Year 11 Revision Pack

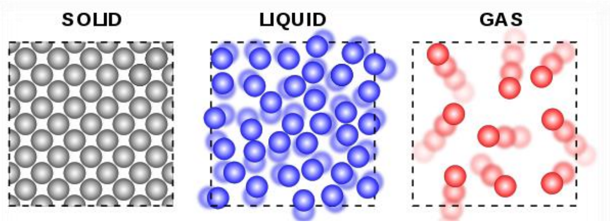
Science

Science

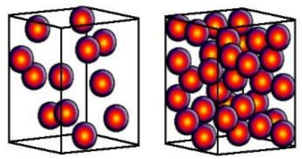
SoW Topic: States of Matter

Topic 1: States of Matter

The Particle Model



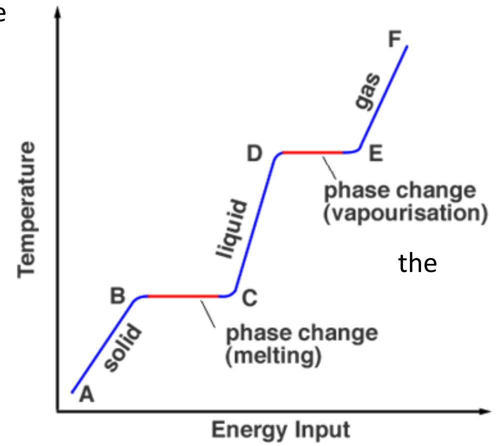
The three states of matter: **Solid**, **Liquid** and **Gas**, are represented by the **Particle Model**. The model shows in a **solid**, **particles** are close together and **vibrate** with little **kinetic energy**. In a **liquid**, **particles** are relatively close together, but have enough **kinetic energy** to move past each other resulting in flow. In a **gas**, **particles** have a high level of **kinetic energy** causing them to move rapidly away from other **gas particles**. The level of **kinetic energy particles** of a substance has, determines what **state** the substance exists as. During the state changes **melting**, **evaporation** and **sublimation**, **particles** gain **kinetic energy** due to an increase in the **environmental temperature**. During **freezing** and **condensation**, the **kinetic energy** of **particles** decreases. The **particle model** does have **limitations** in that it does not account for **variations** in **particle size** due to differences in **atomic structure**. The model also does not represent **intermolecular** or **intramolecular forces** acting on the **particles** (intermolecular – forces between different molecules, Intramolecular – forces within the molecule).



Density

Density refers to the amount of **particles** within a specified **volume**. Differences in **particle/molecule** size as well as the **intermolecular forces** present cause variation in **density** between substances. **Density** is calculated with the equation: **Density** (Kg/m^3) = **Mass** (Kg) ÷ **Volume** (m^3). This equation can also be represented as **$\rho = m/V$**. An object can float on water if it is less **dense** than the body of water directly beneath it. The diagram shows two boxes of the same **volume** with different numbers of **particles**. Assuming each **particle** has the same **mass**, the second box with more **particles** in the same amount of space would have a higher **density** than the first box with less **particles** in the same space.

Specic Heat Capacity and Specific Latent: HeatSpecific heat capacity refers to the level of **energy** in **Joules** required to change the temperature for 1kg of a susbtance by 1°C. Specific heat capacity is calculated using **Energy (J) = Mass (Kg) × Specific heat apacity (J/Kg/°C) × Temperature change (°C)**. This equation can also be represented as **$Q = m \times c \times \Delta T$** (Q = Energy, m = Mass, c = Specific heat capacity and ΔT = Temperature change). In order for a susbtance to change state, a specific amount of **energy** must be put into the substance to cause all **particles** to **transition state**. The **energy** required for this state change is known as the **specific latent heat** and can be calculated using **Energy = mass × Specific latent heat**, also represented as **$E = m \times L$**. The graph to the right shows how the temperature changes as the energy input increases. A phase change refers to a change of state and when this happens there is no increase in temperature. This is due to the **energy** being **transferred** to the **particles** to change state and the temperature will continue to increase once the change in state has finished.



Gas Pressure : Gas pressure is caused by the **collision** of gas **particles** with the side of their container. By manipulating the temperature or volume of the container, gas pressure can be altered. Increasing the temperature increases the **kinetic energy transferred** to the **particles**. As the **kinetic energy** has increased, the **particles collide** with the sides of the container more **frequently**, increasing gas pressure. If the volume of the container is reduced, the gas **particles** will **collide** with the sides of the container more **frequently** as there is a smaller distance for particles to travel. Containers can burst if the gas pressure becomes too great, therefore pressurised containers are kept away from high temperatures and have a suitable volume for the amount of gas held.

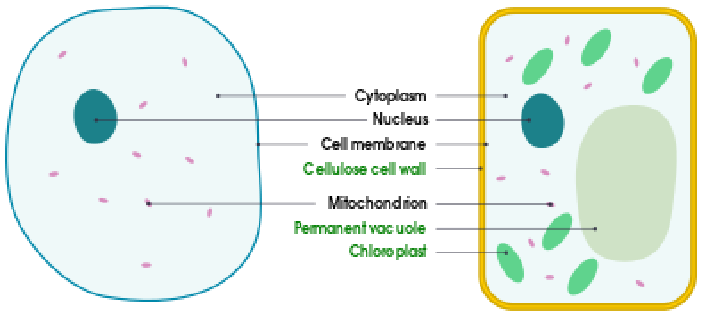
Science

SoW Topic: Cells in animals and plants

Topic 2: Cell Biology

Cell Types

Eukaryotes have a **nucleus** to contain their **genetic information** (E.g. Plant and Animal cells) whereas **Prokaryotes** do not possess a **nucleus** and **genetic information** is free floating (E.g. Bacteria – Bacterial chromosomes).

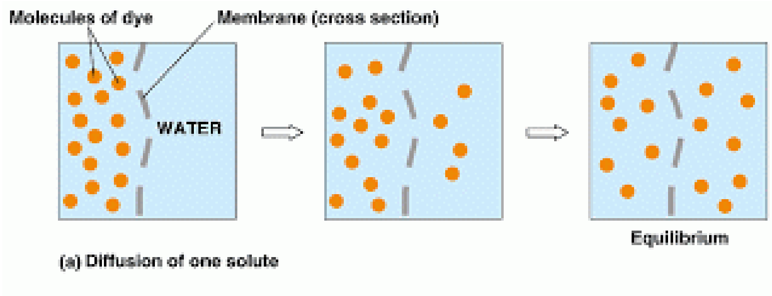


Cell Ultrastructure

Cell **ultrastructure** refers to the internal structure of a cell. The **ultrastructure** is made up of different **organelles**, each with their own function. The cell **ultrastructure** can vary between the different types of cells e.g. **Chloroplasts**, **Vacuoles** and **Cell walls** are not present in animal cells but are in plant cells. Cell **ultrastructure** can include the following **organelles**: **Nucleus** (Contains DNA and coordinates the cell), **Cell membrane** (Allows substances to enter and leave the cell), **Cytoplasm** (Site of cell reactions), **Cell wall** (Maintains cell shape), **Vacuole** (Stores water and minerals), **Chloroplasts** (Produces glucose via photosynthesis), **Mitochondria** (Releases energy in glucose by respiration) and **Ribosomes** (Protein synthesis).

Cell Transport

Cells transport molecules using three different methods: **Diffusion**, **Osmosis** and **Active Transport**. An example of **diffusion** is in the alveoli of the lungs; oxygen **diffuses** from the alveoli into the capillaries whereas carbon dioxide **diffuses** from the capillaries into the alveoli for exhalation. **Osmosis** is similar to **diffusion** but specifically refers to water molecules. An example of **osmosis** can be seen in root hair cells of plants, which have a **large surface area** to allow as much water as possible to pass through the **membrane** into the cell. **Active transport** is the active movement of molecules from a low concentration to a high concentration, against the **concentration gradient** through membrane channels. Active transport requires **energy** as it is causing molecules to move from where there are few of them to where there are many. Active transport can also be seen in root hair cells of plants where mineral nutrients from the soil such as magnesium are taken in by the cell.



Microscopy

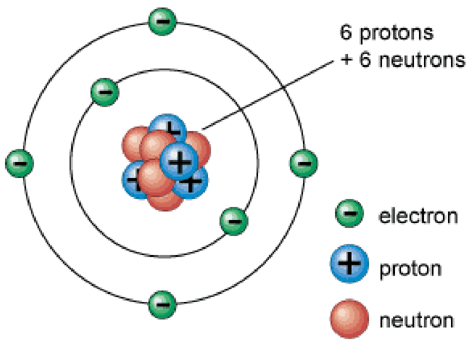
Microscopy is the use of microscopes to view cells and tissues of organisms in greater detail. The cells are magnified to increase their size allowing us to see cell **ultrastructure**. There are two types of microscope: light and electron. Light microscopes are much cheaper and can view the general shape and structure of a cell. Electron microscopes are much more expensive and much larger than their light microscope counterparts. Electron microscopes can magnify the image to a much higher level, allowing scientists to view the smaller **organelles** within a cell that cannot be seen using the light microscopes. The actual size of cells and their organelles can be calculated using the equation: **Actual Size = Image Size ÷ Magnification**.

Enter subject
Support and application

Vocabulary	Wider Research	Apply
1. **Eukaryotic** 2. **Prokaryotic** 3. **Organelle** 4. **Ultrastructure** 5. **Ribosome** 6. **Mitochondria** 7. **Concentration** 8. **Diffusion** 9. **Osmosis** 10. **Active transport** 11. **Gradient** 12. **Microscopy** 13. **Particle** 14. **Kinetic** 15. **Energy** 16. **Intermolecular forces** 17. **Density** 18. **Volume** 19. **Transferred** 20. **Joules** 21. **Collision** 22. **Gas pressure**	**Cell Biology–** https://www.bbc.co.uk/bitesize/topics/z2mttv4 **Cell transport–** https://www.youtube.com/watch?v=PRi6uHDKeW4 **Diffusion Simulation–** https://phet.colorado.edu/en/simulation/legacy/membrane-channels **Microscopy Required Practical–** https://www.youtube.com/watch?v=jBVxo5T-ZQM **States of matter–** **https://www.bbc.co.uk/bitesize/guides/z93jfcw/revision/1** **Density Simulation–** https://phet.colorado.edu/sims/density-and-buoyancy/density_en.html **Specific Heat Capacity Required Practical–** https://www.youtube.com/watch?v=HAPmwu7byGM **Gas Pressure–** https://www.youtube.com/watch?v=NzKAJWTmlwg	States of matter: 1. Recreate the graph representing temperature change over energy input. Explain why there is no temperature increase over points B-C and D-E when there is a temperature increase between points C-D. 2. The specific heat capacity of water is 4.18kj/kg/°C. If 10,000g of water is heated from 10°C to 55°C, how much energy has been transferred to the water. 3. Explain why steel ships are able to remain afloat on water when the density of steel is 8050Kg/m^3 and the density of water is 997Kg/m^3. 4. Explain why gas pressure increases with temperature- add into your answer examples where this is extremely dangerous. 5. Explain why the temperature of a substance determines it's state of matter- relate this to the effect of intermolecular forces. Cells: 1. Draw three diagrams to represent the following cells: Animal, Plant and Bacterial. 2. Create a Venn diagram to show the differences and similarities between plant cells and bacterial cells. 3. Calculate the magnification if the actual size of a cell is 0.015mm and the image size is 15mm. You will need to rearrange the equation. 4. Create a Venn diagram to show the differences and similarities between different types of transport in cells. 5. Explain why active transport is necessary across a cell membrane giving examples of how/when this happens- e.g. glucose moving in and out of cells.

Science - Chemistry
Atomic Structure

Topic 1: Atomic Structure



Carbon atom

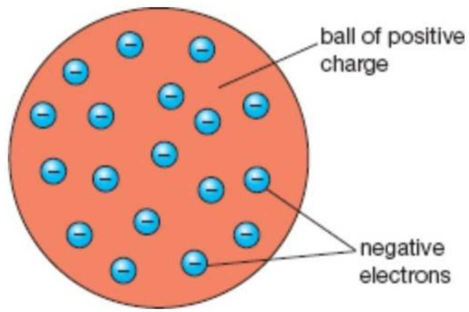
Structure of an Atom

The current model to demonstrate atomic structure is the **'Nuclear Model'** represented by the diagram to the left. The model contains a central **positively charged nucleus** containing **protons** and **neutrons** and surrounding the **nucleus, electron shells** that contain **negatively charged electrons**. **Protons**, **neutrons** and **electrons** are **subatomic** (smaller than an atom) **particles**. **Protons** are **positively charged** and **electrons negatively charged**, while **neutrons** have no charge. Both **protons** and **neutrons** have a relative **mass** of 1 whereas electrons have a miniscule **mass** of 1/1840 which is **negligible** to the total **mass** of the atom.

Structures for Different Elements and Isotopes

Each **element** on the periodic table has a unique structure of **protons**, **neutrons** and **electrons**. The **proton number** is what determines the type of **element** an atom is, for example, Carbon has 6 **protons** and all other atoms with 6 **protons** will be Carbon. The **proton number** and **mass number** for each element is provided on the Periodic Table. The larger number is the **mass number**, made up of the **protons** and **neutrons**. The smaller number is the **proton number** which is also equal to the **electron number**. The equal number of **protons** and **electrons** causes an atom to be **electrostatically neutral**. **Isotopes** are atoms of the same **element** (same proton number) but have a different **mass number** due to a variation in the number of **neutrons** in the **nucleus**. The **neutron number** of an atom is calculated using: **Neutron number = Mass – Proton Number**.

Development of the Atomic Model



The development of atomic models started in 465BC, with Greek philosopher Democritus hypothesising matter was made from atoms. Democritus described atoms as solid and invisible with varying shapes and sizes. In 1804, John Dalton built upon this idea, suggesting particles were spherical, with each element having unique atoms. In 1897, J.J. Thompson discovered the electron which was used to produce the 'Plum Pudding Model' of atomic structure shown to the right. As the mass of electrons was much smaller than that of an atom and atoms were known to be electrostatically neutral, Thompson suggested atoms were spheres of positive charge containing negatively charged electrons. In 1911, Ernest Rutherford suggested an early form of the 'Nuclear Model' accepted today. Rutherford's team emitted alpha particles (radiation) at atoms in gold foil and identified many alpha particles passed through the atoms of the foil, with a few alpha particles being 'reflected' back. In Rutherford's model it was proposed that mass is concentrated in the central nucleus of the atom and much of an atom is empty space. The use of this 'Nuclear Model' eventually led to the discovery of positively charged protons and in 1932, the discovery of neutrons by Chadwick.

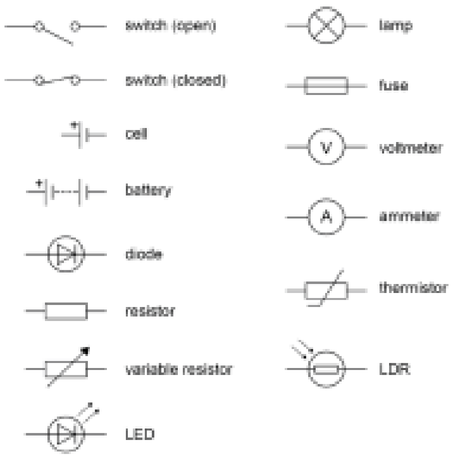
Standard Form and Conversions

Atoms have a **diameter** within the range of 0.1 to 0.5 nanometres depending on the **element**. 1 nanometre is equal to 0.000000001 metres which can make calculations involving these small figures complicated. In order to simply these equations standard form is used. Standard form is used to represent incredibly large or incredibly small numbers to a power of 10. If 1,000,000 was to be **converted** to standard form, the number of figures between 1 and the decimal point would be counted, in this case 6. As there are 6 figures between 1 and the decimal point, the power used is 10^6. To finalise this standard form the first digit, 1, will be taken and multiplied by 10^6 resulting in 1×10^6. When applying this to numbers such as 0.000000001, the power becomes negative, in this case becoming 1×10^{-9}

Science- Physics
Electricity

Topic 2: Electrical Charges & circuits

1. Circuit Diagram Symbols



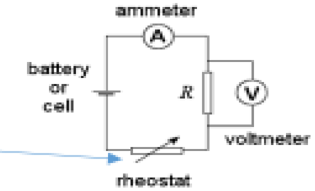
2. Charge & Current

- **Charge**: e.g. electrons – SI unit is **coulombs** (C)
- **Current**: (rate of) flow of charge – SI unit is **amps** (A)
- **Q = I t**
  charge (C), current (A), time (s)

3. Current, Resistance & PD

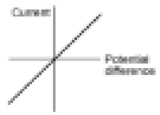
- **PD**: **potential difference** (voltage) – the energy gained or lost by each coulomb of charge – needed for a current - SI unit is **volts** (V)
- **Resistance**: how difficult it is for the electricity to pass – SI unit is **ohms** (Ω)
- Higher resistance means lower current for a given PD
- **V = I R**
  PD (V), current (A), resistance (Ω)
- Circuit for investigating this:

For varying the current through the resistor

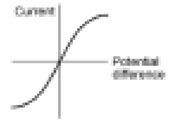


4. Resistors

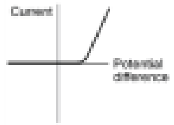
- Ohmic conductor (e.g. fixed resistor): Current directly proportional to PD (resistance does not change)



- Bulb: resistance increases as the temperature of the filament increases



- Diode: current only flows in one direction; it has a v. high resistance in reverse direction

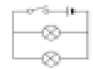


- Thermistor: resistance decreases as temperature increases (used in thermostats)
- LDR: (light dependent resistor) - resistance decreases as light intensity increases (used to switch lights on when it gets dark)

5. Series & Parallel

Series: one loop

- Same current all the way round
- Power supply PD shared between components
- Total resistance = add them up
- Adding resistors → higher resistance as all the current has to go through all the resistors



Parallel: more than one loop

- PD across components all the same
- Total current = add up currents through separate components
- Total resistance = smaller than the smallest resistor
- Adding resistors → lower resistance as current has more paths to go through

8. Energy Transfers in Everyday Appliances

- Work is done when charge flows in a circuit
- **E = P t**
  energy transferred (J), power (W), time (s)
- **E = Q V**
  energy transferred (J), charge (C), PD (V)

Topic 3: Power & Electrical safety

Power

You should recall that power is **the rate of energy transfer**, or the rate at which work is done. In electrical components, including any electrical appliance, the power relates to the potential difference across the component and the current through it. If either p.d. or current increases, the power increases. In other words, the rate of energy transfer increases. This should be clear from the first equation.

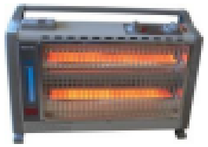
The second equation also finds the power. The equation comes from substituting in $V = IR$. The second equation is useful if you don't know the p.d. across a component.

Energy transfers in electrical appliances

The whole point of electrical appliances is to transfer energy. The electrical potential energy from the supply is transferred to something useful – such as light and sound in your TV. The other way of saying this is that **work is done** when **charge flows** in a circuit.

Some examples of energy transfers in electrical appliances:

- In your mobile phone, electrical potential energy from the dc supply (the battery) is transferred to light, sound and thermal energy. This means the energy from the battery is **dissipated** to the surroundings.
- A washing machine transfers electrical potential energy from the ac mains supply to kinetic energy in the electric motor (that's why it spins), along with heat. Eventually, all the energy of the input is dissipated to the surroundings.
- An electric heater transfers the electrical potential energy of the supply to thermal energy. The energy stored in the supply ends up stored in the air, the walls, the floor and so on around the heater: stored in the heat of the materials.

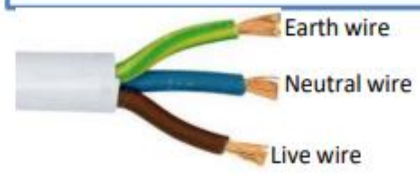


The amount of energy transferred by an appliance depends on the **power** of the appliance and the **time** it is switched on for. To find the amount of energy transferred, simply multiply the power of the appliance by the time it is on for (see third equation).

Furthermore, since p.d. is a measure of how much work is done per coulomb of charge, you can find out how much work is done (aka energy transferred) by a circuit by multiplying the charge flow by the p.d. (see fourth equation).

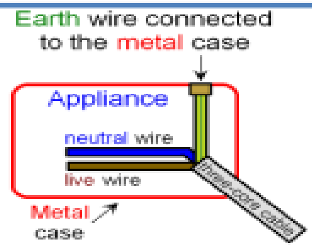
Three-core cables

We connect most electrical appliances to the mains with a three-core cable. The three pins on a plug are just the three ends, or terminals, of the three wires in the cable. Each wire in insulated in a different colour.



Wire in three-core cable	Colour code of the insulation	Function
Live wire	Brown	Carries the alternating p.d. from the supply to the appliance
Neutral wire	Blue	Completes the circuit. The neutral wire is at 0 V (earth potential).
Earth wire	Yellow and green stripes	Earth wires are at 0 V. They are safety wires, and only carry a current if there is a fault and the appliance has become live (electrified).

DANGER (and safety)



The earth wire carries current to the ground (literally, earth). This makes circuits safer because if there is a fault, it conducts the current to the ground rather than making the appliance 'live'. Appliances become live if the live wire touches the case. This is particularly a problem with metal-cased appliances, like cookers or toasters.

The live wire is the most dangerous one, since it is at 230 V. it should never touch the earth wire (unless the insulation is between them, of course!), because this would make a complete circuit from your mains supply to the ground (earth). A shock or fire would be highly likely.

Even if a circuit is switched off (i.e. the switch is **open**), the live wire can still be dangerous. If you touch it, you may complete a circuit between the live wire and the earth (because you'll be standing on the floor), so you get a shock.

Science
Support and application

Vocabulary

1. **Element**
2. **Proton**
3. **Neutron**
4. **Electron**
5. **Subatomic**
6. **Nucleus**
7. **Charged**
8. **Negligible**
9. **Particle**
10. **Kinetic**
11. **Circuit**
12. **Potential difference (V)**
13. **Current- Ampere (I)**
14. **Resistance- Ohms**
15. **Series circuit**
16. **Parallel circuit**
17. **Power – watts (W)**
18. **Work done**
19. **Diode**
20. **Thermistor**
21. **Coulombs (C)**
22. **resistor**

Wider Research

Build an Atom–
https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html

The Atomic Model–
https://www.youtube.com/watch?v=xazQRcSCRaY

The Particle Model–
https://www.bbc.co.uk/bitesize/topics/z3ybb82

How electricity works
https://www.youtube.com/watch?v=mc979OhitAg

Electrical current explained
https://www.youtube.com/watch?v=kcL2_D33k3o

Electricity
https://www.bbc.co.uk/bitesize/topics/zcg44qt

Equation	Meanings of terms in equation
* $P = V\,I$	*P = power (watts, W)* *V = potential difference (volts, V)* *I = current (amps, A)*
* $P = I^2\,R$	*P = power (watts, W)* *I = current (amps, A)* *R = resistance (ohms, Ω)*
* $E = P\,t$	*E = energy transferred (joules, J)* *P = power (watts, W)* *t = time (seconds, s)*
* $E = Q\,V$	*E = energy transferred (joules, J)* *Q = charge flow (coulombs, C)* *V = potential difference (volts, V)*

Apply

Chemistry:

1. Construct a table to represent the three subatomic particles of an atom, their masses as well as their charges.
2. Compare the 'Nuclear Model' of atomic structure to the 'Plum Pudding Model'. Consider mass and charge in your answer.
3. Convert the following to standard form:
   15,000
   2,539,000
   0.0058
   0.00002687

Physics: Topic 2

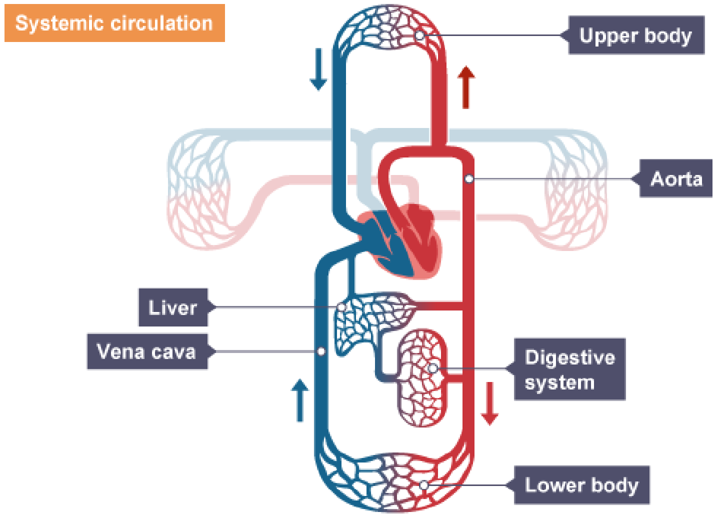
1. If a device has a current 5amps (A) and is switched on for 60 seconds (s) what would its charge (C) be?
2. What would its charge be for 5 minutes?
3. Why does the resistance increase in a filament bulb the longer the light is on?
4. What is the main difference between a series and parallel circuit?
5. Why are diodes used in most modern electrical devices?
6. Calculate the PD (Voltage) of a series circuit running 6amps and a resistance of 2 Ohms? Is this likely to be a DC or AC circuit, justify your answer.

Physics: Topic 3 (use the equations on the left).

7. Calculate how much energy is transferred (j) by an electric kettle with a power of 2000W (2Kw) switched on for 4 minutes.
8. Calculate the power of a device with a current of 8.7 amps and a resistance of 26.4 ohms. What appliance is this likely to be based on its power rating?
9. Why is the earth wire attached to the casing of the appliance?
10. Where does all energy transferred to appliances eventually go?
11. Why is main electricity rated at 230v so much more dangerous than a battery rated at 6v?

Science - Biology
Systems in the Human Body

Topic 1: Systems in the Human Body



<u>Respiration</u>

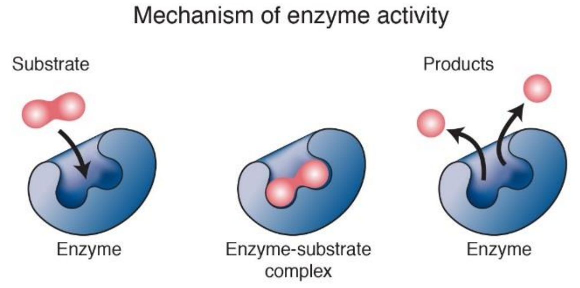
- Respiration is a reaction in which energy stored in compounds such as glucose is released through cell reactions.
- The energy from respiration is used for all cell reactions in the body including digestion and muscle movement.
- There are two methods of respiration, aerobic respiration and anaerobic respiration.
- Aerobic respiration uses oxygen to release a lot of energy stored in glucose, whereas anaerobic respiration does not utilise oxygen, releasing less energy. Aerobic respiration is represented by the equation: Glucose ($C_6H_{12}O_6$) + Oxygen ($6O_2$) -> Carbon dioxide ($6CO_2$) + Water ($6H_2O$).
- Anaerobic respiration is represented by the equation: Glucose -> Lactic acid (Lactate). Aerobic respiration is an oxidation reaction which occurs mainly in the mitochondria of cells, while anaerobic respiration is an incomplete oxidation reaction that occurs in the cytoplasm.

<u>Circulatory System</u>

- The circulatory system is a method of transport in the body and is made up of the heart, blood vessels and blood. The heart pumps blood around the body through muscle contraction.
- Deoxygenated blood enters the heart through the Vena Cava and fills the compartment known as the right atrium.
- The right atrium will contract forcing the deoxygenated blood through a valve into the right ventricle.
- The valve the blood passed prevents back flow in the heart. In the right ventricle, the compartment will contract forcing blood through another valve into the pulmonary artery, which transports the deoxygenated blood to the lungs for gaseous exchange.
- Once oxygenated at the lungs, the blood is transported back to the heart and enters through the pulmonary vein into the left atrium.
- The left atrium contracts forcing blood to the left ventricle, which will contract forcing blood into the aorta to transport the oxygenated blood to the rest of the body.
- The left side of the heart is made up much thicker muscle because it must move the blood through the aorta with enough force to circulate around the body.

<u>Digestive System</u>

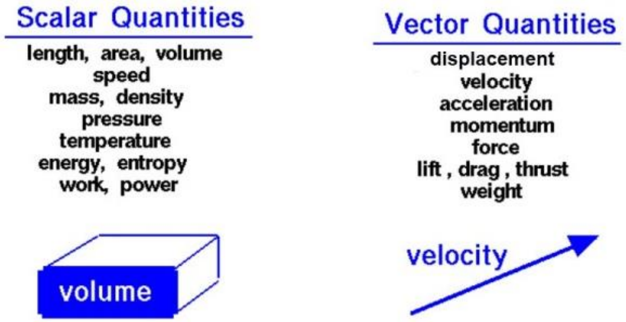
- The digestive system breaks down complex structures into simple molecules.
- Digestion occurs using enzymes, biological molecules that facilitate a reaction in a substrate without being used up themselves. Enzymes end in –ase.
- Different enzymes break down different substrates, carbohydrase breaks starch into glucose, protease breaks proteins into amino acids and lipase breaks fats into fatty acids and glycerol.
- Unwanted amino acids are converted to urea by the liver and excreted as urine by the kidneys.



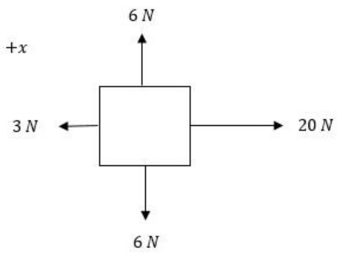
Science - Physics
Forces

Topic 2: Forces

Vector or Scalar, Contact or Non-Contact



- Physical quantities are measured using a scale, two forms: Vector Quantities and Scalar Quantities.
- Scalar and vector quantities have magnitude (have an amount) but vector quantities also have direction.
- Forces can be contact or non-contact. Forces such as friction are contact as it requires two surfaces to be moving past eachother. Gravity is a non-contact force as it acts upon an object even though there is no physical interaction between the force and object.



Free Body Diagrams

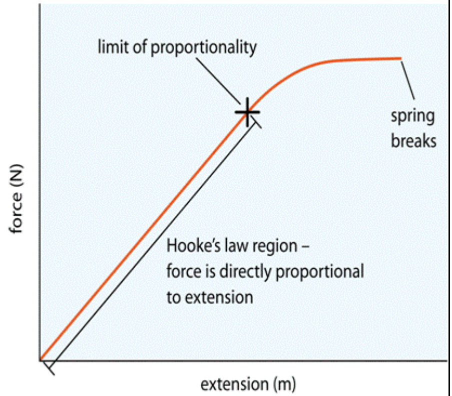
- Free body diagrams are used to demonstrate different forces acting upon an object.
- Free body diagrams will show the forces acting from central point.
- The downwards arrow usually represents the force weight, the upwards arrow reaction force or up thrust and the left and right arrows demonstrating either thrust or air resistance/friction.

Work Done

- Work done is the energy transferred to an object via a force to change the speed, direction or shape of that object.
- Work done is calculated using the equation: Work done = Force (N) x Distance (m).
- As work done is the energy transferred to an object, work done is measured in Joules.

Weight

- Weight is the downwards force acting upon an object, it can be calculated using the equation: Weight = Mass x Gravitational field strength.
- The gravitational field strength of Earth is 9.8N/kg, meaning for every 1kg of mass, 9.8N of force is exerted down as weight.
- Gravitational field strength can vary between the different planets and other celestial objects in the universe. For example, the gravitational field strength of the moon is 1.6N/kg, meaning a person with a mass of 70kg exerts a weight of 112N on the moon. This same mass will exert a force of 686N on Earth.



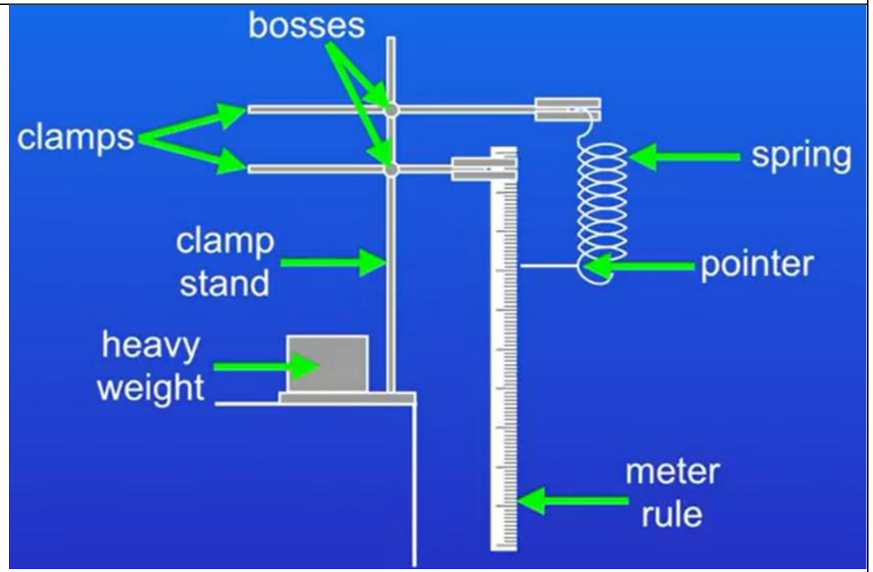
Elastic Potential Energy

- Work is done when a spring is compressed or extended, transferring energy to the spring.
- The work done to the spring will be equal to the elastic potential energy stored within the spring, which can be calculated using the equation: Elastic potential energy = 0.5 x Spring constant x $(\text{Extension})^2$.
- Elastic potential energy will be measured in joules, the spring constant is measured in Newtons per metre (N/m) and extension is measured in m.
- A spring can only be extended by a specific amount of force until it reaches an extension from which it will not return to its original shape.
- This is known as the limit of proportionality. If a spring has a spring constant of 3N/m and is extended by 50cm the elastic potential energy stored in the spring can be calculated using: 0.5 x 3N/m x $(0.5\text{m})^2$ = 0.375J.

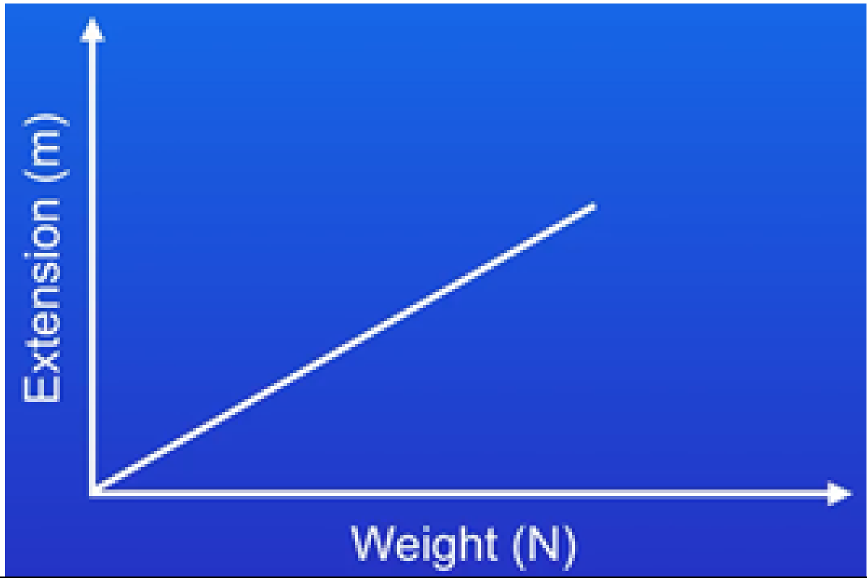
Science- Physics Core Practical
Forces and Extension – Hooke's Law

Topic 3: Forces and Extension

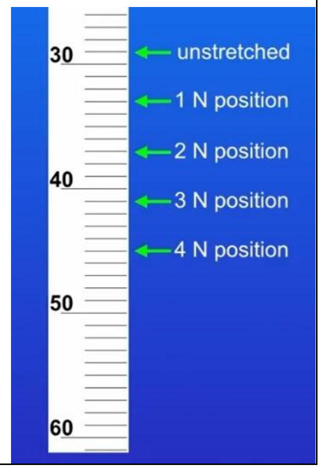
Practical Method



- The aim of this required practical is to investigate the relationship between the force exerted on a spring and the extension of a spring.
- To conduct this experiment a clamp stand must first be set up with two clamps at varying levels.
- On the highest clamp, a spring is attached, with a pointer at the bottom of the spring and on the lower clamp a metre ruler attached.
- The top of the spring must be in line with the zero mark of the metre rule so the level of extension can be accurately recorded. The point on the spring will show the distance moved as the spring extends.
- The initial length of the spring where the pointer is indicating must be recorded to identify this extension. A heavy weight can also be placed onto the clamp stand to prevent the equipment toppling over the bench.
- One Newton (1N) weights can then be added to the spring to cause extension and the distance shown on the metre rule recorded.
- After each 1N weight is added the extension of the spring can be identifed by recording the new length of the spring and substracting the initial length of the spring.



- The data obtained from this investigation used to plot a graph detailing the weight in Newtons along the x-axis and the extension of the spring (m) along the y-axis.
- The second part to this practical is to idenfy the weight of an object based upon the extension of the spring, utilising the graph produced earlier.
- The same method of measuring spring extension will be used as before, the unknown weight is attached to the spring and the extension measured from the metre ruler.
- This extension will be identified on the graph and a line drawn parallel to the x-axis from the measured extension until the line of best fit is intercepted.
- A second line will be drawn parallel to the y-axis from this intercept to identify the weight of the unknown object.



Science
Support and application

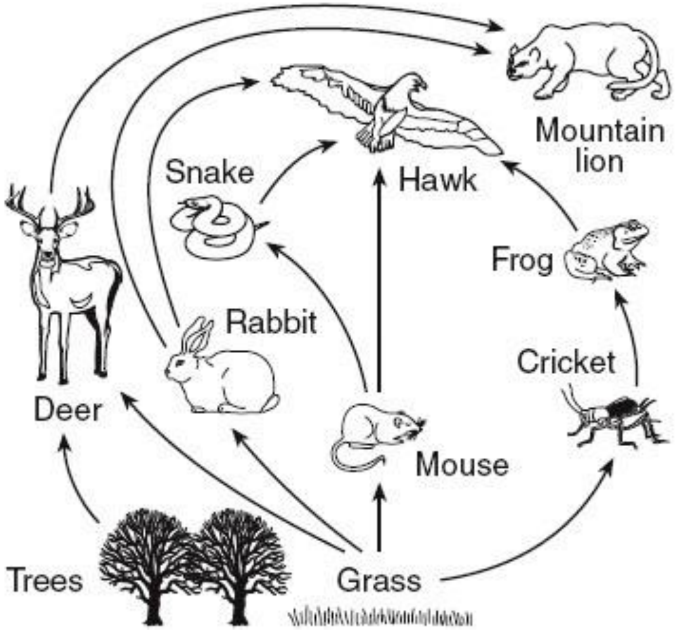
Vocabulary	Wider Research	Apply
23. Force **24. Vector** **25. Scalar** **26. Magnitude** **27. Resistance** **28. Friction** **29. Gravity** **30. Weight** **31. Newton** **32. Joules** **33. Exerted** **34. Proportionality** **35. Compression** **36. Extension** **37. Newton** **38. Relationship** **39. Accuracy** **40. Parallel** **41. Intercept** **42. Equipment** **43. Enzyme** **44. Vessel** **45. Substrate** **46. Ventricle** **47. Atrium** **48. Contraction** **49. Aerobic** **50. Anaerobic** **51. Respiration** **52. Deoxygenated**	Work done – https://www.bbc.co.uk/bitesize/guides/z8pk3k7/revision/1 Forces – https://www.bbc.co.uk/bitesize/guides/zq94y4j/revision/1 Investigating force and weight – https://www.youtube.com/watch?v=jQAt3e6Bz7U Required Practical Simulation – https://phet.colorado.edu/sims/html/masses-and-springs/latest/masses-and-springs_en.html Digestive System - https://www.bbc.co.uk/bitesize/guides/zxcrsrd/revision/1 Circulatory System - https://www.bbc.co.uk/bitesize/guides/zhnk7ty/revision/1	Forces and Energy Change: 1. Draw a free body diagram to show a box with a weight of 50N and a reaction force of 50N. The box is being pushed to the right with a force of 70N and there is an opposite frictional force of 20N. 2. Calculate the resultant force pushing the box above to the right. 3. Compare the weight of a person on Earth and on the moon, who has a mass of 60kg. Hooke's Law Required Practical: 1. Explain the importance of a pointer to investigate the relationship between force and spring extension. 2. Explain what is meant by the limit of proportionality and predict the change in the shape of a spring past this limit Systems in the Human Body: 1. Create a flow chart to show the movement of food through the digestive system. Include the function of each digestive organ. 2. Create a flow chart to show the moment of blood through the circulatory system. Include labels for deoxygenated and oxygenated blood. 3. Create a Venn diagram to compare anaerobic and aerobic respiration. What are the similarities? What are the differences?

Science - Biology
Ecosystems and Biodiversity

Topic 1: Ecosystems and Biodiversity

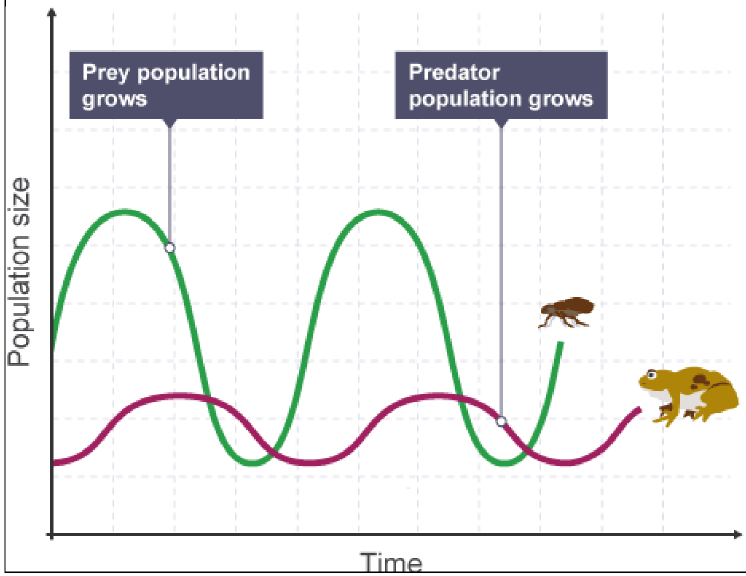
Ecosystem Organisation

- Ecosystems consist of interacting communities of organisms. Communities are groups of different species e.g. Trees, Deer and Mountain Lions.
- The interaction of different species is shown in food webs which display consumption or predation.
- Food webs have producers (plants that synthesise their own glucose), consumers (organisms that consume producers) and predators (organisms that consume other organisms).
- Prey refers to organisms that are consumed by predators.
- Prey and predator populations fluctuate overtime due to increased or decreased predation.



Biodiversity

- Refers to the variation in organism species within an ecosystem.
- A greater biodiversity is preferred as this strengthens the interaction between different organisms e.g. more than one prey species for a predator will help prevent over-hunting or the extinction of that species if one prey organism went extinct.



Competition

- Organisms compete with each other for resources in an ecosystem
- Plants can compete for resources such as light, water and minerals in the soil.
- Animals can compete for resources such as food, territory and mates.

Human Impact

- Humans have damaged ecosystems over time through over-hunting, pollution and over-utilisation of resources. E.g. tree in the Amazon Rainforest being cut down for timber and use of agricultural land.
- This damage to ecosystems has caused a reduction in biodiversity due to the extinction of species.
- Humans have been working to protect ecosystems from further damage.
- This includes captive breeding programmes to help endangered species reproduce, protecting large areas of land as National Parks and reducing the over-utilisation of natural resources such as wood.

Topic 2: Atoms and Ions

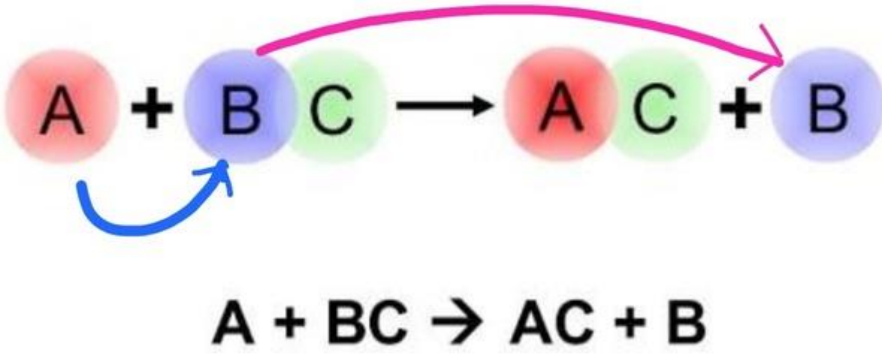
potassium	most reactive	K
sodium	↑	Na
calcium		Ca
magnesium		Mg
aluminium		Al
carbon		C
zinc		Zn
iron		Fe
tin		Sn
lead		Pb
hydrogen		H
copper		Cu
silver		Ag
gold	↓	Au
platinum	least reactive	Pt

Reactivity Series

- Reactivity refers to a substances tendency to change (react).
- Some substances are more reactive than others and this is shown in the reactivity series.
- Group 1 (alkali metals) elements such as potassium are incredibly reactive substances and are higher up the reactivity series.
- Elements like gold are very unreactive and so are further down the reactivity series.

Displacement Reactions

- More reactive elements can replace less reactive elements in a reaction.
- This type of reaction is known as a displacement reaction.
- When copper chloride reacts with sodium, sodium chloride and copper will be produced.



Electrolysis

- Electrolysis is a method of separation that splits compounds using electricity
- There are two electrodes in electrolysis. The cathode is negatively charged and attracts positively charged ions (cations). The anode is positively charged and attracts negatively charged ions (anions).
- This difference in charge at the electrodes is caused by the movement of electrons through a circuit.
- The solution containing the cations and anions to be separated is known as an electrolyte. The solution is typically formed by dissolving compounds in water.
- Separating a solution of hydrochloric acid by electrolysis would produce hydrogen gas at the cathode as hydrogen ions are attracted to the negative charge.
- The hydrogen ions gain electrons to form hydrogen gas.
- Chlorine gas would be produced at the anode as the chloride ions are attracted to the positive charge.
- The chloride ions lose electrons to form chlorine gas.

Chlorine	Test with damp litmus paper.	*Turns red then bleaches*
Oxygen	Test by holding a glowing splint into a test tube of the gas.	*Will relight*
Carbon dioxide	Test by bubbling through limewater.	*Turns cloudy*
Hydrogen	Hold a lit split at the end of a test tube of the gas.	*Will hear a squeaky pop*

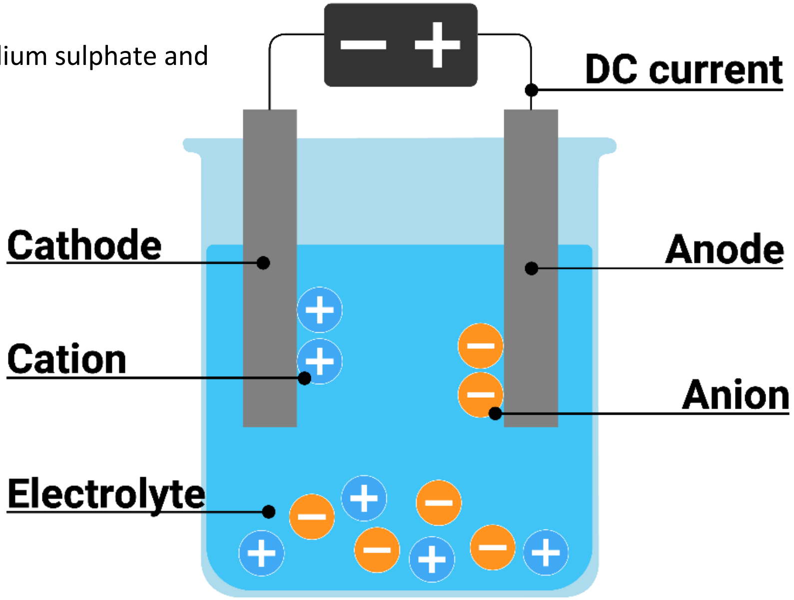
Gas Tests

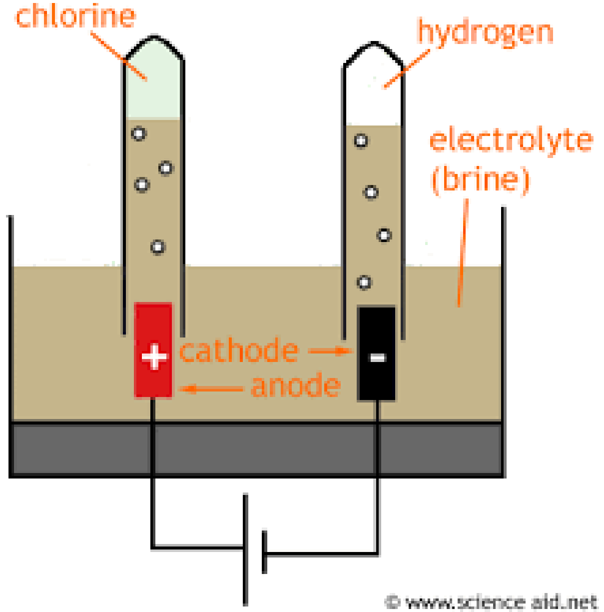
- The type of gas produced by electrolysis can be identified by conducting gas tests.
- These tests are shown in the table to the left.

Topic 3: Electrolysis

Practical Method

- Electrolysis can be used to separate the following substances: Copper sulphate, Copper chloride, Sodium sulphate and sodium chloride.
- To separate copper sulphate, 50cm^3 of copper sulphate solution is added to a beaker.
- A lid containing two graphite (carbon) electrodes is placed on top of the beaker.
- The two electrodes must not touch in the solution.
- A circuit is set up using a low voltage power supply to connect the two electrodes.
- The power supply will be switched on to 4V to allow current to flow
- In the electrolyte solution, bubbling will be seen at the anode as oxygen gas is produced.
- At the cathode, copper will start to build up on the outside of the electrode.
- The electrodes can be cleaned and reused to separate other solutions.
- Copper chloride will see copper formed at the cathode and chlorine gas formed at the anode.
- Sodium sulphate will see sodium formed at the cathode and oxygen gas formed at the anode.
- Sodium chloride will see sodium formed at the cathode and oxygen formed at the anode.





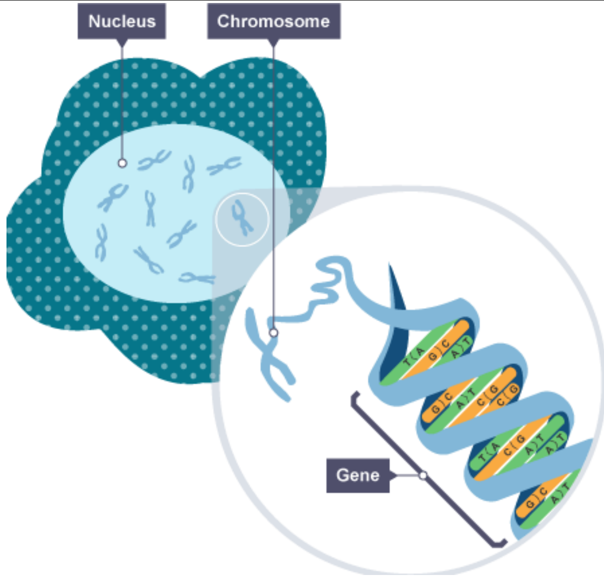
Hazard	Harm	Precaution
Copper sulfate solution	Causes skin irritation	Wear gloves
Copper sulfate solution	Causes serious eye irritation	Wear eye protection
dc electricity supply	Electric shock	Make sure electrodes do not touch; make sure that electricity supply is switched off before handling apparatus

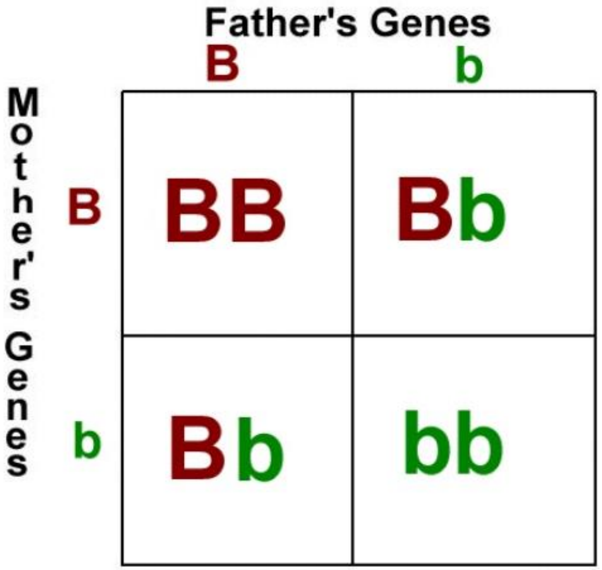
Vocabulary	Wider Research	Apply
53. Ecosystem 54. Producer 55. Consumer 56. Predator 57. Prey 58. Competition 59. Biodiversity 60. Variation 61. Resources 62. Pollution 63. Extinction 64. Endangered 65. Protection 66. Reproduction 67. Community 68. Electrolysis 69. Anode 70. Cathode 71. Anion 72. Cation 73. Electron 74. Electrolyte 75. Solution 76. Reactivity 77. Displacement 78. Conduction 79. Voltage 80. Separation 81. Precaution 82. Irritation	Ecosystems – https://www.bbc.co.uk/bitesize/guides/z9nwtv4/revision/1 Structure of an Ecosystem - https://www.youtube.com/watch?v=eGG7hyx_HlA Reactivity and Displacement - https://www.youtube.com/watch?v=-R2eNZRzg7Q Electrolysis - https://www.bbc.co.uk/bitesize/guides/z9h9v9q/revision/1 Electrolysis Practical Method - https://www.youtube.com/watch?v=AhTRiL6xjBA	Ecosystem and Biodiversity: 4. Research organisms in one of the following ecosystems: Arctic Environment, Forest Environment or Desert Environment. Using information about the plants and animals, create a food web to show the interaction between the organisms. 5. Following the recent Australian Bushfires. Suggest how humans could help support organisms like Koalas so they do not become extinct in the future. Atoms and Ions: 3. Complete the following displacement reactions: • Copper Sulphate + Magnesium • Sodium Chloride + Iron • Potassium + Calcium Nitrate • Aluminium Chloride + Magnesium • Tin + Zinc Sulphate Electrolysis Practical: 4. Create a diagram to show the electrolysis of sodium sulphate. In your diagram highlight what is being produced at each electrode as well as the charges of both electrodes and ions.

Topic 1: Inheritance, Variation and Evolution

DNA and the Genome

- DNA is a polymer of nucleotides (made up of a phosphate, deoxyribose sugar and a base).
- A small section of DNA that codes for a protein is known as a gene. The entire length of DNA that exists in an organism is known as the genome.
- Large pieces of DNA condensed together are known as chromosomes. These contain many different genes for different traits of the body.





Inheritance

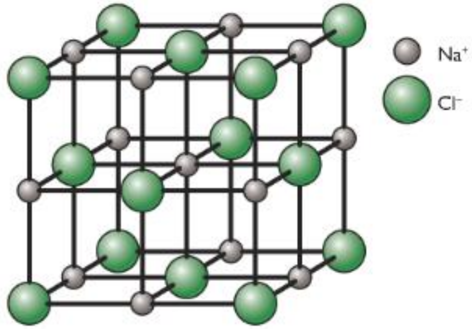
- DNA is passed on from parents to their offspring.
- Genes can be in different forms and these are known as alleles. For example – hair colour is coded for by genes but the DNA sequence is different for Brown hair, Blonde Hair, Black Hair etc.
- Alleles inherited from parents can be dominant (if inherited they will be expressed) or recessive (will only be expressed if inherited from both parents).
- Organisms can be heterozygous or homozygous. Heterozygous organisms will have two different alleles inherited from their parents, e.g. Bb. Homozygous organisms will have inherited the same allele from each of their parents e.g. BB or bb.
- The allele combination is known as the genotype while the physical expression of the gene is known as the phenotype.
- We use Punnett squares to represent the inheritance of alleles from parents. One box on the Punnett square represents a 25% chance of getting that genotype.

Evolution

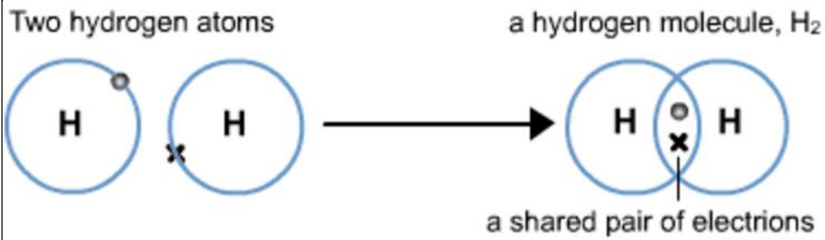
- Within a population there is variation in the physiological characteristics of organisms. Those organisms better suited to their environment, are more likely to survive, reproduce and have offspring with similar characteristics, this is known as Natural Selection. These natural variations are caused by mutations in the DNA sequence.
- We can use fossils to see the changes in a population over time. For example, the evolution of humans can be seen through fossils collected that show the progression of humans from hominids.

Topic 2: Structure and Bonding

Ionic Bonding and Ionic Lattices



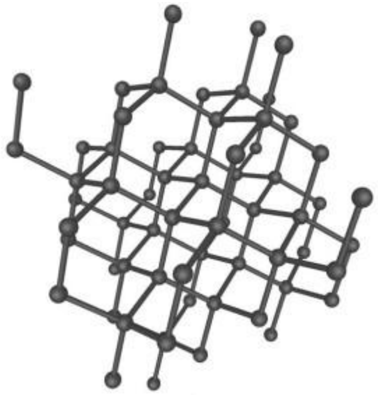
Ionic bonding is the electrostatic attraction between a positively charged ion (cation) and a negatively charged ion (anion). These ions are formed through the transfer of electrons in order to obtain a full outer shell. Elements in group 1 of the periodic table have one electron in their outer shell, in order for these elements to have a full outer shell, they need to lose the one electron. Losing this electron will mean the group 1 elements have one more positively charged proton than they do negatively charged electrons which results in an overall +1 positive charge. The electron lost by the group 1 elements can be transferred to elements in group 7. Group 7 elements have seven electrons in their outer shell and require eight electrons to have a full outer shell. The electron lost by the group 1 element can be gained by the group 7, giving one more negatively charged electron than positively charged protons, resulting in an overall -1 charge. The strong electrostatic interaction between the charged ions requires a lot of energy to break, causing ionic compounds to have high melting and boiling points. Ionic compounds are usually arranged in ionic lattices, large repeating structures of cations and anions as seen to the right. The positively charged cation, in the lattice shown Na^+, if surrounded by four negatively charged ions (Cl^-). Each of those anions is surrounded by four cations and so on. This results in an ionic compound that is overall electrostatically neutral.

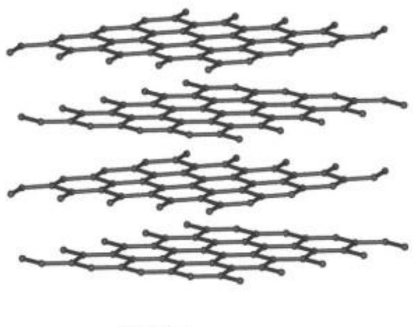


Covalent Bonding and Giant Covalent Compounds

Covalent bonding is the sharing of electrons between two atoms. For example, in a hydrogen gas molecule, each hydrogen atom shares one electron with the other atom. This results in both atoms having a full outer shell of electrons. A single covalent bond is made up of two electrons or one pair. A double covalent bond is made up of four shared electrons or two pairs. These covalent bonds can be drawn using a dot and cross diagram as represented by the diagram to the left. Electrons are drawn as either dots or crosses to differentiate which atom is sharing which electrons. Covalent bonds can be found in giant covalent compounds such as diamond, graphite, graphene and Buckminster fullerenes.

Diamond is a giant covalent compound consisting of carbon atoms arranged in a tetrahedral structure (a triangular pyramid with four faces). Each carbon atom is covalently bonded to four other carbon atoms. This leaves no free electrons to conduct electrical current making diamond an electrical insulator. Graphene is a single layer of hexagonally arranged carbon atoms, where each atom is covalently bonded to three other carbon atoms. This leaves free electrons that are able to conduct electrical current, making graphene a goof electrical conductor.

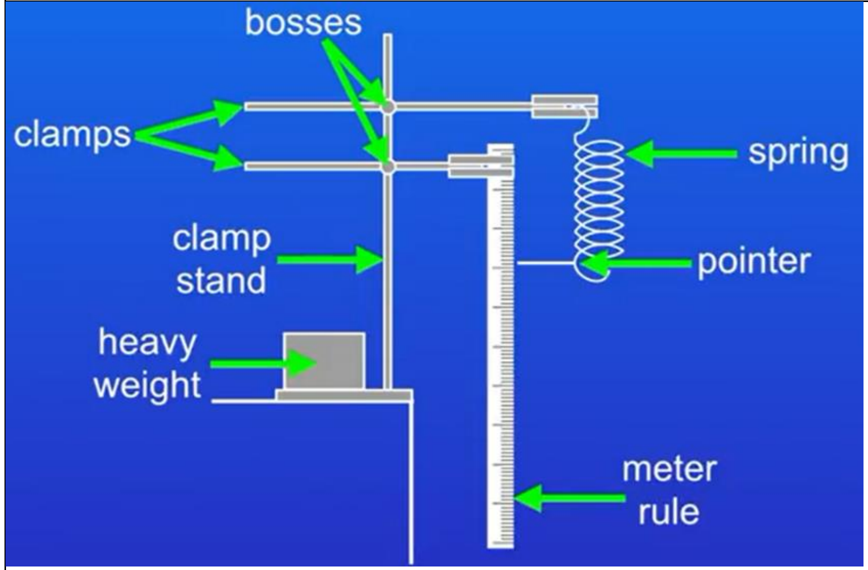

Diamond


Graphene

Metallic Bonding

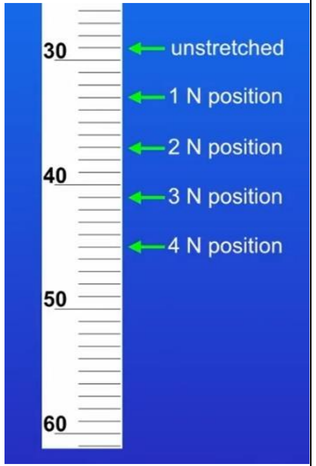
Metallic bonding occurs by the electrostatic interaction from a sea of delocalised negatively charged electrons and positively charged metal cations. This sea of delocalised electrons is what can conduct an electrical current in wires.

Topic 3: The relationship between force and spring extension

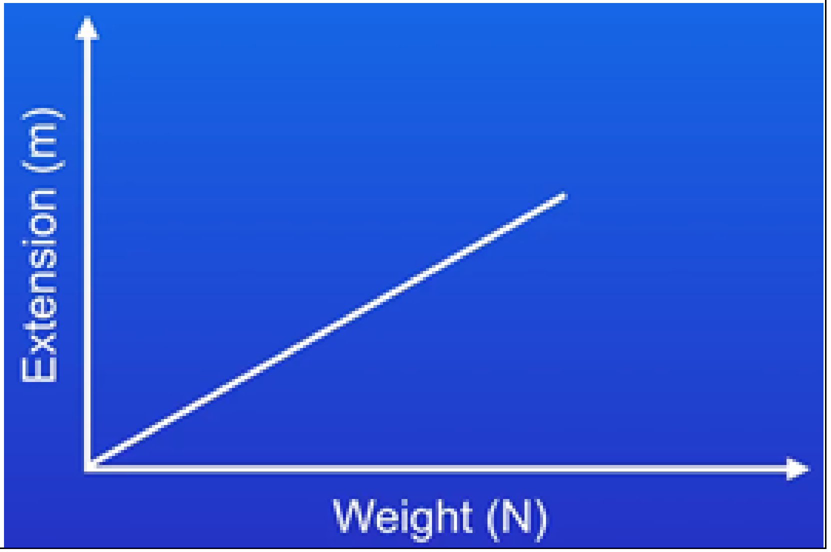


Practical Method

The aim of this required practical is to investigate the relationship between the force exerted on a spring and the extension of a spring. To conduct this experiment a clamp stand must first be set up with two clamps at varying levels. On the highest clamp, a spring is attached, with a pointer at the bottom of the spring and on the lower clamp a metre ruler attached. The top of the spring must be in line with the zero mark of the metre rule so the level of extension can be accurately recorded. The point on the spring will show the distance moved as the spring extends. The initial length of the spring where the pointer is indicating must be recorded to identify this extension. A heavy weight can also be placed onto the clamp stand to prevent the equipment toppling over the bench.



One Newton (1N) weights can then be added to the spring to cause extension and the distance shown on the metre rule recorded. After each 1N weight is added the extension of the spring can be identifed by recording the new length of the spring and substracting the initial length of the spring. The data obtained from this investigation used to plot a graph detailing the weight in Newtons along the x-axis and the extension of the spring (m) along the y-axis. The second part to this practical is to idenfy the weight of an object based upon the extension of the spring, utilising the graph produced earlier. The same method of measuring spring extension will be used as before, the unknown weight is attached to the spring and the extension measured from the metre ruler. This extension will be identified on the graph and a line drawn parallel to the x-axis from the measured extension until the line of best fit is intercepted. A second line will be drawn parallel to the y-axis from this intercept to identify the weight of the unknown object.



Vocabulary	Wider Research	Apply
83. Gene 84. Allele 85. Genome 86. Chromosome 87. Recessive 88. Dominant 89. Phenotype 90. Genotype 91. Homozygous 92. Heterozygous 93. Exerted 94. Proportionality 95. Compression 96. Extension 97. Newton 98. Electrostatic 99. Cation 100. Anion 101. Ionic 102. Transferred 103. Electron 104. Lattice 105. Covalent 106. Shared 107. Delocalised 108. Relationship 109. Accuracy 110. Parallel 111. Intercept 112. Equipment	Mendelian Genetics - https://www.youtube.com/watch?v=Mehz7tCxjSE Variation and Evolution - https://www.youtube.com/watch?v=VjlE5Qzl1S0 Simulating Natural Selection - https://phet.colorado.edu/en/simulation/natural-selection Ionic Lattices - https://www.youtube.com/watch?v=PNKsbnH1vw8 Covalent Structures – https://www.youtube.com/watch?v=FKTsQOpLwdE Dogs Teaching Chemistry: Chemical Bonds – https://www.youtube.com/watch?v=_M9khs87xQ8 Investigating force and weight – https://www.youtube.com/watch?v=jQAt3e6Bz7U Required Practical Simulation – https://phet.colorado.edu/sims/html/masses-and-springs/latest/masses-and-springs_en.html	Inheritance, Variation and Evolution: 5. Create a Punnett square to show the potential genotypes of two heterozygous dominant parents for blue eyes if "B" represents Brown eyes and "b" represents Blue eyes. Structure and Bonding: 1. Draw a dot and cross diagram to show the covalent bonding of a chlorine gas molecule. 2. Explain why graphene is a better conductor than diamond. 3. Suggest how ionic lattices could be altered to conduct electrical current. Required Practical: 4. Explain the importance of a pointer to investigate the relationship between force and spring extension. 5. Explain what is meant by the limit of proportionality and predict the change in the shape of a spring past this limit.

Science – Chemistry

Topic 1: Acids and Alkalis

Producing Salts

- When a metal reacts with an acid – a salt and hydrogen gas is produced
- When an acid reacts with an alkali (insoluble base) – a salt and water are produced.
- Hydrochloric acid produces chloride salts, nitric acid produces nitrate salts and sulphuric acid produces sulphate salts.

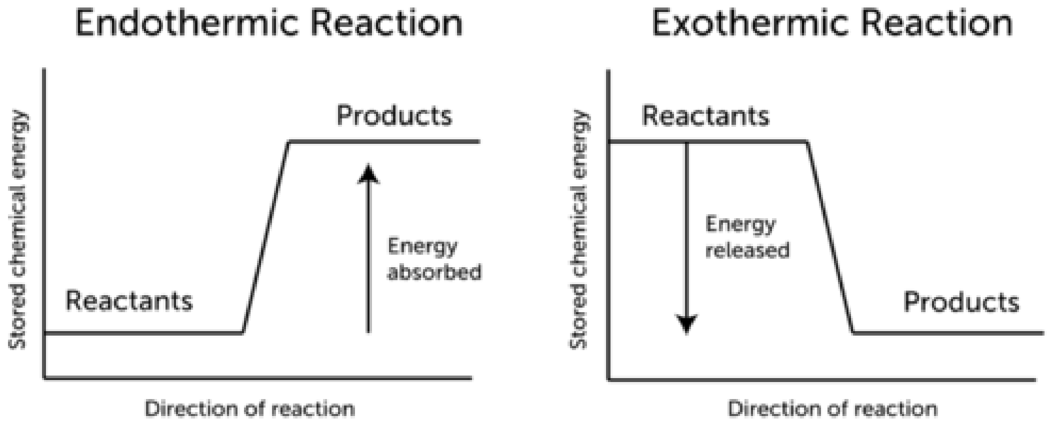
	Hydrochloric acid	Sulfuric acid	Nitric acid
Copper oxide	Copper chloride	Copper sulfate	Copper nitrate
Aluminium hydroxide	Aluminium chloride	Aluminium sulfate	Aluminium nitrate
Zinc carbonate	Zinc chloride	Zinc sulfate	Zinc nitrate

Neutralisation Reaction

- A neutralisation reaction occurs between an acid (pH below 7) and an alkali (pH above 7) to form a neutral (pH of 7) compound.
- The hydrogen ions (H^+) in the acid react with the hydroxide ions (OH^-) in the alkali (base) to form water (H_2O)

Endothermic and Exothermic

- An endothermic reaction transfers energy into the reaction from the environment
- An exothermic reaction transfers energy from within the reaction to the environment.
- An endothermic reaction causes the environmental temperature to decrease whereas an exothermic reaction causes the environmental temperature to increase.
- An endothermic reaction has reactants that possess less energy than the products.
- An exothermic reaction has reactants that possess more energy than the products.

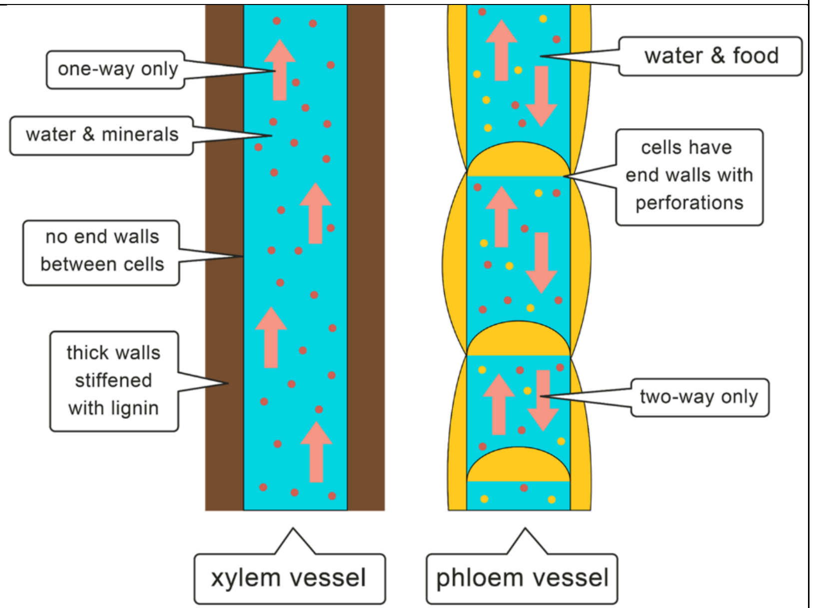


Science – Biology

Topic 2: Plants and Photosynthesis

Specialised Plant Cells, Tissues and Organs

- Plants have cells specialised for specific functions for example, root hair cells allow for the transport of water and mineral ions from the environment into a plant.
- The xylem is a specialised vessel in the plant, transporting water from the roots to the leaves, a process known as transpiration. The water transported to the leaves is evaporated and leaves the plant through the stoma (singular – stomata), tiny holes on a leaf.
- Guard cells cause the stomata to open or close in response to the rate of transpiration, a higher rate causes them to open and lower rate close. The rate of transpiration is affected by light intensity, wind intensity and temperature.
- The phloem is a specialised vessel in the plant which transports sugars around the plant for either immediate use in respiration or for storage. The movement of sugar in a plant is known as translocation.



Meristems

- Meristems are parts of the plant containing undifferentiated cells. These cells can divide and specialise to become any cell type in the plant.
- Meristems are located at root or shoot tips to allow for growth.

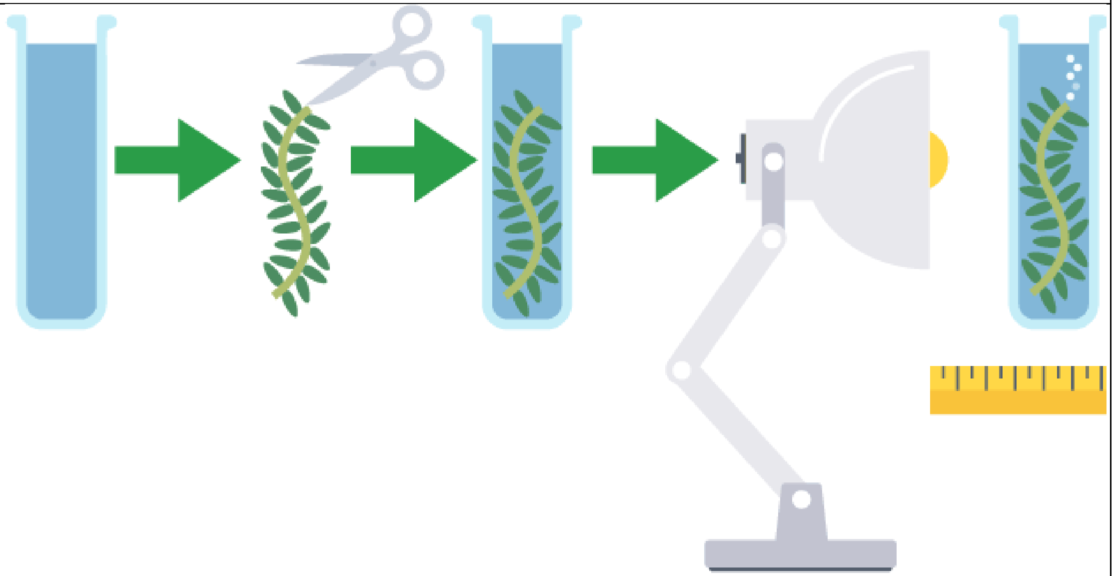
Photosynthesis

- Photosynthesis is an endothermic reaction that produces glucose and oxygen from carbon dioxide and water, using the energy transferred by light absorbed by chlorophyll in chloroplasts. Photosynthesis is represented by the following word and chemical equations:
- Carbon dioxide + Water -> Glucose + Oxygen $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 \rightarrow 6O_2$
- The glucose produced in photosynthesis can be used in respiration to release energy, stored as starch, used to form cellulose cell walls or help produce proteins with nitrate ions taken in by the root hair cells.
- The rate of photosynthesis is affected by the light intensity, carbon dioxide concentration and temperature.

Plant Diseases

- Tobacco Mosaic Virus (TMV) gives leaves a mosaic discolouration which affects the level of photosynthesis that can occur, impacting plant growth.
- Control methods of TMV include removing the infected plants from the area and cleaning gardening tools in between uses.
- Rose Black Spot is a fungal disease that causes black/purple spots to appear on leaves. These spots affect the rate of photosynthesis, impacting plant growth.
- Control methods of Rose Black Spot include not planting roses close together and removing fallen infected leaves that could release fungal spores.

Topic 3: Rate of photosynthesis



Practical Background

- The rate of photosynthesis can be investigated using the aquatic plant Elodea
- As the plants undergo photosynthesis, they release oxygen into the solution forming bubbles.
- The rate of photosynthesis can be investigated by counting the number of oxygen bubbles produced within a specific time frame.
- The independent variable (what is changed in an investigation) will be the distance of the light source from the Elodea plant (simulating light intensity).
- The dependent variable (what is measured in an investigation) will be the number of bubbles seen.
- An LED light is used to not increase the temperature of the Elodea plant; this means temperature is a controlled variable as it will be constant throughout the investigation.
- Sodium hydrogen carbonate is added to the water to ensure there is plenty of carbon dioxide to take place.

Practical Method

- A boiling tube containing a 45cm^3 of a 1% sodium hydrogen carbonate solution is set up and an 8cm piece of Elodea is added into the tube.
- Place the boiling tube 10cm from the light source and allow to stand for a few minutes. Count the number of bubbles being produced by the Elodea for one minute, repeating this at least three times.
- Repeat this process, placing the light source at different distances from the Elodea.

Risks

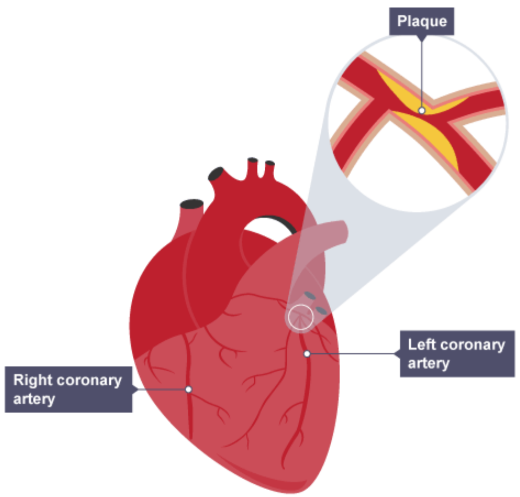
- This practical uses electrical equipment so care must be taken to keep the equipment dry.
- Ensure hands are not wet when handling the light source and moving it closer/further from the Elodea.

Vocabulary	Wider Research	Apply
113. Group **114. Period** **115. Reactivity** **116. Trend** **117. Halogen** **118. Alkali** **119. Inert** **120. Displacement** **121. Electron** **122. Arrangement** **123. Chlorophyll** **124. Chloroplast** **125. Xylem** **126. Phloem** **127. Meristem** **128. Specialised** **129. Transpiration** **130. Stomata** **131. Photosynthesis** **132. Limiting** **133. Measurement** **134. Control** **135. Dependent** **136. Independent** **137. Variable** **138. Constant** **139. Absorption** **140. Repetition** **141. Anomalous** **142. Average**	Development of the Periodic Table – https://www.youtube.com/watch?v=fPnwBITSmgU The Periodic Table – https://www.bbc.co.uk/bitesize/guides/z8b3h39/revision/1 Photosynthesis – https://www.bbc.co.uk/bitesize/guides/zcphqhv/revision/8 Core Practical: Photosynthesis – https://www.bbc.co.uk/bitesize/guides/zs4mk2p/revision/5 Core Practical: Photosynthesis – https://www.youtube.com/watch?v=id0aO_OdFwA	The Periodic Table: 6. Print this periodic table https://filestore.aqa.org.uk/resources/science/AQA-8462-8464-8465-INS-PT.PDF On your Periodic Table annotate each group with the trend in their reactivity, melting point and boiling point. 7. Create a Key to show the distinction between these groups: The Halogens, Alkali Metals, Noble Gases and Alkali Earth Metals. 8. Add a staircase to show the separation of metals and non-metals on the Periodic Table. Plants and Photosynthesis: 6. Create three graphs to show the limiting factors of photosynthesis: Temperature, Carbon Dioxide Concentration and Light Intensity. 7. Compare the reactions of Photosynthesis and Respiration. Create a Venn diagram to help visualise your comparison. Photosynthesis Core Practical: 6. Suggest what needs to be controlled in the investigation, justify your answer. 7. How could the investigation be adapted to measure the amount of oxygen produced?

Topic 1: Disease and Risk Factors

- Non-communicable diseases are those that can't be spread to other people, these include diabetes, coronary heart disease and cancer.
- Diabetes is a disease where there are two types. In type 1 diabetes, the person is unable to control their insulin production whereas in type 2 diabetes the person is less sensitive to the insulin they produce, and their body may not respond to it.
- Cancer is caused by the rapid growth of mutated cells to form tumours. These tumours can be malignant (which spread) or benign (do not spread).

Risk factor	Disease	Effects
Obesity	Type 2 diabetes	The body's cells no longer respond to insulin; blood glucose levels cannot be regulated properly
Smoking	Lung cancer	Carcinogens in cigarette smoke cause cells to become cancerous

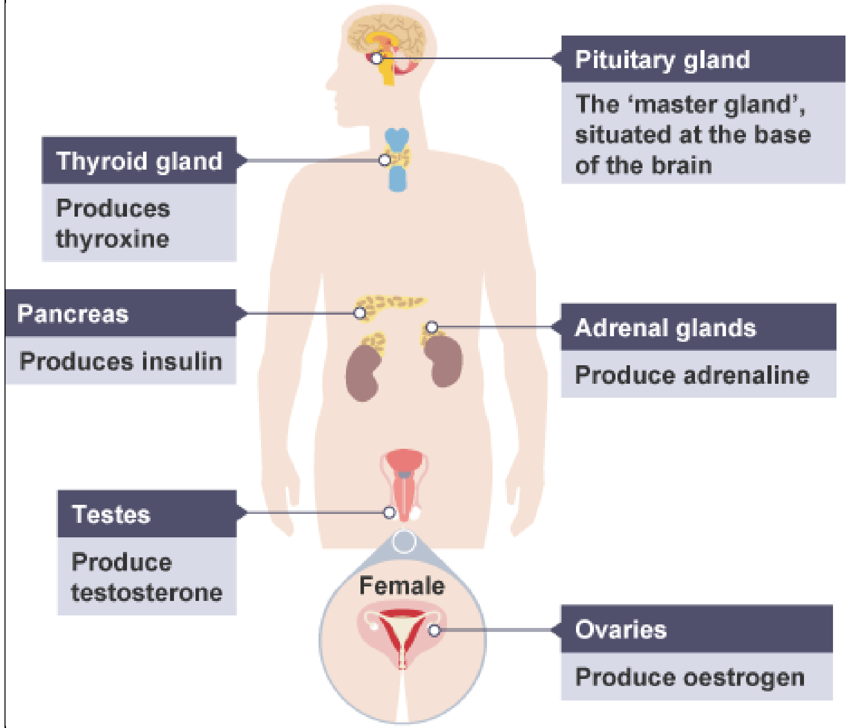


- Coronary heart disease is caused by the build up of fat in the coronary arteries that supply blood to the heart. When these arteries are blocked, it can lead to a heart attack.
- Risk factors increase the chance of a disease happening. Risk factors can include diet, smoking status, age, weight, gender or genetics.
- To ensure good health it is recommended to get regular exercise, have a balanced diet, not smoke and not drink alcohol.
- Smoking increases the chance of developing lung cancer due to the carcinogenic substances present in cigarettes.
- Obesity increases the chance of developing type 2 diabetes due to the excess presence of glucose in blood.
- Obesity, diet and a lack of exercise all contribute to increasing the chance of developing coronary heart disease due to the build of fat in the coronary arteries.
- The overall health of a person is measured as a state of physical, social and mental wellbeing.

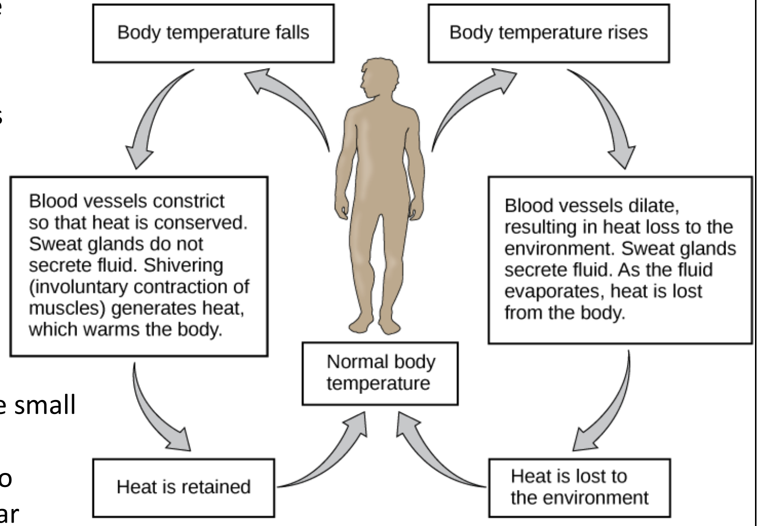
- Communicable diseases are those that can be spread from person to person.
- Communicable diseases are caused by pathogens (microorganisms that causes disease). Pathogens can be a variety of microorganisms such as bacteria, viruses, fungi or protists.

Topic 2: Homeostasis

- Homeostasis is the process by which a constant internal environment is maintained. This can include body temperature, hydration and blood glucose levels.

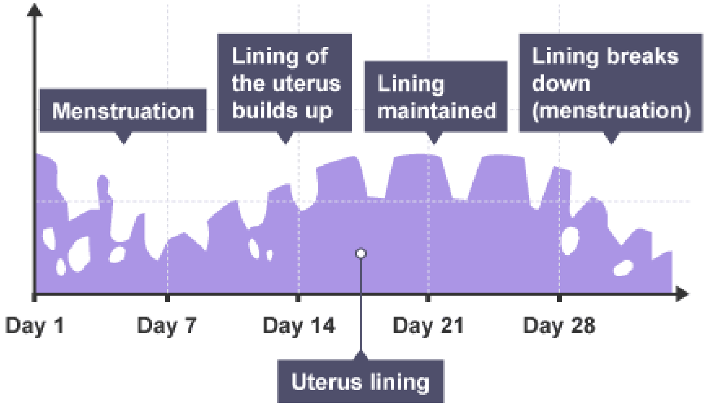


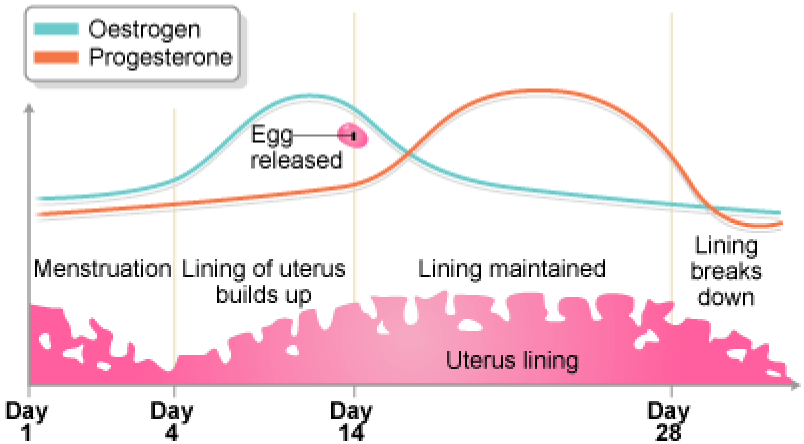
- The endocrine system is an organ system made up glands. These glands release hormones which act as chemical messengers to cause a physiological change.
- Blood glucose is controlled by the hormone insulin which is released by the pancreas.
- When a person eats and digests food, glucose is absorbed through the small intestine into the blood stream.
- Insulin allows glucose in the blood to enter cells so it can be used for cellular respiration.
- As blood glucose levels rise, more insulin is released by the pancreas. As blood glucose levels fall, less insulin is released.
- (Higher Tier) If blood glucose levels fall too low, the hormone glucagon will be released from alpha cells in the pancreas to stimulate the conversion of glycogen (stored in the liver) to become glucose released into the blood stream.



Topic 3: Human Reproduction

- Reproduction is the process by which new offspring is produced. Reproduction can be sexual (resulting in variation) or asexual (resulting in a "clone").
- Sexual reproduction occurs when two gametes (the sperm and the ovum/egg) fuse together to form a zygote. This zygote cell will divide to form an embryo and then a foetus.
- Biological males will produce sperm cells in the testes (testicles) whereas biological females will release ovum cells from the ovaries.
- Ovum cells are released on an average 28-day (monthly) cycle; this may be slightly shorter or longer for some women.
- During the menstrual cycle, the uterus lining will build up to prepare for the implantation of an embryo and subsequently pregnancy.
- If no embryo attaches to the uterus lining, then it will be shed and be released as a menstruation (period) out through the vagina.
- Hormones are involved in the menstrual cycle, these are: oestrogen, progesterone, FSH and LH.





- Oestrogen causes the lining of the uterus to build up and repair.
- Progesterone maintains the lining of the uterus.
- FSH stimulates the maturation of an ovum cell in the ovary
- LH triggers ovulation (the release of an egg)
- Both oestrogen and progesterone are released by the ovaries while FSH and LH are both released by the pituitary gland.
- Days 1 to 12 - oestrogen gradually increases and peaks approximately on the 12th day. Progesterone, LH and FSH stay approximately at the same levels and begin to increase slightly from around day 12.
- FSH and LH patterns are very similar and peak during ovulation at approximately 14 days during this cycle. They drop sharply on day 15 and stay constant until day 28.
- Oestrogen drops during days 13 and 14, and progesterone continues to gradually increase until about day 21, when it slowly beings to decrease again. Oestrogen mirrors this shape and has a second lower peak at about day 21.

Subject: Science

SOW Topic: Forces and Energy Changes

Topic 1: Vectors and scalers.

Scalars

A scalar quantity can be described fully by stating its magnitude (size). Examples of scalar quantities are:

- Mass
- Temperature
- Distance
- Time
- Speed
- Energy

The quantities we write as 15oC, 75kg or 3ms−1 are all scalars.

Vectors

- A vector is a quantity that is not fully described by stating its magnitude.
- Forces are often thought of as a push or a pull.
- Force is a vector quantity. Vectors possess a magnitude and a direction – both properties are required to describe the vector.

There are several vector quantities including:

- displacement (the distance and direction from where you started to where you finished)
- velocity (like speed, but in a certain direction. Velocity = Displacement ÷ Time),

1. acceleration (the change in velocity per second, in a certain dEvaporation/ Vaporisation
2. Condensation
3. Melting/ Fusion

SCALAR	VECTOR
DISTANCE	DISPLACEMENT
SPEED	VELOCITY
TIME	ACCELERATION
ENERGY	FORCE
MASS	WEIGHT
	MOMENTUM

- The resultant force is **the single force that has the same effect as two or more forces acting together**. Two forces in the same direction. Two forces that act in the same direction produce a resultant force that is larger than either individual force.
- Newton's second law can either be expressed as "**resultant force = mass × acceleration**" or "The acceleration of an object is directly proportional to the resultant (or net) force, in the same direction as the force, and inversely proportional to the mass of the object."
- According to Newton's First Law of motion, an object remains in the same state of motion unless a resultant force acts on it. If the resultant force on an object is zero, this means: **a moving object continues to move at the same velocity (at the same speed and in the same direction).**
- To find the resultant force **subtract the magnitude of the smaller force from the magnitude of the larger force**. The direction of the resultant force is in the same direction as the larger force. A force of 5 N acts to the right, and a force of 3 N act to the left. **Now fill in the empty boxes upon the right….**

Forces acting on the table	Balanced or unbalanced	Resultant force	Direction of the net force (left or right)
			
			
			
			
			

Subject: Science

SOW Topic: Forces and Energy Changes

Your teacher will tell you which topic you should revise. Read and learn all the information in the topic, ready for a Quiz in lesson.

Topic 2: Mass, Weight and work done.

Comparison of Mass and Weight

Sr. no.	Mass	Weight
01	Mass is a property of matter. The mass of an object is the same everywhere.	Weight depends on the effect of gravity. Weight varies according to location.
02	Mass can never be zero.	Weight can be zero if no gravity acts upon an object, as in space.
03	Mass does not change according to location.	Weight increases or decreases with higher or lower gravity.
04	Mass is a scalar quantity. It has magnitude.	Weight is a vector quantity. It has magnitude and is directed toward the center of the Earth or other gravity well.
05	Mass may be measured using an ordinary balance.	Weight is measured using a spring balance.
06	Mass usually is measured in grams and kilograms.	Weight often is measured in Newton, a unit of force.

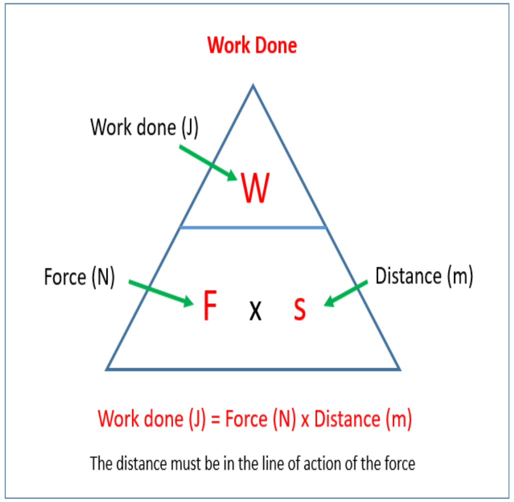
The mass is essentially "how much stuff" is in an object. Weight: There is **a gravitational interaction between objects that** have mass. If you consider an objec interacting with the Earth, this force is called the weight. The unit for weight is the Newton (same as for any other force).

- The difference between mass and weight is that **mass is the amount of matter ir a material**, while weight is a measure of how the force of gravity acts upon that mass. Mass is the measure of the amount of matter in a body. ... Weight usually is denoted by W. Weight is mass multiplied by the acceleration of gravity (g).
- Mass is an intrinsic property of matter and is measured in **kilograms**. The mass o a bird is a constant. A 15-gram bird is 15 grams, whether measured on the Earth, the Moon, or Mars. Weight is a measure of the force of gravity on a physical object and is measured in Newton's.

Energy and work

- Work is the **measure of energy transfer when a force** (F) moves an object through a distance (d). Energy transferred and work done are both measured in joules (J).

Energy and work. Work is the **measure of energy transfer when a force** (F) moves an object through a distance (d). Energy transferred and work done are both measured in joules (J).



Scientifically Work done formula will be given as, **W = F * d**: In this case, the force exerting on the block is constant, but the direction of force and direction of displacement influenced by this force is different.

- work done (*W*) is measured in Joules (J)
- force (*F*) is measured in Newton's (N)
- distance moved along the line of action of the force (*s*) is measured in metres (m)

Note: that one joule of work is done when a force of 1 N causes a movement of 1 m. This means that work done can also be measured in newton-metres (Nm): 1 J = 1 Nm

Take care not to confuse newton-metres (a unit of work done) with Newton meters (calibrated spring balances used to measure weights).

Topic 3: Speed, distance, time graph.

- If an object moves along a straight line, the distance travelled can be represented by a distance-time graph. In a distance-time graph, **the gradient of the line is equal to the speed of the object**. The greater the gradient (and the steeper the line) the faster the object is moving.
- A horizontal line on a distance-time graph shows that the object is stationary (not moving because the distance does not change)
- A sloping line on a distance-time graph shows that the object is moving.
- A distance-time graph **shows how far an object has travelled in a given time**. Distance is plotted on the Y-axis (left) and Time is plotted on the X-axis (bottom). ... A moving object is always 'increasing' its total length moved with time. 'Curved lines' on a distance time graph indicate that the speed is changing.

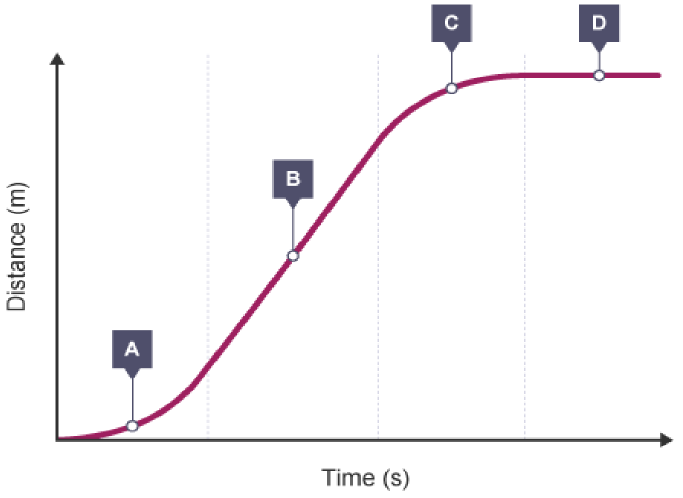
Section of graph	Gradient	Speed
A	Increasing	Increasing
B	Constant	Constant
C	Decreasing	Decreasing
D	Zero	Stationary (at rest)

The uses of distance – time graphs are:
The nature of motion is given at a glance.

The relative motion at various intervals can.

The region of acceleration or retardation can be estimated without any calculation.

The distance of moving body at any time unit can be calculated.



Subject
Support and application

Vocabulary

1. **Vector**
2. **Scaler**
3. **Force**
4. **Mass**
5. **Weight**
6. **Parallelogram**
7. **Resolution**
8. **Energy**
9. **Work**
10. **Gravitational**
11. **Potential**
12. **Elasticity**
13. **Speed**
14. **Distance**
15. **Time**
16. **Graph**
17. **Gradient**
18. **Constant**
19. **Incline**
20. **Decline**
21. **Increase**
22. **Decrease**
23. **Stationary**
24. **Velocity**
25. **Acceleration**
26. **Analyse**
27. **Motion**
28. **Terminal**
29. **Kinetic**
30. **Braking**
31. **Newton's Law**

Wider Research

- Vectors and scalars https://www.bbc.co.uk/bitesize/guides/zydyxfr/revision/1
- Contact and non-contact forces https://www.bbc.co.uk/bitesize/guides/zyxv97h/revision/1
- Forces: Resultant force https://www.bbc.co.uk/bitesize/guides/z3w3h39/revision/5
- Mass and weight https://www.bbc.co.uk/bitesize/guides/z77mbdm/revision/1
- Work and energy https://www.bbc.co.uk/bitesize/guides/zxkc8mn/revision/1
- Work and Power: Gravitational potential energy https://www.bbc.co.uk/bitesize/guides/zgr8nbk/revision/2
- Forces and Elasticity https://www.bbc.co.uk/bitesize/guides/z9hk3k7/revision/1
- Motion – Distance-Time Graphs https://www.bbc.co.uk/bitesize/guides/zwwmxnb/revision/2
- Speed, velocity, and acceleration https://www.bbc.co.uk/bitesize/guides/z3bqtfr/revision/1
- Force and acceleration: Newton's Law https://www.bbc.co.uk/bitesize/guides/zgv797h/revision/1
- Terminal velocity https://www.bbc.co.uk/bitesize/guides/zgv797h/revision/1
- Kinetic Energy https://www.bbc.co.uk/bitesize/guides/zq2csrd/revision/3
- Forces and braking https://www.bbc.co.uk/bitesize/guides/zgv797h/revision/7

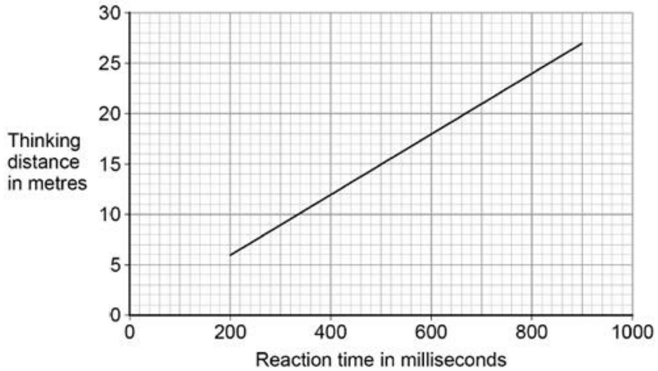
Apply

A rollercoaster car stops above a vertical drop. Suddenly it falls under gravity. The drop is 60 metres high and at the bottom of the drop the car travels at 125 km/h.
The acceleration experienced by the people in the car is 10 m/s^2. The mass of the car and its passengers is 1210 kg.

Calculate the force exerted on the car and its passengers. Show your working.

Force = ______________ N

The thinking distance of a car depends on the reaction time of the driver.
The graph shows how thinking distance varies with reaction time for a car travelling at 30 m/s



(a) The reaction time of a driver can double if the driver is distracted. Explain the effect doubling the reaction time has on the thinking distance. Use data from the graph above.

(b) Give the reason why there are no values of thinking distance for reaction times less than 200 milliseconds

Subject: Science

SOW Topic: 4.10 The Earth’s atmosphere

Your teacher will tell you which topic you should revise. Read and learn all the information in the topic, ready for a Quiz in lesson.

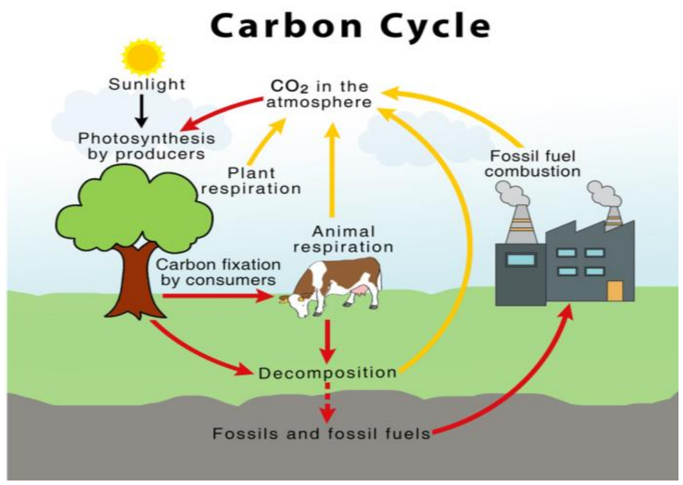
Topic 1: 4.10 The Earth’s atmosphere

Processes in the carbon cycle

The carbon cycle is easiest to understand in terms of its processes and how carbon is converted.

The three key processes and the conversions are shown in the table below.

Process	Carbon starts as	Carbon ends as
Photosynthesis	Respiration	Combustion (burning)
Carbon dioxide	Glucose	Fuel (e.g., methane or wood)
Glucose	Carbon dioxide	Carbon dioxide



1. Carbon enters the atmosphere as carbon dioxide from respiration and combustion.
2. Carbon dioxide is absorbed by producers to make glucose in photosynthesis.
3. Animals feed on the plant passing the carbon compounds along the food chain.
   Most of the carbon they consume is exhaled as carbon dioxide that was formed during aerobic respiration.
   The animals and plants eventually die.
4. Decomposers break down the dead organisms and return the carbon in their bodies to the atmosphere as carbon dioxide by respiration. In some conditions, decomposition is blocked. The plant and animal material may then be available as fossil fuel in the future for combustion.

Increases in carbon dioxide

There is increasing evidence that the level of carbon dioxide in the Earth’s atmosphere is rising. There is also evidence that humans are responsible for this rise. Human factors increasing global warming. Some human activities increase the greenhouse gases in the atmosphere:

- **Burning fossil fuels**, e.g., coal, gas, and oil - these release carbon dioxide into the atmosphere.
- **Deforestation** - trees absorb carbon dioxide during photosynthesis. If they are cut down, there will be higher amounts of carbon dioxide in the atmosphere.
- **Dumping waste in landfill** - when the waste decomposes it produces methane.
- **Agriculture** - agricultural practices lead to the release of nitrogen oxides into the atmosphere.

Natural factors increasing global warming

There are also natural factors which contribute to increased global warming:

- **Orbital changes** - the Earth has natural warming and cooling periods caused by Milankovitch cycles or variations in the tilt and/or orbit of the Earth around the Sun (Wobble, roll and stretch theory).
- **Volcanic activity** - during a volcanic eruption carbon dioxide is released into the atmosphere.
- **Solar output** - there can be fluctuations in the amount of radiation from the sun. If there is high amount emitted there will be an increase in Earth's temperatures.

What is the greenhouse effect?

The greenhouse effect is the name given to the natural process that causes the Earth to be warmer than it would be in the absence of an atmosphere.

The surface of the Earth is heated by the Sun. Greenhouse gases in the atmosphere trap this heat, keeping the planet warm.

1. Solar radiation at most wavelengths passes through the Earth's atmosphere.
2. The Earth absorbs most of the radiation and warms up.
3. The Earth radiates heat energy.
4. Some of the heat escapes into space.
5. Some of the heat is absorbed by greenhouse gases in the atmosphere.
6. Greenhouse gases radiate heat in all directions
7. The lower atmosphere warms up.

What are greenhouse gases?

Greenhouse gases can occur naturally. They trap heat in the Earth's atmosphere. Greenhouse gases present in the atmosphere include:

- water vapour
- carbon dioxide
- methane
- nitrous oxide

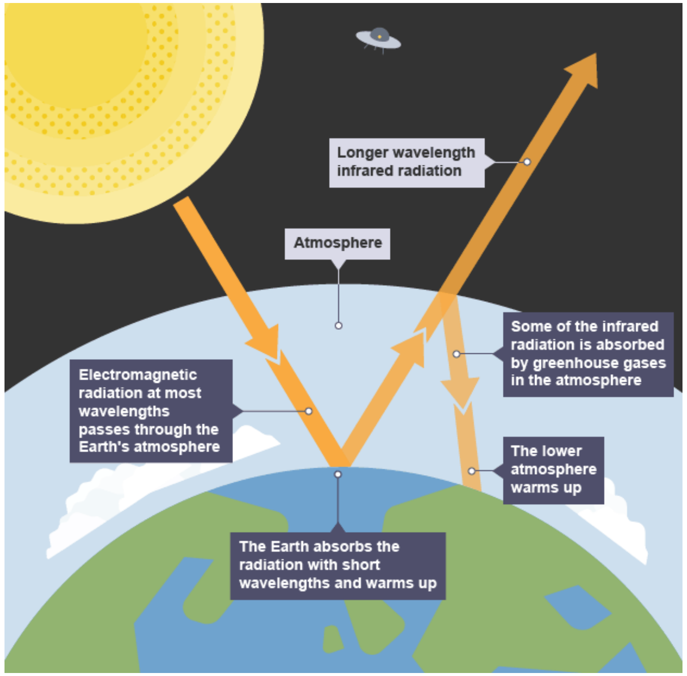
Water vapour is the largest contributor, responsible for 98 per cent of the natural greenhouse effect.

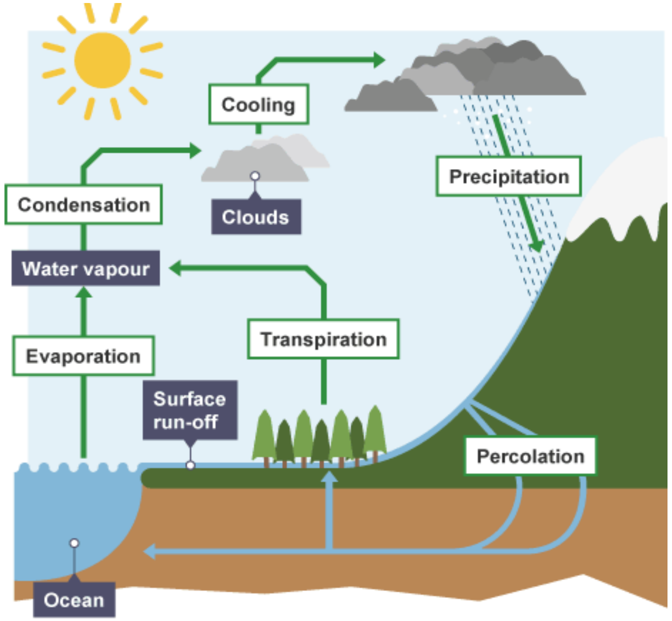
Without the greenhouse effect, the surface of the Earth would have an average temperature of -18 °C (Source: World Meteorological Organization) and be covered in ice. Life as we know it would not be able to survive.

Although these gases have always been present in the world's atmosphere, their concentration is increasing because of human activity.

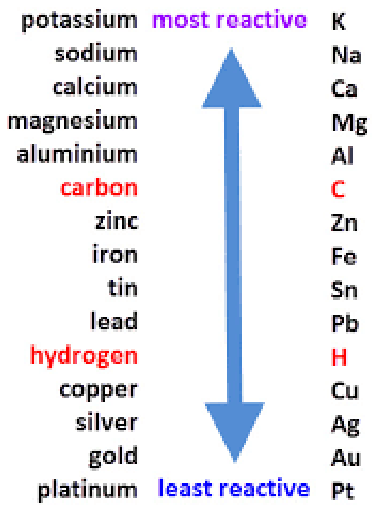
These are the key processes in the water cycle.

Process	What happens to water
Evaporation	Water turns from a liquid to a gas when it evaporates. Energy from the Sun can evaporate water from all places on the Earth's surface such as puddles, ponds, lakes, and oceans.
Condensation	After evaporation water can cool and convert from gas to liquid, often forming clouds.
Transport	Water within clouds can be blown many miles by strong winds and so transported to other areas.
Precipitation	Precipitation occurs when rain, snow, hail, and sleet fall from the sky.
Surface runoff	Much water will be absorbed into the ground after precipitation but if a large volume falls or the ground is already wet some water can run along the surface of the ground.
Infiltration	This occurs when water that has fallen as precipitation is absorbed into the ground. This can then be stored within underground rocks called aquifers.
Transpiration	Plants need to maintain a constant stream of water to their leaves for transport and support. They allow some water to evaporate as water vapour from their leaves, so it is continually 'pulled' to their leaves from the soil.





Topic 2: 7.22 Atoms and ions



The reactivity series

In a reactivity series, the most reactive element is placed at the top and the least reactive element at the bottom.

More reactive metals have a greater tendency to lose electrons and form positive ions.

A **reactivity series of metals** could include any elements. For example:

We can use this reactivity series to predict what substances can be separated using particular methods.

Carbon reduction can liberate a metal from its oxide, as long as the metal is less reactive than carbon. The metal oxide is heated with carbon, causing the oxygen to react with the carbon forming carbon dioxide.

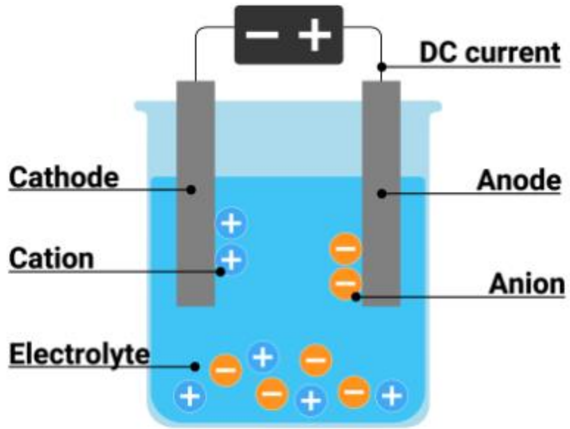
Carbon reduction can separate zinc and iron from zinc oxide and iron oxide respectively, but cannot separate aluminium from aluminium oxide as aluminium is more reactive than carbon.

Element	Reaction with dilute acids
Calcium	Very quickly
Magnesium	Quickly
Zinc	More slowly
Iron	More slowly than zinc
Copper	Very slowly
Silver	Barely reacts
Gold	Does not react

As aluminium is too reactive to separate using reduction, we would use electrolysis. Electrolysis uses electrical current to separate ionic solutions. An electrical circuit is created with two electrodes (an anode and cathode) that are placed in either a molten ionic compound or an ionic solution (both known as the electrolyte). As the electrical current flows, charged ions move to their corresponding electrodes. Cations (positively charged ions) move to the cathode (a negatively charged electrode) and anions (a negatively charged ion) move to the anode (a positively charged electrode).

This method of separation will work with metals more reactive than carbon, however, it is very energy intensive (a lot of energy is needed to complete) and therefore is not a sustainable method to use on mass regularly.

Metals like silver and gold are so unreactive they do not require a technique to separate the metal, often being found in their "pure" form.



Element	Reaction with water
Potassium	Violently
Sodium	Very quickly
Lithium	Quickly
Calcium	More slowly

Subject: Science
Support and application

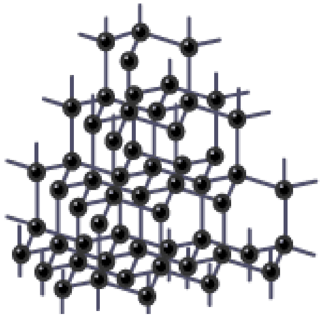
Vocabulary	Wider Research
32. Atoms 33. Ions 34. Cation 35. Anion 36. Reactivity 37. Electron 38. Effervescence 39. Product 40. Reactant 41. Electrolysis 42. Reduction 43. Cathode 44. Anode 45. Electrolyte 46. Pure 47. Evaporation 48. Condensation 49. Precipitation 50. Transpiration 51. Osmosis 52. Radiation 53. Photosynthesis 54. Respiration 55. Fossil 56. Decomposition 57. Fuel 58. Energy 59. Deforestation 60. Glucose 61. Carbon	• History of the Earth's atmosphere https://www.bbc.co.uk/bitesize/guides/zym2k2p/revision/1 • The evolving Earth's atmosphere • Material recycling • The carbon cycle https://www.bbc.co.uk/bitesize/guides/zmd7kty/revision/1 https://www.bbc.co.uk/bitesize/guides/zw4n97h/revision/2 • The greenhouse • Analysing the evidence • The impacts of climate change https://www.bbc.co.uk/bitesize/topics/zpgd8hv/articles/zyqyf82 • Mitigating climate change • Atmosphere pollutants • The water cycle https://www.bbc.co.uk/bitesize/guides/zw4n97h/revision/3 • Potable water • Treating water waste • The reactivity series https://www.bbc.co.uk/bitesize/guides/zqwmxnb/revision/1 • Displacement reactions • Introduction to electrolysis • Changes at the electrodes • Electrolysis of aqueous solutions • Testing for gases

Topic 1: Diamond, Graphite, Graphenes and Fullerenes

Diamond and graphite

Diamond and graphite are different forms of the element carbon. They both have giant structures of carbon atoms, joined together by covalent bonds. However, their structures are different so some of their properties are different.

Diamond - Structure and bonding

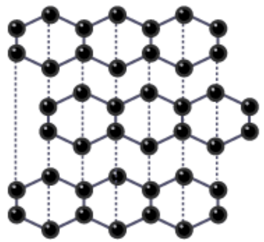


Diamond is a giant covalent structure in which:

- each carbon atom is joined to four other carbon atoms by strong covalent bonds
- the carbon atoms form a regular tetrahedral network structure
- there are no free electrons

Properties and uses

The rigid network of carbon atoms, held together by strong covalent bonds, makes diamond very hard. This makes it useful for cutting tools, such as diamond-tipped glass cutters and oil rig drills. Diamond has a very high melting point because a lot of energy is required to break the strong covalent bonds between the atoms. It does not conduct electricity because it has no free electrons.



Graphite Structure and bonding

Graphite has a giant covalent structure in which:

- each carbon atom forms three covalent bonds with other carbon atoms
- the carbon atoms form layers of hexagonal rings
- there are no covalent bonds between the layers
- there is one non-bonded - or delocalised - electron from each atom

Properties and uses

Graphite has delocalised electrons, just like metals. These electrons are free to move between the layers in graphite, so graphite can conduct electricity. This makes graphite useful for electrodes in batteries and for electrolysis.
The forces between the layers in graphite are weak. This means that the layers can slide over each other. This makes graphite slippery, so it is useful as a lubricant.

Graphene and fullerenes

Graphene and fullerenes are forms of carbon. Their structures are different from those of diamond and graphite, which are also forms of carbon.

Graphene

Graphene is a single layer of graphite. The strong covalent bonds between the carbon atoms mean that graphene:

- has a very high melting point
- is very strong

Like graphite, graphene conducts electricity well because it has delocalised electrons that are free to move across its surface.

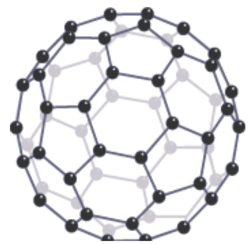
These properties make graphene useful in electronics and for making composites. Graphene has a giant covalent structure, but fullerenes have large molecules.

Fullerenes

Fullerenes are molecules of carbon atoms with hollow shapes. Their structures are based on hexagonal rings of carbon atoms joined by covalent bonds. Some fullerenes include rings with five or seven carbon atoms. Two examples of fullerenes are buckminsterfullerene and nanotubes.

Buckminsterfullerene was the first fullerene to be discovered. Its molecules are made up of 60 carbon atoms joined together by strong covalent bonds. Molecules of C60 are spherical.

There are weak intermolecular forces between molecules of buckminsterfullerene.
These need little energy to overcome, so buckminsterfullerene is slippery and has a low melting point.



Science

SoW Topic: Carbon Chemistry

Your teacher will tell you which topic you should revise. Read and learn all the information in the topic, ready for a Quiz in lesson.

Topic 2: Fractional distillation and Crude Oil

Alkanes

The alkanes form a homologous series. Like all homologous series, the alkanes:

- have the same general formula
- differ by CH_2 in molecular formulae from neighbouring compounds
- show a gradual variation in physical properties, such as their boiling points
- have similar chemical properties

General formula

The general formula for the alkanes is C_nH_{2n+2}, where n is the number of carbon atoms in the molecule.

Example

Decane is an alkane. Its molecules contain 10 carbon atoms. Predict the molecular formula of decane and explain your answer.

The formula will be $C_{10}H_{22}$. This is because $n = 10$. So, $2n + 2 = (2 \times 10) + 2 = 20 + 2 = 22$.

Fractional distillation of crude oil

Fractional distillation separates a mixture into a number of different parts, called **fractions**.

A tall fractionating column is fitted above the mixture, with several condensers coming off at different heights. The column is hot at the bottom and cool at the top. Substances with high boiling points condense at the bottom and substances with lower boiling points condense on the way to the top.

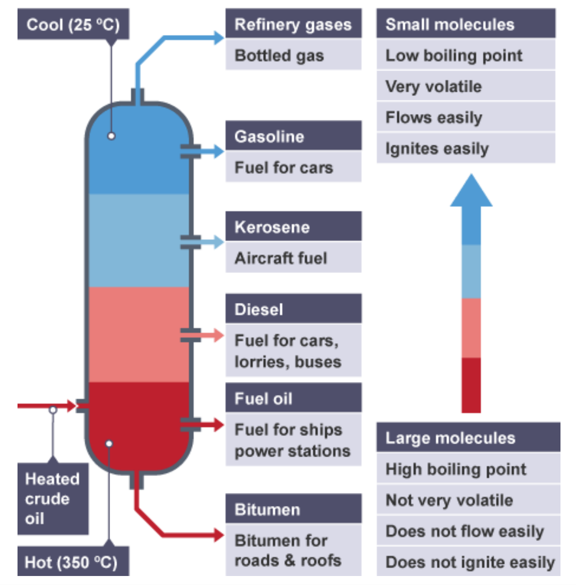
Crude oil is a mixture of hydrocarbons. The crude oil is evaporated and its vapours condense at different temperatures in the fractionating column. Each fraction contains hydrocarbon molecules with a similar number of carbon atoms and a similar range of boiling points.

Oil fractions

The diagram below summarises the main fractions from crude oil and their uses, and the trends in properties. Note that the **gases leave at the top of the column**, the **liquids condense in the middle** and the **solids stay at the bottom**.

As you go up the fractionating column, the hydrocarbons have:

1. lower boiling points
2. lower viscosity (they flow more easily)
3. higher flammability (they ignite more easily).



Other fossil fuels. Crude oil is not the only fossil fuel. **Natural gas** mainly consists of methane. It is used in domestic boilers, cookers and Bunsen burners, as well as in some power stations.

Coal was formed from the remains of ancient forests. It can be burned in power stations. Coal is mainly carbon but it may also contain sulfur compounds, which produce sulfur dioxide when the coal is burned. This gas is a cause of acid rain. Also, as all fossil fuels contain carbon, the burning of any fossil fuel will contribute to global warming due to the production of carbon dioxide.

Topic 3: Pathogens and Transmission

Pathogens - A pathogen is a microorganism that causes a disease.
There are four main types of pathogen: All types of pathogen have a simple life cycle.
They infect a host, reproduce themselves or replicate if it is a virus, spread from their host and infect other organisms. They also all have structural adaptations that make them successful at completing their life cycles, which enable them to cause further disease.

Pathogen	Example in animals	Example in plants
Viruses	HIV potentially leading to AIDS	Tobacco mosaic virus
Bacteria	Salmonella	Agrobacterium
Fungi	Athlete's foot	Rose black spot
Protists	Malaria	Downy mildew

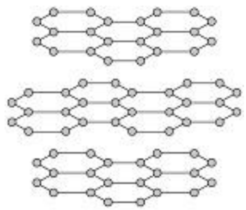
Diseases caused by pathogens are called communicable diseases. This means they can be transferred from one person to another.

There are other types of disease which cannot be caught:

1. Inherited genetic disorders like cystic fibrosis.
2. Deficiency diseases which are caused by a lack of essential vitamins or minerals, such as scurvy which occurs when an individual has insufficient vitamin C.
3. Diseases like cancer that develop as a result of exposure to carcinogens or develop naturally as cell division occurs incorrectly.

All organisms are affected by pathogens. Even bacteria are infected by certain types of virus. Some of these infections can be transferred to organisms of a different species.
Transmission can occur in a number of important ways, as shown in the table below.

Type	Examples
Direct contact	This can be sexual contact during intercourse or non-sexual contact, like shaking hands.
Water	Dirty water can transmit many diseases, such as the cholera bacterium.
Air	When a person who is infected by the common cold sneezes, they can spray thousands of tiny droplets containing virus particles to infect others.
Unhygienic food preparation	Undercooked or reheated food can cause bacterial diseases like Escherichia coli which is a cause of food poisoning.
Vector	Any organism that can spread a disease is called a vector. Many farmers think tuberculosis in their cattle can be spread by badgers.

Vocabulary	Wider Research	Apply
62. Diamond 63. Graphite 64. Carbon 65. Strong 66. Bond 67. Covalent 68. Electron 69. Structure 70. Conduct 71. Electricity 72. Layer 73. High 74. Low 75. Melting point 76. Graphene 77. Fullerene 78. Molecule 79. Nanotube 80. Hydrocarbon 81. Fractional distillation 82. Burning 83. Fuel 84. Cracking 85. Pathogen 86. Disease 87. Infection 88. Bacteria 89. Virus 90. Defence system 91. Vaccination 92. Antibiotics 93. Genetic modification	**Carbon Chemistry:** 1. Diamond and Graphite https://www.bbc.co.uk/bitesize/guides/z9twsrd/revision/2 2. Graphenes and Fullerenes https://www.bbc.co.uk/bitesize/guides/zgq8b82/revision/3 3. Crude oil, hydrocarbons and alkanes https://www.bbc.co.uk/bitesize/guides/zshvw6f/revision/2 4. Communicable diseases https://www.bbc.co.uk/bitesize/guides/zxr7ng8/revision/1 5. Human body defence and response https://www.bbc.co.uk/bitesize/guides/zxr7ng8/revision/8 6. Genetic modification https://www.bbc.co.uk/bitesize/guides/zx6g87h/revision/1] 7. Stem cells https://www.bbc.co.uk/bitesize/guides/z2kmk2p/revision/3	1. Graphene and graphite are used in electronics. Suggest **one** reason why graphene is a more suitable material for use in electronics than graphite. (3 marks) 2. **Figure 2** represents part of the structure of graphite. **Figure 2**  Graphite is used as a contact in electric motors because graphite: • conducts electricity • is slippery Explain why graphite has these properties. You should refer to the structure and bonding of graphite in your answer. (6 marks) 3. Malaria affects many people across the world. Describe how the white blood cells might respond to an infection of the malaria pathogen. (3 marks) 4. A person has been vaccinated against measles. The person comes in contact with the measles pathogen. The person does **not** catch measles. Explain why. (3 marks)

Science

SoW Topic: [1] 7.21 The rate and extent of chemical change

Your teacher will tell you which topic you should revise. Read and learn all the information in the topic, ready for a Quiz in lesson.

Topic 1: Rate of Reaction & Measuring rate, mass & volume

What is a rate of reaction?

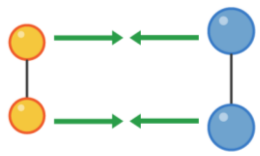
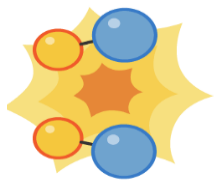
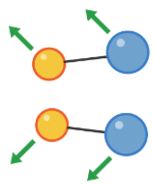
The rate of a reaction is a measure of how quickly a reactant is used up, or a product is formed.

Collision theory

For a chemical reaction to happen:

- reactant particles must collide with each other
- the particles must have enough energy for them to react

A collision that produces a reaction is called a successful collision. The activation energy is the minimum amount of energy needed for a collision to be successful. This is different for different reasons.

		
1. Two pairs of particles move towards each other	2. The pairs collide and reform so that each member of the original pair joins with a member of the other pair, forming two new pairs	3. The new pairs are now moving away from each other

Measuring rates of reaction

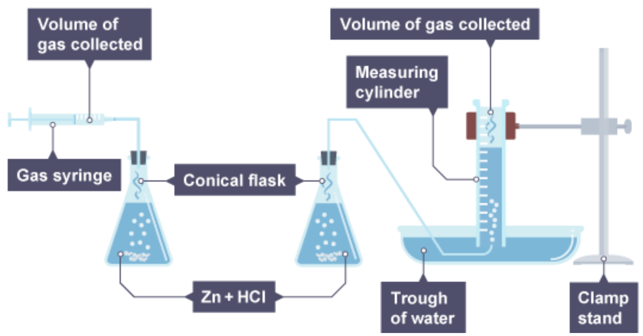
There are different ways to determine the rate of a reaction. The method chosen usually depends on the reactants and products involved, and how easy it is to measure changes in them.
In addition, how long a reaction is observed for depends on the rate of reaction. Reactions can vary from being almost instantaneous to taking years to complete. In the lab, reactions are usually followed over a few seconds or minutes.

Measuring mass

The change in mass of a reactant or product can be followed during a reaction. This method is useful when carbon dioxide is a product which leaves the reaction container. It is not suitable for hydrogen and other gases with a small relative formula mass, M_r. The units for rate are usually g/s or g/m.

Measuring volume

The change in volume of a reactant or product can be followed during a reaction. This method is used when a gas leaves the reaction container. The volume of a gas is measured using a gas syringe, or an upside down burette or measuring cylinder. The units for rate are usually cm^3/s or cm^3/min.



Science

SoW Topic: [1] 7.21 The rate and extent of chemical change

Your teacher will tell you which topic you should revise. Read and learn all the information in the topic, ready for a Quiz in lesson.

Topic 2: Effect of temperature and concentration. Enzymes

Rates and temperature

The greater the frequency of successful collisions, the greater the rate of reaction. If the temperature of the reaction mixture is increased:

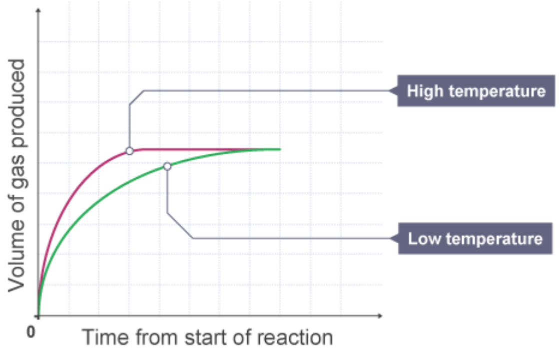
- reactant particles move more quickly
- the energy of the particles increases
- the frequency of successful collisions between reactant particles increases
- therefore the rate of reaction increases

Note that the mean energy of the collisions changes when the temperature changes:

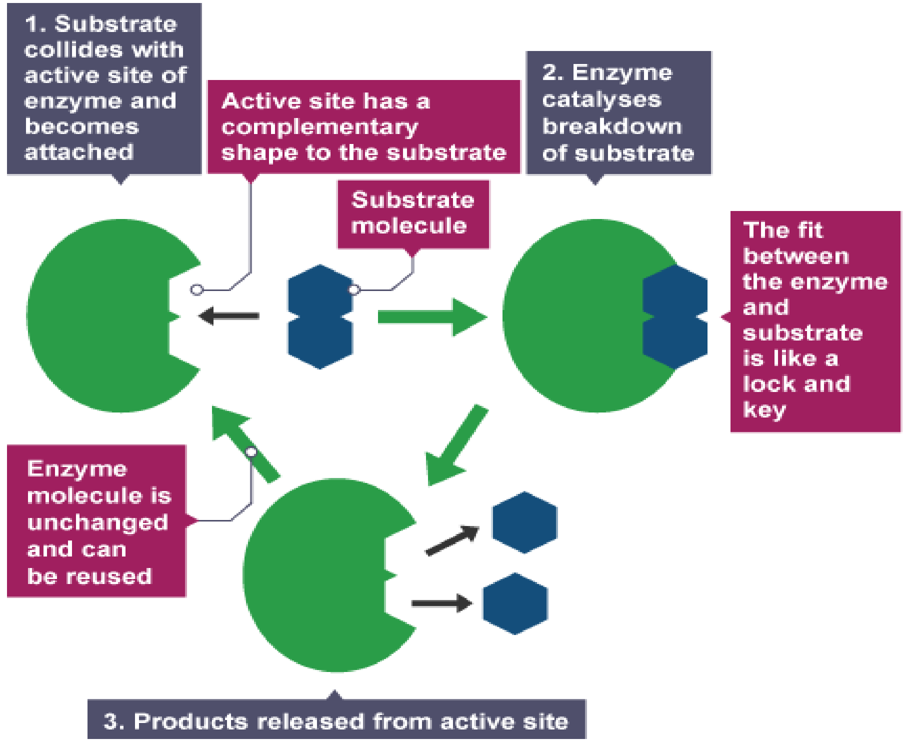
- the frequency of collisions increase
- the proportion of collisions that are successful also increases

Graphs

The rates of two or more reactions can be compared using a graph of mass or volume of product formed against time. The graph shows this for two reactions.



The gradient of the line is equal to the rate of reaction. The faster reaction at the higher temperature:
1. Gives a steeper line
2. Finishes sooner



Factors affecting enzyme action

Physical factors affect enzyme activity.

Temperature

At low temperatures, the number of successful collisions between the enzyme and substrate is reduced because their molecular movement decreases. The reaction is slow.

The human body is maintained at 37°C as this is the temperature at which the enzymes in our body work best. This is not true of the enzymes in all organisms.

Science

SoW Topic: [1] 7.21 The rate and extent of chemical change

Your teacher will tell you which topic you should revise. Read and learn all the information in the topic, ready for a Quiz in lesson.

Topic 3: Core practical: Investigation – Rate of reaction in colour

Required practical - investigate the rate of reaction by colour change

It is important in this core practical to use appropriate apparatus to make and record a range of measurements accurately, including time, temperature and volume. This includes the safe use of apparatus, and monitoring chemical changes.This outlines one way to carry out the practical. Eye protection must be worn.

Aims

To investigate the effect of changing the temperature on the rate of a reaction. Sodium thiosulfate solution reacts with dilute hydrochloric acid:
sodium thiosulfate + hydrochloric acid → sodium chloride + water + sulfur dioxide + sulphur
$Na_2S_2O_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$

The sulfur forms a cloudy yellow-white precipitate during the reaction. The time taken for this to achieve a given cloudiness provides a way to measure the reaction time.

Method

1. Using a measuring cylinder, add 50 cm^3 of dilute sodium thiosulfate solution to a conical flask.
2. Place the conical flask on a piece of paper with a black cross drawn on it.
3. Using a different measuring cylinder, add 10 cm^3 of dilute hydrochloric acid to the conical flask. Immediately swirl the flask to mix its contents, and start a stop clock.
4. Look down through the reaction mixture. When the cross can no longer be seen, record the time on the stop clock.
5. Measure and record the temperature of the reaction mixture, and clean the apparatus as directed by a teacher.
6. Repeat steps 1 to 5 with different starting temperatures of sodium thiosulfate solution.

Results

Record the results in a table. This table gives some example results.

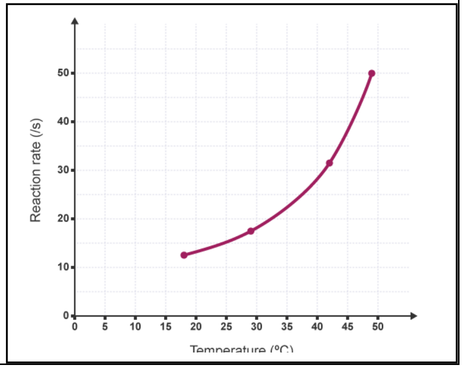
Temperature of reaction mixture (°C)	Reaction time (s)	Reaction rate 1000/s
18	80	12.5
29	57	17.5
42	32	31.3
49	20	50.0

Analysis

1. Calculate 1000/time for each temperature. This value is proportional to the rate of reaction.

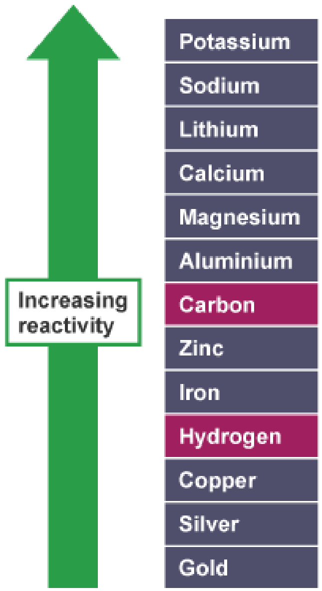
2. Plot a graph to show:

- reaction rate (/s) on the vertical axis
- temperature (°C) on the horizontal axis
- draw a curve of best fit



Vocabulary	Wider Research	Apply
94. Measure 95. Rate 96. Reaction 97. Collision 98. Theory 99. Effect 100. Concentration 101. Temperature 102. Pressure 103. Activation 104. Catalyst 105. Bond 106. Calculation 107. Estimate 108. Graph 109. Predict 110. Factor 111. Reversible 112. Dynamic 113. Equilibrium 114. Alternating 115. Condition 116. Record 117. Dilute 118. Enzyme 119. Denature 120. Substrate 121. Hypothesis 122. Analysis 123. Variable	1. Rate of reaction 2. Collision Theory 3. Surface area 4. The effect of concentration and pressure *Higher Tier* *1. Bond energy calculations* *2. Alternating conditions* *3. Dynamic equilibrium* Core Practical's 1. Investigating rate of reaction – Measure the production of gas	1. Describe how an increase in temperature alters the rate of reaction. Use the term energy in your answer. 2. Explain how decreasing concentration affects the rate of reaction 3. Acidic cleaners are designed to remove limescale (calcium carbonate) when they are used neat (undiluted). They do not work as well when they are undiluted. Explain this using your knowledge of collision theory. 4. Give three clear examples of the type of reactions that are catalysed by enzymes. 5. When you get an infectious disease, you may "get a temperature". One theory is that this is the way your body defends you, as many microorganisms cannot reproduce at high temperatures. However, people always try and bring the temperature down in an ill person. Analyse why this may be the case.

Topic 1: Extracting metals & Extracting aluminium



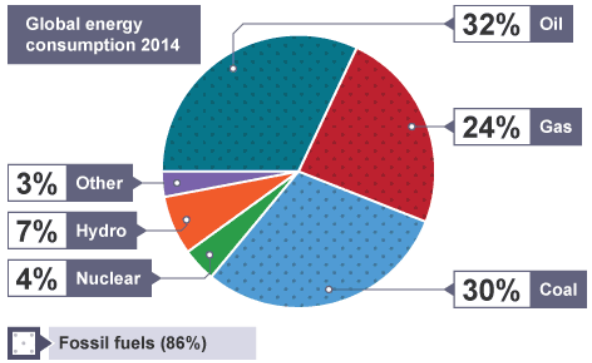
- The most unreactive metals, silver and gold, are found as elements in the rocks. They are not chemically bonded to other elements in compounds. For example, gold (element symbol Au) is an unreactive metal and is found as an element in rocks.
- Most of the metals found in rocks are combined with other elements in compounds. These compounds are called minerals.
- For example, iron (element symbol Fe) is mostly found as the minerals magnetite Fe_3O_4 and hematite Fe_2O_3. Both are compounds of iron chemically bonded to oxygen.
- Different methods are used to extract a metal depending on its position in the **reactivity series**.
- The diagram shows a simple reactivity series, including carbon and hydrogen. Carbon and hydrogen are often included in a reactivity series as they allow us to predict particular chemical reactions.
- The reactivity series can be split up to show how metals are extracted into three groups:
  - *Metals which are found in the pure crust.*
  - *Reduction of metal oxides using carbon.*
  - *Extraction using electrolysis.*
- When metals are above carbon in the reactivity series, they cannot be extracted using reduction with carbon. Carbon is not reactive enough to take the oxygen away from the metal. These metals are extracted using a process called electrolysis. In electrolysis, an electric current is passed through the compound to split up the metal and the oxygen. In industry, this is carried out on a large scale, but a small-scale experiment can be carried out using a power pack to provide the electricity. For example, an electric current can be passed through aluminium oxide (the compound) to split up the metal (aluminium) and the oxygen.

Aluminium oxide → (Electricity) → Aluminium + Oxygen

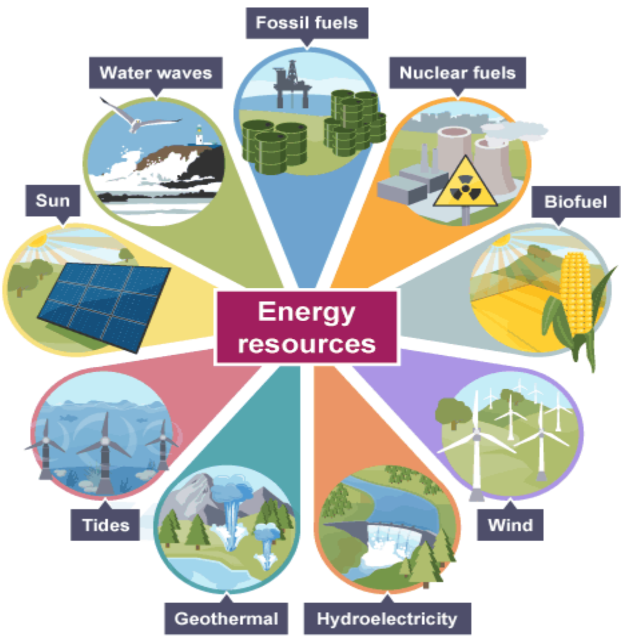
$$2Al_2O_3 \xrightarrow{\text{Electricity}} 4Al + 3O_2$$

Topic 2: Energy demands: Energy from wind, water, solar and the environment

- Nearly everything requires energy and a way to use energy is by transferring it from one energy store to another.
- Systems that can store large amounts of energy are called energy resources. The major energy resources available to produce electricity are fossil fuels, nuclear fuel, biofuel, wind, hydroelectricity, geothermal, tidal, water waves and the Sun. Ultimately, all the energy on Earth originally comes from the Sun but has been stored as different energy resources.
- Energy is needed in:
  - homes - for cooking, heating, and running appliances
  - public services, e.g., schools and hospitals - running machinery and warming rooms
  - factories and farms - operating heavy-duty machines and production chains
  - transport - buses, trains, cars, and boats all need a fuel source and some trains and trams connect to an electricity supply.



- Most of the electricity generated globally is still produced by fossil fuels. This is partly due to:



- the high-power output fossil fuels give compared to other energy resources, like wind and water waves.

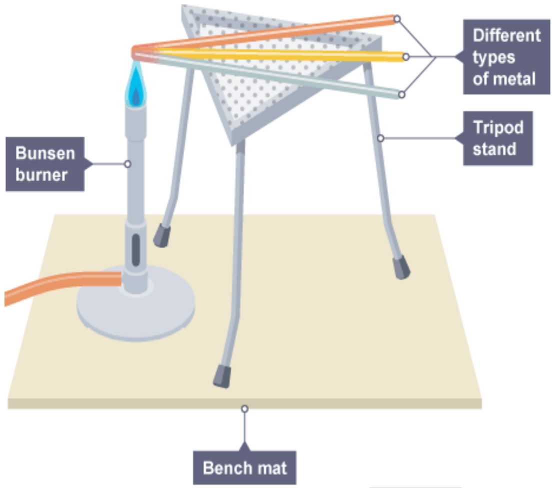
- the existing infrastructure for extracting, transporting, and processing fossil fuels.

- this makes fossil fuels cheaper than setting up new alternatives.

Energy resource	Energy store	Renewable?	Uses	Power output	Environmental impact
Fossil fuels (oil, coal and natural gases)	Chemical	Non-renewable	Transport, heating, electricity generation	High	Releases CO_2 (causes global warming)
Nuclear fuels	Nuclear	Non-renewable	Electricity generation	Very high	Radioactive waste (needs to be disposed of safely)
Bio-fuel	Chemical	Renewable	Transport, heating, electricity generation	Medium	'Carbon neutral', so low impact
Wind	Kinetic	Renewable	Electricity generation	Very low	Takes up large areas that could be used for farming, some people say windmills spoil the view
Hydroelectricity	Gravitational potential	Renewable	Electricity generation	Medium	Local habitats are affected by the large areas that need to be flooded to build dams
Geothermal	Internal (thermal)	Renewable	Electricity generation, heating	Medium	Very low
Tides	Kinetic	Renewable	Electricity generation	Potentially very high, but hard to harness	Tidal barrages can block sewage which needs to go out to sea
Sun	Nuclear	Renewable	Electricity generation, heating	Dependent on the weather and only available during daylight	Very little
Water waves	Kinetic	Renewable	Electricity generation	Low	Very low

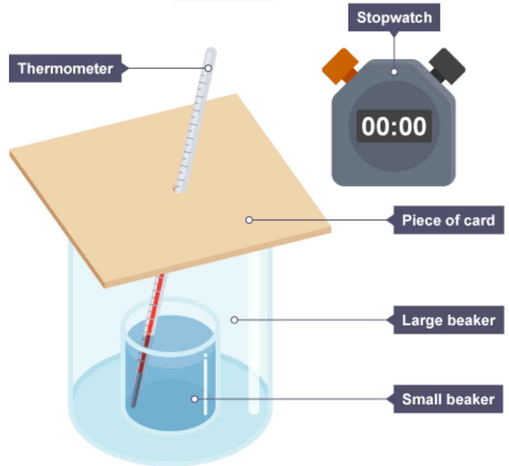
Topic 3: Energy transfer

Thermal conductivity:
Thermal conductivity is a measure of how well a material conducts energy when it is heated.
There are a number of factors that affect how energy flows through an object.
A very important factor is what the object is made from. Comparing conductivities
The conductivity of materials can be compared by examining the time taken to transmit energy through them. A fan of rods made of different materials can be heated at one end with the same flame. Whichever rod gets hottest first at the other end is the best conductor. The material that heats the quickest is said to have a high thermal conductivity.



Required practical - investigating methods of insulation

There are different ways to investigate methods of insulation. In this practical activity, it is important to:
make and record measurements of temperature and time accurately
measure and observe the effect of different materials as thermal insulators
use appropriate apparatus and methods to measure the effectiveness of different materials as thermal insulators.
Aim of the experiment: to compare the effectiveness of different materials as thermal insulators.

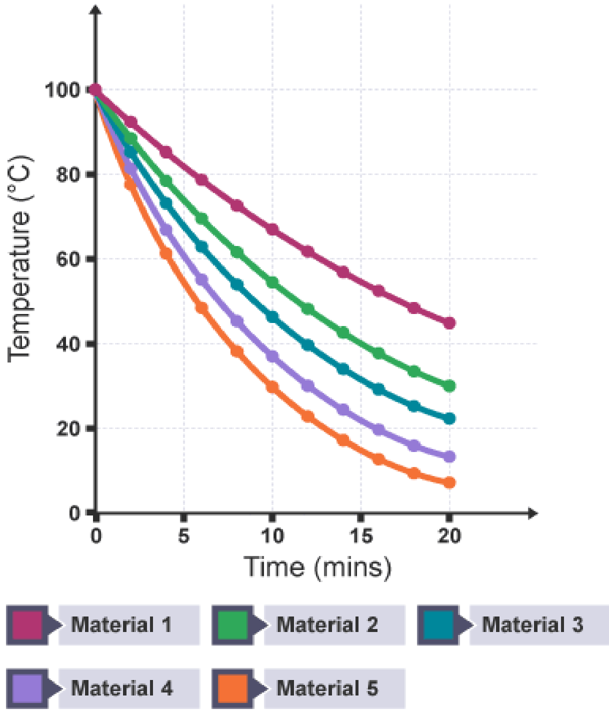


Method

1. Place a small beaker into a larger beaker.
2. Fill the small beaker with hot water from a kettle.
3. Put a piece of cardboard over the beakers as a lid. The lid should have a hole suitable for a thermometer.
4. Place a thermometer into the smaller beaker through the hole.
5. Record the temperature of the water in the small beaker and start the stopwatch.
6. Record the temperature of the water every 2 minutes for 20 minutes.
7. Repeat steps 1-6, each time packing the space between the large beaker and small beaker with the chosen insulating material.
8. Plot a graph of temperature (y-axis) against time (x-axis).

This graph shows:

- The curve which takes the longest time for the water temperature to drop (the shallowest) should be the material which is the best insulator.
- The temperature falls quickly at high temperatures and slowly at low temperatures.
- When the beaker is at a high temperature, there is a big difference between the temperature of the beaker and the temperature of the surrounding air.
  This means there is a high rate of transfer.
- When the beaker is at a lower temperature, there is less difference between the temperature of the beaker and the temperature of the surrounding air.
  This means there is a lower rate of transfer.



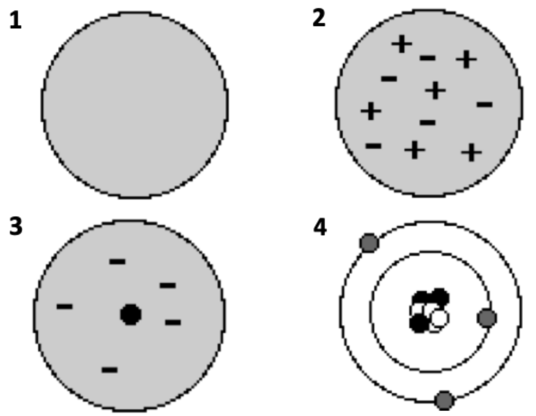
Hazards and control measures

Hazard	Consequence	Control measures
Boiling water	Scald skin	Do not overfill the kettle. Place the small beaker inside the large beaker before gently pouring the water. Remember to place any scald under cold running water for at least 10 minutes.
Knocking beaker off the desk	Scald skin	Place the beaker away from the edge of desk. Carry out the experiment whilst standing.

Science
Support and application

Vocabulary	Wider Research	Apply
1. Extract 2. Energy 3. Chemically bonded 4. Reduction 5. Extraction 6. Electrolysis 7. Element 8. Compound 9. Reactivity 10. Series 11. Ores 12. Demand 13. Resource 14. Percentage 15. Wind 16. Water 17. Solar 18. Hydro 19. Fossil Fuels 20. Environment 21. Stores 22. Dissipation 23. Transfer 24. Particles 25. Heating 26. Insulation 27. Efficiency 28. Reduce 29. Reuse 30. Recycle	• Extracting metals https://www.bbc.co.uk/bitesize/topics/z3ksp4j/articles/zwdxtrd • The extraction of aluminium https://www.bbc.co.uk/bitesize/guides/zhk6pbk/revision/1 • Extracting copper from its ores https://www.bbc.co.uk/bitesize/guides/zsm7v9q/revision/3 • Energy demands https://www.bbc.co.uk/bitesize/guides/zchgdxs/revision/1 • Renewable energy https://www.bbc.co.uk/bitesize/guides/zsmpk7h/revision/1 • Energy resources https://www.bbc.co.uk/bitesize/guides/z8k9v9q/revision/1 • Energy stores and transfers https://www.bbc.co.uk/bitesize/topics/zc3g87h/articles/zg2sn9q • Energy dissipation https://www.bbc.co.uk/bitesize/guides/z8hsrwx/revision/3	1. Aluminium is the most abundant metal in the Earth's crust. Suggest **two** reasons why we should recycle aluminium drinks cans 2. Complete the quiz on Electrolysis https://www.bbc.co.uk/bitesize/guides/zcsyw6f/test 3. Compare the advantages and disadvantages of using fossil fuels and renewable energy. 4.

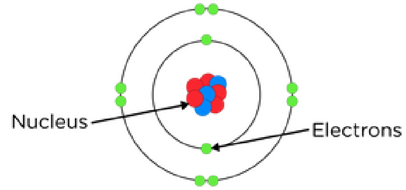
Topic: Atomic Structure

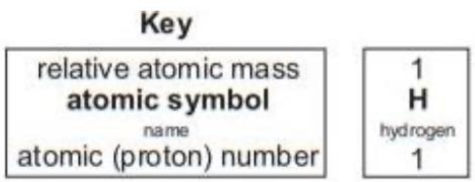


HISTORY OF THE ATOM:			
Discovery	**By**	**Model**	**Diagram**
Solid particle called atom	John Dalton	Particle: solid spheres	1
The electron	JJ Thompson	Plum pudding: positive 'cake' with negative 'plums'	2
Nucleus	Rutherford	Nuclear: Positive nucleus surrounded by electrons	3
Neutron	James Chadwick	Nuclear: Now with protons and neutrons in nucleus	3
Energy levels (shells)	Niels Bohr	Planetary: Electrons now 'orbit' in different shells	4

PROPERTIES OF SUB-ATOMIC PARTICLES:			
Particle	**Relative mass**	**Relative charge**	**Location**
Proton	1	+1	Nucleus
Neutron	1	0	Nucleus
Electron	0	-1	Shells

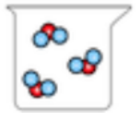
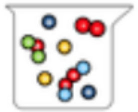
ELECTRON ARRANGEMENT RULES	
1.	Always fill from the inside to the outside
2.	The first shell can only hold 2 electrons
3.	The second and third can hold 8 maximum each



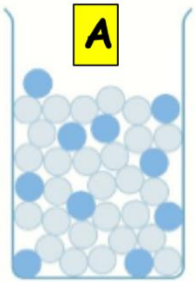


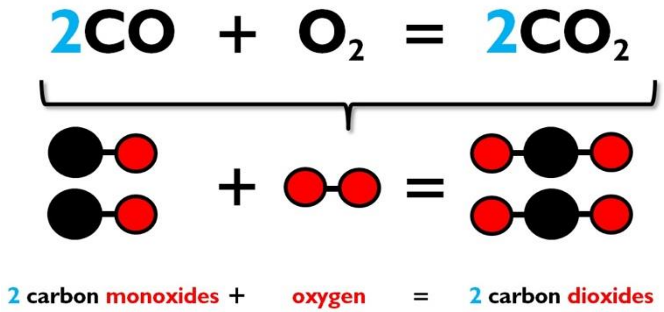
USING THE PERIODIC TABLE:		
Number of..	**Is the...**	**Found by..**
Protons	Atomic (proton) number	Smaller number on periodic table
Electrons	Atomic (proton) number	Smaller number on periodic table
Neutrons	Mass number – atomic number	Big number – small number

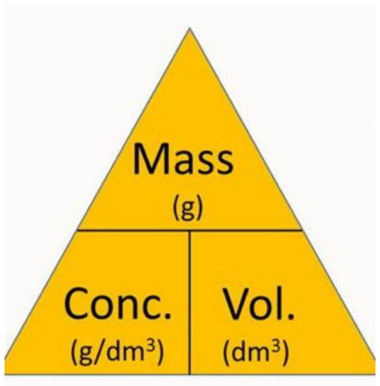
Topic: Chemical Quantities

ATOM:	MOLECULE:	ELEMENT:	COMPOUND:	MIXTURE:
				
The smallest particle of a chemical substance.	A particle made of several atoms that are bonded together.	A substance that consists of only one type of atom.	A substance formed for the chemical union of two or more elements.	Two or more substances that are not joined together. The substances can be elements, compounds or both.

The law of conservation of mass states that no atoms are lost or made during a chemical reaction, so the total mass of the products is equal to the total mass of the reactants.







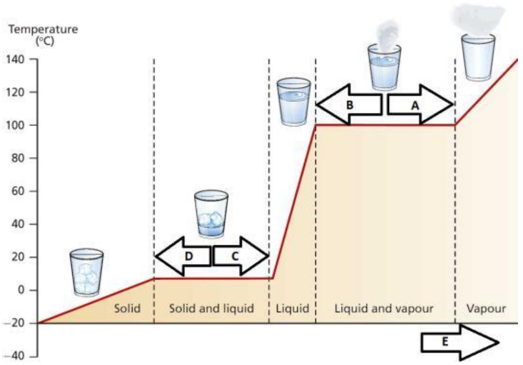
$$g/dm^3 = \frac{g}{dm^3}$$

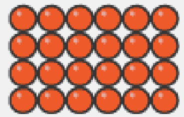
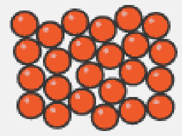
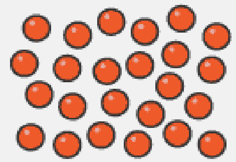
B = concentrated solution

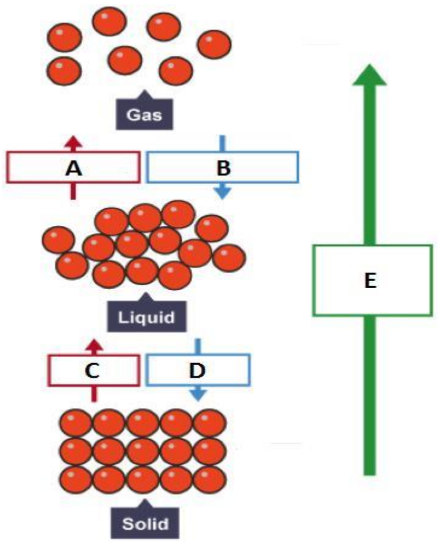
BALANCING EQUATIONS:	
Step:	**Result:**
Check to see if there are an equal number of atoms of each element on both sides. There aren't.	$CO + O_2 \rightarrow CO_2$
There are 3 oxygen atoms on the left, but only 2 on the right; so, put a big 2 on the left of CO_2.	$CO + O_2 \rightarrow 2CO_2$
There are now 4 oxygen atoms on right, but still 3 on the left; so put a big 2 on the left of CO.	$2CO + O_2 \rightarrow 2CO_2$

Topic: States of Matter

CHANGES OF STATE:



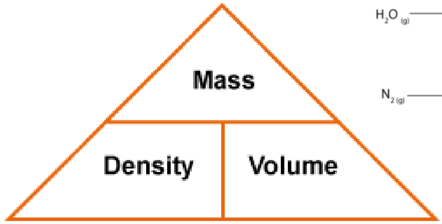
	Solid	Liquid	Gas
Arrangement of particles	Close together Regular pattern	Close together Random arrangement	Far apart Random arrangement
Movement of particles	Vibrate on the spot	Move around each other	Move quickly in all directions
Diagram			

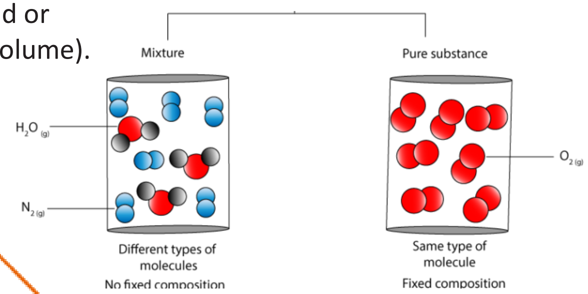


$$\rho = \frac{m}{V}$$

Symbol	Meaning	Unit
ρ	density	kg/m^3
m	mass	kg
V	volume	m

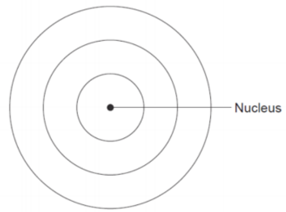
Density describes how closely packed the particles are in a solid, liquid or gas (amount of mass per unit volume).

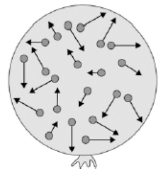




Energy transferred, ΔE	=	mass, m	x	Specific heat capacity, c	x	Temperature change, Δθ
(joules, J)		(kilograms, kg)		(joule per kilogram per degree Celsius, J/kg°C)		(degree Celsius, °C)

The specific heat capacity is the energy required to raise one kilogram (kg) of the material by one degree Celsius (°C).

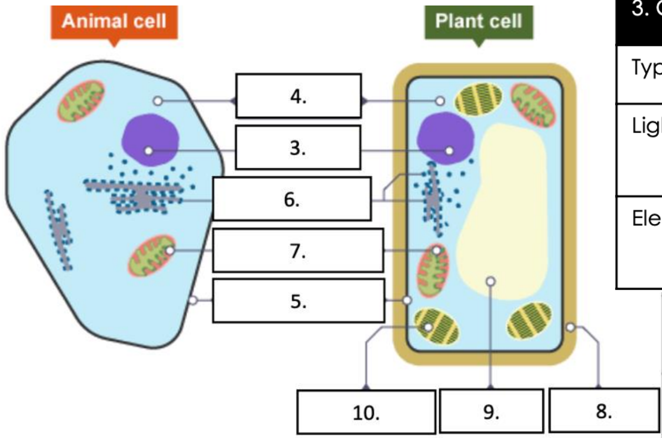
Vocabulary	Wider Research	Apply
1) Atom 2) Element 3) Compound 4) Mixture 5) Electron 6) Proton 7) Neutron 8) Nucleus 9) Shell 10) Atomic Number 11) Mass Number 12) Dilute 13) Concentrated 14) Chemical Formula 15) Conservation of Mass 16) Solid 17) Liquid 18) Gas 19) Internal Energy 20) Specific Heat Capacity 21) Density 22) Evaporation 23) Condensation 24) Melting 25) Freezing	**Atomic Structure:** https://www.bbc.co.uk/bitesize/guides/ztgbpbk/revision/1 https://www.youtube.com/watch?v=dftq9xGXcf8 **Chemical Quantities:** https://www.bbc.co.uk/bitesize/guides/zsm2k2p/revision/1 https://www.youtube.com/watch?v=K4pw_-U6Xpc&list=PL9IouNCPbCxUhxxFUbR4SNfwmaRB8mYX3 **States of Matter:** https://www.bbc.co.uk/bitesize/guides/ztb3h39/revision/1 https://www.youtube.com/watch?v=Ku0oTu8ZWqk	1) An atom of gold can be represented as $^{197}_{79}Au$. State the number of Protons, Electrons and Neutrons in this atom. 2) An aluminium atom has 13 electrons, complete the diagram to show its electronic structure.  3) Complete the balanced equation for the reaction of sodium with water. $\square$ + $\square$ → $\square$ NaOH + H_2 4) One type of copper ore is mainly copper carbonate. When producing copper, the ore reacts with carbon. copper carbonate + carbon → copper + carbon dioxide .... tonnes 24 tonnes 254 tonne 264 tonnes Calculate the mass of copper carbonate needed to produce 254 tonnes of copper. [

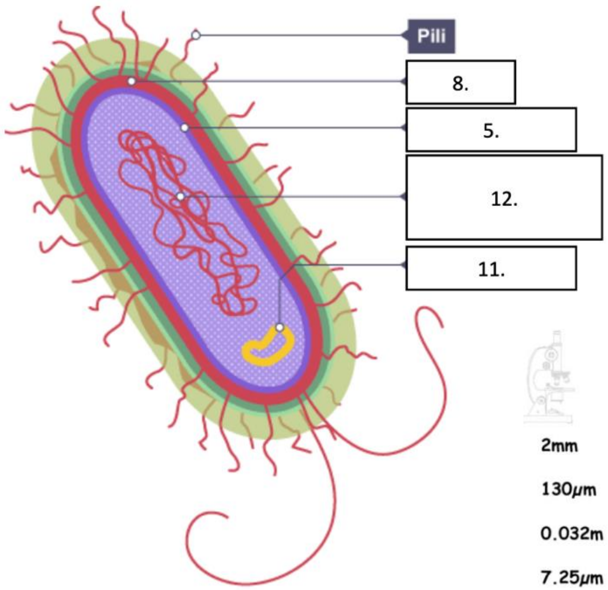
		Mass = [ ] tonnes 5) Calculate the mass of a chemical needed to dissolve in a final volume of $0.4dm^3$ to give a final concentration of 600 g/dm^3. 6) **Figure 2** shows some of the gas particles in a balloon. **Figure 2**  Describe the movement of the gas particles inside the balloon. 7) Name the change of state when a gas becomes a liquid. 8) The gas in the balloon has a mass of 0.032 kg. The balloon has a volume of 0.025 m^3. Calculate the density of the gas in the balloon.

Topic 1: Cells

Keywords

Keywords	
1. Eukaryotic	A complex cell with a nucleus (e.g. animal or plant cells).
2. Prokaryotic	A smaller cell without a nucleus (e.g. bacterial cell).
3. Nucleus	Contains genetic material.
4. Cytoplasm	Where a cells chemical reactions happen.
5. Cell membrane	Controls what goes into and out of a cell.
6. Ribosome	Part of a cell where proteins are made.
7. Mitochondria	Where aerobic respiration takes place.
8. Cell wall	Only found in plant cells. Made of cellulose and supports the cell.
9. Vacuole	Only found in plant cells. Contains cell sap.
10. Chloroplasts	Only found in plant cells. Where photosynthesis takes place.
11. Plasmid	Only found in bacterial cells. A small loop of DNA.
12. Genetic material	Long strands of genes not tightly pack in a nucleus.



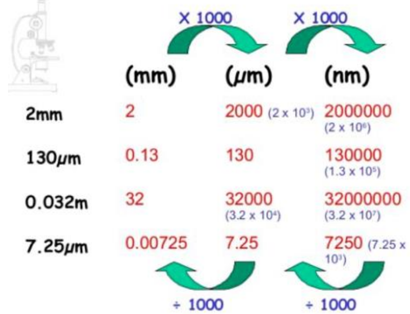


3. Comparing types of microscope

Type of microscope	Advantages	Disadvantages
Light microscope	1. Cheaper 2. Can see colours 3. Can see live specimen	1. Lower magnification
Electron microscope	1. Expensive 2. Higher magnification (x1000 more)	1. Can only see dead specimen 2. No colour

Keywords

Keywords	
Differentiation	A stem cell turning into a specialised cell
Stem cell	A special type of cell which can turn into other specialised cells
Adult stem cells	Can only produce certain types of cell -found in bone marrow
Embryonic stem cells	Can produce all types of cells - controversial
Meristems	Where plant stem cells are found



4. Calculating magnification

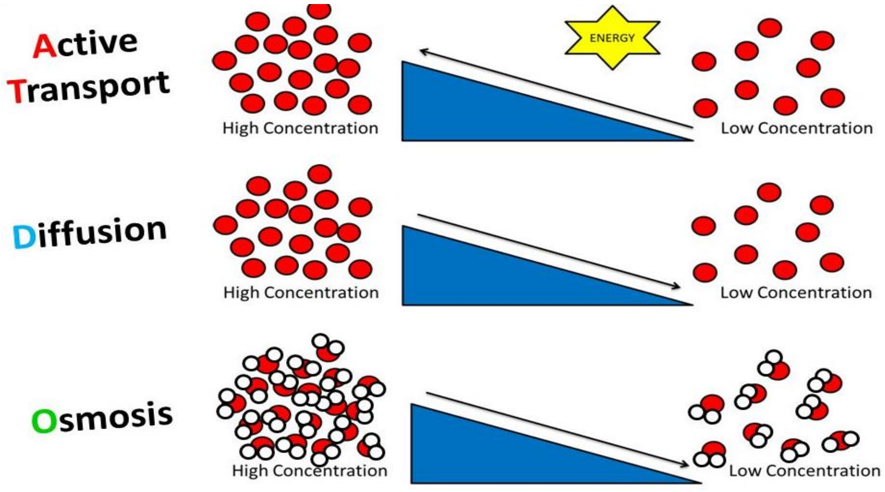
$$\text{magnification} = \frac{\text{size of image}}{\text{actual size of object}}$$

$$\text{actual size of object} = \frac{\text{size of image}}{\text{magnification}}$$

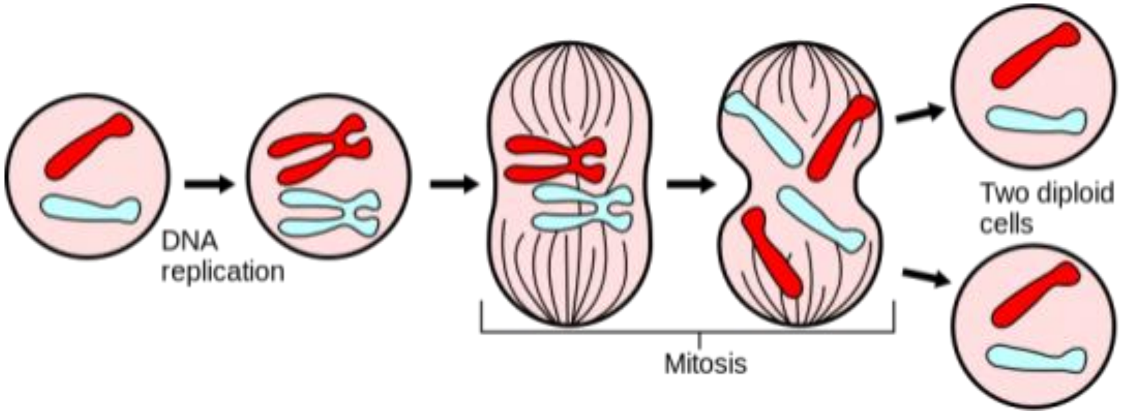
Science
Cell Division & transport in cells

Topic 2: Cell Division and Transport

8. Transport in cells		
Keywords	Definition	Examples
Diffusion	The passive movement of a substance from an areas of high concentration to an area of low concentration	• Oxygen and carbon dioxide in the lungs • Perfume in a room
Osmosis	The movement of **water** molecules across a partially permeable membrane from a less concentrated solution to a more concentrated solution.	• Water uptake in plants • Water absorption in the intestine
Active transport	Movement of a substance from a lower concentration to a higher concentration, against the concentration gradient. **Uses energy**.	• Mineral absorption by roots • Glucose absorption by the intestine
Surface area to volume ratio	The surface area divided by the volume expressed as a ratio	All high • Unicellular organisms • Alveoli in the lungs • Villi in the intestines



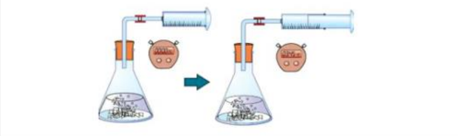
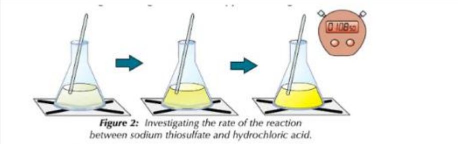
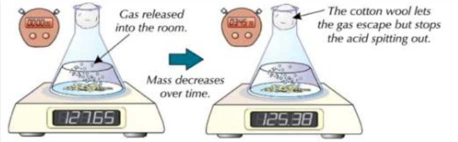
9. Factors that effect the rate of diffusion/osmosis	
Speed up	Slow down
High concentration gradient	Low concentration gradient
High temperature	Low temperature
High surface area of membrane	Low surface area of membrane

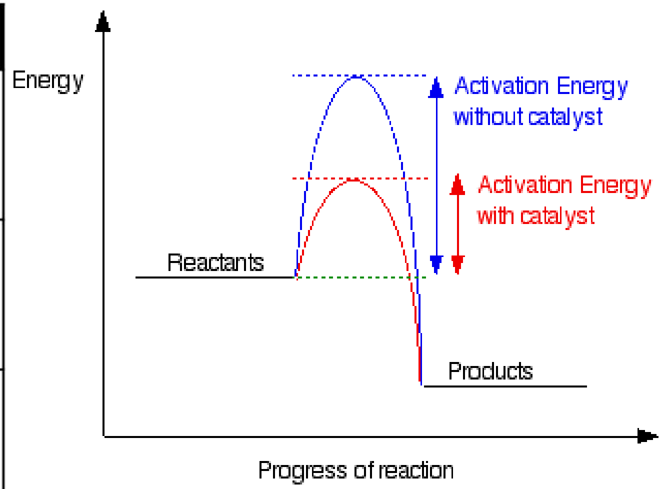


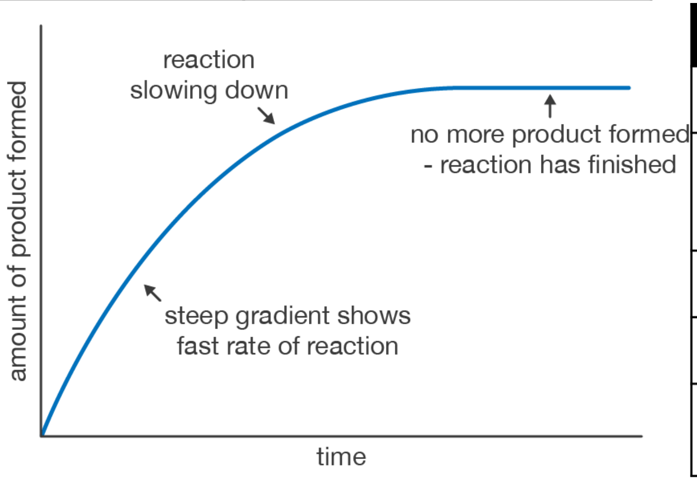
Science
Rates of reaction

Topic 3: Rate of Reaction

1. Keywords	
Rate of reaction	Amount of reactant used or product formed ÷ time
Collision theory	Idea that for a reaction to occur the particles have to hit each other with enough energy
Activation energy	The minimum energy needed for a collision to cause a reaction
Catalyst	A substance which speeds up a chemical reaction by lowering the activation energy
Reversible reaction	A chemical reaction that can go in either direction
Equilibrium	When the forwards and backwards reactions happen at the same rate

2. Ways to measure the rate of reaction	
Volume of gas produced	
Formation of a solid product	
Change in mass	





4. Factors affecting rate of reaction			
Factor	Change	Effect on rate	Reason
Temperature	Increase	Increase	The particles are moving faster so collide more often and with a greater proportion of successful collisions
Concentration	Increase	Increase	The are more particles so collisions are more frequent
Surface area	Increase	Increase	There are more particles available so more collisions
Catalyst	add	increase	The lower activation energy means more particles can successfully collide

$\rightleftharpoons$

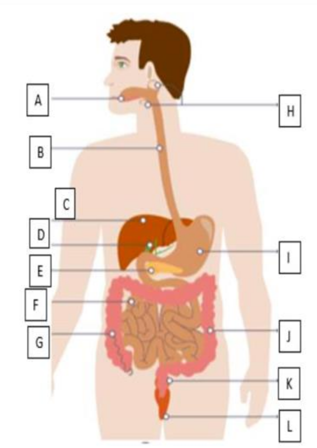
Science

Support and application

Vocabulary	Wider Research	Apply
124. Eukaryotic 125. Prokaryotic 126. Nucleus 127. Cytoplasm 128. Cell Membrane 129. Ribosome 130. Mitochondria 131. Cell Wall 132. Vacuole 133. Chloroplasts 134. Stem Cell 135. Differentiation 136. Resolution 137. Diffusion 138. Osmosis 139. Active Transport 140. Mitosis 141. Meiosis 142. Collision Theory 143. Activation Energy 144. Catalyst 145. Reversible Reaction 146. Equilibrium 147. Reactants 148. Products	**Cells in animals and plants/Cell division & transport in cells:** https://www.bbc.co.uk/bitesize/guides/zwnp7p3/revision/1 https://www.youtube.com/watch?v=HBZcpzr5B2g&list=PL9IouNCPbCxVU74eQtCcqbaQdYmwzAnlC **Rates of reaction:** https://www.bbc.co.uk/bitesize/guides/zp6xdxs/revision/1 https://www.youtube.com/watch?v=UkrBJ6-uGFA&list=PL9IouNCPbCxW8AN0t0py7LaKdKSwfL3fP	1. State one advantage and one disadvantage of using: a. A light microscope (2 marks) b. An electron microscope (2 marks) 2. A cell's image has a diameter of 800µm. The actual cell diameter is 20µm. At what magnification is the cell observed? (3 marks) 3. Suggest why the nucleus and the mitochondria are so important in cells. (4 marks) 4. Describe how active transport differs from diffusion and osmosis (3 marks) 5. Explain why cell division by mitosis is so important in the body (2 marks) 6. Explain the difference between embryonic stem cells and adult stem cells (2 marks) 7. State how many chromosomes are in a normal human body cell, and also a human sperm cell (2 marks) 8. List the factors that can affect the rate of a chemical reaction (4 marks) 9. Explain why the idea of activation energy is an important part of collision theory (2 marks) 10. Explain why food takes longer to cook in a pan than it does a pressure cooker (2 marks) 11. What do chemists mean by the term reversible reaction? (1 mark)

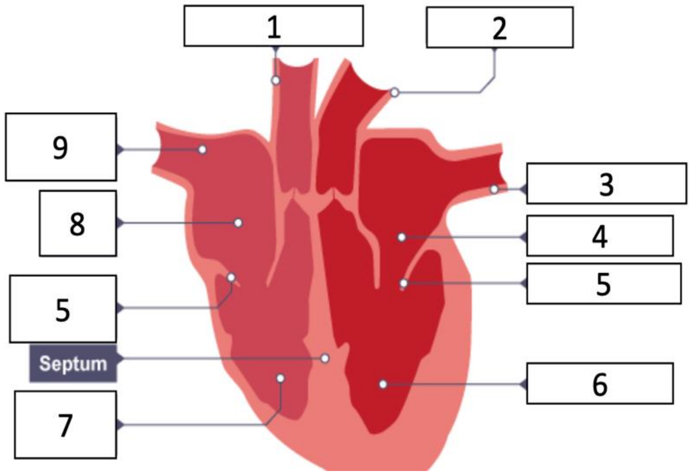
Topic 1:

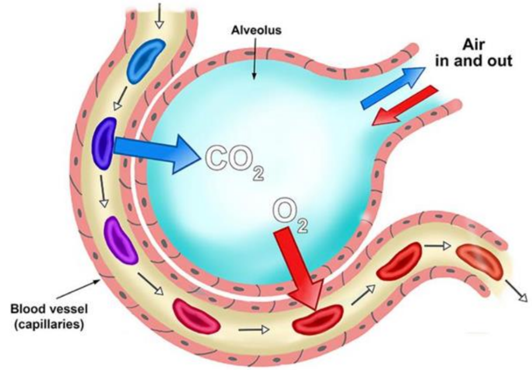
1. Principle of organisation		
Level	Definition	Examples
Cell	Basic building blocks of all living organisms	Cheek Muscle
Tissue	Group of cells with a similar structure and function	Glandular Epithelial
Organ	A group of tissues performing specific functions	Stomach Pancreas
Organ system	A group of organs which work together to form organisms	Digestive system



A	**Mouth**: mechanical breakdown/chew food	G	**Appendix**: useless organ which harbours bacteria (good and bad)
B	**Oesophagus** (gullet): push chewed food to stomach	H	**Salivary Glands**: produce saliva with amylase enzymes to breakdown starch
C	**Liver:** makes bile	I	**Stomach**: Partial digestion of food/mechanically churns food with HCl and protease enzymes
D	**Gall Bladder**: stores bile which breaks down fats (lipids) and neutralises the HCl(stomach acid)	J	**Large Intestine**: re-absorption of water
E	**Pancreas**: production of digestive enzymes	K	**Rectum**: muscular section of the large intestines
F	**Small Intestine:** absorption of small soluble particles	L	**Anus**: where faeces leaves the body

7. The heart		
1	Pulmonary artery	Carries deoxygenated blood to the lungs
2	Aorta	Carries oxygenated blood to the body
3	Pulmonary vein	Brings oxygenated blood from the lungs
4	Left atrium	Pushes blood to left ventricle
5	Heart valve	Prevents backflow of blood
6	Left ventricle	Pumps blood to body
7	Right ventricle	Pumps blood to lungs
8	Right atrium	Pushes blood into right ventricle
9	Vena cava	Brings deoxygenated blood from body

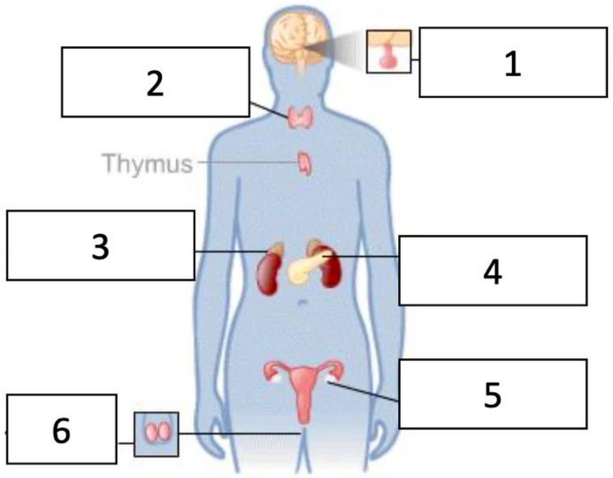




Thin walls	Capillary wall one cell thick
Moist layers	From mucus in alveoli
Large surface area	Many alveoli
High concentration gradient	Blood enters with low O_2 and high CO_2

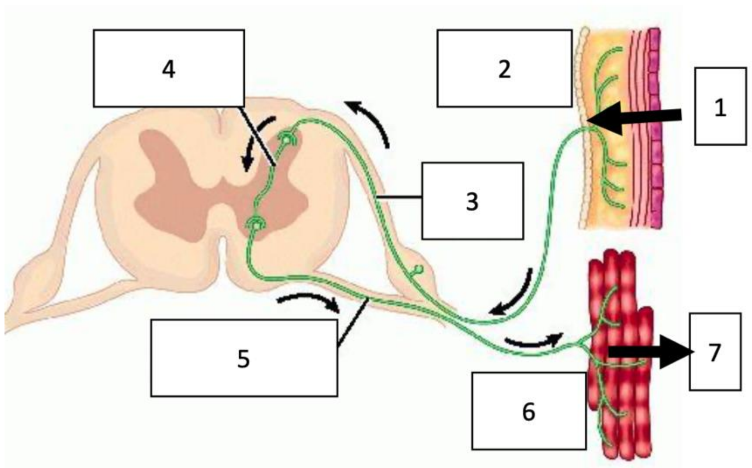
Topic 2:

9. Major glands on the body		
1	Pituitary gland	The 'master gland' makes hormones which affect other glands causing them to secrete hormones
2	Thyroid gland	Controls metabolism
3	Adrenal gland	Makes adrenalin
4	Pancreas	Controls blood sugar levels
5	Ovary	Produces female sex hormones
6	Testes	Produce male sex hormone



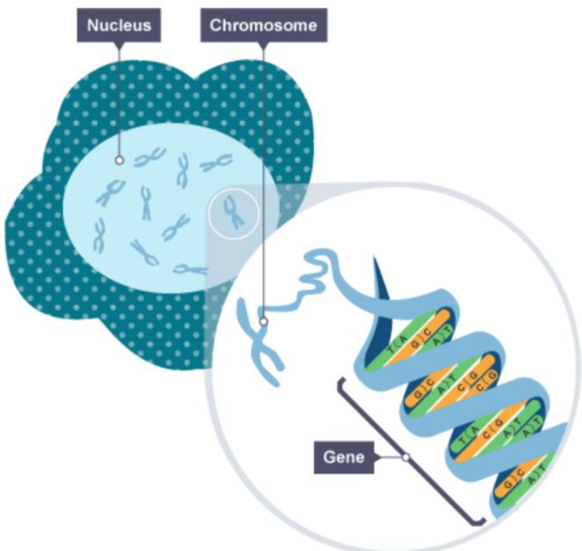
2. Nervous system: Reflex arc							
No.	1	2	3	4	5	6	7
Section	Stimulus →	Receptor →	Sensory neurone →	Co-ordinator →	Motor neurone →	Effector →	Response
Definition	A change to the environment that triggers a nervous response	A cell which detects a specific stimulus	A neurones which carries electrical signal from receptor to CNS	The area that receives and processes the information	Neurone that connects the CNS to the effector	The organ that creates the correct response form the stimulus	The effect of the stimulus. Often designed to prevent injury
Example	Touching a flame	Pain receptor in skin	Sensory neurone	Brain Relay neurone	Motor neurone	Muscle gland	Movement

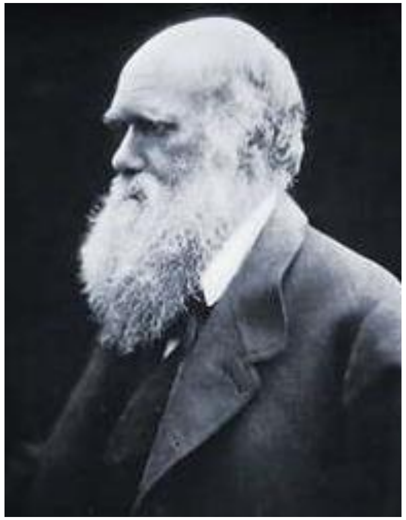
Homeostasis	The regulation of the internal conditions of a cell or organism to maintain optimum conditions for function in response to internal and external changes.
Optimum conditions	The perfect conditions for an organism to survive and grow. E.g. blood glucose level, body temperature and water level.
Nervous response	Uses electrical signal in nerves to make fast changes
Chemical response	Uses hormones in the blood to make changes.
Reflex arc	A nervous response that is fast and automatic for protection. Does not involve the conscious brain.
CNS	(Central nervous system) The brain and the spinal chord
Neurone	Nerve cell. Carries an electrical signal from one end to the other



Topic 3:

Allele	Different forms of the same gene. eg hair colour
Dominant	When only one copy of the allele is needed to show in the offspring
Recessive	When the allele only shows when there are two copies
Homozygous	Two copies of the same allele
Heterozygous	Two different alleles
Genotype	The set of genes in our DNA
Phenotype	The outward appearance a set of genes displays





Evolution	The change in the inherited characteristics of a population due to natural selection. May result in a new species
Natural selection	The process where the organism best adapted to the environment survives and passes on their characteristics
Species	A group of organisms with similar features which can breed to make fertile offspring

Stages of evolution
1. Population shows variation due to their genes
2. Environment changes
3. Some individuals are best adapted and live longer
4. These can breed and produce more offspring
5. Over a long period of time the offspring dominate the population

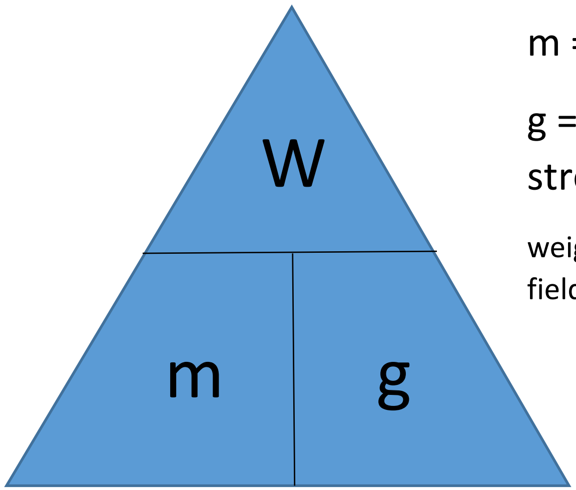
Extinction	When an entire species has died
Causes of extinction	1. Disease 2. New predators 3. Famine 4. Natural disaster (meteor, volcano)

Science
Support and application

Vocabulary	Wider Research	Apply
149. Cell 150. Tissue 151. Organs 152. Alveoli 153. Respiratory system 154. Cardiovascular System 155. Oxygen 156. Carbon dioxide 157. Endocrine System 158. Gland 159. Hormone 160. Nervous System 161. Neurone 162. Stimulus 163. Receptor 164. Coordinator 165. Effector 166. Response 167. Allele 168. Dominant 169. Recessive 170. Homozygous 171. Heterozygous 172. Genotype 173. Phenotype 174. Evolution	**Systems of the human body:** https://www.bbc.co.uk/bitesize/guides/zwyfxfr/revision/1 https://www.youtube.com/playlist?list=PL9IouNCPbCxXGDt3ATU1xM_X_F8JghPCB **Homeostasis & Response:** https://www.bbc.co.uk/bitesize/guides/zc8qdxs/revision/1 https://www.youtube.com/playlist?list=PL9IouNCPbCxW3lptxS1yHCP2I9YDfM2co **Inheritance, Variation & Evolution:** https://www.bbc.co.uk/bitesize/guides/ztwdgdm/revision/1 https://www.bbc.co.uk/bitesize/guides/zyxm8mn/revision/1 https://www.youtube.com/playlist?list=PL9IouNCPbCxWt28Bifo2jK9xn-ym956sf https://www.youtube.com/playlist?list=PL9IouNCPbCxXqJycGYKJhk2PMKICNBBZ8	1. Why is the heart described as a ‘double pump’? (2 marks) 2. The heart is a type of muscle- what chemical reaction occurs to give the heart energy to pump blood around the body? (1 mark) 3. Why is the left side of the heart muscle bigger than the other side? (2 marks) 4. Compare the nervous system with the endocrine system (4 marks) 5. Name the master gland in the human body (1 mark) 6. Describe how the lungs are adapted to allow exchange of oxygen and carbon dioxide between the air and in blood. (3 marks) 7. Describe the difference between a dominant allele and a recessive allele (2 marks) 8. Describe how evolution takes place in terms of natural selection (4 marks) 9. How do fossils provide evidence for evolution? (2 marks) 10. Why does a dominant allele create a higher probability of an offspring affected by a disease, such as cystic fibrosis? (2 marks)

Equations

$W = m\,g$



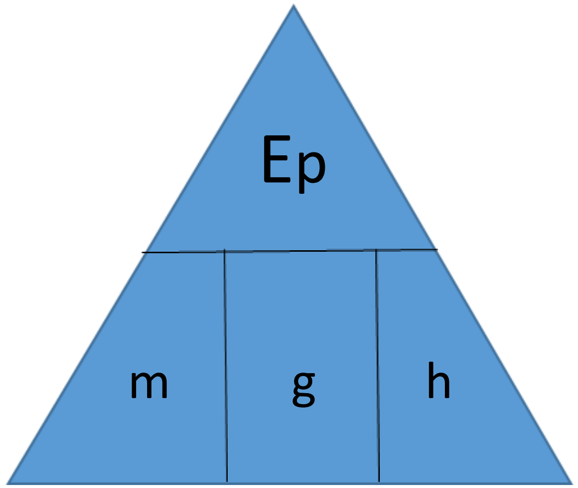
W = weight (N)

m = mass (kg)

g = gravitational field strength (N/kg)

weight = mass x gravitational field strength

$E_p = m\,g\,h$



E_p = gravitational potential energy (J)

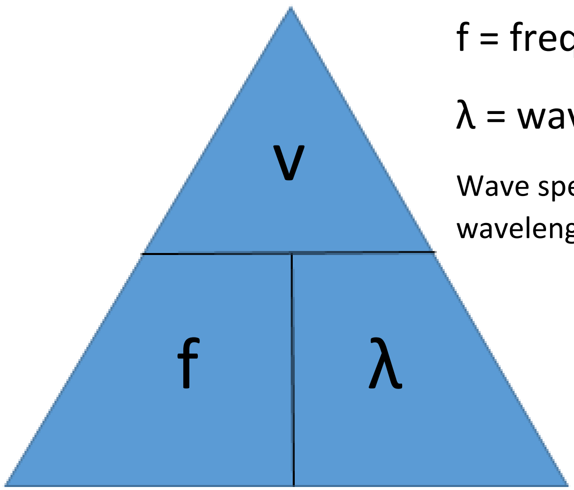
m = mass (kg)

g = gravitational field strength (N/kg)

h = height (m)

Gravitational potential energy = mass x gravitational field strength x height

$v = f\,\lambda$



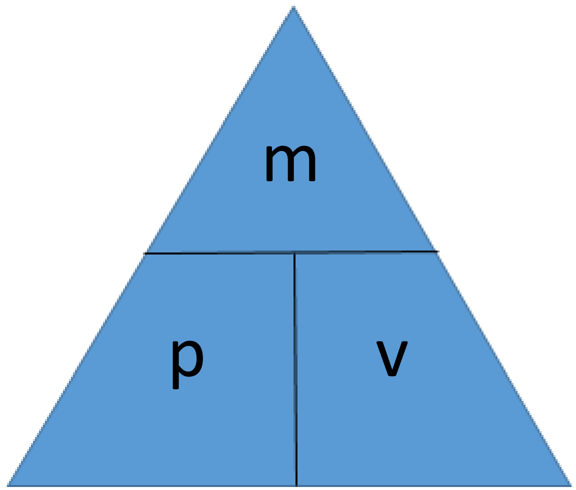
v = wave length (m/s)

f = frequency (hz)

λ = wavelength (m)

Wave speed = frequency x wavelength

$p = \frac{m}{v}$



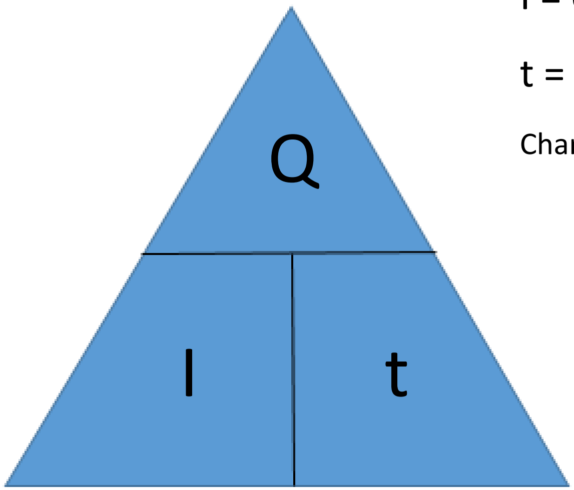
p = density (kg/m^3)

m = mass (kg)

V = volume (m^3)

Density = mass ÷ volume

$Q = I\,t$



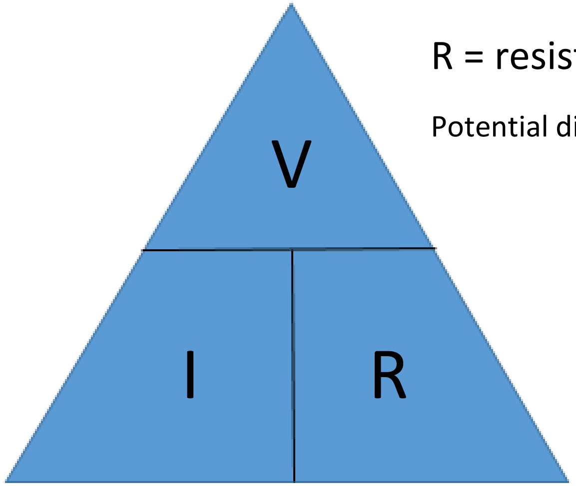
Q = charge flow (C)

I = current (A)

t = time (s)

Charge flow = current x time

$V = I\,R$



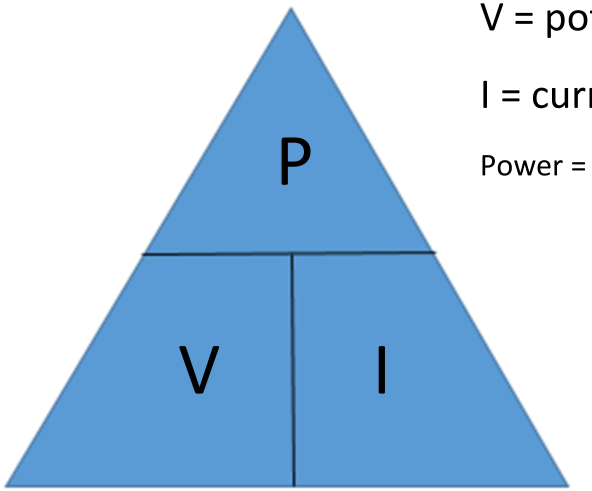
V = potential difference (v)

I = current (A)

R = resistance (Ω)

Potential difference = current x resistance

$P = V\,I$



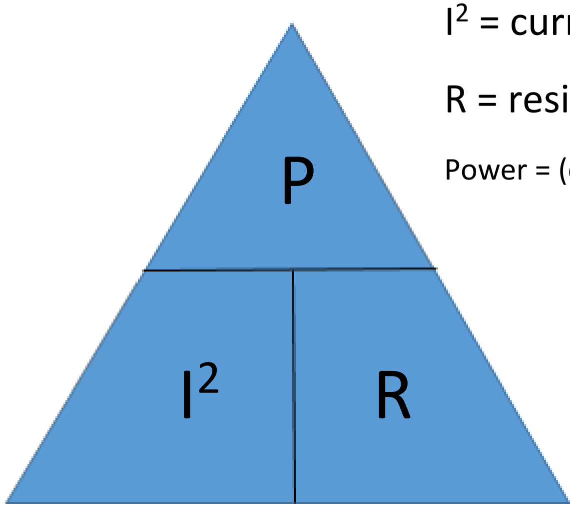
P = power (W)

V = potential difference (V)

I = current (A)

Power = potential difference x current

$P = I^2\,R$



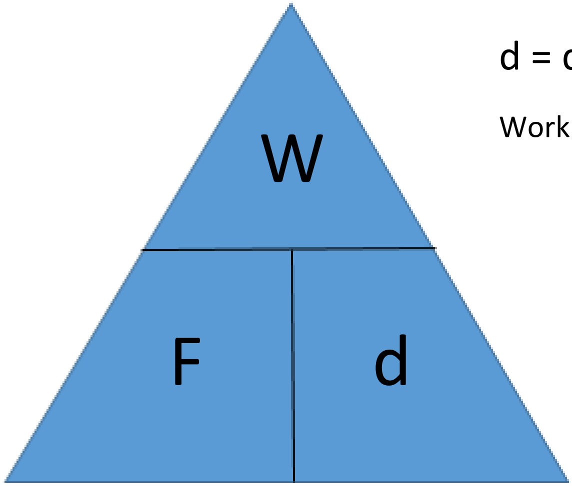
P = power (W)

I^2 = current^2 (A)

R = resistance (Ω)

Power = (current)^2 x resistance

W = F d



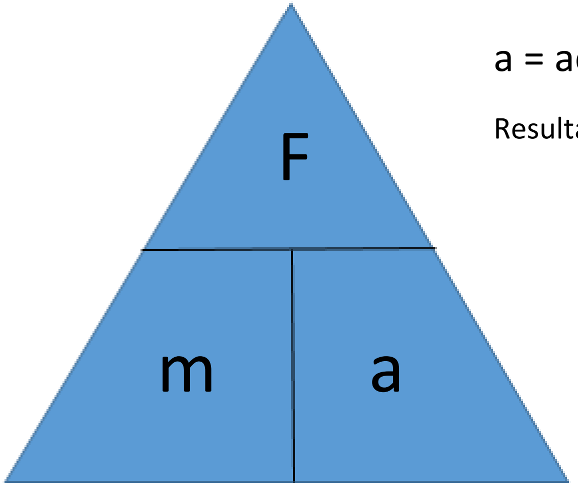
W = work done (J)

F = force (N)

d = distance (m)

Work done = force x distance

F = m a



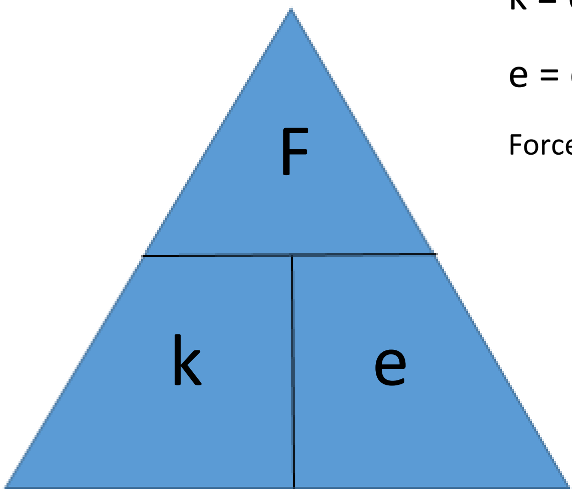
F = force (N)

m = mass (kg)

a = acceleration (m/s^2)

Resultant force = mass x acceleration

F = k e



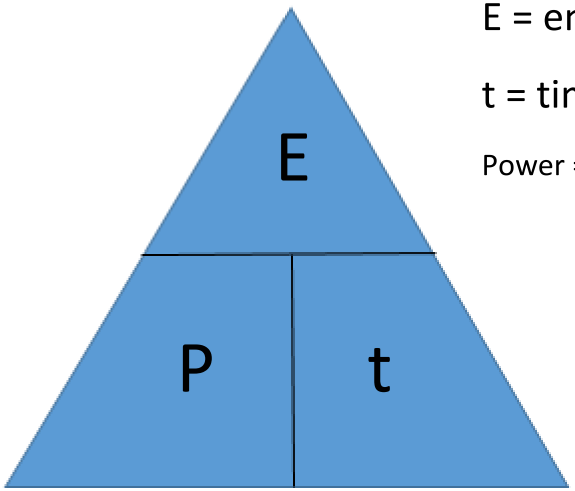
F = force (N)

k = constant (N/m)

e = extension (m)

Force applied to a string = spring constant x extension

$P = \frac{E}{t}$



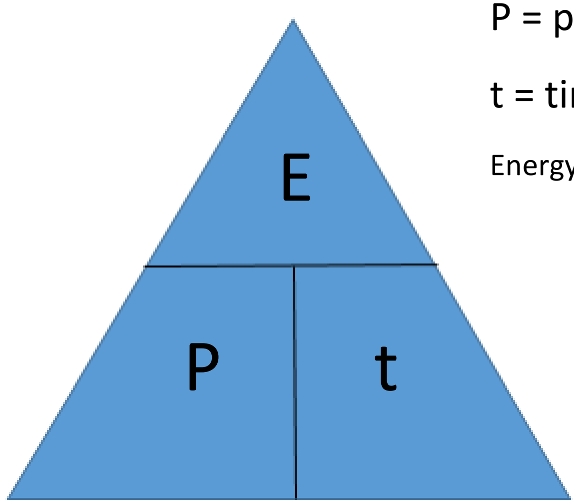
P = power (kWh)

E = energy transferred (kw)

t = time (h)

Power = energy transferred ÷ time

E = P t



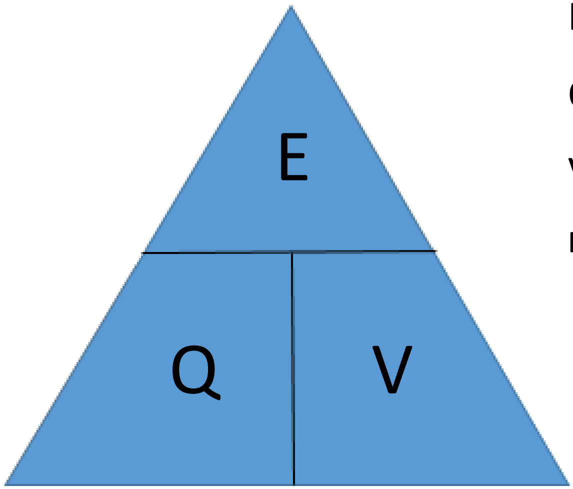
E = energy transferred (kWh)

P = power (W)

t = time (h)

Energy transferred = power x time

E = Q V



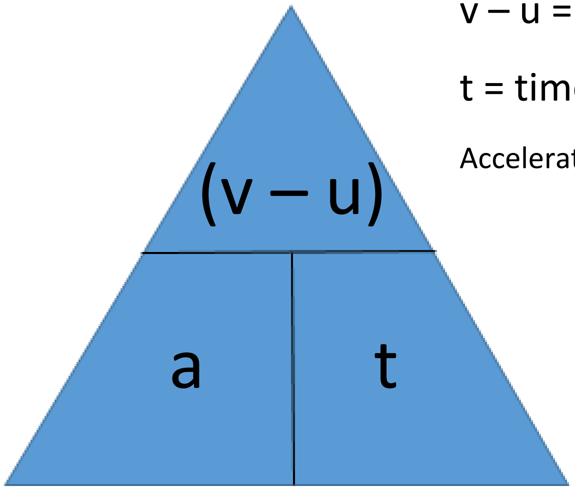
E = energy transferred (J)

Q = charge flow (C)

V = potential difference (V)

Energy transferred = charge flow x potential

$a = \frac{(v-u)}{t}$



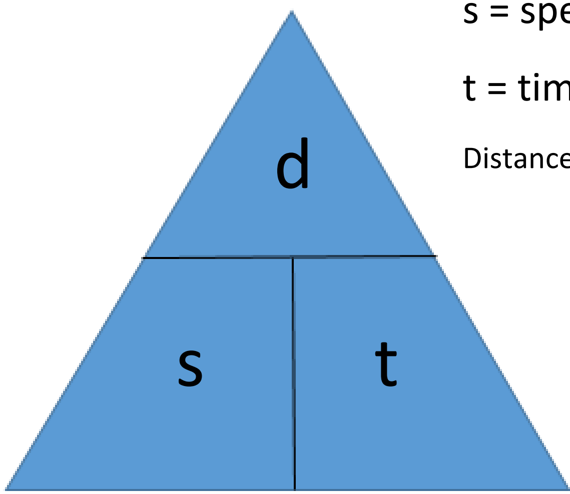
a = acceleration (m/s^2)

v – u = change in velocity (m/s)

t = time taken (s)

Acceleration = change in velocity ÷ time taken

s = d t



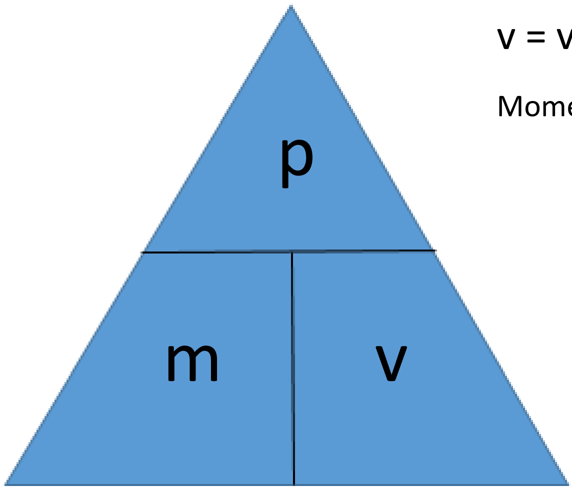
d = distance travelled (m)

s = speed (m/s)

t = time (s)

Distance travelled = speed x time

p = m v



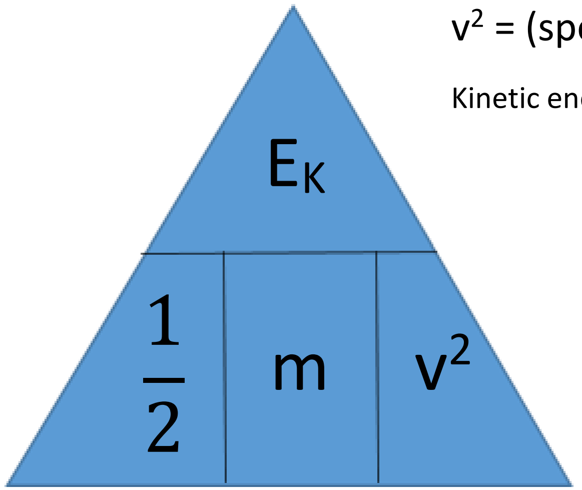
P = momentum (kg m/s)

m = mass (kg)

v = velocity (m/s)

Momentum = mass x velocity

$E_k = \frac{1}{2}\ m\ v^2$



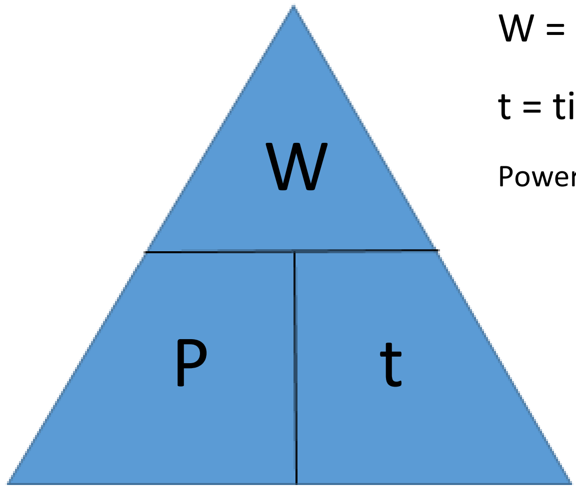
E_k = kinetic energy (J)

m = mass (kg)

$v^2 = (\text{speed})^2$ (m/s)

Kinetic energy = 0.5 x mass x speed

$P = \frac{W}{t}$



P = power (W)

W = work done (J)

t = time (s)

Power = work done ÷ time

Efficiency (%)

Useful power output (J)

Total power output (J)

Efficiency = useful power output ÷ total power input

Efficiency (%)

Total output energy transfer (J)

Total input energy transfer (J)

Efficiency = total output energy transfer ÷ total input energy transfer

GCSE Required Practical – Biology 1 – Using a light microscope

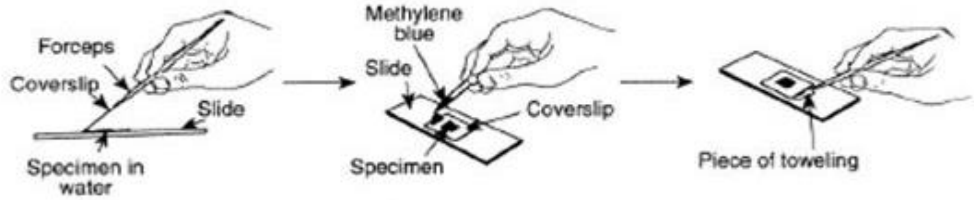
What's the point of the practical?

To find out what cells look like and see how big they are and see how they work.

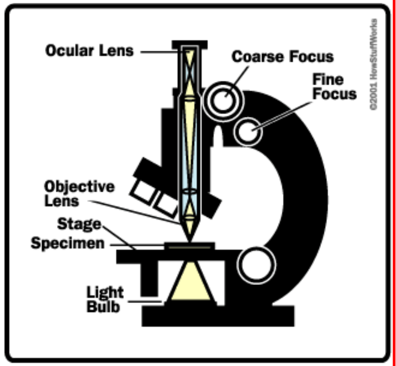
What may they ask us about?

- Make sure you can use and rearrange the equation
- Make sure you know the units:
  1mm = 1000um
  1um = 1000nm
  - You may need a ruler to measure the size of images and work out their real size.
  - Explain why we can see the nucleus and cell wall but not the mitochondria *(they're far too small and not stained)*
  - How can we see smaller parts of cells? (*An electron microscope has much more resolution and magnification)*

Example Apparatus



- Use a stain to make things visible (cell wall, nucleus).
- Get the specimen as flat and thin as possible.
- Start on the smallest lens, focus, then move up a lens.
- a ruler, or eyepiece scale can be used to measure size
- Use the equation:



$$\text{Magnification} = \frac{\text{image size}}{\text{actual object size}}$$

GCSE Required Practical – Biology 1 – Investigating Osmosis

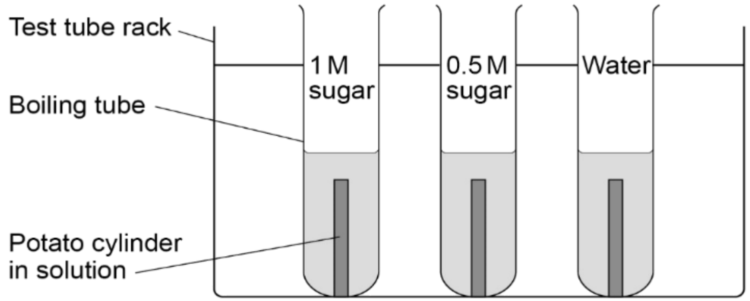
Osmosis: the movement of water from an area with high concentration OF WATER, to an area with lower concentration OF WATER.

Solute: something that dissolves in water

What's the point of the practical?

To find out what happens to cells when you put them in different concentrations of sugar or salt solutions. (to see how the water moves in or out of the plant tissue)

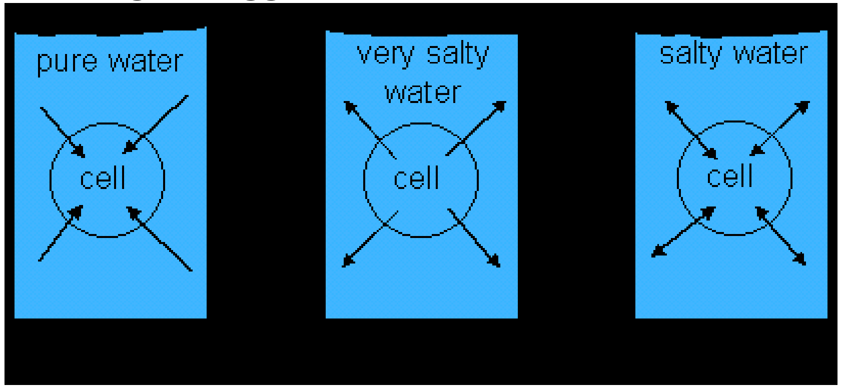
Example Apparatus



- Different concentrations of sugar (or salt)
- Measure the length (or mass) of the potato cylinders before and after.

Results

- High concentration of sugar in solution = water moves out of potato cells into the solution. Potato gets smaller.
- Low concentration of sugar in solution = water moves into the potato cells from the solution. Potato gets bigger.



- If no water goes in or out of the potato overall and it doesn't change mass, then the solution is exactly the same concentration as inside the potato

What may they ask us about?

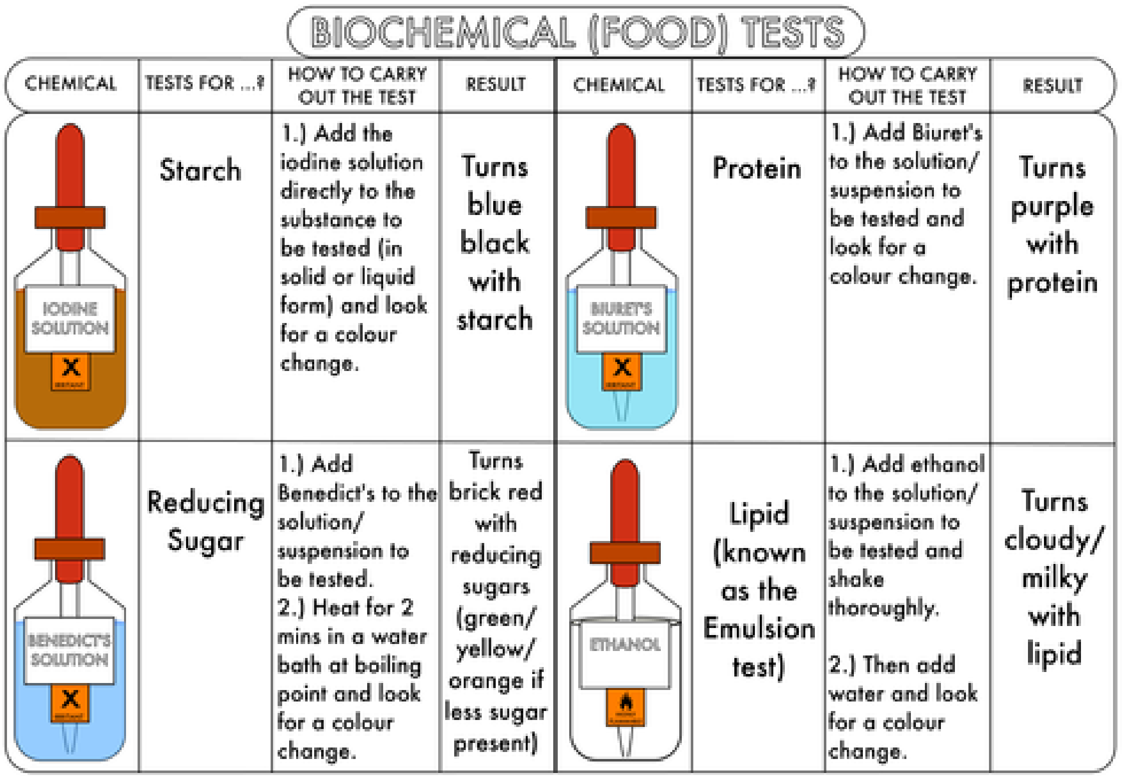
- Control variables
- Accuracy of measurements – why should you remove excess water with paper towel before weighing
- Use a graph of results to find the concentration inside the potato cells
- Why can the water, but not the sugar/salt move through the membrane?

GCSE Required Practical – Biology 1 – Food Tests

What's the point of the practical?

To find out if sugars, starch and/or proteins are in certain foods.

Example Apparatus and results



BIOCHEMICAL (FOOD) TESTS

CHEMICAL	TESTS FOR ...?	HOW TO CARRY OUT THE TEST	RESULT	CHEMICAL	TESTS FOR ...?	HOW TO CARRY OUT THE TEST	RESULT
IODINE SOLUTION	Starch	1.) Add the iodine solution directly to the substance to be tested (in solid or liquid form) and look for a colour change.	Turns blue black with starch	BIURET'S SOLUTION	Protein	1.) Add Biuret's to the solution/ suspension to be tested and look for a colour change.	Turns purple with protein
BENEDICT'S SOLUTION	Reducing Sugar	1.) Add Benedict's to the solution/ suspension to be tested. 2.) Heat for 2 mins in a water bath at boiling point and look for a colour change.	Turns brick red with reducing sugars (green/ yellow/ orange if less sugar present)	ETHANOL	Lipid (known as the Emulsion test)	1.) Add ethanol to the solution/ suspension to be tested and shake thoroughly. 2.) Then add water and look for a colour change.	Turns cloudy/ milky with lipid

What may they ask us about?

- Qualitative test (tell you just yes/no) vs Quantitative (tells you how much) tests.
- Sources of error – how could you make mistakes?
- Why is it hard to judge colour change accurately?
- Resolution of measurements, repeatability, reproducibility etc.

GCSE Required Practical – Biology 1 – Investigating amylase enzyme

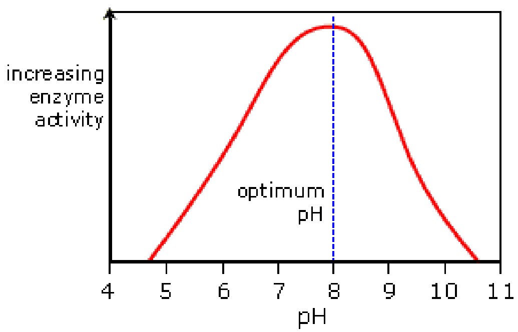
Enzyme: a biological catalyst. Speeds up reactions in the body by lowering the activation energy.
pH: how acidic or alkali a substance is (1 = strong acid, 7=neutral, 14 = strong alkali)
Amylase: an enzyme that breaks down starch into sugar

What's the point of the practical?

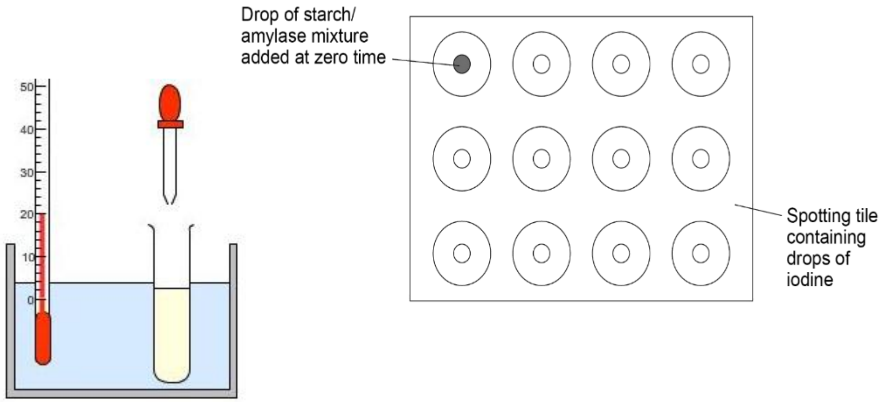
To find out what happens to the rate of enzyme activity when the pH changes.

Results

- At low pH and high pH, the iodine keeps turning black because the enzyme has been denatured.
- After just a few minutes at pH 7-9, the iodine stays brown – the starch has all broken down into sugar.



Example Apparatus



- Starch reacts with amylase in a water bath
- Take samples from the mixture every 30 seconds and add it to iodine
- Iodine goes black = starch present
- Iodine stays brown = no starch present (it's reacted)

What may they ask us about?

- Why do you need a water bath? *(To maintain the correct temperature, because temperature affects reaction rate)*
- If you test at pH 3,4,5,6,7,8,9 and 10, Why don't we know the exact optimum pH? *(because although two answers may both show quick reactions (e.g. pH7 and pH8), the actual optimum could be between those number (e.g. pH 7.6) so you need to test different pH's to find out the exact optimum.*
- Sources of error and weaknesses – e.g. in measuring, starting and stopping timers etc

GCSE Required Practical – Biology 1 – Light and Photosynthesis

Photosynthesis: when plants use carbon dioxide and water to make glucose (and oxygen). Happens in the chloroplast and needs light to happen.

What's the point of the practical?

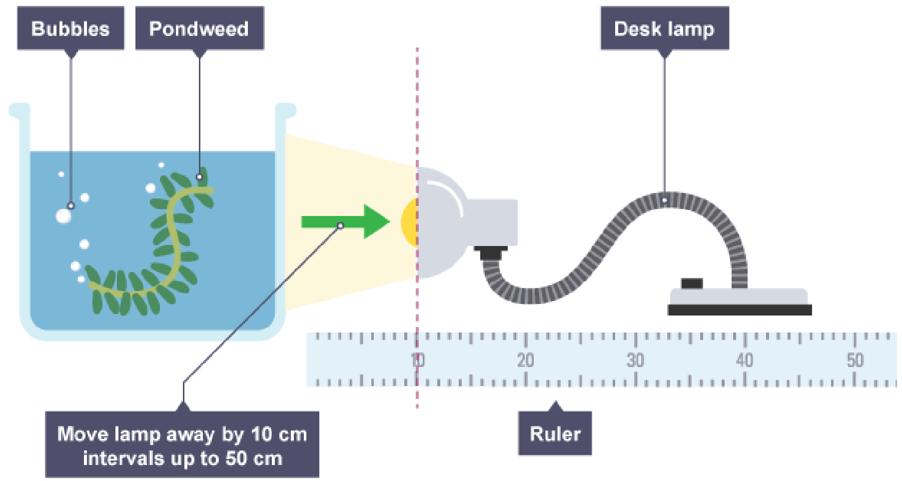
To find out what happens to the rate of photosynthesis when we change the light intensity

Photosynthesis

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

carbon dioxide + water ⟶ glucose + oxygen

Example Apparatus



Results

- The closer the lamp, the quicker the bubbles are produced (so higher rate of photosynthesis)

What may they ask us about?

- Why results may be inaccurate (*difficult to count very small bubbles, each bubble counts as '1' no matter how big it is*)
- Why should you leave the plant for a few minutes before starting to count bubbles (*as it takes time for the plant to adjust to the light/temperature and for photosynthesis to reach the correct rate*).
- Heat from the lamp is a source of error, how could you avoid this? (*Place a glass screen in front of the beaker so that light gets through but heat doesn't*)
- What are the other limiting factors apart from light? Why will rate of photosynthesis level off, even with maximum light? (*The plant also needs enough temperature and* CO_2)

GCSE Required Practical – Biology 1 – Investigating reaction time

Reaction time – the time it takes for you to react. You need to detect the stimulus (eyes) and send an impulse to the brain (sensory neurone) and down to the hand (motor neurone)

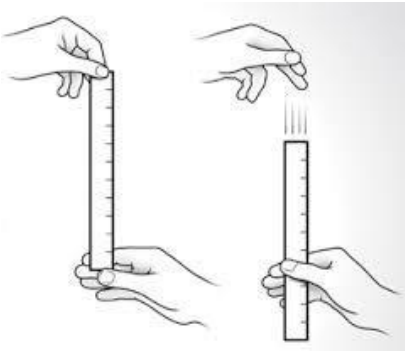
What's the point of the practical?

To find out how a certain variable affects reaction time.

Results

- People react quicker with practice and if they are concentrating.
- They react slower if distracted in any way.

Example Apparatus



- Dropping a metre stick
- Or using an online reaction

test to measure reaction time

(reaction distance with metre stick).

- Many IV's could be tested

e.g. the effect of listening to music, drinking alcohol, drinking caffeine, taking drugs or medicines, gender, age, amount of practice

What may they ask us about?

- Control variables – what had to be kept the same and how did you do it?
- Why is it important to repeat? Calculate means etc
- Range of results, resolution of measurements, uncertainty of results
- Ethical considerations
- Use of control groups to compare to

GCSE Required Practical – Biology 1 – Measuring population size

Population: all the individuals of a species in a particular area. Abiotic factors: non-living factors biotic factors: living factors

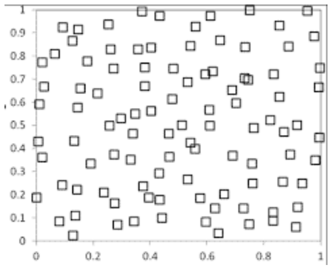
Distribution: how the individuals are 'spread out' across a certain area

What's the point of the practical?

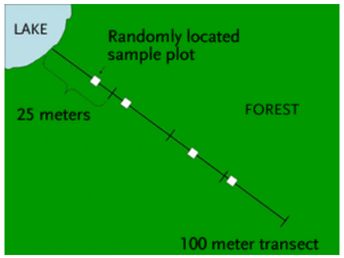
To find out how different factors affect how species are distributed

Results

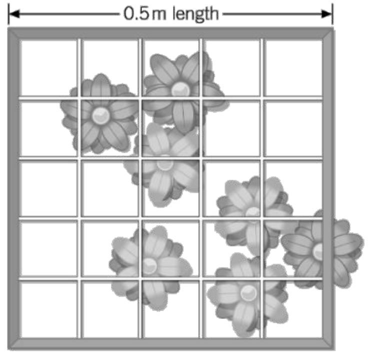
- Random sampling – used when you want to know how the organisms are spread out across an area.



- Line transect – used when you want to see how one particular feature (e.g. a river/road/building) affects an area. You take samples in a line (called a transect) and repeat to compare the difference near and far from the feature.



Example Apparatus



- Quadrat – frame of a certain size used to isolate a particular area so you can see what's in that certain space

What may they ask us about?

- Accuracy of measurements – is it 100% accurate?
- Reproducibility and validity of data – is it completely fair?
- Calculate means and work out the total number in a certain area.
- How could you improve the sample to make it more representative?

GCSE Required Practical –Chemistry 1 – Making a salt from a carbonate or oxide

Salt: an ionic substance soluble: something that dissolves in water insoluble: something that doesn't dissolve in water

Acid + metal carbonate → metal salt + water + carbon dioxide Acid + metal oxide → metal salt + water

What's the point of the practical?

To find out how to make a pure, dry sample of a soluble salt from an insoluble carbonate or oxide.

Results

- Hydrochloric Acid makes Metal Chlorides
- Sulfuric Acid makes Metal Sulfates
- Nitric Acid makes Metal Nitrates

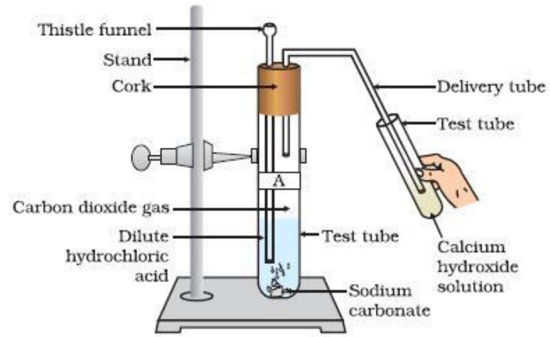
What may they ask us about?

- How do you get solid crystals from the salt solution? (*crystallize, evaporate the water*)
- Why do we heat the solution?
- What are the risks and safety precautions
- Why do we filter the solution?
- How could we test the pH of the salt solution?
- Name the salt produced.

Example Apparatus

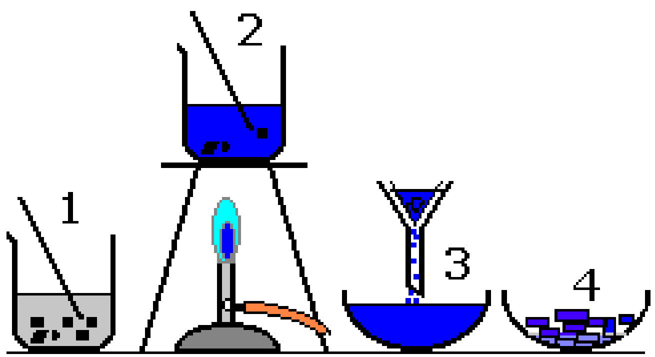
Acid + Carbonate

Limewater (calcium hydroxide can be used To show Co_z is produced



Acid + Metal Oxide

- Excess of metal oxide added
- Need to heat the solution to ensure as acid fully reacts with available metal oxide particles
- Then filter to remove excess metal oxide



GCSE Required Practical – Chemistry 1 – Electrolysis

Electrolysis: when a salt solution is separated using electricity

What's the point of the practical?

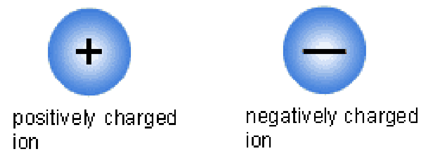
To find out how different solutions behave when electrolysed

What may they ask us about?

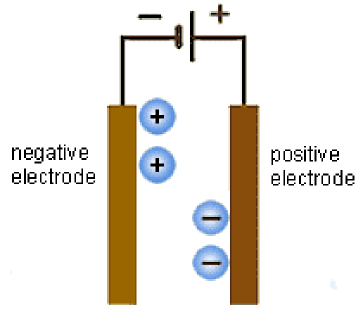
- How could you test the gas that is produced? (*hydrogen = pop, chlorine = bleaches damp litmus paper)*
- What happens when the ……. Ions get to the ……. Electrode? (*positive ions are reduced – gain electrons. Negative ions are oxidised – lose electrons).*
- What would happen if you added universal indicator to the solution? (*turns purple – hydroxide is produced – alkali).*

Example Apparatus

Molten compounds or less reactive salt solutions

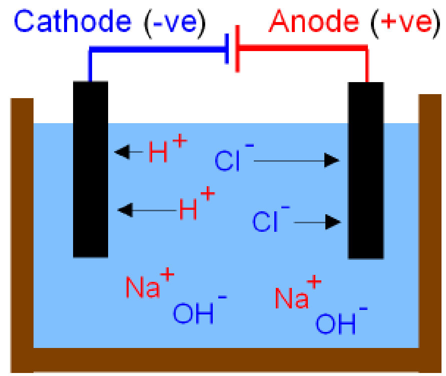


- Positive ions to negative electrode. Negative ions to positive electrode. Easy.



More reactive metal solutions e.g. Sodium Chloride solution (Brine)

- If the metal is more reactive than Hydrogen
- Hydrogen is produced at the Negative electrode (instead of the metal).
- Metal hydroxide is produced In the solution.



GCSE Required Practical –Chemistry 1 – Temperature changes in solutions

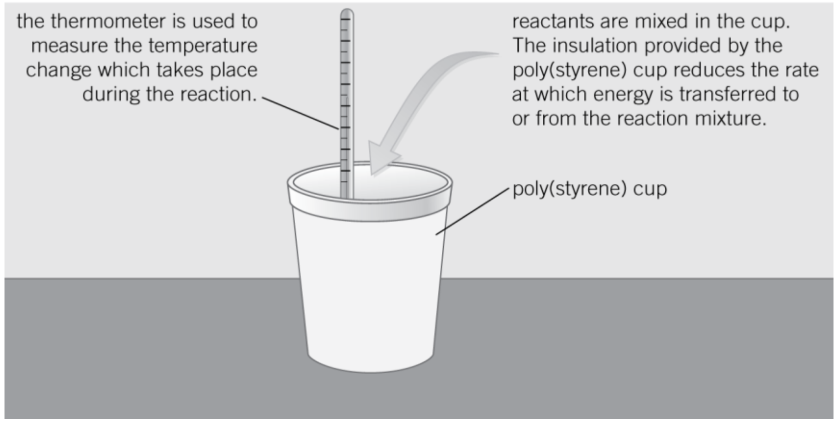
What's the point of the practical?

To find out how different variables affect energy changes in solutions.

Results

- Displacement reactions are exothermic
- Neutralisation reactions are exothermic

Example Apparatus



- Displacement (e.g. Copper Sulfate + Iron → Iron Sulfate + Copper)
- Neutralisation

  (e.g. Hydrochloric Acid + Sodium Hydroxide → Sodium Chloride + Water)

What may they ask us about?

- Why do you use a polystyrene cup / lid? (*to reduce temperature loss to the surroundings - makes results more accurate)*
- Resolution and accuracy of measurements.
- Repeatability, calculating mean results, uncertainty etc

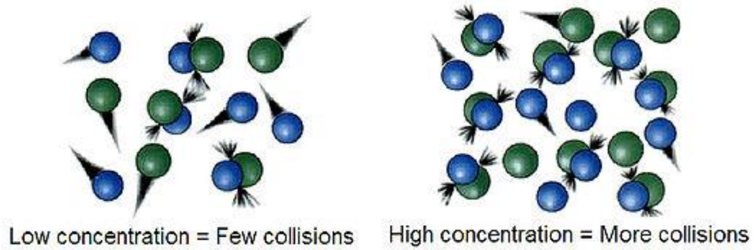
GCSE Required Practical –Chemistry 2 – How does concentration affect rate of reaction

Concentration: the amount of substance in a certain space

What's the point of the practical?
To find out how changes in concentration affect the rate of reaction.

Results

- The higher the concentration, the faster the reaction rate

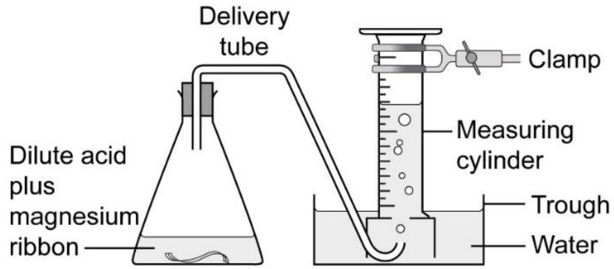


What may they ask us about?

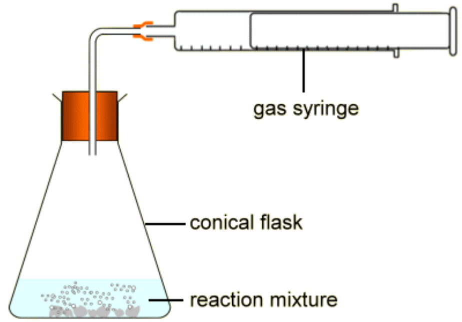
- What are the sources of errors that could lead to anomalous results? (*not getting the bung in quickly enough, starting the timer exactly on time etc)*
- Resolution and accuracy of measurements
- Control variables – just change the concentration – everything else has to stay the same (e.g. why must temperature be controlled)

Example Apparatus

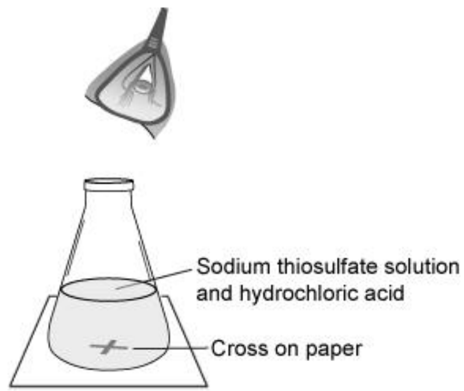
Measuring cylinder - used to measure gas Production over time



Gas syringe - used to measure gas production over time



'Disappearing' cross – used to measure how quickly the colour changes



GCSE Required Practical –Chemistry 2 –Identifying substances using chromatography

Chromatography: the process where a dissolved substance is separated by running a solvent along a material (e.g. paper)

What's the point of the practical?

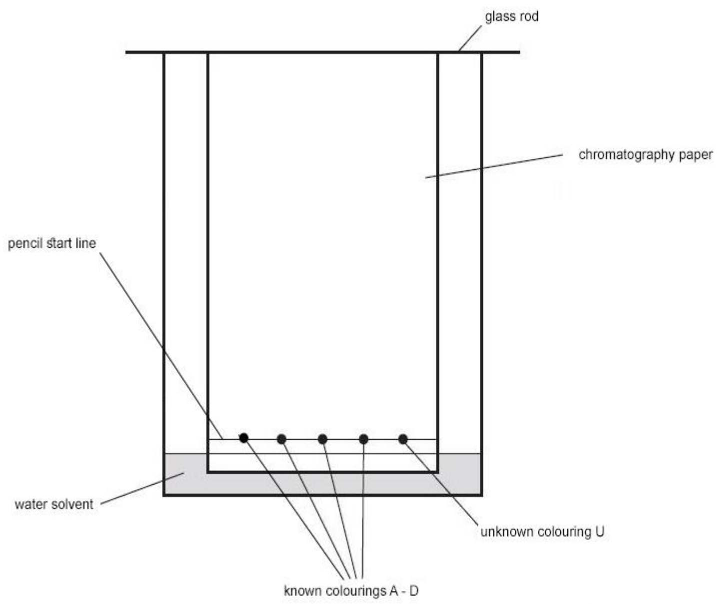
To separate substances and identify what they're made of

Results

- The substance moves up the paper (stationary phase). It is carried by the solvent (mobile phase). Each substance goes a certain distance

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

Example Apparatus



What may they ask us about?

- Why must the start line be drawn in pencil? (*because pencil does not smudge/run in the solvent whereas pen would*)
- Why does there need to be a lid? (*to stop the solvent from evaporating*)
- Measure the R_f value – be accurate. Compare different substances with different R_f values. See what substances are contained in certain mixtures
- Sources of error, resolution or measurements etc.

GCSE Required Practical –Chemistry 2 –Purifying and testing water

Potable water = drinkable water

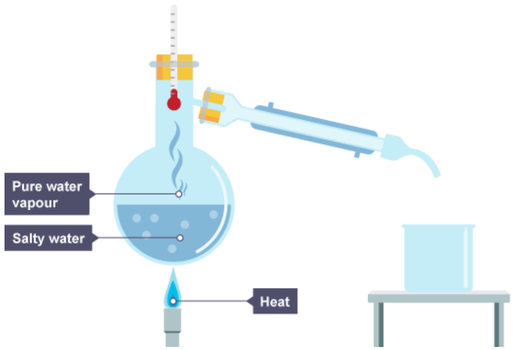
What's the point of the practical?

To analyse and purify water from different sources

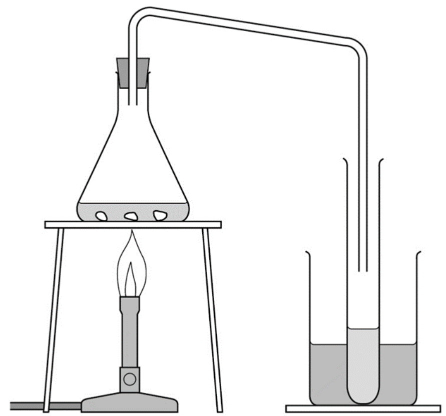
Results

- Pure water boils at exactly 100°C and its pH is 7
- Salt water contains sodium chloride
- Distillation = Heat the solution, the water evaporates, the salt stays in the container.

Example Apparatus



Or...



What may they ask us about?

- Explain how distillation works (*water evaporates at lower temperature as it has a lower boiling point than the dissolved solids, then it condenses back into liquid as it cools down)*
- Why is it not economical to do this on a large scale to make drinking water? (*it costs too much to heat the water*)
- Why may you not get all the water from the solution? (*some does not evaporate, some liquid stays in the tube*)

GCSE Required Practical – Physics 1 – Specific Heat Capacity

Specific Heat Capacity: the amount of energy needed to raise the temp of 1kg by 1°C

What's the point of the practical?

To find out the specific heat capacity of a material.

(You'll need to heat it and work out how much energy has gone in.)

If you haven't got a joulemeter, but do have an ammeter, voltmeter or power meter you can work out the amount of energy by:

Energy = power x time

Power = current x potential difference

Results:

$$\text{specific heat capacity } c \text{ (J/kg °C)} = \frac{\text{energy transferred } \Delta E \text{ (J)}}{\text{mass } m \text{ (kg)} \times \text{temperature change } \Delta\theta \text{ (°C)}}$$

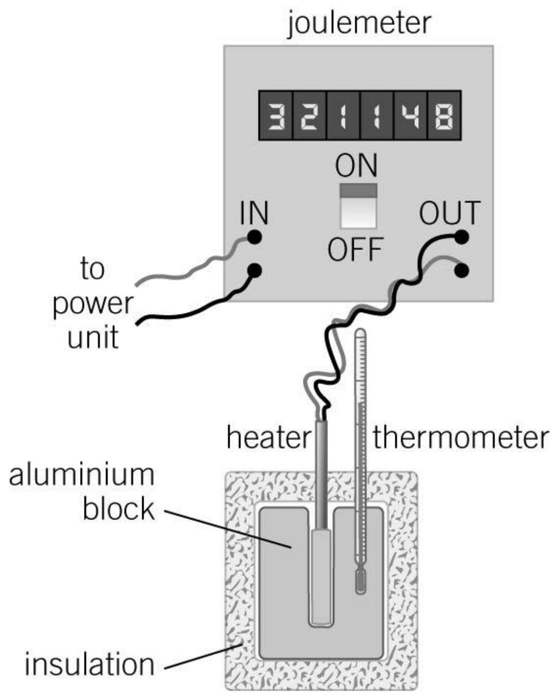
Example Apparatus

Joulemeter – measures Energy going into the heater in joules

Heater – heats the block

Insulation – stops heat Escaping into the atmosphere

Thermometer – measures the temperature rise



What may they ask us about?

Why do you need to insulate the block? (*to stop heat loss to the atmosphere*)

Why is your answer not the true value? (*because not all the heat was transferred into the block and through to the thermometer*)

Why is the temperature increase slower at first? *(because it takes some time for the block to heat up and for the heat to reach the thermometer.)*

It may not be a block of metal. You could use a kettle to heat an amount of water or any other way of heating something.

What's the **resolution** of temperature measurements? This experiment could be repeated and you'd get slightly different readings. They could ask about **repeatability** and ask you to calculate the **mean** or the **uncertainty**.

GCSE Required Practical – Physics 1 – Investigating Resistance

Resistance: how difficult it is for current to flow through part of the circuit.

<u>What's the point of the practical?</u>

To find out resistance of a wire.

(You could look at different lengths of wire, different thicknesses, or even different temperatures)

Results:

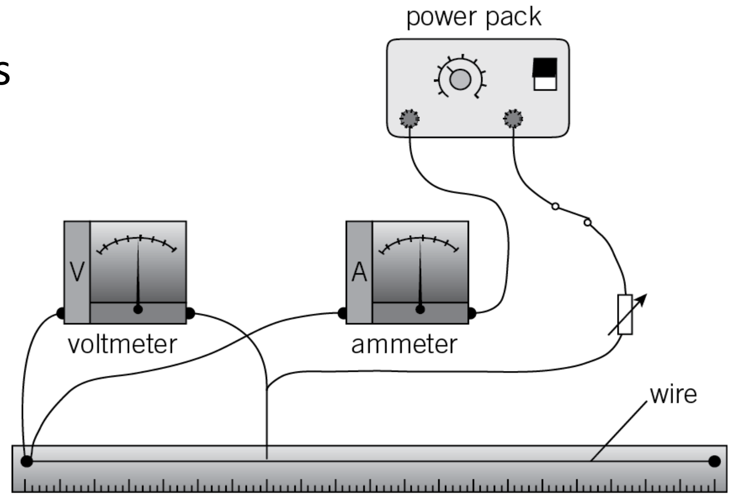
$$\text{resistance (W)} = \frac{\text{potential difference (V)}}{\text{current (A)}}$$

The longer the wire, the more resistance

The thicker the wire, the less resistance

The higher the temperature the more resistance

<u>Example Apparatus</u>



Voltmeter: measures the potential Difference

Ammeter: measures the current

Metre stick:
Measures the length of wire that the current is going through

<u>What may they ask us about?</u>

- Why must the power pack be kept on a low potential difference / What are the hazards *(The wire will get very hot, could burn you)*
- Explain how the temperature affects the resistance (*as the wire gets hot, the ions inside the wire vibrate faster so there are more collisions with the electrons cannot flow as easily)*
- Why is it important to switch the electricity off in between each reading (*to let the wire cool down, as temperature affects resistance)*
- What sort of error could cause all the ammeter/voltmeter readings to be too high (*a zero error – the meters need to be set at zero to start with)*
- Resolution of measurements, repeatability, reproducibility, control variables etc

GCSE Required Practical – Physics 1 – Investigating Electrical Components (lamp, diode, resistor)

Component: part of a circuit   Current: the flow of charge   diode: only allows current to flow one way

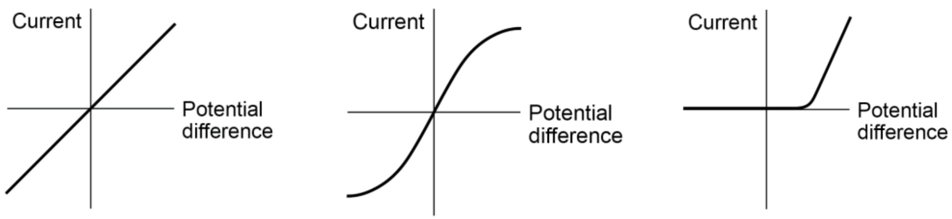
Potential Difference (V): the energy transferred to part of a circuit by each coulomb of charge

Resistor: limits the current in a circuit

What's the point of the practical?

To find out how current and potential difference change in different components

Results:

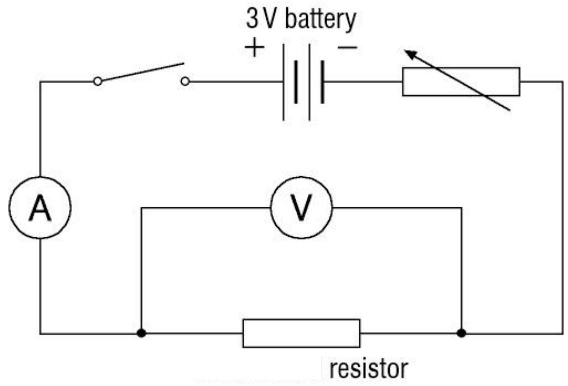


Resistor   lamp   Diode

Example Apparatus

Voltmeter: measures the potential Difference

Ammeter: measures the current



Resistor: what we're testing. (can be replaced with a lamp, then a diode

What may they ask us about?

- Explain the pattern for each component (***resistor**: fixed resistance – more PD =more current. **Lamp:** more PD = more current but at high PD, the filament gets hot, ions vibrate so resistance increases and current levels off. **Diode**: current can only flow in one direction)*
- Resolution of measurements, repeatability, reproducibility, control variables etc

GCSE Required Practical – Physics 1 – Resistors in Series and Parallel

Resistor: limits the current in a circuit

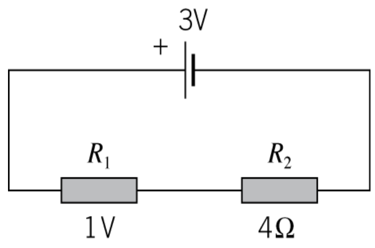
<u>What's the point of the practical?</u>

To find out what happens to the total resistance when resistors are put in series and in parallel

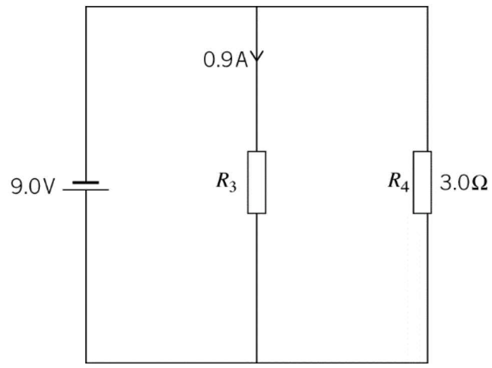
Results for series circuits

the total resistance is the same as both resistors added up. Each time you add a resistor, you get more resistance and less current

<u>Example Apparatus</u>



Series circuit



Parallel circuit

Results for parallel circuits

The total resistance is less than the smallest resistor. Each time you add more resistors, the current increases and the total resistance decreases. (they are more 'routes' overall for the current)

<u>What may they ask us about?</u>

- Why aren't your results completely accurate? (*because the meters aren't completely accurate, the power pack potential difference fluctuates slightly, the temperature of the wires changes which affects resistance)*
- What is the resolution of measurements? (*e.g. 0.41A, 0.32A, 0.39A are all to 0.01 resolution)*
- They may ask you to calculate resistance, current or PD. Or ask what happens if you add/take away resistors.

GCSE Required Practical – Physics 1 – Calculating Density

Density = a substance's mass per unit volume.

$$density = \frac{mass}{volume} = \frac{m}{v}$$

What's the point of the practical?

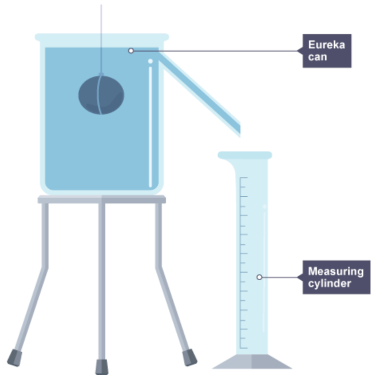
To find out the density of different materials.

Cubes of material are easy for volume (length x width x height). For irregular shapes, you need a eureka can to work out the volume

Results

Material	Mass (g)	Volume (cm^3)	Density (g/cm^3)
Aluminium	22.3	8.0	2.79
Steel	50.2	6.4	7.84

Example Apparatus



Finding Volume

Finding Mass

What may they ask us about?

- What is the resolution of the balance? (*0.1g in this case*)
- How could you get errors when using the eureka can? (*water may spill out of the sides if you drop the object in too quickly / there may already be some water in the measuring cylinder / the water might not be at exactly the level of the spout)*
- How could you get errors when weighing the object (*the balance may not be at exactly zero to start with (not calibrated))*
- What is the uncertainty of the measurements? (the balance has a ±0.05 uncertainty here as it only goes up in 0.1's)

GCSE Required Practical – Physics 2 – Force and acceleration

What's the point of the practical?

To find out what happens to the acceleration when we change the mass.
And to find out what happens to the acceleration when we change the force.

Force (N) = mass (kg) x acceleration (m/s^2)

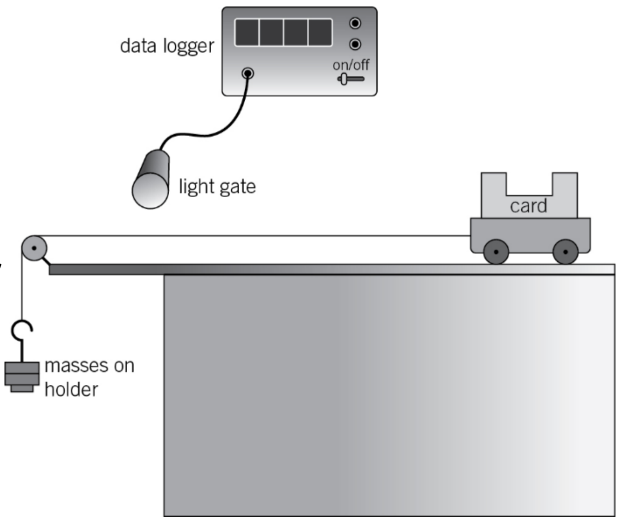
Acceleration (m/s^2) = $\frac{\text{change in velocity (m/s)}}{\text{time (s)}}$

Results:
The more force, the more acceleration.
The more mass, the less acceleration.

Example Apparatus

Data logger and light gate - Measures velocity or acceleration

Masses – make the trolley (car) move

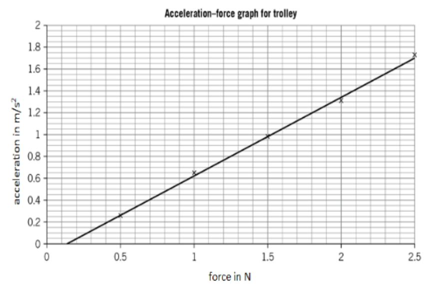


What may they ask us about?

- They may get you to work out acceleration from force and mass (easy) or give you the change in velocity and time so you need to use both equations above.
- State one possible source of error (*friction slows the trolley down, the trolley doesn't go in an exact straight line, the masses hit the floor and stop pulling on the string)*
- What is the IV, DV and control variables for each part of the experiment?

(*remember, if you're changing the mass, the force should stay the same, if you're changing force, the mass should stay the same – only one thing changes)*

- Interpret graphs of results and use them to calculate or make predictions:



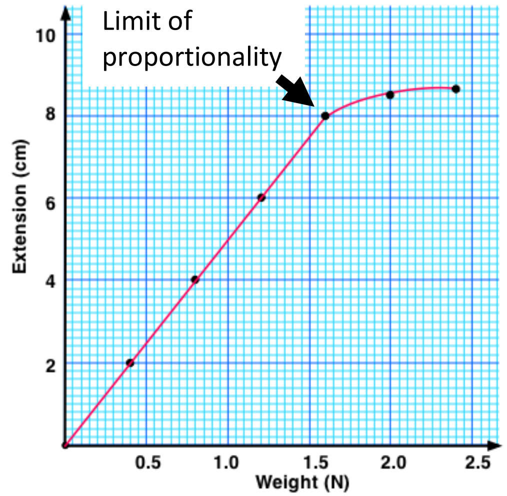
GCSE Required Practical – Physics 2 – Force and extension of a spring

Extension = how much the length has increased from its original length

What's the point of the practical?
To find out the relationship between force and extension.

Results:

Hooke's Law: extension is directly proportional to the force applied, as long as the limit of proportionality is not exceeded

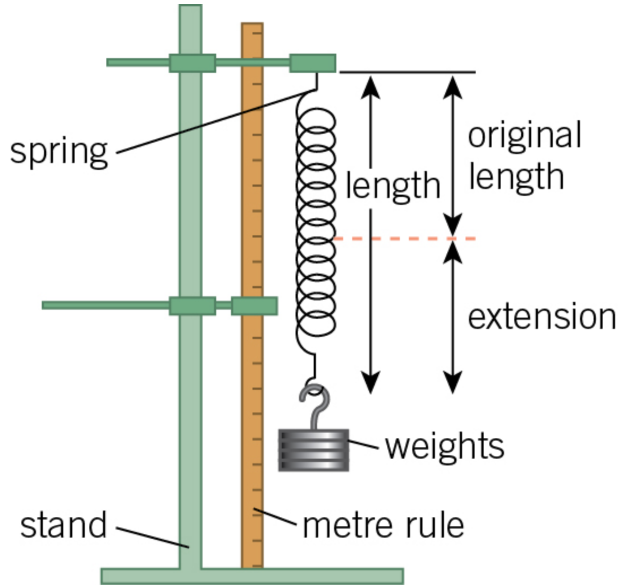


Example Apparatus

Weights – provide a force (N)

Spring - stretches

Metre rule – measures the length of the spring (before and after)



What may they ask us about?

- Describe the relationship (***directly proportional***). Label the **limit of proportionality** (*where it's no longer a straight line*)
- What error could cause the extension to NOT start at zero (*if you measured, the length and not the extension. The **extension** should be zero with no weights, but the **length** of the spring will be a few cm)*
- What is the IV (force), what is the DV (extension), comment on repeatability, resolution, etc

GCSE Required Practical – Physics 2 – Waves in a tank (water)

Wave speed (m/s) = frequency (Hz) x wavelength (m)

What's the point of the practical?

To find out how wavelength, frequency and wave speed are related.

Results:

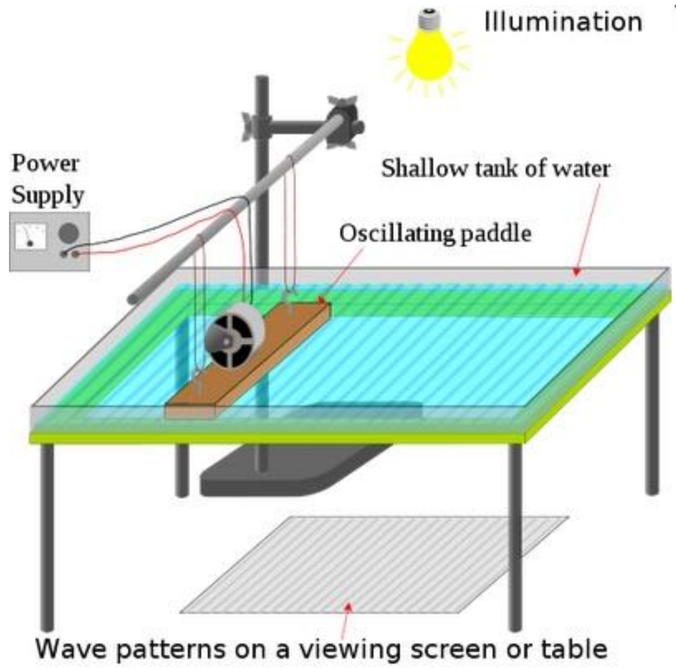
Speed = frequency x wavelength.

If you double the double the frequency, the wavelength is halved and vice versa.

Wave **speed stays the same** because it's always the same material (string)

Example Apparatus

Oscillating paddle – moves up and down to produce waves



What may they ask us about?

- Explain why the wave speeds you calculate are all about the same but **not identical.** (*Wave speed is the same in water but it's hard to be 100% accurate with measurements each time because it's hard to see where exactly the waves are, the waves keep moving, some waves are reflected)*
  - How could you improve the accuracy of measurements? (add insulation to stop reflected waves, use a bigger pool, brighter light, sharper paddle to get nice clean waves)
  - Comment on repeatability, reproducibility, range, uncertainty and calculate means

GCSE Required Practical – Physics 2 – Waves in a solid (string)

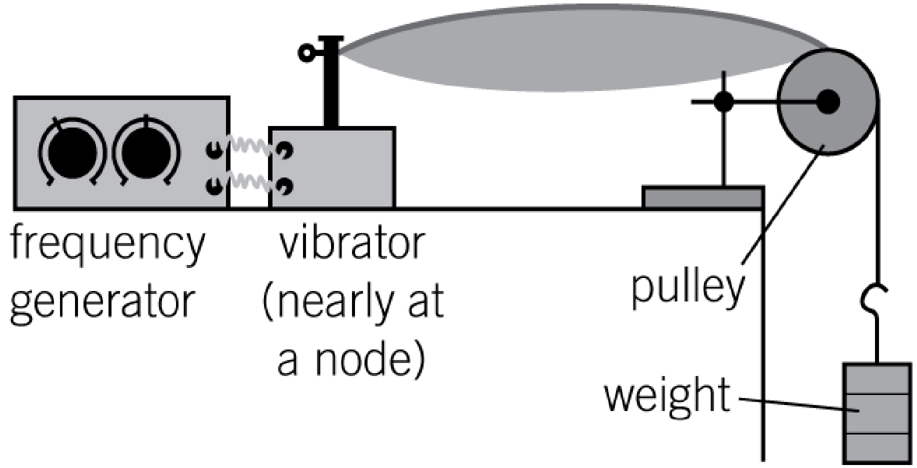
Wave speed (m/s) = frequency (Hz) x wavelength (m)

<u>What's the point of the practical?</u>
To find out how wavelength, frequency and wave speed are related.

Results:
Speed = frequency x wavelength.
If you double the double the frequency, the wavelength is halved and vice versa.
Wave **speed stays the same** because it's always the same material (string)

<u>Example Apparatus</u>

Weight – hold the String tight (taut)



Frequency generator and vibrator (oscillator) – make the string vibrate to produce waves.

<u>What may they ask us about?</u>
How could you measure the waves more accurately? (*use a different colour or width string to make it easier to see the waves)*
Comment on repeatability, reproducibility, uncertainty and calculate means

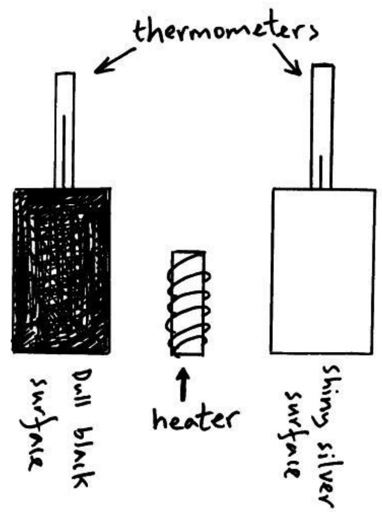
GCSE Required Practical – Physics 2 – Surfaces and radiation

Infrared Radiation: electromagnetic waves that heat things up.   Emit: when something **gives off** something
Absorb: when something takes in or soaks up something (don't say attract!)

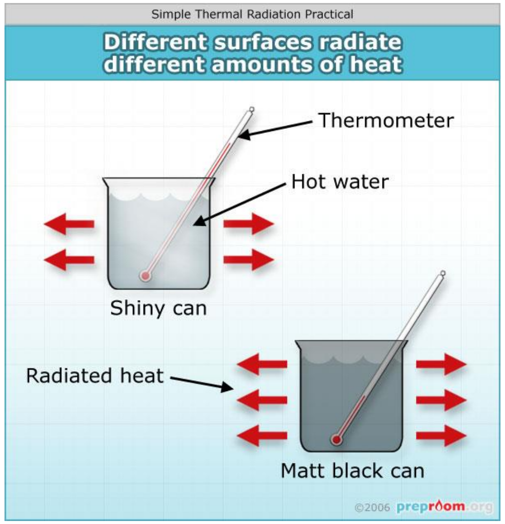
What's the point of the practical?

To find out how the colour and texture of the surface affects how much heat (radiation) is absorbed or emitted

Example Apparatus



Heated from the outside



Heated from the inside

Results:
Matt black surfaces **absorb** and **emit** much more radiation than shiny smooth surfaces.

What may they ask us about?

- Independent, dependent and control variables (*same sizes, same volumes, same thickness, starting temp etc*)
- Why should you put lids on each container? (*to reduce heat loss through convection)*
- Resolution of measurements *(1°C?),* repeatability, reproducibility, calculating means etc
- Why won't you get exactly the same measurements if you repeat the experiment? What are the sources of error? (*hard to read the temp at exactly the right time, slightly different volumes,*