- Contrasts in tone: '**lustily I dipped my oars into the silent lake**' versus '**I struck and struck again' and 'with trembling oars I turned**'.

Storm on the Island by Seamus Heaney

Themes: Power of Nature, Fear

Tones: Dark, Violent, Anecdotal

Content, Meaning and Purpose
- The narrator describes how a rural island community prepared for a coming storm, and how they were confident in their preparations.
- When the storm hits, they are shocked by its power: its violent sights and sounds are described, using the metaphor of war.
- The final line of the poem reveals their fear of nature's power

Context
- Seamus Heaney was Northern Irish, he died in 2013.
- This poem was published in 1966 at the start of 'The Troubles' in Northern Ireland: a period of deep unrest and violence between those who wanted to remain part of the UK and those who wanted to become part of Ireland.
- The first eight letters of the title spell 'Stormont': this is the name of Northern Ireland's parliament. The poem might be a metaphor for the political storm that was building in the country at the time.

Language
- '**Nor are there trees which might prove company**': the island is a lonely, barren place.
- Violent verbs are used to describe the storm: '**pummels**', '**exploding**', '**spits**'.
- Semantic field of war: '**Exploding comfortably**' (also an oxymoron to contrast fear/safety); '**wind dives and strafes invisibly**' (the wind is a fighter plane); '**We are bombarded by the empty air**' (under ceaseless attack).
- This also reinforces the metaphor of war / troubles.
- '**Spits like a tame cat turned savage**': simile compares the nature to an animal that has turned on its owner.

Form and Structure
- Written in blank verse and with lots of enjambment: this creates a conversational and anecdotal tone.
- 'We' (first person plural) creates a sense of community, and 'You' (direct address) makes the reader feel immersed in the experience.
- The poem can split into three sections:
  - Confidence: '**We are prepared:**' (ironic)
  - The violence of the storm: '**It pummels your house**'
  - Fear: '**it is a huge nothing that we fear.**'
- There is a turning point (a volta) in Line 14: 'But no:'.
- This monosyllabic phrase, and the caesura, reflects the final calm before the storm.

London by William Blake

Themes: Power, Inequality, Loss, Anger

Tones: Angry, Dark, Rebellious

Content, Meaning and Purpose
- The narrator is describing a walk around London and how he is saddened by the sights and sounds of poverty.
- The poem also addresses the loss of innocence and the determinism of inequality: how new-born infants are born into poverty.
- The poem uses rhetoric (persuasive techniques) to convince the reader that the people in power (landowners, Church, Government) are to blame for this inequality.

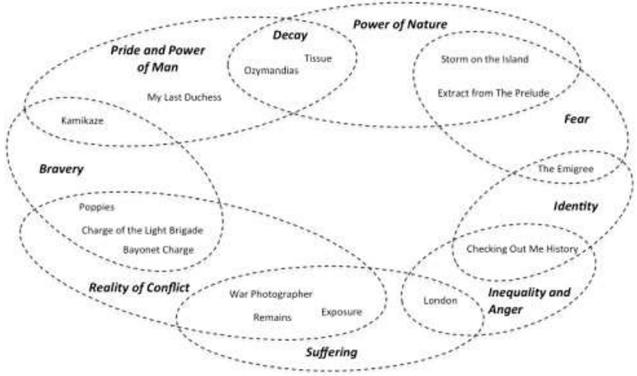
Context
- The poem was published in 1794, and time of great poverty is many parts of London.
- William Blake was an English poet and artist. Much of his work was influenced by his radical political views: he believed in social and racial equality.
- This poem is part of the 'Songs of Experience' collection, which focuses on how innocence is lost and society is corrupt.
- He also questioned the teachings of the Church and the decisions of Government.

Language
- Sensory language creates an immersive effect: visual imagery ('**Marks of weakness, marks of woe**') and aural imagery ('**cry of every man**')
- '**Mind-forged manacles**': they are trapped in poverty.
- Rhetorical devices to persuade: repetition ('**In every..**'); emotive language ('**infant's cry of fear**').
- Criticises the powerful: '**each chartered street**' – everything is owned by the rich; '**Every black'ning church appals**' - the church is corrupt; '**the hapless soldier's sigh / Runs in blood down palace walls**' – soldier's suffer and die due to the decisions of those in power, who themselves live in palaces.

Form and Structure
- A dramatic monologue, there is a first-person narrator ('I) who speaks passionately about what he sees.
- Simple ABAB rhyme scheme: reflects the unrelenting misery of the city, and perhaps the rhythm of his feet as he trudges around the city.
- First two stanzas focus on people; third stanza focuses on the institutions he holds responsible; fourth stanza returns to the people – they are the central focus.

Power and Conflict Poetry

Key themes and connections: poems that you might choose to compare



Language for Comparison

When poems have similarities
Similarly, …
Both poems convey / address…
Both poets explore / present…
This idea is also explored in…
In a similar way, …
Likewise, …

When poems have differences
Although…
Whereas…
Whilst…
In contrast, …
Conversely, …
On the other hand, …
On the contrary, …
Unlike…

Assessment Objectives

Ensure that your answer covers all of these areas:

AO1
- Write a response related to the key word in the question.
- Use comparative language to explore both poems.
- Use a range of evidence to support your response and to show the meaning of the poems.

AO2
- Comment on the effect of the language in your evidence, including individual words.
- Identify any use of poetic techniques and explain their effects.

AO3
- What might the poet's intentions have been when they wrote the poem?
- Comment on the historical context – when was the poem published and what impact might it have had then, and today?

Poetic Techniques

LANGUAGE

- **Metaphor** – comparing one thing to another.
- **Simile** – comparing two things with 'like' or 'as'.
- **Personification** – giving human qualities to the nonhuman.
- **Imagery** – language that makes us imagine a sight (visual), sound (aural), touch (tactile), smell or taste.
- **Tone** – the mood or feeling created in a poem.
- **Pathetic Fallacy** – giving emotion to weather in order to create a mood within a text.
- **Irony** – language that says one thing but implies the opposite e.g. sarcasm.
- **Colloquial Language** – informal language, usually creates a conversational tone or authentic voice.
- **Onomatopoeia** – language that sounds like its meaning.
- **Alliteration** – words that are close together start with the same letter or sound.
- **Sibilance** – the repetition of 's' or 'sh' sounds.
- **Assonance** – the repetition of similar vowel sounds.
- **Consonance** – repetition of consonant sounds.
- **Plosives** – short burst of sound: t, k, p, d, g, or b sound.

STRUCTURE

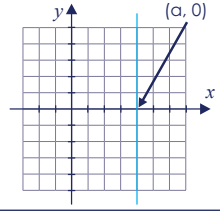
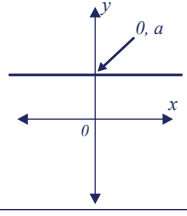
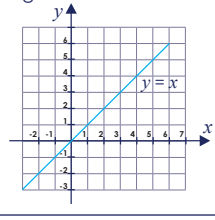
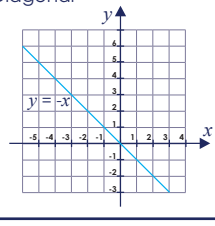
- **Stanza** – a group of lines in a poem.
- **Repetition** – repeated words or phrases.
- **Enjambment** – a sentence or phrase that runs onto the next line.
- **Caesura** – using punctuation to create pauses or stops.
- **Contrast** – opposite concepts/ feelings in a poem.
- **Juxtaposition** – contrasting things placed side by side.
- **Oxymoron** – a phrase that contradicts itself.
- **Anaphora** – when the first word of a stanza is the same across different stanzas.
- **Epistrophe** – when the final word of a stanza is the same across different stanzas.
- **Volta** – a turning point in a poem.

FORM

- **Speaker** – the narrator, or person in the poem.
- **Free verse** – poetry that doesn't rhyme.
- **Blank verse** – poem in iambic pentameter, but with no rhyme.
- **Sonnet** – poem of 14 lines with clear rhyme scheme.
- **Rhyming couplet** – a pair of rhyming lines next to each other.
- **Meter** – arrangement of stressed/ unstressed syllables.
- **Monologue** – one person speaking for a long time.

GCSE Foundation

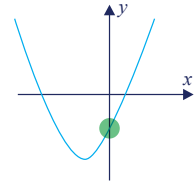
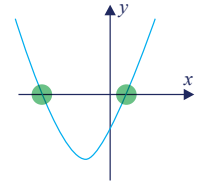
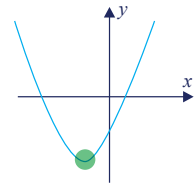
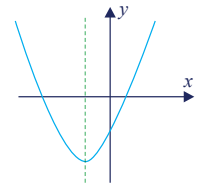
A: Straight Line Graphs

1	x = a	Vertical 
2	y = a	Horizontal 
3	$y = x$	Diagonal 
4	$y = -x$	Diagonal 

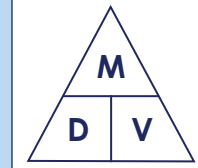
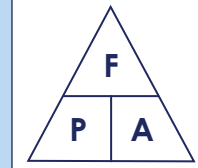
B: Coordinates and Equations of Straight Lines

1	Formula for midpoint of (x_1, y_1) and (x_2, y_2)	$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
2	Equation of a straight line	$y = mx + c$
3	Gradient in the equation of a straight line	m
4	y-intercept in the equation of a stright line	c
5	Formila for gradient of line joinign (x_1, y_1) and (x_2, y_2)	$\frac{y_2 - y_1}{x_2 - x_1}$
6	Parallel lines...	...have the same gradient

D: Quadratic Graphs

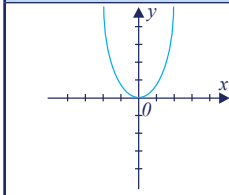
1. y-intercept	2. Roots or Solutions of f(x) = 0
	
3. Turning Point	**4.** Line of Symmetry
	

C: Compound Measures

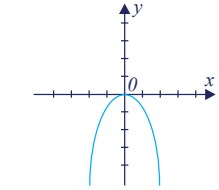
1	SDT Triangle	
2	Speed	Distance ÷ Time
3	Distance	Speed × Time
4	Time	Distance ÷ Speed
5	DMV Triangle	
6	Density	Mass ÷ Volume
7	Mass	Density × Volume
8	Volume	Mass ÷ Density
9	PFA Triangle	
10	Pressure	Force ÷ Area
11	Force	Pressure × Area
12	Area	Force ÷ Pressure

E: Further Graphs

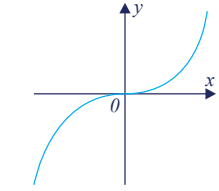
1. $y = x^2$



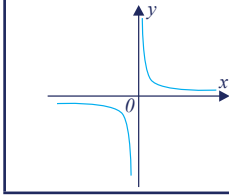
2. $y = -x^2$



3. $y = x^3$



4. $y = \frac{1}{x}$



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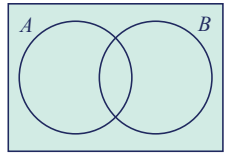
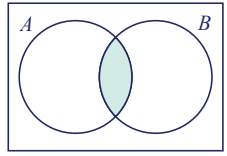
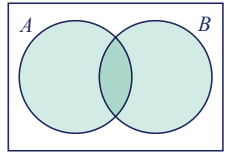
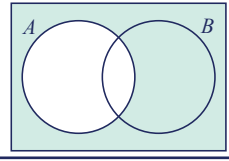
F: Sequences

1	Arithmetic/Linear Sequence	The difference between one term and the next is a constant.
2	nth term of an Arithmetic sequence	$an + b$
3	Fibonacci Sequence	The next term in the sequence is the previous two terms added together.
4	Fibonacci Sequence (first 10)	1, 1, 2, 3, 4, 8, 13, 21, 34, 55
5	Geometric Sequence	Each term after the first is found by multiplying the previous one by a fixed number called the common ratio.
6	Triangular Numbers (first 10)	1, 3, 6, 10, 15, 21, 28, 36, 45, 55
7	Quadratic Sequence	The difference between each term increases or decreases at a constant rate.
8	nth term of an Quadratic sequence	$an^2 + bn + c$

G: Probability

1	Probability	$\frac{\text{Number of successful outcomes}}{\text{Total number of possible outcomes}}$
2	p(A)	Probability of event A
3	P(not A or P(A')	1 - P(A)
4	Predicted Number of Outcomes	Probability × number of trials
5	P(A **and** B)	P(A) × P(B)
6	P(A **or** B)	P(A) + P(B)
7	Experimental Probability	$\frac{\text{Frequency of events}}{\text{Total number of trials}}$

H: Venn Diagrams

1	ξ		Universal Set
2	$A \cap B$		A intersect B, or A and B
3	$A \cup B$		A union B, or A or B
4	A'		Complement of A or not A

I: Percentages

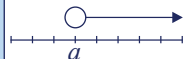
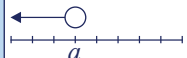
1	Multiplier for **increase** of n%	100 + n, then divide by 100
2	Multiplier for **decrease** of n%	100 - n, then divide by 100
3	Percentage change	$\frac{\text{Actual change}}{\text{Original amount}} \times 100$
4	Compound growth and decay	Starting amount × multiplier^n where n is the number of years

GCSE Foundation

J: Index Laws

1	$a^m \times a^n$	a^{m+n}
2	$a^m \div a^n$	a^{m-n}
3	$(a^m)^n$	a^{mn}
4	a^0	1
5	a^{-1}	$\frac{1}{a}$
6	$a^{\frac{1}{2}}$	$\sqrt[2]{a}$
7	$a^{\frac{1}{3}}$	$\sqrt[3]{a}$

K: Inequalities

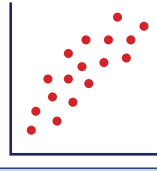
1		$x > a$, greater than a
2		$x < a$, less than a
3		$x \geq a$, greater than or equal to a
4		$x \leq$ a, less than or equal to a
5	Error Interval	Lower bound < x < Upper bound

L: Averages

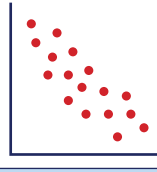
1	Mean	Add up all the numbers and divide by the number of numbers
2	Median	Put the numbers in order and find the middle number
3	Mode	The most common
4	Range	Largest number – Smallest number

M: Scatter Graphs

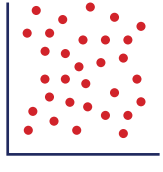
1. Positive Correlation



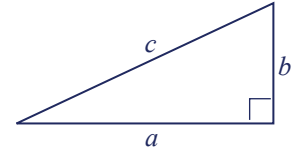
2. Negative Correlation



3. No Correlation

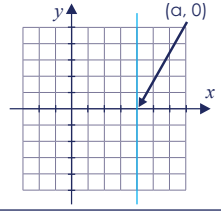
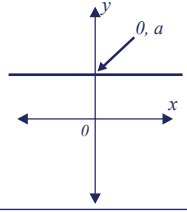
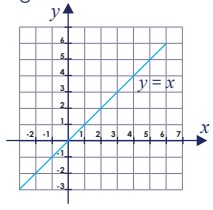
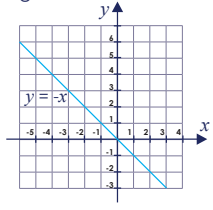


N: Pythagoras

1	Hypotenuse	The longest side, opposite the right angle, c in Pythagoras' Theorem.
2	Labelled Triangle	
3	Pythagoras	$a^2 + b^2 = c^2$

GCSE Higher

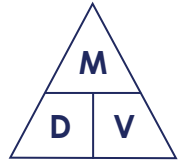
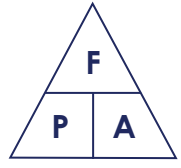
A: Straight Line Graphs

1	x = a	Vertical 
2	y = a	Horizontal 
3	$y = x$	Diagonal 
4	$y = -x$	Diagonal 

B: Coordinates and Equations of Straight Lines

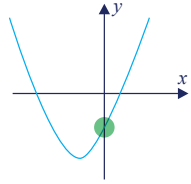
1	Formula for midpoint of (x_1, y_1) and (x_2, y_2)	$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
2	Equation of a straight line	$y = mx + c$
3	Gradient in the equation of a straight line	m
4	y-intercept in the equation of a stright line	c
5	Formila for gradient of line joinign (x_1, y_1) and (x_2, y_2)	$\frac{y_2 - y_1}{x_2 - x_1}$
6	Parallel lines...	...have the same gradient
7	Reciprocal of x	$\frac{1}{x}$
8	Reciprocal of $\frac{1}{x}$	x
9	Gradient of a perpendicular line	The negative reciprocal of m
10	Two lines are perpendicular if...	...their gradients multiply to make -1

C: Compound Measures

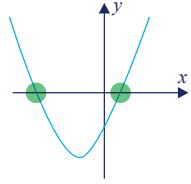
1	SDT Triangle	
2	Speed	Distance ÷ Time
3	Distance	Speed × Time
4	Time	Distance ÷ Speed
5	DMV Triangle	
6	Density	Mass ÷ Volume
7	Mass	Density × Volume
8	Volume	Mass ÷ Density
9	PFA Triangle	
10	Pressure	Force ÷ Area
11	Force	Pressure × Area
12	Area	Force ÷ Pressure

D: Quadratic Graphs

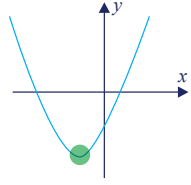
1. y-intercept



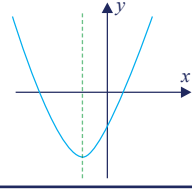
2. Roots or Solutions of $f(x) = 0$



3. Turning Point

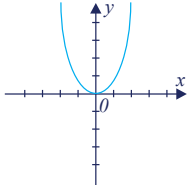
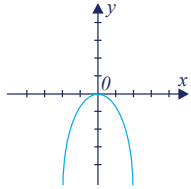
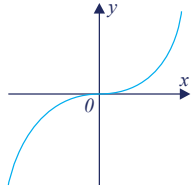
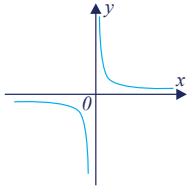
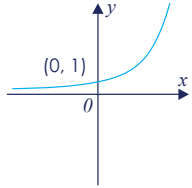
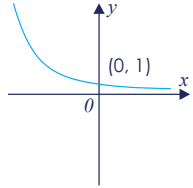


4. Line of Symmetry



GCSE Higher

E: Further Graphs

1. $y = x^2$	2. $y = -x^2$	3. $y = x^3$
		
4. $y = \frac{1}{x}$	**5.** $y = a^x$	**6.** $y = a^{-x}$
		

F: Sequences

1	Arithmetic/Linear Sequence	The difference between one term and the next is a constant.
2	nth term of an Arithmetic sequence	$an + b$
3	Fibonacci Sequence	The next term in the sequence is the previous two terms added together.
4	Fibonacci Sequence (first 10)	1, 1, 2, 3, 4, 8, 13, 21, 34, 55
5	Geometric Sequence	Each term after the first is found by multiplying the previous one by a fixed number called the common ratio.
6	Triangular Numbers (first 10)	1, 3, 6, 10, 15, 21, 28, 36, 45, 55
7	Quadratic Sequence	The difference between each term increases or decreases at a constant rate.
8	nth term of an Quadratic sequence	$an^2 + bn + c$

G: Probability

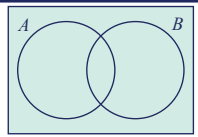
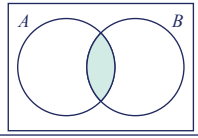
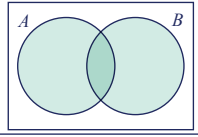
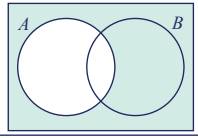
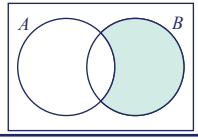
1	Probability	$\frac{\text{Number of successful outcomes}}{\text{Total number of possible outcomes}}$
2	p(A)	Probability of event A
3	P(not A or P(A')	1 - P(A)
4	Predicted Number of Outcomes	Probability × number of trials
5	P(A **and** B)	P(A) × P(B)
6	P(A **or** B)	P(A) + P(B)
7	Experimental Probability	$\frac{\text{Frequency of events}}{\text{Total number of trials}}$

H: Sampling

1	Random Sample	Each item had the same chance of being selected.
2	Qualitative Data	Data that can be counted or measured, e.g. height or weight.
3	Quantitative Data	Data that must be described in words, e.g. hair colour.
4	Discrete Variable	Data that can only take certain values, e.g. number of people.
5	Continuous Variable	Data that can take any value within a range, e.g. height of door.

GCSE Higher

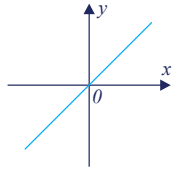
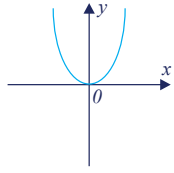
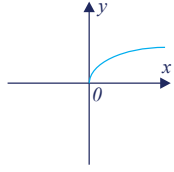
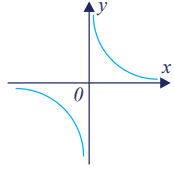
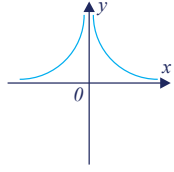
I: Venn Diagrams

1	ξ		Universal Set
2	$A \cap B$		A intersect B, or A and B
3	$A \cup B$		A union B, or A or B
4	A'		Complement of A or not A
5	$A' \cap B$		B but not A

J: Percentages

1	Multiplier for **increase** of n%	100 + n, then divide by 100
2	Multiplier for **decrease** of n%	100 - n, then divide by 100
3	Percentage change	$\frac{\text{Actual change}}{\text{Original amount}} \times 100$
4	Compound growth and decay	Starting amount × multiplier^n where n is the number of years

I: Venn Diagrams

1	$y = kx$		y is directly proportional to x
2	$y = kx^2$		y is directly proportional to the square of x
3	$y = k\sqrt{x}$		y is directly proportional to the square root of x
4	$y = \frac{k}{x}$		y is inversely proportional to x
5	$y = \frac{k}{x^2}$		y is inversely proportional to the square of x

GCSE Higher

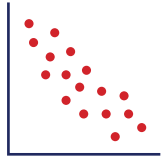
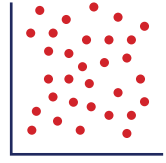
L: Surds

1	$\sqrt{a} \times \sqrt{b}$	$\sqrt{a \times b}$
2	$\sqrt{a} \times \sqrt{a}$	a
3	$\sqrt{\frac{a}{b}}$	$\frac{\sqrt{a}}{\sqrt{b}}$

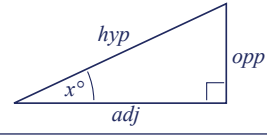
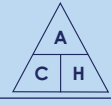
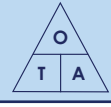
M: Bounds

1	Addition UB	UB + UB
2	Multiplication UB	UB × UB
3	Subtraction UB	UB - LB
4	Division UB	UB ÷ LB
5	Addition LB	LB + LB
6	Multiplication LB	LB × LB
7	Subtraction LB	LB - UB
8	Division LB	LB ÷ UB
9	Error Interval	LB $\leq x <$ UB

N: Scatter Graphs

1. Positive Correlation	2. Negative Correlation	3. No Correlation
		

O: Trigonometry

1	Hypotenuse	The longest side, opposite the right angle
2	Adjacent	The side next to the given angle
3	Opposite	The side opposite the given angle
4	Labelled Triangle	
5		$\sin x = \frac{\text{Opposite}}{\text{Hypotenuse}}$
6		$\cos x = \frac{\text{Adjacent}}{\text{Hypotenuse}}$
7		$\tan x = \frac{\text{Opposite}}{\text{Adjacent}}$

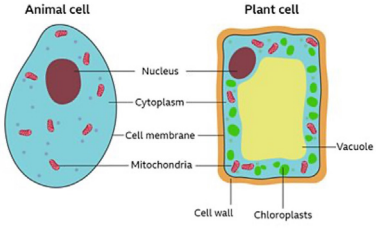
P: Exact Values

1	Sin 0 =	0
2	Sin 30 =	$\frac{1}{2}$
3	Sin 45 =	$\frac{\sqrt{2}}{2}$
4	Sin 60 =	$\frac{\sqrt{3}}{2}$
5	Sin 90 =	1
6	Cos 0 =	1
7	Cos 30 =	$\frac{\sqrt{3}}{2}$
8	Cos 45 =	$\frac{\sqrt{2}}{2}$
9	Cos 60 =	$\frac{1}{2}$
10	Cos 90 =	0
11	Tan 0 =	0
12	Tan 30 =	$\frac{1}{\sqrt{3}}$
13	Tan 45 =	1
14	Tan 60 =	$\sqrt{3}$
15	Tan 90 =	∞

B1 – Cell Biology

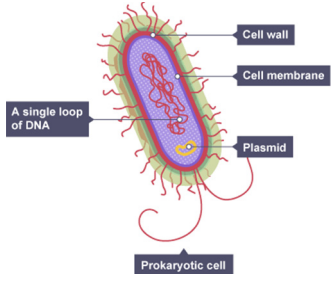
Eukaryotic Cells

They have a nucleus to contain the chromosomes. These can be animal, plant or fungus or protist cells. Animal and plant cells are shown below.



Prokaryotic Cells

They do not have a nucleus, they are usually a lot smaller and may contain plasmids.

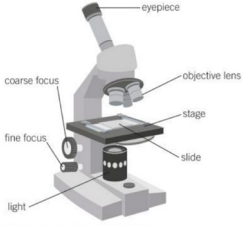


Cell		Features
Animal	Sperm	High number of mitochondria Ribosomes that make enzymes in the head
	Nerve	Long Lots of branches (dendrites)
	Muscle	High number of mitochondria High Number of ribosomes Store glycogen
Plant	Xylem	Walls thickened with lignin to strength the cells into a tube
	Phloem	Sections between cells called sieves to help transport substances like dissolved sugars
	Root hair	Large surface area Lack of chloroplasts Large vacuole

RP1 – Microscopy; Observing Plant Cells

Preparing the slide:

1. Place a thin layer of onion membrane on a glass slide with forceps.
2. Use a drop of iodine to stain the cells.
3. Gently place a glass cover slip over the same and tap carefully to remove air bubbles.



Viewing the slide:

1. Place the slide on the stage and turn on the light.
2. Select the lowest magnification objective lens.
3. Look through the eyepiece and turn the coarse focus until the image can be seen.
4. Turn the fine focus until a clear image is formed.
5. Change the objective lens to another with a higher magnification and turn the fine focus to re-focus the image.

Microscopes

The development of microscopes of the last 200 years has allowed us to study cells and the structures inside them in more and more detail.

Light Microscope	Electron Microscope
Low resolution	High resolution
Low magnification	High magnification
Cheap	Expensive

Calculating Magnification

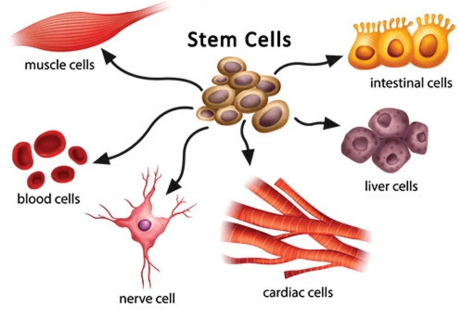
Units for image and actual size may need to be converted before using the equation below.

$$\text{Magnification} = \frac{\text{Image size}}{\text{Actual size}}$$

mm → μm × 1000
μm → mm ÷1000

Cell Differentiation

As an organism develops, cells differentiate to form different types of cells. This is an example in animals.



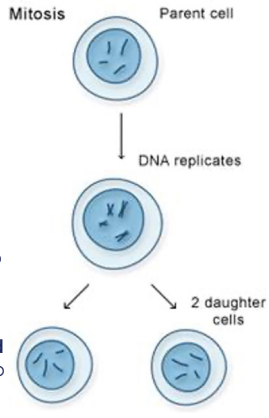
B1 – Cell Biology

Mitosis

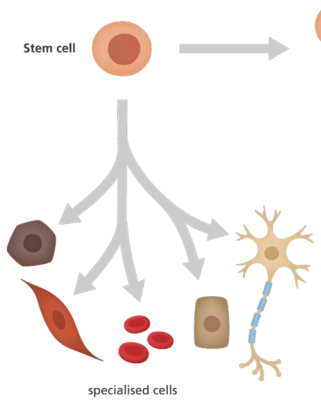
Before a cell can divide it needs to grow and increase the number of sub-cellular structures such as ribosomes and mitochondria. **The DNA replicates** to form two copies of each chromosome.

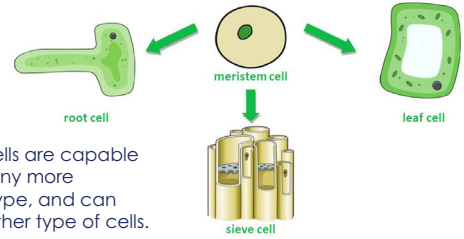
In mitosis one set of chromosomes is pulled to each end of the cell and the **nucleus divides**.

Finally the **cytoplasm and cell membranes divide** to form <u>two identical cells.</u>



Stem Cells





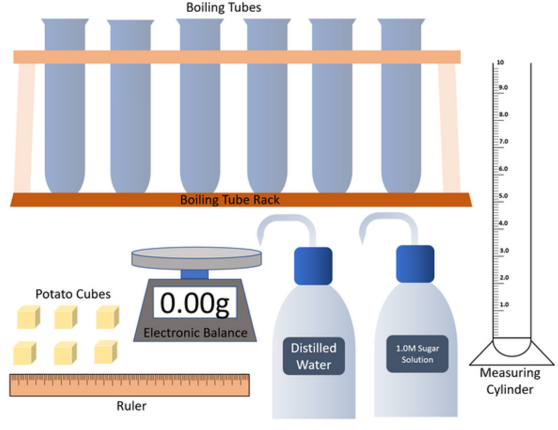
Undifferentiated cells are capable of giving rise to many more cells of the same type, and can differentiate into other type of cells.

Embryonic	Adult	Meristems
Can be cloned and made to differentiate into most different types of human cells	Bone marrow stem cells can form many types of cells including blood cells.	Can differentiate into any type of plant cell, throughout the life of the plant.

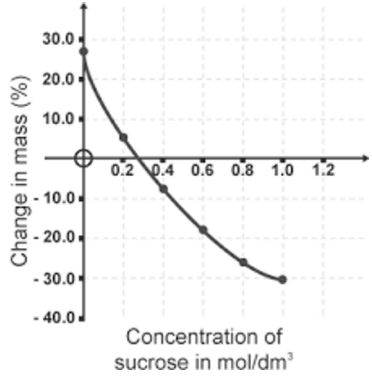
RP2 – Osmosis: The Concentration of Surrounding Solution Affects Mass of Plant Tissue

1. Use a cork borer to create 5 cylinders of plant tissue (usually potato) and cut them all to the same length.
2. Measure the mass of each piece using a top pan balance and the length of each piece with a ruler. Record in a table.
3. Measure out 100cm^3 of each concentration of salt/sugar solution into labelled boiling tubes.
4. Place each piece of potato into a boiling tube for 24 hours.
5. Remove the pieces and blot with a paper towel.
6. Measure the mass of each piece using a top pan balance and the length of each piece with a ruler. Record in a table.
7. Calculate the percentage change in mass.

$$\text{\% change in mass} = \frac{\text{change in mass (g)}}{\text{inital mass of potato (g)}}$$



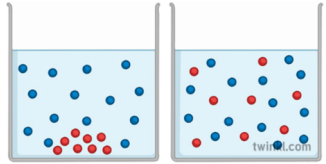
Results Graph

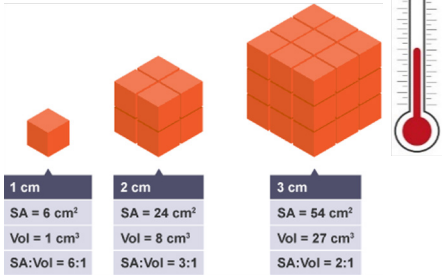


B1 – Cell Biology

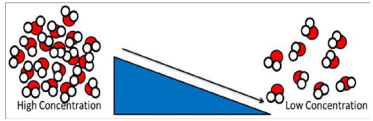
Diffusion

- Substances move a higher concentration of that substance (red particles pictured) to where there is a lower concentration of that substance. (High → Low)
- This happens because of the random movement of the particles in a fluid (liquid or gas).





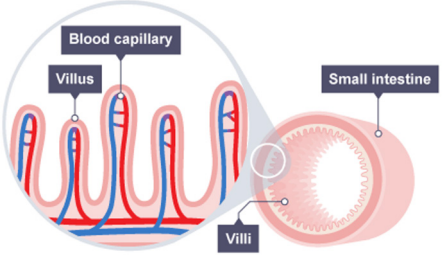
- There are ways the rate of diffusion can be changed:
- The difference in concentrations (concentration gradient)
- The temperature
- The surface area of the membrane

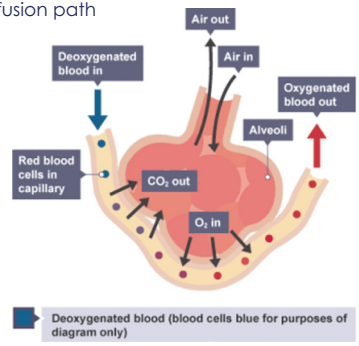


Examples

Alveoli in the lungs and villi in the small intestine are both structured in similar ways so diffusion can happen at a high rate (fast).

- Having a large surface area
- A membrane that is thin, to provide a short diffusion path
- (In animals) having an efficient blood supply



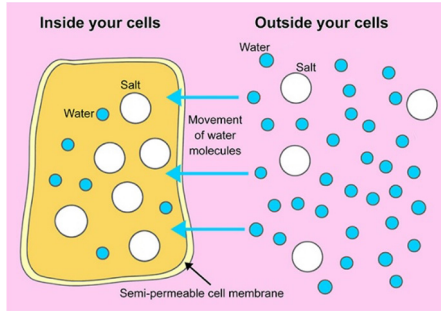


Osmosis

Water may move across cell membranes via osmosis.

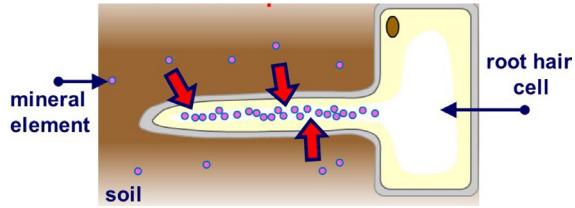
Osmosis is the diffusion of water from a dilute solution to a concentrated solution through a partially permeable membrane (H → L).

Partially permeable means small molecules can move through but large molecules cannot.



Active Transport

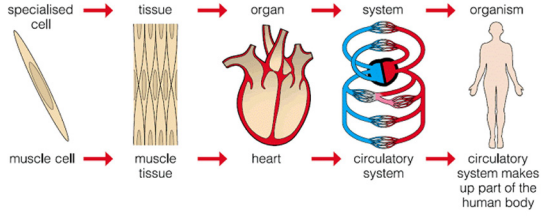
- Active transport is moving substances against the concentration gradient (L → H) so requires energy. This energy comes from respiration.
- This means that cells that carry out a lot of active transport (root hair cells, epithelial cells on villi in the small intestine) contain a lot of mitochondria.



B2 – Organisation

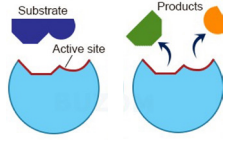
Levels of Organisation

Cells = basic building blocks of all living organisms.
A tissue = group of cells with a similar structure and function.
Organs = aggregations of tissues performing specific functions.
Organs systems = organs organised to form organisms.

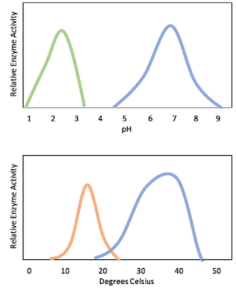


Enzymes

- Biological catalysts
- Digestive enzymes speed up the break down of insoluble food molecules
- Specific shape active site that matches substrate



Enzymes work best at certain temperatures or pH depending on their role.



Bile

The liver makes an **alkaline** solution called bile. Stored by the gall bladder.
Has two jobs:

- Emulsifies fats
- Neutralises stomach acid.

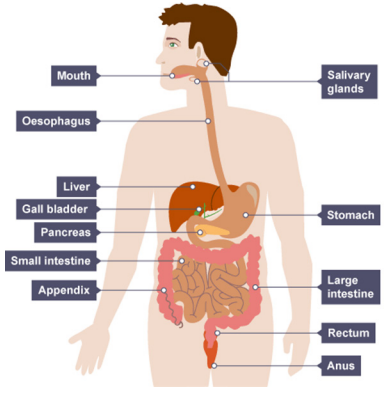
Digestive Enzymes

Starch —**Amylase**→ Glucose

Protein —**Protease**→ Amino Acids

Fats —**Lipase**→ Fatty acids + Glycerol

Digestive System



Embryonic	Meristems
Mouth	Teeth and tongue to chew food.
Salivary Glands	Releases saliva containing enzymes.
Oesophagus	Muscle tube to squeeze food along.
Stomach	Contains enzymes and hydrochloric acid. Is made of muscle to churn food. Hydrochloric acid kills bacteria in food.
Small Intestine	Where digestion is completed and soluble food particles (glucose, amino acids, fatty acids, glycerol) are absorbed.
Large Intestine	Absorbs water.
Liver	Produces bile.
Gall Bladder	Stores bile.
Pancreas	Releases enzymes.

Where are the enzymes?

Enzyme	Salivary glands	Stomach	Pancreas	Small intestine
Amylase	×		×	×
Protease		×	×	×
Lipase			×	×

RP3 – Food Tests

Summaries of the four food tests.

Protein
Add Biuret's reagent
Positive test: blue solution turns **Purple**

Starch
Add Iodine
Positive test: solution turns from orange to **black**

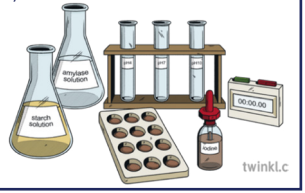
Fats
Add Ethanol and water
Positive test: solution turns **cloudy**

Glucose — Water Bath
Add Benedict's and heat
Positive test: blue solution turns **brick red**

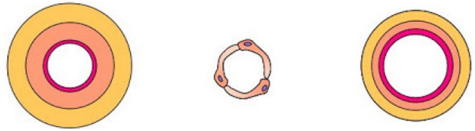
B2 – Organisation

The effect of pH on the rate of reaction of amylase

1. Add 2cm² amylase solution, 2cm² of starch solution and 2cm² of pH2 buffer to a water bath (37°) in separate test tubes. Wait 10 minutes.
2. While waiting, add 2 drops of iodine solution to each well on the spotting tile.
3. Once the solutions in the water bath have reached 37° pour the amylase and PH2 buffer into the starch solution.
4. Immediately take a sample with a pipette and add to the first well of the spotting tile.
5. Repeat step 4 every 30 seconds until there is no colour change when testing with iodine solution.
6. Repeat steps 1–5 with pH4, pH6, pH8 and pH10 buffers.



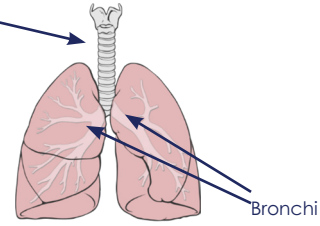
Blood Vessels



Arteries	Capillaries	Veins
• Blood carried away from heart • Thick muscular and elastic walls = withstands high pressure • Small lumen = maintains high pressure	• Walls only one cells thick = shorter diffusion pathway • Lumen just bigger than red blood cell • Blood flows very slowly • Diffusion takes place here	• Blood carried back to heart • Thin walls as blood is low pressure • Large lumen – lower resistance for blood passing through • Valves prevent back flow

Lungs

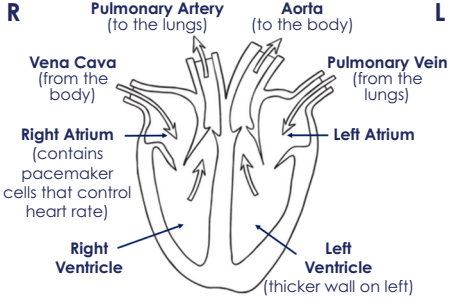
The lungs have two jobs – to get oxygen into the blood and remove carbon dioxide



Structures that cannot been seen on this diagram are the alveoli and capillary network – see 'Unit 1 – Diffusion'.

The Human Heart

Double pump because – left side pumps to whole body, right side pumps to the lungs.



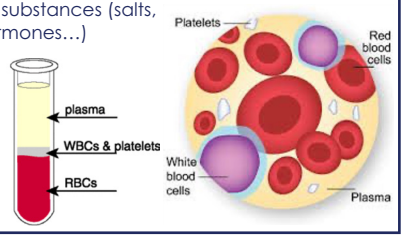
Blood – 4 Components

Red blood cells – contain haemoglobin to carry oxygen. More detail…

White blood cells – fight pathogens (see 'Unit 3 – Infection and Response').

Platelets – cell fragments that clot blood.

Plasma – liquid part that transports cells, cell fragments and dissolved substances (salts, urea, CO_2, hormones…)

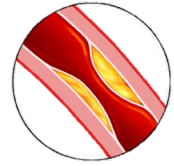


Red Blood Cells (RBCs)

- Contain chemical 'haemoglobin'.
- This reacts/binds with oxygen to be carried around the body.
- RBCs are ~8µm (relative small animal cell) allows them to fit through capillaries
- Bi-concave disc shape for large SA:V

Coronary Heart Disease (CHD)

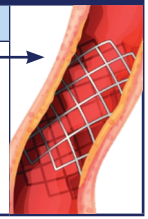
- Coronary arteries supply heart muscle with blood (containing glucose and oxygen for respiration)
- Can become narrowed/ blocked by fatty deposits if cholesterol high, reducing blood flow.
- Reduced muscle contraction in heart.



B2 – Organisation

Heart Disease Treatment – Statins vs Stents

Statins	Stents
• Medication to be taken everyday • Lowers blood cholesterol • Does not work immediately	• Mesh tube to be inserted into artery to hold it open • Surgery required • Works immediately



Faulty Valves

- Valves in veins and the heart prevent backflow of blood
- Faulty valves = don't open or close fully
- Can be replaced with manmade valves or transplants from donors

Cancer

Uncontrolled cell growth
Benign tumours = abnormal cells, contained in one area, in a membrane, do not invade other parts of body.
Malignant tumours = cancer cells, not in a capsule, invade neighbouring tissue, and spread into blood and form secondary tumours.

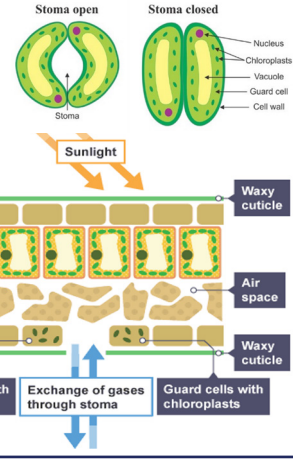
Risk Factors

Lifestyle factors can have be risk factors for certain diseases. E.g. obesity is a risk factor for type 2 diabetes, or drinking and smoking while pregnant affects the development of the foetus.

Leaf Structure

Stomata

- Tiny pores on the underside of the leaf.
- Allow oxygen and CO_2 to diffuse in and out
- Guard cells surround the stomata and can open and close the pore

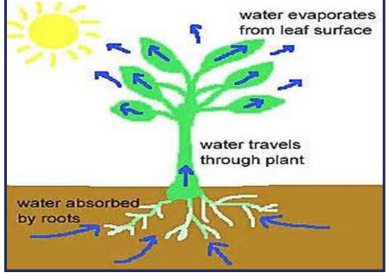


Interaction of Diseases

- Defects in the immune system – individual is more likely to suffer from infectious diseases.
- Viruses can trigger cancers, e.g. HPV can trigger cervical cancer.
- Immune reactions caused by pathogens can trigger allergies such as asthma or rashes
- Severe physical ill health can lead to depression and other mental illness.

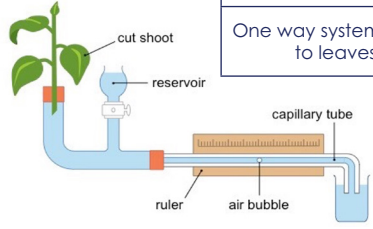
Transpiration

Movement of water through plant from roots to leaves, driven by evaporation through the stomata



Measuring Transpiration

Record the distance the bubble of air moves along the scale during set amount of time to calculate volume of water uptake per minute.



Transpiration	Translocation
Movement of water from roots to leaves	Movement of dissolved sugars from leaves all round the plant
Xylem – hollow tubes strengthened by lignin.	Phloem – tubes of elongated cells.
One way system – roots to leaves.	Two way system – sugars taken to wherever they are needed.

Increasing the rate of transpiration

- Higher temperature
- Lower humidity
- Higher light intensity
- Higher air movement

B3 – Infection and Response

Communicable Diseases – Diseases Caused by a Pathogen

Disease	Pathogen	Symptoms	Spread by	Prevent spread	Treatment
Salmonella	Bacteria	Fever, cramps, vomiting, diarrhoea	Contaminated food	Vaccinating poultry, cooking food thoroughly	Antibiotics or management of symptoms
Gonorrhoea	Bacteria	Yellow/green discharge, pain when urinating	Sexual Contact	Using barrier protection, e.g. condoms	Antibiotics
Measles	Virus	Red rash and fever	Breathing in droplets from coughs/sneezes	Vaccination	No cure – only management of symptoms
HIV	Virus	Flu-like symptoms, develops into AIDS	Sexual contact	Using barrier protection, e.g. condoms	Antiretroviral drugs
Tobacco Mosaic Virus (plants)	Virus	'Mosaic' pattern of discolouration on the leaves	Soil	Destroy infected plants	No treatment
Rose Black Spot (plants)	Fungus	Black spots on leaves	Wind or water	Remove and destroy infected leaves	Fungicides
Malaria	Protist	Recurrent episodes of fever	Insect bites (mosquitoes)	Mosquito nets, insect repellent	Antimalarial drugs

Antibiotics & Painkillers

Antibiotics = kill bacteria (specific antibiotic for specific bacteria) **THEY DO NOT KILL VIRUSES** e.g. penicillin

Antibiotics cannot kill viruses because viruses live inside cells

Painkillers = stop pain (don't kill microbes, just help with symptoms) e.g. paracetamol

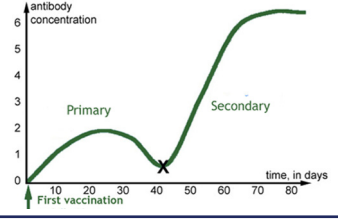
Development of Drugs

Testing for:
- Safety
- Efficacy (does it work)
- Dosage (how much is needed)

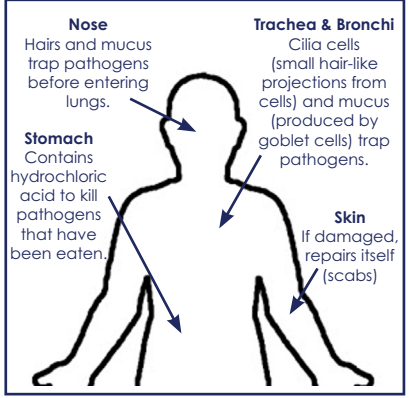
Stage		Translocation
1	Pre-clinical	Tested on cells and tissues. Side effects? Efficacy?
2	Pre-clinical	Tested on animals. Side effects?
3	Clinical	Clinical trials = tested on humans. 1st health volunteers, 2nd patients with the illness. Dosage gradually increased to optimum.

Vaccination

- Introducing small quantities of dead or inactive forms of pathogen into the body.
- Stimulates WBCs to produce antibodies.
- If same pathogen returns (X), WBCs remember how to make the right antibodies.
- They make MORE antibodies, MORE QUICKLY, and they stay in body for LONGER.

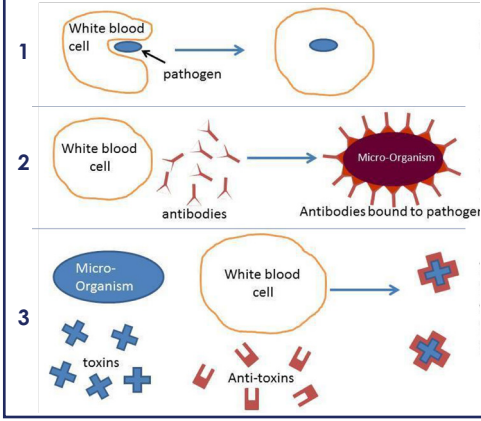


Non-specific Defence Systems



White Blood Cells (WBCs)

1. Phagocytosis – engulfing the pathogen
2. Producing antibodies – specific to the antigen
3. Producing antitoxins – to neutralise toxins



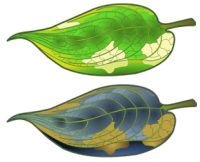
B4 – Bioenergetics

Photosynthesis

Endothermic chemical reaction that takes place in chloroplasts in leaves that produces glucose and oxygen from carbon dioxide and water

Carbon Dioxide + Water → (Light) Oxygen + Glucose

$6CO_2 + 6H_2O \xrightarrow{\text{Light}} 6O_2 + C_6H_{12}O_6$



What do plants do with the glucose?

- Stored as starch
- Stored as fats and oils
- For making cellulose (for cell walls)
- For respiration
- For making amino acids (along with nitrates from soil)

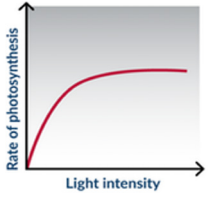
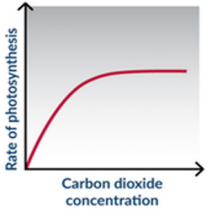
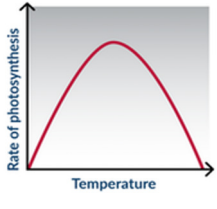
Testing the leaf for starch

- Boil the leaf for 5 minutes to soften
- Put into heated ethanol to remove chlorophyll (turn off Bunsen burner!)
- Spread leaf on a white tile
- Add iodine
- In the places that contain starch the iodine will turn blue/black
- In a variegated leaf, only the parts containing chlorophyll turn blue/black
- This shows chlorophyll is essential for photosynthesis

Factors That Affect Rate of Photosynthesis

- Light
- Temperature
- CO_2 concentration

Whichever one is in the shortest supply is called the **limiting factor** – as it is the one limiting the rate of photosynthesis

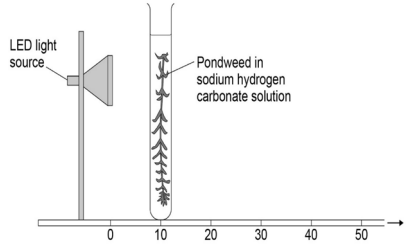
		
Increased light intensity increases the rate, but only up to a point, when CO_2 or temperature become limiting	Increased CO_2 concentration increases the rate, but only up to a point, when light or temperature become limiting	Increased temperature increases the rate, but only up to a point, then the enzymes are denatured & rate drops

RP5 – Effect of Light Intensity on Rate of Photosynthesis

Independent variable – distance between lamp and plant (or light intensity)

Dependent variable – number of bubbles per second / rate of photosynthesis

Controls – temperature of solution, piece of pondweed



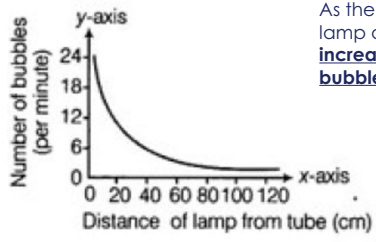
1. Measure 10cm length of pondweed and cut with scissors.
2. Place into beaker of 250ml $NaHCO_3$ solution (this provides CO_2).
3. Place lamp 10cm away from pondweed – turn on lamp and leave for 2 minutes to adjust to light intensity.
4. Count number of bubbles produced in 60 seconds and record in table.
5. Repeat steps 3 and 4 for lamp distances of 20cm–50cm at 10cm intervals.
6. Keep the temperature of the solution the same (LED light is used to not give off heat)

Inverse Square Law (HT only)

As distance of the lamp doubles the light intensity of the plant quarters

$$I = \frac{1}{d^2}$$

Typical Results:



As the **distance** between the lamp and the pondweed **increases**, the **number of bubbles per minute decreases**

B4 – Bioenergetics

Respiration

Respiration is a chemical reaction that happens in the mitochondria of cells to release energy from glucose.

There are two types – Aerobic and Anaerobic.

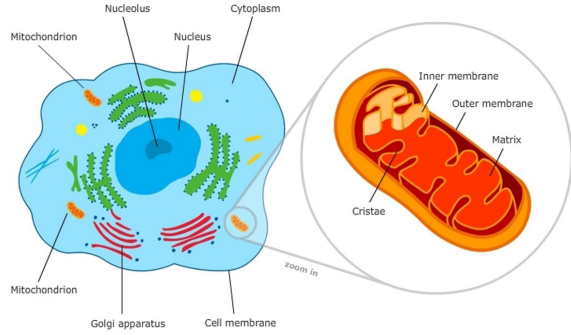
Aerobic – with oxygen

Oxygen + Glucose → Carbon Dioxide + Water

$6CO_2$ + $C_6H_{12}O_6$ → $6CO_2$ + $6h_2O_6$

Organisms need energy for:

- Chemical reactions to build larger molecules
- Movement
- Keeping warm.



Anaerobic Respiration

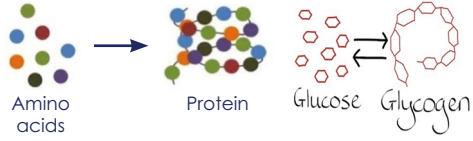
Respiration without oxygen

In animal cells = **glucose → lactic acid**
In plant/yeast cells = **glucose → ethanol + carbon dioxide**
In yeast, this is fermentation and is used in brewing and baking

	Aerobic	Anaerobic
Oxygen used?	Yes	No
Waste products	CO_2 and H_2O	lactic acid (animals) Ethanol + CO_2 (plants/yeast)
Energy released	Lots	Much less

Metabolism

Metabolism is the sum of all the reactions in a cell or the body.
The 'metabolic rate' is the rate at which all of these reactions take place.
An example of a reaction = making proteins using amino acids from digestion.



More examples:

- Glucose → glycogen (in muscles/liver)
- Respiration
- Protein → urea
- Glycerol and fatty acids → fats

Exercise

During exercise, more energy is needed so that muscles can keep contracting. This means more respiration is needed.

Increased breath depth
Get more oxygen into blood per breath and remove CO_2

Increased breathing rate
Get oxygen into blood quickly.

Increased heart rate
Get more oxygenated blood to muscles.

Heart beats harder
More blood is pumped with every beat.

During intense exercise, there is just not enough oxygen getting into the body.

The muscles start to respire anaerobically.

The build up of lactic acid can cause cramp/stitch.

(HT ONLY) When exercise is over, the lactic acid has to be oxidised to CO_2 and H_2O. The amount of oxygen needed to do this is called the oxygen debt.

B5 – Homeostasis and Response

The Nervous System

Job is to **detect** stimuli (changes in environment) and **respond** if needed. Consists of:

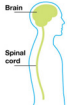
Receptors

Specialised cells that detect stimuli, found in sense organs and internally

Neurones

3 types – sensory, relay and motor
Carry **impulses** joining all parts of the nervous system

Co-ordination Centres



Brain, spinal cord, pancreas. Coordinates the response

Effectors

Organs that bring about a response

muscle or gland

RP6 – Investigation into the Effect of a Factor on Human Reaction Time

1. Person A holds out hand with a gap between thumb and finger.
2. Person B holds ruler with the zero at the top of person A's thumb.
3. Person B drops ruler without telling Person A and Person A must catch it.
4. The distance on the ruler level with the top of person A's thumb is recorded.
5. Repeat this ten times.
6. Repeat steps 1–5 after a factor has been changed.
7. Use conversion table to convert ruler measurements into reaction time.

Control variables: distance above the hand, distance between finger and thumb, hand used (dominant or non-dominant, all other factors listed in the box above except the one being changed).

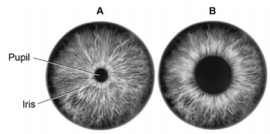
Reflexes

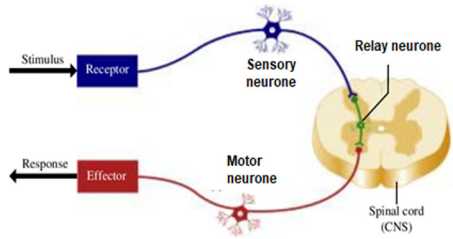
A reflex is an automatic, rapid response.

Reflexes do not involve the conscious part of the brain, so cannot be overridden.

The response might be brought about by:

- muscle – e.g. pupil being constricted with bright light or knee jerk response.
- gland – e.g. mouth watering or tears being released when something gets in your eye.





Reflex Arc

stimulus → receptor → **sensory neurone** → **relay neurone** → **motor neurone** → effector → response

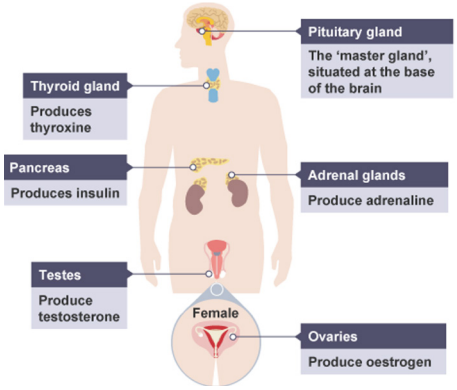
Example

Hot pan → pain receptors → **sensory neurone** → **relay neurone** → **motor neurone** → hand muscles → release pan

B5 – Homeostasis and Response

Hormonal Responses

Hormones are chemicals released by glands.
They are carried in the bloodstream.
Hormonal responses are slower than nervous responses but they last longer.



Homeostasis

This means keeping internal conditions (of the body or a cell) constant to ensure optimum functioning.

In humans, this includes regulating:

- Temperature
- Water levels
- Blood glucose concentration

Homeostasis can involve nervous or hormonal responses.
Receptors detect changes in the body

Coordination centres (brain, pancreas, spinal cord etc) receive and process information

Effectors carry out responses to return to normal

RP 6 - Investigation into the effect of a factor on human reaction time

1. Person A holds out hand with a gap between thumb and finger.
2. Person B holds ruler with the zero at the top of person A's thumb.
3. Person B drops ruler without telling Person A and Person A must catch it.
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5. Repeat this ten times.
6. Repeat steps 1-5 after a factor has been changed
7. Use conversion table to convert ruler measurements into reaction time.

Control variables : distance above the hand, distance between finger and thumb, hand used (dominant or non-dominant, all other factors listed in the box above except the one being changed.

RP 6 - Investigation into the effect of a factor on human reaction time

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Control variables : distance above the hand, distance between finger and thumb, hand used (dominant or non-dominant, all other factors listed in the box above except the one being changed.

B5 – Homeostasis and Response

Adrenaline and Thyroxine (HT only)

Adrenaline is produced by the adrenal glands.

It is produced in times of fear or stress.

It **increases heart rate** to ensure **more oxygen and glucose** to the cells to prepare for the 'fight or flight' response.

Thyroxine is produced by **the thyroid gland**.

It is involved in regulating **metabolic rate** and growth and development.

Puberty

Females – **Oestrogen** is the main female reproductive hormone produced in the ovary. At puberty, eggs begin to mature, and one is released approximately every 28 days. This is called ovulation.

Males – **Testosterone** is the main male reproductive hormone produced by the testes and it stimulates sperm production.

Name of contraception	Description	+	–
Condoms/ diaphragm	Barrier	Very effective, condom protects against STIs	Unreliable if not used properly
Oral Contraception (pill)	Hormonal (oestrogen or progesterone, stops FSH so no eggs mature)	Very effective	Must remember to take everyday, can have side effected
Injection/implant/ skin patch	Slow-releasing hormone	Long lasting	Side effects such as heavy periods
Intrauterine Device (IUD or Coil)	Barrier method. Can also contain hormones	Long lasting (up to 5 years)	Side effects such as heavy periods
Surgical Sterilisation	Tying or cutting of sperm ducts/ oviducts.	Almost 100% effective	Difficult or impossible to reverse

Menstrual Cycle

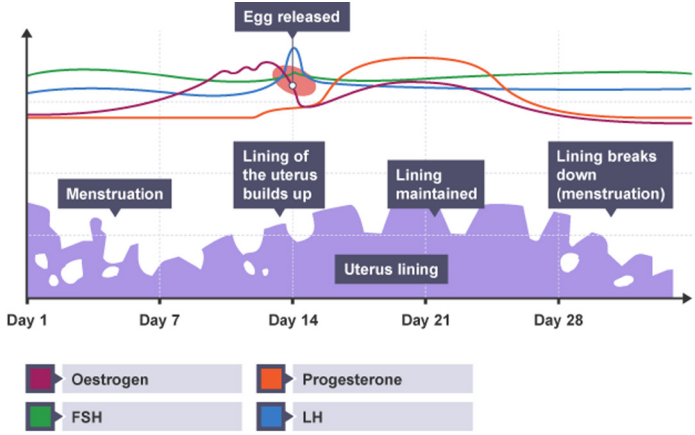
The menstrual cycle is controlled by several hormones:

FSH – from the pituitary. Causes an egg to mature in the ovary

LH – from the pituitary. Causes ovulation

Oestrogen and progesterone are involved in maintaining the lining of the womb.

HT – Oestrogen also feeds back to the pituitary to stop producing FSH.



Infertility (HT only)

Fertility drugs LH and FSH can be given to increase the number of eggs released and increase the change of fertilisation.

IVF

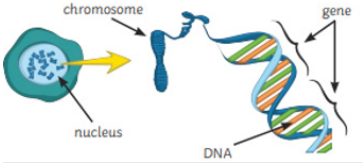
- Woman takes a dose of FSH and LH – stimulates the maturation of several eggs.
- Eggs are collected and fertilised by sperm from the male
- Fertilised eggs develop into embryos.
- One or two embryos inserted into the female's uterus.

Negatives;

- Very emotionally/physically stressful
- Success rates are not high
- Can lead to multiple births (twins, etc.)
- Many embryos are not used & destroyed

B6 – Inheritance, Variation and Evolution

Cells and Cell Division



The chromosomes are in the nucleus of cells.

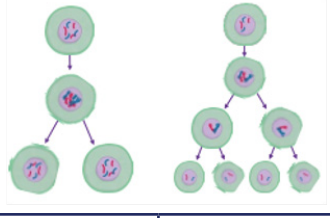
Humans have 46 chromosomes.

Chromosomes contain genes, which code for proteins.

In body cells, chromosomes are in pairs – one from each parent.

In sex cells (gametes) they are not in pairs and there is half the number of chromosomes (e.g. 23 in humans)

Cell division – Two Types:



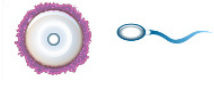
Mitosis (in all body cells)	Meiosis (in testes and ovaries)
2 daughter cells	4 daughter cells
Daughter cells = genetically identical	Daughter cells = not genetically identical
Cell divides once	Two divisions
Daughter cells **have same number** of chromosomes as original cell	Daughter cells have **half the** chromosomes as original cell
Used for growth and repair.	Used for growth and repair.

Reproduction

Two types of reproduction – sexual and asexual.

	Sexual	Asexual
Number of parents	2	1
Gametes used?	Yes	No
Variation in the offspring	lots	None, (unless mutations occur) offspring are clones

Sexual reproduction



The sperm and egg have half of the genes for the offspring (in humans 23 chromosomes).

At fertilisation, the sperm and egg nuclei join (23 + 23 = 46 chromosomes).

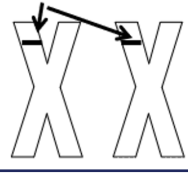
There are two genes for any one characteristic – one on the chromosome from Mum and one from Dad.

Different forms of the same gene are called alleles.

If the alleles are the same, the person is homozygous.

If the alleles are different the person is heterozygous.

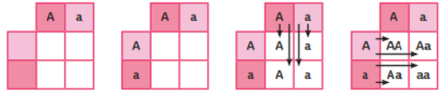
Gene from each parent



How to Complete a Punnet Square

If A = blue eyes, a = green eyes

Calculate the probability of two heterozygous people having a green-eyed child.



Step 1 Put one parents alleles into the boxes at the top

Step 2 Put the other parents alleles into the boxes down the side

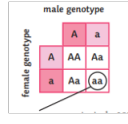
Step 3 Write the alleles from parent one in all boxes underneath

Step 4 Put the alleles from the second parent into the boxes to the right

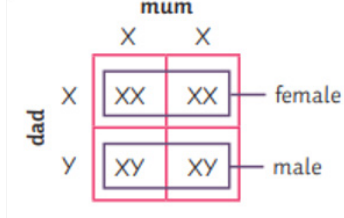
Probability

A green-eyed child would have an aa genotype.

One of these four has the type aa – that's ¼ , 25% or 0.25.



Sex Determination



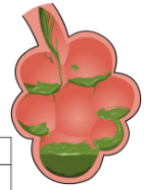
Females carry two X chromosomes (XX). Males carry one X and one Y chromosome (XY). 50% chance of male and female.

B6 – Inheritance, Variation and Evolution

Inherited Disorders

Cystic Fibrosis
Disorder of cell membranes
Caused by a recessive allele
Causes thick mucus to form in membranes
Main organs affected are lungs, digestive & reproductive organs – pancreas and intestines.

Alveoli get blocked with mucus
Increases diffusion path so less O_2 gets into the blood.



♂ Father

♀ Mother	C	c
C	CC	Cc
c	Cc	cc

Polydactyly
Disorder of the hands and feet.
Caused by a dominant allele.
Causes extra digits, fingers and toes.

Embryo Screening
Parents that have inherited disorders may opt for embryo screening.

1. Multiple embryos are made in IVF.
2. One cell is removed from each embryo.
3. The cells are screened for faulty genes.
4. Only embryos without the genes for disorders are transferred to the womb of the mother.

\+ Babies born free of that inherited disorder.
\- no guarantee child will be free of other health issues.
\- Many embryos are destroyed, which are potential human lives.

Variation

May be due to differences in:

- Genes that have been inherited (genetic causes)
- Conditions which they have lived in (environmental causes)
- Combination of genes and the environment.

Mutation = a change in the DNA during copying (randomly). Often has no effect on the gene, but sometimes leads to new proteins being made and a new characteristic being seen

Evolution

Evolution = a change in inherited characteristics of a population over time through natural selection – could lead to a new species.
A **species** is a group of organisms that can successfully breed.
Theory of evolution states that all species have evolved from a simple life forms more than 3 billion years ago.

Natural Selection

Described by Darwin

1. **Variation** within a species – different genes (due to **mutation**).
2. One gene may give characteristics that are better **adapted** for survival in the environment.
3. Those with **advantageous genes** will survive and reproduce – passing genes to **offspring**.
4. Over long periods of time, all members of that species have the characteristic, may even lead to a new **species**.

Extinction

Extinction = no remaining individuals of a species still alive on Earth.

Factors which could cause extinction:

- New disease
- Rapid change in environment (e.g. meteor/ volcano eruption)
- New predators
- New competitors (often man)

Evidence for Evolution: Fossils

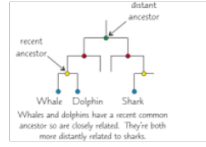
Fossils are the **remains of plants or animals** from **millions of years** ago:
They are formed in different ways:

- Remains of an organism that has not fully decayed as one of the decay conditions was absent (e.g. too cold, not enough O_2).
- Mineralised forms of the harder parts of an organisms (such as bones).
- Traces of organisms such as footprints or burrows.

Many early life forms were **soft bodied** so have left few traces behind, as they decayed so we cannot be sure how life started on Earth. Many have been destroyed by Earth's rock cycle. Fossils help us understand how much or little organisms have changed as life developed on Earth.

Evolutionary Trees

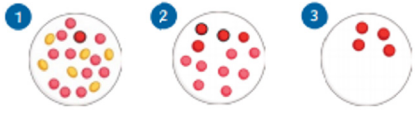
Show how species have evolved from and are related to others.



B6 – Inheritance, Variation and Evolution

Resistant Bacteria

- Bacteria **evolve** rapidly as they reproduce at a fast rate (reproduce approx. every 20 mins).
- Mutations of bacteria can produce new strains.
- Some strains are **resistant** to antibiotics (so are not killed).
- They **survive** and **reproduce** – population of resistant strain rises.
- Resistant strain will spread because people are not immune and there is no effective treatment.
- MRSA is resistant to antibiotics.



There is variation in the bacterial population. One bacterium develops a mutation by chance that means it is resistant to an antibiotic.

The antibiotic kills some of the bacteria, the resistant bacterium survives and reproduces.

The antibiotic kills the rest of the non-resistant bacteria so the person may start to feel a little better. The resistant bacterium has survived the antibiotic and continues to multiply.

How to reduce antibiotic resistant strains:

- Doctors should not prescribe antibiotics for viral infections.
- Patients must complete courses of antibiotics.
- Agricultural use of antibiotics should be restricted.

Genetic Engineering

- Process which involves modifying the **genome** of an organism by introduction a gene from another organism to give a **desired characteristic**.

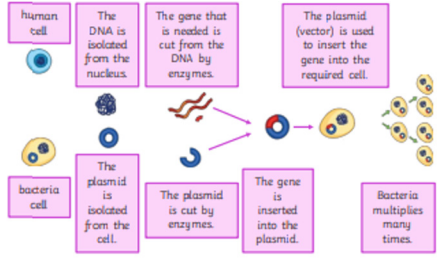
Uses of genetic engineering:

- Plant crops to be resistant to diseases or produce bigger, better fruits.
- Bacteria cells to produce useful substances, such as human insulin to treat diabetes.

Genetically modified (GM) crops

Advantages	Disadvantages
Resistant to insect attack	Not sure on long term effects when eating GM crops
Produce increased yields	Could affect populations of wild flowers and insects

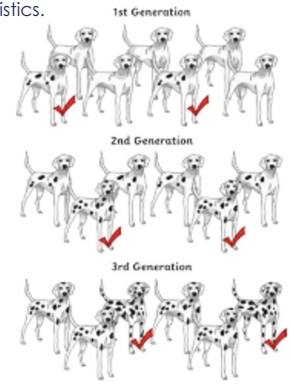
Process of Genetic Engineering (HT only)



Selective Breeding

- Process which humans breed plants and animals for particular genetic characteristics.
- Steps of selective breeding:

1. Choose a male and female with desired characteristics.
2. Breed together
3. Pick the offspring which have the desired characteristic and breed together.
4. Continue over many generations, selecting the best offspring each time, until all offspring show desired characteristics.



Classification

Linnaeus classified things into: Kingdom, phylum, class, order, family genus and species.

Organisms are named by the **binomial system** of genus and species (2 names).

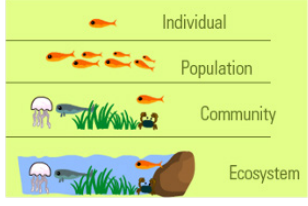
Due to evidence from chemical analysis, there is now a 'three-domain system' by Carl Woese:

Domain	bacteria	archaea	eukaryota			
Kingdom	eubacteria	archaebacteria	protista	fungi	plantae	animalia

B7 – Ecology

Ecosystems

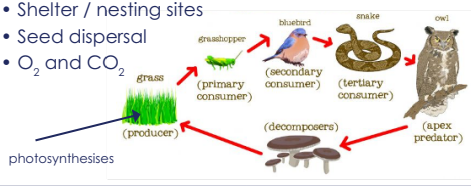
An ecosystem is all the living organisms within an area (community) plus the physical habitat.



Interdependence

Organisms rely on each other for…

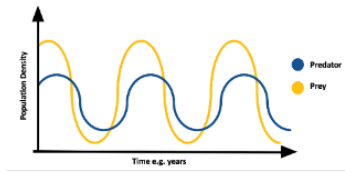
- Food
- Shelter / nesting sites
- Seed dispersal
- O_2 and CO_2



Biotic and Abiotic Factors

Biotic – living	Abiotic – non-living
• Availability of food • New predators arriving • New pathogens • One species outcompeting another so the numbers are no longer sufficient to breed.	• Light intensity • Temperature • Moisture levels • Soil pH and mineral content • Wind intensity and direction • Carbon dioxide levels for plants • Oxygen levels for aquatic animals.

Predator-Prey Relationships



Population increases and decreases follow similar pattern in a cycle because they affect each other – more prey = more food for predator.

However predator and prey not 'in phase', e.g. predator population changes are delayed as it takes time for the predator population to grow.

Competition

Plants	Animals
Light Space Minerals ions Water	Food Mates Territory

Plant Adaptations

Plants in desert areas have:

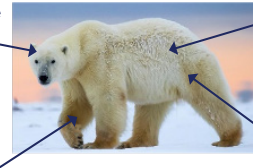
- deep roots to maximise water uptake,
- thin/no leaves to minimise water loss,
- spines to stop them being eaten.

Animal Adaptations

Can be:

- Structural – a feature of the organism's body (e.g. thick fur, bright colours, camouflage)
- Behavioural – responses from the organism (e.g. hibernation, migration, huddling together)
- Functional – a body process (e.g. camel breaking down hump of fat into water, producing little urine

Small surface area to volume ratio = ↓ heat loss

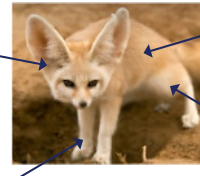


Thick layer of fat

Thick fur

Fur colour camouflaged with snow

Large surface area to volume ratio = ↑ heat loss



Very little fat

Fur colour camouflaged with sand

Thin fur

Extremophiles

Extremophiles are organisms that live in extreme environments.
Extreme environments = high temperatures, high pressure or high salt concentration.

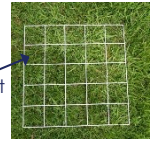
E.g. bacteria living in deep sea vents = extremophiles.

B7 – Ecology

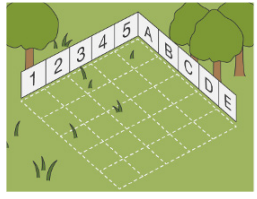
RP7 – Estimating Populations Part 1

1. Calculate area of site.
2. Divide site up into a numbered grid.
3. Use a random number generator to pick coordinates.
4. Randomly throw the 0.25m^2 quadrat at those coordinates.
5. Count the number of particular organism in the quadrat.
6. Repeat steps 3–5 ten times (minimum).
7. Calculate mean number of organism.
8. Calculate estimated number organism in site using the following equation:

a quadrat

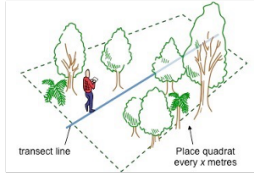


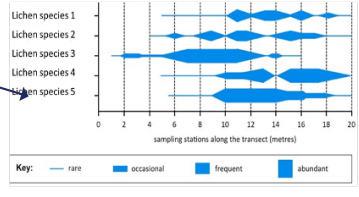
$$\frac{area\ of\ site}{area\ of\ quadrat}\ x\ mean$$



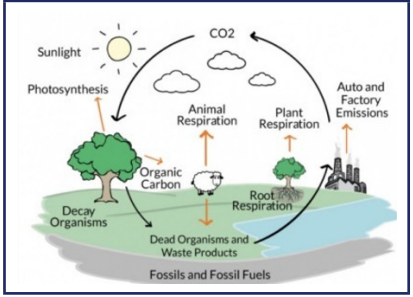
RP7 – How Populations May Change Over a Distance

1. Place tape measure (a transect line) through ecosystem being investigated.
2. Place quadrat at regular, random intervals along the transect line and count the number of particular organisms.
3. Draw a distribution graph of your results. (They might look like this.)

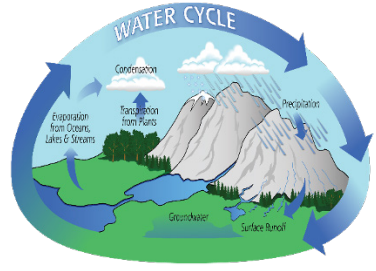




The Carbon Cycle



The Water Cycle



Human Impact on Biodiversity

Waste Management	Rapid growth in the human population = more resources are used and more waste is produced – this contributes to pollution. Can occur in water, in air and on land.
Land Use	Humans reduce the amount of land available for other animals and plants by building, quarrying, farming, dumping waste and the destruction of peat bogs.
Deforestation	In tropical areas it has occurred to provide land for cattle and rice fields or grow crops for biofuels.
Global Warming	Levels of carbon dioxide, methane and water vapour in the atmosphere are increasing, and contribute to 'global warming'.

Decay

Microbes such as fungi and bacteria break down dead or dying material. This returns carbon to the atmosphere as carbon dioxide and mineral ions to the soil.

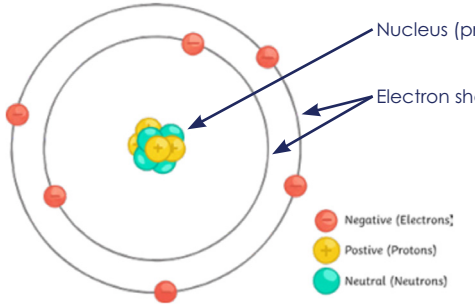
Maintaining Biodiversity

- breeding programmes for endangered species
- protection of rare habitats
- reintroduction of hedgerows
- reduction of deforestation and CO_2 emissions
- increased recycling to avoid landfill

C1 – Atomic Structure and The Periodic Table

Atoms

Made up of protons, electrons and neutrons.



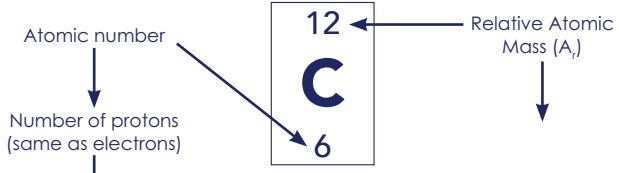
Subatomic Particle	Relative Mass	Charge
Proton	1	Positive
Neutron	1	Neutral
Electron	Very small	Negative

Atoms have a radius of about 0.1nm (1×10^{-10}m)

Radius of nucleus = about 1×10^{-14}m

Elements

- Only have **one type** of atom
- Found on the **Periodic Table**

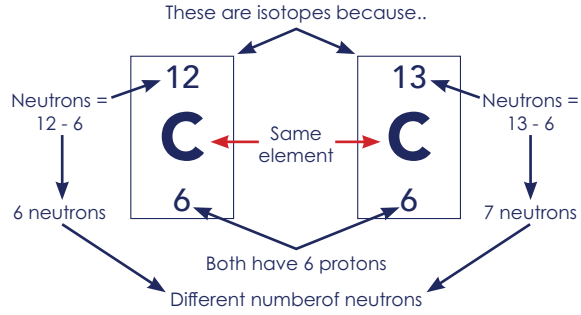


Number of neutrons =

Atomic Mass (top) − Atomic Number (bottom)

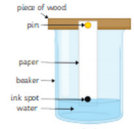
Isotopes

Isotope = atoms of the **same element** which have the **same number of protons**, but **a different number of neutrons.**



Mixtures and Separation

Mixtures – two or more elements or compounds **not** chemically joined. This means the different components of the mixture can be separated by physical methods (below)
E.g. air is a mixture mainly made of nitrogen, oxygen and carbon dioxide.



Chromatography
To separate out mixtures (usually liquids)(e.g. colours in ink)

Filtration
To separate insoluble solids from liquids (e.g. sand and water)

Evaporation
To quickly separate soluble solids from a solution (e.g. salt and water)

Crystallisation
To slowly separate a soluble salt from a solution (e.g. copper sulfate crystals)

Chemical Equations

Shown by using a **word equation**.
E.g. magnesium + oxygen → magnesium oxide

Left of the arrow = **reactants**
Right of the arrow = **products**.

Also can be shown by a **symbol equation**
E.g. $2Mg + O_2 \rightarrow 2MgO$

Compounds

Two or more elements **chemically combined**.

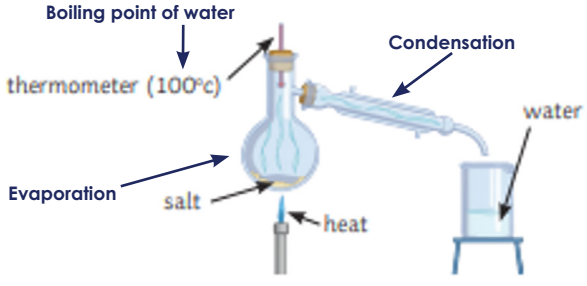
Formed by chemical reactions

For example:
CO_2 H_2O CH_4 HCl NaCl

C1 – Atomic Structure and The Periodic Table

Distillation

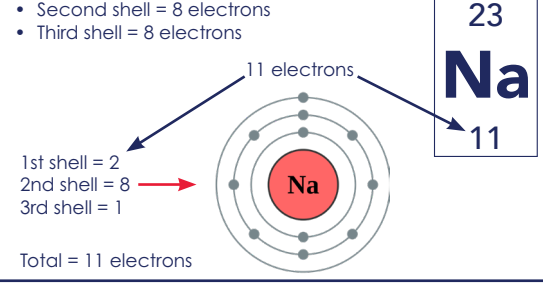
Simple distillation – separating a liquid from a solution.



- Liquid is heated to boiling point and evaporates.
- Vapours travel up into the condenser.
- Condenser has cold water around it.
- Vapours cool and condense (turn back into a liquid).

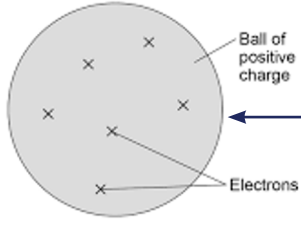
Electronic Structure

- Electrons are found on shells (orbits) orbiting the nucleus.
- There is a maximum number of electrons allowed on each shell:
  - First shell = 2 electrons
  - Second shell = 8 electrons
  - Third shell = 8 electrons



History of the Atom

Plum pudding model



Differences to nuclear model

- Ball of positive charge (no protons)
- No nucleus
- No neutrons
- Evenly distributed mass

Scientist	Time	Discovery
John Dalton	Start of the 19th century	Atoms were first described as solid spheres.
JJ Thomson	1897	Plum pudding model – atom is a ball of + charge with electrons scattered
Ernest Rutherford	1909	Alpha scattering experiment – mass concentrated at the centre, only the nucleus is + charged. Most of the atom is empty space.
Niels Bohr	Around 1911	Electrons are in shells orbiting the nucleus
James Chadwick	Around 1940	Discovered that there are neutrons in the nucleus.

Rutherford tested the plum pudding model

What happened?

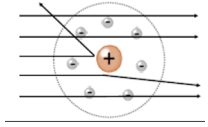
Rutherford's Scattering Experiment

Alpha particles are positively charged

Fired at gold foil

Some alpha particles are deflected/repelled

Most alpha particles passed straight through



Conclusions Made

Observation	Conclusion
Most of the particles passed straight through	Most of the atom is empty space
Some were deflected to the sides	The particles had passed close by a positive charge
A very small number were repelled straight back	The alpha particles had approached the nucleus straight on. The tiny number told him that the positive charge is in a very small dense core

C1 – Atomic Structure and The Periodic Table

Development of The Periodic Table

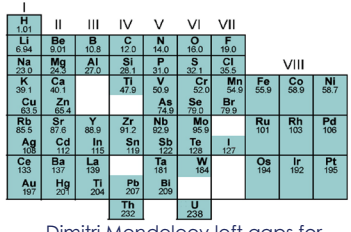
John Newlands – Law of Octaves
- Elements ordered by **atomic weight**.
- Noticed a pattern with every eighth element.
- Some elements placed inappropriately – metals and non-metals grouped together.
- Rejected by other scientists.

Dimitri Mendeleev
- Still ordered by atomic weight.
- Left gaps for **undiscovered elements.**
- Could predict properties of undiscovered elements.
- Some elements didn't fit pattern – switched them to keep pattern of **similar properties**.

Eventually, knowledge of isotopes explained why elements could not be ordered by atomic weight.

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co, Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce, La	Zr	Di, Mo	Ro, Ru

John Newlands' Law of Octaves



Dimitri Mendeleev left gaps for undiscovered elements

Group 1 (alkali metals)

- Similar properties as all have 1 electron in outer shell.
- All lose one electron in reactions to form 1+ ions
- Soft, grey, shiny metals
- Stored in oil as would react with oxygen in air.
- When placed in water they produce an alkali (hence alkali metals) and hydrogen gas

E.g. Lithium + water → lithium hydroxide + hydrogen

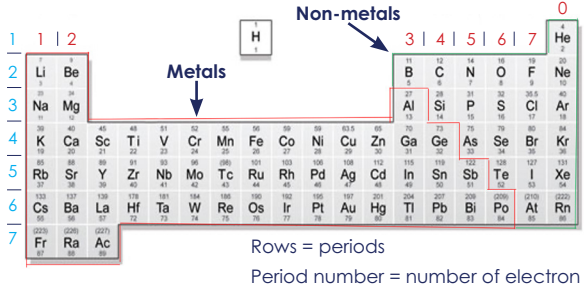
Reactivity of Group 1

Li, Na, K, Rb, Cs, Fr

As you go down the group…
- Elements are more reactive because:
- More electron shells
- Outer electron = further from nucleus and more shielded by the other shells
- The electrostatic force of attraction between outer electron and nucleus is weaker
- Easier for outer electron to be lost

The Modern Periodic Table

Ordered by atomic (proton) number
Columns = groups
Group number = number of electrons in outer shell.
Elements in each group have similar properties.



Rows = periods

Period number = number of electron shells the atom has.

Group 0 (Noble Gases)

- Full outer shell – unreactive as they don't need to lose or gain any electrons

He, Ne, Ar, Kr, Xe, Rn

As you go down…
- Boiling point increases
- More electron shells
- Bigger atoms
- More intermolecular forces
- More energy needed to break forces.

Group 7 (Halogens)

- 7 electrons in outer shell – all react similarly
- All gain one electron when they react to form 1- ions
  - Form molecules (e.g. Cl_2, F_2)
  - Non-metals
  - A more reactive halogen can replace a less reactive halogen in a reaction **(displacement)**

Reactivity of Group 7

F, Cl, Br, I, At

As you go down the group…
- Elements **are less** reactive because:
- More electron shells
- Outer shell is further from nucleus and is **more shielded** by the other shells
- The electrostatic force of attraction between free electron and nucleus is **weaker**
- Harder to attract an electron into the outer shell.

C2 – Bonding, Structure, and The Properties of Matter

Formation of Ions

- **Ions** = a charged particle made when atoms lose or gain electrons.
- **Positive Ion** = atom has lost electrons.
- **Negative Ion** = atom has gained electrons.

Metals form **positive ions**
Non-metals form negative ions

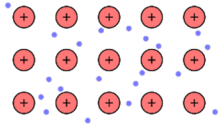
Group	Ions	Example
1	+1	$Li \rightarrow Li^{+} + e^{-}$
2	+2	$Ca \rightarrow Ca^{2+} + 2e^{-}$
6	-2	$O + 2e^{-} \rightarrow O^{2-}$
7	-1	$Br + e^{-} \rightarrow Br^{-}$

Lost electrons

Gained electrons

Metallic Bonding

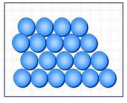
- Happens in **metals only**.
- Positive metal ions surrounded by **sea of delocalised electrons (can move)**.
- Ions tightly packed in rows.
- Strong **electrostatic forces of attraction** between positive ions and negative electrons.



Alloys

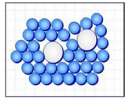
- **Alloys** = mixture of two or more metal atoms
- Pure metals are too soft for many uses.

Pure Metal



- Atoms same size
- Layers slide
- Softer

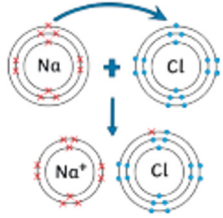
Alloy



- Different sized atoms
- Layers cannot slide
- Stronger

Ionic Bonding

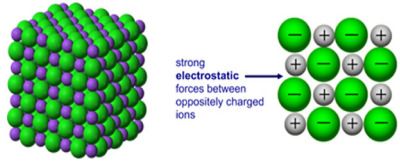
- Between a metal and non-metal.
- Metals give electrons to non-metals so both have a full outer shell.
- **Electrostatic force of attraction** between positive and negative ions.



E.g. Sodium loses one electron to become Na+. Chlorine gains one electron to become Cl-. The two ions attract to form sodium chloride.

Ionic Bonding

Form **giant lattices, as the attraction between ions acts in all directions.**



Properties of Ionic Compounds

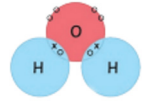
- **High melting point** – lots of energy needed to overcome electrostatic forces.
- **High boiling point**
- **Cannot conduct electricity as solid** – ions cannot move
- **Conducts electricity when molten or dissolved** – ions are free to move.

Covalent Bonding

- **Covalent Bonding** = sharing a pair or pairs of electrons for a full outer shell.
- Between **non-metals only**.

Dot and Cross Diagrams

- Show the bonding in simple molecules.
- Uses the outer shell of the atoms
- Crosses and dots used to show electrons
- You should be able to draw the following:



Water (H_2O)

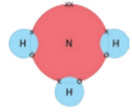
Hydrogen (H_2)

Oxygen (O_2)

Hydrogen chloride (HCl)

Methane (CH_4)

Chlorine (Cl_2)



Ammonia (NH_3)

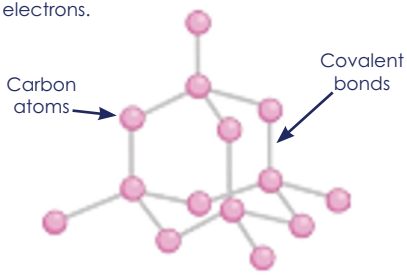
Simple Covalent Molecules

- Form when all atoms have full outer shells so bonding stops
- Examples are the molecules shown above.
- Have **low melting and boiling points**
- Due to **weak intermolecular forces**
- Do not conduct electricity

C2 – Bonding, Structure, and The Properties of Matter

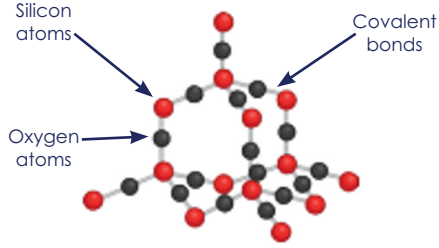
Giant Covalent Structure – Diamond

- Each carbon atom covalently bonded to four others.
- Forms a giant structure
- This makes diamond **strong** → a lot of **energy** needed to break lots of strong covalent bonds.
- **Does not conduct electricity** – has no free electrons.



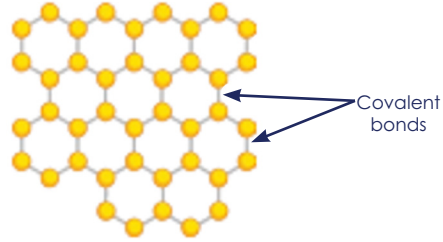
Silicon Dioxide

- Similar structure to diamond
- Giant covalent structure.
- Lots of **strong covalent bonds**.
- These require lots of **energy** to break.
- High melting and boiling points.



Graphene

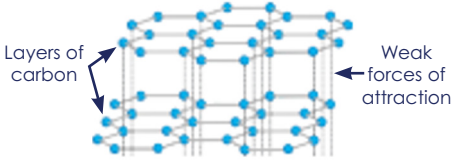
- Graphene = one layer of graphite.
- Very strong → lots of strong covalent bonds.



- Each carbon bonded to three others.
- One **free delocalised electron** → can move to **carry electrical current** throughout **the structure**.

Giant Covalent Structure – Diamond

- Layers of **carbon** arranged in **hexagons**.
- Each carbon bonded to three other carbons.
- Leaves **one delocalised electron** → moves to carry electrical charge **throughout structure**.

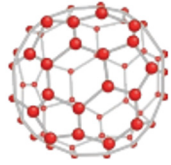


- Layers held together by **weak forces**
- Layers can **slide** over each other easily
- Makes graphite **soft/slippery** → good lubricant.
- Has **high melting point** as has many strong covalent bonds.

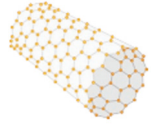
Fullerenes and Nanotubes

- Molecules of carbon shaped into hollow tubes or balls.
- Used to **deliver drugs into body**

Buckminsterfullerene
Formula = C_{60} →

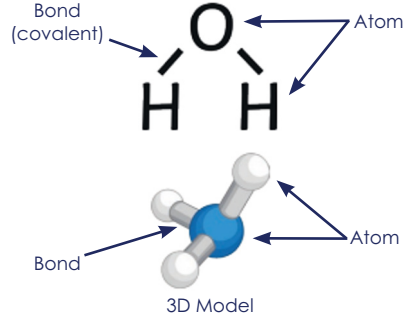


- **Carbon nanotubes** = long narrow tubes.
- Can conduct electricity.
- Can strengthen materials without adding weight.
- Used in electronics and nanotechnology.



Molecular Models

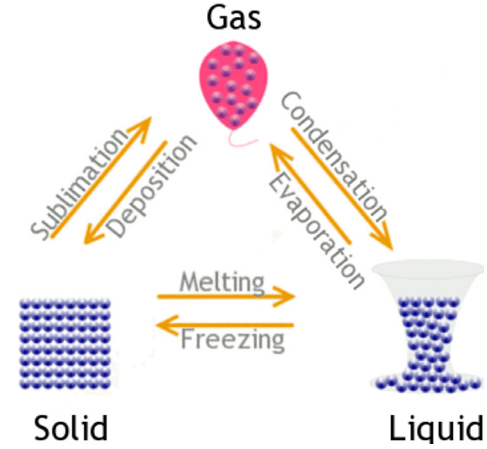
- There are different ways to show a molecule other than dot and cross diagrams.



C2 – Bonding, Structure, and The Properties of Matter

States of Matter

- Graphene = one layer of graphite.
- Very strong → lots of strong covalent bonds.



- Each carbon bonded to three others.
- One **free delocalised electron** → can move to **carry electrical current** throughout **the structure**.

Gas

- Randomly arranged.
- Particles **move quickly** – all directions.
- Highest **amount** of **kinetic energy**.

- Gases **are able to flow** – fill containers
- **Can be compressed as there is space between particles**

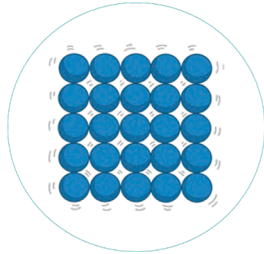
Liquid

- Particles **randomly** arranged and touching.
- Particles can **move around**.
- **Greater amount** of **kinetic energy** than solid

- Liquids **able to flow** – take shape of containers.
- **Cannot be compressed** – particles are close together and cannot be pushed closer

Solid

- **Regular** pattern (rows and columns)
- Particles **vibrate** in a **fixed position**.
- Particles have **low amount of kinetic energy**.



- Have a **fixed shape** – cannot flow because of strong forces of attraction between particles
- **Cannot be compressed** – particles close together.

State Symbols

- States of matter shown in chemical equations:
- Solid (s)
- Liquid (l)
- Gas (g)
- Aqueous (aq)
- Aqueous solutions = substance dissolved in water.

Identifying Physical State of Substances

- If the temperature is lower than a substance's melting point – substance is solid.
- If the temperature is between the melting point and boiling point – substance is liquid.
- If the temperature is higher than the boiling point – substance is a gas.

Limitations of Particle Model (HT)

- No chemical bonds are shown.
- Particles shown as solid spheres – not the case, particles are mostly empty space like atoms.
- The diagrams don't show any of the forces between particles
- The diagrams are unable to show the movement of the particles.

C3 – Quantitative Chemistry

Conservation of Mass

Atoms cannot be created or destroyed during reactions.
Mass of reactants = mass of products.

To show mass is conserved in a reaction:
M_r on the left-side must be same as the right side.

$$\begin{array}{ccccc} 2Mg & + & O_2 & \rightarrow & 2MgO \\ (2 \times 24) & + & (2 \times 16) & \rightarrow & 2(24 + 16) \\ 48 & + & 32 & \rightarrow & 2 \times 40 \end{array}$$

$$80 \rightarrow 80$$

Reacting Masses

Use conservation of mass to predict masses

magnesium + oxygen → magnesium oxide
8g ? 10g

Both sides need to be equal:
10g – 8g = 4g of oxygen

Atomic mass (A_r) and Relative Formula Mass (M_r)

Atomic mass (A_r) is the mass number – i.e. the mass of one atom
Relative formula mass (M_r) = all the **relative atomic masses (A_r)** of the atoms in a compound or molecule added up.

16	12
O	C
8	6

Example

CO_2

$12 + (16 \times 2) = 44$

Percentage Mass

Percentage mass of an element in a compound

$$\frac{\text{Mass of the element in compound}}{\text{Total mass of compound}} \times 100$$

Example Question:
Find the percentage mass of oxygen in magnesium oxide (MgO).

A_r of magnesium = 24 A_r of oxygen = **16**

M_r of MgO = 24 + 16 = **40**

$$\% \text{ mass} = \frac{A_r}{M_r} = \frac{16}{40} = 0.4 \times 100 = 40\%$$

×100 to make a %

40% of the mass of MgO is oxygen

The Mole (HT only)

- Avogadro constant – 6.02×10^{23}
- One mole contains 6.02×10^{23} atoms or molecules
- The mass, in g, of one mole is the A_r (if an element) or M_r if a compound or molecular element

Iron has an A_r of 56, so 1 mole of iron is 56g and contains 6.02×10^{23} atoms of iron

Ammonia (NH_3) has an M_r of 17, so 1 mole of ammonia has a mass of 17g. and contains 6.02×10^{23} molecules of ammonia

Mass Changes

- Mass is always conserved in a reaction.
- Sometimes it may seem like the mass has increased/decreased.

- If a **reactant** is a gas – mass may **increase**.

Magnesium + Oxygen → Magnesium Oxide

Oxygen is in the air before it combines with magnesium – you cannot find the mass of oxygen on the balance.

It will look like the mass has increased when it is re-weighed at the end.

- If a **product** is a gas and the gas is able to escape the system – mass will **decrease**

Sodium Carbonate → Sodium Oxide + Carbon Dioxide

It will look like the mass has decreased as some of the atoms have been given off as gas and have escaped – so cannot be re-weighed.

C3 – Quantitative Chemistry

Concentrations of Solutions

Concentration = mass of dissolved substance in specific volume (e.g. dm^3)

More substance dissolved = more concentrated solution

Concentration = mass ÷ volume
(g/dm^3) (g) (dm^3)

Can be rearranged to find mass dissolved:

mass = concentration × volume
(g) (g/dm^3) (dm^3)

$1000cm^3 = 1dm^3$
$cm^3 \rightarrow dm^3$ = divide by 1000

Calculating Mass in a Given Volume

If you have a known volume of a solution of known concentration then you can calculate the mass of dissolved solid.

E.g. Calculate the mass of dissolved solid in $25cm^3$ of a $96g/dm^3$ solution

$96g/dm^3$ means 96g in every $1000cm^3$

Do the same to the other side (÷40) ↓ 2.4g ↓ $25cm^3$ **How do we get from 1000 to 25? (÷40)**

Moles and Equations (HT only)

You can use moles to help you write balanced symbol equations.

Example Question
18.4g of sodium reacted with 6.4g of oxygen to give 24.8g sodium oxide. Use the masses to write the balanced equation.

Step	Example
Write the equation for the reaction (unbalanced)	$Na + O_2 \rightarrow Na_2O$
Write down the mass or % given in the question	18.4 + 6.4 → 24.8
Write the mass of one mole of each element or compound	23 32 62 (e.g. 18.4 ÷ 23)
Divide the mass given in question by the mass of one mole	0.8 0.2 0.4
Turn the answers into whole number simple ratio	8 2 4 (cancel down) 4 1 2
Put the numbers into the equation	$4Na + O_2 \rightarrow 2Na_2O$

Calculating Reacting Masses (HT)

Example Question
Calculate the mass of calcium needed to make 11.2g calcium oxide

Step	Calculation
Write the balanced equation	$2Ca + O_2 \rightarrow 2CaO$
Write the masses of each substance	80 + 32 → 112
Write down the given mass in the question.	11.2
Work out the 'scale' factor (i.e. what did you have to do to the original number to get to the desired mass	÷ 10
Do the same to the other side	8g

Calculating Reacting Masses (HT)

- If one reactant runs out before the other, then the reaction will stop.
- The reactant that runs out first in a reaction is known as the limiting reactant.

C4 – Chemical Changes

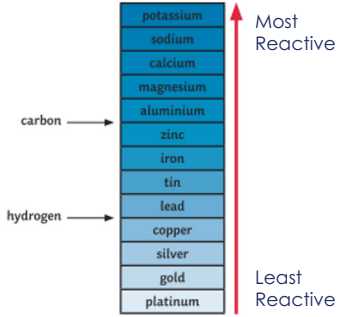
The Reactivity Series

A more reactive metal will replace a less reactive metal in a compound (**displacement**)

e.g. potassium + magnesium chloride → potassium chloride + magnesium

Potassium is more reactive than magnesium

Potassium **displaces** magnesium from the compound and takes it's place.



Reactions of Acids With Metals

Metal + acid → salt + hydrogen

E.g. Iron + Sulfuric acid → Iron sulfate + Hydrogen

Salt

To name salt:
1st name Metal
2nd name Acid used

Acid used	Salt produced
Hydrochloric	Chloride
Sulfuric	Sulfate
Nitric	Nitrate

Extraction of Metals

Extraction = remove metal from an ore or a compound.
Ore = a rock containing enough metal to make extracting metal worthwhile.

How to extract metals:
Less reactive than carbon – reduction with carbon

Reduction = loss of oxygen

E.g. iron oxide + carbon → iron + carbon dioxide

Oxygen has been removed to extract iron.

Carbon and the oxygen removed from the iron react to make carbon dioxide

More reactive than carbon – electrolysis is used.

- Some metals are found in **native** form (not reacted, so in element form) – usually platinum and gold as very unreactive.

Reaction of Metals With Oxygen

Metal + oxygen → metal oxide
e.g. magnesium + oxygen → magnesium oxide

$2Mg + O_2 \rightarrow 2MgO$

Oxidation reaction as metal gained oxygen

- Oxidation = gaining oxygen
- Reduction = losing oxygen

Reaction of Metals With Water

Most metals don't react well with water
Group 1 and group 2 react to form alkalis

Metal + water → metal hydroxide + hydrogen
e.g. lithium + water → lithium hydroxide + hydrogen

$2Li + 2H_2O \rightarrow 2LiOH + H_2$

Metal hydroxides are alkaline

Reactions of Acids With Alkalis

Acid + Alkali → salt + water — neutralisation

Hydrochloric acid + Sodium hydroxide → Sodium chloride + water

Salt

$HCl + NaOH \rightarrow NaCl + H_2O$

Reactions of Acids With Carbonates

Acid + carbonate → salt + water + carbon dioxide

Sulfuric acid + calcium carbonate → calcium chloride + water + carbon dioxide

Salt

$H_2SO_4 + CaCO_3 \rightarrow CaSO_4 + H_2O + CO_2$

C4 – Chemical Changes

Redox Reactions (HT only)

- Redox = reduction and oxidation takes place at same time in a reaction.
- Metal + acid = redox reaction

Example:
$H_2SO_4 + Ca \rightarrow CaSO_4 + H_2$

Ionic equation: $2H^+ + Ca \rightarrow Ca^{2+} + H_2$

Half equation 1: $Ca \rightarrow Ca^{2+} + 2e^-$ ← Lost 2 electrons (oxidation)

Half equation 2: $2H^+ + 2e^- \rightarrow H_2$ ← Gained 2 electrons (reduction)

Strong/Weak Acids (HT only)

Strong acid = completely dissociates in a solution
E.g. $HCl \rightarrow H^+ + Cl^-$
Examples = nitric acid and sulfuric acid

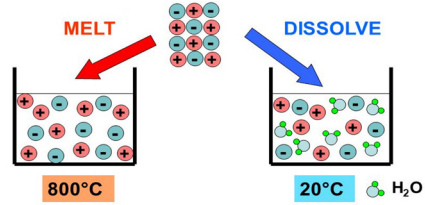
Weak acid = partially dissociates in solution.
E.g. $CH^3COOH \rightleftharpoons CH^3COO^- + H^+$
⇌ = reversible reaction ← Hasn't fully turned into ions – only partially

Concentration = how much is dissolved in every cm^3
Strong/weak = how well it ionises

As pH decreases by 1 unit, **hydrogen ion concentration** of solution increases by factor of 10

Electrolysis

- Splitting up a compound using electricity.
- Used to extract metals from compounds, purify metals (e.g. copper)

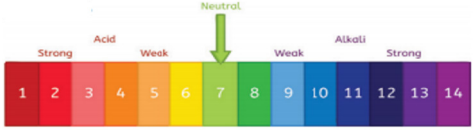


- Must be molten or aqueous (dissolved in water) to allow ions to move to the electrodes

pH Scale

Shows how acidic or alkaline solution is.

- pH 1-6 = acid
- pH 7 = neutral
- pH 8-14 = alkali

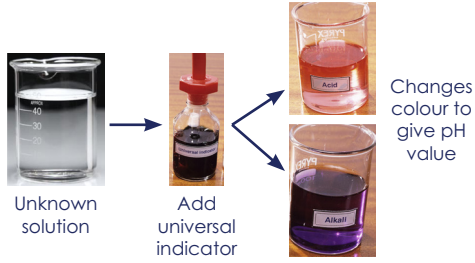


In aqueous solutions:
Acids – produce H+ ions
Alkalis – produce OH- ions

In neutralisation reactions:
$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$

Measuring pH of a solution

- Can use **universal indicator**
- Gives the solution a colour
- Can compare colour to the pH scale

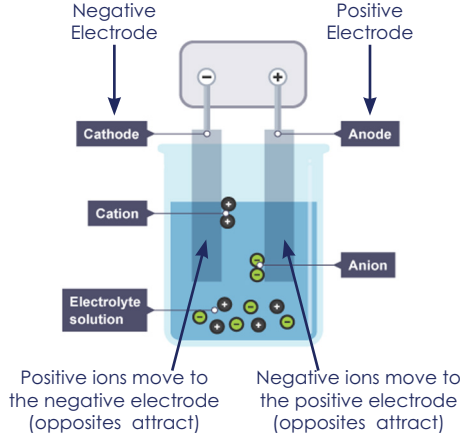


Disadvantages of method

- Colour is **subjective** – different people may see different colours
- Doesn't give an exact pH number (could use **pH probe** to make more **accurate**).

The Process of Electrolysis

Two **electrodes** – made of inert material (doesn't react)



C4 – Chemical Changes - Required Practical
Preparation of soluble salts

Aim

Prepare a pure, dry sample of a soluble salt from an insoluble oxide or carbonate.

Equipment

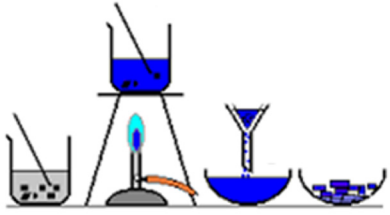
- Beaker
- Measuring cylinder
- Bunsen burner and safety mat
- Filter funnel and filter paper
- Named acid (e.g. hydrochloric acid)
- Metal oxide or carbonate.
- Spatula
- Glass stirring rod

Change method depending on reactants in the question.

Method

(Example copper oxide and sulfuric acid to make copper sulfate)

1. Using measuring cylinder – 20cm^3 sulfuric acid → beaker.
2. Warm the acid gently (not boiling).
3. Using spatula add **copper oxide** to the acid and stir.
4. Keep adding until no more oxide will dissolve (excess).
5. Using a filter funnel and filter paper – filter excess copper oxide.
6. Evaporate some of the filtrate using a water bath.
7. Pour remaining filtrate into an evaporating basin – leave overnight to evaporate water.
8. Pat the crystals dry.



Common Questions

Q1) Why do you heat the acid before adding the oxide?
A1) To speed up the reaction (particles have more energy to react).

Q2) Why is the oxide added in excess?
A2) To make sure that all the acid has been neutralised.

Q3) Why is the solution filtered?
A3) Remove any unreacted, excess solid.

Q4) Why is the solution left overnight in a warm, dry place?
A4) To evaporate excess water, to form crystals (crystallise).

Q5) Name 2 safety precautions you should take during this practical.
A5) Safety goggles and allow equipment to cool before putting away.

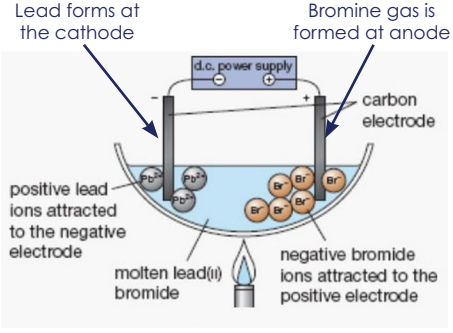
C4 – Chemical Changes

Electrolysis of Molten Ionic Compounds

Molten = melted **so ions** can move.

- Metal = produced at anode
- Non-metal = produced at cathode

Example: Lead Bromide - $PbBr_2$



Using Electrolysis to Extract Metals

Used if metal is **too reactive** to be extracted by reduction with carbon.

Requires **large amount of energy** to melt the compound and produce electrical current. (expensive)

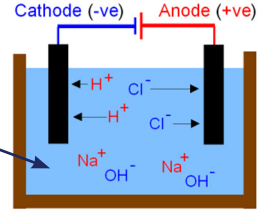
Example: Aluminium Oxide

- **Cryolite** is added – reduces the melting point (less energy needed – less expensive)
- **Carbon** used as positive electrode – needs to be replaced constantly as **oxygen** will react with it to produce CO_2 – it will degrade.

Electrolysis of Aqueous Solutions

Compound is dissolved in water so ions can move.

When aqueous – H^+ and OH^- (from H_2O) are also present along with the two ions from the compound.



Only **one** ion is discharged at each electrode.

- **Anode** – Non-metal or oxygen
- **Cathode** – Metal or hydrogen

Rules

+ ANODE Attracts – ions ('Anions')	**- CATHODE** Attracts + ions ('Cations')
If – ions are group 7 i.e. **chloride Cl^-** **bromide Br^-** **iodide I^-** Then the groups 7 element is produced as a gas	If + ions (metals) are MORE REACTIVE than hydrogen **K, Na, Ca, Mg, Zn, Fe** Then **HYDROGEN** is produced
If – ions are NOT Group 7 Eg sulphate SO_4^{2-} nitrate NO_3^- carbonate CO_3^{2-} OXYGEN is produced.	If + ions (metals) are LESS REACTIVE than hydrogen **Cu, Ag, Au** Then the METAL is produced

Solution	Product at Cathode	Product at Anode
Potassium chloride	Hydrogen – because K is more reactive than H	Chlorine – as it is a halogen
Copper sulfate	Copper – as copper is less reactive than H	Oxygen – as there is no halogen

Half-Equations at Electrodes (HT only)

During electrolysis:

Cathode – positive ions **gain** electrons **(reduction)**

Anode – negative ions **lose** electrons **(oxidation)**

- Ions become **discharged** (lose their charge) at the electrodes to form the atoms again.
- Reactions at electrodes can be represented by half equations.

Examples

Cathode: $2H^+ + 2e^- \rightarrow H_2$

Gained 2 electrons (reduction) — Molecules of hydrogen gas produced

Anode: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

Molecules of oxygen produced — Lost electrons (oxidation)

Cathode: $Cu^{2+} + 2e^- \rightarrow Cu$

Gained electrons (reduction) — Copper atoms are formed at the cathode

Anode: $2Cl^- \rightarrow Cl_2 + 2e^-$

Chlorine molecules are formed — Lost electrons (oxidation)

C4 – Chemical Changes - Required Practical
Electrolysis of Aqueous Solutions

Aim

To investigate the electrolysis of an aqueous solution using inert (unreactive) electrodes.

Equipment

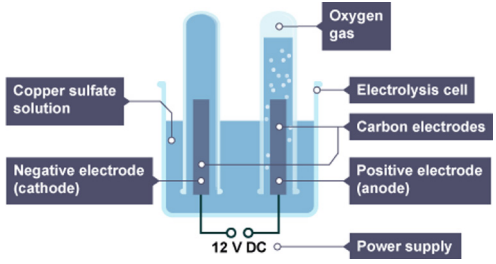
- Beaker
- Two test tubes (or measuring cylinders)
- Graphite electrodes
- Two splints
- Aqueous solution
- DC powerpack

Change method depending on the question.

Method

(example copper sulfate solution.)

1. Pour some copper sulfate solution into a beaker.
2. Place two graphite rods into the copper sulfate solution. Attach one electrode to the negative terminal of a dc supply, and the other electrode to the positive terminal.
3. Completely fill two small test tubes with copper sulfate solution and position a test tube over each electrode as shown in the diagram. **(use measuring cylinders if measuring volume of gas produced)**
4. Turn on the power supply and observe what happens at each electrode.
5. Test any gas produced with a glowing splint and a burning splint.
6. Record observations and the results of your tests.



Common Questions

Q1) How do you test for hydrogen gas?

A1) Lit splint will make a squeaky pop.

Q2) How do you test for oxygen gas?

A2) Glowing splint – will relight.

Q3) Explain why copper is produced at the cathode.

A3) Copper ions are **positive**, so are attracted to the negative electrode (opposites attract). Copper is less reactive than hydrogen so is discharged. The copper ions **gain electrons** and are **reduced** to form **copper atoms**.

Q4) Why do hydrogen ions move to the cathode?

A4) Hydrogen ions are **positive** so move to the negative electrode as **opposites attract**.

Q5) Why are measuring cylinders better to collect the gas?

A5) Because they are more accurate when measuring the volume of gas produced.

C5 – Energy Changes

Exothermic Reactions

- Energy transferred to the surroundings
- Temperature of the reaction mixture **increases**
- This energy is transferred **to** the surroundings

Examples include:

- Hand warmers
- Combustion reactions
- Respiration
- Neutralisation reactions
- Self-heating cans.

Endothermic Reactions

- Energy absorbed from the surroundings
- Temperature of reaction mixture often **decreases**
- Energy is transferred **from** the surroundings

Examples include:

- Ice packs (injuries)
- Reaction of citric acid and sodium hydrogen carbonate
- Thermal decomposition of calcium carbonate

Energy Change of Reactions (HT)

During a reaction:

Energy is **absorbed** in order to break bonds in the reactants

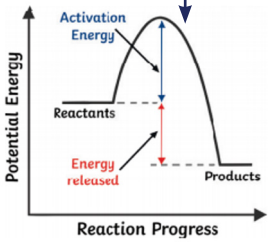
Energy is **released** when bonds are made in the products.

Bond energy = the amount of energy that is released when a bond is made or that is needed to break a bond

Reaction Profiles – Exothermic

- Energy level diagrams show **difference in energy** between reactants and products.
- Exothermic = Energy of products is **lower than** reactants (energy is released)
- **Activation Energy** = minimum amount of energy needed to start the reaction.
- **Energy Change** = the difference in energy between reactants and products.

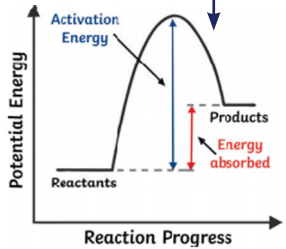
You may need to draw and label this in the exam!



Reaction Profiles – Endothermic

- Energy level diagrams show **difference in energy** between reactants and products.
- Endothermic = Energy of products is **higher than** reactants (energy is absorbed)
- **Activation Energy** = minimum amount of energy needed to start the reaction
- **Energy Change** = the difference in energy between reactants and products.

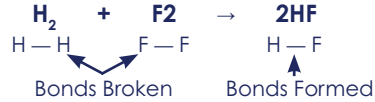
You may need to draw and label this in the exam!



Calculating Energy Changes (HT)

Overall energy change = difference between energy needed to break bonds and the energy **released** when bonds formed.

To calculate energy change :
Energy change = bonds broken – bonds formed



Bond	Bond Energy / kJ mol-1
F — F	158
H — H	436
H — F	568

Bonds Broken	Bonds Broken
436 + 158 = 593	2 × 568 = 1136

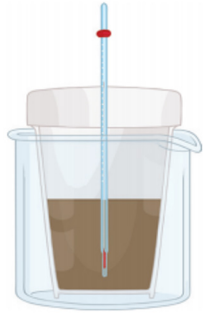
Overall energy change = 593 – 1136
= -543 kJ/mol Exothermic

More energy is released in bond making than is required for bond breaking.

C5 – Energy Changes - Required Practical
Temperature Changes

Hypothesis

The energy change in the reaction between acid and alkali depends on the volume of alkali added.



Equipment

- Polystyrene cup and lid
- Thermometer
- 250cm^3 beaker
- Measuring cylinder
- Liquid reactants

Method

(example for hydrochloric acid and sodium hydroxide)

1. Using measuring cylinder to measure 30cm^3 hydrochloric acid and put in polystyrene cup
2. Stand cup inside beaker to make stable.
3. Use a thermometer to measure the temperature of acid and record.
4. Using measuring cylinder – 5cm^3 sodium hydroxide → polystyrene cup
5. Fit the lid and gently stir with thermometer through hole.
6. When reading stops on thermometer, record temperature in table.
7. Repeat, each time adding 5cm^3 more sodium hydroxide up to a maximum of 40cm^3.
8. Calculate the temperature change on each attempt.
9. Repeat the experiment 3 times and calculate a mean temperature change for each volume of sodium hydroxide.

Variables

Independent – Volume of sodium hydroxide

Dependent – Temperature change

Control – Volume of hydrochloric acid, concentration of acid, concentration of sodium hydroxide

Common Questions

Q1) Why do you use a polystyrene cup and lid?

A1) Because polystyrene cups are insulators, which reduces heat loss in the experiment, making the results more accurate.

Q2) Why should you calculate the temperature change, instead of just using the final temperature?

A2) Because the initial (starting) temperature of the acid may have been different.

Q3) Why is it important to stir the mixture?

A3) To make sure all of the reactants have reacted and to get a uniform temperature.

Q4) Why is the experiment conducted 3 times?

A4) So that anomalies can be seen and removed and a mean calculated

Energy changes could also be investigated using

1. Changing the **mass of metal** added to acid and measuring the **temperature increase**
2. Changing the **type of metal** added to acid and measuring the **temperature increase**
3. Dissolving different **masses of potassium nitrate** into water and observing the **temperature decrease**.

C6 – Rate and Extent of Chemical Change

Rate of Reaction

Measuring the rate of anything always involves a **measurement of time**

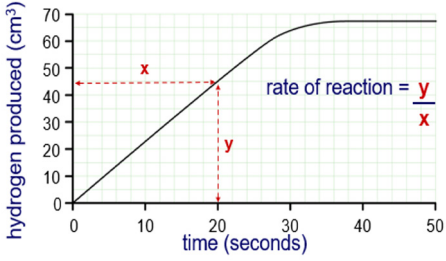
The rate of a chemical reaction can be found using:

$$\text{Rate} = \frac{\text{Quantity of reactant used}}{\text{Time}}$$

$$\text{Rate} = \frac{\text{Quantity of product formed}}{\text{Time}}$$

Quantities for reactants or products are measured in **mass in g** or by **volume in cm³**

Rate calculations can be done from tables of data or graphs:



Volume of hydrogen produced = 45cm

Time taken = 20 seconds

$$\text{Rate} = \frac{45\text{cm}^3}{20\text{ s}}$$

Rate = 2.25 cm³/s

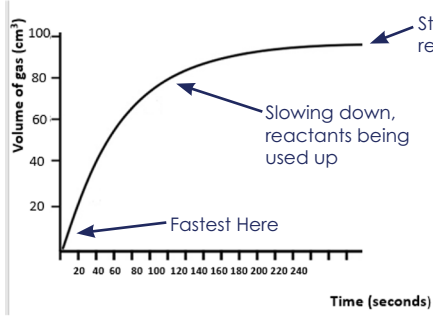
The Progression of a Chemical Reaction

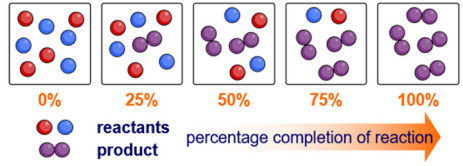
For a reaction to take place, reactant particles have to collide.

The rate of a reaction depends on the **frequency of collisions** and **the energy with which the particles collide**.

The minimum amount of energy needed to start a reaction is called the **activation energy**.

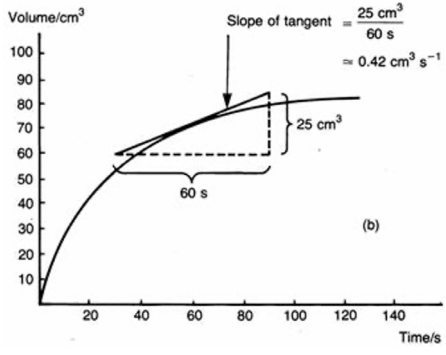
A reaction is always **fastest at the beginning** and slows down over time as the reactants get used up and the frequency of collisions decreases.





Using a Tangent to Calculate Rate (HT)

- Draw a line along the point you're interested in. The line should touch the curve at the point given.
- Make a triangle. Try to make the angles either side of the line equal.
- Measure the change in volume and change in time
- Calculate the gradient
- Use units from the axes to determine the units for rate



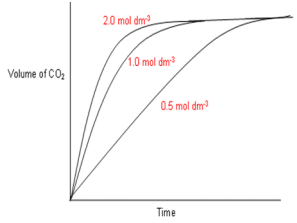
C6 – Rate and Extent of Chemical Change

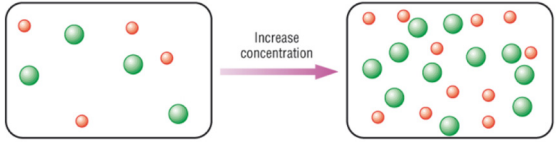
The Effect of Concentration

Concentration means number of particles per cm^3

Increasing the concentration of any of the reactants increases the rate of the reaction

This is because there are more particles per cm^3 so there are **more frequent** collisions, increasing the rate.

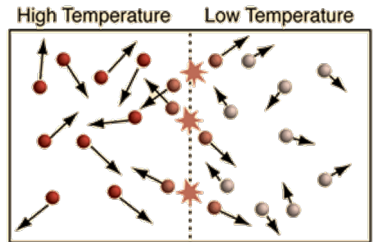


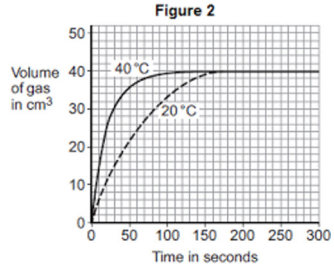


The Effect of Temperature

Increasing the temperature of the reactants increases the rate of the reaction.

This is because the particle have more kinetic energy and therefore move faster, so there are **more frequent** collisions, increasing the rate.



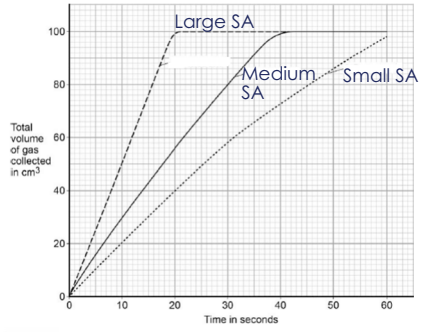


The Effect of Surface Area

The smaller the pieces of a solid, the higher the surface area

Increasing the surface area of solid reactants increases the rate of reaction.

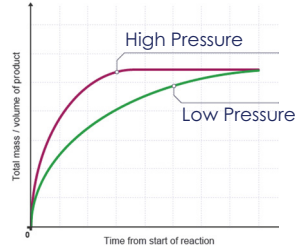
This is because there is a greater area available for collisions to occur so there are **more frequent** collisions, increasing the rate.

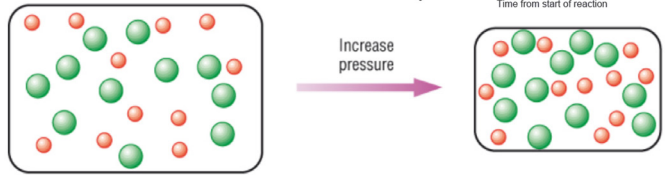


The Effect of Pressure

Increasing the pressure of gaseous reactions increases the rate of the reaction.

This is because the same number of particles are now in a smaller volume, so there are **more frequent collisions**, increasing the rate





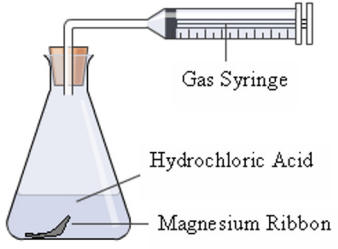
In all cases, the overall amount of product is the SAME, the end point of the reaction is just reached faster

C6 – Required Practical
The Effect of Concentration on Rate of Reaction

Experiment 1

Using volume of gas collected over time as a measure of the rate

$Mg + 2HCl \rightarrow MgCl_2 + H_2$



Independent variable: concentration of HCl

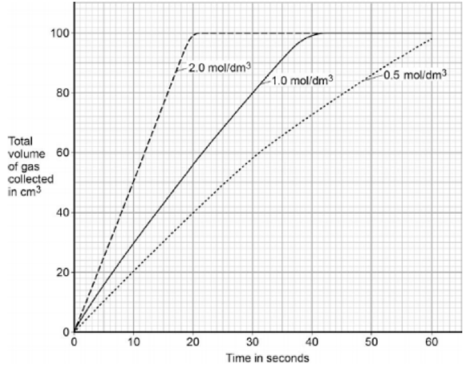
Dependent variable: Volume of gas produced / min

Control variables: volume of HCl, mass of Mg, temperature of acid

Method

1. Measure 20cm^3 0.5M HCl into a conical flask.
2. Insert 2 x 2cm pieces of Mg and attach a gas syringe
3. Start a stopwatch and measure the volume of gas collected every 20 seconds until the reaction is over.
4. Repeat using different concentrations of HCl.

An increase in the concentration leads to an increase in the rate of the reaction, but the same volume of product overall

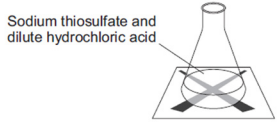


Experiment 2

Investigating the effect of changing the concentration of HCl on the rate of reaction

$HCl_{(aq)} + Na_2S_2O_{3\,(aq)} \rightarrow NaCl_{(aq)} + SO_{2(g)} + S_{(s)} + H_2O_{(l)}$

The sulphur being made is insoluble and is what makes the liquid go cloudy



Independent variable: concentration of HCl

Dependent variable : Time taken for the cross to disappear

Control variables : volume of HCl, volume of sodium thiosulphate, temperature of both solutions, concentration of sodium thiosulphate

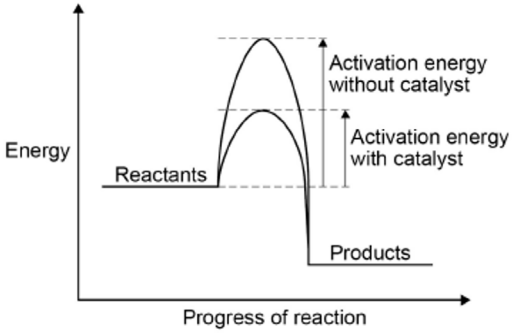
Method

1. Use a measuring cylinder to put 10 cm^3 sodium thiosulfate solution into the conical flask.
2. Put the conical flask on the black cross.
3. Put 10 cm^3 of 0.5M hydrochloric acid into the 10 cm^3 measuring cylinder.
4. Put this acid into the flask. At the same time swirl the flask gently and start the stopwatch.
5. Look down through the top of the flask. Stop the stopwatch when you can no longer see the cross. Record the time.
6. Repeat steps 1-5 using different concentrations of HCl – 1M, 1.5M, 2M and 2.5M

C6 – Rate and Extent of Chemical Change

The Effect of Surface Area

- Catalysts are substances that speed up chemical reactions without themselves being used up.
- They provide a different pathway for the reaction with a lower activation energy.
- Different reactions require different catalysts



Reversible Reactions

These are reactions in which the products can react to produce the original reactants

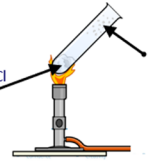
They are represented by the symbol $\rightleftharpoons$

The direction of the reaction can be changed by changing the conditions

For example:

$$\text{ammonium chloride} \underset{\text{cool}}{\overset{\text{heat}}{\rightleftharpoons}} \text{ammonia + hydrogen chloride}$$

NH_4Cl decomposes back into NH_3 and HCl gases when heated



NH_4Cl reforms in the cooler part of the test tube

If a reaction is exothermic in one direction, it is endothermic in the opposite direction.

The same amount of energy is transferred in each case.

hydrated copper sulfate (blue) $\underset{\text{exothermic}}{\overset{\text{endothermic}}{\rightleftharpoons}}$ anhydrous copper sulfate (white) + water

When a reversible reaction takes place in sealed apparatus, then a point occurs when the forward and backward reactions occur at the same rate. This is **equilibrium**

The Effect of Changing Conditions on Equilibrium (HT)

If a system is at equilibrium and a change is made to the conditions, then the system responds to counteract the change.

E.g. – if the temperature is increased, then the system will respond by increasing the rate of the endothermic reaction, to bring the temperature back down

If the concentration of the reactants is increased, then equilibrium will shift right and more products will be made.

In gaseous reactions, a change in pressure will result in equilibrium shifting to the side that restores the pressure.

E.g. :

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

In this reaction, there are 4 moles of gas on the reactants side and only 2 on the product side

If the pressure is increased, equilibrium will shift right as there are fewer moles on the products side, and this will decrease the pressure.

C7 – Organic Chemistry

Crude Oil

Crude oil = a mixture of **hydrocarbons**.

- It is a **non-renewable resource (fossil fuel)**
- Made from remains of dead sea creatures **compressed** over millions of years

Hydrocarbons - molecules containing **hydrogen** and **carbon only**.

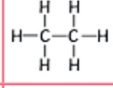
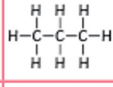
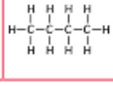
Two types of hydrocarbons are **alkanes** and **alkenes**.

The hydrocarbons in crude oil are mostly alkanes.

Alkanes

- Alkanes = **saturated** hydrocarbons.
- Held together by **single covalent bonds**.
- General formula = C_nH_{2n+2}
- Have different boiling points – longer the chain, higher the boiling point

You need to remember the names, and formulas of the first 4 alkanes.

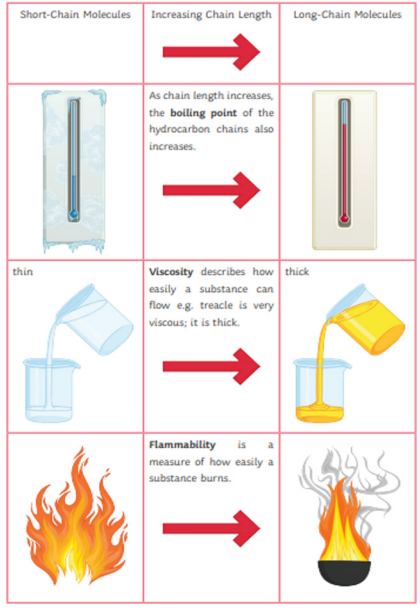
Name of Alkane	Structural Formula	Molecular Formula
methane		CH_4
ethane		C_2H_6
propane		C_3H_8
butane		C_4H_{10}

Fractional Distillation

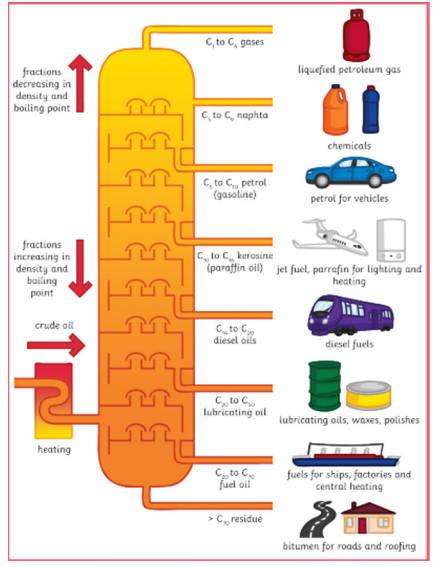
- Used to **separate** the mixtures of hydrocarbons in **crude oil**.

Steps in Fractional Distillation

1. Crude oil enters **fractioning column** and is heated to boiling point so the hydrocarbons evaporate.
2. It is **cooler** at the **top** of the fractionating column and **hotter** at the **bottom**.
3. Vapours rise up the column and, as they rise, they cool
4. The different hydrocarbons condense at different **boiling points**
5. The different 'fractions' have different properties



Uses of The Different Fractions



Supply And Demand

Product	Supply in tonnes	Demand in tonnes
petrol	100	300
diesel	200	100
heating oil	250	50

After fractional distillation, we find:

- We have more of the long chain hydrocarbons than we need
- There are not enough short chain hydrocarbons.
- Short chain are more useful as they are more flammable so can be used as fuels.

C7 – Organic Chemistry

Cracking

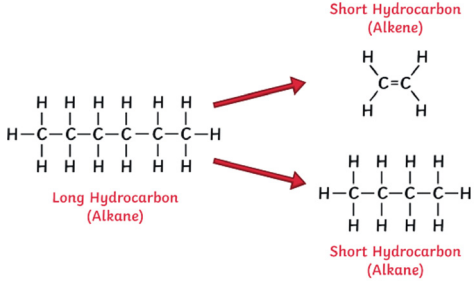
- This is done to solve the problem of having too many long chain hydrocarbons and not enough short ones
- Long hydrocarbons are **broken down** into smaller, more useful hydrocarbons.
- Short chain hydrocarbons are more useful as they are more flammable

Two types of cracking: catalytic and steam cracking.

Catalytic cracking – needs a **high temperature** and a **catalyst**.

Steam cracking – **high temperature and steam**

- Cracking produces a **short-chain alkane** and an **alkene**.



Cracking Equations

Same number of carbon and hydrogen atoms on both sides of the equation:

$$C_{20}H_{42} \rightarrow C_{14}H_{30} + C_6H_{12}$$

Long chain hydrocarbon | Shorter, more useful alkane | Alkene

Alkenes

- Alkenes are unsaturated hydrocarbons.
- Contain carbon-carbon double bonds.

Test for Alkenes

Use bromine water to test for alkenes.

If an alkene is present, the bromine water turns from orange/brown to colourless.

Alkanes do not react with bromine water.

Uses for alkenes:

Can be used as fuels

Can be used as a starting material for other chemicals

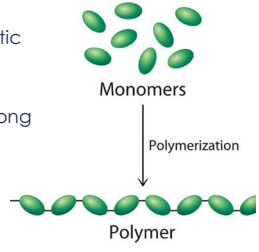
Can be used to make polymers (e.g. plastic)

Polymers

- Polymers are large molecules made of many repeating units (monomers)
- Alkenes (small molecules) are joined together to make polymers

Poly(ethene) – plastic bags/drinks bottles

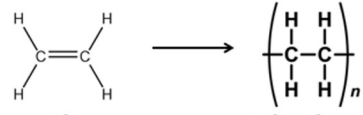
Poly(propene) – strong tough plastics



Drawing and Naming Polymers

1. Redraw the **monomer given**, but without the double bond. Make sure to copy all other elements exactly.
2. Put brackets around the monomer and extend joining bonds out through the brackets on both sides
3. Add an 'n' at the bottom right of the bracket
4. To name the polymer, you put **poly** in front of the monomer name

E.g. Draw and name the polymer made from the monomer ethene:



Ethene **Poly ethene**

Combustion of Hydrocarbons

Combustion means burning.

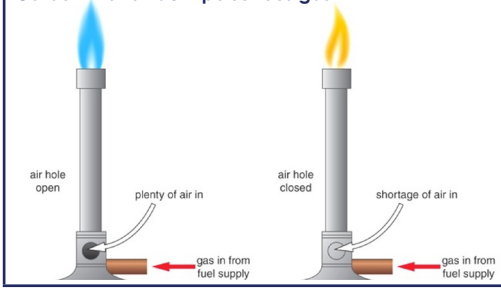
Complete combustion - when there is a good supply of **oxygen** for a fuel to burn.

Fuel + oxygen → carbon dioxide + water

Incomplete combustion - **not enough oxygen**

Products are **carbon monoxide** and water.

Carbon monoxide = poisonous gas



C8 – Chemical Analysis

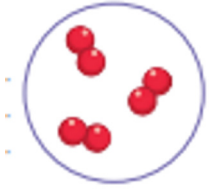
Pure Substances

Pure = single element or compound – not mixed with any other substance.

Testing to see if a substance is pure:- Pure substances have specific melting and boiling points

- Compare your data to a library of known values.

E.g. Water has a boiling point of 100°C, if it is above or below this, it is not pure.



Formulations

Formulation = a mixture that is designed as a useful product.

- Components mixed carefully to get the required properties.

Examples of formulations:

- Fuels
- Cleaning agents
- Paints
- Medicines
- Alloys
- Fertilisers
- Food

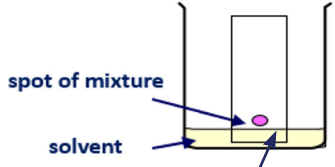
Chromatography

- Technique used to separate mixtures of soluble substances.
- How soluble a substance is determines how far it travels across paper.

More soluble = travels further (higher up paper)

Mobile phase

- Solvent is the mobile phase
- The substances dissolve in the solvent
- The solvent then moves through the stationary phase.

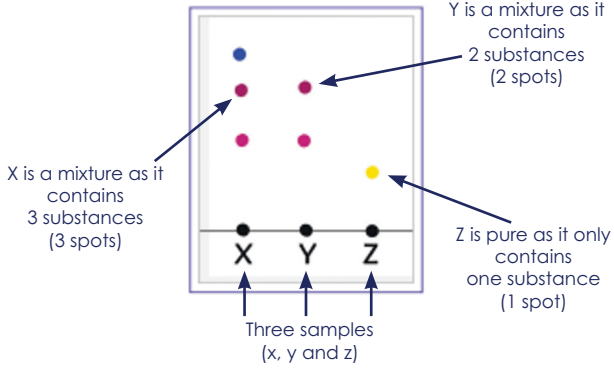


Stationary phase

- Does not move. The paper is the stationary phase.

Important – start line on paper must be drawn in **pencil** as pencil is **insoluble** and **will not run**

The spot and start line must be **above the solvent line** so the colours won't just wash into the solvent in the beaker.

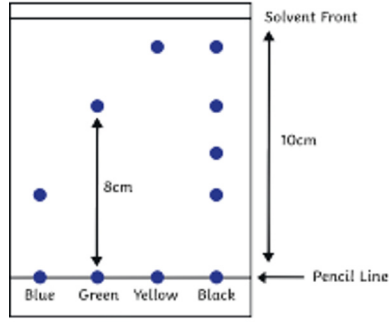


Rf Values

This is the ratio of the distance moved by a substance to the distance moved by the compound

$$R_f = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$$

- Should always be between 0 and 1.
- Each substance has a unique Rf value.
- Can compare Rf values to a library of known substances
- Can identify unknown substances.



Rf value of green:

8cm / 10cm = 0.8

C8 – Chemical Analysis - Required Practical
Paper Chromatography

Aim: Investigate how paper chromatography can be used to separate and distinguish between coloured substances.

Method

1. Using a ruler, measure 1cm from bottom of chromatography paper and draw a line across the paper with a pencil.
2. Using a pipette, drop small spots of each ink onto pencil line (leave a gap so do not merge).
3. Pour solvent into a beaker, do not fill solvent above the pencil line on the paper.
4. Place chromatograph paper into beaker and allow solvent to move up the paper.
5. Remove paper just before solvent reaches top of the paper and leave to dry.
6. Calculate Rf values of all the spots using the equation below:

$$R_f = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$$

Common Questions

Q1) Why is a pencil used instead of a pen?
A1) Ink in the pen would move up the paper with the substances.

Q2) Why do you not fill the solvent above the line?
A2) Substances would wash off into the solvent instead of rising up the paper

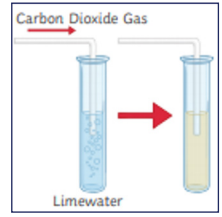
Q3) Why might water not work as a solvent?
A3) Some substances are insoluble in water.

Identification of The Common Gases

Test for hydrogen – Place a **burning** splint at the opening of a test tube. If hydrogen gas is present, it will burn with a **squeaky-pop sound.**

Test for Oxygen – Place a **glowing** splint inside a test tube. The splint will **relight** in the presence of oxygen.

Test for Carbon Dioxide –Bubble the gas through the lime water – if the gas is carbon dioxide, the limewater turns **cloudy**.

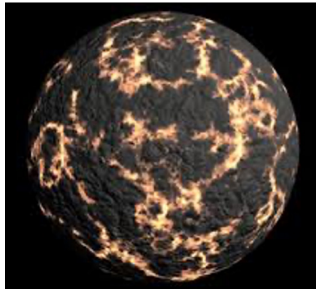


Test for Chlorine – **Damp litmus paper** is held over the of gas. If the tube contains chlorine, the litmus paper becomes **bleached** and **turns white**.

C9 – Earth & Atmosphere

Early Atmosphere vs Modern Atmosphere

Gas	Levels in earth's early atmosphere	Percentage in air today
Nitrogen	None	78
Oxygen	None	21
Others – CO_2 and argon	Very High	1
Water vapour	Very high	Varies – but usually only around 1%
Ammonia	High	None



4.6 billion years →

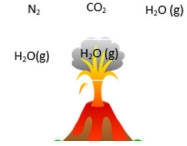
We think that the atmosphere on Earth was once like that of Mars or Venus is today

When Earth was formed it was so hot it was molten on the surface, and the atmosphere was full of toxic gases like methane and ammonia.

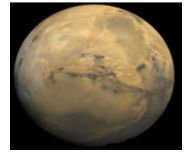
We cannot be sure about exactly what the Earth's early atmosphere as we have no evidence from so long ago

How Did The Atmosphere Change?

1. Volcanoes released nitrogen, carbon dioxide and water vapour

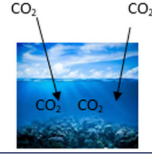


2. The earth cooled and solidified



3. Water vapour in the atmosphere condensed and feel as rain
4. Oceans, lakes and rivers formed

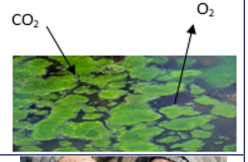
5. Carbon dioxide from the air dissolved in the oceans
6. Some of this reacted to form sedimentary rocks like limestone



7. Algae and then plants evolved, removing carbon dioxide from the air and produced oxygen by photosynthesis

Carbon dioxide + water → glucose + oxygen

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$



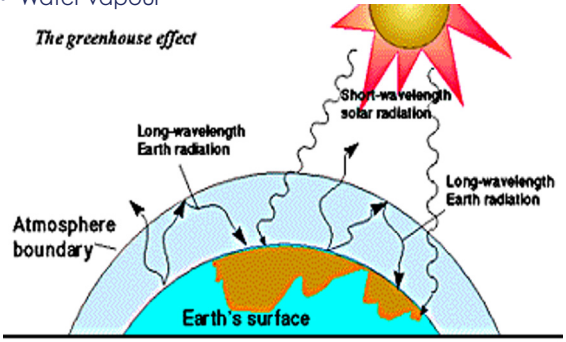
8. Many early plants and marine organisms were buried and decayed underground, locking up carbon in fossil fuels like coal (plants) and oil (animals)

C9 – Earth & Atmosphere

The Greenhouse Effect

The greenhouse layer is a layer of gases in the atmosphere made of:

- Carbon dioxide
- Methane
- Water vapour



1. Short wavelength infrared radiation from the sun reaches Earth
2. Some energy is absorbed by the Earth
3. Longer wavelength IR is reflected by the Earth
4. Longer wavelength IR cannot get through the greenhouse layer as easily so some is trapped, warming the Earth

The thicker the layer of gases, the more heat is trapped

Global Warming

The greenhouse layer is getting thicker, because:

- CO_2 released from fossil fuels to generate electricity
- CO_2 released from fossil fuels in vehicles
- Methane released from cattle
- Methane released from rotting landfill sites

Many scientists believe that human activities are causing the warming of the Earth.

Global Warming

- Melting ice caps
- Loss of habitats for animals and plants
- Damage to coral reefs caused by warmer oceans
- Changes to animal migration patterns
- Extreme weather patterns – more hurricanes, heat waves, droughts, snow and ice
- Difficulty growing crops so reduced food supply

Carbon Footprint

The total amount of CO_2, CH_4 and water vapour released by of a product or service.

E.g. for a concert:

- Electricity in performance
- Fossil fuels used by people travelling there
- Plastics used and disposed of in refreshments etc

Carbon footprints can be reduced by recycling, reducing energy use or eating vegetarian diets but this is hard to get people to do.

Pollutants

Pollutant	Source	Effects
Carbon dioxide	Combustion	Global warming
Carbon monoxide	Incomplete combustion of fuels	Toxic gas, can be fatal
Sulfur dioxide	Traces of sulfur in coal react with oxygen when burned	Acid rain
Nitrogen oxides	Hot engines provide the energy for N_2 to react with O_2	Acid rain
Particulates	Incomplete combustion	Global dimming, breathing problems

C10 – Using Resources

Earth's Resources

We use Earth's resources to provide **warmth, shelter, food and transport.**
E.g.:

- metals from the Earth's crust to build buildings and cars
- Timber and oil to burn for warmth
- Crop plants for food
- Products from crude oil to serve as fuels in cars, trains and planes

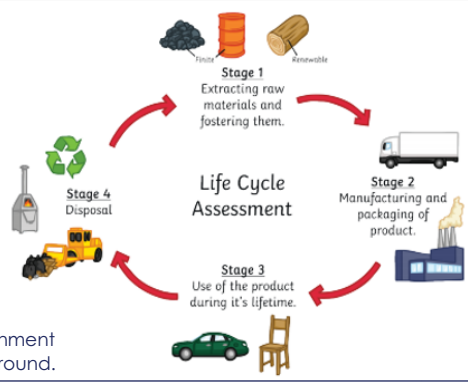
Finite resources – ones that will run out as they are being used much faster than they can be replaced, e.g. oil
Renewable resources – resources that will not run out, e.g. wood, wind etc.

Chemistry plays an important part in finding improvements or alternatives to current resources.

Natural	Abiotic – non-living
Wood for furniture	Plastic/polymers
Food crops	Fertilisers/ artificially grown foods such as Quorn
Oil for fuel	Ethanol/hydrogen fuel cells
Rubber for tyres	Polymers

Life-Cycle Assessments (LCA)

- These assess the environmental impact of a product in these stages:
Stage 1 – extracting raw materials needed to make products.
- Energy cost and effect on habitats of extraction
- Are the raw materials finite/renewable?
Stage 2 – Manufacturing and packaging product
- How much energy and resources are needed?
- What waste products/pollution are released?
- Transportation of goods from factors to user need considering.
Stage 3 – Use of product during its lifetime
- E.g. a car has a significant impact as needs filled up with petrol which is a finite resource.
Stage 4 – Disposal at end of product's life.
1) Landfill – high environmental impact
2) Incineration – burning of product
3) Recycling – e.g. batteries contain metals that are harmful to environment – recycling means no new compounds need to be taken out of the ground.



Natural	Abiotic – non-living
Wood for furniture	Plastic/polymers
Food crops	Fertilisers/artificially grown foods such as Quorn
Oil for fuel	Ethanol/hydrogen fuel cells
Rubber for tyres	Polymers

Example LCA for plastic vs paper bags:

Stage of Life Cycle Assessment	Plastic Bag	Paper Bag
Stage 1 – raw material	Uses finite resource. Process of fractional distillation, cracking and polymerisation all require energy.	Made from trees/recycled paper. Making paper from trees required more energy than recycled paper. Less energy than plastic bags.
Stage 2 – Manufacture	Cheap to make	More expensive to make
Stage 3 – Use	Low environmental impact as can be re-used many times. Much stronger product.	Only be reused a limited number of times – short lifetime.
Stage 4 - disposal	Do not biodegrade easily in landfill.	Paper bags degrade easily in landfill sites.

- Different people have different opinions and so depends on who completes the LCA. Bias may be added.
- Some companies may only discuss some of environmental impacts of their product.
- Accurate numerical values should be used where possible – for example to show how much energy has been used.

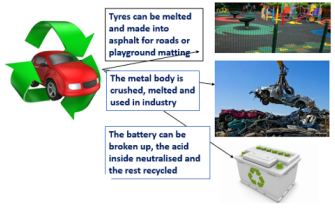
C10 – Using Resources

Reducing the use of resources

Metals, glass, ceramics, building materials and most plastics are produced from limited resources.
The energy for the processes involved in making/extracting raw materials also comes from limited resources – e.g. oil.
We can reduce the use of limited resources by reducing use, reusing materials and recycling materials at the end of their life.

Reduce, reuse, recycle.

E.g.
Glass bottles can be reused.
Metals can be melted down and recast and so recycled.
Scrap steel can be added to extracted iron to reduce the amount of iron that has to be extracted in the blast furnace.



Evaluating methods to reduce, reuse, recycle

Advantages	Disadvantages
Fewer resources such as mines and quarries are needed to extract finite materials	Requires collection and transport of items – involving staff, vehicles and use of fuel
Crude oil does not need to be extracted – avoids high energy costs for fractional distillation etc.	Materials, such as metals, very often have to be separated from other materials first
Less greenhouse gases produced.	Some metals need melting before being reused – energy costs.
Less items in landfill	

Biological extraction techniques (HT only)

- Earth's supply of metal ores is limited.- There are fewer sites that give lots of copper (high grade ore sites)
- New ways of extracting from low grade ore sites are:
- Phytomining - Bioleaching
  Disadvantage = **slow processes**
  Advantage = reduce need for the traditional mining methods of digging, moving and disposing of large amounts of rock.

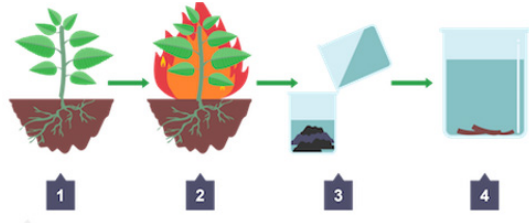
Phytomining (HT only)

1) Plants are grown on a low-grade ore

2) The plants absorb metal ions through their roots

3) The plants are harvested and burnt

4) Ash left behind contains metal compounds5) Ash is dissolved in acid and copper is extracted using electrolysis or displacement with scrap iron.



Bioleaching (HT only)

- Uses **bacteria** to produce a solution called **leachate** – contains copper ions.
- The copper can be extracted by using iron to **displace** the copper from the leachate.
- Does not need high temperatures
- Produces **toxic substances** which can damage the environment.
- Iron is cheaper than copper
- use of scrap iron is a cost-effective way to produce copper from leachate.
- Can also undergo **electrolysis** to produce copper.

C10 – Using Resources – Water

Potable Water

- Water is **essential** for life.
- **Potable water** is water that is safe to drink.
- Potable water is not pure as it contains some dissolved substances.

In the UK – rain water provides water with low levels of dissolved substances that collects in the ground and in lakes and rivers. This is fresh water.

Most potable water is produced by:

1) Choosing an appropriate source of fresh water
2) Passing the water through filter beds
3) Sterilising to kill bacteria

Sterilising agents used for potable water include:

- Chlorine
- Ozone
- Ultraviolet light

Desalination of Sea Water

- **Potable** water can be made from sea water through desalination.
- Required a lot of **energy** to **remove salt** in sea water.

Can be done by:

Distillation

- Sea water heated until it boils
- Steam is **condensed** to make potable water
- Requires a lot of **energy**

Reverse Osmosis

- Water put under **high pressure** and passed through **membrane** with tiny holes in.
- Holes allow water through but not salt/ions
- Very **expensive**
- Produces large volumes of waste water.

Waste Water Treatment

- Waste water needs to be treated before being released back into environment

Pollutants can be present in waste water including:

- Human waste contains harmful **bacteria** and nitrogen – can harm aquatic ecosystems.
- Industrial waste can contain **toxic** substances
- Agricultural waste water can contain **fertilisers** or **pesticides** – disrupt ecosystems.

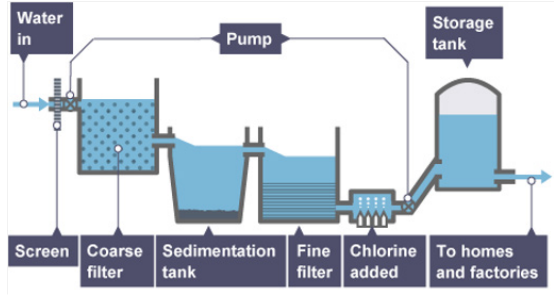
Sewage treatment involves:

1) Screening and grit removal to remove large particles

2) Sedimentation – allows tiny particles to settle – produces sewage sludge and effluent (liquid that remains on the top)

3) Sewage sludge is digested anaerobically by specific bacteria

4) Effluent is treated with aerobic bacteria to reduce volume of solid waste.



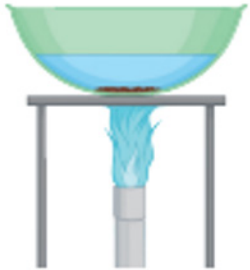
C10 – Using Resources – Required Practical
Analysis and purification of water

Analysing the pH of Water Samples

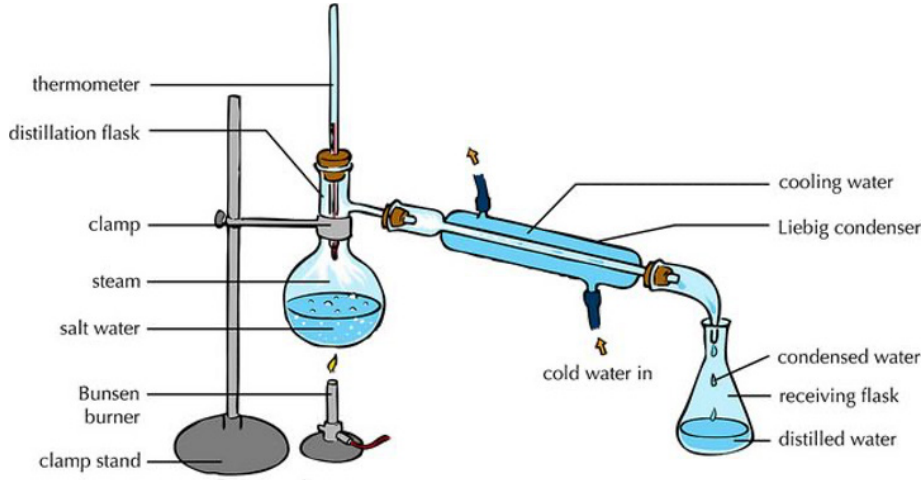
- Test pH of each water sample using pH probe or universal indicator.
- Compare to pH chart if using universal indicator

Analysis the Mass of Dissolved Solids

1. Measure out 50 cm3 of water sample using measuring cylinder.
2. Take the mass of evaporating basin using top pan balance.
3. Heat the sample in the evaporating basin gently until all liquid evaporates.
4. Let the evaporating basin cool
5. Re-take the mass of the evaporating basin.
6. Calculate the mass of the solid left behind by doing: final mass – initial mass.
7. Repeat with different water samples (e.g. rainwater, salt water, spring water)



Distillation of water Sample



1. Set up apparatus as shown in picture with the sample of water in the round bottom flask.
2. Heat water sample until it boils gently.
3. Water vapour enters the tube at the side (condenser).
4. There is cold water surrounding the tube.
5. The water vapour cools and condenses and collects in the flask.
6. The water collected should be pure.

P1 – Energy

Energy Stores

There are 8 energy stores:

Store	Stored in…
Kinetic	Moving objects
Gravitational potential	Objects raised above ground
Elastic potential	Stretched or compressed objects
Thermal	All objects due to particle movement
Chemical	Substances (foods, fuels) that can release energy in a chemical reaction
Nuclear	The nucleus of atoms
Magnetic	Magnets attracting or repelling
Electrostatic	Separation of charges

Conservation of energy law:
Energy is NEVER created or destroyed

Energy is transferred by different pathways – by heating or when work is done

When energy is transferred, some is often transferred to the environment – this is wasted or dissipated energy

Efficiency

Tells us how much of the energy is transferred usefully.

$$\text{Efficiency} = \frac{\text{Useful output energy transferred by the device}}{\text{Total input energy supplied to the device}}$$

$$\text{Efficiency} = \frac{\text{Useful power out}}{\text{Total power in}}$$

Wasted energy always ends up in the thermal store of the surroundings

Calculating Energy Stores

The energy stored in a raised object can be calculated using:

GPE = mass x height × gravitational field strength
GPE = mgh

The energy stored in a moving object can be calculated using:

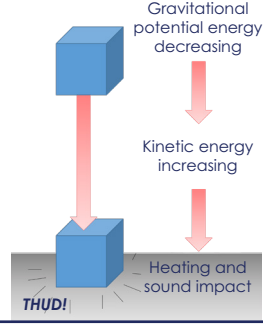
$KE = \frac{1}{2} \text{ mass} \times \text{velocity}^2$
$KE = \frac{1}{2} m v^2$

Energy stored in a stretched or compressed object can be calculated using :

$E = \frac{1}{2} \text{ spring constant} \times \text{extension}^2$
$E = \frac{1}{2} k e^2$

Transfers of energy:

E.g. An object above ground has GPE. If that object falls:
1. Decreases its GPE store
2. Increases its KE store as it falls
3. Waste energy transferred to the environment by heating and sound

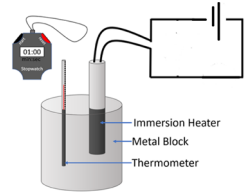


Specific Heat Capacity

The amount of energy needed to change the temperature of 1Kg of a substance by 1°C
It is calculated by:
E = specific heat capacity x mass x temp change
E = SHC × m × Θ

Units for SHC are J/Kg/°C
Different materials have different specific heat capacity values.

This can be investigated using the equipment below:



- Energy is supplied to the block by the immersion heater over a fixed time period (e.g. 5 mins)
- The thermometer measures the temperature of the block at the start and the end of the experiment
- The stopwatch measures the time
- If the power of the heater is known (e.g. 50W) the energy transferred to the block can be found using the equation:

Energy (J) = Power (W) × time (s)

The specific heat capacity of different materials can be investigated by:
- Changing the metal **(independent variable)**
- Measuring the temperature increase **(dependent variable)**
- Keeping the energy supplied, mass and insulation the same **(control variables)**

Insulating the block reduces energy transferred to the thermal store of the environment, improving accuracy

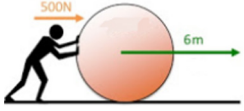
P1 – Energy

Power and Work Done

Work done = energy transferred

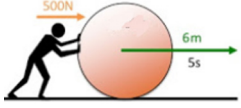
Energy transferred mechanically is calculated:

Work done = force × distance
W (J) = F (N) × s (m)



Work done = 500N x 6m = 3000 J
Power = energy transferred per second
1 Watt = 1 Joule per second

Power = energy transferred ÷ time
P (W) = e (J) ÷ t (s)



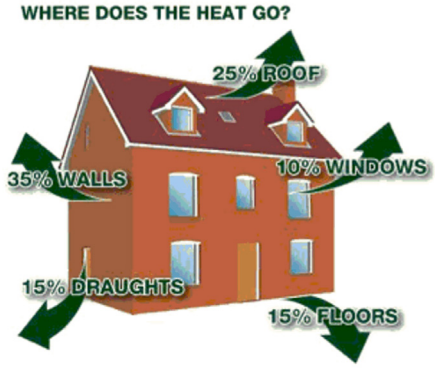
Power = Energy ÷ time
= 3000 J ÷ 5 s
= 600 W

A more powerful appliance transfers more energy per second, e.g.

Reducing Unwanted Energy Transfers

Reducing wasted energy means lower costs

Materials that conduct heat well have a high **thermal conductivity**.



Reducing energy transfers in homes

- Double glazing
- Thick walls
- Walls made of materials with low thermal conductivity
- Insulation – wall and loft

Reducing energy transfers in appliances:

Lubrication – reduces friction

Streamlining – reduces air resistance

Energy Resources

We use energy resources for electricity generation, transport and heating

Non-renewable – ones that are being used faster than they can be replaced and will run out.

Example	+	-
Coal, oil, natural gas	Reliable method of generating electricity	Release CO_2 which contributes to global warming
Nuclear	No CO_2 released	Produces radioactive nuclear waste

Renewable resources:
Ones that will not run out, they are being replenished as they are used

Example	+	-
Solar	No CO_2 released	Don't work at night or well on cloudy days
Wind	No CO_2 released	Doesn't work if it isn't windy
Hydro	No CO_2 released	Damage to habitats
Geothermal	No CO_2 released	Only found in specific places
Waves	No CO_2 released	Damage to habitats
Biofuel	Carbon neutral	Uses crop land to grow new forests

P2 – Electricity

Using Electrolysis to Extract Metals

Electrical current is the flow of electrical charge.

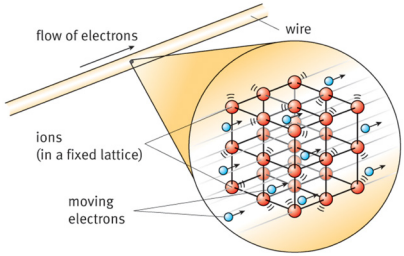
Current is measured in amps (A), charge is measured in Coulombs (C).

The size of the current depends on the rate of the flow of charge – i.e. how many coulombs of charge per second.

Q = I t

Charge = Current × Time

(C) (A) (T)



Ohms Law

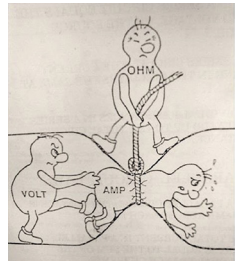
The current through a component depends on the potential difference and the resistance of the component.

If a component has high resistance, the current will be smaller for a given potential difference

Potential difference = current x resistance

V = I R

pd is measured in volts (V), resistance in Ohms (Ω)

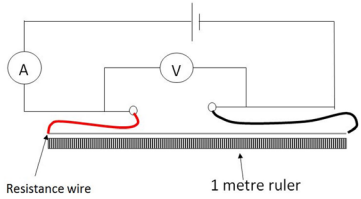


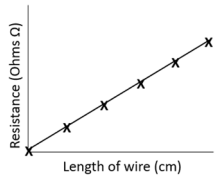
Hypothesis 'The Length of The Wire Affects Resistance'

Independent variable – length of wire
Dependent variable – resistance
Control variables – type of wire, temperature of the wire, diameter of the wire

1. Set up the circuit as shown, with an ammeter in the circuit and a voltmeter connected across the wire
2. Use crocodile clips to change the length of the wire in the circuit
3. Make the wire 10cm long and read the current and pd. Switch off the current between readings or the wire will got hot, increasing the resistance.
4. Repeat for 20, 30, 40, 50 cm. (5 minimum)
5. Calculate resistance using Ohms Law R = V/I

Plot length of wire (IV) against resistance (DV)



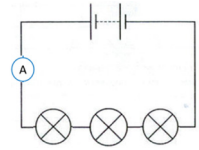


The relationship is directly proportional

Series and Parallel Circuits

Series circuits:

A series circuit is one single loop

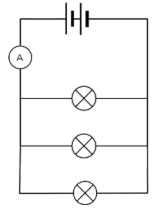


In a series circuit:

- The current is the same at all points in the circuit.
- Potential difference is shared between components (equally if components are identical resistance)
- Total resistance = sum of all resistors

Parallel circuits:

A parallel circuit consists of more than one loop from the battery/cell.



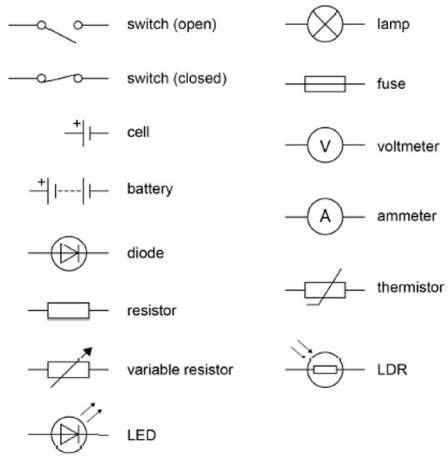
In a parallel circuit:

- The current is shared amongst the branches
- The potential difference is the same across all components
- Resistance in the whole circuit is LESS than that of the smallest resistor

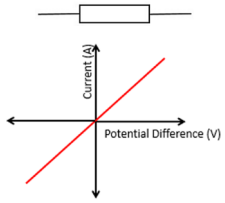
P2 – Electricity

Components

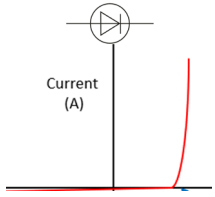
- A **diode** only allows current to flow one way in a circuit
- A **resistor** is a component that provides a fixed resistance in the circuit – e.g. a 5 Ω resistor
- A **variable resistor** is a component whose resistance can be changed – e.g. a dimmer switch
- A **thermistor** is a resistor whose resistance changes with temperature – the higher the temperature the lower the resistance
- An **LDR** (light dependent resistor) has resistance that changes
- An **LED** (light emitting diode) is a light that only allows the flow of current one way



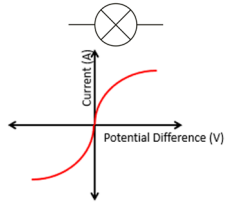
Current, potential difference and resistance for different components



A fixed (ohmic) resistor has fixed resistance current is directly proportional to potential difference
Resistance remains constant (at constant temp)

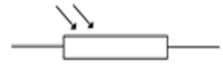


A diode very high resistance in one direction.
Only when the potential difference is positive does current flow



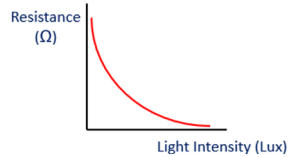
A filament bulb contains a thin wire that glows as current flows.
As the pd increases, the current initially increases.
However, at higher pd, the wire gets hot
The ions in the wire move faster and collide with the moving charges
Resistance increases, so current stops increasing

LDR

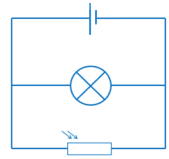


A light dependent resistor has varying resistance.

As the light intensity increases, the resistance decreases



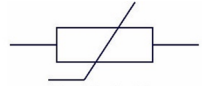
LDRs can be used to switch on lights at night time.



In this circuit, when it is day time, the resistance in the LDR is low, so all current flows through the LDR.

As light levels fall, resistance increases, until eventually there is less resistance in the bulb than the LDR, so current flows through the bulb – switching it on.

Thermistor



As the temperature increases, the resistance in a thermistor decreases.

P2 – Electricity

Domestic Use of Electricity

There are two types of electrical supply – direct (DC) and alternating current (AC)

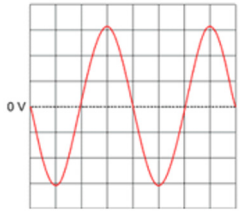
AC

The pd changes direction and magnitude, giving alternating current

The number of times the change of direction happens per second is the frequency.

UK mains is AC - **230V**

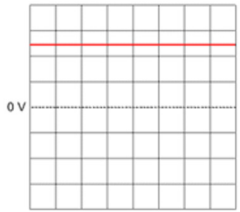
Frequency of **50 Hz**

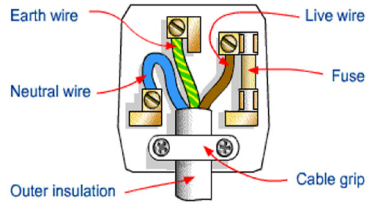


DC

A direct pd produces current that flows in one direction

Batteries supply DC



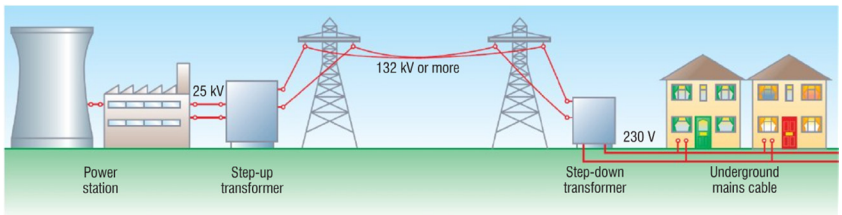


Electrical appliances are connected using 3 core cable

- Brown – live wire, with pd of 230V
- Blue – neutral, 0V, completes the circuit
- Yellow and green – Earth wire, is at 0V unless there is a fault, when it will become live

The National Grid

The National Grid is a system of cables and transformers connecting power stations to homes and businesses.



The National Grid uses very high pd and low current.
High current causes heating in the wires and would result in large energy losses.
Step up transformers increase the pd from the power station (to around 400,000V) so that low current can be used to transmit power.
This means the wires don't get hot, so less energy is lost.
Near homes and businesses, step down transformers reduce the pd to 230V for safety.

Appliances In The Home and Power

Power is measured in Watts (W) or kW

Power can be calculated by using:

Power = Voltage × current

$P = IV$

Power = current^2 × resistance

$P = I^2 R$

Appliances transfer energy.

Energy is measured in Joules (J) or kJ

The energy transferred can be calculated by using:

Energy = charge flow × potential difference

$E = Q V$

Energy = power × time

$E = p t$

For example

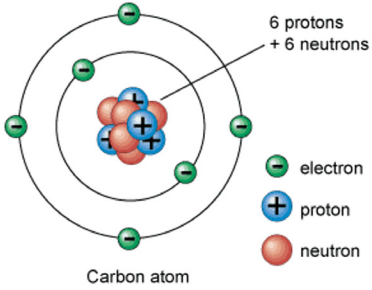
A kettle transfers energy from the thermal store of the filament in the kettle to the thermal store of the water inside.

Some energy is transferred to the thermal store of the surroundings.

P4 – Atomic Structure

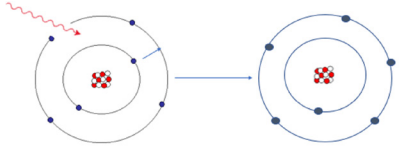
Atoms

- Atoms are tiny – around 10 - 10m
- There is a positive nucleus made of protons and neutrons
- Electrons orbit in shells or energy levels
- The nucleus is 10,000 x smaller than the atom (4 orders of magnitude) so around 10^{-14} m

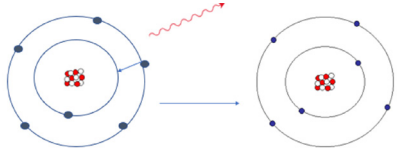


Carbon atom

Electrons can move further away or closer to the nucleus



If EM waves (eg UV /light) are **absorbed** electrons can move up energy levels



If EM waves are **emitted** by the atom, then electrons move closer to the nucleus

How The Atomic Model Developed

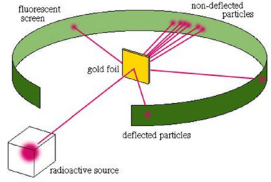
The atomic model has developed over time, when new evidence was discovered.


Atoms were first thought to be tiny spheres that could not be divided.


JJ Thomson then discovered the electron. Led to the plum pudding model. Atoms a cloud of positive charge with electrons randomly scattered.


Rutherford discovered the positive charge is very small and in the nucleus. This discovery was from the Gold leaf experiment.


Chadwick discovered neutrons.
Bohr discovered the electrons orbit in shells.



Rutherford's experiment:

- Alpha particles fired at gold leaf
- Most went straight through
- Some deflected to the side
- Some came straight back
- This told him that most of the atom was empty space and that the positive charge was in a tiny nucleus

- Atoms of the same element have the same number of protons.
- This is the atomic (proton number)
- In an atom, the number of electrons is equal to the number of protons.
- The total number of protons and neutrons is called the mass number

(Mass number) 23
(Atomic number) 11 Na

Sodium has :

- 11 protons
- 11 electrons
- 12 neutrons (23-11)

Isotopes

Isotopes are atoms with same number of **protons**, but different numbers of **neutrons** (different mass number)

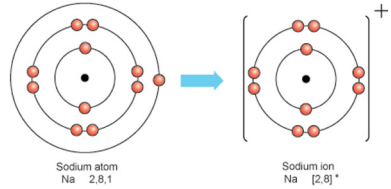
E.g.

$^{16}_{8}O$ $^{18}_{8}O$

These two isotopes both have 8 protons
One has 8 neutrons (16-8)
One has 10 neutrons (18 – 8)

Ions

If atoms lose one or more outer electrons, they turn into positive ions



P4 – Atomic Structure

Nuclear Radiation

If an isotope is unstable, then particles and energy are emitted from the nucleus.
There are 3 main types:

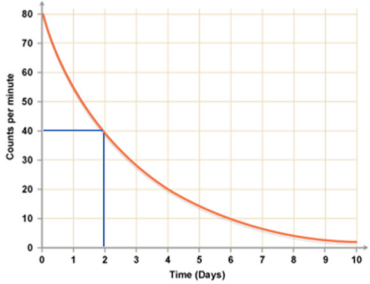
Radiation	What is it?	How far does it travel?	Ionising power	Penetrating power
Alpha α	2 protons and 2 neutrons	A few cm	Strong	Stopped by paper
Beta β	A fast moving electron	Metres	Medium	Stopped by aluminium
Gamma γ	An electromagnetic wave	Kilometres	Weak	Takes thick concrete or lead to stop it

Neutrons can also be emitted from the nucleus.

Half Life

Radioactive decay is random.
The half life of an isotope is the time it takes for half of the atoms in the sample to decay OR for the count rate to fall by half

Half life is calculated from a graph by reading two points off the y axis – one value being half the other. Read the corresponding change in time.



1st point – 80
2nd point – half of that, so 40

Time at 80 = 0
Time at 40 = 2 days

Change in time = 2 days
Half life is 2 days

Isotopes are selected for use depending on their properties and half life – e.g. a medical tracer needs to have a short half life so it isn't in the body for very long.

Alpha Decay

An unstable nucleus gives out 2 protons and 2 neutrons
An alpha particle is written as : ${}^{4}_{2}\alpha$

So when a particle gives out alpha radiation, it loses 2 from the proton number and 4 from the mass number
E.g. ${}^{226}_{88}Ra \rightarrow {}^{222}_{86}Rn + {}^{4}_{2}\alpha$

Beta Decay

In an unstable nucleus, a neutron changes into a proton and an electron.
The electron is fired out as the beta particle

Beta particles are written as : ${}^{0}_{-1}\beta$ or ${}^{0}_{-1}e$

The proton number increases
The mass number stays the same
E.g. ${}^{14}_{6}\text{carbon} \longrightarrow {}^{14}_{7}\text{nitrogen} + {}^{0}_{-1}e$

The emission of a gamma ray **does not change the nucleus**

Irradiation is the exposure to alpha, beta or gamma radiation

Contamination is the presence of radioactive atoms on materials.

P5 – Forces

Scalar and Vector Quantities

Scalar quantities – have magnitude only

E.g. temperature, mass and speed.

Vector quantities – have both **magnitude** and **direction**

E.g. velocity. displacement.

Vectors can be shown using **arrows**:

Size of arrow = magnitude of the quantity

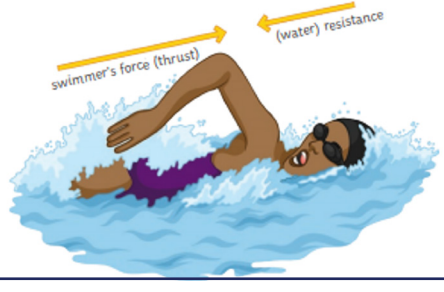
Direction of arrow = direction of quantity

Contact and Non-Contact Forces

Force = a push or pull that acts on an object due to interaction with another object.

All forces are either:

- **Contact forces** – objects are physically touching e.g. friction, air resistance, tension and normal contact force.
- **Non-Contact forces** – objects are physically separated e.g. gravitational force, electrostatic force and magnetic force.
- Forces are **vectors** – shown by arrows.



Gravity

Weight = the **force** acting on an object due to gravity.

- Gravity close to Earth is due to the gravitational field.
- Weight of an object depends on the gravitational field strength at the point where the object is.

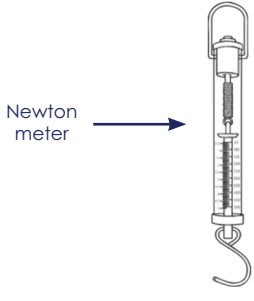
Weight can be calculated using:

Weight = mass × gravitational field strength

$$W = m \times g$$

Newtons (N) — Kilograms (kg) — Newtons per kilogram (N/kg)

- Earth's gravitational field strength = 9.8 N/kg
- Weight of an object can be considered to act at a single point = object's '**centre of mass**'
- Weight can be measured using a **newton meter**.



Resultant Forces

Resultant force = The sum of all forces or overall force acting on an object

Bike is being pushed forward with a force of 13N but there are resistive forces of 13N backwards.
Resultant force = 0N

What happens to the motion depends on what the bike was doing before these forces were applied:
If the bike was stationary, it will stay stationary
if the bike was moving, it will continue to move at a constant velocity

Car is being pushed to the left by a force of 350N. It is also pushed to the right by 500N.
Resultant force is: 500N – 350N = 150N

What happens to the motion depends on what the car was doing before these forces were applied:
If the car was stationary, it will **accelerate** to the right
If the car was already moving to the right, it will move faster (**accelerate**)
If the car was moving to the left (ie reversing), it will slow down (**decelerate**)

P5 – Forces

Vector Diagrams (HT only)

- Used to calculate resultant forces that are not acting directly opposite each other, on a straight line.

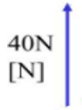
Rules ('tip to tail'):

- Draw first vector to scale, in the direction stated
- Draw second vector, from the tip of the first one in the direction stated.
- Join the two lines in a triangle and measure the resulting line
- Convert length to force using your scale – this is the resultant force

Example:

Two forces act on an toy boat - 40N acting north, 60N acting East. Calculate the resultant force and state the direction.

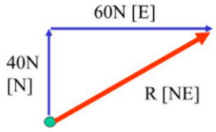
1. Draw the first vector to scale



2. Draw 2nd vector from tip of the first one. Again, to scale.

3. Join the two lines. Measure the resulting line.

Resultant force = 72N NE



Work Done And Energy Transfer

- When a force acts on an object and makes it move – **work is done**.

Work done = energy transferred

Work done is calculated by:

Work done = force × distance

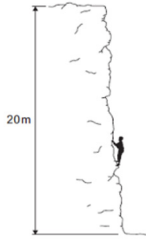
$$W = F \times s$$

Joules (J) Newtons (N) Metres (m)

- One joule of work is done when a force of one newton causes a displacement of one metre.
- 1 joule = 1 newton-metre

E.g A climber and his gear weigh 750N. Calculate the energy transferred climbing to the top of the cliff

W = F s
W = 750 x 20m
W = 15000J



- Work done against the frictional forces acting on an object causes a rise in the temperature.

Forces and Elasticity

- When work is done on an elastic object (e.g. stretching or compressing a spring), energy is stored as elastic potential energy.

Elastic deformation:

- When force is applied, object changes shape and stretches.
- When the force is no longer applied, object returns to original shape.

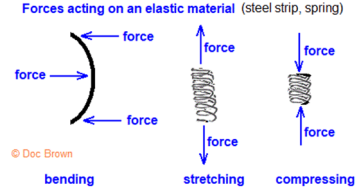
Inelastic deformation = stretched beyond limit – will not return to original shape and size.

Force = spring constant x extension

$$F = k \times e$$

Newtons (N) Newtons per metre(N/m) Metres (m)

Two forces are needed to stretch or compress



Work done in stretching (or compressing) a spring:

Elastic potential = 0.5 × spring constant × (extension)^2 energy

$$E_e = ½ \times k \times e^2$$

P5 – Forces

Required Practical

Aim: Investigate the relationship between force and extension for a spring (or any elastic object, e.g. elastic band)

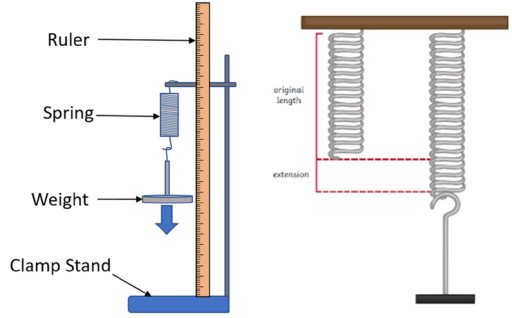
Method

1. Hang a spring from a clamp and stand
2. Measure original length of the spring and record this.
3. Attach a 100g mass – record the new length of the spring.
4. Continue adding 100g masses recording the length each time, up to a total of 500g.
5. Work out the extension for each mass using:
   final length – original length
6. Repeat steps 1-5 twice and calculate a mean
7. Plot a line graph with extension (m) on the x-axis and force (N) on the y-axis.

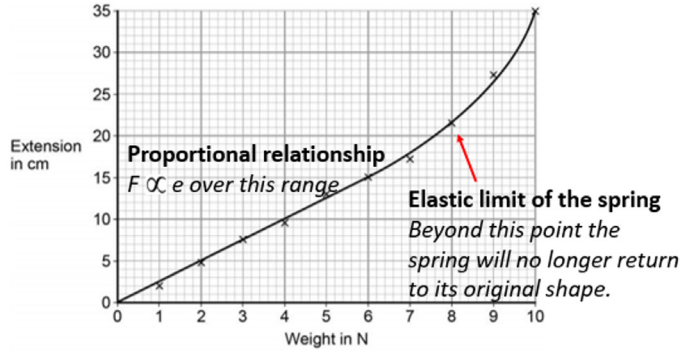
Independent variable : mass on the spring

Dependent variable : extension of the spring

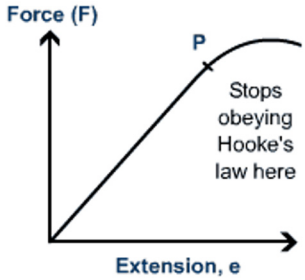
Control variables : same spring



Results



- There is a proportional relationship (shown by a straight line through the origin) at first.
- This means: **Force** ∝ **Extension** (F ∝ E)
- However, there comes a point when the 'elastic limit' of the spring is reached. This is also known as the **limit of proportionality**.
- If more force is applied after this, relationship is **no longer proportional**.
- After this point, the spring will not return to its original shape and size when the force is removed.



You may see the graphs with the axes switched – with extension on X and force on Y.

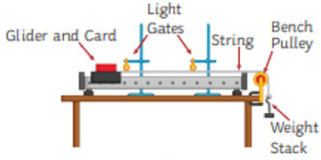
Gradient of linear part = spring constant, k, for the spring being used.

P5 – Forces – Required Practical
Acceleration

Aim: To investigate the effect of **varying force** on the acceleration of an object of constant mass.

You may be given any of the following apparatus set-ups to conduct these investigations:

Independent variable = force applied
Dependent variable = acceleration
Control variables = mass of toy car and surface car is on.



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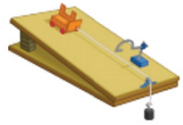

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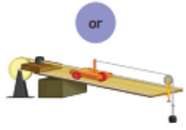
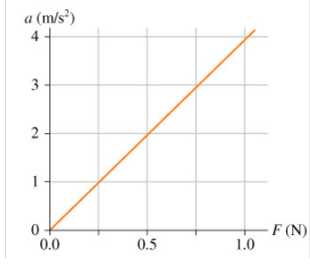


Method (using toy car)

1. Place the car on a ramp. Incline the ramp until the car just does not move. This is to remove as much of the effect of friction as possible.
2. Set up a light gate at the end of the ramp
3. Place a 1N weight on the pulley attached to the toy car.
4. Allow the weight to drop and read the acceleration of the car from the light gate
5. Repeat the experiment several times, decreasing the weight on the pulley each time (e.g. 0.8N, 0.6N, 0.4N etc.) Place the removed mass onto the car to keep the mass of the system constant

Results
Acceleration is proportional to force applied

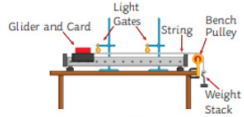


Aim: Investigate the effect of **varying mass** of an object on the acceleration produced by a constant force.

You may be given any of the following apparatus set-ups to conduct these investigations:

Independent variable = mass of glider
Dependent variable = acceleration of glider
Control variables = force applied and surface car is on

Method (using glider)



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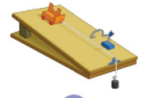

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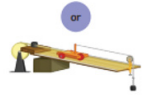
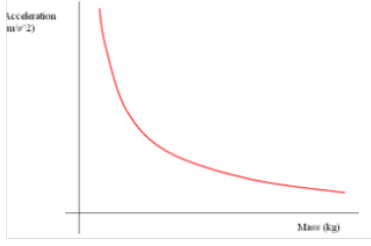


1. Place the glider on the track. Switch on the air blower and adjust until the glider just doesn't move. This is to remove as much of the effect of friction as possible.
2. Set up a light gate at the end of the air track
3. Add a 10g mass onto the glider. Place a 1N weight on the pulley attached to the glider and let go.
4. Record the acceleration from the light gate
5. Repeat the experiment several times, increasing the mass on the glider each time(e.g. 20g, 30g, 40g etc.) whilst keeping the weight (1N) on the pulley constant.

Results
Acceleration is inversely proportional to mass



P5 – Forces

Stopping Distance

Stopping distance = thinking distance + braking distance

- Greater the speed of vehicle – greater the stopping distance.

Thinking Distance (reaction time)

Thinking distance = distance travelled before driver reacts and presses brakes.

Reaction times are typically 0.2s to 0.9s

Factors that affect a driver's reaction time:

- Tiredness- Drugs- Alcohol

- Age- Distractions (e.g. phone/music)

Momentum (HT only)

Defined by the equation:

momentum = mass × velocity

p = m x v

Units:
momentum = kilograms metre per second (kg m/s)
mass = kg
velocity = m/s

- In a closed system, total momentum before an event is equal to the total momentum after the event – this is called **conservation of momentum**.

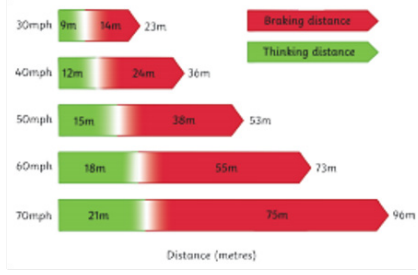
Braking Distance

Braking distance = the distance travelled by a vehicle once with **brakes are applied** until it reaches a full stop.

It can be affected by:
- wet/icy roads
- poor vehicle conditions (brakes/tyres)When a force is applied to brakes, work is done by the friction between the car wheels and the brakes.

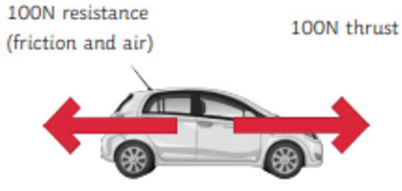
Work done – reduces the **kinetic energy store** and energy is transferred to the t**hermal store of the brakes**, increasing their temperature.

Increased speed = increased force required to stop the vehicle
Very large decelerations can lead to brakes overheating and /or loss of control of the car.



Newton's First Law

If resultant force acting on object is zero:
- Stationary object will remain stationary- Moving object will continue at a steady speed and in the same direction.



(HT only) Inertia = tendency of an object to continue in a state of rest of uniform motion (same speed and direction)

Newton's Second Law

Acceleration of an object is proportional to resultant force acting on it and inversely proportional to the mass of the object

Resultant force = mass x acceleration

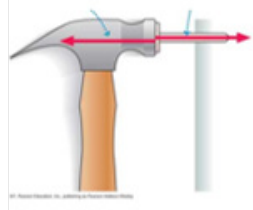
F = m x a

(HT only) Inertial mass = how difficult it is to change an object's velocity. Defined as ratio of force over acceleration.

Newton's Third Law

When two objects interact, forces acting on each other are always equal and opposite.

e.g. a hammer hitting a nail
The hammer exerts a force on the nail, and the nail exerts an equal and opposite force on the hammer.



P5 – Forces

Distance and Displacement

Distance and Displacement
Distance
- How far an object moves
- Does not involve direction
- Distance = scalar quantity

Displacement
- Includes both the **distance** an object moves, measured in a straight line, from start to finish point and the **direction** of that straight line.- Displacement = vector quantity

Speed

You should be able to recall the following typical speeds:

Activity	Typical Speed (m/s)
Walking	1.5
Running	3
Cycling	6
A car	25
A train	55
Speed of sound	330

Calculating speed:
speed = distance x time

E.g. A car travels 100 metres in 3.8 seconds. What is the average speed?

v=s/t

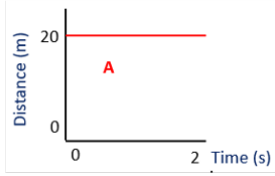
v = 100 m / 3.8 s

v= 26 m/s

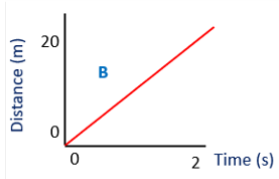
Distance time graphs

Distance time graphs show the motion of an object

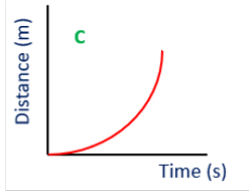
The gradient tells us the speed of the object



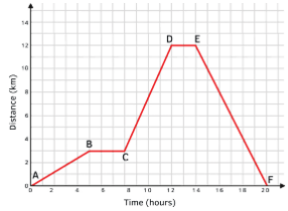
Object is stationary (distance not changing)



Object is travelling at constant speed
v = 20/2
v = 10 m/s



Object is accelerating
(HT only) Speed can be calculated by:- Drawing a **tangent** and finding the **gradient** of the tangent



A journey generally has different speeds. Average speed can be calculated by using total distance ÷ time

Velocity and Acceleration

Velocity & acceleration = vector quantities

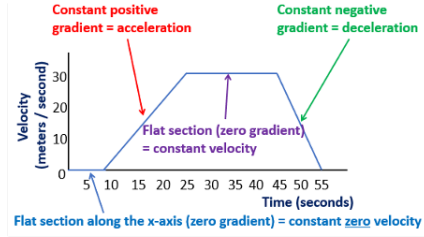
1. Velocity = **speed** in a given **direction**
- positive velocity = forwards (eg +5 m/s)
- negative velocity = backwards (eg -5 m/s)
2. Acceleration is a **change in velocity**
- positive acceleration = speeding up
- negative acceleration = slowing down

Average acceleration of an object can be calculated using:

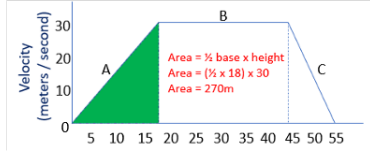
acceleration = $\frac{\text{final velocity – initial velocity}}{\text{time taken}}$

Units for acceleration are m/s2

Velocity time graphs
Show how velocity changes during a journey
The gradient shows the acceleration



HT only - area underneath a velocity time graph is the distance travelled by an object

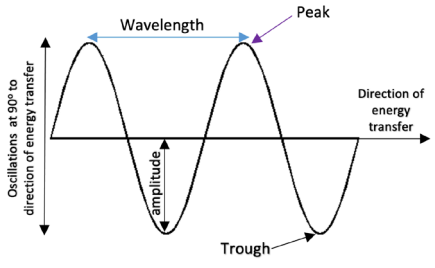


P6 – Waves

Transverse Waves

Oscillations (vibrations) **perpendicular** to direction of energy transfer.

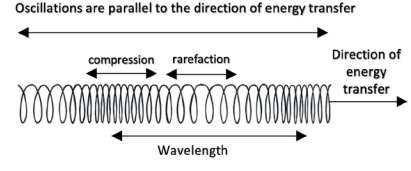
Examples:
- Electromagnetic waves
- Ripples on water.



Longitudinal Waves

Oscillations (vibrations) are **parallel** to direction of energy transfer.

Examples: - Sound waves



Sound waves have areas of compression and rarefaction.
Compression = particles pushed closer together
Rarefaction = particles are further apart

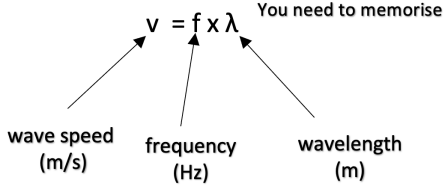
Properties of Waves

Amplitude – maximum displacement from undisturbed position.

Wavelength – distance from a point on one wave to the equivalent point on the next wave.

Frequency – number of waves passing a point each second.
Frequency is measured in Hertz (Hz)
1Hz = 1 wave per second.

Wave speed – the speed at which energy is transferred through a medium.



Measuring speed of sound waves in air

- Stand 50m from a large flat wall.

- One person claps/bangs bricks

- Measure time taken to hear the echo.

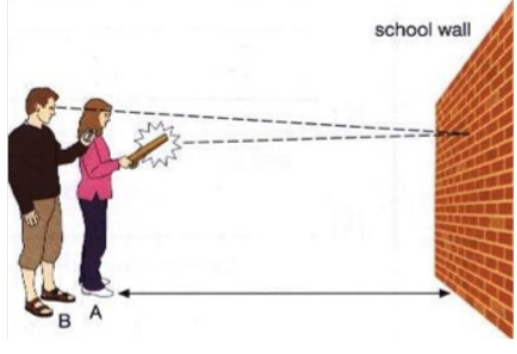
- Calculate speed of sound using:

Speed = distance × time

- Remember distance is double (in this case, 100m) as it travels to the wall and back.

- Take several measurements and calculate the mean to reduce error.

This is unlikely to produce an accurate value for sound in air (330 m/s) as the reaction time of the person operating the stopwatch is likely to be a significant proportion of the time me

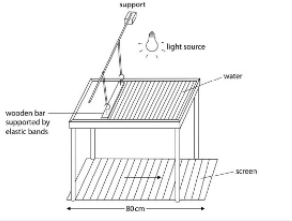


P6 – Waves – Required Practical
Investigating Wave In a Solid And a Ripple Tank

Measuring waves in a liquid

Equipment

- Ripple tank
- Measuring ruler
- Stop watch



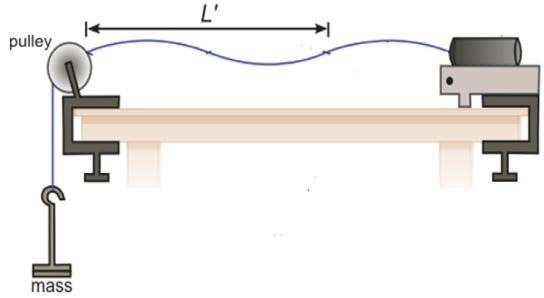
Method

1. Set up the equipment as shown and turn on the motor to produce low frequency waves so that they are able to be counted.
2. Adjust the lamp until pattern is seen clearly on white screen underneath
3. Use a ruler to measure the length of a number of waves (e.g 10) and divide the length by the number of waves to give wavelength. This improves the accuracy of the measurement.
4. Record the waves using a camera or mobile phone. Count the number of waves passing a point in 10 seconds using a stopwatch and slowing the recording down.
5. Divide the number of waves counted by the time to give frequency.
6. Use $v = f \times \lambda$ to calculate the wave speed. Repeat for different frequencies of the motor.

Measuring waves in a solid

Equipment

string, vibration generator, hanging mass set and pulley



Method

1. Set up the equipment as shown.
2. Turn on the vibration generator
3. Adjust the length of the string until a standing wave is achieved
4. The frequency can be read from the vibration generator
5. Measure as many complete waves as possible using a ruler
6. Divide the length by the number of waves to give wavelength
7. Calculate speed using $v = f \times \lambda$

Conclusion:

In both experiments, when you increase the frequency,
the wavelength decreases – the speed remains the same in the same medium

Exp	Length of 10 waves (cm)	Length of 10 waves (cm)	Number of waves in 10 s	Frequency (Hz)	Speed (cm/s)
1	65	0.65	121	12.1	7.9
2	50	0.5	155	15.5	7.9
3	42	0.42	187	18.7	7.9

P6 – Waves

The Electromagnetic Spectrum

- All **transverse waves**
- Transfer energy from the source of waves to an absorber.
- All travel at the same **velocity** through a vacuum or air – **speed of light**.
- Speed of light = 300,000,000 m/s

You must remember all the electromagnetic waves in order!

Long wavelength → Short wavelength

Radio waves	Microwaves	Infrared	Visible light	Ultraviolet	X-rays	Gamma rays

Low frequency → High frequency

Wave	Use	Other information
Radio waves	Television and radio	Easily transmitted through the air. Harmless if absorbed by the body.
Microwaves	Satellite communications and cooking food	Can be harmful when internal body cells become heated by over exposure.
Infrared	Electrical heaters, cooking food and infrared cameras	Can cause burns to skin
Visible light	Fibre optic communications	Only EM wave detectable by human eye.
Ultraviolet	Energy efficient lamps, sun tanning	Causes skin tanning and can lead to burns or skin cancer.
X-rays	Medical imaging and airport security scanners.	Very little energy is absorbed by body tissues. Passes through the body. They can lead to gene mutation and cancer.
Gamma rays	Sterilising medical equipment or food and treatment for some cancers.	

Ray diagrams

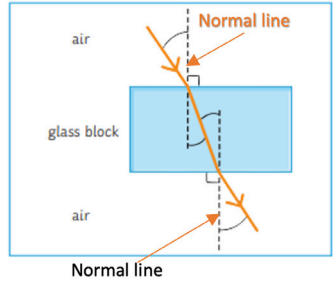
You need to construct ray diagrams to show how a wave is refracted at the boundary of a different medium.

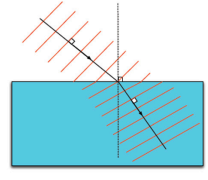
Less dense ➞ More dense
(e.g. air to glass)- Ray **slows down** and bends **towards the normal** line.

More dense ➞ Less dense
(e.g. glass to air)
- Ray **speeds up** and bends **away from the normal** line.

The ray bends because different parts of the wave front cross the boundary at slightly different times –

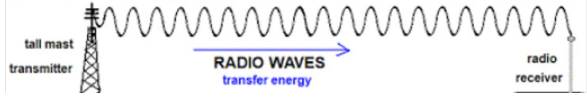
If wave hits medium at an angle of 90° then the ray will slow down but will not be refracted.





Radio waves (HT only)

- Radio waves can be produced by oscillations in electrical circuits. Those radio waves can travel for long distances to receivers.
- When absorbed by the receiver, the radio wave creates an **alternating current** with same **frequency** as the wave itself.
- This is how TV and radio are broadcast.



P6 – Waves – Required Practical
Infrared radiation

Aim

Investigate how the amount of infrared radiation **emitted** (given out) by a surface depends on the nature of that surface.

In this investigation you are finding out which type of surface emits the most infrared radiation:

- **Dark and matt**
- **Dark and shiny**
- **Light and matt**
- **Light and shiny**

Method

1. Place **Leslie cube** on a heat proof mat.
2. Once the kettle has boiled, fill the Leslie cube with water.
3. Hold the infrared thermometer 5cm from the first surface
4. Record the temperature
5. Repeat the experiment three times on each surface and calculate mean for each surface.

Independent variable: surface

Dependent variable: temperature of the air (infrared radiation emitted)

Control variables: Temperature of the water inside, the distance between the cube surface ad the infrared thermometer

In this investigation you are finding out which type of surface absorbs the most infrared radiation:

Method

1. Fill a black and a silver can with water from the tap.
2. Take the temperature of the water in each can
3. Place the infrared thermometer 5cm from the cans
4. Leave for at least 10 minutes
5. Record the temperature of the water in each can and calculate the rise in temperature

Independent variable: surface of the can

Dependent variable: Temperature increase of the water (infrared radiation absorbed)

Control variables: Temperature of the water inside, the distance between the cube surface ad the infrared thermometer

Conclusion

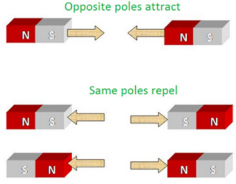
Black matt surfaces absorb and emit the most infrared radiation.

White/silver and shiny surfaces are poor emitters and poor absorbers of infrared radiation

P7 – Magnetism and Electromagnetism

Magnets

- Have two poles - **north** and **south**.



- **Like poles** will **repel** each other (e.g. N-N or S-S)
- **Opposite poles** will **attract** (e.g. N-S)
- Magnetism is a **non-contact** force – magnets do not need to be touching for effect to be observed.

Magnetic materials: only **iron/ steel**, **cobalt** and **nickel** are magnetic.

Types of magnets

Permanent magnet

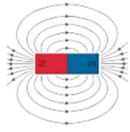
- Produces its own magnetic field.
- Magnetism cannot be turned on or off.

Induced magnet

- Induced magnet = a material which becomes magnetic when placed in a magnetic field.
- Induced magnets only attract other materials and lose magnetism when removed from the magnetic field.

Magnetic Fields

- **Magnetic field** = the area surrounding a magnet where the force will act on another magnet or magnetic material.
- Magnet field is strongest at the **poles** where the field lines are **closest together**.
- Field lines always go away from **magnetic north** and towards **magnetic south**.



Earth's Magnetic Field

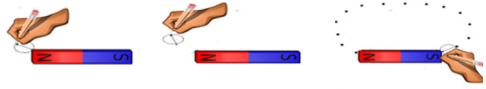
- Earth produces a magnetic field.
- Magnetic compasses use this to help navigation.
- The core of the Earth is made of **iron** (magnetic).

Plotting Magnetic Field Lines

A magnetic compass can be used to plot and draw the magnetic field lines around a magnet.

You need to be able to describe this method!

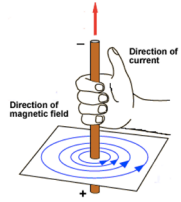
1. Place the bar magnetic in centre of paper.
2. Place a plotting compass at one end of the magnet.
3. Put a pencil dot at the place the compass arrow is pointing to.
4. Move the compass to line up the tail of the compass needle to the dot you just made.
5. Repeat until you reach the other end of the magnet.



6. Join the dots using a line – this is the magnetic field line. Mark on the direction the arrow pointed – it should run N→S.

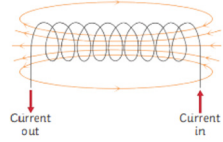
Electromagnetism

- When a current passes through a wire, a **magnetic field** is produced.
- The direction of the field can be found by the right hand thumb rule.
- curl the fingers of the right hand around the wire and point the thumb in the direction of the current (+ to -).



- The direction of the circular field is shown by the fingers.
- Strength of magnet can be increased by increasing the current.
- When the current is switched off, the magnetic field is lost.

Coiling the wire will form a **solenoid**.



To increase strength of magnetic field around a solenoid you can:

- Add an **iron core**
- **Increase number of turns** in coil
- **Increase the current** passing through wire

Electromagnets

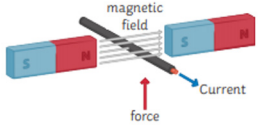
- Electromagnet is a solenoid with an iron core.
- Are **induced magnets** (can be turned on and off)

Uses = electric motors, loudspeakers, electric bells, scrapyards.

P7 – Magnetism and Electromagnetism

The Motor Effect (HT only)

- When a wire carry a **current** is placed in a magnetic field, the two magnetic fields interact and a **force** is exerted on the wire.
- This is called **motor effect**.
- The force produced by the motor effect can be calculated using:



Force (N) = magnetic flux density (T) x current (A) x length (m)

F = B x I x l

For example:

A current of 8A is flowing through a wire that is 75cm long. The magnetic field acting at a right angle on the wire is 0.5T. Calculate the force.

Remember: the equation uses length in m. The question has given you the length in cm so you need to convert it before you answer.

F = 0.5 x 8 x 0.75F = 3N

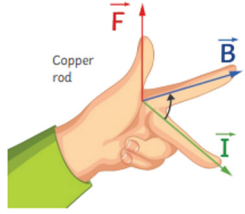
- If current flowing through wire is **parallel** to magnetic field, **no force** is produced.

Fleming's left-hand rule

- You may be asked a diagram and asked to indicate direction of force.
- You can use Fleming's left-hand rule to do this (picture)

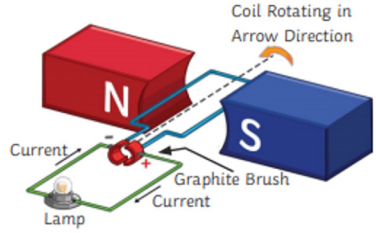
Remember (**F B I**):

- Use your **left hand!**
- The angle between index and middle should be **right angle.**
- Thumb = direction of **force**
- First finger = direction of **magnetic field**
- Second finger = direction of **current** through wire.

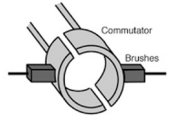


Electric Motors (HT only)

- When wire carrying current is **coiled**, the motor effect causes wire to **rotate**.
- This is how an **electric motor** works.

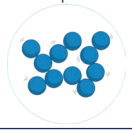


- Current flows force produced acts in **opposite directions** causing coil to **rotate** overall.
- When coil reaches a **vertical position,** force is parallel so would be zero – stops rotating.
- A gap in the **split ring commutator** in the motor cuts the current temporarily.



- Momentum ensures the coil carries on moving
- The commutator reconnects and **changes the direction of the current** to maintain a **constant rotation** in one direction overall.
- Increase speed of rotation by increasing the:
  - current
  - strength of magnet
  - number of turns on the coil

Particle Model of Matter

State	Pattern	Energy and movement	Forces between particles
Solid 	Ordered and all touching	Vibrate around fixed positions	Strong forces between particles
Liquid 	Random and touching	Move around randomly	Weaker than in a solid
Gas 	Random and far apart	Move around randomly	Weak forces of attraction

Models	+	−
Particle diagrams	Easy to see/draw arrangement	• Can't see the forces between particles • Particles look like flat circles rather than 3D spheres • Movement isn't shown
Kinetic models (e.g. marbles or animations)	Easy to see particle arrangement Can see the movement of particles	Can't see forces between particles

Density

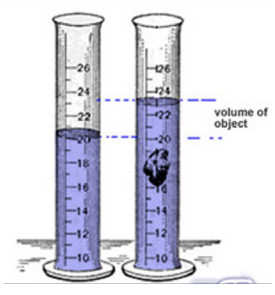
Density is mass per cm^3
It can be calculated using:
Density = mass ÷ volume
ρ = m ÷ V

Required practical – measuring the density of different materials.

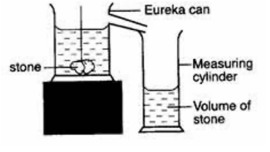
For regular solids:
Mass measured by **top pan balance**
Volume measured by measuring **length × breadth × height**

For irregular solids:
Mass measured by **top pan balance**
Volume measured by **displacement of water**
This means putting the object into water and measuring the volume of water 'pushed out'

Measure the volume of small objects by putting them into a measuring cylinder with 100cm^3 water in

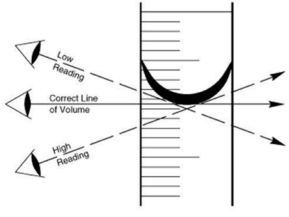


Measure the volume of larger objects by putting them into a full eureka can and catching and measuring the water that is displaced



Zero error

Read the meniscus!



Required Practical Continued : Density of Liquids

1. Find the mass of an empty measuring cylinder using a top pan balance.
2. Pour a known volume (100ml) of liquid into the measuring cylinder.
3. Use the meniscus to measure the volume of the liquid accurately. This is the volume.
4. Now measure the mass of the measuring cylinder + the liquid combined.
5. Subtract the mass of the empty measuring cylinder and this is the mass of the liquid.

Density = mass ÷ volume.

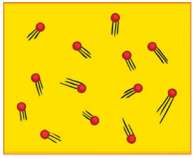
Particle Model of Matter

Internal Energy

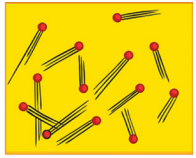
The temperature of any substance is related to the average speed of its particles.

The internal energy of a system is the total kinetic energy and the potential energy of the particles.

The particles in a system **vibrate** or **move around** because they have energy in their **kinetic energy stores**.
The faster a particle moves, the greater its **kinetic energy store.**



Low Temperature

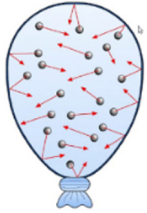


High Temperature

The particles also have energy in their **potential energy stores** due to their position.
As particles **move further apart**, their potential energy stores **increase.**

Gas Pressure

The particles in a gas are in constant random motion
They collide with the walls of their container
This exerts a force **on the container**.



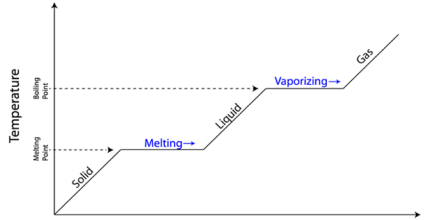
The more energy the particles have, the higher the temperature.
An increase in temperature of a gas causes the particles to move further apart.
If this is not possible, because of the container, then there is an increase in pressure.

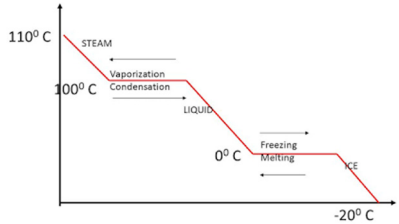
Heating and Cooling

When the internal energy of a substance changes, then either:

- **The temperature** of the substance changes
- **The state** of the substance changes

This can be seen by plotting the temperature change during **heating** or **cooling**.
Heating a solid would give us a graph that looks like this:





- The **temperature stays the same**.
- This is when a change of state is happening – for example melting.
- The energy transferred is not increasing the mean particle speed – it is increasing the potential energy of the particles.

When the line is increasing (heating) or decreasing (cooling)

- The temperature is increasing / decreasing
- The kinetic energy store is increasing /decreasing
- Average particle speed is increasing /decreasing

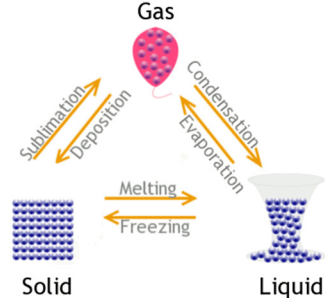
Specific Latent Heat

Specific latent heat is the amount of energy needed to **change 1kg of a substance from one state to another** without changing the temperature.

Specific latent heat will be different for different materials.

Energy needed to change 1kg of Solid → liquid - **specific latent heat of fusion**

Energy needed to change 1kg of Liquid → gas - **specific latent heat of vaporisation**



The amount of energy needed to change 1Kg of a material is found by the equation:

Energy = mass (kg) x specific latent heat (L)

E = m L

Specific Heat Capacity

This is the among of energy needed to change the temperature of 1Kg of a substance by 1°C

It is calculated by:

E = specific heat capacity × mass × temp change

E = SHC × m × Θ

Natural Hazards

1. Natural Hazards

Natural hazard	A natural event that threatens people or has the potential to cause damage, destruction and death. E.g. earthquakes
Tectonic hazards	Caused by movement of the tectonic plates (volcanoes and earthquakes).
Atmospheric hazards	Created in the atmosphere (tropical storms, drought, tornadoes).
Hazard risk	The probability or chance that a natural hazard may take place.
Earthquake	A sudden or violent movement within the Earth's crust followed by a series of smaller shocks.
Volcanoes	An opening in the Earth's crust from which lava, ash and gases erupt.
Factors Increasing Hazard Risk	
Vulnerability	Higher population densities (floodplains). More people living in dangerous areas.
Capacity to cope	Poverty means people can't afford protection/planning e.g. can't evacuate.

3. Distribution of Tectonic Hazards

Plate margin	The margin or boundary between two tectonic plates.
Tectonic plate	A rigid segment of the Earth's crust which can float across mantle.
Hazard	**Distribution**
Volcanoes	At destructive + constructive margins. Ring of Fire around edge of the Pacific. Some aren't on margins. (Hotspots)
Earthquakes	Mostly on plate margins. (All margins) Along w. coast North + South America. Some caused by fracking and mining.

2. Plate Tectonic Theory

Theory	**Explanation**
Convection currents	Occur in the mantle. The heating and cooling of magma in the mantle makes currents which can move tectonic plates. 
Slab pull	Created in the atmosphere (tropical storms, drought, tornadoes).
Ridge push	The probability or chance that a natural hazard may take place.
Structure of the earth	
Crust	The crust is made up of 7 large tectonic plates and several smaller ones.
Oceanic crust	Thin 5 - 10km. More dense. Can be made and destroyed.
Continental crust	Thick 30 - 50km. Less dense. Older, never destroyed.
Mantle	Semi molten rock moves slowly. Convection currents occur here.
Outer core	Liquid. Iron and nickel.
Inner core	Solid. 5500°C.

5. Key Terms

Primary effects	The initial impact of a natural hazard on people and property. Caused directly by the event.
Secondary effects	The after effects that occur as indirect impacts of natural events, sometimes on a longer timescale.
Immediate responses	The reaction of people as the disaster happens and in the immediate aftermath.
Long term responses	Later reactions that occur in the weeks, months and years after the event.

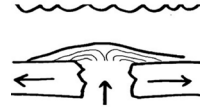
4. Plate Margins

Include processes and ensure correct sequence.

Destructive margins
Composite volcanoes.
Earthquakes.

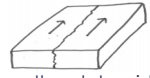
1. **Convection currents** move two plates towards each other.
2. The oceanic plate is denser and so **subducts** under the less dense continental plate.
3. Due to **friction**, and heat in the mantle, the oceanic plate melts.
4. **Pressure** builds up. Magma is eventually released.
5. An explosive eruption forms a **composite volcano**.

Constructive margins
Shield volcanoes.
Earthquakes.



1. **Convection currents** move two plates away from each other.
2. Magma from the mantle rises through the gap.
3. The lava is very runny so travels a long distance before cooling.
4. Over many eruptions, a **shield** volcano is formed.

Conservative margins
Earthquakes.



1. **Convection currents** move the plates side by side.
2. Friction builds up causing **tension**.
3. Eventually the tension will be released as waves of energy which is an **earthquake**.

There are no volcanoes at this margin.

Natural Hazards

6. Tectonic Hazards Vary Between Contrasting Levels Of Wealth

	LIC $730	HIC $40,000	
Earthquake	**Nepal 2015**	**New Zealand 2016**	**Explanation**
Primary effects	• 8,632 died. 22,000 injured. • 22 hospitals destroyed. • 499,000 homes destroyed. • Dharahara Tower collapsed.	• 2 died. 50 injured. • Water/power damaged. • Only 36 red tag buildings. • 400km road/rail destroyed	New Zealand's buildings are earthquake proof. In Nepal building quality is poor, responses ineffective.
Secondary effects	• US $5 billion in damages. • Tourism decreased by 1/3. • 4mill homeless, no water. • Avalanches on Everest (18 deaths)	• US$8.5 billion in damages. • 200 homeless from Waiau. • 100,000 landslides, blocked Clarence River.	Damage costs were higher in New Zealand as more expensive infrastructure.
Immediate responses	• India– search/rescue 15mins • Shelter- Kathmandu tent city • Charities like Oxfam gave aid	• 200 evacuated in 24 hours. • Power restored in 24 hrs. • Clean water supplies set up	Not adequate in Nepal, relied on aid. New Zealand had plans in place rapid and efficient.
Long term responses	• Asian development bank gave US $200 mill • Investment needed for infrastructure	• New water pipes 4 months • Road/rail repaired in 2yrs. • Relief fund for low income	In Nepal these were slow and are still ongoing. Very fast in New Zealand as more money.

7. Why do people continue to live in areas at risk from tectonic hazards?

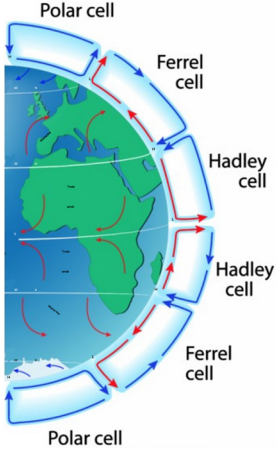
Low frequency	People think they won't happen in their lifetime.
Always lived there	Don't want to leave family / friends.
Monitoring	People feel safe as they'll be warned if a hazard is imminent.
Poverty	People can't afford to leave.
Benefits	Volcanoes have fertile soil and geothermal energy. (Economic)
Protection	EQ proof buildings make people feel safe.

8. Management Can Reduce The Risks From Tectonic Hazards

	Planning	**Prediction**	**Protection**	**Monitoring**
Definition	Actions taken to enable communities to respond to, and recover from, natural disasters.	Attempts to forecast when and where a natural hazard will strike, based on current knowledge.	Actions taken before a hazard strikes to reduce its impact.	Recording physical changes to help forecast when and where a natural hazard might strike.
Earthquake examples	Similar for both. Future development avoids high risk areas. Educate people to know what to do (drills) Plan evacuations. Stockpile emergency supplies i.e. water.	Can't reliably be done for EQs. But we can suggest areas that will be vulnerable.	EQ proof buildings i.e. reinforced concrete. Bridges strengthened with steel frames.	Seismometers and lasers monitor earth movement. Only gives a SMALL warning time.
Volcanoes examples		Can be predicted if the volcano is well monitored. Some LICs can't afford to do this.	Roofs strengthened (heavy ash). Trenches or barriers to divert lava (not successfully).	Seismometers, gases released, changes in shape of the volcano.
How does it reduce the risks?	Less people are vulnerable. Often more efficient in HICs.	Allows evacuation, which can reduce deaths and injuries.	Buildings less likely to collapse reducing injury. But expensive.	Allows a warning to be given to put plans in place like evacuation.

Natural Hazards

9. Global Atmospheric Circulation

Global atmospheric circulation	Worldwide system of winds, which transport heat from the equator to the poles.
Key information	Wind is large scale movement of air from HIGH to LOW pressure. This is caused by differences in temperature at the Equator and the poles. The circulation is divided into loops called CELLS. Low pressure = Rising air = Rain. High pressure = Sinking air = Clear skies.
	At the poles, cool air sinks creating high pressure. (<250mm rainfall). At 60°N air rises between the Ferrel and Polar cell creating an area of low pressure. The UK gets lots of low pressure weather blown in from the Atlantic. At 30°N air sinks between the Ferrel/ Hadley cell creating high pressure (deserts <250mm rain). On the equator air rises as the sun's heat is most concentrated. This creates a low pressure area with high rainfall. (Rainforests >2000mm of rain). Surface winds blow towards the equator (trade winds). Direct hurricanes to west. Here winds blow towards the poles and are called Westerlies. (From the west). The winds curve due to the spin of the earth (Coriolis effect).

10. Weather Hazards in The UK

Extreme weather	A weather event that is significantly different from the average pattern and is especially severe or unseasonal.
Strong winds	Damage property / disrupt transport. 2018 Storm Ali killed 2 people.
Heavy rain	Can cause flooding, costing millions. Cockermouth 2009 314 mm in 24 hrs.
Snow	Injury, death, travel disruption. March 2018 Beast from East. 50 cm.
Drought	Crop failure, rules to conserve water. April 10 - March 12 only 75% of rain.
Heatwaves	Pollution builds up breathing problems. Death. BUT tourism benefits. 2018.

11. Evidence That Weather is Becoming More Extreme…

Our weather is naturally variable BUT extreme events are becoming more common and severe.

Hazard	Example
Temperature	10 warmest years all occurred since 1990. 2018 joint hottest summer on record. Dec 2010 coldest month for 100 years.
Rainfall	More rainfall records broken between 2010 - 2014 than in any other decade. Dec 2015 wettest month on record.

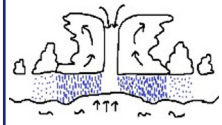
12. An Example of a Recent Extreme Weather Event In The UK

Name	Cockermouth floods 2009.
Causes	314 mm of rain in 24 hours.
Impacts	• 80% of businesses affected. • Damage cost over £100 million. • Police officer died. • 2239 properties flooded. • 110 farms suffered from silt. • Biodiversity / habitats affected.
Management strategies	Immediate responses • Government gave £1 million. • Cumbria Flood Recovery Fund £1 mill. • 'Visit Cumbria' website provided information for locals. Long term responses • £4.4 mill management scheme. H 120m self-raising flood gate. S Flood action group, 2000 trees planted

Natural Hazards

13. Tropical Storms

Hurricanes, cyclones, typhoons. An area of low pressure with winds moving in a spiral around the calm central point called the eye of the storm. Winds are powerful and rainfall is heavy.

Factor	Example
Global distribution	5° – 30° north and south of equator (sea temp warm, wind shear low). More in the northern hemisphere. Move towards the west.
Relationship with ACM	Trade winds (from high to low pressure) send tropical storms to west.
	Circular, can be 100s of km wide. Eye- calm in centre (air LOW). Eyewall - strong winds, torrential rain. Edges - Wind speed falls, rain reduces.
How will climate change affect them?	
Distribution	Increase to higher latitudes (warmer sea temperatures).
Frequency	Number could increase. (Longer Seasons)

14. Formation of Tropical Storms

Include processes and ensure correct sequence.

Conditions	5-30° latitude. Ocean depth > 60m deep. Sea temperature > 27°C. Form summer and autumn.

1. Sun heats the ocean (27°C) > **rapid evaporation**.
2. **Condensation** occurs quickly leading to a large amount of cloud forming (**tropical depression**).
3. Due to the earth's rotation, this cloud mass starts to spin. An eye is formed in the centre.
4. Due to rising air, a **low pressure** area forms below. Air rushes into this creating high wind speeds. (>74mph = **tropical storm**)
5. The low pressure results in the ocean being uplifted forming a **storm surge**.

15. How Can We Reduce The Impacts?

Prediction / monitoring	Satellites and aircraft to monitor storms. Computer models calculate the predicted track. Allows warnings so people can evacuate or protect their home.
Planning	New developments avoid high risk areas Emergency services train and prepare. Plan evacuation routes. Reduces the injuries and deaths.
Protection	Building design- reinforced concrete, stilts to reduce flood risk. Flood defences along rivers and coasts. Reduces the number of buildings

16. Tropical Storms Affect People And Environments.

	Generic	Typhoon Haiyan 2013 Philippines
Primary effects	Direct results of strong winds, high rainfall, storm surges. Flooding, buildings destroyed, death.	• 6,201 deaths. (Most drowned in storm surge.) • 1.1 million houses damaged. • 90% of Tacloban city destroyed.
Secondary effects	Homelessness > lead to poor health. Lack of sanitation > diseases (cholera) Food shortages, price increase.	• 4.1 million homeless. • Damage cost US$12 billion. • 1.1 million tonnes of crops destroyed (rice).
Immediate responses	Evacuate before the storm. Rescue those affected. Provide food, water, blankets. Aid workers arrive from abroad. Recover dead bodies (prevent disease).	• Over 1200 evacuation shelters set up. • Philippines Red Cross delivered basic food aid. • UK sent shelter kits. • 800,000 evacuated (warnings given 2 days early).
Long term responses	Repair homes and infrastructure. Promote economic recovery.	• More cyclone shelters built. • No build zones. • 'Cash for work' programmes.

Natural Hazards

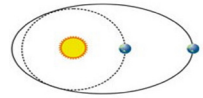
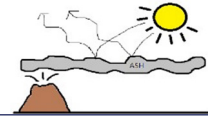
17. Climate Change Key Terms

Climate change	A change in the global climate from the expected. This can be due to natural or human causes.
Global warming	Gradual increase in the temperature of the earth's atmosphere generally attributed to the greenhouse effect.
Quaternary period	The period of geological time from about 2.6 million years ago to today
Glacial periods	Colder periods of time.
Interglacials	Warmer periods of time.
Greenhouse gases	Water vapour, carbon dioxide, methane, nitrous oxide, ozone, CFCs
Enhanced greenhouse effect 	The greenhouse effect is a **natural process** that warms the Earth so humans can survive. However, humans have added **extra** GHGs to the atmosphere trapping too much heat making the climate hotter

18. Evidence For Climate Change

Pollen analysis	Pollen is preserved in peat bogs, we can date the peat and the type of pollen suggests the climate conditions.
Photos	Comparing photos from the 1800's with today show glaciers have shrunk.
Ice cores	Ice cores are extracted by drilling. Analysis of trapped gases tell us the climatic conditions of the past.
Tree rings	Thinner rings indicate colder climates. They can tell us changes in temperature for about 10,000 years.
Temperature records	Records using thermometers show us temperature variations around the globe, but only since the 1850's.

19. Causes of Climate Change

Natural factors	**Orbital changes**	Changes in the pathway of the Earth around the Sun over 96,000 years from circular to elliptical. During the circular rotation the earth is closer to the sun and so the climate is warmer. 
	Volcanic activity	Large volcanic eruptions emit ash/gases into the atmosphere. These reflect the sun's radiation back out to space and reduces temperature on Earth for short periods of time (volcanic winters). 
	Solar output	The sun's output of energy changes on a 11 year cycle. When solar output increases the Earth experiences warmer climates.
Human causes	**Use of fossil fuels**	CO_2 is released into the atmosphere when fossil fuels are burnt. This occurs with cars, factories and to make electricity.
	Agriculture	Farming of livestock produces lots of methane and we now eat more meat. Rice farming also releases methane and is a core food in many cultures.
	Deforestation	Plants remove CO_2 from the atmosphere and convert it to organic matter using photosynthesis. When we cut down trees we stop them absorbing more CO_2. If trees are burnt for fuel or to clear land for farming they release CO_2 into the atmosphere.

20. Effects of Climate Change

On People	- Death rate has increased (some due to heat, some due to cold) - Migration vital from low lying areas - Water stress increases (political tension) - Lower crop yields (malnutrition) - High damage costs from more storms + Higher temperatures bring an economic boost to some areas (hotter = more tourism, countries at high latitude - farms grow more)
Environment	- Glaciers shrink, ice caps melt - Sea levels rise. 82cm by 2100. - Coastal erosion increases - Coral reefs suffer bleaching - Biodiversity may decrease - More extreme weather events (storms, fires)

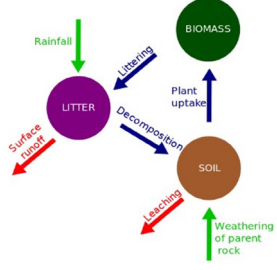
Poor countries tend to suffer the most as they do not have the money to adapt effectively to climate change. Often located in more vulnerable areas.

Natural Hazards

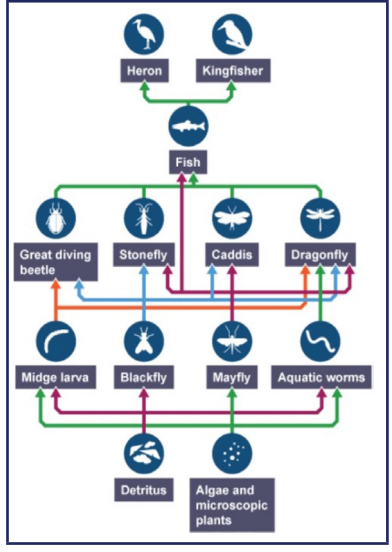
21. Managing Climate Change			
	Strategy	Explanation	Evaluation
Mitigation	Action taken to reduce or eliminate the long term risk to human life and property from natural hazards and climate change.		
	International agreements	1997 Kyoto Protocol. Countries agreed to monitor and cut GHG emissions. UK's target was to cut emissions by 12.5% by 2012 (surpassed it at 22%). 2015 Paris Agreement. 196 countries.	+ Global reduction of CO_2 - The USA didn't ratify the Kyoto agreement and withdrew from the Paris agreement.
	Planting trees	This increases the amount of carbon dioxide that is absorbed from the atmosphere through photosynthesis.	+ Also has other environmental benefits. - Takes a long time for trees to grow
	Alternative energy production	Replace fossil fuels with nuclear power and renewable energy to reduce GHG emissions. The UK is building more offshore windfarms and offering grants for people installing solar panels.	+ Reduces CO_2 emissions. - Expensive, needs large investment.
	Carbon capture and storage	New technology which captures CO_2 from power stations burning fossil fuels and transports it to places it can be stored safely underground.	+ Reduces CO_2 - Expensive technology
Adaptation	Actions taken to adjust to natural events such as climate change, to reduce potential damage, limit the impacts, take advantage of the opportunities, or cope with the consequences.		
	Changes in agricultural systems	Rainfall unreliable, temperatures higher, Drought resistant crops can be used i.e. millet in Kenya. Some countries are changing to grow different crops i.e. peaches and grapes in southern UK.	+ Higher latitude areas can get more varieties of food. - Drought resistant seeds can be expensive, increases food prices > impacts the poor the most.
	Managing water supply	Dry areas getting drier = water shortages. Collect rainwater, recycle waste water. Water meters installed to cut use.	+ Collecting rainfall is cheap. - Water meters may not change use in HICs (habits need changing). - Little use if the is no rain.
	Reducing risk from rising sea levels	Expected to rise by 82cm in 2100. Physical defences like flood barriers can be built. Cheaper options = earth embankments and building houses on stilts.	+ Important as large areas are being affected. - Can be unaffordable for LICs

Living World

1. What Is An Ecosystem?

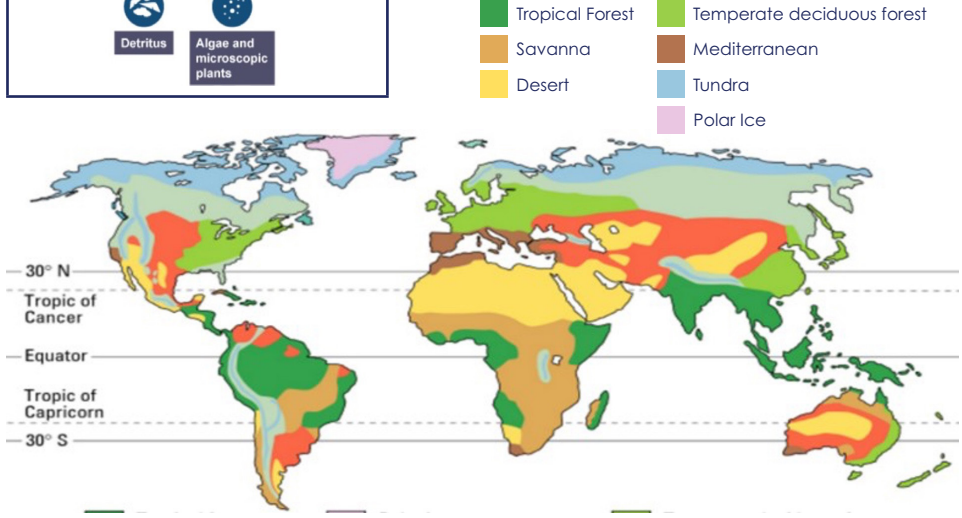
Ecosystem	A community of plants and animals (biotic) that interact with each other and their physical environment - abiotic
Biotic	Living elements e.g. plants, animals.
Abiotic	Non-living elements e.g. soil, climate.
Food Web	A complex hierarchy of plants and animals relying on each other for food. Made of many food chains.
Food Chain	The connection between different organisms that rely on one another as their food source. Single flow of energy
Producer	An organism or plant that is able to absorb energy from the sun through photosynthesis.
Consumer	Organisms that eat other organisms. Primary consumers - grasshoppers. Secondary consumers eat herbivores.
Decomposer	An organism that breaks down organic material and recycles nutrients to the soil. E.g. bacteria and fungi.
Nutrient Cycle	A set of processes whereby organisms extract the nutrients necessary for growth from soil or water, before passing them on through the food chain. Decomposers ultimately return these back to the soil. 

Food Web



2. Example of a Small-scale Ecosystem

Name	Fresh water pond
What?	Consists of pond bottom, mid water, surface, pond margin, above surface.
Interrelationships	Margin provides shelter for insects. Pond surface allows fish to prey on insects like dragonflies. Decomposers live on the pond bottom.
Balance between components	Introduction of more fish means the kingfishers thrive, but the number of caddis decrease due to more predators
	Fertilisers from fields draining into the pond may cause eutrophication. Increases algae but depletes oxygen.



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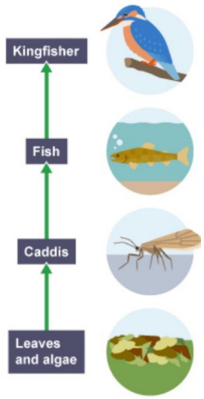
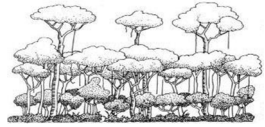
Food Chain



3. Large Scale Natural Ecosystems

Biome	A plant and animal community covering a large area of the Earth's surface. Global ecosystems	
Name	**Distribution**	**Characteristics**
Polar	At the poles. High latitudes.	Very cold and dry all year round (<250mm). 99 per cent of it is covered by ice. Very little vegetation, dark for several months a year. Low biodiversity.
Tundra	60°N, along Arctic Circle.	Winters very cold, summers brief, little rainfall. Treeless, mosses and low shrubs. Layer of permanently frozen ground called permafrost.
Temperate deciduous	Mainly found along the mid latitudes.	Deciduous means trees lose their leaves in the winter. Found in areas with 4 seasons. Summers warm, winters mild, rainfall all year round.
Mediterranean	40° – 45°N.	Hot and dry summer with mild winters. Vegetation includes olive and fruit trees. California and some parts of Australia too.
Desert	Between 15° - 35°. Along the Tropics.	High average temperature and very low precipitation (<250mm). Very hot during the day but cold at night. Vegetation is sparse. Sandy soils.
Savanna	Between 15° – 30°. Between TRF + sav.	Grass land with a relatively dry climate. It has wet and dry seasons. Large herds of animals graze alongside predators such as lions.
Tropical Rainforests	Along the equator, between the Tropics	High temperatures and heavy rainfall (>2000mm) due to it being in a low pressure area. High biodiversity as it has ideal conditions for plants to grow.

4. Rainforest Characteristics

Climate	Consistent all year. No seasons. Very wet. > 2,000 mm per year. Very warm. Average temp. 28°C.
Soil	Latosol (red as rich in iron). Infertile (heavy rain leaches nutrients). Some nutrients on surface. (Decomposition)
Structure (4 layers)	Emergents. Upper canopy. Lower canopy. Shrub layer. 
Biodiversity	Very high, but at risk due to deforestation. >50% of all the species in the world.
Plants	Evergreen as continual growing season. Tall trees. Dense canopy blocks light.
Nutrient cycling	This is very rapid due to the hot and humid conditions.

5. Adaptations To Tropical Rainforests

	Name	Description	Explanation
Plants	**Drip tips**	Waxy leaves shaped like a funnel.	Encourages runoff to reduce water damage and rotting.
	Lianas	Woody creepers rooted to the ground which wind around trees.	By using trees as a ladder to climb, they can get to the sunlight and nutrients.
	Buttress roots	Large roots at the bottom of trees which stand above the surface.	Help support tall trees and overcome shallow soil. They also increase the surface area to help the O_2 / CO_2 exchange.
Animals	**Jaguar**	Spotted fur called rosettes.	Dense canopy leads to dark forest floor. Fur camouflage.
	Sloth	Slow and nocturnal. Thick, dense coats with angled fur	Conserves energy as they only eat leaves. Funnels high amounts of rainfall off.
	Flying	Flaps of skin between their limbs	Allows them to glide between the tall trees to avoid being

Living World

6. Value of Tropical Rainforests	
To people	**To the environment**
25% of all medicines. Resources to sell like wood, nuts, rubber. Indigenous tribes.	>50% of all plants and animals. High biodiversity. Trees absorb carbon (< climate change) 20% of world's fresh water and 28% of world's oxygen.

7. Sustainable management	
Rate of deforestation	Varies across the world. Decreasing in Brazil. Increasing in Indonesia.
Strategy	**Explanation**
Selective logging and replanting	Only SOME high value trees like mahogany or older trees are cut. Encourage growth of smaller trees.
Conservation	Nature reserves are set up where economic activity is restricted.
Education	Educating locals on the values and how to make money sustainably.
Ecotourism	Environmentally friendly (small scale, employs locals, educates tourists).
International hardwood agreements	To prevent illegal logging and promote sustainably sourced timber. E.g. FSC.
Debt reduction	Debt cancelled with the aim that the extra money is spent on

8. Tropical Rainforest Case Study	
Name	Borneo, south east Asia.
Background	Island (Malaysia, Brunei and Indonesia). Rate of deforestation faster in Malaysia than any other tropical country.

Causes of Deforestation	
The cutting down and removal of forest	
Farming	Subsistence- Grow just enough food for their family. Small scale and sustainable. Commercial- Farming to sell produce for a profit. Largest exporter of palm oil.
Logging	Cutting down trees to sell. Largest exporter of tropical wood (1980s) 85% of logging has been illegal in past. Clear felling replaced by selective logging.
Road building	Roads constructed for access to mines. E.g. Sarawak, east Malaysia.
Mineral extraction	Removal of resources from the earth. Tin extracted in Malaysia.
Energy development	Building dams = forest being flooded. Bakhun Dam flooded 700km^2.
Settlement	New settlements form i.e. Penan.
Population growth	Transmigration policy. 15,000 ha. Urban poor encouraged to migrate to the countryside to ease overcrowding.

Impacts of Deforestation	
Soil erosion	No canopy = exposed soil. Roots no longer hold the soil together. Heavy rain washes the soil away.
Economic development	Provides jobs which leads to more tax. Infrastructure improvements open up area for tourism. Profit from selling tin, palm oil, HEP…
Climate conservation	Trees absorb CO_2 during photosynthesis

Living World

9. Hot Desert Characteristics	
Climate	Very little rain. < 250 mm per year. Infrequent; may only rain once every couple of years. Extreme temp. 45°C in day, cold nights
Soil	Shallow and sandy. Lack of rain/plant material means its dry. Salinisation is a problem (high evaporation)
Biodiversity	Low. A further risk from climate change. Highest near water sources.
Plants	Very sparse due to lack of rain. Short life cycle, some appearing only with rain. Many are succulents.
Nutrient cycling	Slow due to a lack of moisture and vegetation. Means infertile soils.
Interdependence	Animals spread seeds through dung. Sparse vegetation limits no. Animals. People are putting extra stress on the ecosystem, e.g. draining water supplies.

10. Adaptations to Hot Deserts			
	Name	**Description**	**Explanation**
Plants	**Succulents E.g. cacti**	Large, fleshy stems. Thick, waxy stems.	To store water during times of reduced rainfall (< 250mm / yr). To reduce water loss (transpiration).
	Tap roots	Long roots (7-10m)	To reach very deep water supplies.
	Dormant seeds	Germinate with rain. Short growth cycle.	As rain is unreliable, seeds germinate when it rains so they survive. They grow, flower, release seeds in weeks- species doesn't die out.
Animals	**Camel**	Wide feet. Long eye lashes.	Spreads the camel's weight so it's easier to walk on the sand. To keep sand out of their eyes.
	Desert Jerboa	Nocturnal	Bury underground during the day to escape the high temperatures.
	Bat eared fox	Large ears	Provides a large surface area to maximise heat loss.
	Peringuey's adder	Slide sideways	Reduces contact with the hot ground.

11. Hot desert case study	
Name	Thar Desert, India and Pakistan.
Background	Most densely populated desert. 80 people per km^2.

Living World

12. Causes of Desertification

The process by which land becomes drier and degraded.

	Cause	Explanation
Plants	**Population pressure**	Our population is increasing which is leading to more…
Plants	**Removal of fuel wood**	Some people still use wood for cooking so cut trees down for fuel Tree roots are vital for holding the soil together so without them more soil erosion occurs.
Plants	**Overgrazing**	Too many cattle reduces vegetation so nutrients aren't returned to the soil. They also compact the soil.
Plants	**Overcultivation**	Crops remove nutrients but does not replenish them so over time soil degrades.
Animals	**Climate change**	Temperature has increased. Made rain unreliable. Dry soil erodes easily. Worsen by human activity.
Animals	**Soil erosion**	Bare soil is exposed to wind and rain and so erodes. Made worse by human activity.

13. Strategies To Reduce Desertification

Water and soil management	Bunds prevent soil washing down hills
	Irrigation takes water from rivers to water crops (but causes salinisation)
Tree planting	Trees roots hold soil together, provide shade, add moisture to soil. Great Green Wall.
Use of appropriate technology	Magic stones (low stone walls), reduce soil erosion.

Development opportunities

Mineral extraction	Limestone, gypsum (making plaster), kaolin (paper whitener). Can be sold for profit and provide jobs.
Energy	Jaisalmer Wind Park, India's largest. Solar power at Bhaleri. Sold for profit, aids industry.
Farming	Mostly subsistence. Indira Ghandi Canal now allows irrigation
Tourism	Growing industry. Jobs (guides), profit. Annual Desert Festival (>10,000 tourists).

Challenges for Development

Extreme temperatures	Temperature reaches 53°C in July. Working outside is hard. Crops struggle
Water supply	Rainfall is low. 100 – 240mm/ year. Shortages frequent due to demand. Impacts farming and industry. Indira Ghandi Canal now helping.
Inaccessibility	Traditional forms of transport like camels in the inner desert. Tarmac melts, sand covers rds; affects trade.

Physical Landscapes - Coasts

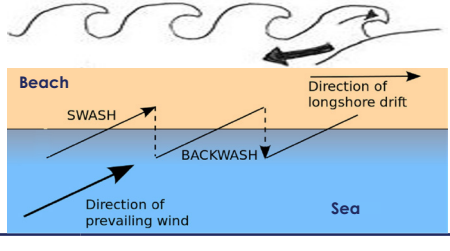
1. The UK's Diverse Landscapes

Relief	Shape of the land.
Upland areas	Land over 200m. Highlands. Steep.
Lowland areas	Land below 100m. Flat or rolling hills

2. Waves

Swash	Movement of the water UP the beach in the direction of the prevailing wind.
Backwash	Movement of water DOWN the beach at right angles (90°) due to gravity.
Constructive Waves	Mostly subsistence. Indira Ghandi Canal now allows irrigation

Destructive Waves	Erode the coast. Weak swash. Strong backwash. Tall height, short wave length. High frequency.



3. Processes

Sub-aerial processes (above the sea)

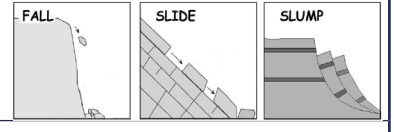
Weathering

Wearing away of rocks in situ. Material not removed

Mechanical weathering	The breaking down of rock without changing its composition. Freeze thaw.
Chemical weathering	The breaking down of rock caused by chemicals. (e.g. weak acid rain).

Mass movement

The downhill movement of material under the force of gravity.



Rockfall	Free fall of rocks under force of gravity
Sliding	Material collapsing in a straight line.
Slumping	Downward rotation of sections of cliff along a slip plane. Worse when saturated

Marine processes - Erosion

The wearing away and removal of material by a moving force such as a breaking wave.

Hydraulic power	The sheer force of the water compressing air into cracks causes bits to break off.
Abrasion	Sediment scraping against the cliff (like sandpaper) removing small pieces.
Attrition	The 'smashing' of sediment against each other to become more rounded.
Solution	Chemical erosion caused by the dissolving of rocks by sea water.

Deposition

Dropping of material	Occurs when there is a loss of energy. e.g. Sheltered bays, when the wind drops

Transportation

Longshore drift	Zig zag movement of sediment along the coastline.

Physical Landscapes - Coasts

4. Erosional Landforms

Headlands and Bays

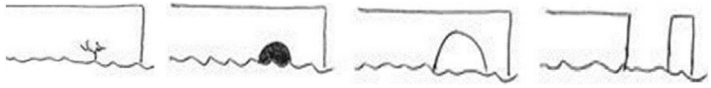
Step 1	Discordant coastlines have alternating bands of more resistant (chalk) and less resistant rock (clay). 
Step 2	The less resistant rock is **eroded** faster through **abrasion**, creating bays.
Step 3	The more resistant rock **erodes** slower and is left jutting out to sea forming a headland.

Wave cut platforms

Step 1	Waves **erode** cliff base between high+ low tide
Step 2	**Abrasion** create a wave cut notch which enlarges over time.
Step 3	The rock above the notch is unsupported so will collapse due to **gravity (mass movement).**
Step 4	Cliff **retreats**, leaving a wave cut platform (the un-eroded original cliff left behind).

Cave, arch, stack

Step 1	**Hydraulic power** enlarges cracks in headland.
Step 2	Over time they turn into a cave.
Step 3	Back of cave is deepened by **abrasion** until it **erodes** through the headland > arch.
Step 4	**Weathering** and **erosion** wear away at the arch until it eventually collapses (gravity).
Step 5	A stack is formed.



Example of a UK coastline. Dorset coastline

Headlands and bays	Swanage Bay, Durlston Head
Wave cut platform	Kimmeridge
Arch	Durdle Door (concordant)
Stack	Old Harry

5. Depositional Landforms

Beaches Swanage

Step 1	Beaches form when **deposition** occurs.
Step 2	There needs to be a source of sediment nearby like soft cliffs.
Step 3	Constructive waves **deposit** material in sheltered areas like bays.

Wave cut platforms

Step 1	Wind blows sand up the beach (**saltation**).
Step 2	Obstacles such as seaweed cause the wind speed to decrease resulting in **deposition**.
Step 3	Over time sand dunes build up and are colonised by marram and lyme grass.
Step 4	This vegetation stabilises the sand dunes.

Cave, arch, stack

Step 1	Longshore drift transports sediment along the coast in the direction of the prevailing wind (**swash** and **backwash**).
Step 2	Where the coastline changes direction…
Step 3	Sediment is **deposited** in calm weather out to sea.
Step 4	Can form a hooked end and a salt marsh behind the spit where it is sheltered. 

Example of a UK coastline. Dorset coastline

Step 1	When a spit joins two headlands.
Step 2	A lagoon forms behind the bar. 

Physical Landscapes - Coasts

6. Coastal Management

Hard Engineering

Man made structures built to control the sea. Reduces flooding and erosion.

Strategy	Explanation	Costs	Benefits
Sea walls	A hard wall made out of concrete that reflects waves back out to sea	Expensive (£2000 per/m). Life span 75 years.	Prevents erosion / flooding. Often protects tourist resorts.
Rock armour	Boulders piled up along the coast. These erode rather than the coast.	Boulders can be moved by waves and need replacing.	Gaps allow water through, reducing wave energy. Cheap
Gabions	Wire cages filled with rocks at the base of cliffs. Absorb wave energy.	Ugly to look at. £100 per/m Metal corrodes over time.	Cheap and easy to build. Reduce erosion.
Groynes	Wooden fences at right angles to the coast, preventing sand moving by longshore drift = wider beach.	Starve beaches further along the coast = more erosion there. Life span only 25 years	Stops longshore drift removing beaches. Fairly cheap.

Soft Engineering

Schemes set up using a natural approach to managing the coast.

Strategy	Explanation	Costs	Benefits
Beach nourishment	Sand and shingle from elsewhere is added to beaches. Wider beaches stop erosion and flooding	Needs redoing every 5 years. Sand has to be brought from elsewhere. Expensive.	Blends with existing beach. Larger beaches = tourists.
Reprofiling	Sediment is redistributed from the lower part to the upper part of the beach. Increases gradient.	Only works if wave energy is low. Needs to be redone lots.	Cheap and simple. Reduces energy of the waves.
Dune regeneration	Creating or restoring sand dunes by nourishment or planting marram grass to stabilise the sand	Protects only a small area. Areas zoned off from public which is unpopular.	Sand dunes create a barrier between the sea and land. Stabilisation is cheap.
Managed retreat Coastal realignment	Remove current defences, allow sea to flood the land behind. Over time land becomes a marshland.	Land is lost = conflict (farmers) Salt water can negatively impact existing ecosystems.	Cheap and easy. Doesn't need maintenance. New habitats created.

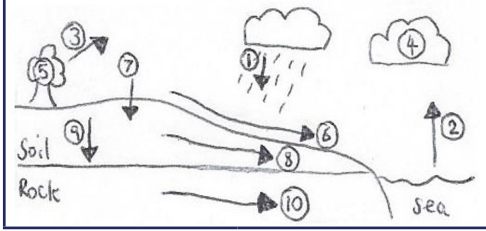
7. An Example Of A Coastal Management Scheme

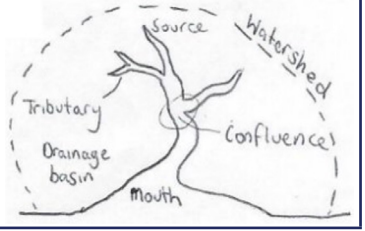
What?	Reasons for management	Management strategy	Effects and conflicts
Bournemouth Beach Management Scheme. Aim: Hold the line and protect tourism.	Coastline would erode at a metre a year. Beach important for tourism (£413million). 3114 homes at risk from collapsing cliffs.	3 phases costing £50 million. HARD: Replaced or added 53 groynes. SOFT: 3 lots of replenishment, every 5 yrs.	• Beaches = More tourists = 9000 jobs • Barton on Sea at risk from erosion. • Conflict: locals vs construction.

Physical Landscapes - Rivers

1. The Water Cycle

Precipitation (1)	Moisture falling from the atmosphere as rain, snow, sleet, hail.
Evaporation (2)	The process of water changing from a liquid into a gas (water vapour).
Transpiration (3)	Evaporation from plant leaves.
Condensation (4)	Process by which water vapour in the air changes into liquid water (clouds).
Interception (5)	Water stored on the leaves of plants.
Surface run (6) **Off** (7)	Water travelling over the surface of the land (increases when soil is saturated). →
Infiltration (8)	Water soaking into the soil. ↓
Through flow (9)	Water flowing sideways through soil. →
Percolation	Water passing vertically through the soil and rock. ↓
Groundwater flow (10)	Water flowing sideways through rock below the water table. →



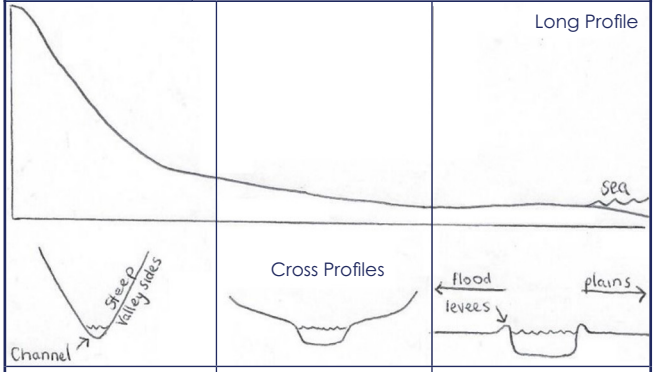


2. Parts of Rivers

Source	The start of a river.
Mouth	The end of a river where it joins the sea.
Drainage basin	The area of land drained by a river.
Watershed	The high land that separates one drainage basin from another.
Tributary	A smaller river, which joins a larger river.
Confluence	The point where two rivers meet.
Valley	Area of lower land between surrounding hills. Has a river channel at the base.
Channel	Part where the river water is.

3. How Does a River Change?

Long profile	Shows changes in the gradient of the river from its source to its mouth.
Cross profile	It is a cross section (slice) across the river showing the shape of the valley.



Steep gradient V shaped valley Shallow + narrow channel	Medium gradient Gently sloping sides Wider + deeper channel	Gentle gradient Flat, wide valley Very wide + deep channel

Physical Landscapes - Rivers

4. Fluvial Processes

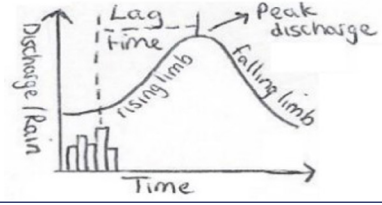
Erosion	
The wearing away and removal of material by a moving force such as a breaking wave.	
Vertical erosion	In the upper course, rivers erode downwards deepening the river channel
Lateral erosion	In the middle course, rivers erode sideways (abrasion on the outside of a meander) widening the river valley.
Hydraulic action	The sheer force of the river against the banks can cause air to be trapped in cracks causing it to weaken and erode.
Abrasion	Sediment carried by the river wears away the riverbed (like sandpaper).
Attrition	The 'smashing' of sediment against each other to become more rounded.
Solution	Chemical erosion caused by the dissolving of rocks by sea water.
Transportation	
Traction	Large, heavy pebbles roll along the bed.
Saltation	Pebbles are bounced along the bed.
Suspension	Lighter sediment is carried by the water.
Solution	Some material is dissolved within water.
Deposition	
Dropping of material	Occurs when there is a loss of energy. E.g. Discharge / velocity ↘ at the mouth

5. What Causes Flooding?

Physical Factors	**Prolonged rainfall**	Saturates the soil so no further water can infiltrate.
	Heavy Rainfall	Water arrives too quickly to infiltrate > more surface runoff.
	Relief	Steep land means water reaches the river channel faster.
	Geology	Rocks like granite are impermeable
Human Factors	**Urbanisation**	More impermeable surfaces = more surface run off. Drains get water to river quickly > discharge.
	Deforestation	Trees intercept rainfall and soak up water. Cutting trees down means more water entering river.
	Agriculture	In winter, a lack of crops means more water enters river channel.

6. Hydrographs

A graph that plots river discharge after a storm. It also displays rainfall.

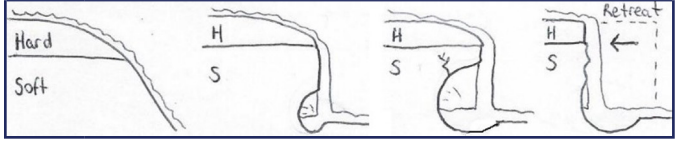


Discharge	Volume of water flowing per sec. Cumecs
Peak discharge	Highest discharge.
Lag time	Delay between peak rainfall + discharge.
Rising limb	Shorter the lag time, worse the flood risk.
Falling limb	Decrease in river discharge.

7. Erosional Landforms

These occur in the **upper course** of the river.

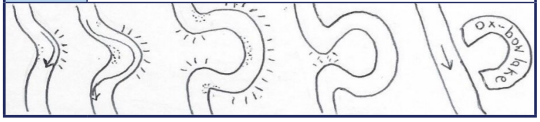
Step 1	Forms when a band of hard rock sits on top of a band of soft rock.
Step 2	Over time the soft (less resistant rock) will be **eroded** through **abrasion** creating a drop.
Step 3	**Hydraulic action** will erode the soft rock at the base of the drop creating a plunge pool.
Step 4	This gets larger undercutting the hard (cap) rock.
Step 5	Eventually due to **gravity** the unsupported cap rock will collapse (**mass movement**).
Step 6	The waterfall **retreats** upstream.
Step 7	A steep sided gorge is left behind.

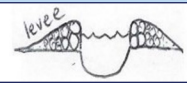


Physical Landscapes - Rivers

Interlocking spurs	
Char.	Hillsides that overlap. The river winds around them. 
Step 1	**Vertical erosion** takes place, creating steep sided, V shaped valleys.
Step 2	The river is not powerful in the upper course so it winds around areas of hard rock.
Step 3	Creating hillsides that overlap.

8. Erosion + Depositional Landforms	
These occur in the **middle course** of the river.	
Meanders and ox bow lakes	
Char.	A meander is a bend in the river. An ox bow lake is a semi-circular lake detached from the river.
Step 1	**Erosion** (mainly **abrasion**) happens on the outside of the river bend as velocity here is faster. This creates a river cliff.
Step 2	**Deposition** occurs on the inside of the bend (velocity slower) creating a slip off slope.
Step 3	The meander **migrates** over time (**lateral erosion**) creating a narrow neck.
Step 4	When the river floods, the water breaks through the narrow neck .
Step 5	The bend is cut off forming an ox bow lake.



9. Depositional Landforms	
These occur in the **lower course** of the river.	
Flood plains	
Char.	Wide, flat areas of land each side of a river. They flood. Fertile soil. 
Step 1	Meanders widen the valley floor through lateral erosion.
Step 2	After heavy rain a river may burst its banks, and the velocity slows due to friction.
Step 3	Depositing its suspended load
Step 4	Layers of alluvium build up over many floods
Levees	
Char.	Natural embankments along the edges of a river channel. Taller on the side of the river. 
Step 1	When a river bursts its banks the water's velocity slows due to friction.
Step 2	The heaviest material is deposited first, but lighter material is carried further.
Step 3	This creates raised embankments along the side of the river called levees.
Step 4	These build up each time the river floods.
Estuaries	
Char.	Tidal landforms where the river meets the sea. Often mudflats or salt marshes. 
Step 1	Water from the river collides with the sea coming up the river mouth at high tide.
Step 2	Velocity slows so sediment is deposited.
Step 3	At low tide, mud flats are exposed.

10. Example of UK River	
Name	River Tees, NE England.
Where?	Source in Pennines. Mouth on North Sea.
Upper course	V shaped valleys in Pennine Hills. Gorge at Low Force. High Force waterfall (20m drop + gorge) Hard dolerite on top of soft limestone.
Middle	Many meanders. E.g. Sockburn.
Lower course	Wide mudflat estuary into North Sea. Flood plains and levees south of Darlington

Physical Landscapes - Rivers

11. River management

Hard Engineering

Man-made structures built to control the flow of rivers and reduce flooding.

Strategy	Explanation	Costs	Benefits
Dams and reservoirs	Dams are barriers built across the river. A reservoir (artificial lake) forms behind. Controls river flow.	Very expensive to build. Floods settlements when created.	Can be used to produce hydroelectricity. Prevent flooding downstream.
Channel Straightening	Meanders are removed. Artificial channels make river straighter. Increases velocity.	May cause more flooding and erosion down steam.	Faster velocity means water leaves the area quickly reducing flood risk.
Embankments	Raised walls built along river banks (man-made levees). Increases capacity of the river.	Quite expensive. Risk of severe flooding if flood water higher or they break.	Floods less frequent as river can hold more water.
Flood relief channels	Channels built to divert water around built up areas, or to divert excess water which would flood.	Increased discharge where it re-joins the river so flooding may occur there.	Removes excess water from the river channel to reduce flooding.

Soft Engineering

Schemes set up using knowledge of a river and its processes to reduce the effects of flooding.

Strategy	Explanation	Costs	Benefits
Flood warning and preparation	Environment Agency warnings. Buildings modified to reduce damage. Residents can add sand bags to their doors prior to floods	Some don't get the warning. Modifications are expensive. Doesn't stop floods but reduces the damage.	People have time to protect their properties or evacuate. Reduces the impacts, fewer insurance claims.
Flood plain zoning	Restrictions prevent building on parts of the flood plain likely to flood.	Not always possible to change existing land uses. Expansion of towns limited.	Flood risk reduced as less impermeable surfaces. Impacts reduced.
Tree planting	Creating or restoring sand dunes by nourishment or planting marram grass to stabilise the sand.	Less land is available for farming.	Discharge and flood risk are reduced because trees intercept the rainfall.
River restoration	Making the river more natural so the floodplain floods naturally.	Local flood risk can increase.	Little maintenance is needed. Creates habitats.

12. Example of management scheme

Where?	Cockermouth
Why was the scheme needed?	Large floods November 2009. Confluence of River Cocker/ Derwent. Rivers hadn't been dredged.
Management strategy	**H** 120m self raising flood barrier. **H** Glass panel flood walls (9). **S** 2000 trees planted. **S** Flood action group. 62% of the population agreed to text warnings. **S** Rivers dredged regularly.
Issues	• 400 homes protected. • Maintain character of town. • Scheme cost £4.4 million pounds. • Storm Desmond in 2015 overwhelmed the defences.

Paper 1

1. Global Pattern Of Urban Change

The world's population is growing rapidly; currently 50% of us live in urban areas.

Urbanisation	An increasing percentage of a country's population living in towns and cities.
HICs	Very slow rate of urbanisation. Already have high urban populations. Urbanisation happened earlier (during the industrial revolution).
NEEs	Fast rate of urbanisation due to industrialisation. Urban population is increasing rapidly
LICs	Fast rate of urbanisation. Urban population is low as many still work in farming.

2. Factors Affecting Urbanisation

Rural-Urban migration	The movement of people from a rural area (countryside) to an urban area (towns and cities).
Push factors	Negative factors that make people leave an area e.g. drought, famine, war, few services.
Pull Factors	Positive factors that attract people to an area e.g. better access to services, better paid jobs, access to electricity.
Natural Increase	When the birth rate is higher than death rate; the population grows. High in NEE cities as migrants are often young and health care is improving.

17. Key Terms

Social Deprivation	The extent an individual or an area lacks services, decent housing, adequate income and employment.
Dereliction	Abandoned buildings and wasteland.
Urban Greening	Process of increasing and preserving open space in urban areas i.e. parks.
Urban Sprawl	Unplanned growth of urban areas into surrounding rural areas.
Integrated Transport System	Different forms of transport are linked together to make it easy to transfer from one to another.
Brownfield	Land that has been used, abandoned and now awaits reuse; they are often found in urban areas.
Greenfield	A plot of land, often in rural areas or on the edges of urban areas that has not been built on before.
Commuter Settlements	A place where people live but travel elsewhere for work e.g. Yate → Bristol.

18. Sustainable Urban Living

Sustainable urban living	Where people living, now, have the things they need, without reducing the ability of people in future to meet their needs.
Water conservation	Recycling grey water. ½ flush toilets. Rainwater harvesting on roofs. Permeable pavements- filters pollutants.
Energy conservation	Energy efficient appliances. Energy saving (south facing windows). Use of renewable energy sources.
Waste recycling	Recycling boxes in houses. Recycling facilities nearby. Encourage websites like 'Freecycle'.
Creating green space	Maintain green spaces around towns- Cools area, encourage exercise, happy

19. Urban Transport Strategies Used To Reduce Traffic Congestion

Problems with congestion	• ↗ air pollution (global warming). • Late for work, deliveries delayed. • ↗ accidents, stress, asthma. In Bristol, 200 people die as a result of air pollution each year.
Beryl Bikes	Shared bikes in Bournemouth + Poole.
Oyster Cards	Quick and easy to pay for more than one type of public transport (London).
Park and ride	Car parks on the outskirts of a town, with buses into the city centre.
Congestion charge	Charge for entering the city centre at peak times.
Bus lanes	Stop buses being held in traffic.

4. Location And Importance Of Lagos

Location	Lagos is located on the south coast of Nigeria, close to the Benin border.
Regional	Good transport links- centre of trade. Large migrant pop.- cultural diversity.
National	Largest city in Nigeria (21 mill megacity) 80% of Nigeria's industry, 30% of GDP.
International	Financial centre of West Africa.

5. Causes Of Urban Growth In Lagos

Rural to urban migration	More than 275,000 migrants arrive in Lagos every year. 1,200 migrants arrive each day.
Natural increase	High birth rate of 35.2 per 1000/year. Migrants are young so have children.

Paper 1

6. Opportunities Created By Urban Growth In Lagos

Social	• Better access to services (health care, water treatment). • 68% have a secondary education. 90% attend primary v.s. 40% in rural areas. • Electricity (Lagos uses 40% of Nigeria's).
Economic	• Jobs available (construction- Eko Atlantic). • Wages 4x higher than in rural areas. • Thriving film/music industry- Nollywood 2nd largest film industry, $3 billion in 2018
Urban industrial areas	Groups of industries located together. • Provide jobs > Wages increase > Home market increases. • Increases exports + tax to government. • Attracts other

7 + 8. Challenges Created By Urban Growth In Lagos

Managing urban growth	66% live in squatter settlements like Makoko (1/4 million people). Squatter settlements are areas of poor-quality housing (often illegal), lacking in basic services i.e. Sewage and water. 3 km to communal water points. Up to 15 households can share 1 toilet.
Providing clean water	Only 40% of the city is connected to the state water supply. Pipes are old and can be contaminated with sewage. Informal market for water- inflated prices.
Providing sanitation	Squatter settlements do not have access to sewers. Causes health problems e.g. cholera.
Providing energy	Not enough power for all… Neighbourhoods have to take turns for a few hours at a time. In squatter settlements, some illegally tap electricity which is dangerous.
Providing access to services	This is better than in rural areas… but not equal for all. Squatter settlements have limited access. Poorer people are less likely to afford services. Makoko has just 1 school and informal, unregistered healthcare centres.
Reducing unemployment	Not enough formal jobs. 60% work in the informal economy. E.g. People scavenge in the Olusosun rubbish dump.
Crime	City is too large to effectively police all of it. High crime rates in squatter settlements. Gangs like 'Area boys'.

Managing Environmental Issues

	Challenge	How is it being managed?
Waste disposal	Produces 9000 tonnes of rubbish each day. Only 40% of rubbish is collected.	LAWMA starting to collect rubbish overnight. Recycling banks added to each estate.
Air and water pollution	10,000 illegal industries = waste disposal and emissions are not controlled. Squatter settlements have no sanitation. Pollution levels are 5x higher than recommended limit > breathing problems.	Lagos has banned the import of mini generators Communities encouraged to share one larger generator. $2.5 million new water treatment plants.
Traffic congestion	40% of Nigeria's cars are registered in Lagos. Bad traffic congestion- poor public transport 2 hours commute called the 'Go Slow'.	Bus Rapid Transit network. Built to cope with 200,000 people daily.

9. Example - How urban planning improves the quality of life for urban poor

What?	How does it improve Quality of Life?	Was it successful?
Makoko Floating School Built in 2013 Educated 100 of the poorest children in Makoko	• Collects rainwater – drinking source • Used for community meetings • Built by unskilled locals (gained new skills) • Improved job prospects for children	✓ Increased quality of life. × Collapsed after a storm in 2016. × Didn't cater for enough children.

Paper 1

11. Location And Importance Of Bristol

Location	South west of the UK, on Bristol Channel. Near to junction of M4 & M5.
Importance within the UK	Largest city in the southwest. 8th most popular city for foreign tourists. 2 universities and 2 cathedrals.
Importance to wider	Largest concentration of silicon chip manufacturing outside of California. International airport (links to Europe).

12. Impact of migration on the growth and character of the city

National migration	1851 - 1891 population doubled as people arrived looking for work.
International migration	Now, international migration accounts for half of its growth. 50 countries. Many from Europe (Poland, Spain).
Impact on character	Many cultural opportunities. Afro-Caribbean- strong community spirit and events (St Paul's Carnival).

13. Urban Change In Bristol

- Population is growing rapidly.
- Population is more ethnically diverse.
- More under 16-year olds than of pensionable age.
- Electrification of railway to London (<70 minutes).
- Become more accessible (road, rail, air).

14. Opportunities Created By Urban Change

Cultural mix	50 countries represented (food, art). St Paul's Carnival (attracts 40,000).
Recreation and entertainment	Underground music scene -Colston Hall. Entertainment (The Bristol Old Vic). 2 football teams (City, Rovers). Shopping Cribbs Causeway, Cabot Circus.
Employment	Highly tech. industries = jobs. 50 silicon businesses. Many TNCs. £100 million improved broadband.
Integrated transport system	Links different types of public transport Reduces congestion in the city. ↗ % people walking and cycling (57%).
Urban greening	> 90% live within 350m of park/water. 300 parks. 1/3 Bristol is open space. 2015 European Green Capital status.

15. Challenges Created By Urban Change

Urban deprivation	Some areas face social deprivation. 1/3 of people in Filwood are in verylow income households. Problems of crime, drug use, low quality housing, lack of transport.
Inequality in housing	Filwood- 50% in council housing. Stoke Bishop- millionaires (large villas)
Inequality in education	Filwood- 36% get top GCSE grades. Stoke Bishop- 94%.
Inequality in health	Filwood- Life expectancy 78 years. Stoke Bishop- 83 years.
Employment	Filwood- 1/3 16-24-year olds. Stoke Bishop- Just 3%.
Dereliction	Industrial buildings derelict (innercity). Stokes Croft (many squatters).
Building on brown and greenfield	2006-13 94% housing on brownfield. Plan for 30,000 homes on brownfield. Temple Meads built on brownfield.
Waste disposal	>1/2 million tonnes of waste/year. (23% lower per head than UK average) ↗ recycling by 50%. Teach it in schools.
Urban Sprawl	Greenbelt to prevent merge with Bath

16. An Example Of An Urban Regeneration Project

Example	Why did it need regeneration?	What are the main features?	Successful?
Temple Quarter, Bristol	• Bristol surrounded by a green belt. • Brownfield site- rundown, ugly. • By Bristol Temple Meads Station- poor impression for new visitors. • Previously an industrial area.	• Enterprise Zone e.g. low rents. • Improve access e.g. ITS. • New bridge across River Avon (access to planned Bristol Arena). • Maintain historical features, cobbled streets- gives character • Brunel's Engine Shed £1.7mill.	✓ 4,000 new jobs by 2020 (17,000 by 2037) ✓ Attracts tourists. ✓ Redeveloped brownfield site × Arena still not built

Economic World. UK Futures

1. What is development

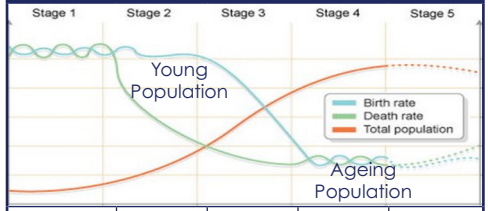
Development	The progress of a country in terms of economic growth, the use of technology and human welfare.
Uneven development	Development takes place at different rates in different places.
Development gap	The difference in standards of living and wellbeing between the world's richest and poorest countries.
Quality of life	General wellbeing (includes health, happiness, social belonging…)
Standard of living	Level of wealth and material goods available to people. $
Economic development	Progress in an economy. New technology can lead to a move from agriculture to industry.
Ways to classify the world	
LIC	Low income countries. GNI per capita of under $1,045. (Poor) e.g. Haiti.
NEE	Newly Emerging Economies. Countries that have begun to experience high rates of economic development, with rapid industrialisation. e.g. Nigeria
HIC	High Income Countries. GNI per capita of over $12,746. (Rich) e.g. UK.
Brandt line	An outdated line from the 1980's that split the world into rich north and poor south.

2. Measuring Development

Arrows show how the indicator changes with development.

GNI per capita	Gross National Income per person. Total income divided by the size of the population. - Doesn't show inequality within a country. It's just an average.
Birth rate	The number of babies born in a year per 1000 of the population. + Reliable- infers female equality.
Death rate	The number of people that die in a year per 1000 of the population. - Less reliable. HICs now have an ageing population -> DR
Infant mortality rate	The average number of deaths of infants under the age of 1, per 1000 live births per year.
Life Expectancy	The average number of years a person might be expected to live. - Less reliable for a LIC due to IMR making it look lower
People per doctor	The number of people who depend on a single doctor for their health care needs
Literacy rate	The percentage of people who have basic reading / writing skills.
Access to safe water	The percentage of people who have access to water that does not carry a health risk such as cholera
HDI	Human Development Index. A combined measure that includes GNI per capita, life expectancy and adult literacy rate. Out of 1. + Best indicator as it includes 💰 and 🧍 data. Removes anomalies
Generic limitations	Data can be out of date or unreliable. Inequalities exist within countries.

3. Demographic Transition Model



-	LIC	NEE	HIC	HIC
High BR	High BR	Falling BR	Low BR	Low BR
High DR	Falling DR	Low DR	Low DR	Low DR
Lack of clean water and reliable food = ← DR High IMR = ← BR	ming = ← BR Medical care improves = → DR	Rural / urban migration. Factories not farming = → BR	Women have careers, marry later, contraception = → BR	Very good health care, healthy diets = → DR

Economic World. UK Futures

4. Causes Of Uneven Development

Physical	Natural disasters	Government has to spend money rebuilding rather than education. e.g. Haiti has had EQs and TS
Physical	Landlocked	No coastline. This hindered trade keeping the GNI low. E.g. Nepal.
Physical	Extreme climates	If it's too hot or cold agriculture is difficult. E.g. Thar Desert
Economic	Debt	A country's money will go to repaying debt rather than education.
Economic	Selling primary products	These are low value goods so the government has restricted income to invest in health care.
Historical	Colonialism	European countries controlled much of Africa and Asia. After regaining power they were poor and civil wars often occurred. E.g. Nigeria- UK colony
Historical	War	Money spent on arms. E.g. Sudan

5. Consequences of Uneven Development

Disparities in wealth	Most developed countries> most wealth Africa owns just 1% of global wealth.
Disparities in health	Health care in LICs poor = ↓ life expect UK LE is 81 years. Nigeria LE is 52 years
International migration	Poor try to migrate to HICs. Mexico into USA. Syrians into Europe.

6. Coastal Management

Fairtrade	When producers in LICs are guaranteed a fair price for the goods they produce ie cocoa, coffee. The better price improves income, aids community projects and protects the environment.	+ Improves quality of life - Poorest can't afford certification
Aid	When a country or non-governmental organisation donates resources or money to another country to improve people's lives.	+ Improves quality of life - Aid may be tied - Corruption of aid
Tourism	Short term emergency aid or long-term aid. Nigeria- NETS4Life.	- Can be unreliable
Microfinance loans	Visitors spend money in a country and infrastructure is improved.	+ Makes women more equal - Can lead to debt
Investment	Countries or TNCs can invest in a country. Might include the development of infrastructure, building dams or industry. Shell.	+ Triggers multiplier effect - Economic leakage can occur
Debt relief	36/39 of the poorest countries have had their debt cancelled if they could guarantee no corruption and they agreed to spend the money on education/ reducing poverty. Nigeria's cancelled 2005.	+ Improves quality of life - They may go into debt again - Corrupt governments…
Intermediate technology	Sustainable technology that is appropriate to the needs, skills, knowledge and wealth of local people. Small scale projects.	+ Affordable - Small scale
Industrial development	Developing the secondary sector. This brings jobs, higher income and infrastructure improvements.	+ Triggers multiplier effect - Environmental damage

Economic World. UK Futures

7. Tourism to Reduce Uneven Development

Nepal	LIC. GNI per capital of US$1,090. Suffered civil war and earthquakes. Trek (Mount Everest), jungles, culture.
Advantages	+ $445 million in 2015. + 8% GNI. + 500,000 jobs. 7% employment.
Disadvantages	- Locals are poorly paid. - Economic leakage. - Earthquake in 2015 reduced tourism by 1/3. - Some out of work for 7 months. - Environmental damage (i.e. O_2 tanks).
Summary	Has been successful but it is unreliable. Need to find a more sustainable method for the long run.

8. Introduction to Nigeria

Located just north of the equator, in west Africa.

Importance of Nigeria	
Global Importance	• NEE in 2014 > 21st largest economy. • 5th largest contributor to UN peace keeping.
Local Importance	• Fastest growing economy in Africa. • In 2014 they had the highest GDP.
Nigeria's Context	
Political	• Boko Haram have killed 17,000 people since 2002.
Environment	• Rainforest- south > savanna - north.
Social	• 500 ethnic groups • Literacy 61%, life expectancy 52 years
Cultural	• Nollywood (2nd largest film industry).

9. Nigeria's Changing Industrial Structure

Industrial structure	The relative proportion of the workforce employed in different sectors of the economy (p, s, t, q).
Primary sector	Jobs that extract/collect natural resources. ↓ Decreasing due to mechanisation and industrialisation. This started rural to urban migration.
Secondary sector	Jobs making things. ↑ Increasing (industrialisation).
Tertiary	Jobs that provide a service. ↑ Increasing as people start to have more disposable income.

How does manufacturing stimulate economic development?

- Factories provide jobs > people have more disposable income > home market enlarges.
- Companies pay tax > government invests in infrastructure like roads > attracts more companies to invest. **Positive multiplier effect.**

10. Transnational Corporations

Transnational Corporation	Companies that operate in more than one country. (40 TNCs in Nigeria)
Host Country	Country the TNC places its factories.
Footloose	Industries not tied to a certain location
Shell in Nigeria	
Advantages	+ 65,000 jobs = > disposable income. + 91% contracts to Nigerian companies (reduces economic leakage)
Disadvantages	- Bodo oil spill 08/09. 11 million gallons of oil spilt over 20km^2.
Jobs	National economic benefits vs local environmental costs in Bodo.

11. Nigeria's Changing Relationships

Political relationships	• Gained independence (UK in 1960). • Member of British Commonwealth.
Trading relationships	• Member of OPEC (oil). • Member of ECOWAS (Western Africa trading group). • Has strong links with China and USA.
International aid in Nigeria	
International aid	Money, goods and services given to help the Quality of Life of **another** country.
Emergency aid	Usually follows a natural disaster or war. e.g. Food, water, shelter.
Developmental aid	Long term support by charities or governments to improve Quality of Life. E.g. infrastructure, education, clean water
Aid in Nigeria	
What?	4% of aid given to Africa. UK gave £360 million in 2014.
Nets for life	Nets to prevent malaria. 82,500 given out in Abuja. ✓ Successful as community based.
Problems with aid	• Sometimes it isn't sustainable. • Corruption. • Can be tied (strings attached).

Economic World. UK Futures

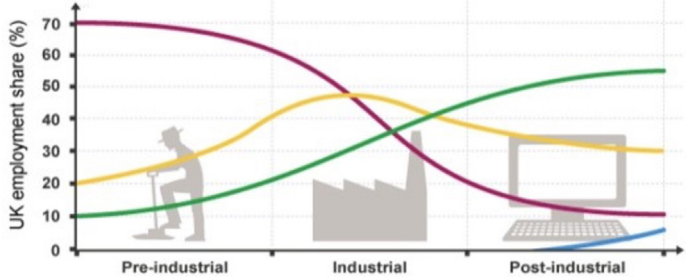
19. Place Of The UK In The Wider World

Trade	UK trades globally. Exports are worth £250 billion. Strong links with USA, Europe, Asia.
Culture	UK culture exported worldwide. Shaun the Sheep in 170 countries.
Transport	Channel tunnel links UK/France. Heathrow major airport hub.
Electronic communication	Most trans-Atlantic cables go through the UK. Many IT firms.

UK Economic And Political Links

European Union	Partnership of 28 countries. The largest single market in the world. 50% of our trade. 40% of immigrants to UK came from EU. Voted to leave in 2016. Not yet left. The UK left 31.1.2020.
Commonwealth	Association of 53 independent states. Aims to improve wellbeing of members. Commonwealth games every 4 years.

13. Economic Change In The UK



Primary	↘ due to mechanisation.
Secondary	↗ due to industrial revolution then ↘ due to de-industrialisation.
Tertiary	↗ due to wealth (↗ disposable income)
Quaternary	High-tech jobs including research and IT. ↗ due to government policies and the increase in technology.
Why has our economy changed?	
Deindustrialisation	The decline of a county's traditional manufacturing industry due to exhaustion of raw materials, loss of markets and competition from NEEs.
Government policies	A plan decided by a government to manage issues in a country.
Globalisation	The process which has created a more connected world; with increases in the movement of goods/people worldwide

14. Post Industrial Economy

Tertiary and quaternary sector employed 81% in 2011.	
IT	Employs over 60,000 people.
Services	Retail is the largest sector. Employs 4.4mill
Finance	London is the world's leading centre. HSBC
Research	Government invested £30bill in 2013.
Science parks	Groups of high tech industries and those doing scientific research. Located near universities (for graduates, share facilities).
Business	Purpose built areas of offices and warehouses (on edge of cities as less

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15. Environmental Impact Of Industry

Air and water pollution. Soil degradation.

Releases CO2 increasing the rate of global warming.

Transport of materials is by road ↗ air pollution.

Example of modern industry being environmentally sustainable

Google	London Landscraper started 2018.
686 bikes spaces 4 car spaces	Encourages cycling to work. < congestion/CO_2 emissions
Solar panels. 19,800 kWh	Reduces fossil fuel consumption and reduces carbon footprint.
Rooftop gardens	Urban greening. < CO_2. Collects rainwater. Encourages wildlife.

16. Changes In The Rural Landscape

Population decline	Outer Hebrides (away from cities, limited opportunities).
Social changes	• Declined by >50% since 1901. • ↑ aging population = care issues. • Less children > schools shut.
Economic changes	• Services close i.e. post offices. • ↑ tourists but infrastructure not there. • Government subsidies cost of ferries.
Population growth	South Cambridgeshire (near large cities, people can commute).
Social changes	• Migrants from Cambridge, some now from Eastern Europe too. • Proportion of elderly increasing (>65). • 80% car ownership = > congestion. • Young people are costed out.
Economic changes	• ↑ house prices. Less affordable housing • Petrol prices ↑.

17. Improvements in infrastructure

Road	Upgrading 'Smart motorways' M4. Variable speeds, reducing accidents, extra lanes. 2014 Road investment strategy £15 bill. New construction jobs, boost economy.
Rail	Crossrail in London. Puts extra 1.5 million within 45 mins commute of capital city. HS2 to reduce journey times. London to Manchester in 1 hr 8 minutes.
Port	Liverpool 2. Doubles capacity to over 1.5 million containers a year. 96% of UK imports/exports through ports.
Airports	Heathrow expansion. 3rd runway £18.6bill

18. North-South divide

Causes	Decline of heavy industry in North (coal) Investment in finance and service industry in the South Investment in infrastructure in South
Impacts in north	Higher unemployment / lower wages (40%) Poor health, lower life expectancy (10 yrs) Poor education. There are SOME exceptions

Strategies attempting to resolve regional differences

Devolving more powers	Give more power to local councils and Welsh and Scottish governments. Plan best how to use their money.
Northern Powerhouse	A plan to attract investment to north. Improve transport links to northern cities. e.g. HS2, Liverpool2. BUT just a CONCEPT not a plan.
Enterprise Zones	55 EZs to encourage businesses to set up in areas of high unemployment. Reduce taxes, simple planning rules, superfast broadband to the area.

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1. What Are Resources?

Resource	A stock or supply of something that has a value or a purpose (food, energy, water).
Resource management	Control and monitoring of resources so they don't become depleted or exhausted.
Strategies attempting to resolve regional differences	
Resources are key to human wellbeing. Their social and economic benefits increase standard of living.	
Food	More than 1 billion are malnourished (this ↑ chance of diseases). Calories provide energy which are vital for people (work, school).
Water	Needed for drinking, cooking and washing. Walking long distances to collect water can stop people working /going to school. Dirty water kills (diseases like cholera).
Energy	Allows industry to develop, creating jobs and making countries richer. Vital for transport. Without it, people burn wood/kerosene to heat homes (takes longer, damages environment)
Resources inequality	
Distribution Uneven	Some countries don't have energy reserves or have unsuitable climates to grow food.
Dependent on wealth	Countries without have to import them or find technological solutions. (Expensive)
Consumption	Greatest in **HIC**s (> money, expect higher living standard). Rapidly increasing in **NEE**s. Low in **LIC**s. Can't afford to exploit resources or import them.

2. Food in The UK

Demand	Increasing… rising population, demand for greater choice, more disposable income.
Importing 40% food	Expensive in the UK due to poor harvests. Greater demand for exotic foods. Labour cheaper in LICs. Unsuitable climate for growing some food. We want seasonal foods all year round.
Problems with importing food…	
Carbon footprint	A measure of the greenhouse gases produced. If we transport goods from abroad the carbon footprint is larger.
Food miles	The distance covered supplying food to the consumer. The smaller the better.
Current food trends in the UK…	
Agribusiness	Large scale, industrial farming aimed to maximise the amount of food produced.
Organic produce	Food grown without the use of chemicals. Higher labours costs can make it expensive.
Eat local	Buy from local farms = lower food miles.

3. Energy in The UK

Demand	We consume LESS energy even though there are more people because of industry decline and energy efficient products like light bulbs.
Energy mix	The different energy resources used by a country. Renewable + non-renewable.
How is it changing?	Renewables are increasing. 1970 – 91% came from coal and oil. 2014 – 19% came from renewable. 50% came from coal and oil.
Reduced domestic supplies coal, gas, oil	North Sea oil + gas reserves running out. We still have coal reserves but all coal fired power stations will close by 2025. By 2020 we will need to import 75%.
Issues with energy exploitation	Economic • Extraction is expensive. • Money needed to research alternatives • UK has to pay to import energy. Environmental • Fracking can cause mini earthquakes. • Burning fossil fuels release CO_2. • Oil spills can leak toxic chemicals.

4. Water in The UK

Demand	Demand is increasing (70% since 1985). Higher pop. > more houses > more water intensive appliances.
Water quality	Water quality improving. But pollution present from fertilisers, oil spills, vehicle pollutants.
Managing pollution	Stricter regulations on fertilisers, filtering water for sediment, purifying water (chlorine).
Areas of deficit	South east. High population = high demand but low rainfall.
Areas of surplus	North + west. High rainfall but low population.
Water transfer	From areas of surplus to areas of deficit. E.g. Mid Wales (surplus) to Birmingham. BUT expensive, affects wildlife, social conflict.

Economic World. UK Futures

5. Energy Overview

Energy Security Affected by:	Energy security means having a reliable, uninterrupted and affordable energy supply. • Supplies available • Size of population • Amount used by each person
Energy surplus	This occurs when a country produces more energy than is required by their population.
Countries with surplus	Oil: Iran, Saudi Arabia. Coal: Australia, China.
Energy deficit	Having too little energy to meet the needs of the people and industry.
Countries with deficit	Politically unstable: Sudan (LIC). Few resources: Ireland (HIC).
High consumption	Wealthy countries (HICs) tend to have higher energy consumption due to car ownership/heating.
Low energy consumption	Poorer countries (LICs) tend to have lower energy consumption due to lifestyle and lack of access.

6. Factors Affecting Energy

Reasons for increasing consumption	
Rising population	More people need more energy.
Economic development	Rapidly increasing in NEEs. More disposable income to spend on luxuries like cars, electronic devices.
Technology	We have more technology. Phones, tablets all require energy.
Factors affecting supply	
Physical factors	Unequal distribution of fossil fuels. Variations in climate mean some energy sources are more suited to certain areas.
Economic factors	Fossil fuels are becoming more costly to extract and prices fluctuate. LIC's can't afford to exploit their energy.
Technology	Some sources are hard to extract so advancements in technology to access. Improvements in technology has made fracking possible.
Political factors	Wars/political instability can affect exports International agreements encourage countries to emit less CO_2 > renewable. Nuclear illegal in some countries.

7. Impacts Of Energy Insecurity

Exploration of difficult and environmentally sensitive areas	Need to seek out new reserves in areas like the Arctic. Oil spills could damage these fragile ecosystems.
Food production	Production uses 30% of energy. Energy deficit may lead to food shortages and malnutrition.
Industrial output	Energy is essential for industry. Power cuts stop production.
Potential for conflict	Middle East produces 56% of oil. They control prices. Can lead to war like Iraq.

8. Strategies To Increase Supply

Renewable	**Will never run out. Increase their use. (7)**	
	Wind	Turbines on land/sea.
	Solar	Solar panels convert sunlight.
	Hydro	Dams. Turbines spin to create electric.
	Tidal	Barrages across estuaries use tides.
	Geothermal	Water heated underground in contact with hot rocks. (Tectonics)
	Wave	Air forced into chambers, turn turbines
	Biomass	Energy produced from organic matter
Non Renewable	**Non-renewable so will run out. (4)**	
	Nuclear	Large amounts, but waste dangerous.
	Fossil Fuel: Coal Gas Oil	Need to search for new reserves. Use new technology to exploit reserves previously too difficult/costly to use.
Extracting a fossil fuel. Fracking.		
Fracking in the UK was stopped in November 2019.		
Advantages	+ Cleanest FF. 45% less CO2 than coal + Large reserves in the UK. + Can create jobs.	
Disadvantages	- Releases CO_2, methane. - Will run out.	

Statistics

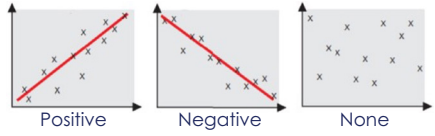
1. Measures of Central Tendency

Key Term	Definition	Example: 9 3 5 4 7 3 8
Mean	Total of items ÷ number of items.	(9+3+5+4+7+3+8 = 39) ÷ 7 = **5.57**
Median	Middle value (when they are in order). Or position can be calculated using (n+1) ÷ 2	3 3 4 **5** 7 8 9 = **5** (7+1) ÷2= 4th position
Mode	Most common.	3 (appears twice) There can be several modes
Modal class	Most common class.	-
Range	Difference between the highest and lowest value.	Highest 9 – lowest 3 = **6**
Upper quartile	Value ¾ of the way through ordered data (smallest to largest). Position = $\frac{3(n+1)}{4}$	3 3 4 5 7 **8** 9 = **8** Position = $\frac{3(7+1)}{4} = 6$
Lower quartile	Value ¼ of the way through ordered data (smallest to largest). Position = $\frac{(n+1)}{4}$	3 **3** 4 5 7 8 9 = **3** Position = $\frac{(7+1)}{4} = 3$
Interquartile range	The difference between the upper and lower quartile.	Upper quartile 8 – lower quartile 3 = IQR 5

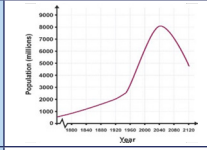
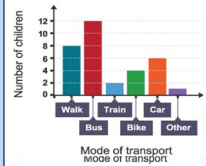
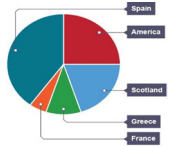
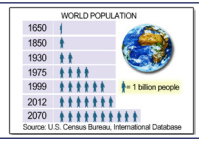
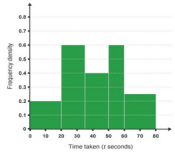
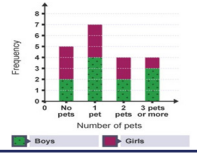
2. Percentages

Strategy	Definition	Example: 9 3 5 4 7 3 8
Percentage	To give the amount (X) as a percentage of a sample (Y): X ÷ Y x 100	45 out of 50 people travel by car… 45 ÷ 50 x 100 = 90%
Percentage increase	To calculate the percentage something has increased by. 1. Work out the difference between the two numbers (the increase). 2. Divide the increase by the original number. 3. Multiply the answer by 100%.	Population in 2020 = 65mill. Population in 2000 = 52 mill. 1. 65m – 52m = 13m 2. 13m ÷ 52m = 0.25 3. 0.25 x 100 = **25% increase**
Percentage decrease	To calculate the percentage something has decreased by. 1. Work out the difference between the two numbers (the decrease). 2. Divide the decrease by the original number. 3. Multiply the answer by 100%.	Cars in 2020 = 40 Cars in 2000 = 70 1. 70 – 40 = 30 2. 30 ÷ 70 = 0.43 3. 0.75 x 100 = **43% decrease**
Use of percentiles	Percentiles are used to indicate the value below which a given percentage of observations fall. For example, the 80th percentile is the value below which 80% of the observations occur and above which 20% of the observations occur.	

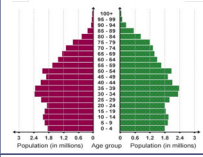
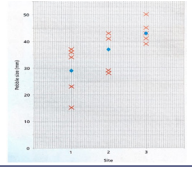
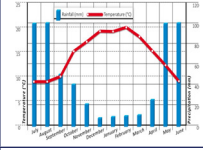
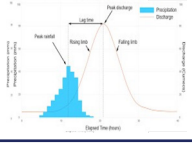
3. Relationships In Bivariate Data

Bivariate data	Data for two variables that may be related. E.g. GNI per capita + life expectancy.
Graphed on…	Scattergraphs
Lines of best fit	Either a completely straight line or a smooth curve, which shows the trend between the two variables. Try to ensure an equal number of points each side of the line.
Correlation	The closer the crosses to the line of best fit the stronger the correlation.  Positive Negative None
Interpolate	Estimating an unknown value from within the data set. 
Extrapolate	Estimate an unknown value that is outside the data set. Makes the data more uncertain. 

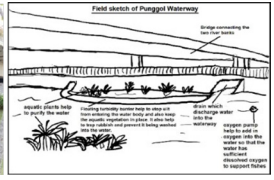
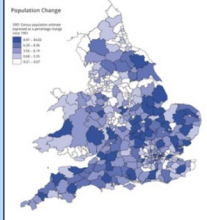
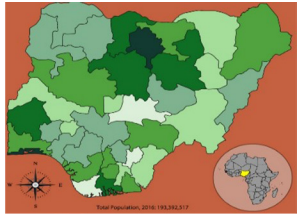
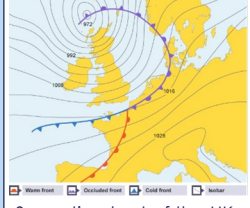
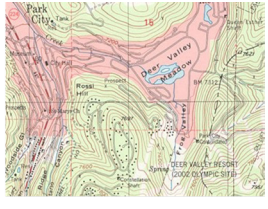
Graphs

Graphical Skills				
Name	**Picture**	**Description**	**Example use**	**Evaluation**
Line graph		Shows how variables change over time. Time is plotted on the x axis.	For continuous data e.g. the number of vehicles (buses, cars and motorbikes) that travel to an area over the day.	+ Can show multiple variables on one graph. + Able to estimate (interpolate) data using the trend of the line. + Easy to spot anomalies. - Data points can cluster making it difficult to draw the line. - Must be accurately plotted to ensure it is useful.
Bar graph		Each bar is the same width but of varying heights, depending on the figure being plotted. Bars are drawn equal distance apart (normally with a gap between each bar).	For data which fits into discrete categories e.g. the number of different types of car, plants or pets.	+ Simple to draw and read. + Easy to make comparisons of quantities between categories. - Only shows one variable against another. - Difficult to find fractions or percentages without further analysis.
Pie chart		Shows the quantity of something by dividing a circle into different parts (slices).	For data which fits into discrete categories e.g. the number of people working in different employment sectors.	+ Visually effective at showing how a total quantity is divided up. + Easy to make comparisons between categories. - Hard to accurately interpret percentages unless written on the pie chart. - Small quantities are difficult to represent with narrow slices.
Pictogram		Shows the quantity of something by using appropriate symbols/pictures that are drawn to scale.	For data which fits into discrete categories e.g. the world population in different years shown with picture(s) of people to represent the quantity.	+ Visually effective at showing quantities. + Easy to read and identify overall trends. - Difficult to accurately interpret data from symbols/ pictures.
Histogram		Shows the frequency of something by using bars of different heights. Bars are touching. X axis shows continuous scale.	For continuous data e.g. the amount of rainfall across a continuous timescale of 24 hours.	+ Visually effective at showing how frequency changes. + Easy to spot anomalies. - Inappropriate intervals on x axis can distort data representation.
Divided bar chat		Each bar is the same width, but the bars are individually subdivided to show how the total quantity is divided up. Bars are drawn equal distance apart.	For discrete groups of data e.g. the number of people working in different employment sectors in different years.	+ Visually effective at showing how a total quantity is divided up. + Summarises large sets of data, allowing comparison. - Can be difficult to identify trends.

Graphs

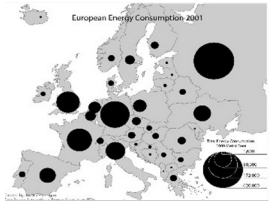
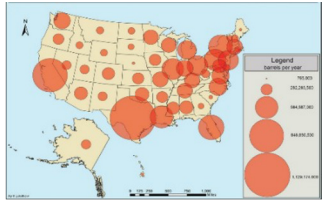
Graphical Skills				
Name	**Picture**	**Description**	**Example use**	**Evaluation**
Scatter graph	 Positive Correlation  Negative Correlation  No Correlation	Shows whether there is a relationship between two sets of data. The pattern of the data points describes the relationship or correlation. Where data points are plotted close to the line of best fit the correlation is said to be strong.	For data for which you want to identify if there is a relationship between e.g. plotting life expectancy against GNI per capita.	+ Line of best fit can be drawn to show correlation, effectively showing a relationship. + Can easily spot anomalies where there is a strong correlation. - A correlation may be chance. - If there are too few data points it can be difficult to identify whether there is a correlation.
Population pyramid		A type of histogram in which the length of the bars is determined by the number of people in a population in that age group.	To show the structure of a population by identifying the number of males and females in age categories.	+ Visually effective at showing which age group has the greatest quantity of people in. + Can be used to approximate a country's birth and death rate. - Detail can be lost if large age intervals are used.
Dispersion graph		Shows the range of a set of data and how the data tends to group together or disperse. The values are plotted on a vertical axis to show the spread.	To show the range of pebble sizes at different locations on a beach.	+ Visual representation of the range of a data set. + Can be used to determine central tendency. - Difficult to plot if the range is small and data points plot close together.
Climate graph		A climate graph shows the average precipitation for each month in a year with a bar graph (blue) and the average temperature each with a line graph (red).		
Hydrographs		A hydrograph shows the amount of precipitation over a continuous timescale on a histogram. It also shows the river discharge as a line graph.		

Maps

Graphical Skills			
Name	**Picture**	**Description**	**Evaluation**
Photos and sketch maps	 Photo of Underpass  Sketch of Underpass	Photos give real world data on a location, are easy to interpret and are cheap and easy to produce. Field Sketches allow the artist to pick important geographical data relevant to their enquiry. Photos can include aerial and satellite.	+ Shows human and physical features of location (land use, vegetation etc). + Photos are easy to produce and keep. Very visual. - Sketch maps may not be of good quality and miss vital information. - Photos only show a single moment in time.
Choropleth map	 Choropleth map of population change  Population density in Nigeria	Uses colours or shades to show data. Used for population density, age or income.	+ Very easy to identity spatial patterns and trends. + Very visual use of data over large areas. - Unable to differentiate within a certain location. - Assumes that all area has the same data. - Suggests abrupt changes in data between areas.
Isoline map	 Synoptic chart of the UK  Contour lines	Isolines can be on a map, graph or image. They connect locations of the same value. Most commonly seen as contour lines. Air pressure on weather maps.	+ Useful for showing gradual changes. + Lines show locations of the same value. - Can be confusing where gradient change is extremely close together, or very far apart. - Requires a lot of data to be effective.

Maps

Graphical Skills

Name	Picture	Description	Evaluation
Dot maps	 Population of UK 1 dot = 1 person  World cities with population of 1 million or more	Dot maps are dots of a fixed size that are used to represent a data set. For example, one dot could be equal to one individual or one million for population size and distribution.	+ Easy to identify spatial patterns. + Great visual tool for large amounts of data. - Clustering of dots makes it impossible to read data. - Areas may appear blank due to value being used per dot – false sense of emptiness.
Desire lines and Flow line maps	 Desire lines showing US exports  Flow line- Immigration movement.	**Desire lines:** Shows movement with a straight line. i.e. goods, trade, people. Line length can show distance. **Flow lines:** Have arrows and show the specific direction of movement (curved lines). Width of the line can show quantity.	+ Shows general movement direction (A to B). + Line width can be proportional to value and size. + Easy to understand. General trends are obvious. - Distance is not always accurate, may not show specific end point, only a country. - Can get difficult to read if there are too many lines. - DESIRE Don't show journey details. (Just start + end) - FLOW Can be difficult to read if lines cross.
Proportional symbols	 EU Energy Consumption 2015  Population of USA states in 2018	Maps that use symbols drawn in proportion to the size of the data. Any symbol can be used but circles are most common. Used for: energy consumption, cars owned, forest fires per state.	+ Useful for comparing data. + Easy to read as symbols are proportional. - Symbol may obscure location or mean less accurate positioning on maps. - Difficult to calculate actual value.

Fieldwork

1. Stages in a Fieldwork Enquiry

1	**Question / Hypothesis**	Tourism has an environmental impact in Swanage.
2	**Data Collection**	Questionnaire. Environmental Quality Survey.
3	**Data Presentation**	Bar chart, pie chart. Radar graph.
4	**Data Analysis**	70% said tourists leave litter.
5	**Conclusion**	Tourism DOES have an environmental impact.
6	**Evaluation**	I need to increase my sample size for my questionnaire.

2. Possible Enquiries

Coasts	Does hard engineering restrict longshore drift?
Rivers	Velocity increases with distance downstream.
Urban	Regeneration has created social and economic opportunities in Boscombe.

3. Suitable Location?

Distance	Can you get there and back in a day?
Access	Is the site public access? Can you get there?
Sampling opps.	Will it be busy enough to get a reliable sample size? Enough locations to survey?

4. Risk Assessment

This is where you consider what could cause people harm while completing fieldwork and think about how to reduce the likelihood of this happening.

Coasts fieldwork	Drowning	Face the sea. Stay 5m from the water.
	Sun stroke	Check the forecast. Take suntan lotion and a hat
Human fieldwork	Getting lost	Arrange a meeting spot. Carry a map
	Traffic accident	Always cross at a crossing. Concentrate- no distractions.

5. Key Terms

Data collection methods	How will you collect the data? E.g. questionnaire, river depths
Data presentation	How will you present your data? E.g. bar graph, flow arrow map…
Accuracy	How close to the true value? (Is it correct to the nearest mm?)
Reliability	The extent to which an investigation produced consistent results. (If you do it again, would you get the same results?)
Validity	How suitable were your methods for answering the question it was intended to?
Limitations	Problems with what you did.
Anomalies	A result that is unusual or does not follow the trend of the other data.
Evaluation	How can you improve your enquiry?

6. Types of data

Key term	Definition	Examples
Primary data	Data that is collected first hand.	Measuring pebble size on a beach yourself.
Secondary data	Data that has been previously collected by someone else.	July temperatures for the last 30 years.
Quantitative data	Numerical data.	River depths.
Qualitative data	Non-numerical, opinion based data.	Questionnaire data / field sketches.

7. Sampling

Why sample?	To save time. To avoid bias.	
Sample size	Number of data sets collected. Larger sample sizes make data more representative. (Reliable)	
Strategy	**Description**	**Example**
Random sampling	Collect data using a random number generator.	Picking up stones from a riverbed using a random number generator.
Systematic sampling	Collect data at specific intervals.	Sampling every 5th groyne.
Stratified sampling	Collect data from different groups of a population to ensure fair representation. (Deliberately introducing bias.)	Surveying 3 residential locations and 3 town centre locations.

8. Conclusion And Evaluation

Improve your methods	Is there better equipment you could have used? Should you have used a different sampling method?
Increase the reliability	Increase your sample size. Collect data at different times of the day or days of the week.
Increase the accuracy	Use digital fieldwork equipment. Take measurements 3 times and take an average.
Future studies?	Go at a different time of day / year? Add additional methods?

Conflict and Tension: First World War 1894 to 1918

Questions on the Exam

Q1) Study Source A. Source A (supports/opposes/is critical of)….. How do you know? Explain your answer using Source A and your contextual knowledge. (4 marks)

Q2) Study Sources B and C. How useful are Sources B and C to a historian studying…..? Explain your answer using Sources B and C and your contextual knowledge. (12 marks)

Q3) Write an account of……. (8 marks)

Q4) 'Statement'. How far do you agree? (16 marks plus 4 for SPaG)

Timeline

1897: Germany and Austria-Hungary form the Dual Alliance

1882: Italy joins Germany and Austria-Hungary to form the Triple Alliance

1904: Britain and France sign the Entente Cordiale

1905-06: The First Moroccan Crisis

1907: Britain, France and Russia form the Triple Entente

1908: The Balkan Crisis

1911: The Second Moroccan Crisis

1912-13: The Balkan Wars

June 1914: Assassination of Franz Ferdinand

July 1914: Austria-Hungary declares war on Serbia

August 1914: Germany, Russia, France and Britain join the conflict

September 1914: Battle of the Marne

1915: Battle of Gallipoli

February 1916: Battle of Verdun

May 1916: Battle of Jutland

July 1916: Battle of the Somme

April 1917: The USA joins the war on the side of the Allies

July 1917: The Battle of Passchendaele

March 1918: Treaty of Brest-Litovsk ends Russia's involvement in the war

March 1918: The Ludendorff Spring Offensive

November 1918: German Kaiser abdicates and the Armistice is signed at 11am on November 11th

Key Words

Abdicated: Resigned from being the monarch

Alliance: An agreement between 2 countries to support each other

Armistice: A ceasefire

Arms Race: When rival nations attempt to outdo each other in the size of their armed forces

Blockade: Stopping supplies reaching an enemy country

Convoy System: Supply ships travelling together in large groups for protection

Counter-attack: When a group of soldiers try to drive back an enemy attack

Creeping Barrage: A slow-moving artillery attack with soldiers following behind it

Dreadnoughts: A type of battleship

Eastern Front: The 1000-mile front line between Russian troops and the soldiers of Germany and Austria-Hungary in Eastern Europe

Empire: A group of nations ruled over by another country

July Crisis: The chain of events from the assassination of Franz Ferdinand to the declaration of war by the major powers from June to August 1914

Kaiser: The German Emperor

Mustard Gas: Gas which causes severe irritation and blistering of the skin

Mutiny: When soldiers refuse to follow orders

Nationalist: A person who feels proud of their country

No Mans Land: An area of land between two countries or armies not controlled by anyone

Shell Shock: Psychological illness caused by exposure to war

Stalemate: A deadlock, when neither side can win

Trench Foot: A painful condition caused by prolonged exposure to cold and wet

Tsar: The male ruler of Russia up to 1917; the female ruler was called the Tsarina

U-Boats: Underwater boats or submarines

Western Front: The 400-mile line of trenches running from the English Channel to Switzerland

Germany 1890 to 1945 Democracy and Dictatorship

Questions on the Exam

Q1) How does Interpretation B differ from Interpretation A about…..
Explain your answers using Interpretations A and B (4 marks)

Q2) Why might the authors of Interpretation A and B have a different interpretation about…
Explain your answer using Interpretations A and B and your contextual knowledge. (4 marks)

Q3) Which interpretation do you find more convincing about…
Explain your answer using Interpretations A and B and your contextual knowledge. (8 marks)

Q4) Describe 2…. (4 marks)

Q5) In what ways were the lives of……affected by…… (8 marks)

Q6) Bullet point question (12 marks)

Timeline

1888: Kaiser Wilhelm becomes Emperor of Germany
1914: First World War begins
November 1918: First World War ends and Kaiser Wilhelm abdicates
January 1919: Spartacists Revolt
June 1919: Treaty of Versailles is signed
August 1919: Weimar Constitution is made
February 1920: Nazi Party founded
March 1920: Kapp Putsch
January 1923: France invades the Ruhr, hyperinflation
November 1923: Munich Putsch
1924: Gustav Stresemann becomes Foreign Minister, Dawes Plan
February 1925: Hindenburg becomes President
February 1929: Young Plan
October 1929: Wall Street Crash
1930: Depression takes hold in Germany
1933: Hitler becomes Chancellor of Germany
June 1934: Night of the Long Knives
August 1934: Hindenburg dies, Hitler becomes Fuhrer
1938: Kristallnacht, Jewish homes and businesses attacked
1939: Germany invades Poland: Second World War begins
January 1942: Wannsee Conference: plan for extermination of the Jews
April 1945: Hitler commits suicide
May 1945: Surrender of Germany

Key Words

Article 48: Part of the Weimar Constitution that gave the President the right to rule in a time of crisis without the support of the Reichstag

Avant-Garde: New and experimental ideas and methods in art, music and literature

Chancellor: The Prime Minister in the government

Communism: Political system where all people are equal and there is strict government control

Concentration Camp: Prison in which people are held under harsh conditions and without freedoms

Dawes Plan: Agreement for loans to be given to Germany to help them build factories and roads

Depression: Time during the 1930s when millions lost their jobs

Der Fuhrer: Supreme leader, the title adopted by Adolf Hitler

Edelweiss Pirates: Rebel youth gang which went camping and sang songs making fun of Hitler

Enabling Act: Law passed in 1933 that allowed the Nazis to make their own laws without consulting the Reichstag

Gestapo: Part of the SS, secret police force controlled by Heinrich Himmler

Holocaust: Murder of millions of Jews by the Nazis during the Second World War

Hyperinflation: Sudden, dramatic rise in prices

Kinder, Kuche, Kirche: 'Children, Church and Cooking': a slogan used by the Nazis which reflected what women should dedicate their lives to

League of Nations: International peace-keeping organisation set up after the First World War, Germany joined in 1926

Propaganda: Spreading ideas and information to influence people's thinking and actions, through the use of films, radio and newspapers

Proportional Representation: Political system in which the number of politicians for a particular party is in proportion with the number of votes they win

Reichstag: the main, elected German Parliament

Reparation: Payments made by Germany to some of the winning nations of the First World War for the damage done by the fighting

Schutzstaffel (SS): Hitler's elite personal bodyguards

Self-sufficient: The Nazis tried to stop trading with the outside world and rely entirely on their own resources

Spartacus League: Group of German Communists who wanted a revolution

SA: Hitler's brown-shirted supporters who beat up opponents and guarded Nazi meetings

Weimar Republic: The name for Germany's democratic system between 1918 and 1933

White Rose Group: anti-Nazi youth group of university students in Munich

Health & The People

Questions on the Exam

Q1) Study Source A. How useful is Source A to a historian studying…?
Explain your answer using Source A and your contextual knowledge. (8 marks)

Q2) Explain the significance of… (8 marks)

Q3) Compare….with…… In what ways were they similar?
Explain your answer with reference to both. (8 marks)

Q4) Has…….been the main factor in……..?
Explain your answer with reference to…… and other factors. (16 marks plus 4 for SPaG)

Timeline

1348: Black Death arrives in England

1628: William Harvey proves circulation of the blood

1798: Edward Jenner develops cowpox as a protection against smallpox

1847: James Simpson uses chloroform as an anaesthetic

1848: First Public Health Act is introduced

1858: Joseph Bazalgette begins building sewers under London's streets

1867: Joseph Lister publishes a description of carbolic antiseptic in surgery

1882: Robert Koch's work on the identification of tuberculosis is published

1906: Liberal social reforms, including free school meals

1928: Alexander Fleming discovers penicillin kills bacteria

1948: NHS starts

1953: Crick and Watson publish their research on the structure of DNA

1963: First liver transplant carried out

Key Words

Anaesthetic: Substance that removes pain

Anatomy: Understanding the structure of the body

Antibiotic: Medicine used to cure and prevent bacterial infections

Aseptic: Being completely free of harmful microbes

Barber-Surgeon: Medieval barber who practised surgery and dentistry

Bloodletting: Removing some blood from a patient by opening a vein or using leeches to suck it out

Bubonic Plague: Plague spread by the bite of a flea

Cauterisation: Using a heated iron to stop bleeding and seal a wound

Cesspit: A pit to dispose of waste and sewage

Epidemic: Disease spread to a large number of people

Inoculation: Using weakened live germs of a disease in a healthy person to build up an immunity against the disease

Miasma: Name given to what people thought was an infectious mist given off by rotting animals, rubbish and human waste, many believed it caused illness and disease

Microbe: Living organism that is too tiny to be seen by a microscope, this includes bacteria

Pneumonic Plague: Plague spread by breathing in germs form the infected lings of a bubonic plague victim

Public Health: Health of the whole population

Trepanning: Drilling holes in the head

Vaccination: Using the dead germs of a disease or one similar to it to build up immunity

Key People

Hippocrates: Said the body was made of 4 humours (blood, phlegm, black bile and yellow bile) and they had to be balanced for a person to be healthy

Vesalius: Dissected bodies to understand how they worked, books were produced spreading his ideas

Pare: Made a mixture of rose oil, egg white and turpentine to heal and soothe wounds

Harvey: Discovered blood circulated around the body

John Hunter: English doctor who used observations and experimentation in his work

Edward Jenner: Created a vaccine for Smallpox using Cowpox to build immunity

Joseph Lister: Used the antiseptic carbolic acid in surgery to reduce infections

James Simpson: Used the anaesthetic chloroform in surgery to numb patients to pain

Louis Pasteur: Discovered germs cause diseases

Robert Koch: Discovered specific germs cause specific diseases

John Snow: Proved cholera was caused by contaminated water

Edwin Chadwick: Produced a report linking poverty and poor living condition to disease

Charles Booth: Wrote a report about poverty in London

Seebhom Rowntree: Wrote a report about poverty in York

Alexander Fleming: Discovered penicillin could be used to kill bacteria that cause infections

Florey & Chain: researched penicillin and mass-produced it for use during WW2

William Beveridge: Wrote The Beveridge Report about how to improve the health of the country after WW2

Aneurin Bevan: Minister of Health who created the NHS

Research, Development & Final

A01 Develop (Research)

**Showing independent and creative research and investigation.
Using ideas from primary resources. E.g. trips/photographs.**

- Research
- Independent
- Theme
- Artist / Fashion designer
- Art movement
- Photographs
- Trips (galleries, museums, fashion shows etc.
- Colour swatch
- Keywords
- Title
- Innovative
- Digital
- Mounte

A02 Refine (Development)

**A visual story of work showing clear links and a thought process in your project.
Demonstrate experimentation of ideas and techniques.**

- Develop/experiment
- Visual story
- Sketching (pencil, pen)
- Painting (watercolour and acrylic paint)
- Charcoal
- Pastels
- Oil pastels
- Lino printing
- Mono Printing
- Block printing
- Photoshop
- Collage
- Marbling
- Embroidery
- Beading
- Freehand machine stitching

A03 Refine (Sketching)

Skilful and realistic sketching through a range of materials, sketching from primary sources if possible.

- Realistic
- Tonal
- Professional
- Shading pencil
- Colouring pencil
- Biro
- Fine Liner
- Paint
- Collage
- Mixed Media
- Machine stitching
- Paper surfaces

(white paper, brown paper, sugar paper, graph paper, paper towel, newspaper etc.

A04 Present (Final product)

A professional and sophisticated final piece which has clear links to A01, A02 and A03 (this should take you at least 10 hours to complete).

- Skilful
- Relevant
- Sophisticated
- Developed
- Chosen media

Learning Outcome 1

Contemporary Issues in Sport – Learning Outcome 1 Understand the issues which affect participation in Sport			
Learning Outcome 1	**Key Elements that must be covered**	**Key Terms**	**Explanation**
Understand the issues which affect participation in sport 	The different user groups who participate in sport	User Groups	E.g. ethnic minorities ○ retired people/ people over 50 ○ families with young children ○ single parents ○ children ○ teenagers ○ disabled ○ unemployed/economically disadvantaged ○ working singles and couples
	The possible barriers which affect participation in sport (with reference to the different user groups)	Employment/time Work restrictions and family commitments Disposable income Accessibility of facilities/equipment Lack of role models Provision of activities Awareness of activity provision Portrayal of gender issues by the media	Not much free time available Women still seen as bringing up the family and not being involved in sport Cannot afford cost of participation Transport not available, no disabled access Few ethnic role models, few female role models Limited activities on offer What is currently available Mainly male sports shown on TV
	The solutions to barriers which affect participation in sport	Provision Promotion Access Participation Environment Spectatorship Media Coverage Success for teams and individuals Role Models Acceptability	Programming, providing and planning of times Targeted promotions, using role models and initiatives Access to facilities, equipment, sensible pricing Football has widespread mass participation Snow sport involve trips away or artificial terrain Live professional rugby matches readily available BBC1 sole coverage of Wimbledon – but Ashes not on free-to-air TV Sir Hoy's success at the Olympics has increased participation in cycling Lack of role models e.g. lack of Asian footballers E.g. Opposition to horse racing due to perceived animal cruelty
	How the factors which can impact upon the popularity of sport in the UK relate to specific sporting	**R**ole Models, **E**nvironment, **P**opularity, **S**uccess, **M**edia coverage, **A**cceptability, **P**rovision, **S**pectatorship • Current trends in the popularity of different sports in the UK • Growth of new/emerging sports in the UK	R E P S M A P S Studies and statistics show that fishing, cycling and swimming are the most popular growing sports in the UK E.g. Ultimate Frisbee is increasing in popularity

Learning Outcome 2

Contemporary Issues in Sport – Learning Outcome 2 – Know about the role of sport in promoting values			
Learning Outcome 2	**Key Elements that must be covered**	**Key Terms**	**Explanation**
Know about the role of sport in promoting values	Values which can be promoted through sport 	Team Spirit	Learning how to work together and support others by playing as part of a team
		Fair Play	Learning the importance of adhering to rules and being fair to others through playing sport
		Citizenship	Get involved in your local community through sport
		Tolerance	Developing understanding of different countries and cultures through sport
		Inclusion	Initiatives to get under-represented social groups involved in sport
		National Pride	Supporters and performers unite behind country in international events
		Excellence	Striving to be the best that you can in your favourite sport
	The Olympic and Paralympic movement	The Creed	*"The most important thing is not to win but to take part, just as the most important thing in life is not the triumph but the struggle. The essential thing is not to have conquered, but to have fought well."* Pierre De Coubertin
		The Symbol	Five interlocking rings represent the union of the five continents
		The Olympic and Paralympic values	Respect, Excellence, Friendship, Courage, Determination, Inspiration and Equality
	Other initiatives and events which promote values through sport (e.g. FIFA's 'Football for Hope' campaign	Examples	ECB's "Chance to Shine" Sport Relief Premier League's Creating Chances initiative £10m Sport England Scheme
	The importance of etiquette and sporting behaviour of both performers and spectators	Reasons for observing etiquette and sporting behaviour	Fairness, promoting values, safety of participants etc.
		Sportsmanship	E.g. football: giving the ball to the opposition when they have kicked it out when an injury occurs to your team
		Gamesmanship	E.g. time wasting
		Spectator Etiquette	E.g. quiet during rallies at Wimbledon, quiet during play in snooker, quiet during the playing of national anthems
		Sports Initiative to break down barriers	E.g. Kick Racism Out of Football
	The use of performance-enhancing drugs in sport	Reason why they are used	Pressure to succeed, pressure to succeed as a Nation
		Reasons against use	Long term ill health, consequences when found guilty, unfair advantage
		World Anti-Doping Agency (WADA) – whereabouts rule Testing methods	Blood sample, urine sample, hair sample, nail sample
		Current initiatives	Sanctions
		Drug offences by elite performers	E.g. Dwain Chambers & David Millar
		Impact of drug taking on the reputation of sport	Mistrust of results such as Tour de France as a result so many scandals
		Ethical issues related to drug taking	Should there be a distinction between use of performance enhancing and recreational drugs?

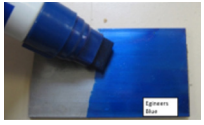
Learning Outcome 3

Contemporary Issues in Sport – Learning Outcome 3 – Know about the role of sport in promoting values			
Learning Outcome 3	**Key Elements that must be covered**	**Key Terms**	**Explanation**
Understand the importance of hosting major sporting events	The features of major sporting events 	○ Regularity/scheduling, i.e.	• 'one-off' (e.g. hosting the Olympic and Paralympic Games will only happen in any given country/city once in a generation) • Regular (e.g. UEFA Champions League final is an annual event which a city could host more than once in a relatively short period of time but it is shared around as a rule)
		○ Regular and recurring	E.g. hosting a Formula 1 Grand Prix would be annual and is normally contracted for a period of years to the host country/city
		○ International element	I.e. involves competitors, and therefore supporters/interest, from more than one country (e.g. the Olympic and Paralympic Games; FIFA World Cup; Rugby Union Heineken Cup)
	Level of investment	• Required • Which may be attracted	Depending if the bid is won, host and create a potential legacy for the country
	Potential 'legacy'	• Sporting • Social • Economic	Money, tourism, new facilities etc.
	The potential benefits and drawbacks of cities/ countries hosting major sporting events	Benefits	• Investment in developing/improving transport system • Increased direct and indirect tourism • Commercial benefits (e.g. money from sponsors, external investment which would not otherwise have been attracted) • Participation may increase in some sports • Infrastructure/social facilities built can be used by people who live in the area where the events have been held • Sports facilities will be improved or new facilities built • Raise the status of the country / 'shop window effect' • Morale of the country is raised
	The potential benefits and drawbacks of cities/ countries hosting major sporting events	Drawbacks	• Bidding to host can be expensive and you may not be awarded the event • Event can cost hosts more than it raises in revenue • Facilities can end up not being used after the event if not planned properly • Can have negative impact on the status of the country if event runs poorly / is disorganised • While hosting the event will help to promote one area of sport, others may suffer as a consequence • Can cause divisions in the country if the specific area which hosted (e.g. one city) is perceived to have been the only beneficiary
	The links between potential benefits and drawbacks and legacy	• Many of the benefits and drawbacks are relevant to more than one of the legacy areas (sporting, social, economic)	(E.g. sports facilities could have both sporting and social legacy).

Learning Outcome 4

Contemporary Issues in Sport – Learning Outcome 3 – Know about the role of sport in promoting values			
Learning Outcome 4	**Key Elements that must be covered**	**Key Terms**	**Explanation**
Know about the role of national governing bodies in sport 	Promotion	• Promoting participation • Increasing the popularity of the sport • Exposure in the media	• E.g. equal opportunities policies • E.g. schemes for schools • E.g. press releases, public relations
	Development	• Elite training and development • Coaching awards • Training of officials	• E.g. national performance squads and national teams in many sports • E.g. England Netball UK Coaching Certificate coaching awards from Level 1 upwards • E.g. the Rugby Football Union has a young officials award which can be used as a starting point to becoming an official
	Infrastructure	• Competitions and tournaments (e.g. England Basketball organise national competitions for over 500 teams from senior to under-13 level) • Rule-making and disciplinary procedures (e.g. the Football Association has a disciplinary procedure for any individual or team connected with the sport) • Providing a national directive and vision • Providing guidelines, support and insurance to members • Assist with facility developments	• E.g. England Basketball organise national competitions for over 500 teams from senior to under-13 level • E.g. the Football Association has a disciplinary procedure for any individual or team connected with the sport
	Policies and initiatives	• Anti-doping policies • Promoting etiquette and fair play • Community programmes • Information and guidance on safeguarding	• E.g. the England and Wales Cricket Board has an anti-doping policy and has a list of all substances which are permitted and those that are banned • E.g. The Football Association's 'Respect' campaign • E.g. Amateur Swimming Association's 'Swimfit'
	Funding	• Lobby for, and receive, funding • Distribution of funds	i.e. • Grants • Government, non-government • Membership • Subscriptions/match fees • Lottery funding • Income from media/sponsorship/advertising • Private investment and donations • Merchandising • Admission charges • Fund raising events • Provide members with advice about funding
	Support	• Providing technical advice • Providing location and contact details for local clubs, how to get started in the sport etc.	E.g. England Hockey provide information about playing surfaces

Engineering Tools - Marking Out

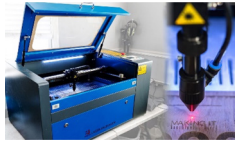
Name of Tool	Description of Tool
Marking Gauge 	Used in woodworking and metalworking to mark out lines for cutting.
Engineers Square 	Used to mark out a workpiece at 90 degrees.
Centre Punch 	Used to punch a small indentation at the location of the centre of a hole to be drilled.
Engineers Blue & Scribe  	Used to mark or scribe a guide line onto a workpiece prior to it being machined.
Calipers 	Measurement tool that is used to measure the distance between two opposite sides of an object.
Steel Rule 	A basic measuring tool. When used correctly, a good steel rule is a surprisingly accurate measuring device.

Engineering Tools - Modification

Name of Tool	Description of Tool
Screwdriver 	Used for turning screws. It consists of a metal rod with a flat or cross-shaped end that fits into the top of the screw.
Hacksaw 	A fine-toothed saw, originally and mainly made for cutting metal.
Junior Hacksaw 	The blade of a junior hacksaw is much smaller than a regular one, so the tool can be used for more precise cutting.
Coping Saw 	A type of bow saw used to cut intricate external shapes and interior cut-outs in woodworking.
Hand Drill 	A small portable drilling machine designed to be held and operated by hand.
Spanner 	A metal tool with a shaped end, used to turn nuts and bolts.
Ball Peen Hammer 	Also known as a machinist's hammer, is a type of hammer used in metalworking.

Name of Tool	Description of Tool
Tin Snips 	A hand tool specifically designed to cut sheet metal.
Jigsaw 	A power tool that's used for cutting curvy lines in wood or other materials.
Pliers 	A small tool with two handles for holding or pulling small things like nails, or for cutting wire.
Claw Hammer 	A tool primarily used for driving nails into, or pulling nails from wood.
Wood Router 	A power tool that is used to rout (hollow out) an area into wood .
Tenon Saw 	Used for carpentry as it makes a straight, precise cuts.
Scroll Saw 	A machine saw with a table for supporting the material and a narrow vertically reciprocating blade for cutting curved lines.

Engineering Tools - Modification

Name of Tool	Description of Tool
Laser Cutter - CAM 	Computer Aided Manufacture - Laser Cutter. Laser cutting is a fabrication process that uses a thin, focused, laser beam to cut and etch materials.
Cordless Drill 	A cordless drill is an electric drill which uses rechargeable batteries. Drills are primarily used for drilling circular holes in material, or for inserting screws .
Angle Grinder 	An angle grinder is a handheld power tool that can be used for a variety of metal fabrication jobs that include cutting and grinding.
File 	A file is used for smoothing or forming objects, especially of metal.
Pillar Drill 	A small portable drilling machine designed to be held and operated by hand.

Name of Tool	Description of Tool
Lathe 	A lathe is a tool that rotates the workpiece on its axis to perform various operations such as cutting, sanding, drilling, facing and turning, Tools are applied to the workpiece to create an object with symmetry about an axis of rotation.
CNC Lathe 	A CNC Lathe is programmed and controlled by Computer Numerical Control (CNC). It's a machine that rotates a workpiece on a spindle to cut away excess material.
CNC Milling Machine 	CNC Milling Machines are machine operated cutting tools that are programmed and managed by Computer Numerical Control (CNC) systems to accurately remove materials from a workpiece.

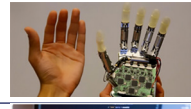
Engineering Tools - Joining

Name of Tool	Description of Tool
Rivet Gun 	Riveting is a technique that is used to join or rivet thin pieces or sheets of metal or plastic.
Glue Gun 	An electric gun-shaped device that heats up cylindrical canisters of glue. The hot glue is applied to the workpiece when the trigger is squeezed. The glue sets quickly so it is ideal for prototype model building in card.
Soldering Iron 	A hand tool used in soldering. It supplies heat to melt solder so that it can flow into the joint between two workpieces.
Nail Gun 	A nail gun is **used to drive nails into wood or other materials**. It is usually driven by compressed air.
Components – Nails, screws, rivets, nut & bolt	

Engineering Tools - Finishing

Name of Tool	Description of Tool
Hand Sander 	Power tool used to smooth surfaces by abrasion with sandpaper.
Disc Sander 	A machine that has a flat circular disk faced with abrasive sandpaper for smoothing wood surfaces.
Buffing Wheel 	A wheel covered with a soft material, such as lamb's wool or leather, used for shining and polishing.

Engineering Disciplines

Name of Tool	Description of Tool
Mechanical Engineering - Hydraulics (Pascal's principle), gears and pulleys	
Electrical and electronic - power station, household appliances, integrated circuits	
Communications - telephone, radio and fibre optic	
Civil Engineering - bridges, roads and railways	
Aerospace - aircraft, space vehicles, missiles	
Chemical Engineering - pharmaceuticals, fossil fuels, food and drinks	
Automotive - cars, motorcycles and trains	
Biomedical - prosthetics, medical devices and radiotherapy	
Software - applications, systems and computer programming	

SI Units of Measurement & COSHH

Name of Tool	Description of Tool
Electric Current 	**Ampere (Amps)** – Microamp, milliamp, amp, kiloamp
Luminous Intensity 	**Candela** – microcandela, millicandela, candela
Temperature 	**Kelvin (Celsius)**
Mass 	**Kilogram** – milligram, gram, kilogram
Length 	**Metre** – micrometre, millimetre, centimetre, metre, kilometre
Amount of Substance 	**Mole** - nanomole, micromole, millimole, mole
Time 	**Second** – microsecond, millisecond, second, minute, hour

- **C**ontrol
- **O**f
- **S**ubstances
- **H**azardous
- **H**ealth

- COSHH is the law that requires employers to control substances that are hazardous to health.
- Providing control measures to reduce harm to health
- Providing information, instruction and training for employees and others

- **Controls against**
- Dust
- Fumes
- Chemicals

RIDDOR & HASAWA

- **R**eporting
- **I**njuries
- **D**iseases
- **D**angerous
- **O**ccurrences
- **R**egulations

RIDDOR puts the duty onto employers (the Responsible Person) to report certain serious workplace accidents, occupational diseases and specified dangerous occurrences (near misses).

- Person Responsible
- Reportable Incidents
- Report Forms

- **H**ealth
- **A**nd
- **S**afety
- **A**t
- **W**ork
- **A**ct

The Health and Safety at Work etc Act 1974 is the primary piece of legislation covering **occupational health and safety** in Great Britain. It's sometimes referred to as the 1974 Act or HASAWA.

It sets out the general duties which:

- Employers have towards employees and members of the public
- Employees have to themselves and to each other
- Certain self-employed have towards themselves and others

PPE - Personal Protective Equipment & MHOR

Name of Equipment	
Safety Goggles	
Leather Gauntlets	
Safety Boots	
Apron	
Dust Mask	
Hard Hat	
Ear Protectors	

• **M**anuel • **H**andling • **O**perations • **R**egulations	Covers the safe lifting and moving of objects

Composite Materials

Carbon Fibre Reinforced Polymer (CFRP)

- CFRP Composites are lightweight, strong materials used in the manufacturing of numerous products used in our daily life.
- Carbon Fibre is the primary structural component.

Glass Reinforced Plastic (GRP)

- **Fibreglass** is a composite material. It is lightweight and strong.
- It is made of a **plastic reinforced** by fine fibres made of **glass**. **Fibreglass** is cheaper and more flexible than carbon fibre.

Plastics (Polymers) & Ferrous Metals (alloys)

Thermo Plastics	Thermoset Plastics	Elastomers
Acrylic	**Epoxy resin**	**Rubber**
HIPS (High Impact Polystyrene)	**Urea Formaldehyde**	**Neoprene**
Polypropylene	**Polyester Resin**	**Silicone**

- **Thermoplastics** can be heated and re-shaped.
- **Thermoset** plastics cannot be reshaped once they have been moulded

Ferrous Metals (alloys)		Uses
Mild Steel - 0.25% Carbon		Structural items • Malleable • Rusts
Cast iron - 4% Carbon		Expensive cooking pans • Doesn't rust • Hardwearing
Stainless Steel - Alloy – mixed with chromium		Cutlery • Attractive • Doesn't rust • Hardwearing

Non - Ferrous Metals (alloys)		
Brass - Brass is a metal alloy that is always made with a combination of **copper** and **zinc**.		Ornaments / musical instruments • Attractive • Doesn't rust
Pewter - Alloy of tin and copper.		Jewellery • Malleable • Low Melting Point • Silvery colour
Solder		Attaching components into circuit boards • Low Melting Point

Pure Non - Ferrous Metals		Uses
Aluminium		Drink cans, bikes, garden furniture • Lightweight • Attractive • Doesn't rust
Copper		Electrical Cable • Malleable • Good Conductor
Lead		• Fishing weight, lead solder • Low Melting Point • Very Dense (heavy)

Woods / Timbers

Softwoods (evergreen trees)	Manufactured Boards (Man Made)	Hardwoods (Deciduous Trees)
Pine 	Plywood 	Balsa 
Cedar 	MDF 	Oak 
Spruce 	Chipboard 	Ash 

Systems Architecture

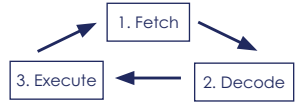
1. The purpose of The CPU

The purpose of the CPU	To manage basic operations of the computer. To be the 'brains' of the computer.
The main components of the CPU	Control Unit. Arithmetic Logic Unit. Registers. Cache.
Von Neumann Architecture	The architecture that allows for the storage of instructions and data in the same location.
The FDE Cycle	The cycle the CPU continuously carries out to process instructions.
Binary	The number system used to store instructions and data in the computer.
The role of a register in the CPU	It is a place to temporarily hold data and instructions as they are being processed by the CPU.
The PC	The Program Counter keeps the address of the next instruction to be processed.
The MAR	The Memory Address Register is used to tell the CPU where to locate data in Main Memory.
The MDR	The Memory Data Register is used to store data that is fetched from Main Memory.
The ACC	The Accumulator stores results of logic operations and calculations used during processing.

2. Common CPU Components and Their Function

The Control Unit has two functions	(1) Sending signals to control the flow of data and instructions, and (2) decoding instructions.
Cache memory	A small section of extremely fast memory used to store commonly used instructions and data. It is useful as the CPU can access the (fast) cache directly. L1 cache is closest to the CPU, L3 cache furthest.
The ALU has the following functions	It carries out mathematical operations / logical operations / shifting operations on data; for example multiplication, division, logical comparisons.
An Address	This is a location in he Main Memory (RAM) that stores data or instructions in the Von Neumann Architecture.
Buses	Transfer information between the CPU and Main Memory (and other places). For example the Address bus carries memory addresses between the CPU and the RAM.

3. The F-D-E (Fetch Decode Execute) Cycle

The F-D-E Cycle repeatedly cycles	
The Fetch Stage	The address is generated by the Program Counter (PC) and is carried to the Memory Address Register (MAR) using the Address Bus. The PC then updates and stores the next memory address, ready for the next round of the cycle. The data or instruction that is in that memory location is placed on the data bus and carried to the processor and is stored in the Memory Data Register (MDR)
The Decode Stage	The data or instruction is then the Memory Data Register (MDR). Decoded to find out if it is a piece of data or if it is an instruction to do something such as ADD, STORE, SWITCH, REPEAT etc.
The Execute Stage	The CPU performs the actions required by the instruction. If it is an instruction to control input or output devices the Control Unit will execute the instruction. If it is a calculation then the Arithmetic and Logic Unit (ALU) will execute the instruction. The results of any calculations are recorded in the Accumulator.

4. Performance of The CPU

Cores	CPUs with multiple cores have more power to run multiple programs at the same time.
Clock Speed	The clock speed describes how fast the CPU can run. This is measured in megahertz (MHz) or gigahertz (GHz) and shows how many fetch-execute cycles the CPU can deal with in a second.
Cache Size	The more data that can be held in the cache, the shorter the trips the electric pulses need to make so this speeds up the processing time of each of those billions of electrical signals, making the computer noticeable faster overall.

5. Embedded Systems

Definition	A computer system which forms part of an electronic device.
Re-programmable	Not for different purposes but firmware can sometimes be upgraded.
Reasons	They are cheaper to make and smaller than a General Purpose Computer.
Examples	Washing machine, Smart Oven, Car Engine, Pacemaker.

Primary and Secondary Storage

1. The purpose of RAM and ROM in a Computer System

The purpose of RAM	RAM is the main memory (also called primary storage) for storing data and programs while they are in use.
The purpose of ROM	ROM stores the boot sequence, which is a set of instructions that the computer executes every time it is switched on. ROM is essential since if loads the operating system.
We use RAM rather than Secondary Storage	The RAM can be accessed at a much higher speed than the secondary storage. If the CPU was having to communicate directly with secondary storage for the F-D-E cycle the computer would be incredibly slow.
Volatility	ROM is non-volatile (it keeps its contents when the power is turned off). RAM is volatile (it loses its contents when the power is turned off).
Primary Storage Devices	Primary storage devices are internal to the system and are the fastest of the memory/storage device category. Typically, primary storage devices have an instance of all the data and applications currently in use or being processed. The computer fetches and keeps the data and files it in the primary storage device until the process is completed or data is no longer required. RAM, ROM, Graphics Card RAM, cache and registers are common examples of primary storage devices.
Increasing RAM	This can speed the computer up since there is less need for virtual memory.

2. The Need for Virtual Memory

Definition of virtual memory	A temporary storage space taken up on a secondary storage device (e.g. hard disk) to allow more space for running programs and data than can fit in primary storage (RAM).
Use of virtual memory	Open applications / data that are not in current use are 'paged' out to the secondary storage. When they are need they are 'paged' back into primary memory.
Advantage of virtual memory	Having virtual memory available allows a computer to run more programs at the same time, or to run larger programs; or to work with much larger amounts of data than could fit in the primary storage (main memory / RAM).
Disadvantage of virtual memory	It is relatively slow compared with RAM. The need to page data in and out of the secondary storage device slows down the computer. It can also lead to 'disk thrashing'.

3. Secondary Storage

Difference from primary storage	Primary storage (e.g. RAM, cache) is volatile. Secondary storage is non-volatile. It retains its data when the power is switched off.
Cache memory	A small section of extremely fast memory used to store commonly used instructions and data. It is useful as the CPU can access the (fast) cache directly. L1 cache is closest to the CPU, L3 cache furthest.
ROM as secondary storage	Not really. ROM is read only. Secondary storage generally needs to be written to as well as read from.

4. Common types of storage

Optical	The surface of a CD is covered in microscopic dots. A laser would skim across the surface reading these. As the laser passes over, the pattern on the surface is picked up. If the laser hits a dot it is reflected differently to if there were no dot present. Examples : CD/CDR/CDRW/DVD/BluRay.
Magnetic	Magnetic hard drives use silver coloured disks which are covered on both sides with a magnetic film divided into billions of tiny areas. Each one of those areas can be independently magnetised (to store a 1) or demagnetised (to store a 0). The read/write heads would flicker quickly over the surface as it reads and writes the data. Several platters would be installed in one hard drive to give greater storage capacity. Examples: Hard Disk Drive / DAT / Tape Drive / Cassette.
Solid State	Solid-state secondary storage does not have any moving parts. Solid state secondary storage stores data using circuit chips. They are sometimes called flash drives. Examples : USB drives / SD Cards / SSD Drives.

5. Considerations for the Most Suitable Storage Device

Capacity	How much data needs to be stored.
Speed	How quickly can the data be stored. How quickly does it need to be read.
Portability	Does the device need to be transported? Are weight and size important.
Reliability	Is it mission critical? Will it be used over and over again?
Cost	How expensive is the media per byte of storage

6. Typical Uses

Optical	Read only distribution on a large scale (CD/DVD). Relatively small capacity.
Magnetic	High data capacity. Reasonably fast. Low cost. Cloud storage on server farms.
Solid State	Low power. Small. Rugged. Silent. Very fast. Medium data capacity.

Data Storage

1. Data units

Bit (b)	The smallest unit of data. 0 or 1
Nibble (N)	4 bits
Byte (B)	8 bits (note the difference between b and B)
Kilobyte (KB)	1000 bytes. Note KB is different from Kb
Megabyte (MB)	1000 KB
Gigabyte (GB)	1000 MB
Terabyte (TB)	1000 GB
Petabyte (PB)	1000 TB

2. Conversions

- **Binary to Denary**
- **Denary to Binary**
- **Hexadecimal to Denary**
- **Denary to Hexadecimal**
- **Binary to Hexadecimal**
- **Hexadecimal to Binary**
- **Left Binary Shift**
- **Right Binary Shift**

3. Operations

Binary addition	You should arrange the two binary numbers above each other so that the columns line up. Start on the rightmost digit and add them. If there are any carries, write them down next to the next left column.
Overflow	If the answer to the left column results in a carry, this is known as an overflow and it causes an overflow error. This can cause problems if a computer program hasn't been written to handle overflows.
Left Binary Shift	Make the number longer, and therefore bigger. Each place it shifts will double the value. A binary left shift of one place (<<1) will double the value, a binary left shift of two places (<<2) with quadruple.
Right Binary Shift	Make the number shorter, and smaller. The right most digit is "lost", so we forget about it. A binary right shift of one place (written as >>1) halves the number, and a binary right shift of two places (>>2) will quarter it.

4. Characters

Individual Characters	Each character is assigned an individual binary code to represent it. The number of bits depends on the 'encoding' used.
Character Set	The name given to a collection of characters matching to binary codes. There are many examples.
Choice of Character Set	A character set encoded with more bits allows more characters. This is useful for accents, symbols, emojis, other languages (e.g. Chinese).

5. Examples of Character Sets

ASCII	7-bits to represent characters allowing 127 characters to be represented.
Unicode	16 / 24 / 32 bits. Covers many modern and historic languages, as well as lots of symbols which are used in maths and other specialist areas.

6. Images

Pixel	The smallest element of a bitmap image. Pixels desk.
Vector vs Bitmap	A vector image describes the lines and shapes. A bitmap image consists of rows of coloured dots.
Colour Depth	The number of bits used to represent each pixel in a bitmap image. An 8 bit image can show 2^8 or 256 colours.
Resolution	In a bitmap image resolution is measured in DPI (dots per inch). The higher the resolution the better the picture quality.
Metadata	Data that is saved before and after the image to tell the computer how to decode the image. It includes the size in pixels (width x height), the colour depth, the resolution, the GPS location of where the image was taken, etc.
Image size	The size of an image is width × height × colour depth (+10% for metadata).
Factors	Greater colour depth and/or greater resolution will make the file size bigger, and improve the quality of the image; and vice versa.

7. Sound

Analogue / Digital	Analogue sound waves must be converted into digital sound waves by taking a sample of the sound at set intervals. This is because computers can only work with digital 'numbers', and not analogue 'sound'.
Sample rate	Number of times analogue signal is sampled per second. Measured in Hertz.
Bit depth	Number of bits used per sample. Sometimes known as sample resolution.
File size	Sample rate x sample resolution x seconds.
Factors	Larger sample rate and/or bit depth will make the file size bigger and improve the playback quality; and vice versa. Also, making the duration of the recording longer will make the file size bigger, and vice versa.

8. Compression

Compression	Compression is when a file is encoded so it uses fewer bits than the original file format.
Lossless compression	Gets rid of unnecessary data to re-present data without losing any information. This process is reversible.
Lossy compression	Gets rid of the least essential data. This is an irreversible process: once data is lost it can't be recovered.

Networks and Network Topologies

1. Types of Networks

Network	A set of connected computers and other devices (e.g. printers, phones, HomeKit devices) for the purpose of sharing resources.
LAN	Local Area Network. Covers a small geographical area (a home, a school, etc.) The infrastructure is often owned by the individual / organisation.
WAN	Wide Area Network. Covers a large geographical area. WANs are made up of LANs joined together. The infrastructure is often owned by a Telecoms or other company rather than the individual.
Advantages to using a LAN	• Resources (files, etc.) and devices (printers, etc.) can be easily shared across the network. • Computers can be configured with the same 'image' so you have the same programs and access to your data from any computer (like in school). • You can control devices (e.g. HomeKit).
Disadvantages to using a LAN	• Security. Malware can spread across a network. • Complexity of setting up and maintaining.

2. Factors affecting performance of a network

Latency	You can get bottlenecks in parts of your network, either because of a faulty switch, or due to the design of your network. Latency is the term used describe the time it takes data to travel from one designated point to another on the network.
Bandwidth	The maximum amount of data transmitted over an internet or LAN connection in a given amount of time.
Transmission Media	WiFi generally has less bandwidth than wired connections. Wired connections (ethernet) can be different speeds (10Mbps, 100Mbps, Gigabit). Switches and routers also have maximum speeds.
Concurrent Users	The more users there are on a network the more data is likely being transmitted. This means it can take longer as you have to wait your turn for your packets to travel across the network.

3. Network Types

Client-Server 	The network relies on a central server and all the clients (devices) request services from the server such as print services, file services etc. Additional hardware is needed in this type of network: a server. All files can be stored and backed-up centrally on a server which means workers can access files from any computer on the network and the computers can also be updated centrally.
Peer-to-Peer 	All computers have equal status and any computer can act as a client and a server—even at the same time. All computers can request and provide network services. For example, any computer can use a resource physically connected to a different computer. There is no need to buy a dedicated server.

4. Required Hardware

NIC	The Network Interface Card is in each computer/devices and allows connection to other devices on the network. It can allow wired connections, wireless connections, or both.
Transmission Media	What connects the computer/devices to each other. Copper cables, fibre optic cables, wireless signals.
Switch	A device on the network that receives signals from a computer/device and transmits the signal to its intended recipient.
Router	A device used to connect different networks together. For example a home LAN to the internet, or a fibre optic cable to a home WiFi network.
WAP	A Wireless Access Point is a device that receives and transmits wireless signals on the network. Often connected to rest of the network by cables.

5. The Internet

The Internet	The Internet is a global collection of interconnected networks.
DNS	The Domain Name Server is a large directory allowing the Internet Service Provider (ISP) to look up the correct IP address for the desired website.
Hosting	If you don't own your own servers and host your website yourself you can use a company to do it for you. They will monitor and maintain their servers they are renting you space on.
The Cloud	Data can be stored 'in the cloud'. This means on servers (in server farms) run by big companies. The data can be accessed from anywhere.
Web Servers and Clients	Servers provide services (e.g. Web server -> Web pages, File server -> file storage/retrieval). Clients request / use services from a server.

6. Star and Mesh Topologies

Star Network	Cheaper than mesh network. Less cabling. Easy to add devices BUT total reliance on central node. If it fails whole network fails. 	**Mesh Network**	Full or partial. More cabling than star. Costs more to install. Harder to add a device. Harder to maintain BUT no Single Point of Failure. 

Protocols and Layers

1. Modes of Connection

Wired	Ethernet is a set of standards (protocols) for how data is transmitted over a wired local area network. It is the most common set of protocols. Data is transmitted in frames.
Inside an Ethernet 'frame'	• Preamble of bits used to synchronise transmission. • Start frame delimiter to signify start of data part of the frame. • Source and destination MAC address. • The actual data. • Error checking information (cyclic redundancy check - CRC).
Wi-Fi	Wi-Fi is a means of allowing computers, smartphones, or other devices to connect to the Internet or communicate with one another wirelessly within a particular area. It has a range of about 100m, takes quite a lot of power (relatively), and has a high bandwidth (but less than a wired connection).
Wi-Fi advantages and disadvantages	• Users can move around freely. • Easier to set up, and less expensive than wired. • Speeds are slower than wired networks. • Relies on signal strength to the wireless access point (WAP). • Signal can be obstructed. • Less secure than wired networks.
Bluetooth	Bluetooth is a standard for the short-range wireless interconnection of mobile phones, computers, and other electronic devices. It has a range of about 10m, takes very little power, and has a relatively low bandwidth.

2. Wireless Encryption

SSID	Wireless networks are identified by a unique "Service Set Identifier" (SSID). Can be invisible/visible and have a password. The SSID has to be used by all devices which want to connect to that network.
Encryption	Data is encrypted by scrambling the data into cipher text using a "master key" created from the SSID of the network and the password. Data is decrypted by the receiver using the same master key, so this key is not transmitted. Protocols used for wireless encryption include WEP, WPA, WPA2.

3. IP and MAC Addresses

MAC address	Every device on a network has a Network Interface Card (NIC). Every NIC (in the world) has a unique Media Access Control (MAC) address. It is used to route frames on a LAN.
IP address	IP Addressing is used to route frames on a WAN (called packets). Every device on the internet has a unique IP (Internet Protocol) address which is assigned to the device by a server. Two main standards (IPv4 and IPv6).
Internal and External IP Addresses	A router will have a unique WAN facing IP address and a LAN facing IP address. Often all devices on a LAN (with unique internal IP addresses) will share a single external IP address.

4. Standards

Definition	A set of specifications for hardware/software. Enables products to be compatible with each other and interact with each other.
ASCII/Unicode	Character set standards.
IEEE	Computer cables standards.
HTML	Standard for creating websites.
PNG, GIF, MP3	Standards for documents, images, sounds, videos, etc.

5. Common Protocols

TCP/IP	Transmission Control Protocol/Internet Protocol. Used to communicate over LANs and WANs.
HTTP / HTTPS	Hypertext Transfer Protocol (secure). Used for webpage requests.
FTP / FTPS	File Transfer Protocol (secure). Used for file transfers.
POP	Post Office Protocol. Used for receiving e-mail. Downloads e-mail from the server to your device and deletes it from the server.
IMAP	Internet Message Access Protocol. Used for receiving e-mail. Keeps emails on the server. This allows your device to stay in sync with the server.
POP vs IMAP	POP you have your mail on one device since it is deleted from the server. IMAP each device syncs to server so your mail can be on multiple devices.
SMTP	Simple Mail Transfer Protocol. Transfers outgoing emails from one server to another / from a email client to a sever.

6. Layers

Concept	The concept of layering is to divide the complex task of networking into smaller, simpler tasks that work with each other.
Responsibility	The hardware and/or software for each layer has a defined responsibility. Each layer provides a service to the layer above it.
Advantages	Reduces the complexity of the problem into manageable sub-problems. Devices can be manufactured to operates at a particular layer. Products from different vendors will work together.

Network Security

1. Types of Networks

Malware	Software written in order to infect computers and commit crimes e.g. fraud or identify theft. Malware exploits vulnerabilities in software.
Types of Malware	Malware is term that covers (among other things) viruses, trojans, worms, ransomware, spyware and adware.
Phishing	Online fraud technique used by criminals. It is designed to get you to give away personal information such as usernames, passwords, bank details, credit card details… Achieved by disguising as a trustworthy source in an electronic communication, e.g. an email or fake website.
Brute Force Attack	A trial and error method used to decode encrypted data (such as passwords). Uses every combination until it hits upon the correct one.
DOS Attack	Denial of Service attack. Floods a server with useless traffic causing the server to become overloaded and unavailable.
DDOS Attack	Distributed Denial of Service Attack. Using multiple computers (zombies) in a Botnet to undertake a DOS attack.
Data Interception and Theft	Stealing information from an unknowing victim's computer in order to get confidential information, or to compromise their privacy. E.g. to sniff usernames and passwords.
SQL Injection	A technique used to view or change data in a database by inserting additional code into a text input box, creating a different SQL command.
Zero Day Attack	An attack using an unknown and undocumented vulnerability in software code (unknown to the code owner).

2. Threats posed to Networks

Malware	• Files are deleted, become corrupt or are encrypted. • Computers crash, reboot spontaneously and slow down. • Internet connections become slow. • Keyboard inputs are logged and sent to hackers.
Phishing	• Accessing a victim's account to withdraw money, or purchase merchandise and services. • Open bank accounts, credit cards, cashing illegitimate cheques. • Gain access to high value corporate data. • Financial services can blacklist the company
Brute Force Attack	• Theft of data. • Access to corporate systems.
(D)DOS Attack	• Loss of access to a service for customers. • Lost revenue. • Lower productivity. • Damage to reputation.
Data Interception and Theft	• Usernames and passwords compromised. • Disclosure / theft of corporate data.
SQL Injection	• Contents of databases can be output, revealing private data. • Data in the database can be amended or deleted. • New rogue records can be added to the database.
People	• Many system vulnerabilities are caused by people being careless: • Not installing operating system updates. • Not keeping anti-malware up to date. • Not locking doors to computer rooms. • Not logging off or locking their computer. • Leaving printouts on desks. • Writing passwords down on sticky notes attached to computers. • Sharing passwords. • Losing memory sticks / laptops. • Not applying security to wireless networks. • Not encrypting data.

3. Identifying and Preventing Vulnerabilities

Malware	• Security software (Spam filter, Anti-virus, Anti-spyware, Anti-spam). • Enabling OS and security software updates. • Staff training. • Backup files regularly onto removable media.
Phishing	• Strong security software. • Staff training: awareness of spotting fake emails and websites. • Staff training: not disclosing personal or corporate information. • Staff training: disabling browser pop-ups.
Brute Force Attack	• Network lockout policy, Using progressive delays. • Staff training.
(D)DOS Attack	• Strong firewall and packet filtering. • Properly configuring servers and auditing and monitoring systems.
Data Interception and Theft	• Encryption and using virtual networks. • Staff training and computer use policies.
SQL Injection	• Validation on text boxes. • Database permissions.

Systems Software

1. Definitions

Systems Software	Systems Software is the software used to control the hardware of the computer. It is contrasted to application software which is used to enable the user to perform tasks and create content and products.
Operating System	An operating system is a piece of system software that communicates with the hardware of the computer and allows other programs to run. It is comprised of system software, or the fundamental files your computer needs to boot up and function.
Peripherals	Peripherals are controlled by software called device drivers. Standard drivers (mouse and keyboard) are included in the operating system, however more specialist peripherals may need drivers programmed by the manufacturer which convert signals into machine code and are installed separately.
Utility Software	Utilities are programs that are installed to perform a specific function, usually to improve the efficiency or security of a computer system.

2. The Function of Operating Systems

What does an Operating system do?	An operating system manages all of the software and hardware on the computer. Most of the time, there are several different computer programs running at the same time, and they all need to access your computer's central processing unit (CPU), memory, and storage. The OS co-ordinates this activity.
Interaction	A user interacts with the computer by means of an interface provided by the operating system.

3. Types of Interface

GUI	A Graphical User Interface provides windows, icons, menus, (mouse or other) pointer… Sometimes calls WIMP. It is visual, interactive, and intuitive. Optimised for mouse/touch input.
CLI	A Command Line Interface is text based. It uses less resources than a GUI. It is more efficient but harder to learn. Often repetitive processes can be automated with scripts.
Menu	A Menu Interface presents successive menus to the user with options to choose at each stage. Often used with buttons on a keypad. (Think calculator when you press the 'MENU' button).
Natural Language	A Natural Language Interface responds to questions in a spoken language. They are not always reliable but are improving all the time. (Think Siri or Alexa).

4. Features Often Provided by an Operating System

Multitasking	Running multiple applications at the same time by giving each application a small time-slice of processor time. This allows more than one program to be held in memory at a time, and data shared between them such as copy and paste. It also enables you to listen to music on your PC at the same time as word processing for example.
Memory Management	When programs are loaded, the operating system decides where they are held in memory. Over time the memory becomes fragmented as programs are loaded and closed because they use different amounts of memory. The operating system must keep track of different program fragments. When the memory is full, the operating system uses virtual memory.
Device Drivers	Translates operating system instructions into commands that the hardware will understand. Each peripheral will need a device driver and many common ones are built into the Operating System.
User Management	Providing for different users to log into a computer. The operating system will retain settings for each user, such as icons, desktop backgrounds etc. Each user may have difference access rights to files and programs. A client server network may impose a fixed or roaming profile for a user, and manage login requests to the network.
File Management	Data is stored in files. An extension to the filename tells the operating system which application to load the file into. Files can also be placed in folders for ease of organising.

5. Examples of Utility Software

Encryption	Encryption utilities use an algorithm to scramble plain text into cipher text. It can be decrypted and read again with a Key.
Defragmentation	Defragmentation utilities reorganise files on a hard disk, putting fragments of files back together, and it collects together free space. This reduces the movement of a read/write head across the surface of the disk, which speeds up file access. Solid state drives should not be defragmented (it is unnecessary as they have no moving parts. It also reduces their lifespan).
Compression	Compression utilities reduce the size of a file so that it takes up less space, and is quicker to download/upload. Compressed files must be extracted before they can be read. Compression is lossy or lossless.
Backup	Backup utilities take a copy of the data and place it elsewhere (disks, tapes, cloud, etc.). Backups can be either full (backup everything) or incremental (back up changes since the last backup).

Ethical, Legal, Cultural and Environmental Concerns

1. Privacy Issues

Implications	• Implications for personal privacy have arisen due to the vast array of cameras and surveillance systems around. • The amount of data that we share and that is recorded about us is growing hugely. • Free speech / freedom of expression / right to personal privacy vs. Law and Order / Public security / government's role.

2. Cultural Issues

Implications	• The impact of technology in our daily lives (Technology is changing how people live their lives today. We have an ever increasing dependency on technology in the 21st Century). • The digital divide (Access to technology and the Internet is not the same across the world). • Globalisaion (As people around the world become more exposed to technology this impacts on the values and expectations of the people in each country).
Positive Effects	• In the developing world, the rapid spread of technology, fuelled by the Internet has led to positive cultural changes in developing countries. • Easier, faster communication has contributed to the rise of democracy, as well as working towards the alleviation of poverty. • Globalisation can also increase cultural awareness and promote diversity.
Negative Effects	• Diffusion of technology must be carefully controlled to prevent negative cultural consequences. • Developing countries risk losing their cultural identities and assimilating themselves into an increasingly westernised world. • Challenges of inequality from the uneven distribution of technology within a country also still remain. • Traditionally, most computer applications are designed by developers in North America. These designers unintentionally apply their cultural values and systems of thought whilst developing computer applications.

3. Environmental Impact

Fossil Fuels	Fossil fuels are consumed in the manufacturing of computer devices.
Energy	2% of global energy consumption is used by data centres.
Disposal	Old computing equipment is often shipped to countries with lower standards for disposal. People trawl through waste looking for metals to be recycled and sold, exposing themselves to danger.

4. Impacts of Digital Technology on Wider Society

Customers	Customers can do more from home with less travelling involved. They can do things 24/7. They can access their data on many devices. Computers can make instant decisions without human involvement. Potentially open to hacking. Less personal.
Staff	Job losses as things become more automated. New types of jobs created that didn't previously exist. Up-skilling required.
Companies	Less overheads (salary, rent, utility bills) if fewer staff and buildings required. More ways to target potential customers. Increased importance of data protection and security.
Local Communities	Local shops may suffer is town centres are more empty. Elderly and vulnerable customers may have nowhere local to go as local services are scaled back.

5. Legislation

Data Protection Act (2018) [implementing GDPR]	• Data must be processed lawfully, fairly and in a transparent manner. • Data must only be collected for specified, explicit and legitimate. • Data must be adequate, relevant and limited to what is necessary. • Data you collect must be accurate and kept up to date. • Data you hold must be kept for no longer than is necessary. • Data you hold must be processed in a manner that ensures appropriate security of the personal data. • Data controllers must be able to prove that their data protection measures are sufficient.
Computer Misuse Act (1990)	It is illegal to make any unauthorised access to data… …with the intent to commit further offences. …with the intent to modify data, e.g. viruses.
Copyright Designs and Patents Act (1998)	It is illegal to copy, modify or distribute software, music, videos or other intellectual property without permission from the author

6. Open Source vs Proprietary Source

What does an Operating system do?	An operating system manages all of the software and hardware on the computer. Most of the time, there are several different computer programs running at the same time, and they all need to access your computer's central processing unit (CPU), memory, and storage. The OS co-ordinates this activity.
Interaction	A user interacts with the computer by means of an interface provided by the operating system.

Algorithms

1. Computational Thinking

Abstraction	The process of removing unnecessary details and including only the relevant details. It is a method of computational thinking that focusses on what is important in problem solving
Decomposition	The process of breaking a complex problem down into smaller more manageable parts. Dealing with many different stages of a problem at once is much more difficult than breaking a problem down into a number of smaller problems and solving each, one at time.
Advantages of Program Decomposition	• Makes problems easier to solve. Different people can work on different parts of a problem at the same time reducing development time. • Program components developed in one program can easily be used in other programs.
Algorithmic Thinking	A way of getting to a solution by identifying the individual steps needed. By creating a set of rules, an algorithm that is followed precisely, leads to an answer. Algorithmic thinking allows solutions to be automated.

2. Input Processes and Output

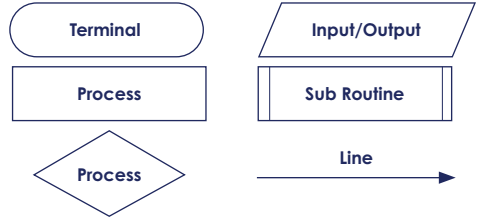
Inputs	Anything which needs to be supplied to the program so it can meet its goals. • Often input by the user. • Consider an appropriate variable name and data type for the input.
Processes	• Consider what calculations need to be performed while the program is running. • Does data need to change formats or data types
Outputs	• Consider what your program need to output. • Consider what form this output need to take. • Consider an appropriate variable name and data type for any output.

3. Structure Diagrams

- Structure diagrams illustrate problem decomposition.
- They can be used for developers to understand a problem to code and to share with users during systems analysis.
- They are produced using a method known as step-wise refinement.
- Break problem down using decomposition into ever smaller components.
- Some areas of the program will needed breaking down more than others.
- The lowest level nodes should achieve a single task.
- These can then be coded as a single module or sub-program.

3. Flowcharts, Pseudocode and OCR Reference Language

Flowchart	A method of representing the sequences of steps in an algorithm in the form of a diagram. Sometimes called a Flow diagram.
Structure Diagram	A diagram showing a top-down breakdown of a complex problem.
Pseudocode	A text based alternative of representing the sequences of steps in an algorithm. Pseudo-code can be thought of as a simplified form of programming code.
OCR Reference Language	You must be able to read this but you can always use Python in your exams—but be precise.



4. Types of Errors

Syntax Error	Syntax errors are errors which break the grammatical rules of the programming language. They stop it from being run/translated.
Logic Errors	Logic errors are errors which produce unexpected output. On their own they won't stop the program running.

5. Trace Tables

- A vital skill for understanding program flow and testing the accuracy of an algorithm for logic is called "Tracing Execution".
- Examine a printed extract of program code and running thorough the program.
- Take each line at a time and write out in a trace table the current state of each variable. Noting down any output the program produces.
- Each variable present in the program should have its own column in the trace table.
- A new row should be added under any column if the state of a variable changes.
- Trace tables are an excellent way to track down logic errors in a problem.

Searching and Sorting Algorithms

1. Binary Search

The Algorithm	• Calculate a mid-point in the data set. • Check if that is the item to be found. • If not… • If the item to be found is lower than the mid-point, repeat on the left half of the data set. • If the item to be found is greater than the mid-point, repeat on the right half of the data set. • Repeat until the item is found or there are no items left to check.
Requirements/ Efficiency	• Requires the data set to be in order of a key field. • Can be done with letters as well as numbers—use alphabetical order. • More efficient than a linear search on average

2. Linear Search

The Algorithm	• Starting from the beginning of a data set, each item is checked in turn to see if it is the one being searched for.
Requirements/ Efficiency	• Doesn't require the data set to be in order. • Will work on any type of storage device. • Can be efficient for smaller data sets. • Is very inefficient for large data sets.

3. Bubble Sort

The Algorithm	• Sorts an unordered list of items. • It compares each item with the next one and swaps them if they are out of order. • The algorithm finishes when no more swaps need to be made. • In effect it "bubbles" up the largest (or smallest) item to the end of the list in successive passes.
Efficiency	• This is the most inefficient of the sorting algorithms but is very easy to implement. • This makes it a popular choice for very small data sets.

4. Insertion Sort

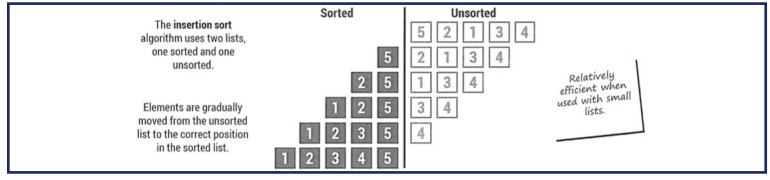
The Algorithm	• The insertion sort inserts each item into its correct position in a data set one at a time.
Efficiency	• It is a useful algorithm for small data sets. • It is particularly useful for inserting items into an already sorted list. • It is usually replaced by more efficient sorting algorithms for large data sets.

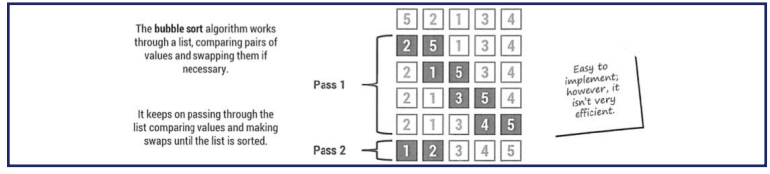
5. Merge Sort

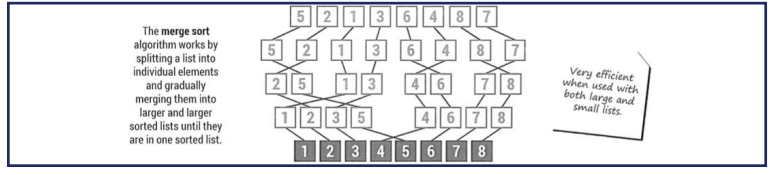
The Algorithm	• A very efficient method of performing a sort. • Uses a divide and conquer method. • Creates two or more identical sub-problems from the largest problem, solving them individually. • Combines their solutions to solve the bigger program. • Data set is repeatedly split in half until each item is in its own list. • Adjacent lists are then merged back together.
Efficiency	• Works very well for large data sets.

6. For the exam

✓ Understand the main steps of each algorithm.
✓ Understand any pre-requisites of an algorithm.
✓ Apply the algorithm to a data set.
✓ Identify an algorithm if given the code for it.
✓ Show all your steps in detail.
x To remember the code for these algorithms.







Programming Fundamentals 1

1. Types of Networks

Variable	A value stored in memory that can change while the program is running.
Constant	A value that does not change while the program is running, and is assigned when the program is designed.
Operator	A character that represents an action, e.g. "+" is a mathematical Operator.
Assignment	Giving a variable or constant a value.
Casting	Converting a variable from one data type to another.
Input	A value that is entered into the program after the program has started running.
Output	A value that produced by the program and either saved or displayed to the user.

2. Correct Use of Data Types

Integer	A positive or negative whole number used when arithmetic will be required.
Real/Float	A positive or negative decimal number.
Character	A single alphanumeric.
String	Multiple characters joined together [n.b. use this for credit card numbers].
Others	Some languages have others, e.g. date, picture…

3. The Three Basic Programming Constructs

Sequence	Executing one instruction after another.
Selection	Program branching depending on a condition.
Interation	Sometimes called looping, is repeating sections of code. Condition controlled or count controlled.

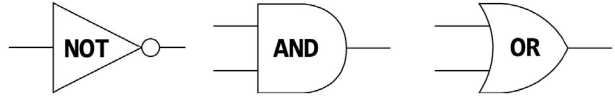
4. Common Arithmetic Operators

+	Addition
-	Subtraction
*****	Multiplication
/	Division
^	Exponentiation
MOD	Modulus

5. Common Comparison Operators

==	Is equal to
!=	Is not equal to
<	Is lesser than
>	Is greater than
<=	Is lesser than or equal to
>=	Is greater than or equal to

5. The Common Boolean Operators



6. Basic String Manipulation (general)

string.length	Obtains the length of the string in characters.
string.upper	Converts the string to uppercase.
string.lower	Converts the string to lowercase.
string.left(n)	Gets the left-most n characters of the string.
string.right(n)	Gets the right-most n characters of the string.
string. substring(a,b)	Gets b characters of the string starting at position a.
ASC(char)	Returns the numerical ASCII value of char.

Note : this is NOT the way things are done in any particular programming language. In particular Python does things differently.

7. Basic File Handling Operations (OCR Reference Language)

myFile=open("…")	Open a file.
myFile.close()	Close a file.
myFile.readLine()	Read a line from a file.
myFile.writeLine()	Write a line to a file.
myFile=("…")	Create a new file.
string. substring(a,b)	Gets b characters of the string starting at position a.
A Workflow	myFile = open ("sample.txt") while NOT myFile.endOfFile() print (myFile.readLine()) endwhile myFile.write("Hello") myFile.close()

Note : this is NOT the way things are done in any particular programming language. In particular Python does things differently.

Programming Fundamentals 2

1. Storing Data in Records

In Text Files	• Stored on the secondary storage (hard disk/SSD/flash). • Used to store data when the application is closed. • Useful for small volumes of data. E.g. configuration files. • Each entry is stored on a new line or separated with an identifier such as a comma or tab. • Can require a linear search to find/read data which is slow (if there is no order to the data or record structure). • Structured text files E.g. CSV, XML & JSON are popular for storing and exchanging data between applications.
In Arrays and Lists	• Stored in RAM. • Used to store data when a program is running. • Useful for small volumes of data an algorithm is using. • Can be single or multi-dimensional allowing for tables of data to be stored. • Uses indexes to refer to data items. • Efficient algorithms or linear searches can be used to find data.
In Databases	• Often stored on remote servers. • Often used to store data shared by many users, e.g. ticket booking system. • Data is stored in records and fields. • Uses advanced data structures to store data efficiently. • Uses very efficient algorithms to search and sort data executed on the servers. • More secure than text files. • The order of the fields in the database in independent of the code
Record Structure	• A collection of related fields. • A field is a variable. • Each field in a record can have a different data type. • Note the dot syntax when using records: record<dot>Field e.g. car1.Make

2. SQL

SELECT	Which fields to be returned. * can be used to indicate all fields.
FROM	Which table. Databases can have more than one table, each with their own unique name.
WHERE	Records meet a condition. LIKE and % can be used as a wildcard.
Example	SELECT name, age, iq FROM person WHERE name LIKE 'FIS%'.

3. Arrays

Definition	An array is a series of memory locations – or 'boxes' – each of which holds a single item of data, but with each box sharing the same name. All data in an array must be of the same data type.
Use	• Indexes usually start at 0 for the first data item (known zero indexed). • Arrays may be single or multiple dimensions. • Visualise dimensions as a column (single dimension) or table (two dimension) • In Memory two dimensional arrays are still stored in a linear fashion

4. Sub programs

Why Use them	• Larger programs are developed as a set of sub-programs called subroutines. • Structuring code into sub-programs makes the code easier to read and debug. • Each sub-program can easily be tested. • Sub-programs can be saved into libraries and reused in other programs.
Functions	Functions return values and create reusable program components.
Procedures	Procedures create a modular structure to a program making it easier to read. They do not return values

5. Random Numbers

Deterministic	Programs that run on computer systems are deterministic – with exactly the same inputs they should produce exactly the same outputs.
Real World	Randomness is easy to produce in the real world – spinning a wheel, rolling a dice and so on are millennia-old techniques but producing the same randomness in a computer program is actually rather tricky.
Computer	• Computers do not produce random numbers at all • They use complex mathematical techniques to produce a series of numbers that may appear random but are really only an approximation to randomness (called pseudo-random numbers) • We refer to them as random numbers anyway
OCR Reference Language	myVariable = random (1,6) will produce a random number between 1and 6

Producing Robust Programs

1. Input Validation

Validation	Does not ensure that the data entered is correct, just that it is possible and sensible.
Type Check	The input is in the correct data type. E.g. Integer, Real, String.
Range Check	The input is within a correct range. E.g. Between 1 and 2.
Presence Check	Some data has been entered. E.g. Reject blank inputs.
Format Check	The input is in the correct format. E.g. dd/mm/yyyy.
Length Check	The input has the correct number of characters. E.g. 8 or more chars.
Why use input validation?	• • The program is more robust. • • The program is more user friendly. • • To prevent further errors occurring later in the algorithm.

2. Anticipating Misuse

Division by Zero	In mathematics, there is no number which when multiplied by zero returns a non-zero number. Therefore the arithmetic logic unit cannot compute a division by zero.
Communication Error	Online systems require connections to host servers. If this connection is dropped, unable to be established or the server is overloaded, it could potentially cause a program to crash or hang when loading/saving data.
Peripheral Error	Any peripheral may be in an error mode (e.g. paper jam).
Disk Error	Programs that read and write to files must handle exceptions, including: • • The file/folder not being found. • • The disk being out of space. • • The data in the file being corrupt. • • The end of the file being reached.
Authentication	• Username and password to access systems. • Password recovery by e-mailing to an authenticated e-mail address. • Encryption of data files. • Check for human and not bot attempting access (e.g. reCAPTCHA).

3. Maintainability

Comments	These explain the purpose of the program, or a section of code. They may also explain any unusual approaches or temporary 'fixes'.
White Space	Make each section of the code stand out. Use spaces so code is not cramped up and hard to read.
Indentation	Mandatory in Python but use indentation to show the flow of the program.
Variable Names	Use sensible variable names that have some meaning as to what they are being used for.
Sub Programs	Use Procedures and functions to structure the code and eliminate duplicating portions of it.
Constants	Declare constants at the top of the program.

4. Testing

Reasons for Testing	• To ensure there are no errors (bugs) in the code. • To check that the program has an acceptable performance and usability. • To ensure that unauthorised access is prevented. • To check the program meets the requirements
Iterative Testing	• Each new module is tested as it is written. • Program branches are checked for functionality. • Checking new modules do not introduce new errors I not existing code. • Tests to ensure the program handles erroneous data and exceptional situations.
Final / Terminal Testing	• Testing that all modules work together (integration testing) • Testing the program produces the require results with normal, boundary, invalid and erroneous data. • Checking the program meetings the requirements with real data.

5. Suitable Test Data

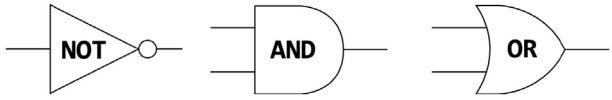
Normal Inputs	Data which should be accepted by a program without causing errors.
Boundary Inputs	Data of correct type on the edge of accepted validation boundaries.
Invalid Inputs	Data of the correct type but outside accepted validation checks.
Erroneous Inputs	Data of the incorrect type which should be rejected by a computer system. This includes no input being given when one is expected.

6. Refining Algorithms

What do we mean by refining?	• Code should anticipate all inputs and it should deal with 'bad' data, or missing data, and not crash. • It should ensure prompts to the user are helpful and that the input can only be of the correct type
How to refine	Many languages have exception handling commands

Boolean logic, Programming Languages and IDEs

1. Logic Gate Symbols



~A | A ^ B A & B | A v B A | B

2. Truth Tables

A	NOT A
0	1
1	0

A	B	A AND B
0	0	0
0	1	0
1	0	0
1	1	1

A	B	A OR B
0	0	0
0	1	1
1	0	1
1	1	1

3. Levels of Programming Languages

Machine Code 1st Generation	• Binary representation of instructions in a format that the CPU can decode and execute. • Have an operation code (opcode) instruction and address or data to use (operand).
Low-Level Languages 2nd Generation	• Written in Assembly language. • Translated by an assembler into machine code. • Used for embedded systems and device drivers where instructing the hardware directly is necessary. • One instruction translated into one machine code instruction. • The code works on one type of processor only. • The programmer works with memory directly. • Code is harder to write and understand. • Memory efficient. • Code is fast to execute.
High-Level Languages 3rd Generation	• Source code is written in languages as Python, C++. • Translated by a compiler or interpreter into machine code. • Makes the writing of computer programs easier by using commands that are like English. • One source code instruction translates to many machine code instructions. • Code will run on different types of processors. • The programmer has lots of data structures to use. • Code is quicker and easier to understand and write. • Less memory efficient. • Code can be slower to execute if it is not optimised.

4. Translators

Assembler	Assembles' assembly language into machine code. Translates the whole code before execution.
Compiler	Translates source code from high-level languages into object code and then into machine code ready to be processed by the CPU. The whole program is translated into machine code before it is run.
Compiler Advantages	• No need for translation software at run-time, and no need to share original source code. • Speed of execution is faster because code is usually optimised.
Complier Disadvantages	• You cannot compile the program if there are syntax errors anywhere in it which can make it tricky to debug. • If you change anything you need to recompile the code.
Interpreter	Translates source code from high level languages into machine code ready to be processed by the CPU. The program is translated line by line as the program is running.
Interpreter Advantages	• Easy to write source code because the program will always run, stopping when it finds a syntax error. • Code does not need to be recompiled when code is changed, and it is easy to try out commands when the program has paused after finding an error.
Interpreter Disadvantages	• Translation software is needed at run-time, so you beed to share the original source code. • Speed of execution is slower because the code is not optimised.

5. Integrated Development Environments

Debugging Tools	• Breakpoints – stopping at a line of code during execution. • Stepping through lines of code one at a time. • Tracing through a program to output the values of variables.
Run Time Environment	• Output window. • Simulating different devices the program can run on.
Usability Functions	• Navigation, showing/hiding sections of code. • Formatting source code often in different colours. • Text-editor functions. • Illustrating keyword syntax and auto-completing command entry.
Translator	Some IDEs have an inbuilt translator to test the program and make small alterations before compiling the final program into an executable file for distribution.

Glossary for Unit 1

Term	Definition	Term	Definition
Application software	A program containing a set of instructions to the computer that allows the user to carry out a specific function.	**Compression**	Making files smaller by reducing the number of bits used to store the information.
Artificial Intelligence (AI)	When computers perform tasks normally requiring human intelligence, such as problem solving, adapting according to previous experience.	**Cookies**	Cookies are text files containing small pieces of data that are sent from the website you are browsing. They are stored in your computer and provide a way to recognise you and keep track of your preferences.
Augmented reality	The process of superimposing a computer-generated image on a user's view of the real world.	**Cyberbullying**	Bullying using digital communication tools such as the Internet or mobile phones.
Authentication	When a user confirms their unique identity on a computer system.	**Data**	A collection of text, numbers, or symbols in a raw or unorganised form.
Back-up	A copy of a file that is kept in a location away from the computer which can be used to restore data in case of loss.	**Data capture**	The process of taking information from a document and converting it into data which a computer can read.
Biometrics	Technologies that recognise human body characteristics (e.g., fingerprint) to authenticate a person's identity.	**DDoS**	A distributed denial-of-service attack, which is a malicious attempt to disrupt the operation of a service or network by flooding the target with fake traffic
Bionics	The science of constructing artificial systems (e.g. limbs) that have some of the characteristics of biological systems.	**Digital footprint**	The data left behind when you have made an interaction online.
Bluetooth	A wireless communication protocol for exchanging data over short distances.	**Drone**	A flying robot that can be remotely controlled.
Cloud computing	Software applications and data that are stored online and used through the Internet.	**E-commerce**	Commercial transactions made electronically on the Internet.
Communication software	A program designed to pass information from one system to another.	**Encoding**	The process of converting data from one form to another.

Glossary for Unit 1

Term	Definition	Term	Definition
Encryption	The process of scrambling data when it is being sent to protect it from unauthorised users, as they do not have an encryption key to decode it.	**Knowledge**	When a person gains information such as facts, or the understanding of information such as how to solve problems.
Ethernet	The most usual way of connecting computers together in a local area network (LAN).	**Local Area Network (LAN)**	A network that links computers that are geographically close enough together to be hard wired.
E-Waste	Electronic appliances such as mobile phones, computers, and televisions that are thrown away without the intention of re-use.	**Logical Protection**	Software security controls put in place to manage access to computer systems (e.g. passwords).
Expert System	A computer system that stores facts and can search these facts for information according to a set of rules, copying the decision-making ability of a human expert.	**Malware**	Short for malicious software, it covers all software that is specifically designed to disrupt, damage or gain unauthorised access to a computer system.
Extranet	An extranet is a controlled private network that is accessible to some authorised users outside of the organisation.	**Near-Field Communication (NFC)**	A set of communication protocols based on a radio frequency (RF) field, designed to exchange data between two electronic devices through a simple touch gesture.
Green It	Environmentally responsible and eco-friendly use of computers and their resources in order to reduce the carbon footprint.	**Open Source Software**	Software that is distributed with its source code so that anyone can inspect, modify or enhance it.
Hacking	The gaining of unauthorised access to data in a computer system.	**Output Device**	A piece of equipment that receives data from your computer once it has been processed (e.g. a monitor).
Hardware	The physical components of a computer.	**Packet Sniffing**	A computer program or computer hardware that can intercept and monitor network traffic.
Information	Information Data that has been processed, normally by a computer, to give it meaning.	**Physical Protection**	Protecting equipment by physically preventing access to it.
Information Handling Software	The process of gathering, recording and presenting information in a way that is helpful to others (e.g. in a graph).	**Port**	A docking point available for connection to peripherals such as input and output devices.
Input Device	A piece of equipment that transfers data into a computer so it can be processed.	**Protocol**	A standard set of procedures that allow data to be transferred between electronic devices.
Internet	A public worldwide system of computer networks.	**Radio-Frequency Identification (RFID)**	A technology to record the presence of an object using radio signals.
Intranet	A private operated network where data content and access is controlled.	**Ransomware**	A type of malware that prevents you from using your computer or accessing certain files until you pay a ransom to the hacker.
Key Logging	The use of a computer program to record every keystroke made by a computer user without their knowledge and usually in order to gain fraudulent information.	**Robotics**	The use of robots to perform tasks done traditionally by humans.

Glossary for Unit 1

Term	Definition	Term	Definition
Social Engineering	When users are tricked into making security mistakes, so they give up confidential information.	**Utility Software**	A program designed to help to analyse, configure, optimise or maintain a computer.
Social Network	An online service or site that allows people to communicate with friends on the Internet using a computer or mobile phone.	**Validation**	Checking input to make sure it meets a set of defined rules and is sensible in order to prevent errors.
Software	The programs that tell a computer what to do.	**Verification**	Checking input to make sure that the data entered is identical to the original source in order to prevent errors.
Spyware	Software that enables a user to obtain information about your computer activities by transmitting data secretly from your hard drive.	**Video Conference**	An electronic meeting, allowing users to hold face-to-face meetings without having to be in the same place physically.
Storage Device	A piece of internal or external hardware used for saving, carrying and extracting data from a computer.	**Virtual Reality**	A computer-generated simulation in which a person can interact within an artificial three-dimensional environment.
System Software	A type of computer program that operates a computer's hardware and provides a platform to run application programs.	**Virus**	A piece of code which is capable of copying itself and is placed on your computer with the aim of damaging the system.
Teleworking	When you work at home, while communicating with your office using a wide area network (WAN).	**Wearable Technologies**	Smart electronic devices that are designed to be worn by the user and have sensors that collect data such as heart rate.
Topology	The way in which computers are arranged in a network.	**Wide Area Network (WAN)**	A telecommunications network that extends over a large geographical area, connecting more than one Local Area Network (LAN).
Trojan Horse	A type of malware that is usually disguised as legitimate software used by hackers trying to gain access to your computer system.	**Wireless**	Uses a technology such as radio or microwaves to transmit signals rather than using wires or cables.
USB	An industry standard method of transferring data between a host device (e.g. a computer) and a peripheral device (e.g. a mouse). Stands for Universal Serial Bus.	**Worm**	A computer program that replicates itself in order to spread malicious code throughout your system.

Glossary for Unit 2

Term	Definition	Term	Definition
Absolute Referencing	Using a dollar ($) sign before either the letter or number (or both), this is a reference that will always point to that exact cell.	**Form**	A database form is a user-friendly way to enter, edit, or display data from a table or a query.
Alpha	The opacity of the pixel (how opaque the pixel is)	**Formula**	An expression that operates on values in named cells to carry out a calculation.
Cloning	Allows you to copy one part of an image over another.	**Function**	A pre-defined formula that operates on values in named cells to carry out a calculation (e.g. SUM to add a range of cells).
Combo Box	A combination of a drop-down list and an editable text box that allows users to enter a value.	**Header**	Information, such as a title, that will appear at the top of every page of a document.
Copyright	The legislation that ensures the copyright owner has the right to control how their material is used.	**Intellectual Property Rights**	The rights given to persons over the ideas that they have created.
Criteria	In terms of a database query, the criteria are the values or rules which decide whether a record will be included in the result (e.g. =yes).	**Interface**	The software and hardware that enable a user to communicate with a computer or device.
CSV File	A text file that uses commas to separate values and allows data to be saved in a tabular format.	**Lasso**	A tool that operates on the active layer of an image, which is used by clicking and dragging to trace the edges of a selection.
Customisation	The act of making or changing something to suit a particular individual or task	**Macro**	Programs which you can create to automate frequently used processes. A macro records a sequence of mouse actions or keystrokes and then runs them when the macro is selected.
Data Redundancy	Data redundancy occurs when the same piece of data in a database is stored in two or more separate places.	**Magic Wand**	A graphics tool which selects pixels based on the tone, colour, hue, brightness or opacity of an object or area.
Database	An organised collection of data.	**Marquee**	A tool which selects items within a rectangle.
Entity	Something or someone about which data is captured and stored in tables.	**Masking**	Image masking is a method of hiding or filtering some portions of an image.
Field	A category of information within a table (the column headings).	**Navigation**	The way you get from one part of a program to another (e.g. a button that will take you to a different page).
Filter	A way of displaying only the specific records you want to view.	**Optimise**	A form of compression that reduces the file size of the image without losing quality.
Footer	Information, such as a page number, that will appear at the bottom of every page of a document.	**Parameter**	A piece of information you supply to a query when you run it, allowing you to create a query that can be updated to reflect a new search term
Foreign Key	A field in one table of a relational database that links to the primary key in another table	**Place Holder**	Text that temporarily takes the place of the final data, allowing the document fields to be selected before the source file is available.

Glossary for Unit 2

Term	Definition	Term	Definition
Primary Key	A unique identifier for each record.	**Relationship**	The link between different tables in a database.
Query	A method of retrieving data from a database based on certain specific criteria.	**Relative Referencing**	The type of cell reference that will automatically change when the reference is replicated to other columns or rows (e.g. A8).
Raster	A type of digital image that uses a grid of pixels to represent an image.	**Report**	Formatted output of database queries.
Record	In a database a record stores data about an entity (the row of information about one person or thing).	**Resolution**	A measure of pixel density, it states how many pixels are in an image.

Describing A Photo

Sur la photo il y a... (In the photo there is...)

People	
Un homme	A man
Une femme	A woman
Un garçon	A boy
Une fille	A girl
Des jeunes	Some young people
Il est vieux	He is old
Elle est vieille	She is old
Grande	Tall
Petite	Short
Jolie	Pretty/handsome

Actions	
Il est en train de/	He is/they are in the
Ils sont en train de	Middle of
...Parler	...Talking
...Rire	...Laughing
Se disputer	Arguing
Marcher	Walking
Fêter	Celebrating
Travailler	Working
Jouer	Playing
Manger	Eating

Locations	
Il/elle est	He/she is
Ils sont	They are
Dehors	Outside
Dedans	Inside
À la maison	At home
En plein air	In the open air
Des arbres	Some trees
Des édifices	Some buildings
Au collège	At school
Au travail	At work

Mood	
Il/elle semble	He/she seems
Ils semblent	They seem
(Mal)contente/s	(Un)happy
Triste/s	Sad
Fatiguée/s	Tired
Énervée/s	Angry
Surprise	Surprised
Pressée	In a hurry
Ennuyée	Bored
Ravie	Delighted

Weather	
il fait beau	It's
il fait du soleil	It's sunny
il pleut	It's raining
il neige	It's snowing
il y a du vent	It's windy
il fait beau	It's nice
il fait du soleil	It's sunny
il pleut	It's raining
il neige	It's snowing
il y a du vent	It's windy

General	
Au premier plan	In the foreground
Au deuxième plan	In the background
À gauche	On the left
À droite	On the right
Près de	Next to
Devant	In front of
Au milieu	In the middle
Derrière	Behind
Je peux voir	I can see
La photo montre	The photo shows

GIVING YOUR OPINION

You can also give your opinion of the photo and add a little information, e.g.
J'aime cette photo parce que c'est coloré (colourful) et j'adore jouer au foot

Topic 1: Me, My Family and Friends

Je m'appelle Emilie et j'ai quatorze ans	**I'm called** Emilie and I'm 14 years old
J'aurai 15 **ans** dans trois mois	**I will be** 15 **years old** in three months
Je pense que je suis assez typique	**I think that** I am quite normal
Quand j'étais petit, j'étais un peu pénible	**When I was** little I was a bit annoying
mais plus maintenant car j'ai grandi	**But not anymore** because I've grown up
Tout le monde dit que je suis sociable	**Everyone says that** I am sociable
Et que j'aime **m'amuser**	And that I like **to have fun**
Il y a cinq personnes dans ma famille	**There are** five people in my family
Mes parents **sont mariés depuis** 2001	My parents **have been married since** 2001
Ma mère qui s'appelle Ellie est généreuse	**My mum who is called Ellie** is generous
mais **mon père, Albert, est** très sévère	But **my dad, Albert**, is very strict
Je m'entends bien avec ma soeur Aline	Get on well with my sister Aline
J'ai de la chance de l'avoir	**I'm lucky** to have her

Ma grand-mère **est morte** il y a cinq ans	My grandmother **died** five years ago
Elle était sympa et **elle** me manque	She was nice and I **miss** her
Je pouvais parler de tout avec elle	**I could** talk about everything with her
Hier **je suis allée** en ville avec mon ami	Yesterday **I went** into town with my friend
Car **il y avait** le marché de Noël	Because **there was** the Christmas market
Nous **avons acheté** des cadeaux pour...	We **bought** presents for...
Ensuite **nous sommes allés** voir un film	Next **we went** to see a film
À l'avenir je voudrais me marier	**In the future** I would like to marry
Mon mari/femme idéale **serait**...	My ideal husband/wife **would be...**
J'aurai un grand mariage romantique	**I will have** a large and romantic wedding
Bien que j'aie une grande famille	**Although** I have (subjunctive) a large family
Je **ne voudrais pas** avoir des enfants	I **wouldn't like** to have children

Topic 2: Technology in Everyday Life

Je me sers de mon portable pour tchatter	**I use** my phone (for) to chat
Je **l'**utilise aussi pour surfer sur internet	I also use **it** to surf the internet
Je ne m'**en** sers pas pour faire mes devoirs	I don't use **it** to do my homework
Car l'écran est **trop** petit	Because the screen is **too** small
J'aime **écouter** de la musique	I like **to listen** to music
Et **faire des recherches** sur internet	And **do research** on the internet
Hier soir **j'ai téléchargé** des films	Last night **I downloaded** some movies
Puis je suis allée sur **les réseaux sociaux**	Next, I went on **social media**
Et **j'ai actualisé** ma page personnelle	And **I updated** my homepage
Avant de me déconnecte	**Before** switching off
J'ai partagé un photo **sur** Instagram	**I shared** a photo on Instagram
Selon moi l'internet **peut être** dangereux	According to me the internet **can be** dangerous
Il est important de sécuriser son mot de passe	**It's important to** secure (y)our password

Il faut faire attention quand on est en ligne	**You must** pay attention when you're online
Et **il ne faut pas** ajouter en ami	And **you must not** add as a friend
Les gens qu'**on ne connaît pas**	People that **you don't know**
D'autre part, ce n'est pas dangereux	**On the other hand**, it's not dangerous
Dans le passé les portables étaient lents	**In the past** phones were slow
Il était difficile de communiquer	**It was difficult to** communicate
Les ordinateurs étaient **grands** et chers	Computers were **large** and expensive
Et la connexion **n'était pas** fiable	And the connection **was not** reliable
À l'avenir **il y aura** des robots	In the future **there will be** robots
Et des voitures **sans conducteur**	And cars **without drivers**
La technologie **sera plus avancée**	Technology **will be more advanced**
Et **plus rapide** dans vingt ans	And **faster** in twenty years

Topic 3: Free-time Activities

Je fais beaucoup de sports **comme** le foot	I do a lot of sport **such as** football
Pour développer mes capacités	**In order to** develop my skills
Je joue **au tennis** mais je ne fais pas du vélo	I play **tennis** but I don't go cycling
Parce que **je le trouve** trop fatiguant	Because **I find it** too tiring
Normalement **je regarde** les infos	Normally **I watch** the news
Car **ça m'intéresse** beaucoup	Because **it interests me** a lot
Et **je ne rate jamais** les feuilletons	And **i never miss** the soaps
Au ciné **je préfère voir** les films d'action	At the cinema **i prefer to see** action films
En mangeant ... Et en buvant ...	**While eating** ... And while drinking ...
Je trouve les films bon pour ma culture	**I find** films good for my culture
Et j'aime regarder **les films étrangers**	And I like to watch **foreign films**
Pour améliorer mes compétences linguistiques	**In order to improve** my language skills
Je suis **un rat de bibliothèque**	I'm **a bookworm**

Récemment **j'ai lu** un bon roman	Recently **I read** a good novel
Mais normalement **je préfère** écouter	But normally **I prefer** to listen
De la musique ou **à la** radio	**To** music or **to the** radio
Plus que lire des livres	**More than** reading books
Le weekend prochain **je vais aller** au parc	Next weekend **i'm going to go** to the park
Il faut acheter des choses pour le collège	**I have to** buy some things for school
Ensuite je vais **traîner** avec mes potes	Next i'm going **to hang out** with my homies
Les loisirs sont importants pour déstresser	Hobbies are important for destressing
Je peux **oublier** mes soucis	I can **forget** my worries
Bien que je sois/je lise/je fasse...	**Although** I am/I read/i do...
C'est une **perte de temps**	It's a **waste of time**
On aurait préféré	We would have preferred

Topic 4: Customs And Festivals In The French-Speaking World

À mon avis **les fêtes** et les jours fériés	In my opinion **festivals** and bank holidays
Sont importants pour **passer du bon temps**	Are important for **having a good time**
Mais **en ce qui concerne** la saint valentin	But **as far as** Valentine's day **is concerned**
C'est **une perte d'argent**	It's **a waste of money**
Ma fête religieuse préférée est **pâques**	My favourite religious holiday is **Easter**
Le chocolat, c'est **mon péché mignon!**	Chocolate is **my guilty pleasure!**
Nous **la** célébrons avec toute la famille	We celebrate **it** with all the family
Nous cherchons les oeufs dans le jardin	**We look for** eggs in the garden
La fête de la musique a *lieu* en france	**World Music Day** takes place in France
Pour célébrer **le début de l'été** le 21 juin	To celebrate **the start of summer** on 21st June
L'année dernière j'**y** ai participé	Last year I took part **in it**
Et **tout le monde** jouait dans les rues	And **everyone** was playing in the streets
Quand **j'avais** quinze **ans**	When **I was** fifteen **years old**

J'ai fêté mon anniversaire avec mes amis	**I celebrated** my birthday with my friends
Nous sommes allés regarder un film	**We went** to watch a film
Et quand **je suis rentrée** à la maison	And when **I got back** home
J'ai reçu **de nombreux** cadeaux	I received **a lot of** presents
Ce sera différent l'année prochaine	**It will be** different next year
J'aurai **une** grande **boum**	I will have **a** big **party**
Et toute ma famille **sera** là	And all my family **will be** there
Je serai traitée comme une princesse	**I will be treated** like a princess
Mon cadeau idéal serait un portable	**My ideal present** would be a phone
Et **je pourrais** télécharger des applis	And **I would be able to** download apps
Je voudrais **aussi** des nouveaux vêtements	I'd **also** like some new clothes
Pour porter à **ma fête d'anniversaire**	To wear to **my birthday party**

Topic 5: Home, Town, Neighbourhood and Region

J'habite **à** Highbridge, une petite ville	I live **in** Highbridge, a small town
Dans **le sud-ouest** de l'Angleterre	In **the south-west** of England
J'y habite avec ma famille depuis un an	**I have lived there** for a year
C'est situé au bord de la mer	**It's situated** by the seaside
Il n'y a grand-chose à faire **pour les jeunes**	There's not a lot **for young people** to do
Mais il y a **des magasins** et un jardin public	But there are **some shops** and a park
J'aime **habiter** à la campagne	I like **living** in the countryside
Parce que c'est **plus tranquille qu**'en ville	Because it's **quieter than** in town
Selon moi, ma région est très jolie	**According to me**, my region is very pretty
Et en été il y a beaucoup de touristes	**And in summer** there are a lot of tourists
Ma région **est connue pour** le cidre	My region **is known for** its cider
Et le fameux fromage de Cheddar	And the famous Cheddar cheese
C'est une région historique aussi	It's a historic region too

La semaine dernière **j'ai visité** le musée	Last week **I visited** the museum
Et **j'y ai appris** beaucoup	And **I learned** a lot **there**
J'ai aussi **fait des courses** en ville	I also did some shopping in town
J'ai rencontré mes amies au ciné	I met my friends at the cinema
Et **on a regardé** un film d'horreur	And **we watched** a horror film
Ça m'a donné la chair de poule!	**It gave me goosebumps!**
À l'avenir je voudrais habiter en ville	**In the future** I would like to live in town
À Londres **ou même** Bristol c'est plus animé	In London **or even** Bristol it's livelier
J'achèterais un appartement spacieux	**I would buy** a spacious apartment
Je sortirais tous les soirs	**I would go out** every evening
J'irais à toutes les boîtes de nuit	**I would go** to all the nightclubs
Je m'amuserais bien	I would have a lot of fun

Topic 6: Social Issues

Pour aider les SDF/les démunis	To help the homeless/those in need
je travaille comme **bénévole** pendant l'été	I work as a **volunteer** during the summer
Je pense que **les associations caritatives**	I think that **charities**
Jouent un rôle important dans **la société**	Play an important role in **society**
En aidant ceux qui ont besoin d'eux	**By helping** those who need them
Bien que ne j'aie pas trop le temps	**Although** I don't have too much time
Je voudrais **créer** une association caritative	I would like **to create** a charity
Pour aider les mères célibataires	**To help** single mums
Et **leurs enfants** car **ça m'inquiète** le plus	And **their children** because **that worries me** the most
Je vais collecter des choses nécessaires	**I'm going to collect** essential things
comme des produits d'hygiène	**Such as** hygiene products
Je vais essayer de faire mon mieux	**I'm going to try** to do my best
Pour que ces femmes ne manquent de rien	**So that** these women don't lack anything

Si j'avais plus de temps et d'argent	**If I had** more time and money
J'aiderais **le monde** entier	I would help **the** entire **world**
J'ai le coeur sur la main	**I am all heart**
Les jeunes **font face à** la pression des paires	Young people **face** peer pressure
En étant connectés en ligne tout le temps	**By being** connected online all the time
Les jeunes **peuvent** être intimidés	Young people **can** be intimidated
Ce qui peut avoir un impact	**Which** can have an impact
Sur leur **santé mentale** et travail scolaire	On their **mental health** and schoolwork
Ils peuvent avoir **d'autres** problèmes	They can have **other** problems
Comme **l'anorexie**, les drogues ou l'alcool	Such as **anorexia**, drugs or alcohol
Il est important de parler de ses problèmes	**It's important** to talk about one's problems
Pour les résoudre	**In order to** resolve them

Past, Present & Future Tense

Perfect Tense ("has done/did")

Start with the present tense of avoir/être, then add the past participle of the second verb:

-er	-ir	-re
Remove -er Add -é	Remove -r	Remove -re Add -u
jouer → (j'ai) joué	finir → (j'ai) fini	vendre → (j'ai) vendu

VERBS USING ÊTRE e.g. je suis allé(e)

monter entrer sortir venir aller naître partir descendre arriver tomber rester mourir retourner (and all reflexive verbs)

The past participle for these verbs must agree with the subject in gender and number:

je suis allé (m) je suis tombée (f)
on est entrés (mpl) on est entrées (fpl)

Present Tense ("does/is doing")

Remove the -er/-ir/-re and add these endings:

	jouer	finir	vendre
je	jou**e**	fin**is**	vend**s**
tu	jou**es**	fin**is**	vend**s**
il/elle/on	jou**e**	fin**it**	vend
nous	jou**ons**	fin**issons**	vend**ons**
vous	jou**ez**	fin**issez**	vend**ez**
ils/elles	jou**ent**	fin**issent**	vend**ent**

Être
je suis / tu es / il est / nous sommes / vous êtes / ils sont
Avoir
j'ai / tu as / il a / nous avons / vous avez / ils ont

Present Tense ("does/is doing")

Remove the -er/-ir/-re and add these endings:

	jouer	finir	vendre
je	jouer**ai**	finir**ai**	vendr**ai**
tu	jouer**as**	finir**as**	vendr**as**
il/elle/on	jouer**a**	finir**a**	vendr**a**
nous	jouer**ons**	finir**ons**	vendr**ons**
vous	jouer**ez**	finir**ez**	vendr**ez**
ils/elles	jouer**ont**	finir**ont**	vendr**ont**

Irregular Stems

être (ser-)	avoir (aur-)	faire (fer-)
venir (viendr-)	savoir (saur-)	aller (ir-)
devoir (devr-)	pouvoir (pourr-)	voir (verr-)

Imperfect Tense ("was doing/used to do")

Remove -ons from the nous form of the present tense, add these endings (ais/ais/ait/ions/iez/aient)

	jouer	finir	vendre
je	jou**ais**	finiss**ais**	vend**ais**
tu	jou**ais**	finiss**ais**	vend**ais**
il/elle/on	jou**ait**	finiss**ait**	vend**ait**
nous	joui**ons**	finiss**ions**	vendi**ons**
vous	joui**ez**	finiss**iez**	vendi**ez**
ils/elles	jou**aient**	finiss**aient**	vend**aient**

Near Future Tense ("is going to do")

Use the present tense of aller followed by the infinitive:

je	vais	jouer finir vendre être aller vouloir etc.
tu	vas	
il/elle/on	va	
nous	allons	
vous	allez	
ils/elles	vont	

Conditional Tense ("would do")

Begin with the future stem, add imperfect endings:

	jouer	finir	vendre
je	jouer**ais**	finir**ais**	vendr**ais**
tu	jouer**ais**	finir**ais**	vendr**ais**
il/elle/on	jouer**ait**	finir**ait**	vendr**ait**
nous	jouer**ions**	finir**ions**	vendr**ions**
vous	jouer**iez**	finir**iez**	vendr**iez**
ils/elles	jouer**aient**	finir**aient**	vendr**aient**

IRREGULAR STEMS
Same as for the simple future
EXTRA MARKS: USE WITH THE IMPERFECT TENSE
Si j'avais le temps, j'irais... (If I had time, I'd go to...)

PLUPERFECT TENSE ("had done")

Very similar to the perfect tense, except you start with the imperfect tense of auxiliary verbs avoir/être:
e.g. j'avais joué, il avait fini, nous étions allés, elles s'étaient brossées les dents

Translations

Present Tense ("does/is doing") Remove the -er/-ir/-re and add these endings:

e.g. ils jouent		jouer	finir	vendre
que	je	joue	finisse	vende
	tu	joues	finisses	vendes
	il/elle/on	joue	finisse	vende
	nous	jouions	finissions	vendions
	vous	jouiez	finissiez	vendiez
	ils/elles	jouent	finissent	vendent

Irregular Verbs

être	(je sois)
avoir	(j'aie)
faire	(je fasse)
venir	(je vienne)
savoir	(je sache)
aller	(j'aille)
devoir	(je doive)
pouvoir	(je puisse)
vouloir	(je veuille)
falloir	(il faille)

Only use the subjunctive after these phrases such as:

bien que	(although)	vouloir que	(to want that)
falloir que	(to be necessary that)	préférer que	(to prefer that)
désirer que	(to desire that)	être important que, être essentiel que	
penser que, croire que	(negative only)	être urgent que	

E.g. je **veux que** tu le fasses (I want you to do it - lit: I **want that** you **do** it)
je **préfère qu**'elle **soit** sympa (I **prefer that** he **be** nice)
il **ne pense pas qu**'elle **soit** belle (He **doesn't think that** she **is** beautiful)
bien que je n'**aie** pas l'argent (**although** I don't **have** the money)

The Negative
Put the negative around the main verb

Ne...pas	Not
Ne...jamais	Never
Ne...rien	Nothing
Ne...personne	Nobody
Ne...que	Only
Ne...plus	No more/any more
Ne...aucun	Not a single one
Ne...guère	Hardly, barely
Ne...ni...ni	Neither...Nor
EXAMPLES	
il **n**'a **jamais**	He **never** has
il **n**'a rien bu	He drank **nothing**
il **ne** l'aura **pas**	He **won't** have it
je **n'**ai vu **ni** l'un	I did**n't** see **neither**
ni l'autre	One **nor** the other

Pronouns (Saying "it")
Put le, la or les in front of the main verb

je **le** mange	I eat **it**
je **l**'ai mangé	I ate **it**
je **le** mangeais	I was eating **it**
je vais **le** manger	I'm going to eat **it**
je **le** mangerai	I will eat **it**
je **le** mangerais	I would eat **it**
que je **le** mange	that I eat **it** (subj.)
If the pronoun is feminine or plural, you need to make the past participle agree:	
je **les** ai mangés	I ate **them**
je **l**'avais vue	I had seen **her**
Use y for 'there', and en for 'some/any':	
j'**y** suis allé	I went **there**
je n'**en** ai pas	I don't have **any** [of them]

Comparative & Superlative Replace "..." with any adjective

Plus ... que	More ... than
Moins ... que	Less ... than
Aussi ... que	As ... as
Mieux	Better
Pire	Worse
Le/la plus ...	The most ...
Le/la moins ...	The least ...
Le/la mieux	The best (thing)
Le/la pire	The worst (thing)
EXAMPLES	
Plus grand que	More tall/tall**er** than
Moins grand que	Less tall/short**er** than
Aussi grand **que**	**As** tall **as**
Le **plus** grand	The **most** tall/tall**est**
La **moins** grande	The **least** tall/short**est**

Translations

Opinion Phrases
Don't just say j'aime or je déteste!

Je pense que	I think that
Je crois que	I believe that
À mon avis	In my opinion
Selon moi	According to me
Je trouve que	I find that
Je préfère	I prefer
Je dirais que	I would say that
Je sais que	I know that
J'estime que	I reckon that
Il me semble que	It seems to me that
Il me paraît que	It appears to me that
En ce qui	As far as X is
Concerne x	Concerned

Don't forget - you should always justify your opinion using *parce que* or car!

USING PROF3C
to ace the writing and speaking exams!

P ast tense	Hier j'ai joué au foot
R easons (&)	(J'adore le foot
O pinions	parce que c'est top)
F uture tense	Demain j'étudierai avec mes copains
3 rd person	Mes amis adorent le français
C onditional	Je voudrais habiter en France à l'avenir

Use PROF3C to help you answer:

- 40/90 word essay (F)
- 90/150 word essay (H)*
- General conversation (F/H*)

* To have access to the highest marks for these questions, you should also try to add a subjunctive phrase, pronouns etc. too (everything from these two pages)

Before, During, After
Saying when something happens

avant de (+*infinitive*)
before ___ing
avant de faire mes devoirs
(before doing my homework)

après avoir (+*past participle*)
after having ____
après avoir fait mes devoirs
(after having done my homework)

être en train de (+*infinitive*)
to be in the midst of ___ing
je suis en train de faire mes devoirs
I'm in the midst of doing my homework

EXAMPLE
Avant de sortir, ma mère m'avait demandé de ranger ma chambre après avoir fait mes devoirs, mais j'étais en train de parler sur mon portable

Topic 7: Global Issues

L'environnement est **menacé**	The environment is **threatened**
Par les émissions de dioxyde de carbone	By the emission of carbon dioxide
Les températures seront augmentées	Temperatures will rise
Et **il y aura** un manque d'eau potable	And **there will be** a lack of drinking water
Si **on ne protège pas** l'environnement	If **we don't protect** the environment
Il faut **réduire**, réutiliser et recycler	It is necessary to **reduce**, reuse and recycle
Je recycle le papier/carton/ plastique/verre	I recycle paper/cardboard/ plastic/glass
Je prends une douche au lieu d'un bain	**I take** a shower instead of a bath
J'éteins la lumière quand je sors	**I turn off** the light when I go out
Il faut aussi **baisser** le chauffage	It is also necessary **to turn down** the heating
Avant de quitter la maison	**Before** leaving the house
Ma mère **achète** toujours les produits bio	My mum always **buys** organic products
Et mon père fait **du covoiturage**	And my dad does **carsharing**

Il va acheter **une voiture électrique**	He is going to buy **an electric car**
Je supporte **le commerce équitable**	I support **fair trade**
Je ne veux pas que les ouvriers soient exploités	**I don't want** the workers to be exploited
Récemment **j'ai participé** à une manifestation	Recently **I took part** in a protest
Je me suis inscrite à l'association WWF	**I subscribed** to the charity WWF
J'ai ramassé les déchets dans le parc	**I cleared up** the rubbish in the park
J'ai nettoyé le lac près de chez moi	I **cleaned** the lake near to my house
Au collège on va **trier** les déchets	At school we're going **to sort** the rubbish
On va organiser **une journée verte**	We're going to organise **a 'green' day**
On va planter **plus** de fleurs et d'arbres	We're going to plant **more** flowers and trees
J'ai la main verte	**I have green fingers**
Je vais **consommer** moins de viande	I'm going to **consume** less meat

Topic 8: Travel and Tourism

D'habitude **je reste** en angleterre en été	Normally **I stay** in England during summer
Il y a beaucoup **à faire** et à visiter	There is a lot **to do** and to visit
C'est ma destination **favorite/ préférée**	It's my **favourite** destination
Je préfère **voyager** en voiture	I prefer **to travel** by car
Parce que j'ai **toujours** le mal de mer	Because I **always** get seasick
Et **j'ai** vraiment **peur de** voler	And **I'm** really **scared of** flying
Quand j'étais petite j'allais en france	**When I was little** I used to go to France
Nous visitions disneyland paris	We used to visit Disneyland Paris
On **faisait la queue** depuis des heures	We **used to queue** for hours
Pour voir **les manèges** et les princesses	To see **the rides** and the princesses
Je **ne** m'ennuyais **jamais**	I was **never** bored
Mes **dernières** vacances étaient terribles!	My **last** holiday was terrible!
On est allés en californie **pendant un mois**	We went to California **for a month**

Car mon père **a** toujours **voulu** y aller	Because my dad **has** always **wanted** to go there
Mes frères **se sont chamaillés** tout le trajet	My brothers **bickered** the whole journey
La réceptionniste à l'hôtel était **impolie**	The hotel receptionist was **impolite**
Et la chambre était très **sale**	And the room was very **dirty**
Le pire était de perdre mon passeport	**The worst thing** was losing my passport
Quel désastre!	What a disaster!
Si **je gagnais l**a loterie	If **I won** the lottery
Je voyagerais autour du monde	**I would travel around** the world
Je nagerais dans l'océan pacifique	**I would swim** in the Pacific Ocean
Je ferais de **la plongée**	I would go **scuba diving**
Pour voir les poissons tropicaux	**In order to see** the tropical fish
Ce serait le pied !	**It would be awesome!**

Topic 9-10: My Studies/Life at School or College

Mon collège **s'appelle** ...	My school **is called ...**
C'est un collège **mixte**	It's a **mixed/co-educational** school
Pour les jeunes **de** onze **à** dix-huit ans	For young people **from** 11 **to** 18 years old
Je trouve les profs sympa mais un peu strictes	**I find** the teachers nice but a little strict
Le collège est grand et assez moderne	The school is **large** and quite modern
Il y a environ treize cent étudiants	There are **approximately** 1300 students
Je porte une chemise blanche,	**I wear** a white shirt
Une veste noire et un pantalon noir	a black blazer and black trousers
Je n'aime pas du tout mon uniforme scolaire	I **don't like** my school uniform **at all**
C'est inconfortable et moche	It's **uncomfortable** and ugly
Les cours commencent à neuf heures	Lessons **commence** at 9am
Et finissent à trois heures de l'après-midi	And **finish** at three **in the afternoon**
Au collège de mes rêves	In the school **of my dreams**

Il n'y aurait pas d'uniforme scolaire	**There wouldn't be a** school uniform
Et le collège finirait à midi	And school **would finish** at noon
Pour que je puisse bavarder l'après-midi	**So that I could** chat in the afternoon
J'étudie l'anglais, les maths et l'eps	I study **English**, Maths and PE
Mais ma matière préférée, c'est le français	But **my favourite subject** is French
Parce que c'est très amusant	Because it's **very** amusing
Et le prof est vraiment sympa	And the teacher is **really** nice
Par contre je déteste les sciences	**On the other hand** I hate science
Car c'est trop difficile et ennuyeux	Because it's **too** difficult and boring
Bien que j'aie choisi la géographie	**Although** I've chosen Geography
Je ne suis pas douée en ça	**I'm not gifted** at it
Mais je le trouve très intéressant	But I find **it** very interesting

Topic 11-12: Education Post-16/Job Choices and Career Ambitions

Je ne vais pas aller au lycée	I am **not** going to go to college
Je vais étudier le français et l'allemand	**I'm going to study** French and German
Je pense que les langues sont importantes	I think that languages are important
Pour trouver un bon emploi	to find **a good job**
Pour mon stage j'ai travaillé dans un bureau	**For work experience** I worked in an office
Ce n'était pas mal mais c'était ennuyeux	**It wasn't** bad but it was boring
Je crois que je voudrais travailler dehors	**I believe that** I'd like to work outside
Parce que j'aime être en plein air	Because **I like** to be in the open air
Je voudrais devenir vétérinaire	I would like **to become** a vet
D'abord je dois aller à l'université	First **I have to** go to university
Parce qu'il faut avoir un diplôme	Because **you have to have** a degree
Je sais que je dois travailler dur	**I know that** I must work hard
Mais je vais réussir dans la vie	But **I'm going to succeed** in life

Et je serai fier/fière de moi	And I will be **proud** of myself
Ma mère est institutrice	My mum is **a primary school teacher**
Et mon père travaille dans un magasin	And my dad works **in a shop**
Ma mère trouve ça enrichissant	My mum finds it **rewarding**
Et mon père adore aider les clients	And my dad loves **to help** the customers
En ce moment j'ai un petit boulot	At the moment I have **a part-time job**
Je fais du baby-sitting le soir	**I do babysitting** in the evenings
Ce n'est pas bien payé	It's not well paid
Mais je veux gagner mon propre argent	But I want **to earn** my own money
Un jour je voudrais travailler avec les enfants	**One day** I'd like to work with children
Après avoir travaillé comme vétérinaire	**After having** worked as a vet
Mais je ne sais pas quand. On verra.	But **I don't know** when. We will see.

Unit 3

About This Unit:

This unit will assess your knowledge about the development of children aged 0-5 years.

You will be expected to know about the different types of care settings and your responsibilities if you were learning how to work with children.

You will need to show that you understand how children develop, what can affect their development and the individual needs they may have.

You will need to show that you know ways to care for them and simple activities that help them to develop in a healthy and safe way.

You will also need to show that you understand the ways that can support your own learning.

Responsibilities

- Parent/carer asking for advice
- Complaints and concerns are raised
- Child discloses harm/abuse of this is suspected
- Child requires first aid treatment
- Health needs raise a concern
- Medical intervention.
- Risk assessment
- Activity planning, doing and reviewing
- Mealtimes and snacks
- Tidying away/cleaning.

Behaviour and Conduct

- General appearance
- Language and communication with children and colleagues, parents and carers
- Respecting colleagues, parents and children
- Valuing the expertise and advice of the staff
- Working within policies and procedures of the setting
- Following instructions and guidance courteously and asking questions if unsure about any of the tasks that may be set

Skills and Behaviours

- Dress code
- Behaviour and conduct
- Timekeeping
- Use of initiative
- Confidentiality

Settings

- Nursery School
- Nursery Class
- Day Care
- Pre-School
- Childminder
- Nanny
- Crèche
- Holiday Club
- Before School Club
- After School Club
- Primary School
- Sure Start/Children's Centre or Community Group.

Preferred Learning Style and Develop Relevant Study Skills

- Sewing
- Riding a bike
- Reading a book
- Writing a poem
- Playing a sport
- Cooking or baking
- Doing calculations.

Photographs may help learners to think too.

Revision Strategies:

- Highlighting text
- Writing notes
- Making bullet points
- Asking others to test you
- Reading aloud
- Testing yourself
- Using mapping skills
- Practising past papers
- Writing out as much as you can remember

Dress Code

- Jewellery
- Personal hygiene
- Footwear

Fairness And Inclusive Practice

- Equality
- Diversity
- Inclusion.

Confidentiality

- Information sharing
- Records and reports
- Storage
- Online safety
- When confidentiality is breached

Unit 3

How the Early Years Worker Meets the Care Needs Of Children During Day to Day Practice

- Food and hydration
- Fresh air and activity/movement
- Rest/sleep
- Protection from harm and injury
- Security-emotional and physical
- Shelter/warmth.
- It will also be useful to consider toileting/personal care routines (bathing, care of skin, hair and teeth) and how these change as the child matures to allow for independent care routines.

Use of Initiative

- Risk assessment
- Activity planning including setting up resources at the beginning of the day/session
- Preparation for snack/meals
- Tidying away at the end of a session including routine cleaning tasks.

Time Keeping

- Being reliable
- Professional practice
- Ratios and supervision of children
- Reputation
- Trust and integrity

Areas of Development

- Physical
- Language
- Intellectual/cognitive
- Social
- Emotional

Unexpected Transitions Experienced By Children:

- Birth of a new baby
- Unexpected change of school or childcare provider
- Moving house
- Violence or abuse in the family
- Parents divorcing; new step-parents or step-families
- Serious illness, accident or death in the family.

Routine Experiences:

- Setting the table
- Getting dressed
- Shopping
- Cooking
- A short walk to the shops.

Factors affecting Children's holistic development:

- Housing
- Diet
- Poverty and low income
- Pollution
- Parents health and lifestyle
- Sleep
- Events in life
- Medical conditions and infections

Observations

- Narrative
- Checklist
- Longitudinal
- Sociogram
- Event sample
- Time sample
- Photographs

Why are children observed?

- To understand the pattern of child development.
- To assess a child's current stage of development.
- To ensure appropriate activities are provided to support development.
- To monitor ongoing development and plan for the next stage.
- To identify any particular difficulties a child may have.
- To know and understand a child better.
- To record any behaviour that causes concern. .
- To monitor progress towards national targets.
- To evaluate the standard of provision.

How do you observe Children?

- There are many different methods to carry out your observations of children.
- Complete a checklist to identify specific behaviour. Tick list/Observation Schedule.
- Write a detailed written record of the behaviour that is being observed. Anecdotal/Narrative observation.
- Pick a period of time and the child is observed at set periods throughout e.g. every 15 minutes. Time sample observation.
- Quick note on a specific behaviour that is shown. Free description observation.

Unit 2

Top Tips

- Remember – You must complete ALL the assessment criteria (AC 1.1 – AC 3.5) to pass this unit.
- Use the Hospitality and Catering Revision Guide and the internet to research information.
- On some of the assessment criteria you need to relate the research you have carried out to the Learner Assignment Brief (LAB) – This is the 'Waste Not Want Not' task. You must refer back to the brief to achieve Merits and Distinctions.

AC 1.1 – Describe functions of nutrients in the human body (Max grade L2M)

Revision Guide – pages 92 - 94

Explain the importance of the following nutrient groups in the human body;

- Protein
- Fats
- Carbohydrates
- Vitamins - A, B, C, D, E & K
- Minerals – Calcium, Iron & Sodium
- Water
- Dietary Fibre

AC 1.2 Compare nutritional needs of specific groups (Max grade- L2D)

Revision Guide – pages 95 - 98

Max grade for this section is **L2D** so it needs to be detailed.
Explain the nutritional needs of the following groups. You should write a paragraph for each

- Children
- Teenagers
- Adults
- Older adults
- Vegetarian
- Vegan
- Lactose intolerant (medical)
- Gluten intolerant (medical)

Finally you need to compare the similarities and differences of two of the groups from the learner assignment brief – 'Waste not Want Not Bistro'
The bistro is aimed at families with young children. Therefore you could compare the nutritional needs of **'Children'** and **'Older Adults'** (Grandparents)

You could do this as a table if you want;

Young Children and Older Adults - Comparison of Nutritional Needs	
Similarities - - - -	Differences - - - -

AC 1.3 Explain characteristics of unsatisfactory nutritional intake (Max Grade L2M)

Revision Guide – pages 98 - 100

Explain the characteristics of nutritional deficiencies (too little) and excess (too much) of the following nutrients;

- Protein
- Fats
- Carbohydrates
- Dietary Fibre
- Vitamin A
- Vitamins B1, B2 and B3
- Vitamin B9
- Vitamin B12
- Vitamin C
- Vitamin D
- Vitamin K
- Calcium
- Iron
- Sodium
- Fluoride

This could be done as a table

Nutrient	Nutritional Deficiency (too little)	Nutritional Excess (too much)
Protein		
Fats		

Unit 2

AC 1.4 Explain how cooking methods impact on nutritional value (Max Grade L2P)

Revision Guide – page 101

Compare the following methods of cooking;
- Boiling
- Steaming
- Baking
- Grilling
- Stir Frying
- Roasting
- Poaching

AC 2.1 Explain factors to consider when proposing dishes for menus (Max Grade L2M)

Revision Guide – pages 103 - 106

Who is going to eat the food- families with young children are the main customers at the 'Waste Not Want Not' bistro

When is it going to be eaten – lunch and evening meals.

Where is it going to be served/eaten – Waste Not Want Not bistro is on the edge of the city centre. Located on the roof of a canal side warehouse

What type of food is going to eaten - locally sourced, seasonal ingredients. Healthy and sustainable living should be promoted.

Time of year
- Menu will need to be rotated as the restaurant 'waste not want not' wants ingredients to be seasonal locally sourced where possible. (Give examples eg salads in the summer, vegetables n the winter)
- Time of year will also affect the type of food on the menu as customers prefer different food depending on the weather. For example curries in the winter and salads in the summer.
- Dishes may be planned around festive periods such as Easter and Christmas.

Skills of the staff
Explain why the following skills will be important;
- Cookery
- Food safety knowledge
- Leadership and management
- Costing and budgeting

Time available
- Time will need to managed effectively so customers receive their food within an acceptable waiting time.
- Dishes where ingredients can be pre-prepared is an advantage
- Not too many dishes on the menu increases speed and efficiency in the kitchen

AC 2.1 Explain factors to consider when proposing dishes for menus (Max Grade L2M)

Revision Guide – pages 103 - 106

Finances
- Food costs –ingredients for the dishes must be costed correctly order the correct amount of food to reduce waste and save money
- Rotate stock so the food with the shortest use by date is used first. This stops food going out of date so reduces waste and saves money.

Customer needs
- Options of dishes for special dietary needs e.g. vegan or gluten free
- Children's menu- smaller portions which are bright, colourful and appealing to children. The dishes must meet all of their nutritional needs to support healthy growth and repair. The menu can be printed on paper which can be coloured on to entertain the children.
- Menu should include dishes with a varied price range to cater for families with different incomes
- The dishes should be healthy and balanced according to the Eatwell plate. Meals should have correct portion control.

AC 2.2 Explain how dishes on a menu address environmental issues (Max Grade L2P)

Revision Guide – pages 107 - 109

Discuss the following issues;
- Carbon Footprint
- Preparation and cooking methods – environmental impact
- Ingredients used- sustainable, seasonal, organic, locally sourced
- Packaging
- Water and energy conservation
- Reduce, Reuse, Recycle
- Sustainability – food miles

Unit 2

AC 2.3 Explain how menu dishes meet customer needs (Max grade L2M)

Revision Guide – pages 110 - 111

You need to explain how the four dishes you have proposed for the menu meet customer needs. You must refer to the LAB for this criteria.
Examine the following;

- Suitability for target group
- Cost
- Seasonality of Ingredients
- Skills, Preparation and Cooking Methods
- Nutrition
- Healthy Eating
- Customer Needs – Appearance, Flavour, Texture and Aroma of dishes

It could be done as table or in paragraphs

2.3 How menu dishes meet customer needs

Proposed dishes for the menu	*Nutrition / Healthy Eating*	*Sustainability & Environmental issues*	*Cost*	*Customer Needs*
Lasagne with side salad Preparation and cooking skills; Peeling, sieving, weighing, chopping, blending (sauce), frying & baking	• Eatwell plate – carbohydrate, protein, fruit and veg and dairy. • Vitamins & nutrients • Healthy alternatives	• Locally sources ingredients • Food could be grown at the bistro – herbs and salads	• Children's menu • Pensioner menu • Range of dishes of varying price gives customers choice.	• Sight - presentation of dish • Smell -aroma of food • Taste – flavour

AC 2.4 Plan production of dishes for a menu (Max Grade L2D)

Revision Guide – pages 112 - 115

This is the most important criteria from the unit as this will be your plan to prepare, cook and present your two chosen dishes. It must be detailed to achieve a L2D

The plan needs to contain;

- Ingredient List
- Equipment List
- Mise en Place
- Production Plan
    - o The two dishes must be 'dovetailed' in the plan
    - o You must include accurate timings
    - o Include special points (Health and Safety, Checks & Contingency plans)
    - o Detailed step by step guide on how to prepare, cook and present dishes

AC 3.1 – 3.5 – Practical completion of your two chosen dishes (Max Grade L2D)

You will be assessed on your competence in the following areas;

- Food Safety
- Techniques used in food preparation
- Cooking Techniques
- Presentation of dishes

Notes

Useful Links

Website	Username	Password

Time Table Week A

	Registration 8.30 – 8.50	Period 1 8.50 – 9.50	Period 2 9.50 – 10.50	Break 10.50 – 11.05	Period 3 11.05 – 12.05	Period 4 12.05 – 13.05	Lunch 13.05 – 13.45	Period 5 13.45 – 14.45	Daily Reflection 14.45 – 15.00
Monday									
Tuesday									
Wednesday									
Thursday									
Friday									

Time Table Week B

	Registration 8.30 – 8.50	Period 1 8.50 – 9.50	Period 2 9.50 – 10.50	Break 10.50 – 11.05	Period 3 11.05 – 12.05	Period 4 12.05 – 13.05	Lunch 13.05 – 13.45	Period 5 13.45 – 14.45	Daily Reflection 14.45 – 15.00
Monday									
Tuesday									
Wednesday									
Thursday									
Friday									

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