

Biology Paper 1 - AQA Combined Science

Topic 1: Cell Biology	Topic 2: Organisation
<ol style="list-style-type: none">1. Compare prokaryotic and eukaryotic cells2. Cell differentiation3. Cell Division	<ol style="list-style-type: none">1. Components of blood2. Digestive enzymes, their structures, how they work and where they are produced.3. Cancer4. Explaining symptoms of faulty valves in the heart
Topic 3: Infection and Response	Topic 4: Bioenergetics
<ol style="list-style-type: none">1. Bacterial diseases2. How we become immune3. Antibiotics	<ol style="list-style-type: none">1. Photosynthesis – required practical.2. How to determine the activity of photosynthesis in pondweed

Can you do the following key skills:

1. Identify variables from a method
2. Compare data (give similarities and differences)
3. Calculate percentages

Sparx Science

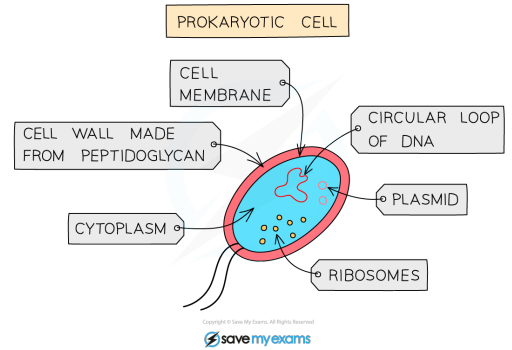
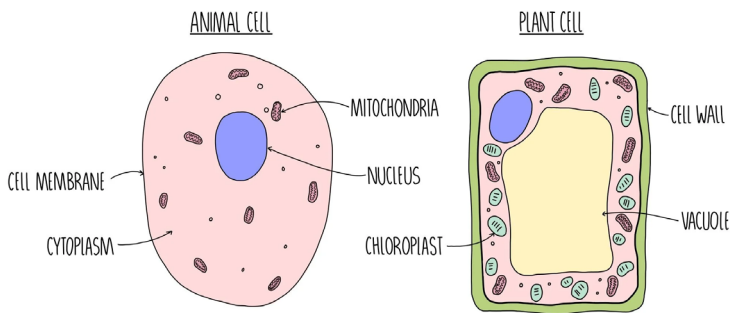
To practice question, you can log into sparx science, then click independent learning.

Select biology, then select one of the topics from your list. You can adjust the level to make the questions easier or harder.

If you need help logging in, please speak to your teacher.

Topic 1: Cell Biology

Eukaryotic & Prokaryotic Cells

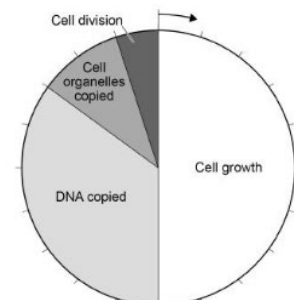
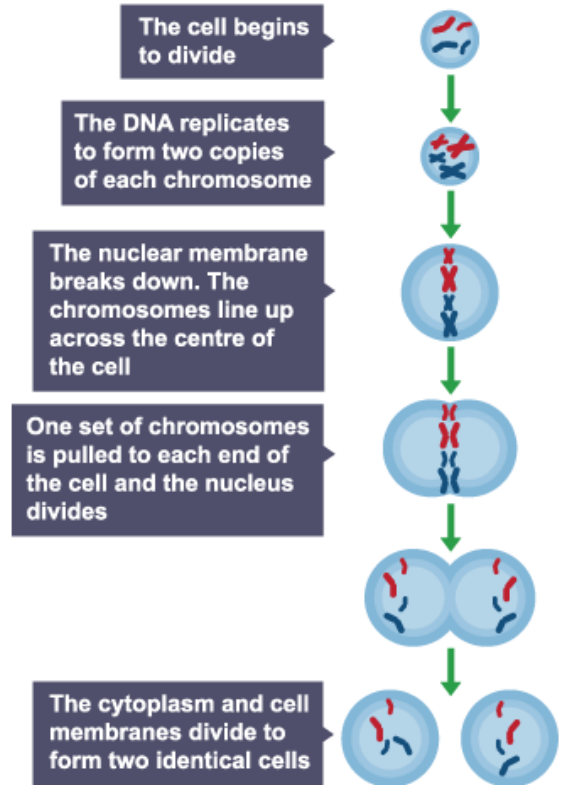


Cellular component	Function
Cell membrane	Hold the cell together, separating the inside of the cell from the environment outside, controlling what can and cannot enter or leave the cell
Cytoplasm	A jelly-like substance where many chemical reactions inside the cell happen. Surrounds sub-cellular structures
DNA	The genetic material that controls the activities of the cell
Ribosomes	The site of protein synthesis in the cell

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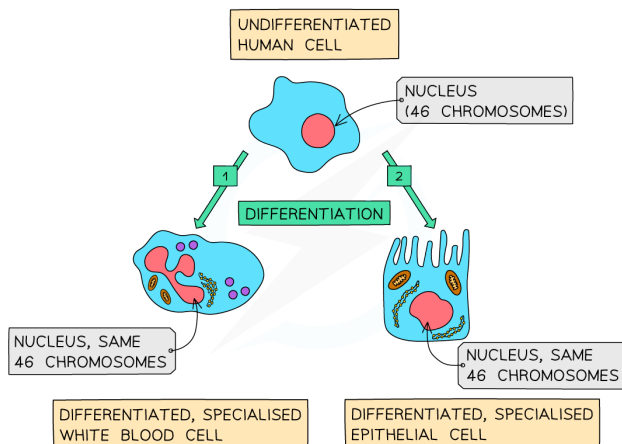
COMPONENT	EUKARYOTES	PROKARYOTES
CELL MEMBRANE	Y	Y
CYTOPLASM	Y	Y
GENETIC MATERIAL	Y – IN A NUCLEUS	Y – IN THE CYTOPLASM
NUCLEUS	Y	N

Cell Division



Cell Differentiation

Cell differentiation is the process by which a cell changes to become specialised for a particular job in the body.

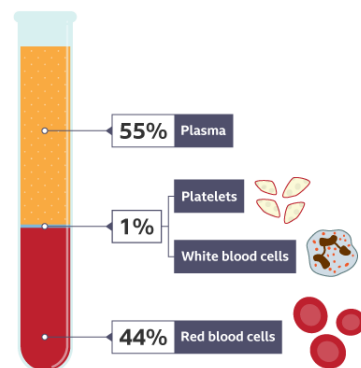


Topic 2: Organisation

Components of the blood

Each component has a function.

Component	Function
Red blood cell	To carry oxygen from the lungs to every cell in the rest of the body
White blood cell	To fight infection by pathogens and stop disease
Plasma	Carries the blood cells and platelets around the body
Platelet	Broken down parts of cells that form scabs



Digestive Enzymes

- **Amylase:** breaks down starch into glucose (sugar). The optimum pH is 7. This enzyme is found in the salivary glands, pancreas and small intestine.
- **Protease:** breaks down protein into amino acids. The optimum pH is 3. This enzyme is found in the stomach, pancreas and small intestine.
- **Lipase:** breaks down fats (lipids) into fatty acids and glycerol. The optimum pH is 8. This enzyme is found in the pancreas and small intestine.

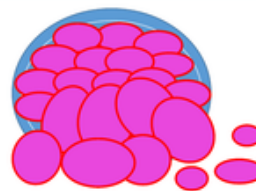
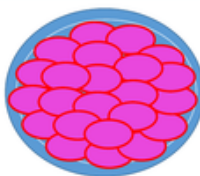
What is cancer?

Changes within the cell, mainly genetic, leads to uncontrolled growth and division of cells. These growths are called tumours.

What factors cause cancer?

Age, diet, smoking, obesity, exercise and genetic changes/abnormalities.

Benign	Malignant
Do not spread to other organs.	Spread to different organs and form secondary tumours.
Usually contained within a membrane.	Invade other organs via the blood.
These tumours are not cancerous.	These tumours are cancerous.



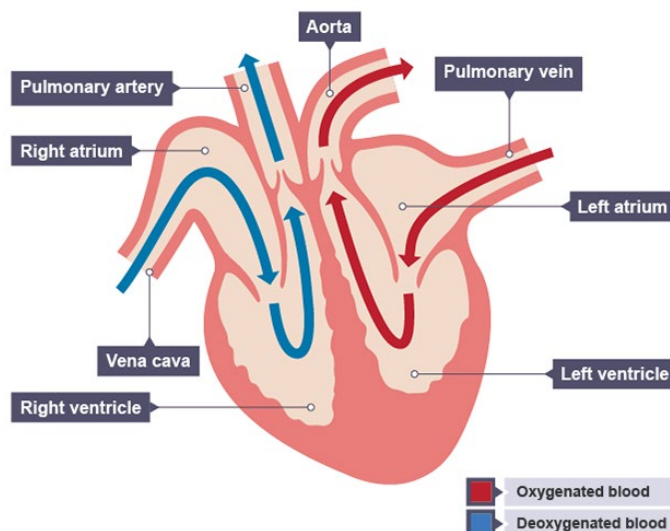
Valves

Valves prevent blood from flowing backwards.

In the heart, the valves can stiffen or become leaky which can disrupt blood flow.

These valves can be replaced by biological valves (from humans and mammals) or mechanical valves (man-made).

Replacing valves is less risky than a heart transplant but may still lead to blood clots.



Topic 3: Infection & Response

Pathogens

Pathogen	Example of disease	Prevention/Treatment
Virus	HIV, TMV, Covid, Flu, Measles	Fluids and rest. You can prevent them by being vaccinated
Bacteria	Salmonella, Gonorrhoea,	Antibiotics (like penicillin) which kill bacteria only
Fungus	Rose Black Spot	Remove infected leaves to kill pathogen
Protist	Malaria (spread by mosquitos)	Destroy breeding grounds by draining water from swamps

Drug types

- Painkiller
- Antibiotics **i**

Painkillers **i** are chemicals that relieve the symptoms but do not kill the pathogens. Common examples include paracetamol and aspirin, and they can relieve a headache or a sore throat.

As the symptoms are treated, your immune system still needs to combat the pathogen.

Antibiotics

Antibiotics are substances that slow down or stop the growth of bacteria **i**. They are commonly prescribed medicines, examples include penicillin **i** and amoxicillin. These can be taken to cure the disease by killing the pathogen, but only cure bacterial diseases and **not** viral ones.

Problems with antibiotics

Commonly prescribed antibiotics are becoming less effective due to a number of reasons:

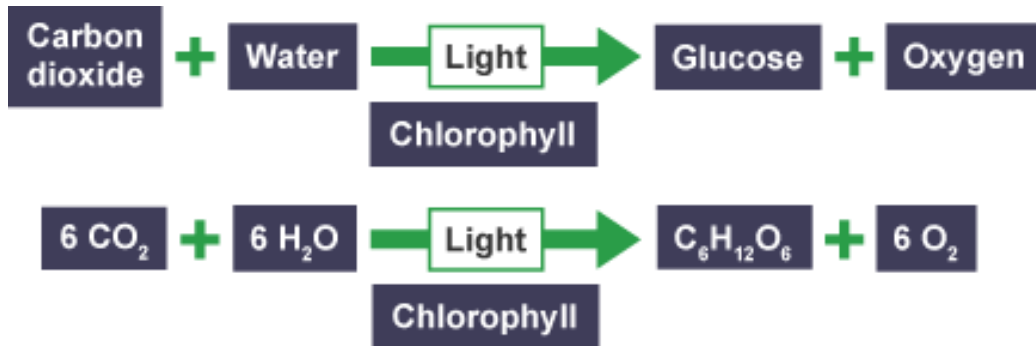
- overuse of antibiotics
- failing to complete the fully prescribed course by a doctor
- use of antibiotics in farming

These can lead to the effectiveness of antibiotics being reduced, and the incidence of **antibiotic resistance** **i** increasing. These bacteria are commonly known as superbugs.

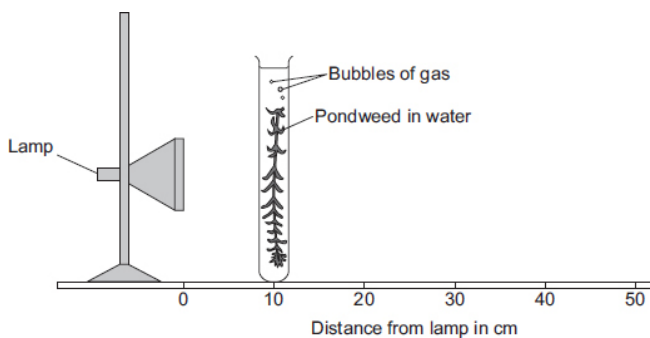
Topic 4: Bioenergetics

Photosynthesis

During photosynthesis, plants produce glucose from simple inorganic molecules – carbon dioxide and water – using light energy.



Method: Investigating the effect of light intensity on photosynthesis



1. Set up lamp 10cm away from pondweed.
2. Count the bubbles produced per minute.
3. Repeat this process moving a further 10cm away from the pond weed each time until 70cm.
4. Repeat the reading at each distance at least three times and CALCULATE A MEAN.
5. Control the temperature by leaving time between each reading.
6. Control the light colour by using the same lamp each time.

Variables

Independent (CHANGE):
distance of lamp from pondweed

Dependent (MEASURE): Bubbles per minute

Control

(SAME):

- Temperature
- Light colour
- CO₂ levels

How to accurately measure the rate of reaction:

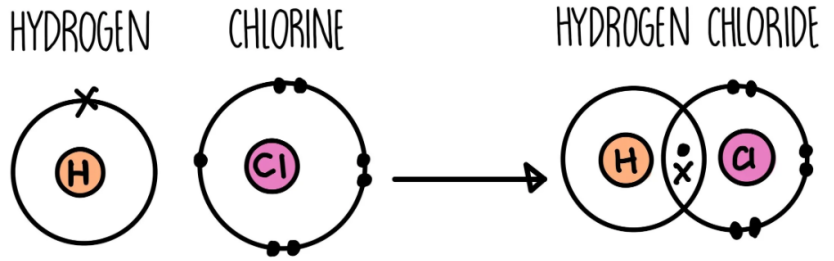
- Collect the oxygen gas in a gas syringe or inverted measuring cylinder
- Use a stopwatch, measure how much gas is produced in a set time
- Repeat the measurements three times and calculate a mean
- You should ignore any anomalous results and don't include in the mean

Chemistry Paper 1 - AQA Combined Science

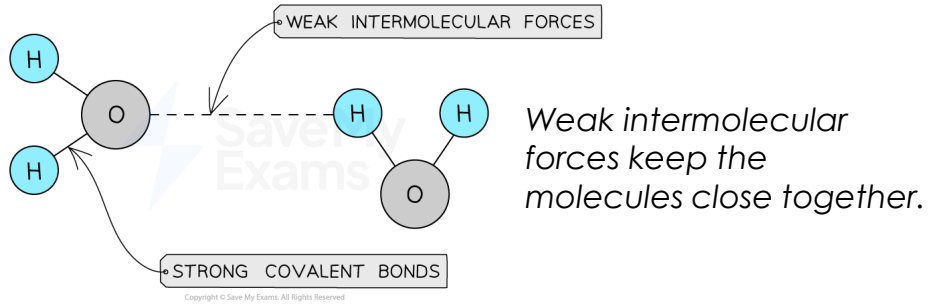
Topic 1: Atomic Structure and the Periodic Table	Topic 2: Bonding, Structure and Properties of Matter
<ol style="list-style-type: none">1. Group 7 of the periodic table	<ol style="list-style-type: none">1. Predicting formula from ions2. Metal alloy properties3. Covalent Bonding4. Bonding in polymers and their properties5. How metals conduct electricity6. How ionic compounds can conduct electricity
Topic 3: Quantitative Chemistry	Topic 4: Chemical Changes
<ol style="list-style-type: none">1. Calculating a limiting reactant2. Balancing symbol equations	<ol style="list-style-type: none">1. Making salts required practical with a metal carbonate2. pH Scale3. Identifying neutralisation reactions and displacement reactions4. Difference between strong and weak acids
Topic 5: Energy Changes	Sparx Science
<ol style="list-style-type: none">1. Temperature change required practical – writing a method2. Bond energy calculations	<p>To practice question, you can log into sparx science, then click independent learning.</p> <p>Select biology, the select one of the topics from your list. You can adjust the level to make the questions easier or harder.</p> <p>If you need help logging in, please speak to your teacher.</p>

Topic 2: Bonding & Structure

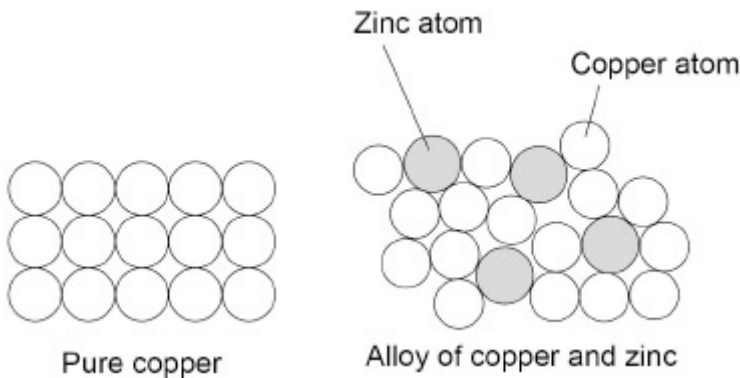
Covalent Bonds & Intermolecular forces



Strong covalent bonds hold the atoms together to make the compound/molecule



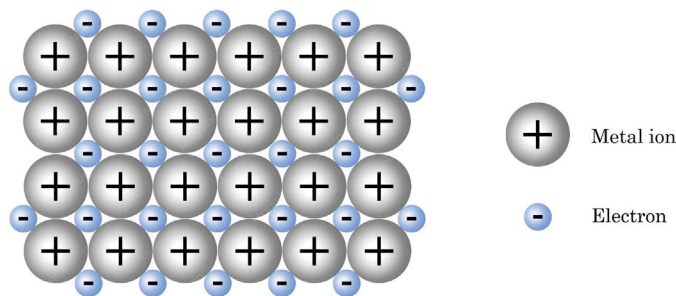
Metal Alloys



Why are alloys harder than normal metals?

- In alloys, the atoms are different sizes
- So the layers are distorted
- So they can't slide over each other

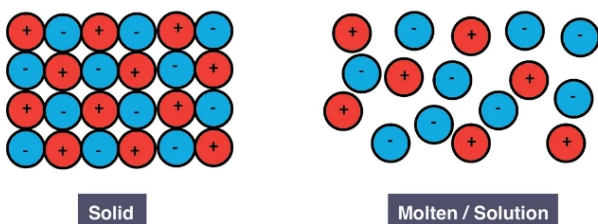
Metallic Bonding



How metals conduct electricity:

- Metals have a sea of delocalised electrons
- Which can carry charge through the metal

How Ionic Compounds Conduct Electricity



How ionic compounds conduct electricity:

- The compound needs to be molten or in solution
- So, the ions are free to move
- Allowing the charge to flow

Topic 3: Quantitative Chemistry

Calculating Uncertainties

We can calculate the **uncertainty** of a mean from a set of results. If you have a set of results that vary quite a lot between each repeat then your **uncertainty** will be larger. This is because your results will not be precise. On the other hand, if your results are very consistent for each repeat, then your **uncertainty** will be smaller.

The equation to calculate the uncertainty is:

$$\text{Uncertainty} = \frac{\text{Range}}{2}$$

We represent the **uncertainty** by writing the mean, followed by a "±" and then the uncertainty. For example, 5.06 ± 0.05 m etc.

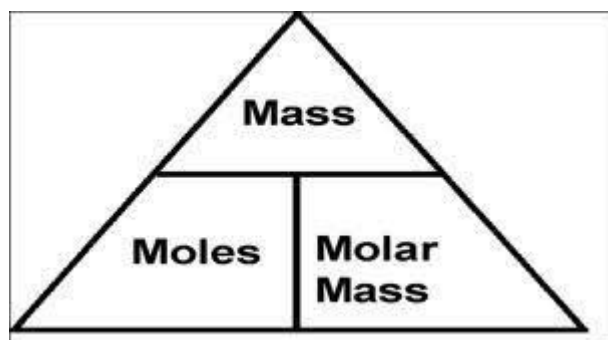
Concentration

- A solid substance that dissolves in a liquid is called a **solute**, the liquid is called a **solvent** and the two when mixed together form a **solution**
- Most chemical reactions occur between solutes which are dissolved in solvents, such as water or an organic solvent
- **Concentration** simply refers to the amount of solute there is in a specific volume of the solvent
- The greater the amount of solute in a given volume, the **greater** the concentration
- A general formula for concentration is thus:

$$\text{concentration (g/dm}^3\text{)} = \frac{\text{mass of solute (g)}}{\text{volume of solution (dm}^3\text{)}}$$

- Concentration can be measured in grams per cubic decimetre
- 1 decimetre cubed (dm^3) = 1000 cm^3
 - 1 decimetre cubed (dm^3) is the same as 1 litre

$$\begin{array}{ccc} & \div 1000 & \\ \text{cm}^3 & \xrightarrow{\hspace{2cm}} & \text{dm}^3 \\ & \xleftarrow{\hspace{2cm}} & \\ & \times 1000 & \end{array}$$



Topic 4: Chemical Changes

pH Scale

The pH scale is a logarithmic scale used to measure the acidity or basicity of a solution. It ranges from 0 to 14:

- A pH of 7 is considered neutral (like pure water).
- A pH less than 7 indicates an acidic solution. Range 0 - 6
- A pH greater than 7 indicates a basic (alkaline) solution. Range 8 - 14

The scale reflects the concentration of hydrogen ions (H^+) in the solution, with lower pH values corresponding to higher acidity

The pH scale is logarithmic.

This means a change of $\times 10$ in concentration = change of 1 pH unit.

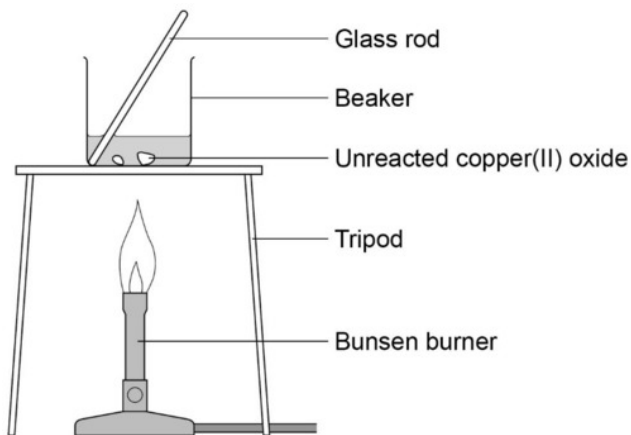
So:

- if the concentration of an acid is changed by a factor of 10, pH decreases by 1 unit
- If the concentration of an acid changed by a factor of 100, pH decreases by 2 units

Strong Acids – the acid completely ionises in aqueous solution

Weak Acids – the acid partially ionises in aqueous solution

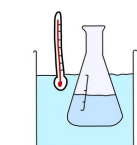
Making Salts – This is a neutralisation reaction



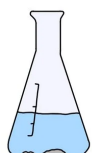
Bases are insoluble so heating and stirring will help them dissolve.

You will observe:

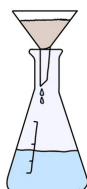
- The base disappearing as it dissolves
- The colour of the solution changing
- (If it's a carbonate) You will observe fizzing as it releases carbon dioxide



HEAT ACID IN WATER BATH



ADD INSOLUBLE BASE IN EXCESS
MIX TO REACT



FILTER TO REMOVE
UNREACTED BASE



GENTLY HEAT TO EVAPORATE WATER



LEAVE TO CRYSTALLISE
WASH AND DRY

Heating and stirring helps it react

Adding in excess makes sure all the acid reacts. You then filter to remove excess.

Heating using a water bath makes it safer

Topic 5: Energy Changes

Aim: Investigate whether concentration affects change in temperature

1. Measure 10cm³ of hydrochloric acid and add it to a polystyrene cup.
2. Record the starting temperature of the acid.
3. Measure the mass of a metal on a balance. Then add to cup.
4. STIR WELL to distribute the heat equally.
5. Measure the end temperature when it has stopped changing.
6. Find the temperature difference.
7. Repeat 3 times and calculate a mean
8. Repeat for different metals with the same mass and surface area.

Variables

Independent (CHANGE):

Type of metal

Dependent

(MEASURE): Temperature change

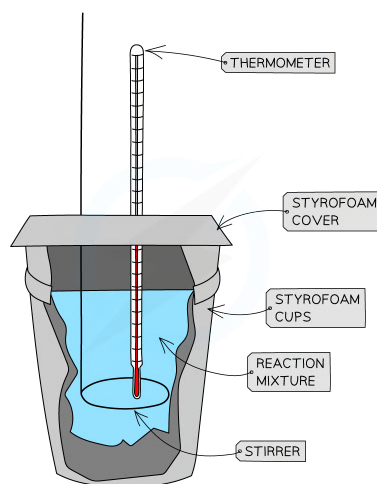
Control (SAME):

- Concentration of hydrochloric acid
- Surface area of metal

To improve accuracy

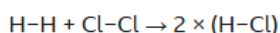
Use a polystyrene cup with A LID to stop heat being lost to the surroundings.

Make sure to stir the solution.



To calculate bond energy

1. Add together the bond energies for all the bonds in the reactants \ominus – this is the 'energy in'.
2. Add together the bond energies for all the bonds in the products \oplus – this is the 'energy out'.
3. Calculate the energy change = energy in – energy out.



Bond	Bond energy (kJ/mol)
H-H	436
Cl-Cl	243
H-Cl	432

1. Energy in = 436 + 243 = 679 kJ/mol (this is the energy absorbed when the bonds of the reactants break).
2. Energy out = 2 × 432 = 864 kJ/mol (this is the energy released when the bonds of the products form).
3. Energy change = in – out = 679 – 864 = **-185 kJ/mol**

Physics Paper 1 - AQA Combined Science

Topic 1: Energy	Topic 2: Electricity
<ol style="list-style-type: none">1. Specific heat capacity – required practical2. Describing energy changes – (what store increases, what store decreases)	<ol style="list-style-type: none">1. The national grid – step-up and step-down transformers2. LDRs and Thermistors3. Functions of diodes and LED's
Topic 3: Particle Model of Matter	Topic 4: Atomic Structure
<ol style="list-style-type: none">1. Gas pressure and how temperature effects it	<ol style="list-style-type: none">1. Alpha, Beta and Gamma radiation properties2. Nuclear decay equations3. How half-life affects stability

Sparx Science

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Topic 1: Energy

The tables in this section show you how to convert units back to base.

Focus your revision on recognising how to convert each prefix.

E.g. How do you convert kilo?
 10^3 (x 1000)

The example unit, shows what it would look like in an exam question. (e.g. kJ, kW)

Remember:

Mass is the only exception to this rule.

It should always be kg.

Conversions which are bigger than the base unit

Prefix	Example Unit	Standard Form	How to convert
Kilo, k	<i>kJ, kW</i>	10^3	x 1000
Mega, M	<i>MJ, MW</i>	10^6	x 1,000,000
Giga, G	<i>GJ, GW</i>	10^9	x 1,000,000,000

Conversions which are smaller than the base unit

Prefix	Example Unit	Standard Form	How to convert
milli, m	<i>mm, mA</i>	10^3	/ 1000
micro, μ	<i>μm, μA</i>	10^6	/ 1,000,000
nano, n	<i>nm, nA</i>	10^9	/ 1,000,000,000

Energy Changes

Energy store

Kinetic
Gravitational
Elastic
Electrostatic
Magnetic
Chemical
Nuclear
Thermal

Energy Change Scenarios: you need to explain what energy stores decrease then increase for each scenario

- an object projected upwards

*Kinetic energy **decreases**, GPE **increases***

- a moving object hitting an obstacle

*Kinetic energy **decreases**, thermal energy **increases***

- an object accelerated by a constant force

*Chemical energy **decreases**, kinetic energy **increases***

- a vehicle slowing down

*Kinetic energy **decreases**, thermal energy **increases***

- bringing water to a boil in an electric kettle

Thermal energy of heating element increases, thermal energy of water increases



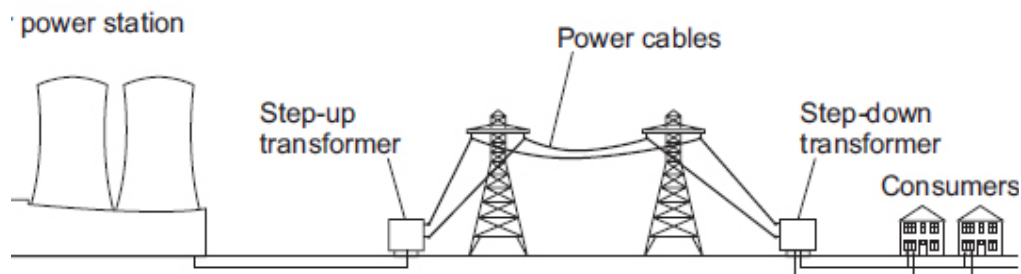
Jumping on a trampoline

- The child's GPE decreases and the kinetic energy increases as they fall
- Then the kinetic energy decreases as the EPE of the springs increases
- Thermal energy will be lost to the surroundings

Topic 2: Electricity

National Grid:

This is a network of cables and transformers across the country



Step-Up Transformers

- Increase potential difference
- Decrease current
- So, less energy is lost from the power cables to the surroundings
- Which increases the efficiency

Step-Down Transformers

- Decrease potential difference
- So, it is safe for the consumers

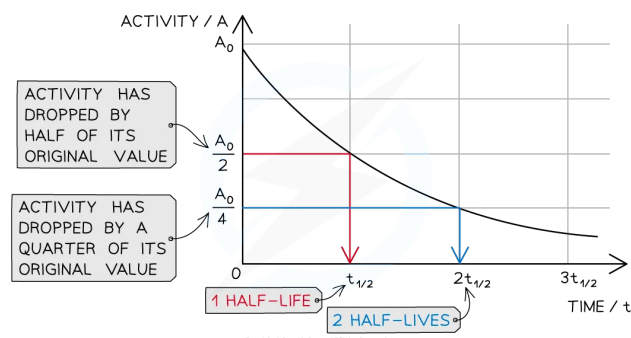
Topic 4: Atomic Structure

Particle	What is it	Charge	Range in air	Penetration	Ionisation
Alpha (α)	2 protons + 2 neutrons	+2	Few cm	Stopped by paper	High
Beta (β^-)	Electron	-1	Few 10s of cm	Stopped by few mm Aluminium	Medium
Gamma (γ)	Electromagnetic wave	0	Infinite	Reduced by few mm Lead	Low

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Half-Life

- Use the graph to work out the time taken for the activity to decrease by half



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Isotopes with short half-life

- Less stable nucleus
- Decay at a faster rate
- So, they have more activity

Isotopes with long half-life

- More stable nucleus
- Decay at a slower rate
- So, they have less activity

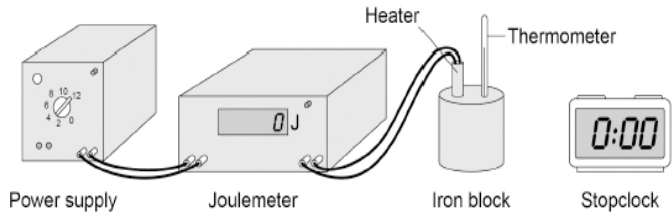
Topic 3: Particle Model

Aim: Investigate the energy needed to change the temperature of 1kg of a substance by 1°C

Method

1. Turn on the **heater** and leave to warm up for a few minutes.
2. Record the **initial temperature** using a **thermometer**.
3. Measure mass using balance.
4. Set the **timer** for 5 minutes.

5. Measure the energy going into the block using the **joulemeter**



6. Record the **final temperature** and **calculate temperature** 6.

Use energy = mass x specific heat capacity x temperature change

How could you improve the accuracy of the investigation?

If thermal energy is transferred to surroundings it could make SHC appear higher than its true value.

Insulating the metal block would improve accuracy as it would reduce thermal energy transferred to surroundings.

Sources of error

Random (parallax) from not reading thermometer at eye level – use a digital thermometer instead.

Variables

Independent variable:
substance type

Dependent variable:
Energy transferred

Control variable: mass,
time.

Gas Pressure

To create gas pressure:
Particles collide with surfaces.
→ this exerts a force on the area
→ this creates pressure

Increasing temperature, gives particles more kinetic energy
→ so, there is more frequent collisions
→ creating more force
→ so, more pressure

Changes of State

Internal energy is the **total kinetic energy and potential energy** of all the particles (atoms and molecules) that make up a system.
→ Increasing temperature increases the kinetic energy of the particles
→ This increases the internal energy