Year 10 Knowledge Organisers

Assessment Fortnight 1

Monday 10th – Friday 21st November 2025

BLESSED TRINITY RC COLLEGE

Topic Overviews for

Assessment Fortnight 1

English	An Inspector Calls
Maths	Congruence, similarity and endurance Trigonometry Equations and inequalities
Biology	Cell biology Bioenergetics Infection and response Organisation
Chemistry	Atomic structure and the periodic table Bonding, structure and the properties of matter Energy changes Quantitative chemistry
Physics	Electricity Atomic structure
RE	Origins
History	Causes of WW1
Geography	Natural hazards
Spanish	Holidays
Computing	Data
Music	Musical terms and signs
DT	Graphics - Introduction to key terms Textiles – key concepts and skills
Art	Introduction and key words
Photography	Introduction and key words
Sociology	Families
PE	Skeletal system
Sports and Coaching	Improving sporting performance

English

'An Inspector Calls' by J.B. Priestley: A Knowledge Organiser

Characters

Inspector Goole	Priestley's mouthpiece; advocates social justice; serves as the Birlings' conscience	Socialist, moralistic, righteous, powerful, intimidating, unconventional, mysterious, imposing, sardonic, omnipotent
Mr. Arthur Birling	Businessman; capitalist; against social equality; a self-made man (new-money)	Capitalist, arrogant, foolish, Panglossian, emasculate, prejudice, ignorant, selfish, stubborn, vainglorious
Mrs. Sybil Birling	Husband's social superior; believes in personal responsibility	Arrogant, cold-hearted, insincere, prejudice, naïve, conformist, bitter, controlling, remorseless
Sheila Birling	Young girl; comes to change views and pities Eva; feels regret	Transformative, remorseful, socialist, pseudo-inspector, sensitive, astute, strong-minded, empowered
Eric Birling	Young man, drinks too much; forces himself on Eva Smith; regrets actions	Rebellious, reckless, immature, insubordinate, compulsive, desperate, disgraced, dualistic, irresponsible
Gerald Croft	Businessman; engaged to Sheila; politically closest to Birling	Aristocratic, evasive, secretive, dishonest, disingenuous, oleaginous, chivalric, privileged, pragmatic
Eva Smith	Unseen in play; comes to stand for victims of social injustice (changes her name to Daisy Renton	Suffragist, victim, emblematic, allegorical, vulnerable, desperate, socialist, moralistic, principled

Theatrical Stagecraft: Dramatic Devices

Dramatic irony	Birling's speeches, Mrs. Birling's witless implication of Eric
Stage directions	Instructions for the actors; often revealing – such as the lighting change when the Inspector arrives: "Pink and intimate then brighter and harder"
Setting	Constant throughout but subtle changes e.g. lighting; characters on/off stage
Tension	Builds up throughout the play ; interrogation of characters, personal relationships, secrecy
Cliff-hanger	Eric's reappearance in Act 3; the ending allows the audience to make up their minds
Foreshadowing	Symbolism (The Titanic), Mr. Birling's "knighthood", war
Time-lapse	Set in 1912, written in 1945; audience in a privileged position.
The 4th Wall	The Inspector's final speech addressed directly to audience.

Social, Historical and Literary Allusions

"the Titanic"	The Titanic sailed from Southampton and sank in the early hours of 15th April 1912. Priestley clearly wants his audience to see his drama play out against a background of real historical events and he has also chosen a moment in time when Birling's comments appear particularly ironic.
"Nobody wants war"	In reality, economic rivalry between the British Empire and the new German Empire was one of the many causes of the First World War.
"Russia"	The irony here suggests that Russia will have progressed further than other European countries by the 1940s.
"Bernard Shaws and H. G. Welses"	Both the noted Irish playwright George Bernard Shaw (1856-1950) and the father of science-fiction H. G. Wells (1866-1946) were well-known and outspoken socialists.

Plot

Act 1	Set in April 1912, Brumley, Midlands, UK. The Birling family and Gerald Croft are celebrating Sheila Birling's engagement to Gerald with a dinner. Mr Birling lectures his son, Eric Birling, and Gerald about the importance of every man looking out for himself if he wants to get on in life. Edna (the maid) announces that an inspector has arrived. Inspector Goole says that he is investigating the death of a young woman who committed suicide, Eva Smith. Mr Birling is shown a photograph of Eva, after initially denying recognising the woman in the photo, he remembers firing her in 1910 for organising a strike over workers pay. Sheila recalls also having Eva sacked about her manner when served by her in an upmarket department store. The Inspector reveals that Eva Smith changed her name to Daisy Renton. Gerald reveals to Sheila he had an affair with Daisy Renton.
Act 2	Gerald explains to The Inspector that he had an affair with Eva, but hasn't seen her since he ended their relationship back in Autumn 1911. Sheila gives her engagement ring back to Gerald. The Inspector turns his attention to Mrs Sybil Birling, she confesses that she also had contact with Eva, but Eva gave herself a different name to Mrs Birling. Eva approached a charity chaired by Mrs Birling to ask for help. Eva was desperate and pregnant but help was refused by Mrs Birling because she was offended by the girl calling herself 'Mrs Birling'. She tells Eva that the baby's father should be made entirely responsible. She also tells Inspector Goole that the father should be held entirely responsible and should be made an example of.
Act 3	Eric is revealed as the father. He stole money from Mr Birling's office to provide money to Eva. The Inspector delivers his final speech. After he leaves, the family begin to suspect that he was not a genuine police inspector. A phone call to the Chief Constable confirms this. Next, they phone the infirmary to be informed that no suicide case has been brought in. Mr Birling, Mrs Birling and Gerald congratulate themselves that it was all a hoax and they continue can continue as before. This attitude upsets Sheila and Eric. The phone rings. Mr Birling announces to the family that a girl has just died on her way to the infirmary, a police inspector is coming to question them

Key concepts and context: *Think about…*

1912	Set just before WWI and the sinking of the Titanic. A moment of rising international tensions and industrial expansion. End of Victorian era saw the demise of the rigid class system. Labour Party, founded in 1900, gaining momentum. The Russian Revolution began in 1917.
1945	People were recovering from six years of warfare, danger and uncertainty. Class distinctions greatly reduced as a result of two world wars. Women had a more valued place in society. Desire for social change. Following WW2, Labour Party won a landslide victory over Winston Churchill and the Conservatives.
Wealth, Power and Influence	The Birlings and the Crofts are representative of the wealthy upper-class. They all misuse their social influence to benefit themselves. Their actions adversely affect the vulnerable people in society.
Blame and Responsibility	Who is to blame for Eva's death? Each of the Birlings contribute to a chain of events leading to the destruction of Eva Smith. What responsibilities do the characters have to each other? To society?
Public v Private	How do the public lives, the facades, of the Birlings juxtapose their private personas? What are their motivations for this? What are the repercussions, and for who?
Morality and Legality	What are the moral and legal laws of the society depicted in the play? How do they interweave? What actions do the characters undertake that are wrong, morally or legally?
Class Politics	How do the ideologies of capitalism and socialism collide in the play? Which characters are representative of which political allegiance? Is there a correlation between a character's political beliefs and their behaviours?
Prejudice	What are the prejudices held by the Birlings? What are their inherent views regarding class and status? How do they act on these prejudices, and what are the consequences?
Young v Old	What differences are evident between the younger and older generation? They react and behave differently throughout the play – why? What are their attitudes towards each other? What do they learn? Which characters change, and how?

AN INSPECTOR CALLS Quotes - J.B. PRIESTLEY

ACT	Order of the Inspector's Questioning
Act 1	*Sheila and Gerald's engagement is celebrated.*
Act 1	*Birling says there will be no war; references Titanic*
Act 1	*Inspector arrives; a young girl has committed suicide.*
Act 1	*Birling threw her out after strike; Sheila had her fired for laughing.*
Act 2	*Gerald had an affair with Daisy Renton*
Act 2	*Mrs. Birling refused to give charity to Eva; blames father.*
Act 3	*Eric's involvement revealed; possible rape hinted at.*
Act 3	*Inspector leaves. Gerald returns; met policeman, no Inspector G*
Act 3	*Telephone rings; an inspector is coming.*

Key Notes

Priestley asks his audience to examine their **individual** and **collective responsibility** to society. He wants a **welfare state.**

The **hypocrisy** of **middle-class Edwardian** society is uncovered: **appearance** & **reputation** matter more than **reality** & **morality.**

Priestley criticises the selfishness of **capitalism** and wants a fairer, **socialist** future after the horrors of two world wars..

Priestley shows the **older generation** to be set in their ways, while the young are **open to change.**

Eva Smith is the **embodiment** of young, **working-class women** who were **oppressed** by the **middle/upper classes.**

The play demonstrates that when workers do not have **full employment rights** they cannot fight back

Thematic Quotes

Social responsibility	"We are responsible for each other" *Inspector* "Public men, Mr Birling, have responsibilities" *Inspector* "It's what happened to the girl and what we all did to her that mattered." *Eric*
Capitalism	"These silly capital vs labour agitations." *Birling* "A man has to make his own way" *Birling*
Class	"A girl of that class" *Mrs Birling* "Well, we've several hundred young women there, y'know, and they keep changing." *Birling*
Age	"the famous younger generation" *Birling* "What's the matter with that child?" *Birling* "Just keep quiet, Eric" *Birling*
Gender & attitudes to women	"I hate those *hard-eyed dough-faced women*" - *Gerald* "And you think young women ought to be protected against unpleasant and disturbing things?" *Inspector* "She had far too much to say, far too much" *Birling*

Character Quotes

Birling's Confidence	''We're in for a time of steadily increasing prosperity'
Birling on society	''The way some of these cranks talk and write now, you'd think everybody has to look after everybody else'
Shelia's recognition	'but these girls aren't cheap labour – they're people''
Sheila's regret	'it's the only time I've ever done anything like that, and I'll never, never do it again to anybody'
Sheila on the inspector	'we all started like that – so confident, so pleased with ourselves until he began asking us questions'
Sheila on Eric	''he's been steadily drinking too much for the last two years'
Inspector on guilt	'I think you did something terribly wrong – and that you're going to spend the rest of your life regretting it'
Mrs Birling defends herself	'she was claiming elaborate fine feelings and scruples that were simply absurd in a girl in her position'
Eric explains	'I'm not very clear about it, but afterwards she told me she didn't want me to go in but that – well, I was in that state when a chap easily turns nasty – and I threatened to make a row'
The inspector says	'but each of you helped to kill her. Remember that'
Inspector's message	'there are millions and millions and millions of Eva Smiths and John Smiths still left with us, with their lives, their hopes and fears, their suffering, and chance of happiness, all intertwined with our lives, with what we think and say and do. We don't live alone.'

Maths

Y10 Congruence, similarity and enlargement

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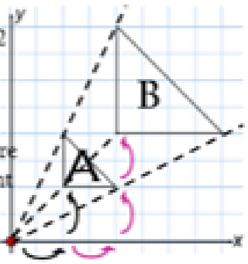
Positive scale factors (R)

Enlarge shape A by SF 2 from (0, 0)

The shape is 2 times bigger

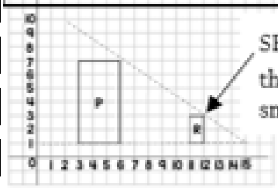
The distance from the centre of enlargement has also doubled



Fractional scale factors

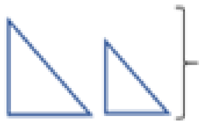
Fractions less than 1 make a shape SMALLER

R is an enlargement of P by a scale factor $\frac{1}{3}$ from centre of enlargement (15,1)



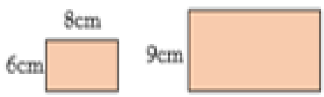
SF: $\frac{1}{3}$ - R is three times smaller than P (R)

Identify similar shapes



Angles in similar shapes do not change.
e.g. if a triangle gets bigger the angles can not go above 180°

Similar shapes



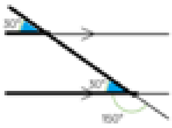
Scale Factor: Both sides on the bigger shape are 1.5 times bigger

Compare sides: 6 : 9 = 2 : 3 and 8 : 12 = 2 : 3

Both sets of sides are in the same ratio

Angles in parallel lines

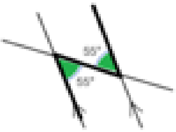
Alternate angles



Because alternate angles are equal the highlighted angles are the same size

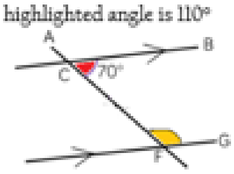
Corresponding angles

Because corresponding angles are equal the highlighted angles are the same size



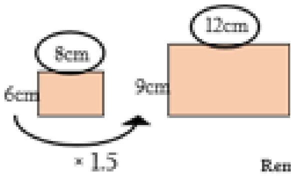
(R) **Co-interior angles**

Because co-interior angles have a sum of 180° the highlighted angle is 110°



As angles on a line add up to 180° co-interior angles can also be calculated from applying alternate/ corresponding rules first

Information in similar shapes



Compare the corresponding side on both shapes

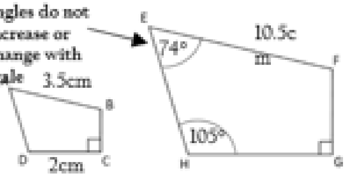
Scale Factor is the multiplicative relationship between the two lengths

Shape ABCD and EFGH are similar

Notation helps us find the corresponding sides

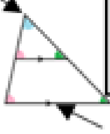
AB and EF are corresponding

Remember angles do not increase or change with scale



Similar triangles

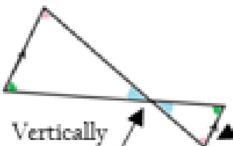
Shares a vertex



Because corresponding angles are equal the highlighted angles are the same size

Parallel lines – all angles will be the same in both triangle

All angles are the same this is similar

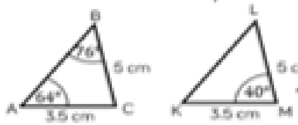


Vertically opposite angles

All the angles in both triangles are the same and so they are similar

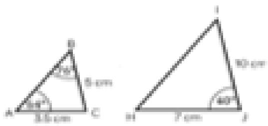
Congruence and Similarity

Congruent shapes are identical – all corresponding sides and angles are the same



$A\hat{C}B = K\hat{M}L$

Because all the angles are the same and AC=KM BC=LM triangles ABC and KLM are congruent



Because all angles are the same, but all sides are enlarged by 2 ABC and HIJ are similar

Congruent triangles

Triangles are congruent if they satisfy any of the following conditions

Side-side-side

All three sides on the triangle are the same size

Angle-side-angle

Two angles and the side connecting them are equal in two triangles

Side-angle-side

Two sides and the angle in-between them are equal in two triangles

Right angle-hypotenuse-side

The triangles both have a right angle, the hypotenuse and one side are the same

Y10 (H) – Congruence, similarity and enlargement

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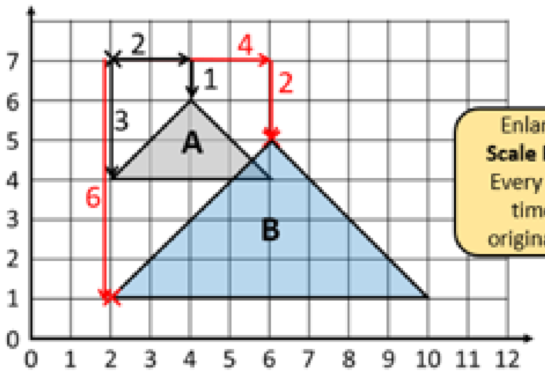
Enlarge by a positive scale factor

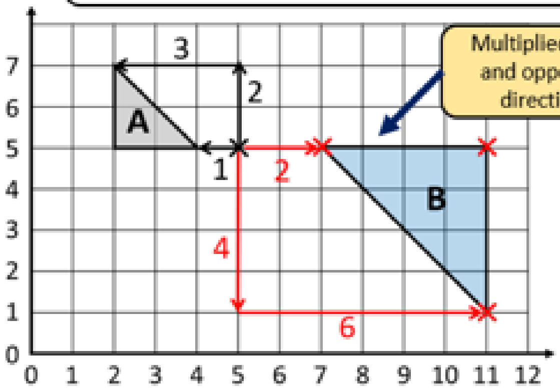
Enlarge Shape **A** by a **scale factor** of 2 from a **centre of enlargement** (2, 7)



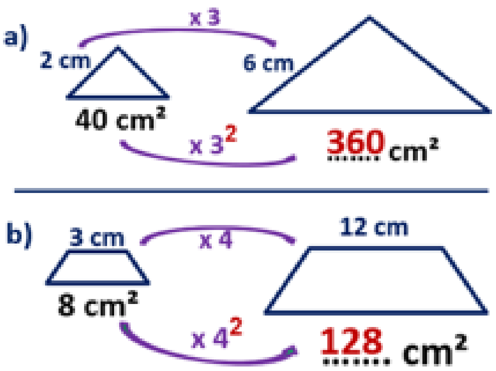
Enlarged by **Scale Factor 3.** Every side is 3 times the original length

Enlarge by a negative scale factor

Enlarge Shape **A** by a **scale factor** of -2 from a **centre of enlargement** (5, 5)

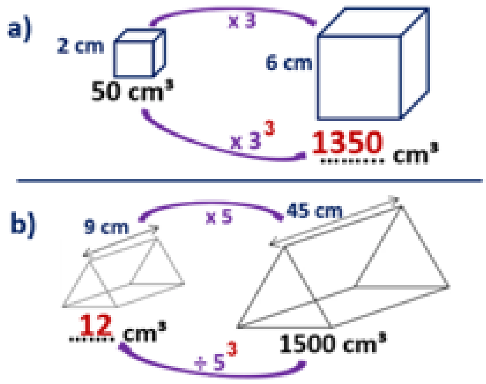


Area of similar shapes



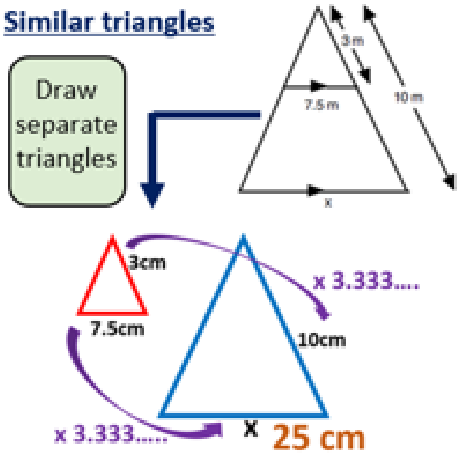
Enlarge **area** ↓ **Square** scale factor

Volume of similar shapes



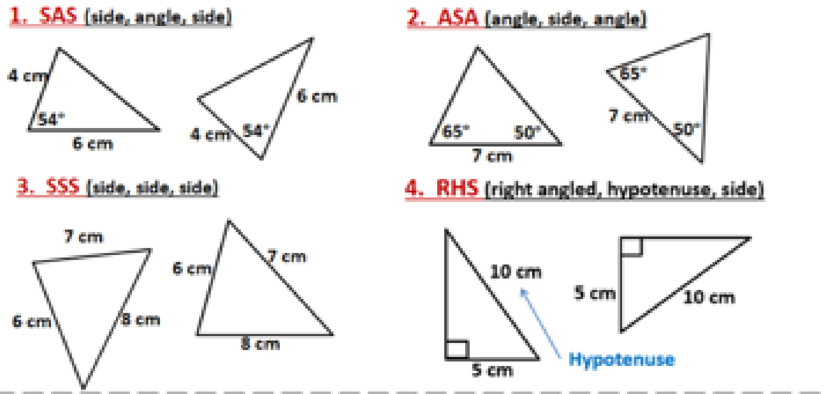
Enlarge **volume** ↓ **Cube** scale factor

Similar triangles



Congruent triangles

Two shapes are **CONGRUENT** if they have the same angles and the same side lengths.



Y10 Trigonometry

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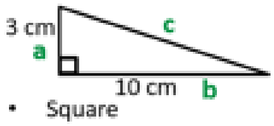
Pythagoras theorem $a^2 + b^2 = c^2$

R

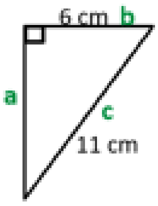
Finding the hypotenuse "c"



- Square
- Add $3^2 + 10^2 = 109$
- Square root

$\sqrt{109} = 10.44\ cm$

Finding "a" or "b"



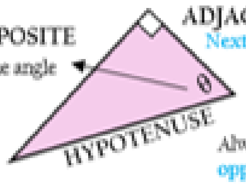
- Square
- Subtract

$11^2 - 6^2 = 85$

- Square root

$\sqrt{85} = 9.22cm$

Labelling a right-angled triangle



SOHCAHTOA - Side lengths

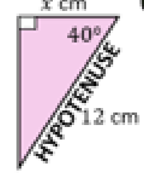
$\text{Sin}\theta = \frac{Opposite}{Hypotenuse}$

$\text{Sin}50° = \frac{x}{12}$

$x = 12 \times \text{Sin}50°$

$= 9.2\text{cm}$

$\text{Cos}\theta = \frac{Adjacent}{Hypotenuse}$



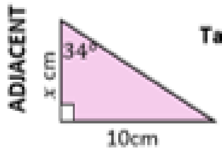
$\text{Cos}40° = \frac{x}{12}$

$x = 12 \times \text{Cos}40°$

$= 9.2\text{cm}$

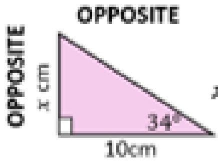
$\text{Tan}\theta = \frac{Opposite}{Adjacent}$

Substitute into the formula



$\text{Tan}34° = \frac{10}{x}$

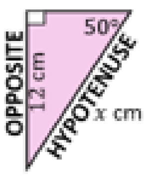
$x = \frac{10}{Tan\ 34} = 14.8\text{cm}$



$\text{Tan}34° = \frac{x}{10}$

$x = 10 \times \text{Tan}34°$

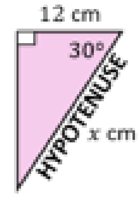
$= 6.7\text{cm}$



$\text{Sin}50° = \frac{12}{x}$

$x = \frac{12}{Sin50°}$

$= 15.7\text{cm}$



$\text{Cos}30° = \frac{12}{x}$

$x = \frac{12}{Cos30°}$

$= 13.9\text{cm}$

SOHCAHTOA - Angles

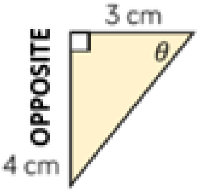
Inverse trigonometric functions

$\theta = \text{Sin}^{-1}\left(\frac{opp}{hyp}\right)$

$\theta = \text{Cos}^{-1}\left(\frac{adj}{hyp}\right)$

$\theta = \text{Tan}^{-1}\left(\frac{opp}{adj}\right)$

Label your triangle and choose your trigonometric ratio



Substitute values into the ratio formula

$\theta = \text{Tan}^{-1}\left(\frac{opp}{adj}\right)$

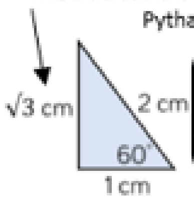
$\theta = \text{Tan}^{-1}\left(\frac{4}{3}\right)$

$\theta = 53.1°$

Exact Trig values

Cos0 = 1	Sin0 = 0
Cos90 = 0	Sin90 = 1
Tan0 = 0	~~Tan90~~

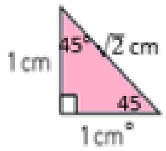
This side could be calculated using Pythagoras



$\text{Tan}30 = \frac{1}{\sqrt{3}}$ | $\text{Tan}60 = \sqrt{3}$

$\text{Cos}30 = \frac{\sqrt{3}}{2}$ | $\text{Cos}60 = \frac{1}{2}$

$\text{Sin}30 = \frac{1}{2}$ | $\text{Sin}60 = \frac{\sqrt{3}}{2}$



$\text{Tan}45 = 1$

$\text{Cos}45 = \frac{1}{\sqrt{2}}$

$\text{Sin}45 = \frac{1}{\sqrt{2}}$

This value cannot be defined – it is impossible as you cannot have two 90° angles in a triangle

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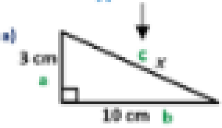
Pythagoras Theorem

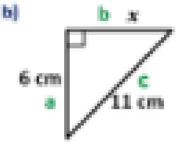
Label hypotenuse "c"

a)



$a^2 + b^2 = c^2$
$3^2 + 10^2 = x^2$
$109 = x^2$
$x = \sqrt{109}$
$x = 10.44$ cm

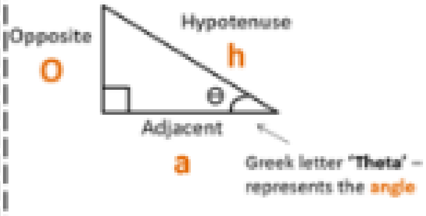
b)



$b^2 = c^2 - a^2$
$x^2 = 11^2 - 6^2$
$x^2 = 85$
$x = \sqrt{85}$
$x = 9.22$ cm

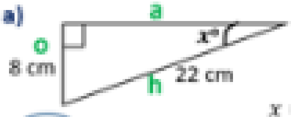
SOH - CAH - TOA

$\sin\theta = \frac{o}{h}$ $\cos\theta = \frac{a}{h}$ $\tan\theta = \frac{o}{a}$



Trigonometry – angles

a)



SOH CAH TOA

$\sin x = \frac{8}{22}$
$x = \sin^{-1}\left(\frac{8}{22}\right)$
$x = 21.3°$

b)

SOH CAH TOA

$\tan x = \frac{9}{11}$
$x = \tan^{-1}\left(\frac{9}{11}\right)$
$x = 39.3°$

Trigonometry – side lengths

Tan ratio

a)

SOH CAH TOA

$\tan 43 = \frac{o}{a}$
$\tan 43 = \frac{x}{17}$
$x = 17 \times tan43$ **$= 15.85$ cm**

Sine ratio

b)

SOH CAH TOA

$\sin 35 = \frac{o}{h}$
$\sin 35 = \frac{x}{28}$
$x = 28 \times sin35$ **$= 16.06$ cm**

Cosine ratio

c)

SOH CAH TOA

$\cos 19 = \frac{a}{h}$
$\cos 19 = \frac{32}{x}$
$x = \frac{32}{cos19}$ **$= 33.84$ cm**

Exact trig values

$sin30$	$sin45$	$sin60$
$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$

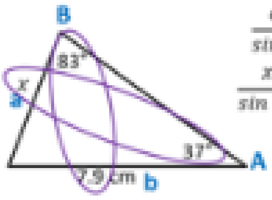
$cos30$	$cos45$	$cos60$
$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$

$tan30$	$tan45$	$tan60$
$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$

Sine rule

Sine rule for lengths:

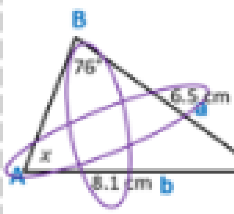
$\frac{a}{sinA} = \frac{b}{sinB}$ Lengths on top



$\frac{a}{sin\ A} = \frac{b}{sin\ B}$
$\frac{x}{sin\ 37} = \frac{7.9}{sin\ 83}$
$x = \frac{7.9}{sin\ 83} \times \sin 37$
$= 4.79$ cm

Sine rule for angles:

$\frac{sinA}{a} = \frac{sinB}{b}$ Angles on top



$\frac{\sin x}{6.5} = \frac{\sin 76}{8.1}$
$\sin x = \frac{\sin 76}{8.1} \times 6.5$
$\sin x = 0.778632372..$
$x = \sin^{-1} 0.778632372..$
$= 51.1°$

Cosine rule

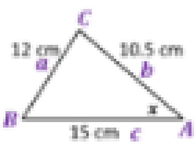
Cosine rule for lengths:

$a^2 = b^2 + c^2 - 2bc\ CosA$

$a^2 = b^2 + c^2 - 2bc\ CosA$
$x^2 = 7.5^2 + 11.2^2 - 2 \times 11.2 \times 7.5 \times Cos27$
$x^2 = 32.00090394 \ldots$
$x = \sqrt{32.0009394 \ldots}$ **$= 5.66$ cm**

Cosine rule for angles:

$CosA = \frac{b^2 + c^2 - a^2}{2bc}$



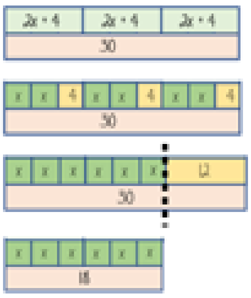
$CosA = \frac{b^2 + c^2 - a^2}{2bc}$
$CosA = \frac{10.5^2 + 15^2 - 12^2}{2 \times 10.5 \times 15}$
$CosA = 0.607142857 \ldots$
$A = \cos^{-1} 0.607142857 \ldots$ **$= 52.6°$**

Y10 – Equations and inequalities

KNOWLEDGE ORGANISER

Solve equations (R)

$3(2x + 4) = 30$



$3(2x + 4) = 30$ — Expand the brackets

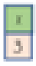
$6x + 12 = 30$

-12 -12

$6x = 18$

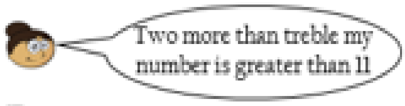
$\div 6$ $\div 6$

Substitute to check your answer.
This could be negative or a fraction or decimal



$x = 3$

Form and solve inequalities (R)



Form

$x \rightarrow \times 3 \rightarrow +2 \rightarrow 11$

$3x + 2 > 11$

Solve

$x \leftarrow \div 3 \leftarrow -2 \leftarrow 11$

$x > 3$

Solutions on a number line

$x < 1$ $x \leq 1$ $x > 1$ $x \geq 1$

Both represent values less than 1

Includes the value 1

Both represent values more than 1

Includes the value 1

● Includes the value it sits above
○ Does NOT include the value it sits above

$-1 < x \leq 3$

This includes the integer values 0, 1, 2, 3

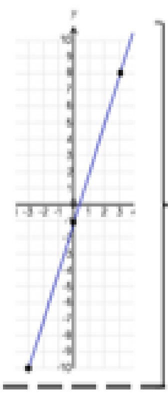
Plotting straight line graphs (R)

$y = 3x - 1$ → $\times 3$ the x coordinate then -1

x	-3	0	3
y	-10	-1	8

Draw a table to display this information

This represents a coordinate pair (−3, −10)



You only need two points to form a straight line

Plotting more points helps you decide if your calculations are correct (if they do make a straight line)

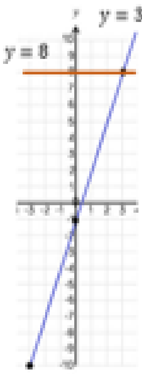
Remember to join the points to make a line

Find solutions

For linear equations there is only one point the graph meets the x value

$x = 2$
$y = 4$

These two lines will cross at (2,4) because they are just x= and y= they are parallel to axes and meet in one place



$3x - 1 = 8$

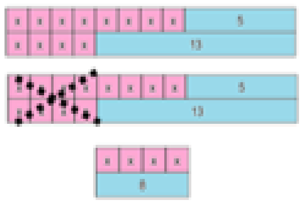
Remember equation of a line format is $y = mx + c$

The solution is the point the two lines meet

(3, 8)

Equations: unknown on both sides (R)

$8x + 5 = 4x + 13$



$8x + 5 = 4x + 13$

$-4x$ $-4x$

$4x + 5 = 13$

-5 -5

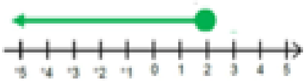
$4x = 8$

$\div 4$ $\div 4$

$x = 2$

Inequalities: unknown on both sides

$8x + 5 \leq 4x + 13$ → $x \leq 2$

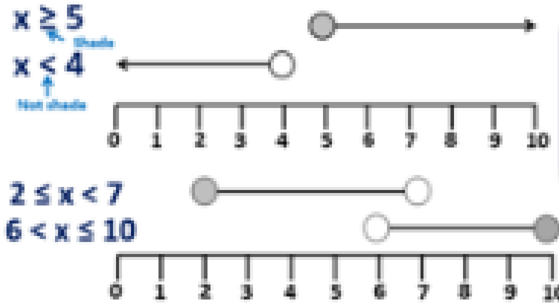


Any value 2 or less will satisfy this inequality

Y10 (H) – Equations and inequalities

KNOWLEDGE ORGANISER

Represent inequalities on a number line



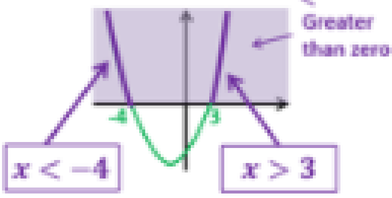
(≤, ≥) then the circle is shaded

(<, >) then the circle is not shaded

Solve quadratic inequalities

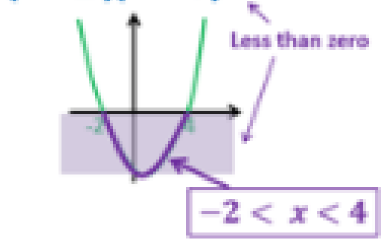
$x^2 + x - 12 > 0$

$(x + 4)(x - 3) > 0$



$x^2 - 2x - 8 < 0$

$(x + 2)(x - 4) < 0$



Equations with unknown on both sides

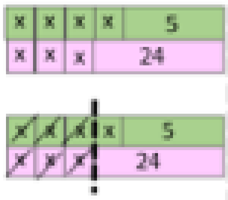
$4x + 5 = 3x + 24$

$-3x \quad -3x$

$x + 5 = 24$

$-5 \quad -5$

$x = 19$



Inequalities with unknown on both sides

$5(x + 4) < 3(x + 2)$

$5x + 20 < 3x + 6$

$2x + 20 < 6$

$2x < -14$

$x < -7$

Check it!

$5(-8 + 4) < 3(-8 + 2)$

$5(-4) < 3(-6)$

$-20 < -18$ ✓

Factorise quadratics

1. $x^2 + 7x + 12 = (x + 3)(x + 4)$

add to make 7; multiply to make 12

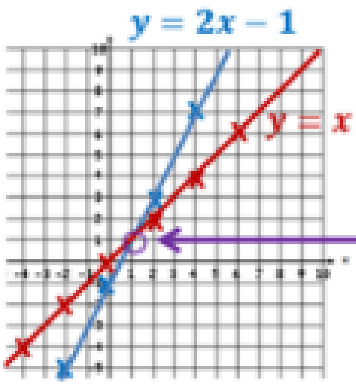
1, 12
2, 6
3, 4

2. $x^2 + 5x - 6 = (x - 1)(x + 6)$

add to make 5; multiply to make -6

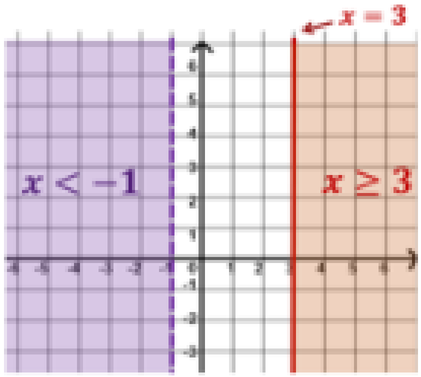
-1, 6
1, -6
-2, 3
2, -3

Solve equations using a graph



Solutions are where the graphs intersect

Represent inequalities on a graph



1) Find the region that satisfies $x \geq 3$ (Solid line)

2) Find the region that satisfies $x < -1$ (Dashed line)

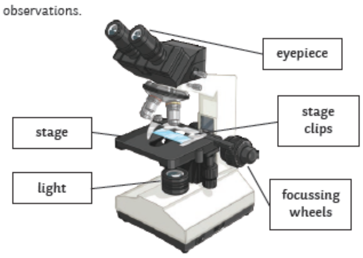
Science - Biology

Cell Biology Knowledge Organiser – Foundation and Higher

Required Practical

Microscopy Required Practical

- Includes preparing a slide, using a light microscope, drawing any observations – use a pencil and label important observations.



Osmosis and Potato Practical

- Independent variable – concentration.
- Dependent variable – change in mass.
- Control variable – volume of solution, temperature, time, surface area of the potato.

The potato in the sugar solution will lose water and so will have less mass at the end; the potato in the pure water solution will gain water.

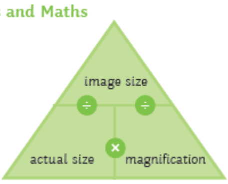
Specialised Cells

When a cell changes to become a specialised cell, it is called differentiation.

Specialised Cell	Function	Adaptation
sperm	To get the male DNA to the female DNA.	Streamlined head, long tail, lots of mitochondria to provide energy.
nerve	To send electrical impulses around the body.	Long to cover more distance. Has branched connections to connect in a network.
muscle	To contract quickly.	Long and contain lots of mitochondria for energy.
root hair	To absorb water from the soil.	A large surface area to absorb more water.
phloem	Transports substances around the plant.	Pores to allow cell sap to flow. Cells are long and joined end-to-end.
xylem	Transports water through the plant.	Hollow in the centre. Tubes are joined end-to-end.

Equations and Maths

Equation

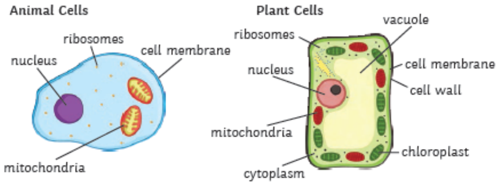


Maths Skills

Conversions:
Micrometres to millimetres: divide by 1000.

Standard Form:
$0.003 = 3 \times 10^{-3}$
$5.6 \times 10^{-5} = 0.0056$

Prokaryotic and Eukaryotic Cells

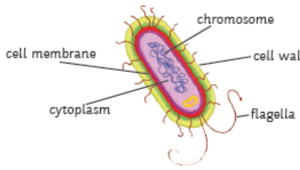


Plant and animal cells have similarities and differences:

	Animal	Plant
nucleus	✓	✓
cytoplasm	✓	✓
chloroplast	X	✓
cell membrane	✓	✓
permanent vacuole	X	✓
mitochondria	✓	✓
ribosomes	✓	✓
cell wall	X	✓

Bacterial Cells

Bacterial cells do not have a true nucleus, they just have a single strand of DNA that floats in the cytoplasm. They contain a plasmid.



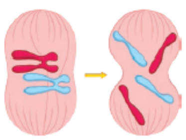
Cell Biology Knowledge Organiser - Foundation and Higher

Chromosomes and Mitosis

In the nucleus of a human cell there are 23 pairs of **chromosomes**. Chromosomes contain a double helix of **DNA**. Chromosomes have a large number of genes.

The **cell cycle** makes new cells.

Mitosis: DNA has to be **copied/replicated** before the cell carries out mitosis.



Key Vocabulary

active transport
alveoli
chromosome
diffusion
eukaryotic
gas exchange
mitosis
multicellular
osmosis
prokaryotic
undifferentiated
replicated
specialised
villi

Stem Cells

Embryonic stem cells are **undifferentiated** cells, they have the potential to turn into any kind of cell.

Adult stem cells are found in the bone marrow, they can only turn into some types of cells e.g. blood cells.

Uses of stem cells:

- Replacing faulty blood cells;
- making insulin producing cells;
- making nerve cells.

Some people are against stem cell research.

For Stem Cell Research	Against Stem Cell Research
Curing patients with stem cells - more important than the rights of embryos.	Embryos are human life.
They are just using unwanted embryos from fertility clinics, which would normally be destroyed.	Scientists should find other sources of stem cells.

Stem Cells in Plants

In plants, stem cells are found in the **meristem**. These stem cells are able to produce clones of the plant. They can be used to grow crops with specific features for a farmer, e.g. **disease resistant**.

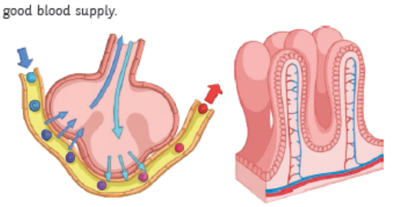
Exchange – Humans

Multicellular organisms have a large surface are to volume ratio so that all the substances can be exchanged.

Gas exchange: Lungs

The alveoli are where gas exchange takes place.

They have a large surface area, moist lining, thin walls and a good blood supply.

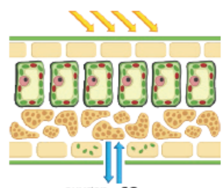


Villi: Small Intestine

Millions of villi line the small intestine increasing the surface area to absorb more digested food.

They are a single layer of cells with a good blood supply.

Exchange in Plants



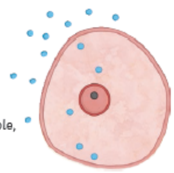
The surface of the leaf is flattened to increase the surface area for more gas exchange by diffusion.

Oxygen and water vapour diffuse out of the stomata. Guard cells open and close the stomata, controlling water loss.

Key Processes

Diffusion is the spreading out of particles from an area of higher concentration to an area of lower concentration.

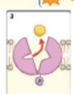
Cell membranes are semi-permeable, only small molecules can get through.



Cell Diffusion

Osmosis is the movement of water molecules across a partially permeable membrane from a region of higher concentration to a region of lower concentration.

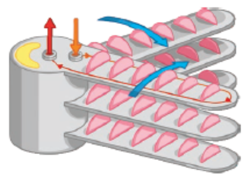
Active transport is the movement of substances against the concentration gradient. This process requires energy from respiration.



Active Transport in Cells

Exchange in Fish

Fish have a large surface area for gas exchange. These are called **gills**. Water enters the fish through the mouth and goes out through the gills. The oxygen is transported from the water to the blood by **diffusion**. Carbon dioxide diffuses from the blood to the water. Each gill has **gill filaments** which give the gills a large surface area. **Lamellae** cover each gill filament to further increase the surface area for more gas exchange. They have a **thin surface layer** and **capillaries** for good blood supply which helps with diffusion.



AQA GCSE (Combined Science) Unit 4: Bioenergetics Higher

Photosynthesis

Photosynthesis is a chemical reaction which takes place in plants. It converts **carbon dioxide** and **water** into **glucose** and **oxygen**. It uses **light** energy to power the chemical reaction, which is absorbed by the green pigment **chlorophyll**. This means that photosynthesis is an example of an **endothermic** reaction. The whole reaction takes place inside the **chloroplasts** which are small organelles found in plant cells.

Plants acquire the carbon dioxide via diffusion through the **stomata** of their leaves. The water is absorbed from the soil through the **roots** and transported to the cells carrying out photosynthesis, via the **xylem**.

$6CO_2$ Carbon dioxide + $6H_2O$ Water → (Light, Chlorophyll) $C_6H_{12}O_6$ Glucose + $6O_2$ Oxygen

The glucose made in photosynthesis is used for respiration, stored as starch, fat or oils, used to produce cellulose or used to produce amino acids for protein synthesis.

The Rate of Photosynthesis and Limiting Factors

A **limiting factor** is something which stops the photosynthesis reaction from occurring at a faster rate. **Temperature**, **light intensity** and **carbon dioxide** level are all limiting factors.

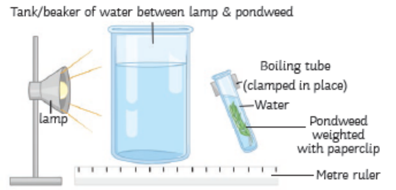
Increasing the temperature of the surroundings will increase the rate of reaction, but only up to around 45°C. At around this temperature, the enzymes which catalyse the reaction become denatured.

Increasing the light intensity will increase the rate of reaction because there is more energy to carry out more reactions.

Increasing the carbon dioxide concentration will also increase the rate of reaction because there are more reactants available.

The Effect of Light Intensity on the Rate of Photosynthesis (RPI)

The amount of light a plant receives affects the rate of photosynthesis. If a plant receives lots of light, lots of photosynthesis will occur. If there is very little or no light, photosynthesis will stop.



Method

1. Measure 20cm³ of sodium hydrogen carbonate solution and pour into a boiling tube.
2. Collect a 10cm piece of pondweed and gently attach a paper clip to one end.
3. Clamp the boiling tube, ensuring you will be able to shine light onto the pondweed.
4. Place a metre rule next to the clamp stand.
5. Place the lamp 10cm away from the pondweed.
6. Wait two minutes, until the pondweed has started to produce bubbles.
7. Using the stopwatch, count the number of bubbles produced in a minute.
8. Repeat stages 5 to 7, moving the lamp 10cm further away from the pondweed each time until you have five different distances.
9. Now repeat the experiment twice more to ensure you have three readings for each distance.

The **independent** variable was the light intensity.

The **dependent** variable was the amount of bubbles produced. Counting the bubbles is a common method, but you could use a gas syringe instead to more accurately measure the volume of oxygen produced.

The **control** variables were same amount of time and same amount of pondweed. A bench lamp is used to control the light intensity and the water in the test tube containing the pondweed is monitored with a thermometer to monitor and control the temperature.

Interaction of Limiting Factors (HT only)

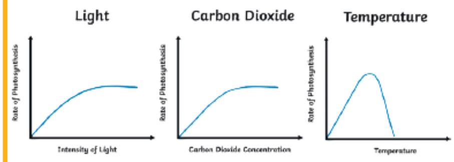
The limiting factor for the reaction will depend on the environmental conditions.

For example:

At night, light intensity is the limiting factor.

In winter, temperature is the limiting factor.

In other conditions, carbon dioxide is usually the limiting factor.



From the graph, you can see that increasing one of the factors will also increase the rate of reaction, but only for so long before it plateaus. This is because another factor will have then become the limiting factor. E.g. you could increase the supply of carbon dioxide, but if there is not enough chlorophyll to absorb the sunlight, then the sunlight will become the limiting factor instead.

Greenhouse Economics (HT only)

To grow plants in the most suitable conditions, a greenhouse can be used.

A greenhouse traps the sun's radiation as heat inside the greenhouse, so that temperature is not a limiting factor for the rate of photosynthesis.

Artificial lighting can be installed in the greenhouse to provide constant light energy and prevent light intensity being a limiting factor.

A paraffin heater can be used in the greenhouse to not only maintain a suitable temperature, but the by-product of the combustion off the paraffin is carbon dioxide.

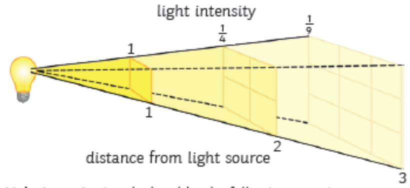
Enclosing the crops in a greenhouse and regulating all the conditions in this way can be expensive; however, it is often outweighed because the harvest of the crop is much healthier, faster-grown crops. Furthermore, the enclosed conditions mean that disease and pests can be easily controlled and prevented.

AQA GCSE (Combined Science) Unit 4: Bioenergetics Higher

Inverse Square Law and Light Intensity

The **inverse square law** is used to describe the light intensity at different distances from the source.

The inverse square law states that: **the intensity of light is inversely proportional to the square distance from the source.**



Light intensity is calculated by the following equation:

$$\text{light intensity} \propto \frac{1}{\text{distance}^2}$$

- The symbol, ∝, means 'is proportional to'.
- Distance is measured in metres, m.

In other words, if an object is moved twice as far away from the light source, the light intensity received is reduced to just one quarter.

Worked example:

If the light source is 10cm from a plant, calculate the light intensity reaching the plant.

1 ÷ (distance²)

1 ÷ (0.10 × 0.10)

1 ÷ 0.01

= 100 arbitrary units

If the light source is moved 25cm from the plant, calculate the light intensity reaching the plant.

1 ÷ (distance²)

1 ÷ (0.25 × 0.25)

1 ÷ 0.0625

= 16 arbitrary units

Respiration

Respiration is the chemical reaction which occurs inside the **mitochondria** of all living cells to release energy for living functions and processes, e.g. movement, warmth and building larger molecules for growth and repair. The reaction is **exothermic**, meaning that energy is released to the surroundings.

Respiration can be either **aerobic** (using oxygen) or **anaerobic** (without using oxygen).

glucose + oxygen → carbon dioxide + water + energy

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

In anaerobic respiration, the glucose is not completely oxidised. This means that there is less energy released than in aerobic respiration.

glucose → lactic acid + energy

$C_6H_{12}O_6 \rightarrow 2C_3H_6O_3 + ATP$

In plants and yeast, anaerobic respiration makes some different products. The reaction is also called fermentation and is used in bread-making and beer-brewing.

glucose → ethanol + carbon dioxide + energy

$C_6H_{12}O_6 \rightarrow C_2H_5OH + CO_2 + ATP$

Effect of Exercise

When a person exercises, their body (specifically their **muscles**) need much more energy. To release more energy, the amount of respiration reactions occurring has to increase.

The **heart** pumps faster and the **breathing** rate and breath volume all increase to supply more **oxygen** to the muscles via the bloodstream.

If the muscles are not receiving enough oxygen to keep up the demand needed by the respiration reactions, then **anaerobic** respiration begins to occur. This incomplete oxidation of the glucose produces **lactic acid**, which can build up in the muscles and results in an **oxygen debt**.

After long periods of exercise, the muscles can become fatigued and stop contracting. You might experience a pain commonly called a **stitch**.

Metabolism

Metabolism is the combination of all the reactions in a cell or in the body.

Energy released during respiration is used during metabolic processes to synthesise new molecules:

- Glucose is converted to starch, glycogen and cellulose.
- Glycerol and three fatty acids are joined to form a lipid molecule.
- Glucose and nitrate ions are joined to form amino acids.
- Amino acids are joined to form proteins.
- Excess proteins are broken down and released as urea during excretion.

Respiration itself is also a process which is included in metabolism.

Oxygen Debt (HT only)

During vigorous exercise, the body can begin to carry out **anaerobic respiration** and produces **lactic acid**.

Lactic acid is transported via the bloodstream to the **liver**. The liver converts the lactic acid back into **glucose**. However, **oxygen** is needed to carry out this reaction.

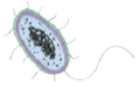
The **oxygen debt** is the amount of the oxygen required by the body to convert the built-up lactic acid back into glucose and remove it from the respiring cells.

Infection and Response Knowledge Organiser – Foundation and Higher

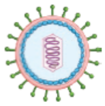
Communicable Disease

Pathogens are **microorganisms** that enter the body and cause communicable disease (infectious). Plants and animals can be infected by them.

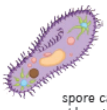
Bacteria are small cells that can reproduce very quickly in the body. They produce **toxins** that make you feel ill, damaging your cells and tissues.



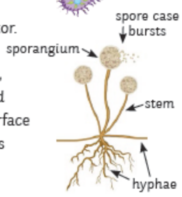
Viruses are much smaller than bacteria; they can also reproduce quickly in the body. Viruses live inside your cell where they replicate. They then burst out of the cell, releasing new viruses.



Protists are eukaryotes (multicellular). Some are parasites which live on or inside other organisms, often carried by a vector.



Fungi are sometimes single celled, others have hyphae that grow and penetrate human skin and the surface of plants. They can produce spores which can spread to other plants.



How Pathogens Are Spread

Pathogens can be spread in many ways, for example:

Water – by drinking dirty water, e.g. cholera.

Air – carried by air and breathed in, e.g. influenza.

Direct contact – touching contaminated surfaces including the skin, e.g. athlete's foot.

Viral Diseases

Measles is spread by droplets of liquid from sneezes and coughs etc., symptoms include a red rash on the skin and a fever. Measles can be serious or even fatal, it can lead to pneumonia. Most people are vaccinated against measles when they are very young.

HIV is spread by sexual contact or exchanging body fluids. HIV can be controlled be antiviral drugs; this stops the viruses replicating. The virus attacks the cells in the immune system. If the immune system is badly damaged, the body cannot cope with other infections. This is the late stage and is called aids.

Tobacco mosaic virus affects plants, parts of the leaves become discoloured. This means plants cannot carry out photosynthesis; this will affect the plants growth.

Fungal and Protist Diseases

Fungal

Rose black spot shows as black spots on the leaves of the plant, this means less photosynthesis occurs. As a result, the plant does not grow as well. It is spread by the wind or the water. They can be treated by using fungicides and taking the leaves off the infected plant.

Protists

Malaria is caused by a protist, mosquitoes are the vectors. They become infected when they feed on an infected animal. The protist is inserted into the blood vessel. Malaria can cause fever, it can also be fatal.

Bacterial Diseases

Salmonella bacteria causes food poisoning. Symptoms include fever, stomach cramps, vomiting and diarrhoea. The symptoms are caused by the toxins produced by the bacteria. Food contaminated with salmonella can give you food poisoning. Most poultry in the UK will have had a vaccination against salmonella.

Gonorrhoea is a sexually transmitted bacterial disease, passed on by sexual contact. Symptoms include pain when urinating and thick yellow/green discharge from the vagina or penis. To prevent the spread, people should be treated with antibiotics and use a condom.

How to prevent the spread:

Being hygienic –

washing hands thoroughly.

Destroying vectors –

killing vectors by using insecticides or destroying their habitat.

Isolation –

isolating an infected person will prevent the spread.

Vaccination –

people cannot develop the infection and then pass it on.

Infection and Response Knowledge Organiser – Foundation and Higher

Fighting Diseases

Defence System

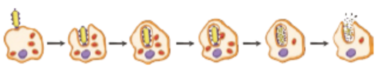
1. The skin acts as a barrier to pathogens.
2. Hairs and mucus in your nose trap particles.
3. The trachea and bronchi secrete mucus to trap pathogens. They also have cilia which move backwards and forwards to transport the mucus towards the throat. This traps any pathogens and the mucus is usually swallowed.
4. The stomach contains hydrochloric acid to kill any pathogens that enter the body via the mouth.

The Immune System

This kills any pathogens that enter the body.

White blood cells:

- **Phagocytosis** is when white blood cells engulf pathogens and then digest them.
- They produce **antitoxins** to neutralise the **toxins**.
- They also produce **antibodies**. Pathogens have **antigens** on their surface, antibodies produced by the white blood cells lock on to the antigen on the outside of the pathogen. White blood cells can then destroy the pathogens. Antibodies are specific to one antigen and will only work on that pathogen.



Vaccinations

Vaccinations have been developed to protect us from future infections. A vaccination involves an injection of a **dead** or **weakened** version of the pathogen. They carry antigens which cause your body to produce antibodies which will attack the pathogen. If you are infected again, the white blood cells can produce antibodies quickly.

Pros	Cons
Helps to control communicable diseases that used to be very common.	They don't always work.
Epidemics can be prevented.	Some people can have a bad reaction to a vaccine – however, that is very rare.

Fighting Disease – Drugs

Painkillers relive the pain and symptoms, but do not tackle the cause.

Antibiotics kill the bacteria causing the problem, but do not work on viruses. Viruses are very difficult to kill because they live inside the body cells.

Developing Drugs

There are three main stages in drug testing:

Pre-clinical testing:

1. Drugs are tested on human cells and tissues.
2. Testing carried out on living animals.

Clinical testing:

3. Tested on healthy human volunteers in clinical trials. Starts with a very low dose, then tested on people with the illness to find the optimum dose.

Placebo is a substance that is like the drug, but does not do anything.

Placebo effect is when the patient thinks the treatment will work even though their treatment isn't doing anything.

Blind trial is when the patient does not know whether they are getting the drug or the placebo.

Double-blind trial is when both the doctor and the patient do not know whether they are getting the drug.

Drugs from Plants

Chemicals produced by plants to defend themselves can be used to treat human diseases or help with symptoms.

Drug	Plant/Microorganism
aspirin	willow
digitalis	foxglove
penicillin	mould - penicillium

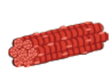
New drugs are now made by chemists, who work for the pharmaceutical industry, in laboratories.

Key Vocabulary

antibodies
antigens
antitoxins
bacteria
blind trial
double-blind
fungus
microorganism
phagocytosis
placebo
protist
toxins
vaccination
vector
virus

AQA GCSE Biology (Combined Science) Unit 2: Organisation

Principles of Organisation

				
cell	tissue	organ	organ system	organism
Cells are the basic building blocks of all living things.	A group of cells with a similar structure and function is called a tissue.	An organ is a combination of tissues carrying out a specific function.	Organs work together within an organ system.	Organ systems work together to form whole living organisms.

Food Tests (Required Practical)

What are you testing for?	Which indicator do you use?	What does a positive result look like?
sugar	Benedict's reagent	Once heated, the solution will change from blue-green to yellow-red.
starch	iodine	Blue-black colour indicates starch is present.
protein	biuret	The solution will change from blue to pink-purple.
lipid	sudan III	The lipids will separate and the top layer will turn bright red.

Effect of pH on the Rate of Reaction of Amylase (Required Practical)

Iodine is used to test for the presence of **starch**. If starch is present, the colour will change to blue-black.

The **independent variable** in the investigation is the pH of the buffer solution.

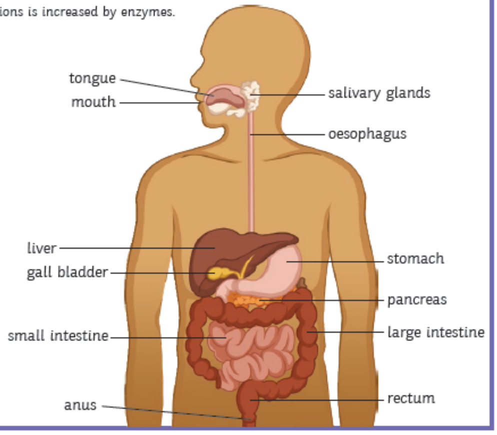
The **dependent variable** in the investigation is the time taken for the reaction to complete (how long it takes for all the starch to be digested by the amylase).

Method:

1. Use the marker pen to label a test tube with the first value of pH buffer solution (pH 4) and stand it in the test tube rack.
2. Into each well of the spotting tiles, place a drop of iodine.
3. Using a measuring cylinder, measure 2cm³ of amylase and pour into the test tube.
4. Using a syringe, measure 1cm³ of the buffer solution and pour into the test tube.
5. Leave this to stand for five minutes and then use the thermometer to measure the temperature. Make a note of the temperature.
6. Add 2cm³ of starch solution into the test tube, using a different measuring cylinder to measure, and begin a timer (leave the timer to run continuously).
7. After 10 seconds, use a pipette to extract some of the amylase/starch solution, and place one drop into the first well of the spotting tile. Squirt the remaining solution back into the test tube.
8. Continue to place one drop into the next well of the spotting tile, every 10 seconds, until the iodine remains orange.
9. Record the time taken for the starch to be completely digested by the amylase by counting the wells that were tested positive for starch (indicated by the blue/black colour change of the iodine). Each well represents 10 seconds of time.
10. Repeat steps 1 to 8 for pH values 7 and 10.

The Digestive System

The purpose of the digestive system is to break down large molecules into smaller, soluble molecules, which are then absorbed into the bloodstream. The rate of these reactions is increased by enzymes.



Enzymes

An enzyme is a biological **catalyst**; enzymes speed up chemical reactions without being changed or used up.

This happens because the enzyme lowers the **activation energy** required for the reaction to occur. Enzymes are made up of chains of amino acids folded into a globular shape.

Enzymes have an **active site** which the **substrate** (reactants) fits into. Enzymes are very specific and will only catalyse one specific reaction. If the reactants are not the complimentary shape, the enzyme will not work for that reaction.

Enzymes also work optimally at specific conditions of pH and temperature. In extremes of pH or temperature, the enzyme will **denature**. This means that the bonds holding together the 3D shape of the active site will break and the active shape will deform. The substrate will not be able to fit into the active site anymore and the enzyme cannot function.

Enzyme	Reactant	Product
amylase	starch	sugars (glucose)
protease	protein	amino acids
lipase	lipid	glycerol and fatty acids

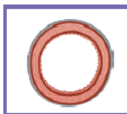
The products of digestion are used to build new carbohydrates and proteins and some of the glucose is used for respiration.

Bile is produced in the **liver** and stored in the gall bladder. It is an **alkaline** substance which **neutralises** the hydrochloric acid in the stomach. It also works to **emulsify** fats into small droplets. The fat droplets have a higher **surface area** and so the rate of their digestion by lipase is increased.

The Heart and Blood Vessels

The **heart** is a large muscular organ which **pumps blood** carrying oxygen or waste products around the body. The **lungs** are the site of **gas exchange** where oxygen from the air is exchanged for waste carbon dioxide in the blood. Oxygen is used in the **respiration** reaction to release energy for the cells and carbon dioxide is made as a waste product during the reaction.

glucose + oxygen ⟶ carbon dioxide + water + [energy]

		
vein	artery	capillary

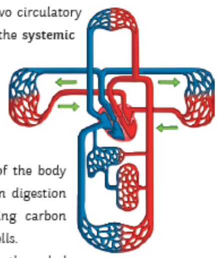
The three types of blood vessels, shown above, are each adapted to carry out their specific function.

Capillaries are narrow vessels which form networks to closely supply cells and organs between the veins and arteries. The walls of the capillaries are only **one cell thick**, which provides a short **diffusion pathway** to increase the rate at which substances are transferred.

The table below compares the structure and function of arteries and veins:

	Artery	Vein
direction of blood flow	away from the heart	towards the heart
oxygenated or deoxygenated blood?	oxygenated (except the pulmonary artery)	deoxygenated (except the pulmonary vein)
pressure	high	low (negative)
wall structure	thick, elastic, muscular, connective tissue for strength	thin, less muscular, less connective tissue
lumen (channel inside the vessel)	narrow	wide (with valves)

The Heart as a Double Pump



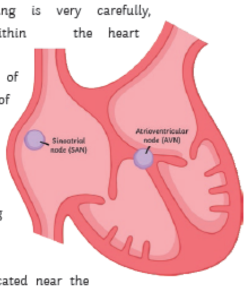
The heart works as a **double pump** for two circulatory systems; the **pulmonary** circulation and the **systemic** circulation.

The pulmonary circulation serves the lungs and bring deoxygenated blood to exchange waste carbon dioxide gas for oxygen at the **alveoli**.

The systemic circulation serves the rest of the body and transports oxygen and nutrients from digestion to the cells of the body, whilst carrying carbon dioxide and other waste away from the cells.

The systemic circulation flows through the whole body. This means the blood is flowing at a much higher pressure than in the pulmonary circuit.

The Heart as Pacemaker



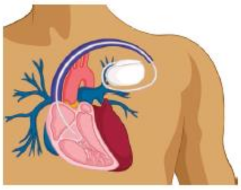
The rate of the heart beating is very carefully, and automatically, controlled within the heart itself.

Located in the muscular walls of the heart are small groups of cells which act as pacemakers. They produce electrical impulses which stimulate the surrounding muscle to contract, squeezing the chambers of the heart and pumping the blood.

The **sino-atrial node (SAN)** is located near the right atrium and it stimulates the atria to contract.

The **atrio-ventricular node (AVN)** is located in between the ventricles and stimulates them to contract.

Artificial pacemakers can be surgically implanted into a person if their heart nodes are not functioning correctly.



Coronary Heart Disease

Coronary heart disease is a condition resulting from **blockages** in the **coronary arteries**. These are the main arteries which supply blood to the heart itself and they can become blocked by build-up of **fatty deposits**.

In the UK and around the world, coronary heart disease is a major cause of many **deaths**.

The main symptoms can include **chest pain, heart attack** or **heart failure**. Yet, not all people suffer the same symptoms, if any at all.

Lifestyle factors can increase the risk of a person developing coronary heart disease.

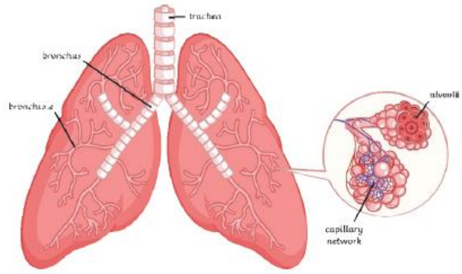
Diet – a high-fat diet (containing lots of saturated fat) can lead to higher cholesterol levels and this cholesterol forms the fatty deposits which damage and block the arteries.

Smoking – chemicals in cigarette smoke, including nicotine and carbon monoxide, increase the risk of heart disease. Carbon monoxide reduces the amount of oxygen which can be transported by the red blood cells and nicotine causes an increased heart rate. The lack of oxygen to the heart and increased pressure can lead to heart attacks.

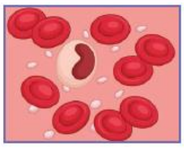
Stress – prolonged exposure to stress or stressful situations (such as high pressure jobs) can lead to high blood pressure and an increased risk of heart disease.

Drugs – illegal drugs (e.g. ecstasy and cannabis) can lead to increased heart rate and blood pressure, increasing the risk of heart disease.

Alcohol – regularly exceeding unit guidelines for alcohol can lead to increased blood pressure and risk of heart disease.



Blood



Blood is composed of red blood cells (erythrocytes), white blood cells and platelets, all suspended within a plasma (a tissue).

The **plasma** transports the different blood cells around the body as well as carbon dioxide, nutrients, urea and hormones. It also distributes the heat throughout the body.

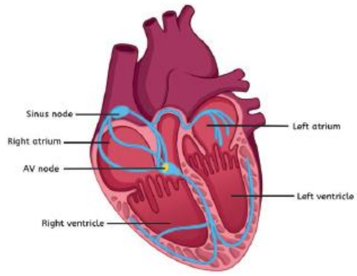
Red blood cells transport oxygen attached to the haem group in their structure. It has a biconcave shape to increase surface area and does not contain a nucleus so it can bind with more oxygen molecules.

White blood cells form part of the immune system and ingest pathogens and produce antibodies. **Platelets** are important blood clotting factors.

at the lungs

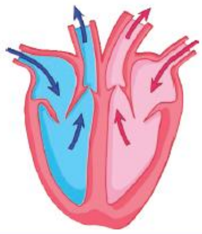
haemoglobin + oxygen ⇌ oxyhaemoglobin

at the cells



The **right atrium** receives deoxygenated blood via the **vena cava**. It is then pumped down through the valves into the right ventricle. From here, it is forced up through the **pulmonary artery** towards the **lungs** where it exchanges carbon dioxide for oxygen. The oxygenated blood then enters the **left atrium** via the **pulmonary vein** and down into the left ventricle. The muscular wall of the **left ventricle** is much thicker so it can pump the blood more forcefully out of the heart and around the entire body, via the **aorta**.

The blood only flows in **one direction**. This is because there are **valves** in the heart which close under pressure and prevent the backward flow of blood.



Rate Calculations for Blood Flow

The number of beats the heart performs each minute is called the **pulse** (or heart rate).

It is easily measured by counting the number of beats in a given time, e.g. 15s, and finding the total beats **per minute**.

Typically, a lower resting pulse rate indicates a greater level of physical **fitness**. During exercise, and for some time after, the pulse rate increases while the heart is working to provide more **oxygen** to the muscles.

Cardiac output is a measure of the volume of blood pumped by the heart each **minute**. **Stroke volume** is a measure of the volume of blood pumped from the heart each **contraction** (heart beat).

Cardiac output (cm^3/min) = heart rate (bpm) × stroke volume (cm^3/beat)

Cancer

Cancer is the result of **uncontrolled** cell growth and division. The uncontrolled growth of cells is called a **tumour**.

Benign Tumour	Malignant Tumour
• Usually grows slowly. • Usually grows within a membrane and can be easily removed. • Does not normally grow back. • Does not spread around the body. • Can cause damage to organs and be life-threatening.	• cancerous • Usually grows rapidly. • Can spread around the body, via the bloodstream. • Cells can break away and cause secondary tumours to grow in other areas of the body (metastasis).

Plant Tissues, Organs and Systems

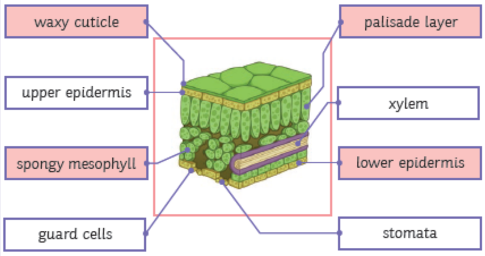
Leaves are plant organs and their main function is to absorb sunlight energy for use in **photosynthesis**. Within the cells are small organelles called **chloroplasts** which contain a green pigment called **chlorophyll**. This is the part of the plant which absorbs the sunlight and where photosynthesis occurs.

$$\text{carbon dioxide} + \text{water} \xrightarrow{\text{sunlight}} \text{oxygen} + \text{glucose}$$

Leaves are adapted to carry out their function. Leaves are typically flat and thin with a large **surface area**. This means they have a maximum area to absorb the sunlight and carbon dioxide. The **thin** shape reduces the distance for **diffusion** of water and gases.

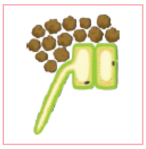
Leaves contain vessels called xylem and phloem. The **xylem** transport water and dissolved minerals toward the leaves. The **phloem** transport glucose and other products from photosynthesis around the plant.

The large **air spaces** between the cells of the spongy mesophyll layer allow for the diffusion of gases. **Carbon dioxide** enters the leaves and **oxygen** exits the leaves.



The **guard cells** are specially adapted cells located on the underside of the leaf. They are positioned in pairs, surrounding the **stomata** (a small opening in the epidermis layer). The guard cells change shape to open and close the stomata, controlling the rate of **gas exchange** in the leaf.

Root Hair Cells

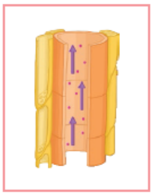


Plants absorb water by **osmosis** through the root hair cells of the roots. Dissolved in the water are important minerals for the plant's growth and development, which are absorbed by **active transport**.

The **root hair cells** are adapted to their function with the following features:

- Finger-like projection in the membrane increases the **surface area** available for water and minerals to be absorbed across.
- The narrow shape of the projection can squeeze into small spaces between soil particles, bringing it closer and reducing the distance of the **diffusion pathway**.
- The cell has many **mitochondria**, which release energy required for the active transport of some substances.

Xylem and Phloem



Xylem vessels transport **water** through the plant, from roots to leaves. They are made up of **dead**, lignified cells, which are joined end to end with no walls between them, forming a long central tube down the middle. The movement of the water, and dissolved minerals, along the xylem is in a **transpiration** stream.

Xylem vessels also provide **support** and **strength** to the plant structure. They are found in the middle of roots so they aren't crushed within the soil. They are found in the middle of the stem to provide strength and prevent bending. In the leaves, they are found in **vascular bundles** alongside the phloem and can be seen as the veins which network across the leaf.

AQA GCSE Biology (Combined Science) Unit 2: Organisation

Phloem vessels transport **food** such as dissolved sugars and glucose from photosynthesis. The food is transported around the plant to where growth is occurring (root and shoot tips), as well as to the organs which store the food. The transport occurs in **all directions** throughout the plant. The cells making up the phloem tube are **living**, with small holes in the walls where the cells are joined.

Transpiration and Translocation

Transpiration is the loss of water, by **evaporation** and **diffusion**, from the leaves of the plant. Water is a cohesive molecule and as it evaporates, there is less water in the leaf, so water from further back moves up to take its place. This, in turn, draws more water with it. This is the **transpiration stream**.

Transpiration occurs naturally as there is a tendency for water to diffuse from the leaves (where the concentration is relatively high) to the air around the plants (where the concentration is relatively low), via the **stomata**.

Environmental factors can change the rate at which transpiration occurs:

- Increased **light intensity** will increase the rate of transpiration because light stimulates the stomata to open. The leaf will also be warmed by the sunlight.
- Increased **temperature** will cause the water to evaporate more quickly and so increase the rate of transpiration.
- Increased **humidity** (moisture in the air) will reduce the rate of transpiration. Whereas if the air becomes drier, the rate increases. A greater concentration gradient will increase the rate of diffusion.
- If the **wind speed** increases, then the rate of transpiration also increases. This is because as the water surrounding the leaves is moved away more quickly, the concentration gradient is increased.
- If the **water content** in the soil is decreased, then the rate of absorption in the roots decreases. This causes the stomata to become flaccid and close, reducing transpiration. If the loss of turgor affects the whole plant, then it will wilt.

Disease Interactions

Having one type of illness can often make a person more susceptible to another type of illness:

- immune disorders ⟶ increased risk of infectious disease
- viral infection of cells ⟶ increased risk of cancer
- immune reactions ⟶ can trigger allergies
- very poor physical health ⟶ increased risk of depression or other mental illness

Health and Disease

Health is the state of being free from **illness** or **disease**. It refers to **physical** and **mental** wellbeing.

Disease and lifestyle factors, such as diet, stress, smoking, alcohol consumption and the use of illegal drugs, can all impact the health of a person.

Some conditions are associated with certain lifestyle choices:

- Liver conditions are associated with poor **diet** and prolonged excessive **alcohol** consumption.
- Lung cancer is associated with **smoking**.
- Memory loss, poor physical health and hygiene are associated with the use of illegal or recreational **drugs**.
- Obesity and diabetes are associated with poor diet.
- Anxiety and depression are associated with **stress** and prolonged excessive alcohol consumption.

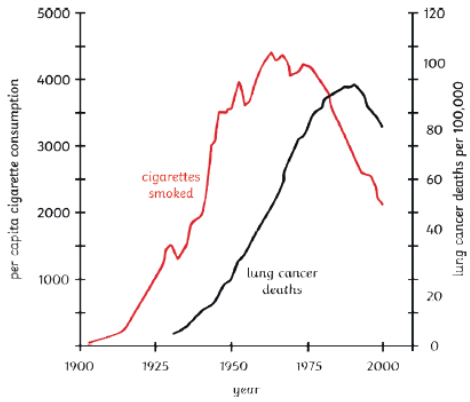
There can often be correlations between some factors and types of illness or specific diseases.

For example, in the graph shown to the right, there is a positive correlation between the number of cigarettes smoked and the number of lung cancer deaths.

However, there are other factors which can contribute to the development of lung cancer e.g. working with asbestos, genetic predisposition.

This means that although the evidence in the graph gives a strong indication that smoking is a cause of lung cancer, it cannot be stated that **'smoking will cause lung cancer'**. Not every person who smokes will develop lung cancer and not every person who develops lung cancer will be a smoker.

Therefore, it can be stated that **smoking increases the risk of lung cancer**.



AQA GCSE Biology (Combined Science) Unit 2: Organisation

Heart Disease (Treatments)

There are a range of medical treatments for heart disease.

Treatment	Description	Advantages	Disadvantages
statins	**Drugs** used to lower cholesterol levels in the blood, by reducing the amount produced in the liver.	• Can be used to prevent heart disease developing. • Improved quality of life.	• Long-term treatment. • Possible negative side-effects.
stents	**Mechanical device** which is used to stretch narrow or blocked arteries, restoring blood flow.	• Used for patients where drugs are less effective. • Offers long-term benefits. • Made from metal alloys so will not be rejected by the patients body. • Improved quality of life.	• Requires surgery under general anaesthetic, which carries risk of infection.
heart transplant	The entire organ is replaced with one from an organ **donor** (a person who has died and previously expressed a wish for their organs to be used in this way).	• Can treat complete heart failure in a person. • extended life • Improved quality of life. • Artificial plastic hearts can be used temporarily until a donor is found.	• Requires major surgery under general anaesthetic, which carries risks. • Lack of donors available. • Risk of infection or transplant rejection. • Long recovery times.

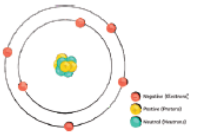
Science – Chemistry

Atomic Structure and the Periodic Table – Foundation and Higher

Atoms

Contained in the nucleus are the **protons** and **neutrons**. Moving around the nucleus are the **electron** shells. They are negatively charged.

Particle	Relative Mass	Charge
proton	1	+1
neutron	1	0
electron	Very small	-1



Overall, atoms have no charge; they have the same number of protons as electrons. An ion is a charged particle - it does not have an equal number of protons to electrons.

Atomic Number and Mass Number

Equations and Maths

To calculate the relative atomic weight, use the following equation:

relative atomic weight (A_r) =

$$\frac{\text{sum of (isotope abundance} \times \text{isotope mass number)}}{\text{sum of abundances of all isotopes}}$$

Balancing Symbol Equations

There must be the same number of atoms on both sides of the equation:

$CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$

C = 1

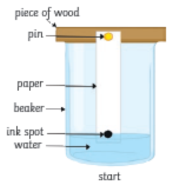
O = 4

H = 4

Mixtures, Chromatography and Separation

Mixtures – in a mixture there are no chemical bonds, so the elements are easy to separate. Examples of mixtures are air and salt water.

Chromatography – to separate out mixtures.



Filtration – to separate solids from liquids.

Evaporation – to separate a soluble salt from a solution; a quick way of separating out the salt.

Crystallisation - to separate a soluble salt from a solution; a slower method of separating out salt.

Separating out salt from rock salt:

1. Grind the mixture of rock salt.
2. Add water and stir.
3. Filter the mixture, leaving the sand in the filter paper
4. Evaporate the water from the salt, leaving the crystals.

Elements

Elements are made of atoms with the same atomic number. Atoms can be represented as symbols.

N = nitrogen **F** = fluorine **Zn** = zinc **Ca** = calcium

Isotopes – an isotope is an element with the **same number of protons** but a **different number of neutrons**. They have the same atomic number, but different mass number.

Isotope	Protons	Electrons	Neutrons
$^{1}_{1}H$	1	1	1 - 1 = 0
$^{2}_{1}H$	1	1	2 - 1 = 1
$^{3}_{1}H$	1	1	3 - 1 = 2

Compounds – a compound is when two or more elements are chemically joined. Examples of compounds are carbon dioxide and magnesium oxide. Some examples of formulas are CO_2, NaCl, HCl, H_2O, Na_2SO_4. They are held together by chemical bonds and are difficult to separate.

Chemical Equations

A chemical reaction can be shown by using a **word equation.**

e.g. magnesium + oxygen → magnesium oxide

On the left-hand side are the reactants, and the right-hand side are the products.

They can also be shown by a **symbol equation.**

e.g. $2Mg + O_2 \rightarrow 2MgO$

Equations need to be **balanced,** so the same number of atoms are on each side. To do this, numbers are put in front of the compounds.

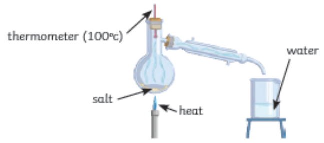
$CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$

Atomic Structure and the Periodic Table – Foundation and Higher

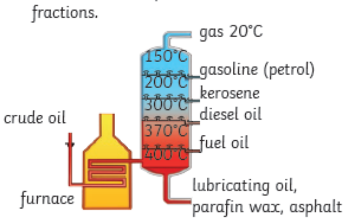
Distillation

To separate out mixtures of liquids.

1. **Simple distillation** – separating a liquid from a solution.



2. **Fractional distillation** – separating out a mixture of liquids. Fractional distillation can be used to separate out crude oil into fractions.



Metals and Non-metals

They are found at the **left** part of the periodic table. Non-metals are at the **right** of the table.

Metals

Are strong, malleable, good conductors of electricity and heat. They bond metallically.

Non-Metals

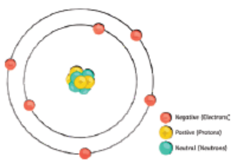
Are dull, brittle, and not always solids at room temperature.

History of the Atom

Scientist	Time	Discovery
John Dalton	start of 19th century	Atoms were first described as solid spheres.
JJ Thomson	1897	Plum pudding model – the atom is a ball of charge with electrons scattered.
Ernest Rutherford	1909	Alpha scattering experiment – mass concentrated at the centre; the nucleus is charged. Most of the mass is in the nucleus. Most atoms are 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.

Electronic Structure

Electrons are found in shells. A maximum of two in the most inner shell, then eight in the 2nd and 3rd shell. The inner shell is filled first, then the 2nd then the 3rd shell.



Group 7 Elements and Noble Gases

Halogens

The halogens are **non-metals**: fluorine, chlorine, bromine, iodine. As you go down the group they become less reactive. It is harder to gain an extra electron because its outer shell is further away from the nucleus. The melting and boiling points also become higher.

Noble Gases

The **noble gases** (**group 0** elements) include: **helium**, **neon** and **argon**. They are un-reactive as they have full outer shells, which makes them very stable. They are all colourless gases at room temperature.

The boiling points all increase as they go down the group – they have greater intermolecular forces because of the increase in the number of electrons.

Development of the Periodic Table

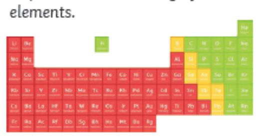
In the early 1800s, elements were arranged by atomic weight. The periodic table was not complete because some of the elements had not been found. Some elements were put in the wrong group.

Dimitri Mendeleev (1869) left gaps in the periodic table. He put them in order of **atomic weight**. The gaps show that he believed there was some undiscovered elements. He was right! Once found, they fitted in the pattern.

The Modern Periodic Table

Elements are in order of **atomic weight/proton number**. It shows where the metals and non-metals are. **Metals** are on the **left** and **non-metals** on the **right**. The **columns** show the **groups**. The **group number** shows the number of **electrons** in the **outer shell**. The rows are **periods** – each period shows another full shell of electrons.

The periodic table can be used to predict the reactivity of elements.



Alkali Metals

The alkali metals (**group 1 elements**) are soft, very reactive metals. They all have **one electron** in their **outer shell**, making them **very reactive**. They are **low density**. As you go down the group, they become more reactive. They get bigger and it is easier to lose an electron that is further away from the nucleus.

They form ionic compounds with non-metals.

They react with water and produce hydrogen.

E.g.

lithium + water → lithium hydroxide + hydrogen

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

They react with chlorine and produce a metal salt.

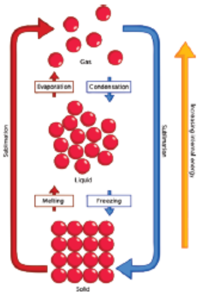
E.g.

lithium + chlorine → lithium chloride

$2Li + Cl_2 \rightarrow 2LiCl$

They react with oxygen to form metal oxides.

AQA GCSE Chemistry (Combined Science) Unit 2: Bonding, Structure and Properties of Matter



The three states of matter are **solid, liquid and gas**.

For a substance to change from one state to another, **energy** must be **transferred**.

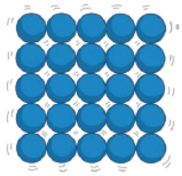
The particles gain energy. This results in the breaking of some of the **attractive forces** between particles during melting.

To evaporate or boil a liquid, more energy is needed to overcome the remaining chemical bonds between the particles.

Note the difference between **boiling** and **evaporation**. When a liquid **evaporates**, particles **leave the surface** of the liquid **only**. When a liquid **boils**, **bubbles** of gas form **throughout** the liquid before rising to the surface and escaping.

The amount of energy needed for a substance to change state is dependent upon the **strength** of the **attractive forces** between particles. The **stronger** the **forces of attraction**, the **more energy** needed to **break them apart**. Substances that have strong attractive forces between particles generally have **higher melting and boiling points**.

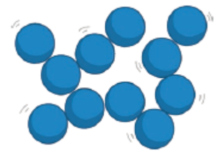
Solid



The particles in a **solid** are arranged in a regular pattern. The particles in a solid **vibrate** in a fixed position and are tightly packed together. The particles in a solid have a **low amount of kinetic energy**.

Solids have a **fixed shape** and are unable to flow like liquids. The particles **cannot be compressed** because the particles are very close together.

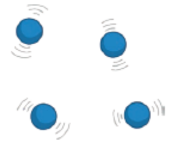
Liquid



The particles in a **liquid** are randomly arranged. The particles in a liquid are able to **move around** each other. The particles in a liquid have a **greater amount** of **kinetic energy** than particles in a **solid**.

Liquids are able to **flow** and can take the shape of the container that they are placed in. As with a solid, liquids **cannot be compressed** because the particles are close together.

Gas



The particles in a **gas** are randomly arranged. The particles in a gas are able to **move around very quickly** in all directions. Of the three states of matter, gas particles have the **highest amount** of **kinetic energy**.

Gases, like liquids, are able to **flow** and can fill the container that they are placed in. The particles in a gas are **far apart** from one another which allows the particles to move in any direction.

Gases can be **compressed**; when squashed, the particles have empty space to move into.

Limitations of the Particle Model (HT only)

The chemical bonds between particles are not represented in the diagrams above.

Particles are represented as solid spheres – this is not the case. Particles like atoms are mostly empty space. Particles are not always spherical in nature.

Identifying the Physical State of a Substance

If the given temperature of a substance is **lower** than the **melting point**, the physical state of the substance will be **solid**.

If the given temperature of the substance is **between** the **melting point and boiling point**, the substance will be a **liquid**.

If the given temperature of the substance is **higher** than the **boiling point**, the substance will be a **gas**.

State Symbols

In chemical equations, the three states of matter are represented as symbols:

solid **(s)**
liquid **(l)**
gas **(g)**
aqueous **(aq)**

Aqueous solutions are those that are formed when a substance is dissolved in water.

AQA GCSE Chemistry (Combined Science) Unit 2: Bonding, Structure and Properties of Matter

Formation of Ions

Ions are charged particle. They can be either positively or negatively charged, for example Na^+ or Cl^-.

When an element loses or gains electrons, it becomes an ion.

Metals **lose** electrons to become **positively charged**.

Non-metals **gain** electrons to become **negatively charged**.

Group 1 and 2 elements **lose** electrons and group 6 and 7 elements **gain** electrons.

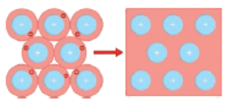
Group	Ions	Element Example
1	+1	$Li \rightarrow Li^+ + e^-$
2	+2	$Ca \rightarrow Ca^{2+} + 2e^-$
6	-2	$Br + e^- \rightarrow Br^-$
7	-1	$O + 2e^- \rightarrow O^{2-}$

Metals and Non-metals

Metals are found on the **left-hand side** of the **periodic table**. Metals are strong, shiny, malleable and good conductors of heat and electricity. On the other hand, non-metals are brittle, dull, not always solids at room temperature and poor conductors of heat and electricity. **Non-metals** are found on the **right-hand side** of the **periodic table**.

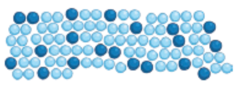
Metallic Bonding

Metallic bonding occurs between **metals only**. Positive metal ions are surrounded by a **sea of delocalised electrons**. The ions are tightly packed and arranged in rows.



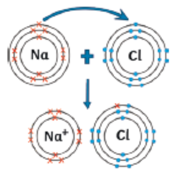
There are strong electrostatic forces of attraction between the positive metal ions and negatively charged electrons.

Pure metals are too soft for many uses and are often mixed with other metals to make alloys. The mixture of the metals introduces different-sized metal atoms. This **distorts the layers** and **prevents them from sliding over one another**. This makes it harder for alloys to be bent and shaped like pure metals.



Ionic Bonding

Ionic bonding occurs between a metal and a non-metal. Metals lose electrons to become positively charged. Opposite charges are attracted by electrostatic forces – an ionic bond.



Ionic Compounds

Ionic compounds form structures called giant lattices. There are **strong electrostatic forces of attraction** that act **in all directions** and act between the **oppositely charged ions** that make up the giant ionic lattice.

Properties of Ionic Compounds

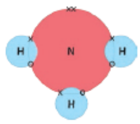
- High melting point – lots of energy needed to overcome the electrostatic forces of attraction.
- High boiling point
- **Cannot conduct electricity** in a solid as the ions are not free to move.
- Ionic compounds, when **molten** or in **solution**, can **conduct electricity** as the ions are free to move and can carry the electrical current.

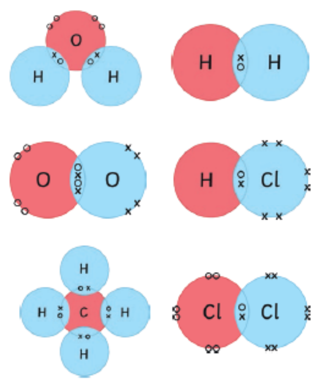
Covalent Bonding

Covalent bonding is the sharing of a pair of electrons between atoms to gain a full outer shell. This occurs between **non-metals only**. Simple covalent bonding occurs between the molecules below. Simple covalent structures have **low melting and boiling points** – this is because the **weak intermolecular forces** that hold the molecules together break when a substance is heated, not the strong covalent bonds between atoms. They **do not conduct electricity** as they do not have any free delocalised electrons.

Dot and cross diagrams are useful to show the **bonding** in **simple molecules**. The **outer electron shell** of each atom is represented as a **circle**, the circles from each atom overlap to show where there is a **covalent bond**, and the electrons from each atom are either drawn as **dots or crosses**. There are **two different types of dot and cross diagram** – one with a circle to represent the outer electron shell and one without.

You should be able to draw the dot and cross diagrams for the following simple covalent structures: chlorine, oxygen, nitrogen, water, ammonia, hydrogen chloride and methane.

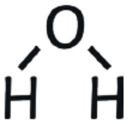




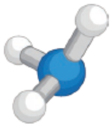
AQA GCSE Chemistry (Combined Science) Unit 2: Bonding, Structure and Properties of Matter

Structural Formulae

In this type of diagram, the element symbol represents the type of atom and the straight line represents the covalent bonding between each atom.



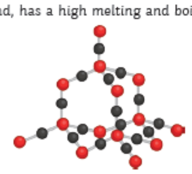
The structure of small molecules can also be represented as a 3D model.



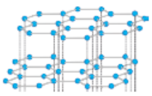
Giant Covalent Structure – Diamond

Each **carbon** atom is **bonded** to **four** other carbon atoms, making diamond very strong. Diamond has a high melting and boiling point. **Large** amounts of **energy** are needed to break the strong covalent bonds between each carbon atom. Diamond **does not conduct** electricity because it has **no free electrons**.

Silicon dioxide (silicon and oxygen atoms) has a similar structure to that of diamond, in that its atoms are held together by **strong covalent bonds**. Large amounts of energy are needed to break the strong covalent bonds therefore silicon dioxide, like diamond, has a high melting and boiling point.

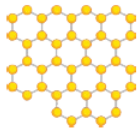


Giant Covalent Structure – Graphite



Graphite is made up of layers of **carbon** arranged in **hexagons**. Each carbon is bonded to **three** other carbons and has **one free delocalised electron** that is able to move between the layers. The layers are held together by weak intermolecular forces. The layers of carbon can slide over each other easily as there are no strong covalent bonds between the layers. Graphite has a high melting point because a lot of energy is needed to break the covalent bonds between the carbon atoms. Graphite can **conduct** electricity.

Giant Covalent Structure – Graphene



Graphene is one layer of graphite. It is very **strong** because of the covalent bonds between the carbon atoms. As with graphite, each carbon in graphene is bonded to three others with one **free delocalised electron**. Graphene is able to **conduct electricity**. Graphene, when added to other materials, can make them even stronger. Useful in electricals and composites.

Nanoscience

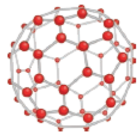
Nanoscience refers to structures that are **1–100nm** in size, of the order of a few hundred atoms. Nanoparticles have a **high surface area to volume ratio**. This means that smaller amounts are needed in comparison to normal sized particles. As the side length of a cube decreases by a factor of 10, the surface area to volume ratio increases approximately

Name of Particle	Diameter
nanoparticle	1–100nm
fine particles ($PM_{2.5}$)	100–2500nm
coarse particles (PM_{10})	2500–10000nm

Polymers

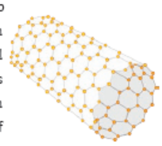
Polymers are long chain molecules that are made up of many smaller units called **monomers**. Atoms in a polymer chain are held together by **strong covalent bonds**. Between polymer molecules, there are **intermolecular forces**. Intermolecular forces **attract** polymer chains towards each other. Longer polymer chains have stronger forces of attraction than shorter ones therefore making stronger materials.

Fullerenes and Nanotubes



Molecules of carbon that are shaped like hollow tubes or balls, arranged in hexagons of five or seven carbon atoms. They can be used to **deliver drugs into the body**.

Buckminsterfullerene has the formula C_{60}



Carbon Nanotubes are tiny carbon cylinders that are very long compared to their width. Nanotubes can conduct electricity as well as strengthening materials without adding much weight. The properties of carbon nanotubes make them useful in electronics and nanotechnology.

Possible Risks of Nanoparticles

As nanoparticles are so **small**, it makes it possible for them to be inhaled and enter the lungs. Once inside the body, nanoparticles may **initiate harmful reactions** and toxic substances could bind to them because of their large surface area to volume ratio. Nanoparticles have many applications. These include medicine, cosmetics, sun creams and deodorants. They can also be used as catalysts.

Modern nanoparticles are a relatively new phenomenon therefore it is difficult for scientists to truly determine the risks associated with them.

AQA GCSE Chemistry (Combined Science) Unit 5.3: Quantitative Chemistry Knowledge Organiser - Foundation

Conservation of Mass

No atoms can be created or made during a chemical reaction, so the mass of the reactants will equal the mass of the product.

Reactions can be shown as a word or symbol equation.

magnesium + oxygen → magnesium oxide

Mg + O → MgO

Symbol equations should also be balanced; they should have the same number of atoms on each side.

$2Mg + O_2 \rightarrow 2MgO$

Relative Formula Mass

The relative formulas mass is the sum of all the relative atomic masses of the atoms in the formula.

Examples:

HCl

A_r of H = 1

A_r of Cl = 35.5

1 + 35.5 = 36.5

H_2SO_4

A_r of H = 1

A_r of S = 32

A_r of O = 16

(1 × 2) + 32 + (16 × 4)

2 + 32 + 64 = 98

Calculating Percentage Mass of an Element in a Compound

percentage mass of an element in a compound =

$$A_r \times \frac{\text{number of atoms of that element}}{M_r \text{ of the compound}}$$

Find the percentage mass of magnesium in magnesium oxide.

A_r of magnesium = 24 A_r of oxygen = 16

M_r of MgO = 24 + 16

= 40

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

During a reaction the mass can change. If one of the reactants is a gas, the mass can go up.

E.g.

magnesium + oxygen → magnesium oxide

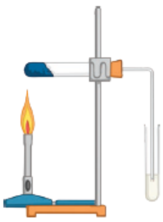
Oxygen from the air is added to the magnesium (making the product) which will be heavier in mass.

If one of the products is a gas, the mass can go down.

E.g.

sodium carbonate → sodium oxide + carbon dioxide

When sodium carbonate is thermally decomposed, carbon dioxide gas is produced and released into the atmosphere.



Concentration of Solutions

Concentration is the amount of a substance in a specific volume of a solution. The more substance that is dissolved, then the more concentrated the solution is.

It is possible to calculate the concentration of a solution with the following equation:

concentration (g/dm^3) = mass (g) ÷ volume of solvent (dm^3)

The equation can be rearranged to find the mass of the dissolved substance:

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

Conservation of Mass

Show that mass is conserved in a reaction.

$2Mg + O_2 \rightarrow 2MgO$

(2 × 24) + (2 × 16) → 2(24 + 16)

48 + 32 → 2 × 40

80 → 80

Total M_r on the left-hand side of the equation is the same as the M_r on the right-hand side.

Calculate the mass of the product.

8g of magnesium reacts with 6g of oxygen:

8 + 6 = 14g of magnesium oxide

Conservation of Mass

No atoms can be created or made during a chemical reaction, so the mass of the reactants will equal the mass of the product.

Reactions can be shown as a word or symbol equation.

magnesium + oxygen → magnesium oxide

Mg + O → MgO

Symbol equations should also be balanced; they should have the same number of atoms on each side.

$2Mg + O_2 \rightarrow 2MgO$

Relative Formula Mass

The relative formula mass (M_r) is the sum of all the relative atomic masses (A_r) of the atoms in the formula.

Examples:

HCl

A_r of H = 1

A_r of Cl = 35.5

M_r of HCl = 1 + 35.5 = 36.5

H_2SO_4

A_r of H = 1

A_r of S = 32

A_r of O = 16

M_r of H_2SO_4 = (1 × 2) + 32 + (16 × 4)

M_r of H_2SO_4 = 2 + 32 + 64

M_r of H_2SO_4 = 98

Calculating Percentage Mass of an Element in a Compound

percentage mass of an element in a compound =

$$A_r \times \frac{\text{number of atoms of that element}}{M_r \text{ of the compound}}$$

Find the percentage mass of oxygen in magnesium oxide.

A_r of magnesium = 24 A_r of oxygen = 16

M_r of MgO = 24 + 16

= 40

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

During a reaction the mass can change. If one of the reactants is a gas, the mass can go up.

E.g.

magnesium + oxygen → magnesium oxide

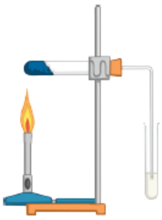
Oxygen from the air is added to the magnesium (making the product) which will be heavier in mass.

If one of the products is a gas, the mass can go down.

E.g.

sodium carbonate → sodium oxide + carbon dioxide

When sodium carbonate is thermally decomposed, carbon dioxide gas is produced and released into the atmosphere.



Concentration of Solutions

Concentration is the amount of a substance in a specific volume of a solution. The more substance that is dissolved, then the more concentrated the solution is.

It is possible to calculate the concentration of a solution with the following equation:

concentration (g/dm^3) = mass (g) ÷ volume of solvent (dm^3)

The equation can be rearranged to find the mass of the dissolved substance:

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

Conservation of Mass

Show that mass is conserved in a reaction.

$2Mg + O_2 \rightarrow 2MgO$

(2 × 24) + (2 × 16) → 2(24 + 16)

48 + 32 → 2 × 40

80 → 80

Total M_r on the left-hand side of the equation is the same as the M_r on the right-hand side.

Calculate the mass of the product.

6g of magnesium reacts with 4g of oxygen:

6 + 4 = 10g of magnesium oxide

The Mole

The Avogadro constant, 6.02×10^{23}, is the number of molecules of a substance that make up one mole of that substance.

Iron has an A_r of 56, so 1 mole of iron has a mass of 56g.

Oxygen (O_2) gas has an M_r of 32, so 1 mole of oxygen has a mass of 32g.

Ammonia (NH_3) has an M_r of 17, so 1 mole of ammonia has a mass of 17g.

$$\text{number of moles} = \frac{\text{mass in g (of an element or compound)}}{M_r \text{ (of the element or compound)}}$$

Moles and Equations

Write a balanced symbol equation for the reaction in which 5.6g of iron reacts with 10.65g of chlorine to form iron chloride.

Work out the M_r of all the substances.

A_r of Fe = 56 and A_r of Cl = 35.5

Divide the mass of each substance by its M_r to calculate how many moles of each substance reacted or produced.

moles Fe = 5.6/56 = 0.1

moles Cl = 10.65/35.5 = 0.3

Divide by the smallest number of moles

$Fe = \frac{0.1}{0.1} = 1 \qquad Cl = \frac{0.3}{0.1} = 3$

Write down the balanced symbol equation.

Fe + 3Cl

Chlorine exists as Cl_2 so the whole thing must be multiplied by 2.

$2Fe + 3Cl_2 \rightarrow 2FeCl_3$

Limiting Reactions

If one reactant gets used up in a reaction before the other, then the reaction will stop. The reactant that has been used up is limiting.

If you halve the amount of reactant then the amount of product will also be halved.

AQA GCSE Chemistry (Combined Science) Unit 4: Chemical Changes Knowledge Organiser

The Reactivity Series

Here's a mnemonic to help you learn the order:

purple (potassium)
slime (sodium)
can (calcium)
make (magnesium)
a (aluminium)
careless (carbon)
zebra (zinc)
insane (iron)
try (tin)
learning (lead)
how (hydrogen)
camels (copper)
surprise (silver)
gorillas (gold)

potassium
sodium
calcium
magnesium
aluminium
carbon →
zinc
iron
tin
lead
hydrogen →
copper
silver
gold
platinum

The reactivity series is a league table for metals. The more reactive metals are near the top of the table with the least reactive near the bottom. In chemical reactions, a more reactive metal will displace a less reactive metal.

Reactions of Metals with Water

Metals, when reacted with water, produce a metal hydroxide and hydrogen.

lithium + water → lithium hydroxide + hydrogen

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

The more reactive a metal is, the faster the reaction.

Reactions of Metals with Dilute Acid

Metals, when reacted with acids, produce a salt and hydrogen.

Sodium + hydrochloric acid → sodium chloride + hydrogen

$2Na + 2HCl \rightarrow 2NaCl + H_2$

Metals that are below hydrogen in the reactivity series **do not** react with dilute acids.

Reactions of Acids

The general formula for the reaction between an acid and a metal is: acid + metal → salt + hydrogen

For example: hydrochloric acid + sodium → sodium chloride + hydrogen

$2HCl + 2Na \rightarrow 2NaCl + H_2$

When an acid reacts with an alkali, a neutralisation reaction takes place and a salt and water are produced.

The general formula for this kind of reaction is as follows:

acid + alkali → salt + water

hydrochloric acid + sodium hydroxide → sodium chloride + water

$HCl + NaOH \rightarrow NaCl + H_2O$

Naming Salts

The first part comes from the metal in the metal carbonate, oxide or hydroxide. The second part of the name comes from the acid that was used to make it.

Acid Used	Salt Produced
hydrochloric	chloride
nitric	nitrate
sulfuric	sulfate

For example, sodium chloride.

Redox Reactions (Higher Tier Only)

When metals react with acids, they undergo a redox reaction. A **redox reaction** occurs when both **oxidation** and **reduction** take place at the **same time**.

For example:

$2H^+ + Ca \rightarrow Ca^{2+} + H_2$

The ionic equation can be further split into two half equations.

$Ca \rightarrow Ca^{2+} + 2e^-$

Oxidation is loss of electrons.

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

Reduction is gaining of electrons.

Reactions with Bases

The general formula for the reaction between an acid and a metal oxide is: acid + metal oxide → salt + water

sulfuric acid + copper oxide → copper sulfate + water

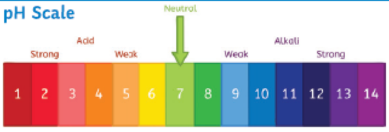
$H_2SO_4 + CuO \rightarrow CuSO_4 + H_2O$

Reactions with Carbonates

The general formula for the reaction between an acid and a carbonate is: acid + carbonate → salt + water + carbon dioxide

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

pH Scale



In aqueous solutions, acids produce H^+ ions and alkalis produce OH^- ions.

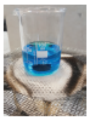
Neutral solutions are pH7 and are neither acids or alkalis.

For example, in neutralisation reactions, hydrogen ions from an acid react with hydroxide ions from an alkali to produce water:

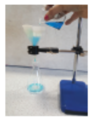
$H^+ + OH^- \rightarrow H_2O$

Making Soluble Salts

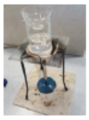
1. Make a saturated solution by stirring copper oxide into the sulfuric acid until no more will dissolve.



2. Filter the solution to remove the excess copper oxide solid.



3. Half fill a beaker with water and set this over a Bunsen burner to heat the water. Place an evaporating dish on top of the beaker.



4. Add some of the solution to the evaporating basin and heat until crystals begin to form.

5. Once cooled, pour the remaining liquid into a crystallising dish and leave to cool for 24 hours.

6. Remove the crystals with a spatula and pat dry between paper towels.

AQA GCSE Chemistry (Combined Science) Unit 4: Chemical Changes Knowledge Organiser

Strong and Weak Acids (Higher Tier Only)

A **strong** acid **completely dissociates** in a solution. For example: $HCl \rightarrow H^+ + Cl^-$

Hydrochloric acid is able to completely dissociate in solution to form hydrogen and chloride ions.

Examples of strong acids include nitric acid (HNO_3) and sulfuric acid (H_2SO_4).

Weak acids in comparison only partially dissociate.

For example acetic acid **partially dissociates** to form a hydrogen and acetate ion.

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

The **double arrow** symbol indicates that the reaction is **reversible**. Both the forward and reverse reaction occur at the same time and the reaction never goes to completion.

The Process of Electrolysis

Electrolysis is the **splitting up** of an ionic substance using **electricity.**

On setting up an electrical circuit for electrolysis, two **electrodes** are required to be placed in the electrolyte. The electrodes are **conducting rods**. One of the rods is connected to the **positive** terminal and the other to the **negative** terminal.

The **electrodes** are **inert** (this means they do not react in the reaction) and are often made from **graphite** or platinum.

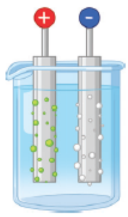
During the process of electrolysis, **opposites attract.** The positively charged ions will be attracted toward the negative electrode. The negatively charged ions will be attracted towards the positive electrode.

When ions reach the electrodes, the charges are lost and they become elements.

The **positive** electrode is called the **anode.**

The **negative** electrode is called the **cathode.**

Electrolysis of Aqueous Solutions



Gases may be given off or metals deposited at the electrodes. This is dependent on the reactivity of the elements involved.

If the metal is **more reactive** than **hydrogen** in the reactivity series, then **hydrogen** will be **produced** at the **negative cathode.** At the **positive anode,** negatively charged ions **lose** electrons. This is called **oxidation** and you say that the ions have been oxidised.

Using Electrolysis to Extract Metals

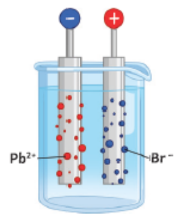
Metals are extracted by electrolysis if the metal in question reacts with carbon or if it is too reactive to be extracted by reduction with carbon. During the extraction process, large quantities of energy are used to melt the compounds.

Aluminium is manufactured by the process of electrolysis. Aluminium oxide has a high melting point and melting it would use large amounts of energy. This would increase the cost of the process, therefore molten **cryolite** is added to aluminium oxide to lower the melting point and thus reduce the cost.

Electrolysis of Molten Ionic Compounds – Lead Bromide

Lead bromide is an **ionic** substance. Ionic substances, when solid, are **not** able to conduct electricity. When molten or in solution, the ions are free to move and are able to carry a charge.

The **positive** lead ions are attracted toward the **negative cathode** at the same time as the **negative bromide** ions are attracted toward the **positive anode.**



Oxidation is the loss of electrons and reduction is the gaining of electrons. **OIL RIG** (Higher Tier Only).

We represent what is happening at the electrodes by using **half equations** (Higher Tier Only).

The lead ions are attracted towards the negative electrode. When the **lead ions** (Pb^{2+}) reach the cathode, each ion **gains two electrons** and becomes a neutral atom. We say that the lead ions have been **reduced.**

$Pb^{2+} + 2e^- \rightarrow Pb$

The bromide ions are attracted towards the positive electrode. When the **bromide ions** (Br-) reach the anode, each ion **loses one electron** to become a neutral atom. Two bromine atoms are then able to bond together to form the covalent molecule Br_2.

$2Br^- \rightarrow Br_2 + 2e^-$

AQA GCSE Chemistry (Combined) Unit 5 Energy Changes Knowledge Organiser

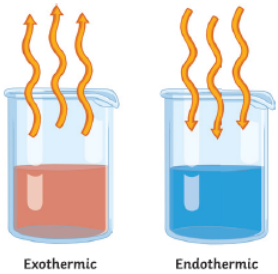
Exothermic and Endothermic Reactions

When a chemical reaction takes place, **energy** is involved. Energy is transferred when chemical **bonds are broken** and when new **bonds are made.**

Exothermic reactions are those which involve the transfer of energy **from the reacting chemicals to** the surroundings. During a practical investigation, an exothermic reaction would show an **increase in temperature** as the reaction takes place.

Examples of exothermic reactions include **combustion, respiration and neutralisation** reactions. Hand-warmers and self-heating cans are examples of everyday exothermic reactions.

Endothermic reactions are those which involve the transfer of energy **from the surroundings to** the reacting chemicals. During a practical investigation, an endothermic reaction would show a **decrease in temperature** as the reaction takes place.



Examples of endothermic reactions include the **thermal decomposition** of calcium carbonate.

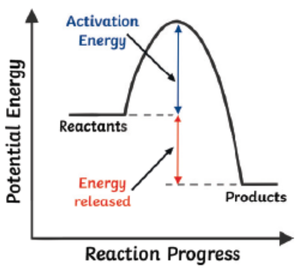
Eating **sherbet** is an everyday example of an endothermic reaction. When the sherbet dissolves in the saliva in your mouth, it produces a cooling effect. Another example is **instant ice packs** that are used to treat sporting injuries.

Reaction Profiles – Exothermic

Energy level diagrams show us what is happening in a particular chemical reaction. The diagram shows us the **difference in energy** between the reactants and the products.

In an exothermic reaction, the **reactants** are at a **higher** energy level than the products.

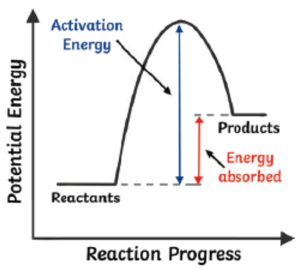
In an **exothermic** reaction, the difference in energy is **released** to the surroundings and so the **temperature** of the surroundings **increases**.



Reaction Profiles – Endothermic

In an **endothermic** reaction, the **reactants** are at a **lower** energy level than the products.

In an **endothermic** reaction, the difference in energy is **absorbed** from the surroundings and so the **temperature** of the surroundings **decreases**.



Activation Energy – the minimum amount of energy required for a chemical reaction to take place.

Catalysts – increase the rate of a reaction. Catalysts provide an alternative pathway for a chemical reaction to take place by **lowering** the activation energy.

Bond Making and Bond Breaking

In an **endothermic** reaction, energy is needed to break chemical bonds. The **energy change (ΔH)** in an endothermic reaction is **positive.**

You may also find, in some textbooks, **ΔH** referred to as the **enthalpy change.**

In an **exothermic** reaction, energy is needed to form chemical bonds. The **energy change (ΔH)** in an exothermic reaction is **negative.**

Bond energies are measured in **kJ/mol.**

AQA GCSE Chemistry (Combined) Unit 5 Energy Changes Knowledge Organiser

Calculations Using Bond Energies (Higher Tier Only)

Bond energies are used to calculate the change in energy of a chemical reaction.

Calculate the change in energy for the reaction: $2H_2O_2 \longrightarrow 2H_2O + O_2$

The first step is to write the symbol equation for the reaction. Once you have done this, work out the bonds that are breaking and the ones that are being made.

2H–O–O–H ⟶ 2H–O–H + O=O

Bond	Bond Energy kJ/mol
H-O	464
O-O	146
O=O	498

On the **left-hand side** of the equation, the **bonds are breaking.**

There are two **O–H** bonds and one **O–O** bond.

So 464 + 146 + 464 = 1074

There are two moles of H_2O_2 therefore the answer needs to be multiplied by two.

So 1074 × 2 = 2148

On the **right-hand** side of the equation, the **bonds are made.**

There are two **H–O** bonds

So 464 + 464 = 928

Two moles of H_2O are made therefore the answer needs to be multiplied by two.

So 928 × 2 = 1856

There is also one **O=O** bond with a bond energy of 498

So 1856 + 498 = 2354

ΔH = sum (bonds broken) – sum (bonds made)

ΔH = 2148 – 2354 = -206 kJ/mol

The reaction is exothermic as ΔH is negative.

Required Practical

Aim

To investigate the variables that affect temperature changes in reacting solutions, e.g. acid plus metals, acid plus carbonates, neutralisations and displacement of metals.

Equipment

- polystyrene cup
- measuring cylinder
- thermometer
- 250cm^3 glass beaker
- measuring cylinder
- top pan balance

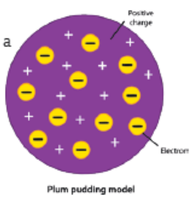
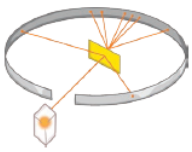
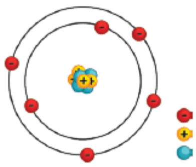
Method

1. Gather the equipment.
2. Place the polystyrene cup inside the beaker. This will prevent the cup from falling over.
3. Using a measuring cylinder, measure out 30cm^3 of the acid. Different acids such as hydrochloric or sulfuric acid may be used. Pour this into the polystyrene cup.
4. Record the temperature of the acid using a thermometer.
5. Using a top pan balance, measure out an appropriate amount of the solid (for example, 10g) or use one strip of a metal such as magnesium.
6. Add the solid to the acid and record the temperature. You may choose to record the temperature of the acid and metal every minute for 10 minutes.

Science – Physics

Atomic Structure Knowledge Organiser – Foundation and Higher

Developing the Model of the Atom

Scientist	Time	Contribution
John Dalton	Start of 19th century	Atoms were first described as solid spheres.
JJ Thomson	1897	Thomson suggested the plum pudding model – the atom is a ball of charge with electrons scattered within it. 
Ernest Rutherford	1909	Alpha Scattering experiment – Rutherford discovered that the mass is concentrated at the centre and the nucleus is charged. Most of the mass is in the nucleus. Most atoms are empty space. 
Niels Bohr	Around 1911	Bohr theorised that the electrons were in shells orbiting the nucleus. 
James Chadwick	Around 1940	Chadwick discovered neutrons in the nucleus.

Isotopes

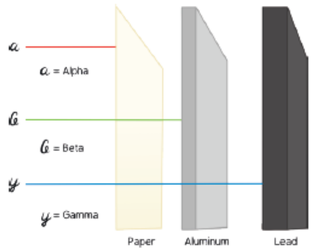
An isotope is an element with the same number of protons but a different number of neutrons. They have the same atomic number, but different mass numbers.

Isotope	Protons	Electrons	Neutrons
^1_1H	1	1	0
^2_1H	1	1	1
^3_1H	1	1	2

Some isotopes are unstable and, as a result, decay and give out radiation. Ionising radiation is radiation that can knock electrons off atoms. Just how ionising this radiation is, depends on how readily it can do that.

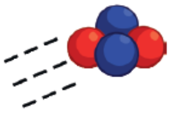
Beta

Beta radiation is a fast moving electron that can be stopped by a piece of aluminium. Beta radiation is emitted by an atom when a neutron splits into a proton and an electron.



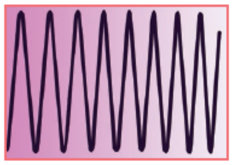
Alpha

Alpha radiation is an alpha particle emitted from the nucleus of a radioactive nuclei. It is made from two protons and two neutrons. They can't travel too far in the air and are the least penetrating – stopped by skin and paper. However, they are highly ionising because of their size.



Gamma

A gamma wave is a wave of radiation and is the most penetrating – stopped by thick lead and concrete.



Atomic Structure Knowledge Organiser – Foundation and Higher

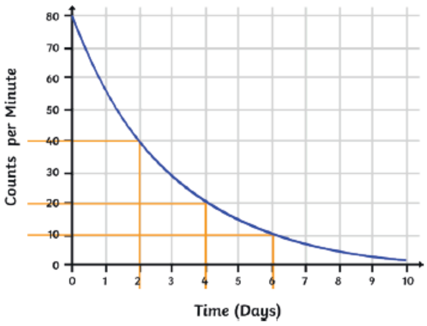
Half-life

The half-life is the time taken for the number of radioactive nuclei in an isotope to halve.

Radioactivity is a random process – you will not know which nuclei will decay. Radioactive decay is measured in becquerels Bq. 1 Bq is one decay per second.

Radioactive substances give out radiation from their nucleus.

A graph of half-life can be used to calculate the half-life of a material and will always have this shape:



Judging from the graph, the radioactive material has a half-life of two days.

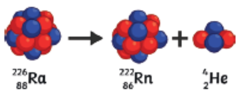
Irradiation

Irradiation occurs when materials are near a radioactive source. The source is sometimes placed inside a lead-lined box to avoid this.

People who work with radioactive sources will sometimes stand behind a lead barrier, be in a different room or use a remote-controlled arm when handling radioactive substances.

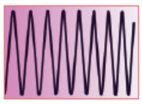
Alpha Decay Equations

An alpha particle is made of two protons and two neutrons. The atomic number goes down by two and its mass number decreases by four.



Gamma rays

There is no change to the nucleus when a radioactive source emits gamma radiation. It is the nucleus getting rid of excess energy.



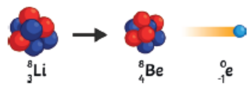
Contamination

When unwanted radioactive atoms get onto an object, it is possible for the radioactive particles to get inside the body.

Protective clothing should be worn when handling radioactive material.

Beta Decay Equations

A neutron turns into a proton and releases a an electron. The mass of the nucleus does not change but the number of protons increases.



Alpha radiation is more dangerous inside the body. It is highly ionising and able to cause a lot of damage. Outside the body it is less dangerous because it cannot penetrate the skin.

Beta radiation is less dangerous inside the body as some of the radiation is able to escape. Outside the body it is more dangerous as it can penetrate the skin.

Gamma radiation is the least dangerous inside the body as most will pass out and it is the least ionising. Gamma is more dangerous outside the body as it can penetrate the skin.

Energy Stores and Systems

Energy Stores	
kinetic	Moving objects have kinetic energy.
thermal	All objects have thermal energy.
chemical	Anything that can release energy during a chemical reaction.
elastic potential	Things that are stretched.
gravitational potential	Anything that is raised.
electrostatic	Charges that attract or repel.
magnetic	Magnets that attract or repel.
nuclear	The nucleus of an atom releases energy.

Energy can be transferred in the following ways:

mechanically - when work is done;

electrically - when moving charge does work;

heating - when energy is transferred from a hotter object to a colder object.

Conservation of Energy

Energy can never be created or destroyed, just transferred from one form to another. Some energy is transferred usefully and some energy gets transferred into the environment. This is mostly wasted energy.

Insulation - reduces the amount of heat lost. In your home, you can prevent heat loss in a number of ways:

- thick walls;
- thermal insulation, such as:
- loft insulation (reducing convection);
- cavity walls (reduces conduction and convection);
- double glazing (reduces conduction).

Power

Power is the rate of transfer of energy - the amount of work done in a given time.

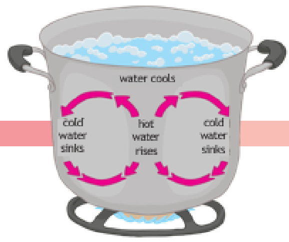
power = energy transferred ÷ time

Energy Transfer

Lubrication reduces the amount of friction. When an object moves, there are frictional forces acting. Some energy is lost into the environment. Lubricants, such as oil, can be used to reduce the friction between the surfaces.

Conduction - when a solid is heated, the particles vibrate and collide more, and the energy is transferred.

Convection - when a liquid or a gas is heated, the particles move faster. This means the liquid or gas becomes less dense. The denser region will rise above the cooler region. This is a convection current.



Required Practical

Investigating Specific Heat Capacity

Method:

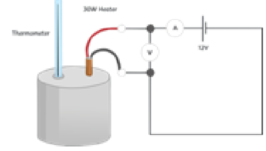
1. Using the **balance**, measure and record the **mass** of the copper block in kg.
2. Wrap the insulation around the block, to reduce energy loss to surroundings.
3. Put the heater into the large hole in the block and the block onto the heatproof mat.
4. Connect the **joulemeter** to measure the total **energy** transferred by the heater to the block.
5. Using the pipette, put a drop of water into the small hole.
6. Put the thermometer into the small hole and measure the temperature.
7. Switch the power pack to 12V and turn it on.
8. Record the **temperature change** after 10 minutes using the **thermometer**.
9. Record the results in the table.
10. Use the equation:

$$\Delta E = m \times c \times \Delta\theta$$

(J) (kg) (J/kg°C) (°C)

To calculate the SHC of the block.

Specific heat capacity (SHC) is the amount of energy needed to raise the temperature of 1kg of a material by 1°C.



Efficiency

When energy is transferred, some energy is wasted. The less energy that is wasted during the transfer, the more efficient the transfer.

There are two equations to calculate efficiency:

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

Some energy is always wasted. Nothing is 100% efficient.

Efficiency

Non-renewable - coal, oil, gas - they will all run out, they damage the environment, but provide most of the energy.

Renewable - they will never run out, can be unreliable and do not provide as much energy.

solar - using sunlight	Renewable, no pollution, in sunny countries it is very reliable.	Lots of energy needed to build, only works during the day, cannot increase power if needed.
geothermal - using the energy of hot rocks	Renewable and reliable as the rocks are always hot. Power stations have a small impact on environment.	May release some greenhouse gases and only found in specific places.
wind - using turbines	Renewable, no pollution, no lasting damage to the environment, minimal running cost.	Not as reliable, do not work when there is no wind, cannot increase supply if needed.
hydroelectric - uses a dam	Renewable, no pollution, can increase supply if needed.	A big impact on the environment. Animals and plants may lose their habitats.
wave power - wave powered turbines	Renewable, no pollution.	Disturbs the seabed and habitats of animals. Unreliable.
tidal barrages - big dams across rivers	Renewable, very reliable, no pollution.	Changes the habitats of wildlife, fish can be killed in the turbines.
biofuels	Renewable, reliable, carbon neutral.	High costs, growing biofuels may cause a problem with regards to space, clearance of natural forests.
non-renewable - fossil fuels	Reliable, enough to meet current demand, can produce more energy when there is more demand.	Running out, release CO_2, leading to global warming, and also release SO_2 which causes acid rain.

Trends in energy resources - most of our electricity is generated by burning fossil fuels and nuclear. The UK is trying to increase the amount of renewable energy resources. The governments are aware that non-renewable energy resources are running out; targets of renewable resources have been set. Electric and hybrid cars are also now on the market.

However, changing the fuels we use and building renewable power plants cost money. Many people are against the building of the plants near them and do not want to pay the extra in their energy bills. Hybrid and electric cars are also quite expensive.

AQA Combined Science: **Physics Topic 2 Electricity – Foundation and Higher**

Required Practical

Investigating Resistance in a Wire

Independent variable: length of the wire.

Dependent variable: resistance.

Control variables: type of metal, diameter of the wire.

Conclusion: As the length of the wire increases, the resistance of the wire also increases.

Investigating Series and Parallel Circuits with Resistors

Independent variable: circuit type (series, parallel).

Dependent variable: resistance.

Control variables: number of resistors, type of power source.

Conclusion: Adding resistors in series increases the total resistance of the circuit. In a parallel circuit, the more resistors you add, the smaller the resistance.

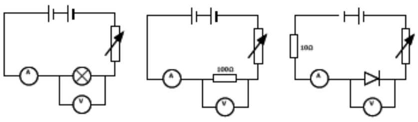
Investigating I-V Relationships in Circuits (Using a filament bulb, ohmic conductor, diode.)

Independent variable: potential difference/volts (V).

Dependent variable: current (A).

Control variable: number of components (e.g. 1 filament bulb, 1 resistor), type of power source.

Set up the circuits as shown below and measure the current and the potential difference.



Draw graphs of the results once collected.

Equations and Maths

Equations

Charge:	$Q = It$
Potential difference:	$V = IR$
Energy transferred:	$E = Pt$
Energy transferred:	$E = QV$
Power:	$P = VI$
Power:	$P = I^2R$

Maths

1kW = 1000W

0.5kW = 500W

Charge

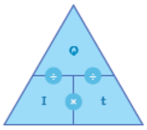
Electric current is the flow of electric charge. It only flows when the circuit is complete.

The **charge** is the current flowing past a point in a given time. Charge is measured in **coulombs (C)**.

Calculating Charge

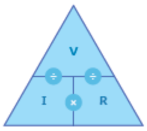
charge flow (C) = current (A) × time (s)

$Q = It$



potential difference = current x resistance

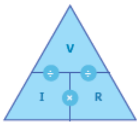
V (V) = I (A) × R (Ω)



Resistance

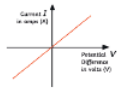
voltage (V) = current (A) × resistance (Ω)

V = IR



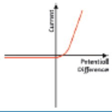
Graphs of I-V Characteristics for Components in a Circuit

1. **Ohmic conductor**: the current is directly proportional to the potential difference - it is a straight line (at a constant temperature).



2. **Filament lamp**: as the current increases, so does the temperature. This makes it harder for the current to flow. The graph becomes less steep.

3. **Diode**: current only flows in one direction. The resistance is very high in the other direction which means no current can flow.

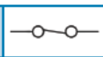
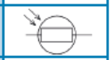
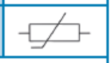
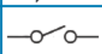
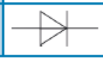


Current and Circuit Symbols

Current: the flow of electrical charge.

Potential difference (voltage): the push of electrical charge.

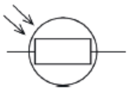
Resistance: slows down the flow of electricity.

cell		closed switch		fuse	
resistor		ammeter		LDR	
battery		voltmeter		LED	
variable resistor		bulb		thermistor	
open switch		diode			

AQA Combined Science: **Physics Topic 2 Electricity – Foundation and Higher**

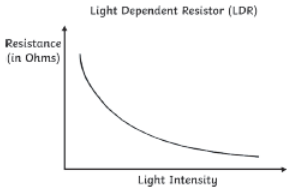
Circuit Devices

LDR – Light Dependent Resistor



An LDR is dependent on light intensity. In bright light the resistance falls and at night the resistance is higher.

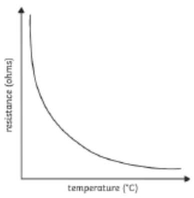
Uses of LDRs: outdoor night lights, burglar detectors.



Thermistor

A thermistor is a temperature dependent resistor. If it is hot, then the resistance is less. If it becomes cold, then the resistance increases.

Uses of thermistors: temperature detectors.



Series and Parallel Circuits

Series Circuits

Once one of the components is broken then all the components will stop working.

Potential difference – the total p.d. of the supply is shared between all the components.

$V_{total} = V_1 + V_2$

Current – wherever the ammeter is placed in a series circuit the reading is the same.

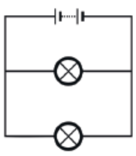
$I_1 = I_2 = I_3$

Resistance – In a series circuit, the resistance will add up to make the total resistance.

$R_{total} = R_1 + R_2$

Parallel Circuits

They are much more common - if one component stops working, it will not affect the others. This means they are more useful.



Potential Difference – this is the same for all components.

$V_1 = V_2$

Current – the total current is the total of all the currents through all the components.

$I_{total} = I_1 + I_2 + I_3$

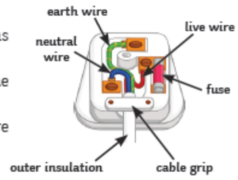
Resistance – adding resistance reduces the total resistance.

Electricity in the Home

AC – alternating current. Constantly changing direction - UK mains supply is 230V and has a frequency of 50 hertz (Hz).

DC – direct current. Supplied by batteries and only flows in one direction.

Cables – most have three wires: live, neutral and earth. They are covered in plastic insulation for safety.



Live wire – provides the potential difference from the mains.

Neutral wire – completes the circuit.

Earth wire – protection. Stops the appliance from becoming live. Carries a current if there is a fault.

Touching the live wire can cause the current to flow through your body. This causes an electric shock.

Energy Transferred – this depends on how long the appliance is on for and its power.

energy transferred (J) = power (W) × time (s) $E = Pt$

Energy is transferred around a circuit when the charge moves.

energy transferred (J) = charge flow (C) × potential difference (V) $E = QV$

power (W) = potential difference (V) × current (A) $P = VI$

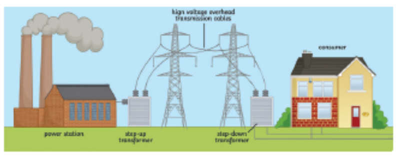
power (W) = current² (A) × resistance (Ω) $P = I^2R$

The National Grid

The National Grid is a system of cables and transformers. They transfer electrical power from the power station to where it is needed. Power stations are able to change the amount of electricity that is produced to meet the demands. For example, more energy may be needed in the evenings when people come home from work or school. Electricity is transferred at a low current, but a high voltage so less energy is being lost as it travels through the cables.

Step-up transformers – increase the voltage as the electricity flows through the cables.

Step-down transformers – decrease the potential difference to make it safe.



AQA Combined Science: **Physics Topic 3 Particle Model of Matter**

Required Practical

Measuring the density of a regularly shaped object:

- Measure the mass using a balance.
- Measure the length, width and height using a ruler.
- Calculate the volume.
- Use the density ($\rho = m/V$) equation to calculate density.

Measuring the density of an irregularly-shaped object:

- Measure the mass using a balance.
- Fill a eureka can with water.
- Place the object in the water - the water displaced by the object will transfer into a measuring cylinder.
- Measure the volume of the water. This equals the volume of the object.
- Use the density ($\rho = m/V$) equation to calculate density.

Density

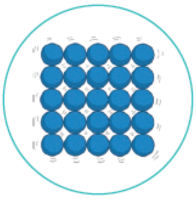
Density is a measure of how much mass there is in a given space.

Density (kg/m^3) = mass (kg) ÷ volume (m^3)

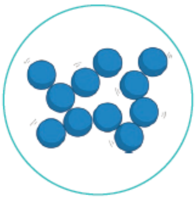
A more dense material will have more particles in the same volume when compared to a less dense material.

Particles

Solids have strong forces of attraction. They are held together very closely in a fixed, regular arrangement. The particles do not have much energy and can only vibrate.



Liquids have weaker forces of attraction. They are close together, but can move past each other. They form irregular arrangements. They have more energy than particles in a solid.

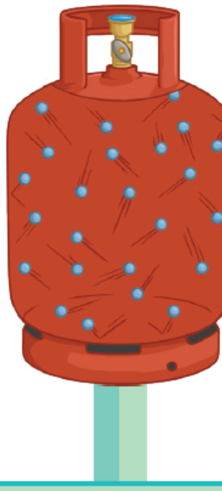


Gases have almost no forces of attraction between the particles. They have the most energy and are free to move in random directions.

Particles

Gas particles can move around freely and will collide with other particles and the walls of the container. This is the pressure of the gas.

If the temperature of the gas increases, then the pressure will also increase. The hotter the temperature, the more kinetic energy the gas particles have. They move faster, colliding with the sides of the container more often.



Density

The density of an object is $8050 kg/m^3$ and it has a volume of $3.4 m^3$ - what is its mass in kg?

8050 = mass ÷ 3.4

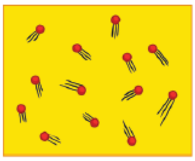
8050 × 3.4 = mass

27 370kg

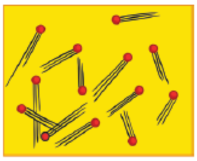
AQA Combined Science: **Physics Topic 3 Particle Model of Matter**

Internal Energy

Particles within a system have kinetic energy when they vibrate or move around. The particles also have a potential energy store. The total internal energy of a system is the kinetic and potential energy stores.



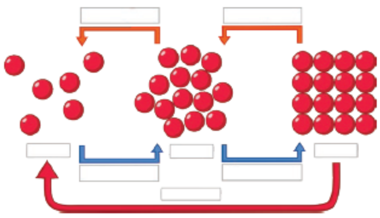
Low Temperature



High Temperature

If the system is heated, the particles will gain more kinetic energy, so increasing the internal energy.

Changing State

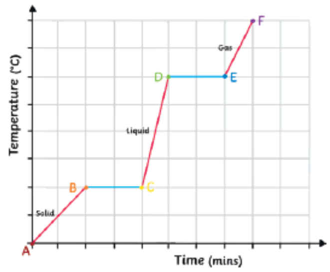


If a system gains more energy, it can lead to a change in temperature or change in state. If the system is heated enough, then there will be enough energy to break bonds.

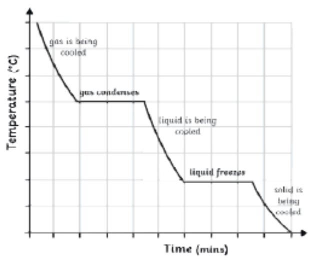
When something changes state, there is no chemical change, only physical. No new substance is formed. The substance will change back to its original form. The number of particles does not change and mass is conserved.

Specific Latent Heat

Energy is being put in during melting and boiling. This increases the amount of internal energy. The energy is being used to break the bonds, so the temperature does not increase. This is shown by the parts of the graph that are flat.



When a substance is condensing or freezing, the energy put in is used to form the bonds. This releases energy. The internal energy decreases, but the temperature does not go down.



The energy needed to change the state of a substance is called the 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.

- solid ⟶ liquid - specific latent heat of **fusion**
- liquid ⟶ gas - specific latent heat of **vaporisation**

Specific Latent Heat Equation

The amount of energy needed/released when a substance of mass changes state.

energy (E) = mass (m) × specific latent heat (L)

$E = mL$

RE

What are the origins of the universe?

Key ideas	Essential knowledge	Sources of Authority
1 Catholic beliefs about the origin of the universe	• God is an omnipotent and transcendent Creator. • beliefs based on the book of Genesis & the teachings of St Augustine (ex nihilo) • creation stories are not meant to be taken literally. • stories of creation are symbolic & reveal important truths about humans, the world & God • Catholic belief and science are compatible. • Big Bang first proposed by a Catholic priest, also a physicist • The theory of evolution is part of God's plan	A. "In the beginning God created the heavens and the earth.." *Genesis 1;1* B. *"All things came into being through him, and without him not one thing came into being." John 1:3*
2 Fundamentalist Christian beliefs about the origin of the universe	• the account of creation in the Bible is an accurate account of what happened – creationism. • the creation of the world and everything in it took place in six calendar days, exactly as the book of Genesis says. • Comes from the view that the Bible is the direct word of God, so never mistaken. • God doesn't lie	C. *"I am the first and I am the last; besides me there is no God" Isaiah 44:6* D. "From nothing, then, you created heaven and earth.". *St Augustine, Confessions*
3 Jewish beliefs about the origin of the universe	• God is the creator and source of all life. • Beliefs based on Genesis, the first book of the Torah (Jewish written law). • Most Orthodox Jews say Genesis creation is the literal world of God, given to Moses on Mt Sinai. • They celebrate the creation weekly with Sabbat and with the festival of Rosh Hashanah. • Reform Jews believe the creation stories are symbolic	E. "The universe "did not spring forth complete from the hands of the Creator. The universe was created "in a state of journeying" (in statu viae) toward an ultimate perfection…" *Catechism of the Catholic Church* F. "there is no conflict between evolution and the doctrine of faith regarding man and his vocation" *Pope St John Paul II*
4 Non-Religious views about the origin of the universe	• creation of the world was caused by the Big Bang. • this theory was developed by Prof Stephen Hawking. • Hawking says gravity proves the universe can create itself without the need for God • life on earth is a result of Evolution. • This idea was proposed by Charles Darwin. • organisms develop into new species by a process known as 'natural selection'.	G. "because there is a law such as gravity, the universe can and will create itself from nothing" *Stephen Hawking* H. "Blessed be he who spoke and the world came into being." *Baruk She'amar prayer*

Useful terms	Definition
Big Bang Theory	*First proposed by Fr George Lemaitre, the Big Bang theory says the universe is still expanding from a single explosion 13.7 billion years*
Creation ex nihilo	*"creation out of nothing". Before God created the universe, nothing existed. Only God can create out of nothing.*
Eternal	*without beginning or end*
Evolution	*the process of mutation and natural selection leads to changes in species over time to suit particular environments.*
Fundamentalist	*Christian who believe the Bible creation stories are a factual, literal account*
Humanism	*Atheist belief system that emphasises the value of human beings. Uses critical thinking and evidence to make moral decisions.*
Omnibenevolent	*The belief that God is all-loving*
Omnipotent	*God is all-powerful*
Omniscient	*God is all-knowing*
Natural selection *(survival of the fittest)*	*A process in which animals survive so that animals that are better adapted to their environment are more likely to survive.*
Transcendent	*The belief that God exists above and beyond space and time.*

History

Conflict & Tension: The First World War Unit 1: Causes of WW1

Timeline

1879	Germany and Austria-Hungary form the Dual Alliance
1882	Italy joins Germany and Austria-Hungary to form the Triple Alliance
1892	Alliance formed between France and Russia
1904	Britain and France sign the Entente Cordiale
1905-6	The First Moroccan Crisis
1907	Britain, France and Russia form the Triple Entente
1908-9	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

Key People

Archduke Franz Ferdinand	The nephew of the Austro-Hungarian Emperor and heir to the Austro-Hungarian throne. He was sent to the Bosnian capital of Sarajevo to show Austria-Hungary's power and authority over Serbia. During his visit, he and his wife were shot and killed by an assassin from a Serbian terrorist gang. The murder sent shock waves across Europe and is seen as the short-term trigger that started the First World War.
Kaiser Wilhelm II	The ruler of Germany, who had absolute power over the country. His main ambition was to build Germany's empire, which was much smaller than the empires of the other European powers. His desire that Germany should be a world power with an empire was known as 'Weltpolitik'. He began to involve Germany in world affairs, including opposing France's takeover of Morocco in 1905. He began to build up Germany's military from 1898 and threatened Britain's position as the most powerful country in Europe. He wanted Germany to have a large navy to rival Britain's and help him build an empire.

Key Terms

Alliance	An agreement between two countries to support each other.
Treaty	An official agreement or deal between two or more nations.
Semi-independent	An area that controls some parts of its rule, but is mainly ruled by the controlling government or nation.
Pan-Slavism	The idea of uniting all Slavs into one country.
Annexation	The addition of an area, region or country to another country or state.
Splendid Isolation	Britain's position in the late 1880s and early 1900s, meaning it was 'isolated' from alliances with other nations.
Two-power standard	The idea that Britain's navy should be at least equal in size to the combined strength of the next two largest navies in the world.
Weltpolitik	Meaning 'world policy'. Used to describe Kaiser Wilhelm II's desire to be a world power.
Foreign policy	The action and strategy taken by a leader or government in dealing with other nations.
Arms race	When rival nations attempt to outdo each other in the size and quality of their armed forces.
Nationalist	A person with great love for their nation. Nationalist can also mean a person or group within a country that desires political independence.
Assassin	A person who kills someone for political or religious reasons.
July Crisis	The term used to describe the chain of events from the assassination of Franz Ferdinand to the declarations of war by the major powers from late June to early August 1914
Mobilise	Prepare for war.
Ultimatum	Terms or demands presented by one power (or group of powers) to another.

Key Questions

How did the Alliance system increase tension in Europe?

- Each of the major European powers formed alliances with others to increase their influence and security.
- Two rival camps formed: The Triple Alliance (Germany, Austria-Hungary, Italy) and the Triple Entente (Britain, France, Russia)
- The alliance system meant that if one country became involved in conflict with a rival country, its allies would also become involved. If a disagreement started between any two nations in opposite alliances, the others could quickly get dragged into the conflict, resulting in a large-scale war between several well-armed countries.

How did events in Morocco and the Balkans increase tension?

- The Moroccan Crises were major moments of tension that tested the alliance system and showed Germany's ambition.
- The Kaiser ultimately agreed to back down in Morocco when faced by firm opposition from Britain and France, but the crises showed how tense the situation was, and Germany's humiliation meant the Kaiser would be unlikely to back down from another crisis, wherever and whenever it occurred.
- The collapse of the Ottoman (Turkish) Empire created unrest in the Balkans, with the more powerful countries in the area trying to increase their influence.
- Following the Balkan Wars, Serbia became the strongest of the Balkan nations. Austria-Hungary saw the growth of Serbia as a threat, particularly as it was aligned with Russia. Many Serbs in Bosnia, which was controlled by Austria-Hungary, wanted Bosnia to become part of Serbia.

How did Europe countdown to war?

- In June 1914, the Archduke of Austria-Hungary, Franz Ferdinand, was assassinated in Sarajevo by the Black Hand, a group who wanted Bosnia to become part of a Greater Serbia.
- Austria-Hungary blamed Serbia and declared war. This started a chain reaction which triggered the alliance system.
- By 6 August, the whole of Europe was at war.
- The period of time between the assassination and the outbreak of war is sometimes called the July Crisis

Geography

Natural Hazards Knowledge Organiser (Paper 1, Section A)

Key Terms:

Natural Hazard: Natural hazards are extreme natural events that could cause loss of life, extreme damage to property and disrupt human activities.

Tectonic Hazard: A hazard caused by movement in the tectonic plates (E.G. earthquake, volcano)

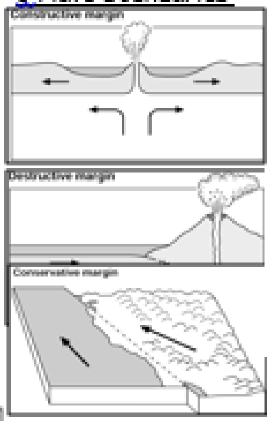
Climatic Hazard: Occur when a region has certain weather conditions, for example heavy rainfall can lead to flooding.

Climate Change: A long-term change in the earth's climate, especially a change due to an increase in atmospheric temperature.

Greenhouse Effect: The name given to the natural process that causes the Earth to be warmer than it would be in the absence of an atmosphere.

	Chile 2010	Nepal 2015
Deaths	500	9000
Injuries	12,000	20,000
Affected	800,000	8,000,000
Cost	$5bn	$30
Other effects	4500 schools destroyed	7000 schools destroyed
Responses	Power and water restored to 90% of homes within 10 days	Half a million tents needed to provide shelter for the homeless

3 Plate Boundaries:



Constructive boundary

At a constructive margin two plates are moving apart. Magma then forces its way to the surface. As it breaks through the overlying crust, it causes earthquakes (weak). Shield volcanoes are found at this margin.

Destructive boundary

As the plates collide, the oceanic plate is forced beneath the continental plate. This is known as subduction. This happens because the oceanic plate is denser (heavier) than the continental plate. Strong earthquakes and composite volcanoes are found at this margin.

Conservative boundary

At conservative margins, two plates are moving past each other. Friction between the plates then causes earthquakes. No volcanoes are found at this margin.

Managing Tectonic Hazards:

Prediction: Use of past earthquake data, monitoring gases, seismometers to predict next event.

Planning: Actions taken to enable communities to respond to, and recover from, natural disasters (e.g. evacuation, disaster packs).

Protection: Actions taken before a hazard strikes to reduce the impact, such as building sea walls or boarding up doors/windows.

Weather Hazards:

3 Conditions for a Tropical Storm to form:
- Seas 70m+ deep
- Warm oceans (27°C)
- 5-15° north and south of the equator

3 Features of a Tropical Storm:
- Eye in centre
- Eye wall
- Thunderstorms

Effects of Typhoon Haiyan:
- 6,300 deaths
- 600,000 displaced
- 40,000 homes damaged or flattened
- 90% of Tacloban city destroyed.
- 30,000 fishing boats destroyed
- 14 million affected
- 6 million lost a source of income.

Responses to Typhoon Haiyan:
- 1200 evacuation centres set up
- French, Belgian and Israeli field hospitals set up.
- 'Cash for work' programmes

3 ways Climate Change could affect Tropical Storms:
- They could become more powerful (stronger winds)
- They may be found outside of the current hazard zone, such as the south Atlantic (warmer oceans).
- Climate change may increase or decrease the number of tropical storms.

Managing Tropical Storms:
- Satellites to track route
- Board up windows and doors.
- Build sea walls
- Evacuation plan
- Disaster pack

Climate Change:

Evidence of past climate change:
- Fossils
- Ice cores
- Tree rings

Natural Causes of Climate Change
- Changes to Earth's orbit shape meaning more extreme ranges in temperature
- Sunspots
- Volcanic eruptions

Human Causes of Climate Change:
- Burning fossil fuels to create energy releases CO_2, enhancing the Greenhouse Effect
- Deforestation and the burning of wood
- Decaying organic matter in landfill sites and compost tips

Mitigating (Reducing) Climate Change:
- Alternative energy (e.g. HEP, nuclear, solar, tidal and wind)
- Carbon capture
- Planting trees
- International agreements

Adaptations to Climate Change:
- Coastal houses built on stilts to reduce flood risk
- Managing water supply
- Changing farming practices

Spanish

Holidays

Grade		Examples:
9	Subjunctive verbs or Subjunctive expressions	**Cuando sea mayor** me gustaría visitar Italia. **Si fuera rica,** me gustaría visitar los Estados Unidos.
	Idioms	**Llueve a cántaros / cuesta un ojo de la cara**
	Direct object pronouns	Fui a España y **lo** pasé bomba, me gustaría **visitarlo** otra vez.
8	If clauses + the future or conditional	**Si fuera rico/a iré** a Dubai. **Si** gano la lotería, **compraría** una mansión.
	Subordinate clauses	Cuando hace calor, nado en el mar. Cuando tengo tiempo, toco la guitarra.
7	Si tuviera + conditional Si pudiera + conditional	**Si tuviera** la oportunidad, me gustaría quedarme en un hotel. **Si pudiera, viviría** en España.
	Future tense	El año próximo, **iré** a Francia y **nadaré** en el mar con mi familia. También **tomaré** el sol en la playa, **será** estupendo.
	Infinitive structures	**Quiero ir** a Florida porque **se puede ir** a Disney World.
6	Imperfect tense	El hotel **tenía** una piscina y un restaurante y **había** aire acondicionado.
	Reflexive verbs	**Me alojé /nos alojamos** en un apartamiento.
	Complex opinion phrases	**Me chiflan** las vacaciones activas porque se puede ver monumentos. **Me flipa** practicar deportes acuáticos.
	Conditional tense verbs	**Iría** a Cuba y **sería** lujoso porque **tendría** una piscina exterior y vistas al mar.
5	Superlatives	**Lo mejor fue** cuando fui al parque temático. **Lo peor fue** cuando tuve un accidente.
	Comparatives	Diría que las vacaciones actives son **menos** aburridas **que** las vacaciones exóticas.
	Preterite tense verbs (irregular)	El año pasado, **fui** a España y **saqué** fotos. En verano **hice** una barbacoa y **fue** relajante.
	Correct use of ser/estar	La ciudad **está** situada en el norte y **es** muy preciosa.
4	Me gustaría + infinitive	**Me gustaría ir** a Francia el año que viene. **Me gustaría visitar** Escocia en el futuro.
	Negative structures	El hotel **no** fue **ni** moderno **ni** grande. **No** me gustan **nada** de mis vacaciones.
	Preterite tense verbs (regular)	**Me alojé** en un hotel de cinco estrellas y **comí** comida típica. **Bebí** refrescos y **monté** en bici.
3	Near future tense verbs	El año próximo **voy a ir** a Francia y **voy a hacer** esquí.
	Time phrases	**Cada año** voy a Irlanda pero **a veces** voy a Gales.
	Justified opinions	Me encantan las vacaciones en el campo **porque son relajantes y divertidas.**
2	Intensifiers	El hotel es **bastante** grande y **muy** moderno.
	Connectives	Voy al parque **y** la piscina **pero** no voy al gimnasio.
1	Adjectival agreement	**El** hotel era limpi**o** pero **la** piscina era suci**a**.
	Present tense (regular)	En la playa y **nado** en el mar y **tomo** al sol, también **monto** a caballo.

Holidays

Grade		Examples:
9	Subjunctive verbs or Subjunctive expressions	When I am older I would like to visit Italy. If I were rich, I would like to visit America.
	Idioms	It rains cats and dogs. It costs an arm and a leg.
	Direct object pronouns	I went to Spain and I had a great time. I would like to visit it again.
8	If clauses + the future or conditional	If I were rich, I would go to Dubai. If I won the lottery, I would buy a mansion.
	Subordinate clauses	When it is hot, I swim in the sea. When I have time, I play the guitar.
7	Si tuviera + conditional Si pudiera + conditional	If I had the opportunity, I would like to stay in a hotel. If I could, I would live in Spain.
	Future tense	Next year I will go to France and I will swim in the sea with my family. Also, I will sunbathe on the beach and it will be brilliant.
	Infinitive structures	I want to go to Florida because I could go to Disney World.
6	Imperfect tense	The hotel had a pool and a restaurant and there was air conditioning.
	Reflexive verbs	I stayed/we stayed in an apartment.
	Complex opinion phrases	I love active holidays because you can see the monuments. I love to do water sports.
	Conditional tense verbs	I would like to go to Cuba because it would be luxurious but it would have an outdoor pool and sea views.
5	Superlatives	The best thing was when I went to the theme park. The worst thing was when I had an accident.
	Comparatives	I would say that active holidays are less boring than exotic holidays.
	Preterite tense verbs (irregular)	Last year I went to Spain and I took photos. Last year I made a bbq and it was relaxing.
	Correct use of ser/estar	The city was situated in the North and it was very beautiful.
4	Me gustaría + infinitive	I would like to go to France next year. I would like to visit Scotland in the future.
	Negative structures	The hotel was not modern or big. I don't like the holidays at all.
	Preterite tense verbs (regular)	I stayed in a 5 star hotel and I ate traditional food. I drank fizzy drinks and I rode a bike.
3	Near future tense verbs	Next year I am going to go to France and I am going to go skiing.
	Time phrases	**Every year** I go to Ireland but sometimes I go to Wales.
	Justified opinions	I love holidays in the countryside because they are relaxing and fun.
2	Intensifiers	The hotel is quite big and very modern.
	Connectives	I am going to go to the park and the pool but I am not going to the gym.
1	Adjectival agreement	The hotel was clean but the pool was dirty.
	Present tense (regular)	On the beach **I swim** in the sea and **I sunbathe**. **I also ride** a horse.

Computing

Topic 2 – Data

***Binary** – A number system made up of 0 and 1 used by computers to store and represent data such as numbers, sound, and graphics*

- Also known as Base 2
- Computers use binary because the CPU contains transistors, which are either on or /off

***Binary States** – The number of states which can be represented in a given number of bits using binary*

- To calculate the number of states use the formula 2^n where n is the length of the pattern
- Limits on the number of bits available affect how much data can be stored

***Hexadecimal** – A number system made up of 16 symbols, 0-9 and the letters A-F.*

- Also known as Base 16
- Useful because large numbers can be represented using fewer digits.
- Easier to understand, write and check than binary.
- Commonly used for colour values and MAC addresses.

Measuring Storage

Size	Unit
8 bits	1 byte
1,024 bytes	1 kilobyte - KB
1,024 kilobytes - 1,024 KB	1 megabyte - MB
1,024 megabytes - 1,024 MB	1 gigabyte - GB
1,024 gigabytes - 1,024 GB	1 terabyte - TB
1,024 terabytes - 1,024 TB	1 petabyte - PB

***ASCII** – American Standard Code for Information Interchange*

- A 7 bit method to represent characters using binary
- 7 bits allows 128 characters.
- The characters are represented in a table, called the ASCII table.
- ASCII characters include control codes, punctuation, upper and lower case letters, numbers.
- Upper and lower case characters have different codes.

Character	Denary	Binary	Hexadecimal
A	65	1000001	41
Z	90	1011010	5A
a	97	1100001	61
z	122	1111010	7A
0	48	110000	30
9	57	111001	39

Bitmap Images

Allow computers to represent images in binary.
Images are broken down using a grid.
Each square in the grid is known as a pixel

Colour Depth

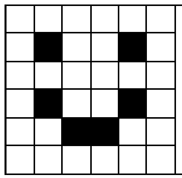
- The more colours an image needs, the more bits per pixel are used.
- The greater the colour depth, the larger the image file will be.
- one bit per pixel (0 or 1) - two possible colours
- two bits per pixel (00 to 11) - four possible colours
- three bits per pixel (000 to 111) - eight possible colours

Resolution

- Higher quality image = higher resolution = more pixels in the same space = smaller pixels.
- Higher resolution = more space needed.
- Calculated by multiplying the width in pixels by the height in pixels.

File Size

The file size of an image can be calculated using the formula :
height in pixels X width in pixels X colour depth per pixel



0	0	0	0	0	0
0	1	0	0	1	0
0	0	0	0	0	0
0	1	0	0	1	0
0	0	1	1	0	0
0	0	0	0	0	0

6 x 6 image, one bit colour
12 pixel resolution, 12 bit file size

Sounds in Binary

Amplitude - The height of the sound wave at the time it was sampled. The higher the amplitude the louder the sound.
Sample Interval – How often (in milliseconds) the sound is sampled
Small sample interval = better quality sound file = larger file.
Sample Rate –we often use the term sample rate instead of sample interval.
The sample rate (in Hz) is the number of samples in one second.
Sample Rate = 1 / Sampling Interval
Small sampling interval = high sample rate = better quality sound file = larger file.
Bit Depth - the number of bits used to record each sample.
Higher bit depth = higher quality audio = larger file size.
Usually 16 bits on a CD and 24 bits on a DVD.

Binary Maths

Addition

- 0 + 0 = 0
- 1 + 0 = 1
- 1 + 1 = 10 (binary for denary 2)
- 1 + 1 + 1 = 11 (binary for denary 3)

Multiplication (using binary shifts)
Move the digits to the left and fill the gaps after the shift with 0.
Move 1 place for X2, 2 places for X4 etc.
Division (using binary shifts)
Move the digits to the right and fill the gaps after the shift with 0.
Move 1 place for X2, 2 places for X4 etc.

Unsigned and Two's Compliment Integers

Unsigned integers must be positive
Signed integers can be positive or negative

- Both are as accurate
- Both can have overflow errors
- Unsigned integers store more positive values (unsigned is 0 to 255, signed is -127 to 127)

Two's complement

- Used by computers to show negative numbers.
- More effective when performing mathematical operations.
- The bit at the far left of the bit pattern - the most significant bit or MSB - is used to indicate positive or negative and the remaining bits are used to store the size of the number.

Using two's complement for negative numbers

- Find the positive binary value for the negative number.
- Add a 0 to the front of the number, to indicate that it is positive.
- Invert or find the complement of each bit in the number.
- Add 1 to this number.

Compression

Lossy Compression

- Some data is removed, reducing the amount of data and the size of the file.
- There is a balance to be struck between reducing file size and maintaining quality.
- Images can be compressed by reducing colour depth.
- Audio files can be compressed by reducing the bit depth of the samples.
- Lossy standards include:
  - JPEG file format for images
  - MPEG file format for video and audio
  - MP3 file format for audio

Lossless compression

- Files are reduced in size without the loss of data.
- Lossless compression results in a smaller reduction in file size than lossy compression.
- Lossless compression gives a better file quality that lossy compression
- Lossless standards include:
  - PDF file format for documents
  - GIF file format for images

Converting Between Bases

Binary to Denary

1) Draw your conversion table.
2) Write the binary number in the conversion table.
3) Add together all numbers with a 1 beneath them

128	64	32	16	8	4	2	1
1	1	0	0	1	1	0	0

128 + 64 + 8 + 4 = 204

11001100 in binary is 204 in denary

Denary to Binary

1) Draw your conversion table.
2) Is the number higher than the first column in the table?
   a) If so, put a 1 in that column and work out the difference.
   b) If not, put a 0 in that column.
3) Repeat the step above with the difference.
4) Keep going until the difference is 0, put a 0 in any empty columns.
5) Read the number from the bottom row of the table.

128	64	32	16	8	4	2	1
1	1	0	0	1	0	0	0

200 – 128 = 72
72 – 64 = 8
8 – 8 = 0

200 in denary is 11001000 in binary

Denary to Hexadecimal

1) Divide the denary number by 16 and write down both the answer and the remainder.
2) Divide the answer by 16 again. Write down both the answer and the remainder.
3) Keep going until you reach an answer of 0.
4) Read the remainders from bottom to top.
5) Convert each remainder to hex.

62 ÷ 16 = 3 R 14
3 ÷ 16 = 0 R 3
3 14
3E

62 in binary is 3E in hexadecimal

Binary to Hexadecimal

1) Draw two separate conversion tables.
2) Write the binary number across both tables.
3) For each table, add up the numbers which have a 1 beneath them.
4) Convert each number to hexadecimal.

8	4	2	1	8	4	2	1
0	1	1	0	1	1	0	1

4 + 2 = 6   8 + 4 + 1 = 13
6   D

01101101 in binary is 6D in hexadecimal

Music terms and signs

Glossary - Eduqas GCSE Music

eduqas

Dynamics

pp	*p*	*mp*	*mf*	*f*	*ff*
PIANISSIMO	PIANO	MEZZO PIANO	MEZZO FORTE	FORTE	FORTISSIMO
very soft (v.quiet)	soft (quiet)	moderately soft	moderately loud	loud	very loud

crescendo (cresc.)	diminuendo (dim.)
gradually getting louder	gradually getting quieter

Tempo

LARGO	LENTO/ ADAGIO	ANDANTE/ MODERATO	ALLGRETTO	ALLEGRO/ VIVACE	PRESTO
v.slow	slow	walking pace/ moderate	quite fast	quick/lively	very quick

- **Accelerando:** gradually getting faster
- **Rallentando/ritardando:** gradually getting slower
- **A tempo:** return to the original speed
- **Ritenuto:** in slower time
- **Rubato:** rhythms are played in a more free/flexible way ('robbed time').

Time values

NOTE	NAME	LENGTH (duration)	REST
	Semibreve	4 beats	
	Minim	2 beats	
	Crotchet	1 beats	
	Quaver	½ beats	
	Semiquaver	¼ beats	

A dot after the note increases its length by half:

NOTE	NAME	LENGTH (duration)	REST
	Dotted minim		
	Dotted crotchet		

Groups of quavers/semiquavers are usually beamed together:

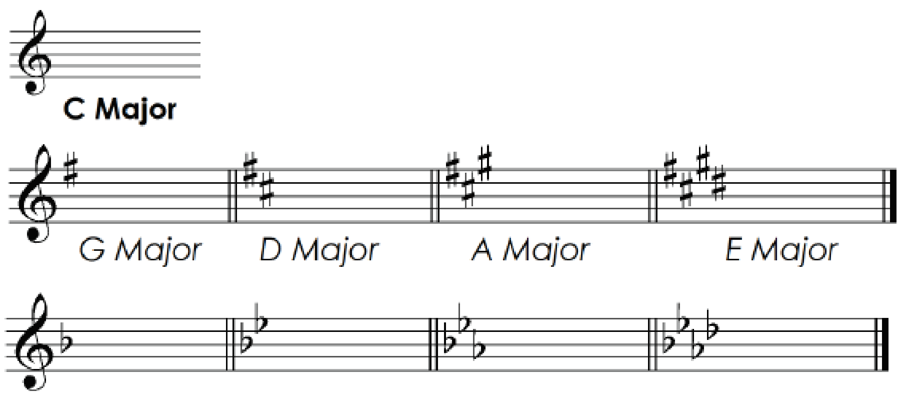
Terms and signs

#	**Sharp**	Raises a note by a semitone.
♭	**Flat**	Lowers a note by a semitone.
♮	**Natural**	Cancels a previous sharp or flat for a note.
	Staccato	Detached.
	Slur	Play smoothly.
	Tie	Hold the notes for the full value of the tied notes.
<	**Accent**	Emphasize the note (play forcefully).
	Pause	Hold the note longer.
sfz	**Sforzando**	Sudden stress/ accent.

Music terms and signs

Glossary - Eduqas GCSE Music

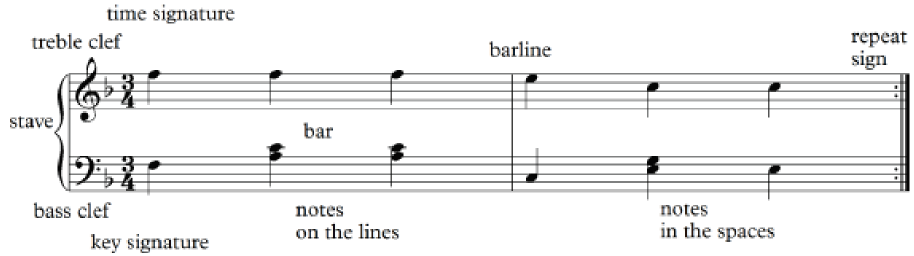
Key signatures



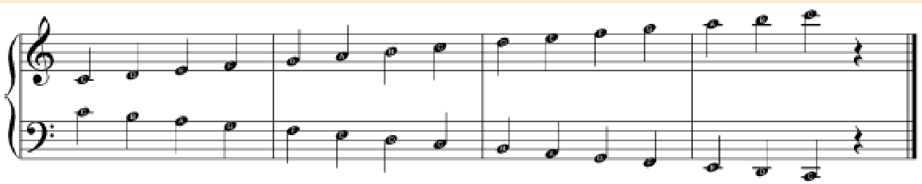
F C G D A E B

Order of sharps # →

← Order of flats b

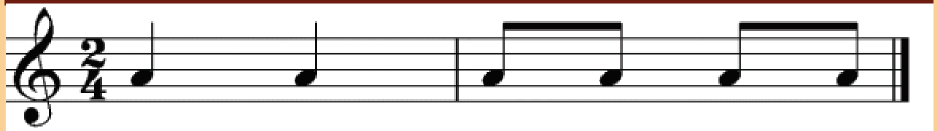


Treble clef notes

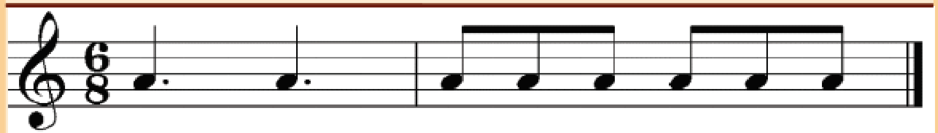


Bass clef notes

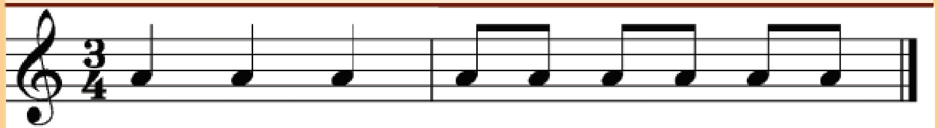
Time signatures



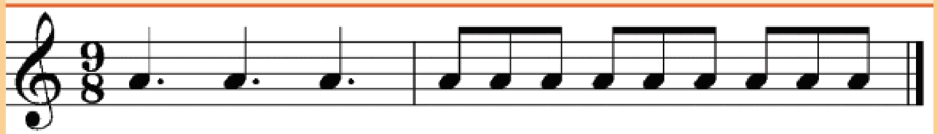
Two crotchet beats per bar: simple duple



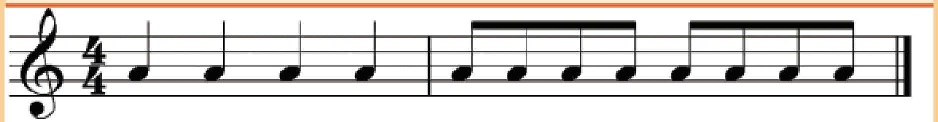
Two dotted crotchet beats per bar: compound duple



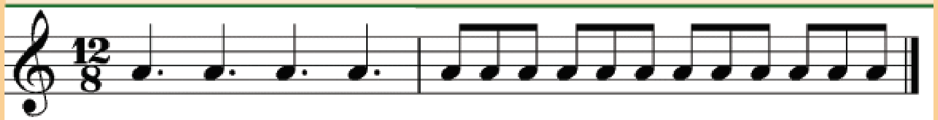
Three crotchet beats per bar: simple triple



Three dotted crotchet beats per bar: compound triple



Four crotchet beats per bar: simple quadruple



Four dotted crotchet beats per bar: compound quadruple

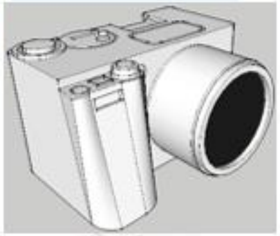
A triplet is when three notes are played in the time of two.

Graphics

Knowledge Organiser Y10 Term 1: Graphics

Physical card prototyping

CAD prototyping



Isometric projection

Exploded drawing

1 Point Perspective

2 Point Perspective

Mass production

Batch production

Continuous production

Karim Rashid
Industrial designer

- Pop or pastel tones
- Bold combinations & glossy finishes
- Plastic & solid surfaces that can be coloured & printed
- "Sensual minimalism": soft forms

These buildings are all one-offs!

Lord Norman Foster
Architect

- High-tech & modernist
- Innovative use of steel & glass.
- Jewel-like designs

Dame Zaha Hadid
Architect

- Futuristic style
- Curving façades, sharp angles
- Concrete & steel

Perspective drawing	Objects get smaller the closer they are to the vanishing points.
Isometric projection	Horizontal lines are at 30°. Most common way of realistically presenting ideas.
Exploded drawing	Drawing showing parts of an object taken apart e.g. IKEA instruction manual
Prototype/ One-off production	Only 1 item is made e.g. bespoke wedding dress. High level of skill & expensive per unit.
Batch production	Set of identical items made. Design can be adapted after each batch e.g . Cupcakes.
Mass production	Popular products made in large quantities. Automation, specialised machines & assembly lines used e.g. cars.
Continuous production	Never stops 24/7. High in demand every day items, little human input e.g. petrol.
JIT production	Items are made to order. No need to store parts in factory. Just In Time.
Automation	Use of machines & computers that can operate without humans (AI…)
CAD/CAM/ CNC	Computer Aided Design/ Manufacture/ Computer Numerical Control. (LASER cutter, 3D printer)
Image manipulation	Editing pictures (resize, filters) using a software such as Photoshop,
6Rs/ Sustainability	Refuse, Reduce, Recycle, Repair, Rethink, Reuse. Creating products with minimal negative impact on the environment.
Life Cycle Assessment	Evaluate the environmental impact of a product, from materials/ production- packaging/transport – usage – disposal.
Planned obsolescence	Design a product to fail (stop working, go out of fashion) e.g. lightbulbs, tights.
Design for maintenance	Design a product to last a long time/ be easy to repair e.g. low-tech & molecular.

Textiles

D&T/Art Knowledge Organiser

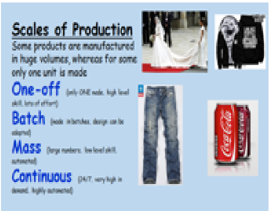
Name:

Year: 10 **Subject:** Textiles

Period of learning: Autumn Part 1

Key Concepts

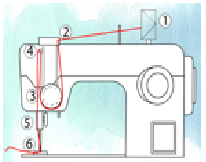
- Scales of Production
- Planned Obsolescence
- Fashion and the environment
- 6 R's
- Following a design Brief
- Sewing Techniques And understanding a commercial pattern.
- Manufacturing

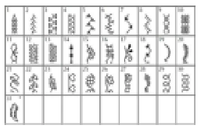


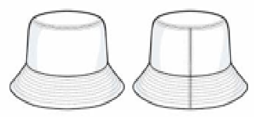
Repair Refuse Re-use Recycle Rethink Reduce

Key Skills

- Threading a sewing machine and problem solving
- Fabric decoration
- Creativity
- Upcycling
- Design to product
- Machine sewing stitches







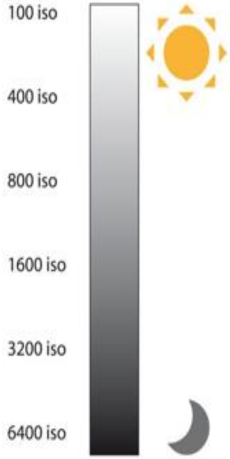
Word	Definition
One off	One-off and job production is often creating niche and tailor-made woodworking products. These can simply be driftwood furniture or bespoke cabinets that are customised for the end user.
Batch	Batch products are produced in smaller quantities. Batch production is used for products that have a smaller shelf life or need to be adapted and changed throughout the year.
Mass	Products are produced in their thousands, such as small crates. Tooling and machining costs will be fairly high but there will be a degree of flexibility to change dimensions, for instance.
Continuous	Continuous production can run 24 hours seven days a week. These products are either in high demand or thousands of people use them.
Planned Obsolescence	It is the **deliberate shortening of the lifespan of a product** to force people to purchase functional replacements.
Automation	Automation is the application of technology, programs, robotics or processes to achieve outcomes with minimal human input.
The 6 R's	Rethink - Be mindful of what you buy. ... Refuse - Don't buy something you don't need. ... Reduce - Cut down on the amount of products and services you use. Re-use - Take a product / item and repurpose it for a different item. Repair - Fix, don't replace your products. Recycle-

Photography Knowledge Organiser Project 1: Introductory course

How to hold the camera correctly

Learning camera functions

Composition/leading lines

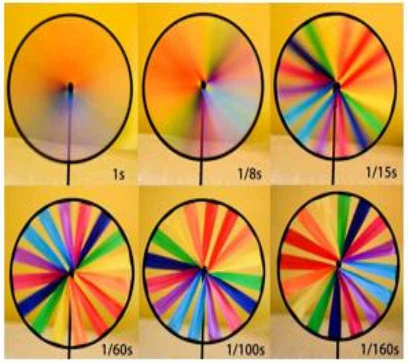


ISO

Assessment criteria

AO1: Develop ideas through investigations, demonstrating critical understanding of sources.
AO2: Refine work by exploring ideas, selecting and experimenting with appropriate media, materials, techniques and processes.
AO3: Record ideas, observations and insights relevant to intentions as work progresses.
AO4: Present a personal and meaningful response that realises intentions and demonstrates understanding of visual language.

Rule of thirds



Shutter speed

Critical Studies – Sarah Graham

Word	Definition
Composition	The arrangements of elements within a work of Art/Photograph
Shutter speed	How fast the lens opens and closes.
Formal elements	Line, tone, texture, pattern, shape and colour
Light painting	Drawing with various light sources
Symmetry	The same shapes on each side of a central line. Mirrored
Critical Studies	Taking inspiration from the work of others
Focal point	The main or principal point of focus

Light painting

Photoshop tools/editing

Frame/focal point/symmetry/monochrome

Art

D&T/Art Knowledge Organiser

Name:

Year: 10 Subject: GCSE Fine Art

Period of learning: Natural Forms

Key Concepts

- Abstract
- Personal Responses
- Research
- Annotation
- Critical Studies – Georgia O'Keefe
- Exploring Ideas

Key Skills

- Art Appreciation
- Time-management
- Dexterity
- Flexibility.
- Harnessing appropriate Media
- Informed responses.

Word	Definition	
Environmental Art	Art that utilises or transforms the natural environment.	
Media	The different materials used to create artwork.	
Montage	A composition of many other images, drawings, paintings and photographs.	
Unity	The relationship between different elements in a design or artwork.	
Formal elements	Line, colour, form, shape, tone, texture, pattern, space.	
Organic shapes	Forms that have a natural look with often a curving, flowing appearance, such as leaves, flowers and shells.	
Seamless	Smooth, gradual changes in colour or tone.	

Sociology

Families Knowledge Organiser

Functionalist
The family is a key social structure as it performs several essential functions for individuals and society. Murdock (1949) argues four vital functions:
1. Sexual Function: regulates sexual behaviour that is approved by society.
2. Reproductive function: New family members- procreation & childrearing.
3. Economic function: providing shelter, food & clothes. Economic cooperation between husband & wife.
4. Educational function: primary socialisation and discipling.

Marxist
The family is one of the key institutions that social inequalities are passed on through the generations.
- The bourgeoise pass on their wealth to family members
- Educational advantages are passed down as people from wealthy backgrounds can afford to send their children to private schools
- Through the socialisation process people learn to accept their position.

Feminist
Families have a negative impact on the lives of women. Families socially construct gender differences- canalisation. Children also learn gender expectations through the division of domestic labour e.g. Mum cleaning up.

Segregated conjugal roles: Clear division of tasks divided into male and female tasks. Husband & wife spend little time together.

Joint conjugal roles: Do not have a rigid division of household tasks. Husband & wife spend time together.

Household: Consists of one person who lives alone or a group of people living at the same address.

Reasons for increase in one-person households:
- Remain single and childless
- Divorced
- International migrants
- Living alone through choice
- Cohabiting (potentially before marriage)
- Choosing to live apart from partner.

How have families changed?:
- Smaller (less children)
- Marriage is less likely
- Parents are older
- Joint Conjugal roles
- Family diversity
- Increase in divorce, rise in reconstituted.

Why have families changed?:
- Laws (gay rights, divorce is easier.)
- Rise of feminism
- Diversity
- Technology (contraception, fertility)
- Changing norms & values
- Secularisation- religion is less of an influence.

Parent & child relationship change:
- Parents are now less **authoritarian**
- Families used to rely on children's income until the **Education Act** of 1918 and childhood began
- Children are seen as important members of the family and their opinions are listened to.
- **Boomerang children:** Young people who leave home (for university or travelling) & return to living with their parent(s)

Contemporary social issues:
- The quality of parenting
- Relationships between teenagers & adults
- Care of the elderly.

Patterns of marriage:
- Decline
- Later in life
- Civil partnership/same-sex
- Increase in cohabitation
- Increase in births outside of marriage

Patterns of divorce:
- Changes in the law
- Changing social attitudes & values
- Impact of secularisation
- Changes in the status of women
- Influence of media

Consequences of divorce:
- Emotional distress
- Financial hardship
- Remarriage

Nuclear Family (cereal packet) Father, Mother & Children

Same-Sex Family Gay or lesbian couple living in a house, possibly with children.

Extended family Includes relatives beyond the nuclear family

Beanpole Families Multiple generations of older people and few children

Lone-Parent Families One parent and child(ren) who live together

Reconstituted Families Sometimes referred to as a step family. Children from a previous relationship so one adult is a biological parent, the other is a step-

Musculo - Skeletal System

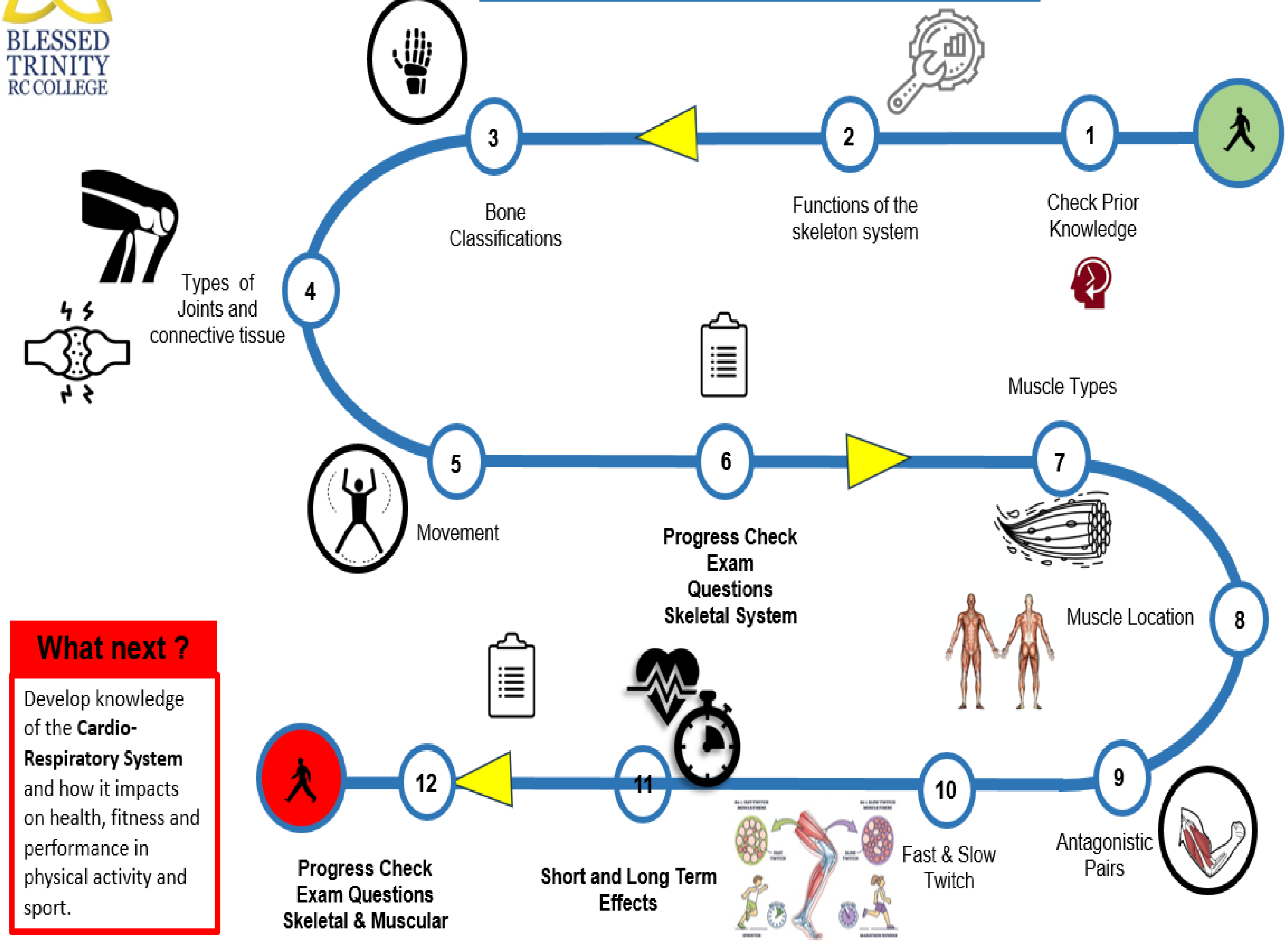
Sport & Coaching Physical Education

Why this ?

Develop knowledge of the **Musculo – Skeletal System** and how they impact on health, fitness and performance in physical activity and sport.

Why now ?

Body Systems Foundation blocks. Builds on prior knowledge of body systems from science.



What next ?

Develop knowledge of the **Cardio-Respiratory System** and how it impacts on health, fitness and performance in physical activity and sport.

PE

Unit 2 – Improving Sporting Performance

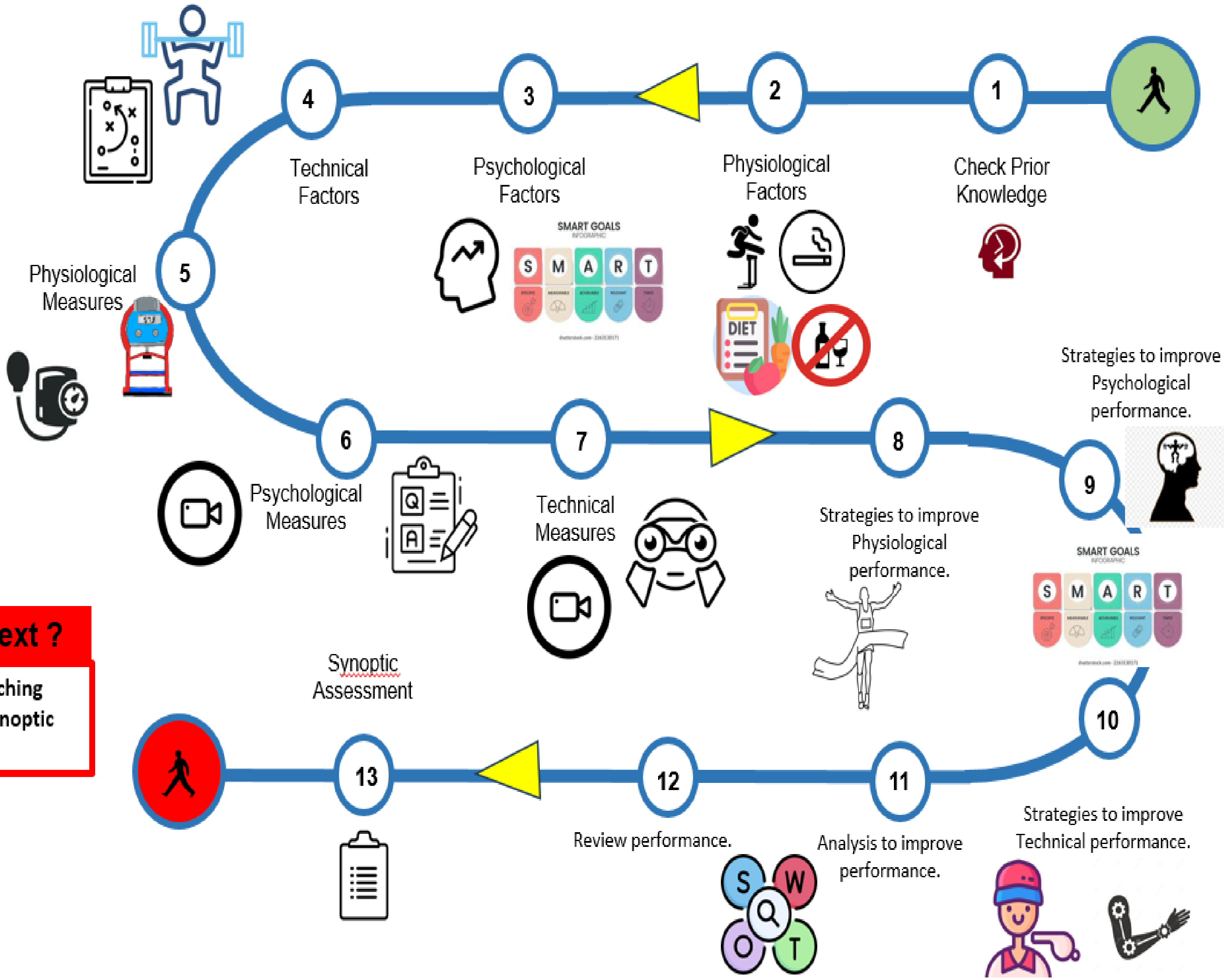
Sport and Coaching
Physical Education

Why this ?

The purpose of this unit is for learners to gain the knowledge and understanding needed to be able to analyse performance of individuals and review options to improve performance.

Why now ?

Through this unit you will learn about psychological, physiological and technical factors that affect performance. You will learn about how to measure the effect of these factors on performance, analyse the results and determine the best way to improve the performance of that individual.



What next ?

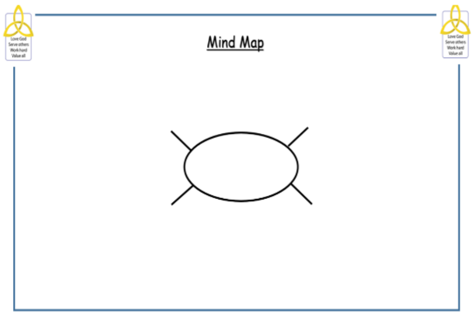
Unit 3 – Coaching Principles Synoptic Assessment

Sports and Coaching

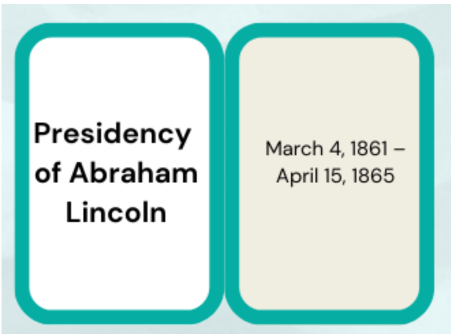
Top Tips!

How to use these KO's to revise

- Highlight the key words
- ***Make a mind map***



- ***Make some flash cards*** – Put the key word on one side and the facts/ important information on the back (just the key info!) – use the Leitner system shown to you in forms.



- ***Self-test*** – memorise the KO organiser, turn it over and then see how much you can remember
- ***Peer test*** – memorise the KO organiser then get someone else to test you (friend, family etc)