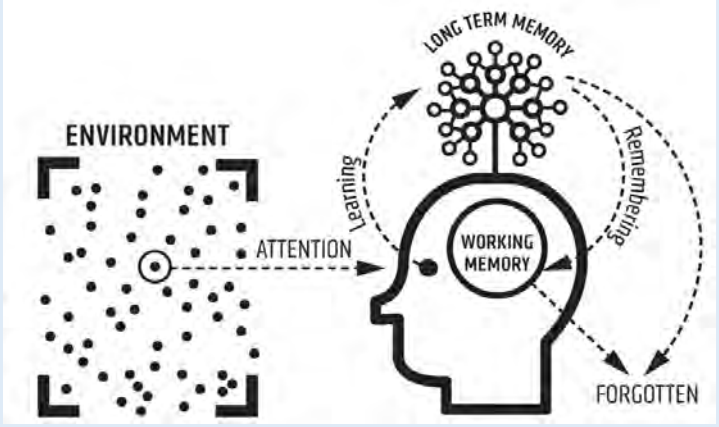
Knowledge Organiser Booklet Year 11 Term 3 Core

Our working memories can only store a limited amount of information, whereas our long term memories can store limitless information. To learn successfully, we need to store core knowledge into our long term memories, so we can retrieve it when we need it.

For instance, if you are at work or in the shops and need to work out a 25% discount, you can't memorise 25% of every number, so you need to be able to quickly recall the method for calculating a percentage. Committing core knowledge to our long-term memories is a life-hack. It makes thinking about difficult things easier.

Using a knowledge organiser with regular retrieval activities is a way for you to store core knowledge & subject specific words, into your long term memory so it is there when you need it.

Click here to be taken to the knowledge organiser part of the school website.



Contents

Clicking on the subjects below will take you directly to the knowledge organisers for each subject. These are to support learning that has taken place this past term. Use these to help reinforce the key knowledge. Use some of the strategies explained in the introduction to help you retain this important information.

Blended Learning Expectations

Make sure you have **access to a computer at home** (If you don't please make pastoral staff aware or email langley.homelearning@taw.org.uk)

Download Microsoft Teams on both your phone and computer. (If you don't know how to do this please ask a member of staff or do this in your next computing lesson)

Spend at least 2 hours a week using teams EVERY WEEK. (Engagement in teams can be tracked and monitored). You need to be accessing each of your class teams and recapping on the previous learning or completing additional tasks set by your class teacher.

If you have any issues with teams (e.g. login problems or missing classes etc then please email langley.homelearning@taw.org.uk)

Teams is a tool to support ongoing learning and should **only be used for educational purposes.**

How to complete homework your teacher has set

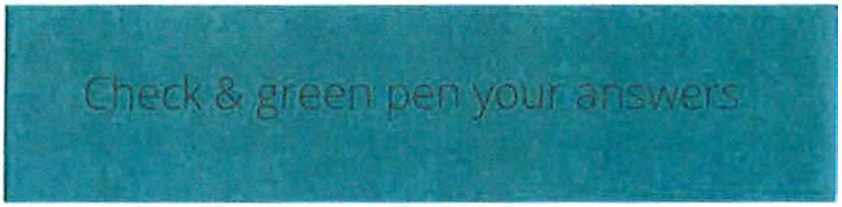
	LOOK, COVER, WRITE, CHECK	DEFINITIONS TO KEY WORDS	FLASHCARDS	DUAL CODING
STAGE 1	Look at & study an area of your knowledge organiser 	Write down the key words & definitions 	Write key words, dates/formulae, equations/quotes on one side & answers on the other	Draw pictures/diagrams/ cartoon strips 
STAGE 2	Cover up your knowledge organiser and write everything you remember 	Cover up the definitions. How many can you remember? Repeat. 	Include pictures or diagrams if it helps. Read through them. 	Label your pictures/diagrams/ cartoon strips 
STAGE 3	Check. Correct mistakes in green and add anything you missed. Repeat 	Check. Correct mistakes in green pen. Which ones do you find hard to remember? 	Test yourself and get someone to test you. 	Explain out loud to yourself or family/friend what your images show 

	SELF QUIZZING	MINDMAPS	PAIRED RETRIEVAL	SPEAK, COVER, WRITE, CHECK
STAGE 1	Use your knowledge organiser to create quiz questions. 	Create a mindmap of everything you can remember from your knowledge organiser 	Give a family member/friend the knowledge organiser to hold 	Read out loud the information from the knowledge organiser several times. 
STAGE 2	Write down the answers to your quiz 	Check your knowledge organiser & use a green pen to make any corrections. 	Get them to test you using the knowledge organiser 	Cover up your knowledge organiser and write everything you remember 
STAGE 3	Keep self-quizzing until you get all the answers correct 	Add additional information to your mindmap or make connections to other knowledge 	Write down your answers to their questions 	Check. Correct mistakes in green and add anything you missed. Repear. 

Retrieval Placemat

Look at your knowledge organiser. Now cover it up and write down Key vocabulary & definitons from memory:

First time: Look. Cover. State 3 facts	Second time: Look. Cover. State 3 facts	Third time: Look. Cover. State 3 facts



Look at the knowledge organiser again. Now cover it up and without looking, explain a concept or idea in your own words

Re-read your answer above. Look at the knowledge organiser again. Now cover it up and improve on your previous explanation in green pen.

Retrieval Relay

Look at your knowledge organiser. Now cover it up.

First time: Write down everything you can remember

Second time: Look. Cover. Write down everything you can remember

Third time: Look. Cover. Write down everything you can remember

Write down everything here that you didn't remember:

Vocabulary focus 1

Look at your knowledge organiser. Select a key word and write it here:

Write a definition of the key word in your own words - not the same as the one on the knowledge organiser:

Write a sentence with the key word in it:

Create a question where the key word is the answer:

What other words are connected to this key word?

Draw a picture or diagram to help you remember this key word:

Vocabulary focus 2

Definition:

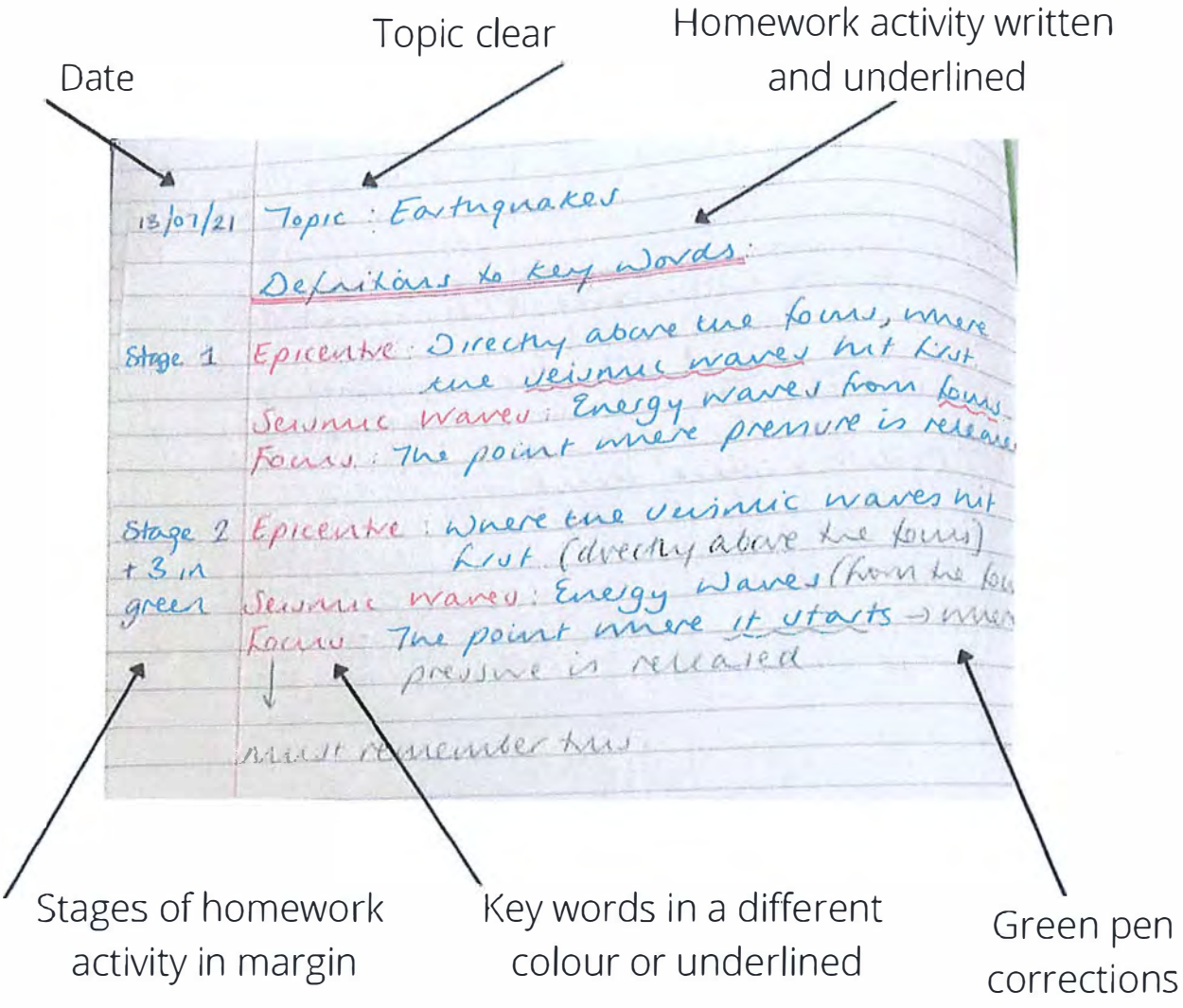
Characteristics:

Key word:

Examples:

Non-examples:

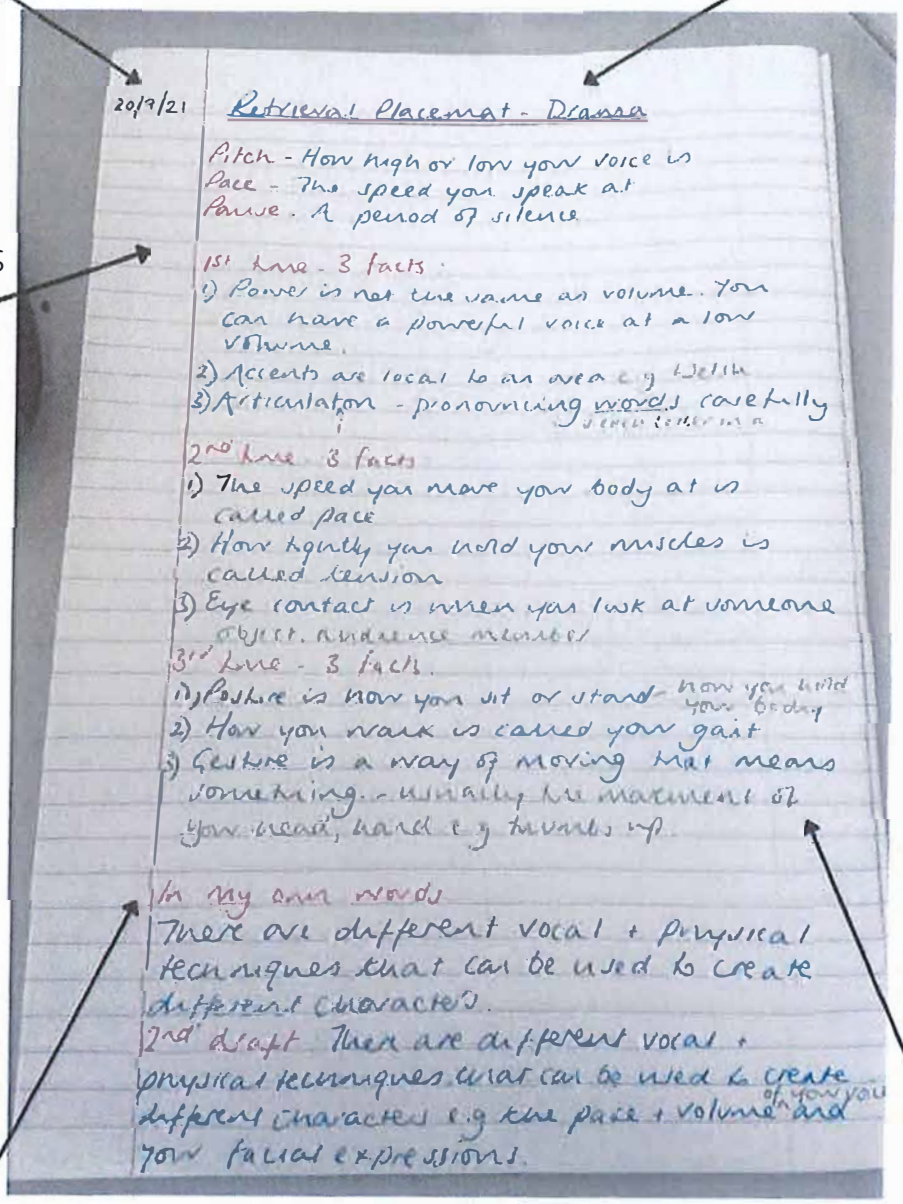
What should my knowledge organiser homework look like?



What should my knowledge organiser homework look like?

Homework activity written and underlined

Date



Key words in a different colour

Green pen corrections

Stages of homework activity as subtitles

Biology

Year 7 – Cells

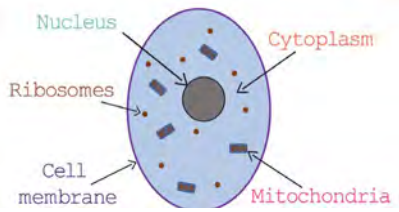
Threshold Concept

Understand that all living things are made of cells

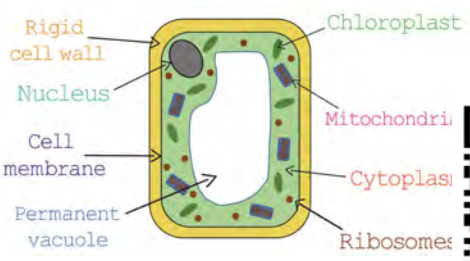
Keywords

Animal Cell - Building block of all animal life
Plant Cell - Building block of plant life
Microscope - Utensil used to enlarge objects
Prokaryote - Cell without nucleus
Eukaryote - Cell containing a nucleus
Cell - Basic building block

Structure of animal cell



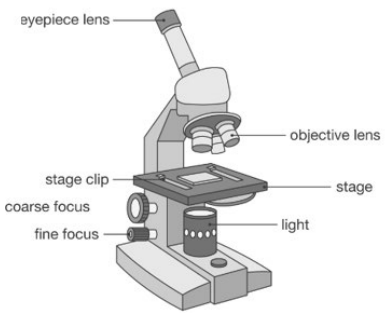
Structure of plant cell



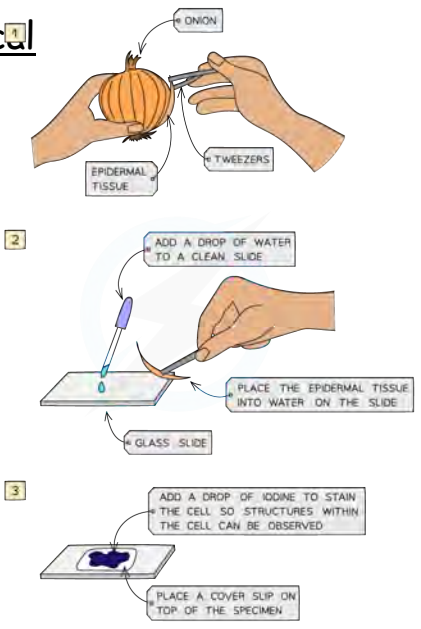
Comparing cells

Organelle	*Responsible for*
Nucleus	Housing DNA, 'brain' of the cell
Mitochondria	Energy production, 'power house' of the cell
Golgi apparatus	Sorting, packaging and transport of proteins
Endoplasmic reticulum	Synthesis and processing of proteins, lipid expression
Chloroplast	Photosynthesis, only present in plants
Flagellum	Locomotion and sensory functions
Vacuole	Storage and maintaining homeostasis
Lysosome	Digestions of larger molecules
Peroxisome	Degradation of hydrogen peroxide
Ribosome	Synthesis of proteins
Proteasome	Break down of proteins with expired func

Microscope



Required practical



Specialised cells

Equations for this topic

Image Size = Actual Size x Magnification

Reproduction

Threshold Concept

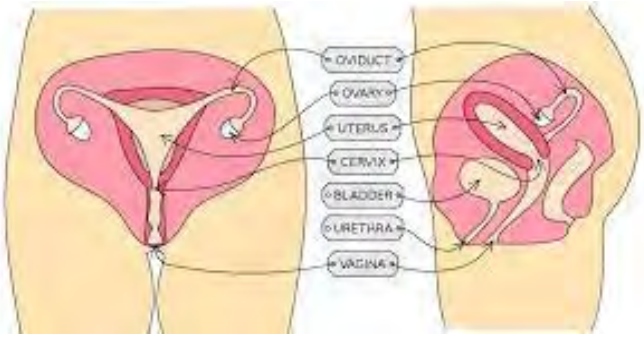
Reproduction can happen sexually and asexually

Keywords

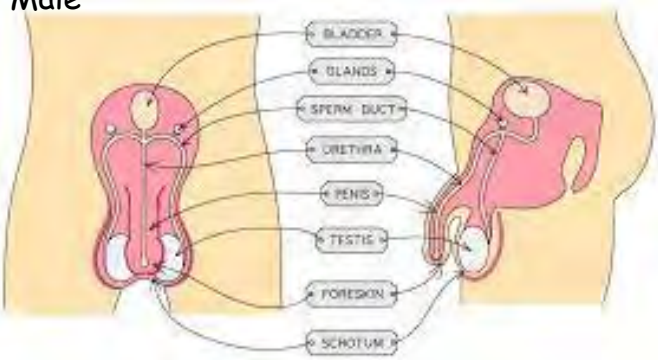
- **Sperm:** male reproductive cell that contains genetic material
- **Egg**: female reproductive cell that contains genetic material
- **Reproduction**: the joining of sex cells (a sperm and egg) to produce offspring
- **Fertilisation:** the joining of a male and female sex cell/genetic material
- **Develop**: build upon given information

Reproductive organs

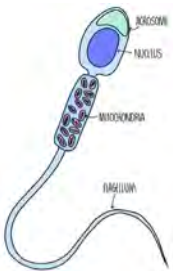
Female



Male



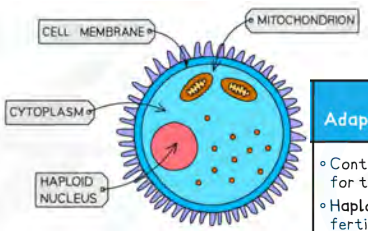
Sperm cell



Adaptations

- The head contains the genetic material for fertilisation in a **haploid nucleus** (containing half the normal number of chromosomes)
- The **acrosome** in the head contains digestive **enzymes** so that a sperm can penetrate an egg
- The mid-piece is packed with **mitochondria** to release **energy** needed to swim and fertilise the egg
- The **tail** enables the sperm to **swim**

Egg cell

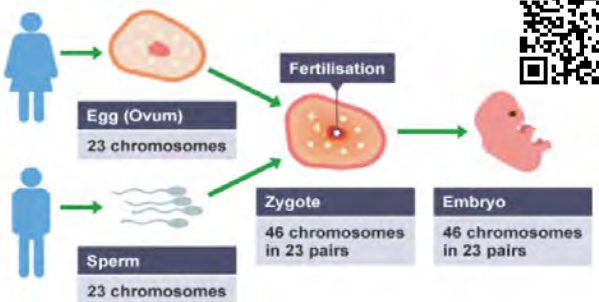


Adaptations

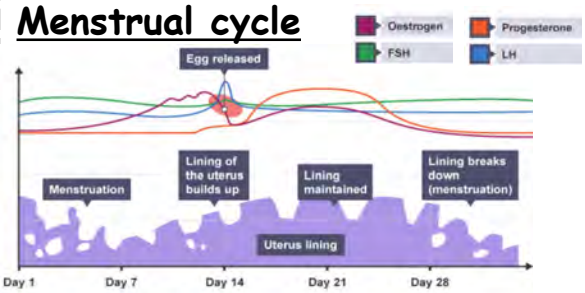
- Contains a **lot of cytoplasm** which has **nutrients** for the growth of the early embryo
- **Haploid nucleus** contains the genetic material for fertilisation
- Cell membrane **changes after fertilisation** by a single sperm so that **no more sperm** can enter

Fertilisation

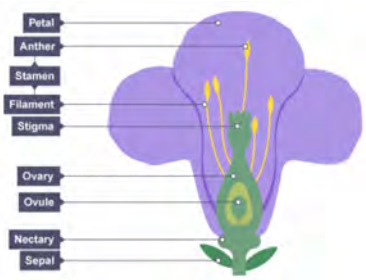
When the sperm and egg nuclei join, they form a ZYGOTE



Menstrual cycle

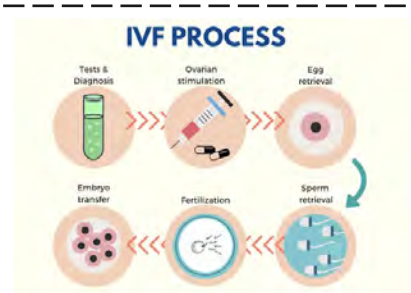


Plant structures



IVF

In Vitro Fertilisation is used to help people with fertility issues conceive



Equations for this topic

Ecology

Threshold Concept

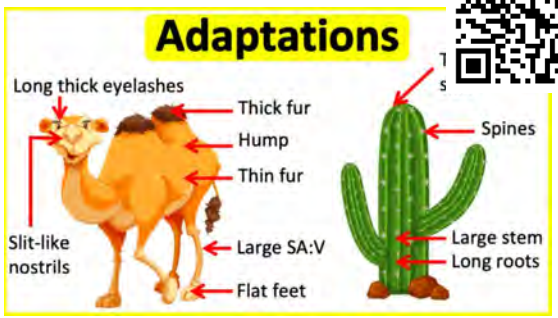
Understand that living things interact with the world around them

Keywords

Living – Undertaking the seven processes of living things
Changes – structural, physiological and behavioural changes that allow species to compete
Animal – Living creature of one of seven domains
Plant – Living tissue that is a producer
Energy – The flow through all organisms and food chains

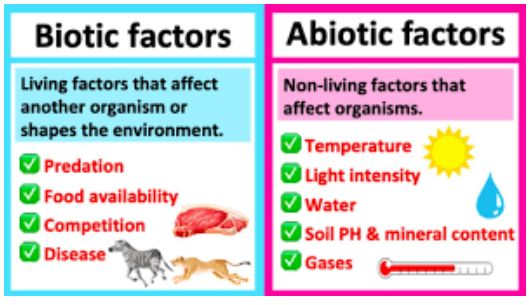
Different Habitat- An area where an organism is at home

Adaptations



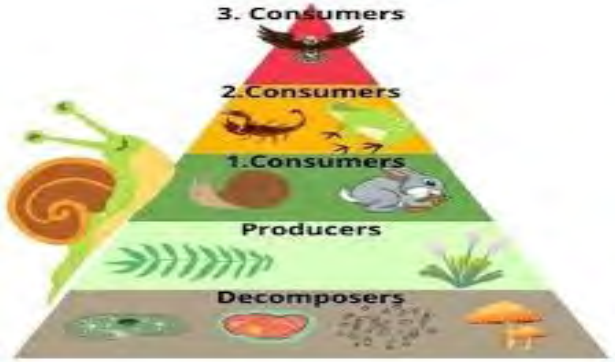
Food Chains/Webs – show the flow of energy

Abiotic and Biotic Factors



Required practical

Producers and Consumers



Equations for this topic

Organisation

Threshold Concept

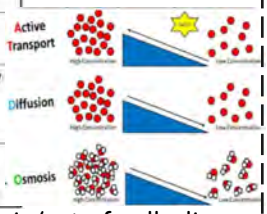
Understand the order of structures and relationships with an organism

Keywords

Organism – any living thing
Organelle – the small, organ-like structures found inside cells
Cell – the structures that make up all living things
Organ system – a group of organs that work together to perform a specific structure
Organ – a group of tissues working together for a specific function
Tissue – a group of cells working together for a shared function

Movement of substances

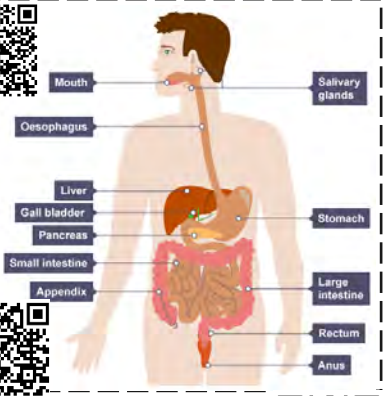
Process	Movement of	Condition	Additional requirements
Diffusion	Molecules/ ions	High conc. to low conc.	Down a conc. gradient
Osmosis	Water molecules	High water potential to low water potential	Across a partially permeable membrane
Active transport	Particles of substances	Low conc. to high conc.	Against a conc. Gradient; Energy required



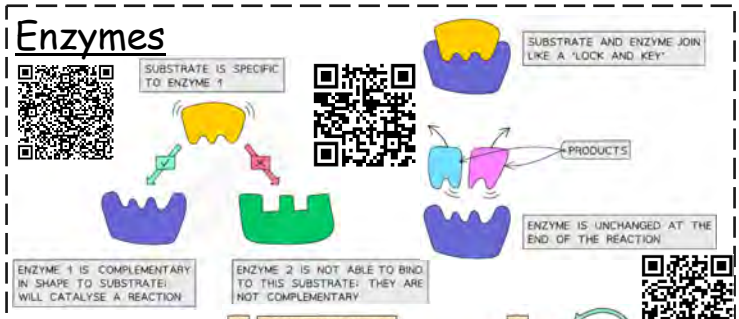
Diffusion –digestion, gas exchange, in/out of cells, liver
Osmosis – water in digestion, in/out of cells, plant roots
Active transport – ions in plant roots, glucose to intestine walls

Digestion

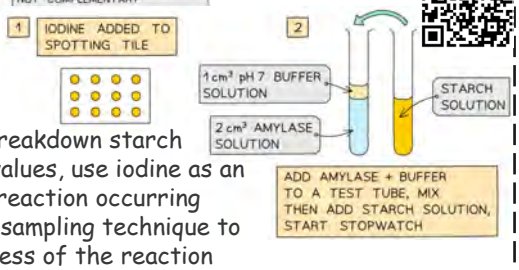
Digestion is the breaking down of the food we eat into other substances that our bodies can absorb and use. There are mechanical and chemical digestive processes.



Enzymes

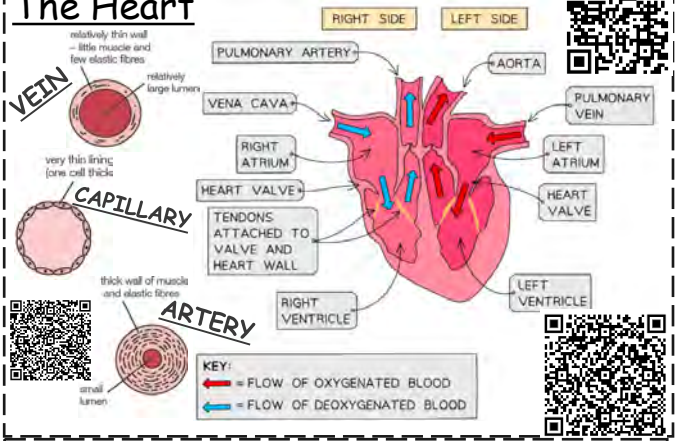


Required practical



- Use amylase to breakdown starch at a range of pH values, use iodine as an indicator for the reaction occurring
- Use a continuous sampling technique to monitor the progress of the reaction

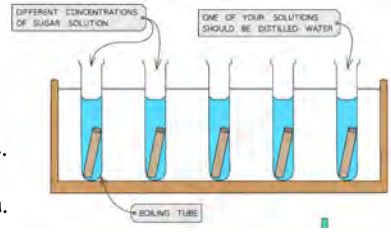
The Heart



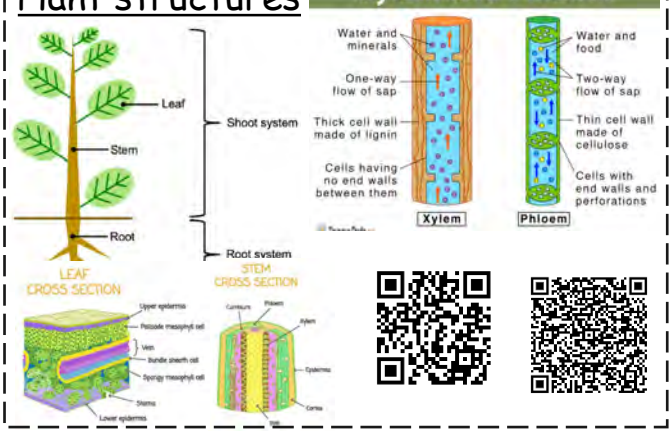
Required practical – Osmosis

Variables

- **Independent** - concentration of sugar solution.
- **Dependent** - Change of mass of plant tissue
- **Controls**
  - Volume of plant tissue.
  - Surface area of plant tissue.
  - Length of time in solution.
  - Temperature of the solution.

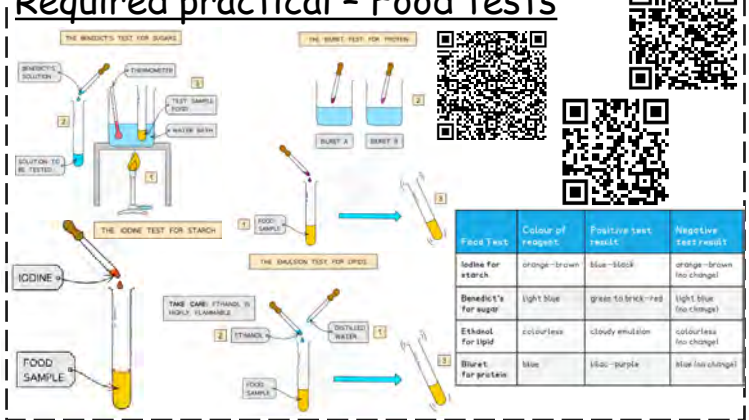


Plant structures



Xylem and Phloem

Required practical – Food tests



Food Test	Colour of reagent	Positive test result	Negative test result
Iodine for starch	orange-brown	blue-black	orange-brown (no change)
Benedict's for sugar	light blue	green to brick-red	light blue (no change)
Ethanol for lipid	colourless	cloudy emulsion	colourless (no change)
Biuret for protein	blue	lilac-purple	blue (no change)

Bioenergetics

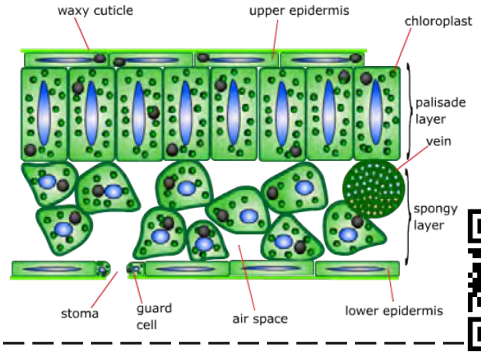
Threshold Concept

Respiration and photosynthesis are chemical processes that provide plants and animals with energy.

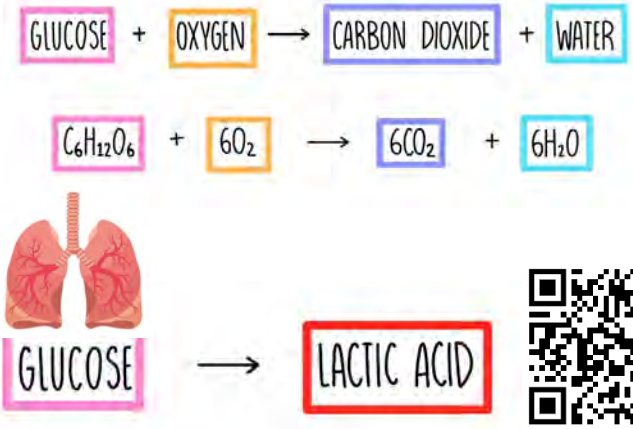
Keywords

- **Respiration:** Respiration is the body's way of producing energy from the food we eat. It involves the breakdown of glucose in the presence of oxygen into carbon dioxide and water with the release of energy-generating molecules called ATP.
- **Photosynthesis:** is a chemical reaction that takes place in the chloroplasts of green plant cells, where light energy is used to convert carbon dioxide and water into glucose and oxygen.
- **Energy:** The ability to do work
- **Limiting factors:** Limiting factors affect the rate of a reaction. A limiting factor is a condition, that when in shortage, slows down the rate of a reaction.
- **Reaction:** A chemical reaction is when one or more substances change and produce one or more new chemical substances.

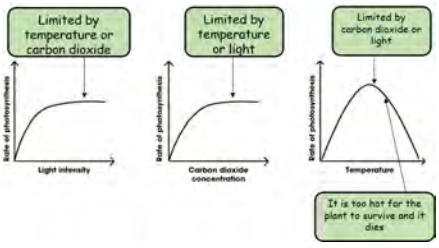
Structure of the leaf



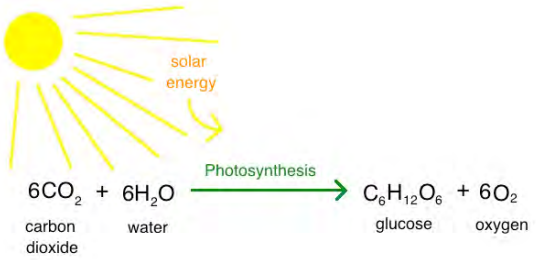
Respiration



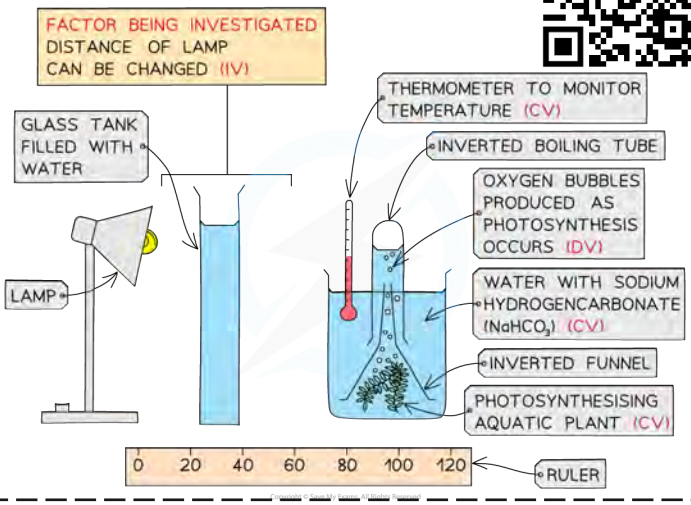
Limiting factors of photosynthesis



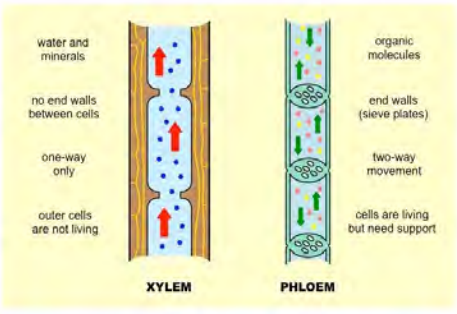
Photosynthesis



Required practical



Xylem and Phloem



Equations for this topic

$$\text{REACTION RATE} = \frac{\text{CHANGE IN MASS OF REACTANT OR PRODUCT}}{\text{TIME}}$$

Homeostasis

Threshold Concept

Homeostasis is organisms maintaining a constant internal environment

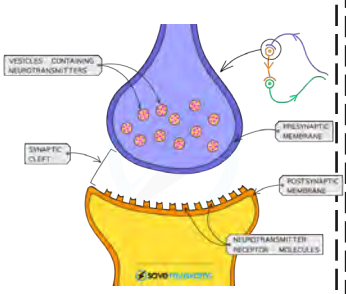
Keywords

- **Nerves:** Specialised cells which carry electrical impulses
- **Hormones**: Chemical messenger produced in glands and carried by the blood to specific organs in the body.
- **Organism:** Living things that are capable of reacting to stimuli, reproduction, growth, and homeostasis.
- **Regulate**: control or maintain the rate or speed of a process so that it operates properly.
- **Response:** as a result of the stimulus that is detected by the receptor a response is caused

The nervous system:

- The central nervous system (CNS) – the brain and spinal cord.
- The peripheral nervous system – nerve cells that carry information to or from the CNS.

Synapse:



Body controls:

Homeostasis maintains optimal conditions for enzyme action throughout the body, as well as all cell functions.

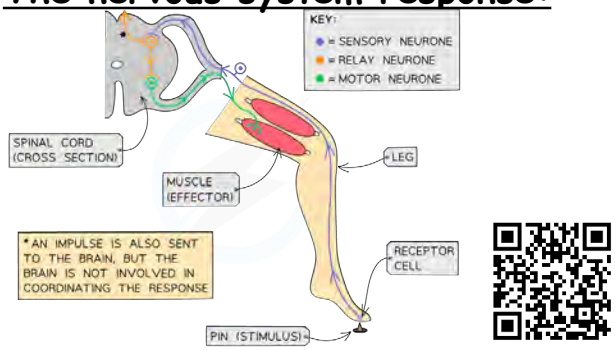
In the human body, these include the control of:

1. Blood glucose concentration
2. Body temperature
3. Water levels

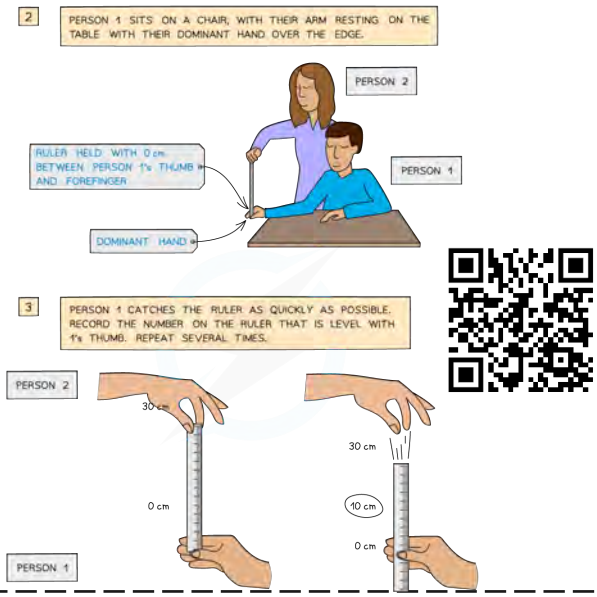
The menstrual cycle:

1. The menstrual cycle is the reproductive cycle in women, which starts with a period (menstruation), if the woman is not pregnant.
2. There are four hormones involved: follicle stimulating hormone, luteinising hormone, oestrogen & progesterone.
3. FSH (released by the pituitary gland) causes eggs to mature in the ovaries.
4. FSH stimulates ovaries to produce oestrogen.
5. Oestrogen inhibits further release of FSH and stimulates release of LH.
6. LH (released by the pituitary gland) stimulates the release of an egg (ovulation) from an ovary.
5. LH stimulates secretion of progesterone by the empty follicle.
6. Progesterone inhibits the release of LH and FSH.
7. Oestrogen and progesterone maintain the lining of the uterus.

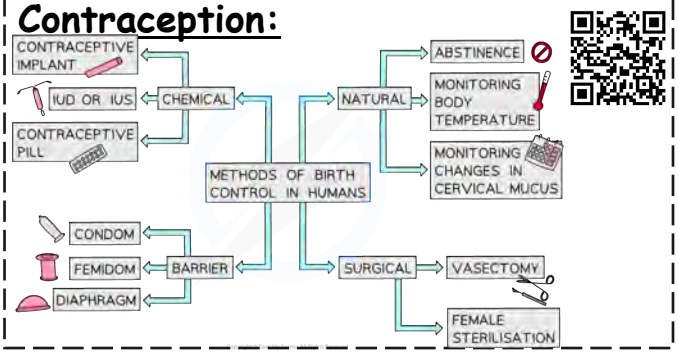
The nervous system response:



Required practical: Reaction time



Contraception:



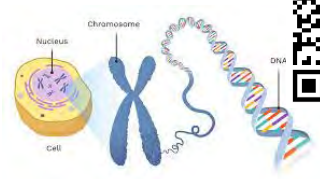
Equations for this topic

Inheritance

Threshold Concept

Organisms pass on their DNA in order to survive.

DNA

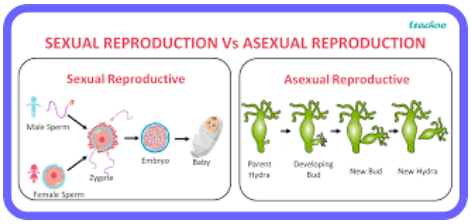


DNA is found in the nucleus of cells and contains all the genetic material to make the organism

Keywords

Cell……. The smallest unit that can live on its own and makes up all living organisms
Nucleus ……. The organelle inside cells that contains the cells genetic material
DNA……. The molecule inside cells that contains all the genetic information responsible for the development and function of an organism
Chromosomes……. A structure made up of proteins and DNA organised into genes inside the nucleus of a cell
Gene ……. Genes carry information that determine what characteristics are inherited from an organism's parents
Reproduction……. The production of offspring

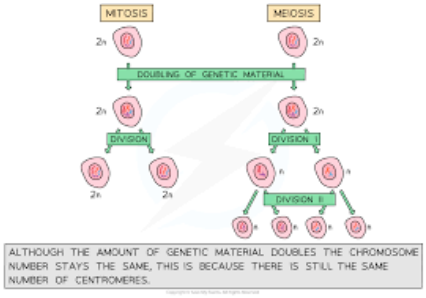
Sexual and asexual reproduction



There are two main forms of reproduction: sexual and asexual reproduction. In sexual reproduction, an organism combines the genetic information from each of its parents and is genetically unique. In asexual reproduction, one parent copies itself to form a genetically identical offspring

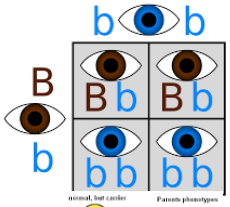
Mitosis / Meiosis

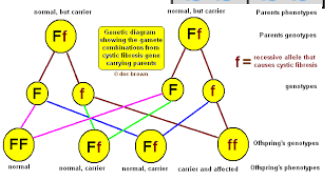
Mitosis is a form of cell division which produces two identical, diploid body cells. Meiosis is a form of cell division which produces four non-identical, haploid sex cells or gametes (sperm and ova in humans



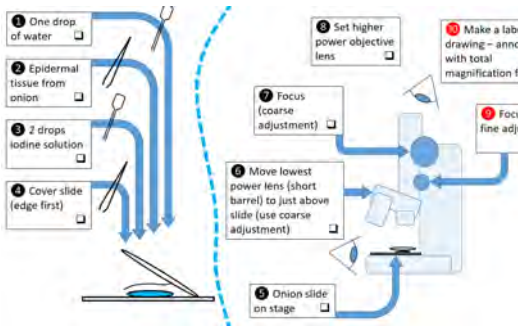
Genetic cross diagrams

Genetic crossing describes breeding two selected individuals so their offspring can be studied to understand how a particular trait is inherited down the generations.





Required Practical



Equations for this topic

Image size = actual size x magnification

Variation

Threshold Concept

All living things need to change to live.

Keywords

Variation……. any difference between the individuals in a species or groups of organisms of any species

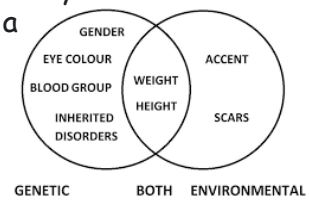
Evolution ……. the change in the characteristics of a species over several generations and relies on the process of natural selection

Adaptation……. the adjustment of organisms to their environment in order to improve their chances at survival in that environment

Natural Selection……. the process through which populations of living organisms adapt and change

Variation

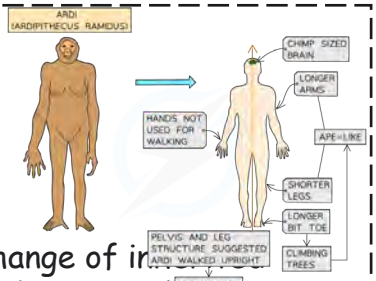
Individuals in a population are usually similar to each other, but not identical. Some of the variation within a species is genetic , some is environmental - the conditions in which they have developed and some is a combination of both



Natural Selection

In any environment, the individuals that have the best adaptive features are the ones most likely to survive and reproduce

Evolution



Evolution is the change of inherited characteristics within a population over time through natural selection, which may result in the formation of a new species

Five main processes that lead to evolution:

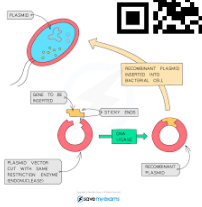
-mutation
-non-random mating
-gene flow
-finite population size (genetic drift)
-natural selection.

Selective Breeding

Selective breeding or artificial selection is when humans breed plants and animals for particular genetic characteristics. Humans have bred food crops from wild plants and domesticated animals for thousands of years

Genetic Engineering

Genetic engineering involves modifying the genome of an organism by introducing a gene from another organism to result in a desired characteristic



Fossils

A fossil is the preserved remains of a dead organism from millions of years ago. **Evidence for early forms of life comes from fossils**. By studying fossils, scientists can learn how much (or how little) organisms have changed as life developed on Earth

Required Practical

Equations for this topic

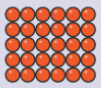
Chemistry

Foundations of chemistry

Threshold Concept

All matter is made of particles

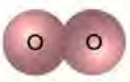
States of matter:

State	Solid	Liquid	Gas
Closeness of particles	Very close	Close	Far apart
Arrangement of particles	Regular pattern	Randomly arranged	Randomly arranged
Movement of particles	Vibrate around a fixed position	Move around each other	Move quickly in all directions
Energy of particles	Low energy	Greater energy	Highest energy
2D diagram			

Atoms and compounds:

Elements contain just **one type of atom**.

Oxygen (O_2)



Compounds contain **different types of atom** bonded together.

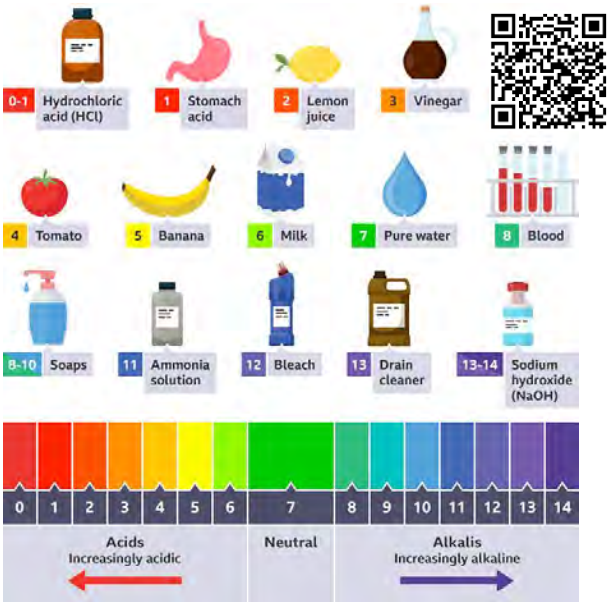
Carbon dioxide (CO_2)

Pure substances:

Pure substances are made from only one chemical element or one compound.

For example, salt is a pure substance made only of sodium chloride.

The pH scale:

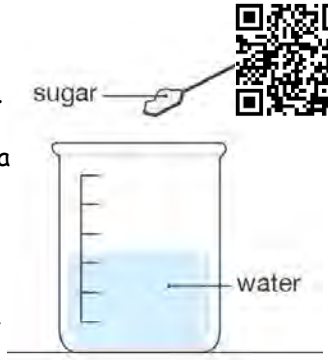


Keywords

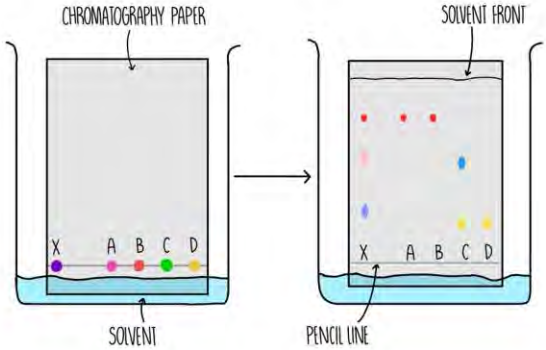
- **Particles:** The tiny things that all materials are made from. The smallest unit of matter.
- **Atom:** Atoms are the building blocks of all matter. Everything is made of atoms - even yourself. They are the smallest particle of an element, which are far too small to see.
- **Solid:** Have a fixed shape and cannot flow, because their particles cannot move from place to place, cannot be compressed (squashed), because their particles are close together and have no space to move into.
- **Liquid:** Flow and take the shape of their container, because their particles can move around each other, cannot be compressed, because their particles are close together and have no space to move into
- **Gas:** Flow and completely fill their container, because their particles can move quickly in all directions, can be compressed, because their particles are far apart and have space to move into

Solubility:

- Some solids dissolve in water to make a solution.
- These solids are soluble.
- A solution is made from a solute (usually a solid) and a solvent (liquid).
- Some gases, such as oxygen and carbon dioxide, can also dissolve in water.



Required practical: Chromatography



Equations for this topic:

$$R_f \text{ value} = \frac{\text{distance travelled by substance } (B)}{\text{distance travelled by solvent } (A)}$$

Periodic Table

Threshold Concept

All elements fit within the Periodic Table

Link to information on most of the topic, consisting of slides, videos, and quizzes

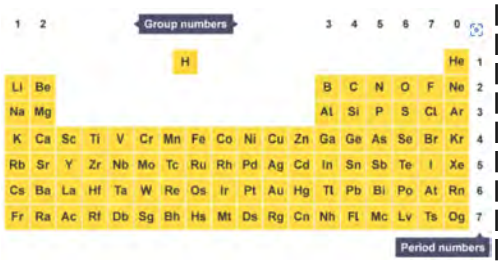
Keywords

Elements - a substance that cannot be broken down into any other substance.
Periodic Table – a table showing every element that is known to exist.
Symbol – a sign/letter/character that is used to represent something

Periodic Table & Developing the Periodic Table

Task 1 & 2

Mendeleev redesigned Newlands periodic table by organising the periodic table by atomic weights and the properties of the elements. Some gaps were left based on his predictions of other elements that hadn't been discovered yet.
As more elements were found, the modern periodic table took from organised by atomic number.

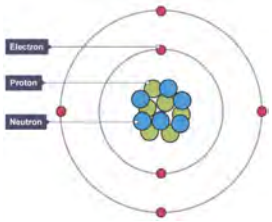


RAM & Isotopes

Task 10

RAM

Atomic Structure



Task 8

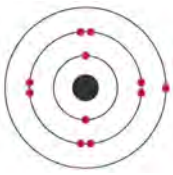
Subatomic particle	Relative mass	Relative charge
Proton	1	+1
Neutron	1	0
Electron	Very small	-1

Electronic Configuration

Task 9

No. of electrons per shell
1st shell: up to 2
2nd shell: up to 8
3rd shell: up to 8
etc

Example, using an atom of sodium



Group 1 – Alkali Metals

Task 4

1

Li
Na
K
Rb
Cs
Fr

All share similar properties:
- Are soft (can be cut)
- Have relatively low MP
- Have low densities

The further down the group you go, the more reactive the elements become.
- They will react will air and tarnish quite quickly.
- They will react with water to produce an alkaline solution (hence the name) and turn universal indicator blue/purple

Group 7 - Halogens

Task 5

7

F
Cl
Br
I
At
Ts

All have 7 electrons in outer shell.
All diatomic (made up of two atoms bonded together.

The further down the group you go, the less reactive the elements become.
The further down the group you go, the higher its MP and BP, because:
- Molecules become larger
- Intermolecular forces become stronger
- More energy is needed to overcome these forces

Group 0 – Noble Gases

Task 3

0

He
Ne
Ar
Kr
Xe
Rn
Og

All have full outer shells.
All unreactive (inert).

All have low boiling points. Lower down the group, the higher it gets.
This is because, going down the group:
- Atoms become larger
- Intermolecular forces between atoms become stronger
- More energy is needed to overcome these forces

Metals

Threshold Concept

Identify most metals have similar properties

Keywords

Metal…….. DEFINITION
Non metal ……. DEFINITION
Property ……. a characteristic of a particular substance
Reaction ……. a process that leads to the change of one set of chemical substances into another
Alloy ……. a mixture of two or more metals, or a metal and a non-metal
Displacement ……. A more reactive metal will displace a less reactive metal from its compound.

Metals and non metals

Most elements on the periodic table are metals. They are grouped together in the middle to the left-hand side of the periodic table.
Non metals are on the right-hand side.

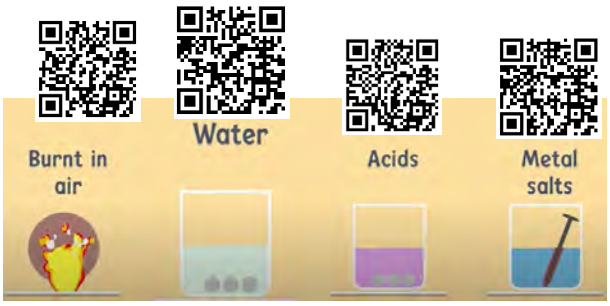
Metals and alloys

Making alloys changes the metals properties by changing its structure. Alloying is done for many reasons, typically to increase strength, increase corrosion resistance, or reduce costs

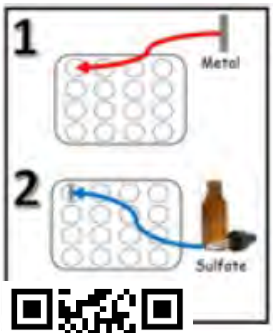
Physical properties of metals

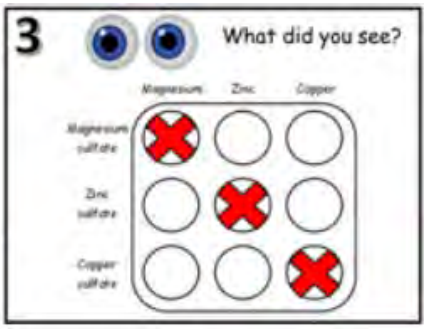
Properties	Metals	Non-metals
Appearance	Shiny	Dull
Hardness	Very hard or hard	
Malleability	Malleable	Non
Ductility	Ductile	No
Heat conduction	Good conductor	Bad
Conduction of electricity	Good conductor	Bad
State	Solid	Solids
Density	Higher	

Chemical properties of metals

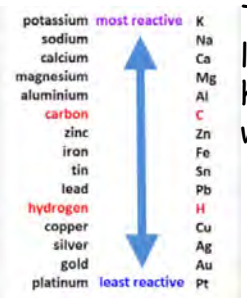


Practical





The reactivity series



The Reactivity Series lists metals in order how easily they react with other substances

Equations for this topic

Metal + acid → salt + hydrogen
Metal + oxygen → Metal oxide
Metal + water → Metal hydroxide + hydrogen

Rock Cycle

Threshold Concept

Understand that rocks change within 3 types over time.

Types of rocks

Sedimentary rocks

Sedimentary rocks are formed from sediments that have settled at the bottom of a lake, sea or ocean, and have been compressed over millions of years.

Metamorphic rocks

Metamorphic rocks are formed from other rocks which change due to **heat** or **pressure**.

Igneous rocks

Igneous rocks are formed from molten (liquid) rock that has cooled and solidified.

Types of weathering

1. Biological weathering

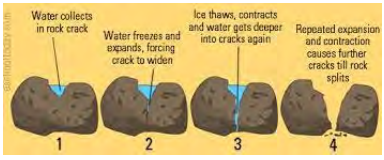
This describes rocks being broken up by the roots of plants, or animals burrowing into them.

2. Chemical weathering

This describes rocks being broken up because substances in rainwater, rivers and seawater or the air, react with the calcium carbonate $CaCO_3$ in the rocks.

3. Physical weathering

This describes rocks being broken up by changes in temperature, freezing and thawing of trapped water or the action of waves and rivers.



Keywords

- **Rock:** The solid mineral material forming part of the surface of the earth and other similar planets, exposed on the surface or underlying the soil.

- **Earth:** The planet on which we live; the world.

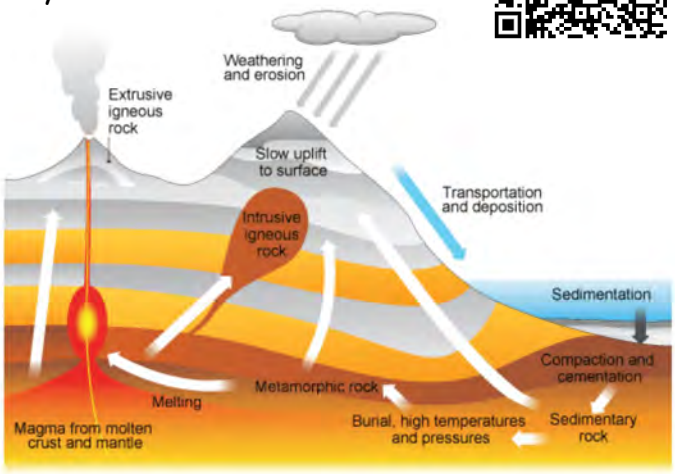
- **Cycle:** Move in or follow a regularly repeated sequence of events.

- **Temperature:** The degree or intensity of heat present in a substance or object.

- **Pressure:** Continuous physical force exerted on or against an object by something in contact with it.

The rock cycle

Rocks on earth do not always stay the same.



Rocks are continually changing due to processes such as, weathering, erosion and large earth movements. The rocks are gradually recycled over millions of years, changing between the different rock types.

Required practical

Equations for this topic

Chemistry of the atmosphere

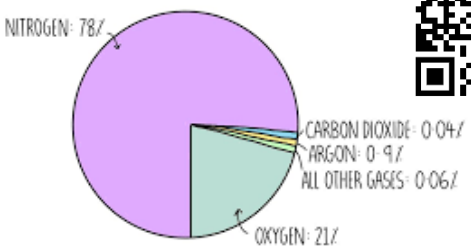
Threshold Concept

The Earth's atmosphere is made of different gases.

Keywords

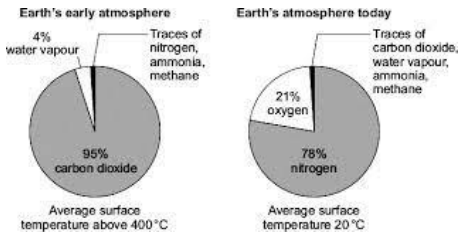
- **Atmosphere**: An atmosphere is the layers of gases surrounding a planet.
- **Pollutants**: A pollutant is a chemical. or biological substance which harms water, air, or land quality.
- **Climate change**: Climate change refers to long-term shifts in temperatures and weather patterns.
- **Combustion**: Combustion is another name for burning. In a combustion reaction, fuel is burned and reacts with oxygen to release energy.
- **Global Warming**: Global warming is the long-term warming of the planet's overall temperature.

The Proportion of gases in the earths atmosphere



History of the earths atmosphere

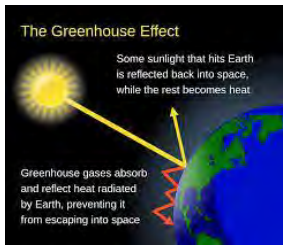
- The proportion of oxygen increased because of **photosynthesis** by plants and algae.
- The proportion of ammonia decreased as it reacted with the newly formed oxygen in the atmosphere to form nitrogen and water vapour.
- The proportion of methane decreased as it reacted with the newly formed oxygen to form carbon dioxide and water.



Greenhouse gases

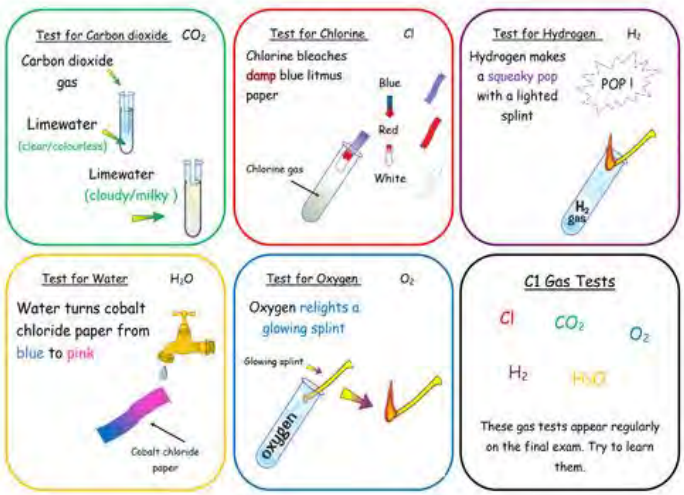
Greenhouse gases present in the atmosphere include:

- water vapour
- carbon dioxide
- methane



Required practical

Testing for gases



Combustion

Complete combustion:

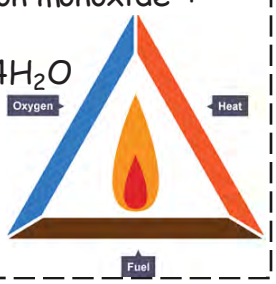
Propane + oxygen → carbon dioxide + water

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

Incomplete combustion:

Propane + oxygen → carbon monoxide + carbon + water

$C_3H_8 + 3O_2 \rightarrow 2CO + C + 4H_2O$



Equations for this topic

Bonding Part 2

Threshold Concept

How do 100 elements make up everything in the universe?

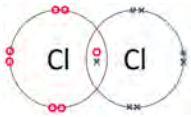
Keywords

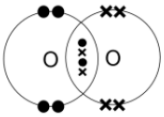
Electron - a subatomic particle with a negative charge
Electrostatic attraction - strong attraction between oppositely charged ions
Weak intermolecular forces - force of attraction between atoms, elements and molecules
Delocalised electron - free moving electron that isn't a part of any atom
Ion – a charged particle

Covalent bonds

Two non-metals will form a covalent bond. The atoms share electrons to make themselves stable.

Cl — Cl





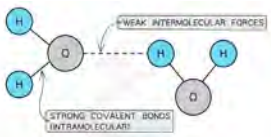
O=O

- 1 shared pair = a single bond
- 2 shared pairs = a double bond
- 3 shared pairs = a triple bond

Simple Covalent compounds

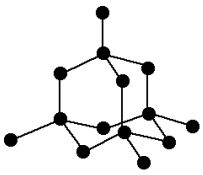
Simple covalent compounds have strong covalent bonds between atoms and weak intermolecular forces between molecules.

Properties – low m.p and b.p
- cannot conduct electricity

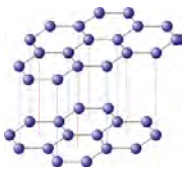


Giant Covalent Structures

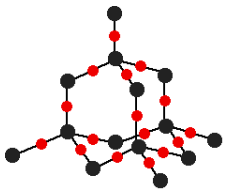
Diamond



Graphite

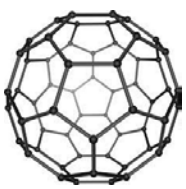


Silicon dioxide



Graphene

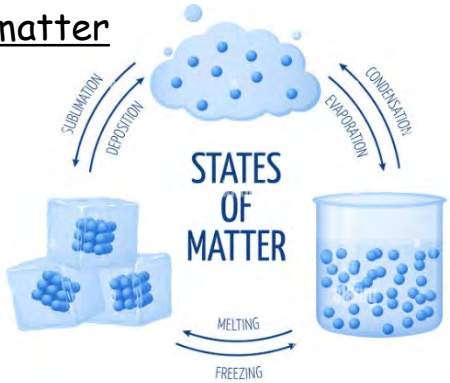
Fullerenes



Metallic bonding

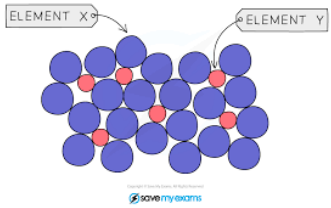
Metals consist of a giant metallic structure. They are positive metal ions surrounded by a sea of delocalised electrons

States of matter



Alloys

Alloys are a mixture of metals and another element.
Alloys are stronger than metals as the different sized atoms distort the layers



Rates of Reaction

Threshold Concept

All particles must collide with a minimum amount of energy in order to react

Keywords

Particle - A particle is the smallest possible unit of matter
Energy - Energy is what holds the atoms in a molecule together
Collision - If the two molecules A and B are to react, they must get close enough to break and make the new bonds that are needed in the products
Reactant - A substance put into a chemical reaction
Product - A substance made in a chemical reaction

Rate of reaction

Rate of reaction is how fast reactants are changed into products

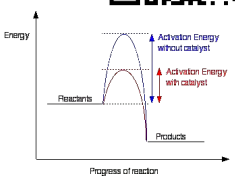
Collision theory and activation energy

The rate of reaction is directly proportional to the number of successful collisions.

- **To react**: particles must first **collide**
- with enough **activation energy** to be successful.

Catalysts

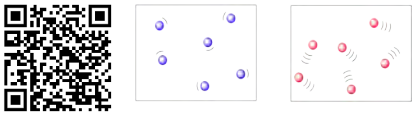
- Catalysts: increase the rate of a reaction without getting used up.
- Catalysts decrease the activation energy required to begin the reaction.
- Catalysts are often used in industry to speed up chemical processes.



Factors affecting rate of reaction

Effect of Temperature:

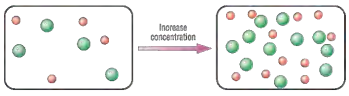
- Increasing the temperature increases the speed that particles are moving
- This means there are more frequent collisions, and those collisions have more energy



Video of all

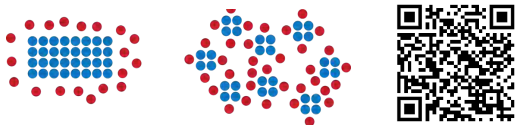
Effect of Concentration:

- Increasing concentration increases the number of reacting particles.
- This increases the frequency of collisions



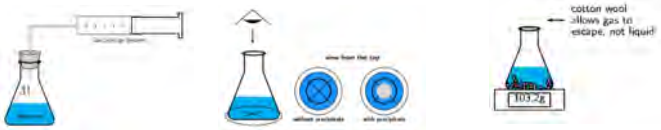
Effect of Surface Area:

- Increasing the surface area increases the proportion of (solid) particles available to react.
- This increases the frequency of collisions.



Measuring rate of reaction

- There are various ways to measure quantity of reactant used or quantity of product formed. Measuring the volume of gas collected can be the easiest way to measure.

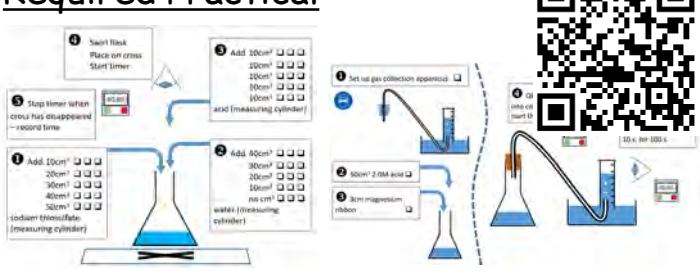


- The units of rate depend on what you are measuring. For example, when measuring gas in cm^3 you will end up with rate units of cm^3/s. When measuring the change in mass (g), you will end up with units of g/s

$$mean\ rate\ of\ reaction = \frac{quantity\ of\ reactant\ used}{time\ taken}$$

$$mean\ rate\ of\ reaction = \frac{quantity\ of\ product\ formed}{time\ taken}$$

Required Practical



Equations for this topic

Using Resources

Threshold Concept

Understand how to reduce, re-use and recycle the Earth's resources.

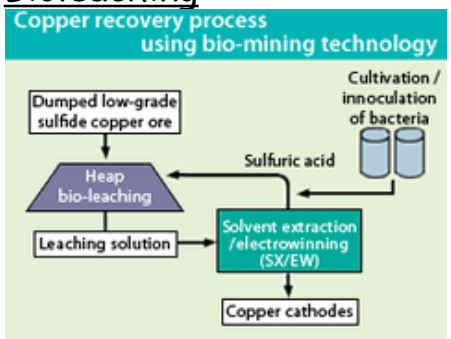
Resources and sustainability

Reducing doesn't just reduce the use of that specific material, but also reduces the use of any materials used to manufacture it in the first place.

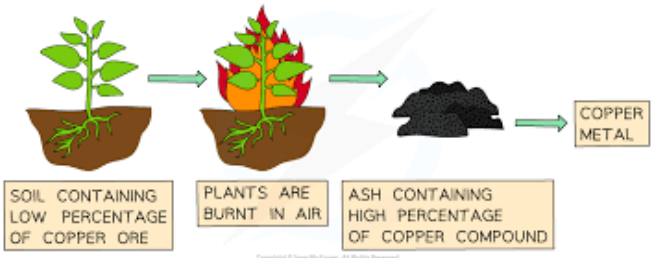
Keywords

Reduce – using materials/resources less
Reuse – using materials/resources again
Recycle – converting waste into reusable material
Renewable – when a resource is produced at least at the same rate that it is being used
Non-renewable – when a resource is being used at a faster rate than it can be made
Sustainable – fulfilling the needs of the current generation without compromising the needs of future generations

Bioleaching

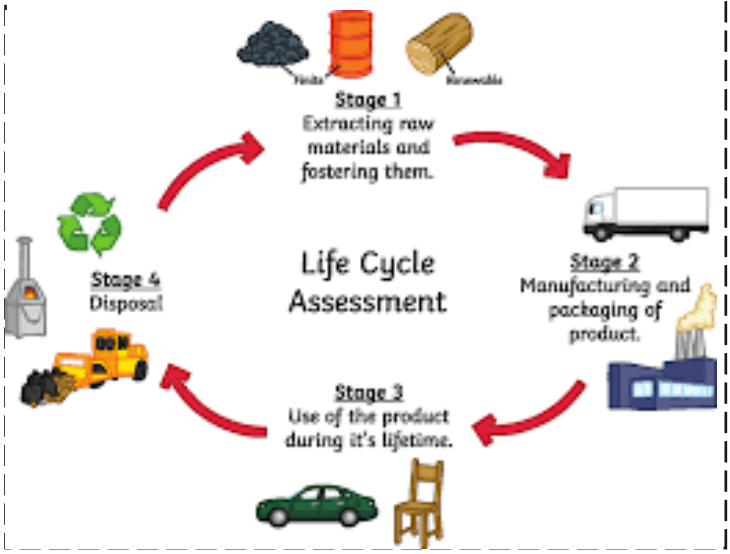


Phytomining



Life Cycle Assessments

A 'cradle to grave' analysis of the impact of a manufactured product on the environment.

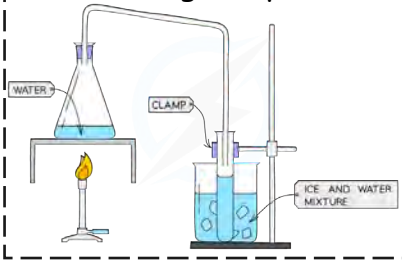


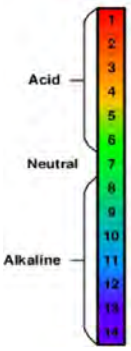
Potable Water (inc Required Practical)

Don't forget to click on the worksheet tab to try some tasks.

Required Practical involves:

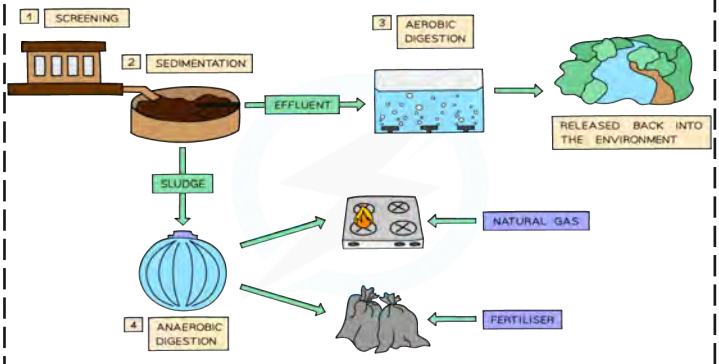
- pH testing using a pH meter, then neutralisation using titration, if needed.
- Ion testing (flame testing)
- Distillation
- Retesting for pH and ions.





Waste Water Treatment

Don't forget to click on the exam questions tab to try some tasks.



Chemical analysis Triple

Threshold Concept

What other organic compounds are made out of?

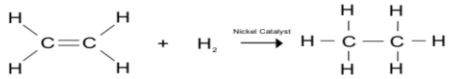
Keywords

Functional group – a group of atoms that are responsible for how a compound reacts
Homologous series – a group of compounds that share a functional group and react similarly
Alcohol – a group of compounds with the functional group OH
Carboxylic acids – a group of compounds with the functional group COOH
Esters – a group of compounds with the functional group COO

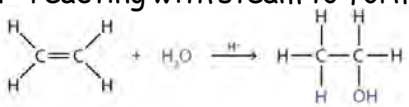
Reactions of Alkenes

Alkenes will go through a number of different addition reactions to form new products.

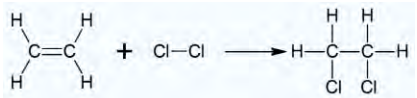
Hydrogenation – reacting with hydrogen to form alkanes



Hydration – reacting with steam to form alcohols

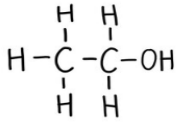


Halogenation – reacting with halogens to form a haloalkane



Alcohols

Alcohols are a group of compounds with the functional group is OH.
The general formula is $C_nH_{2n+1}OH$

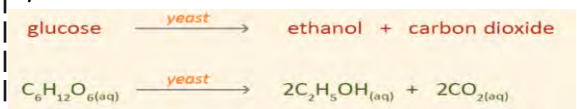


Ethanol

Uses:
- Alcoholic drinks
- Solvents
- Fuels

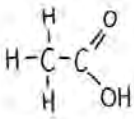
Fermentation

Ethanol can be produced by fermentation.
Glucose is converted into ethanol using enzymes in yeast.



Carboxylic acids

Carboxylic acids are weak acids with the functional group COOH.



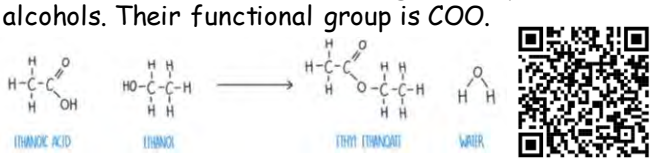
Ethanoic acid

Carboxylic acids behave like other acids and react with metals/metal compounds to form salts.

CARBOXYLIC ACID + METAL ⟶ SALT + HYDROGEN

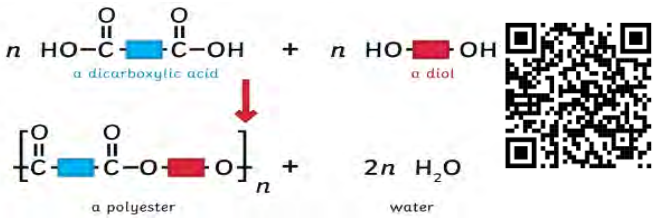
ETHANOIC ACID + CALCIUM ⟶ CALCIUM ETHANOATE + HYDROGEN

Esters are formed from reacting carboxylic acids and alcohols. Their functional group is COO.



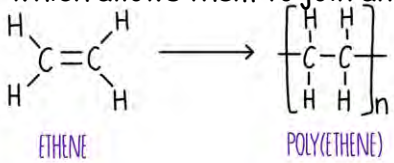
Condensation polymerisation

Condensation polymerisation requires 2 monomers; a diol and a dicarboxylic acid.
Water is always a by-product of this type of polymerisation.



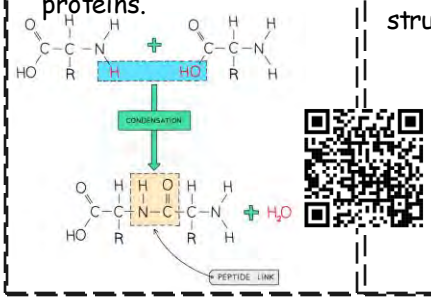
Addition polymerisation

Addition polymerisation involves breaking the carbon-carbon double bond of the monomer which allows them to join and form a polymer.

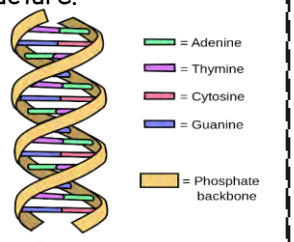


Naturally occurring polymers

Amino acids can join to form a polypeptide. These long chains form proteins.



DNA is a large natural polymer. It's monomers are called nucleotides and the form a double helix structure.



Organic Chemistry

Threshold Concept

Hydrocarbons are chains of hydrogen and carbon

Keywords

Hydrogen - a non-metallic element that is the simplest and lightest of the elements
Carbon - a non metallic chemical element with atomic number 6
Formula - a chemical formula is a way of presenting information about the chemical proportions of atoms that make up a particular chemical compound or molecule
Equation - A word or symbol representation of a reaction.

Crude oil and hydrocarbons

Crude oil is a fossil fuel. It's formed from the remains of plants and animals, mainly plankton, that died millions of years ago.

- It is a non-renewable fuel; one day it will run out.
- Crude oil is a mixture of lots of different hydrocarbons,
- Hydrocarbons are the simplest organic compounds.

There are two types of hydrocarbon:

- Alkane
- Alkene

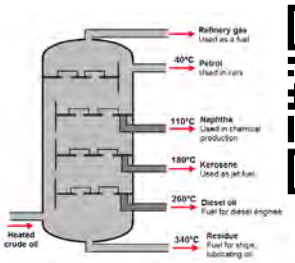
Hydrocarbon properties changes as the chain gets longer.

The shorter the chain the:

1. Less viscous the substance is (this means they are more runny)
2. More volatile the substance is (this means they have a lower boiling point)
3. More flammable the substance is (this means they are easier to ignite)

Fractional distillation

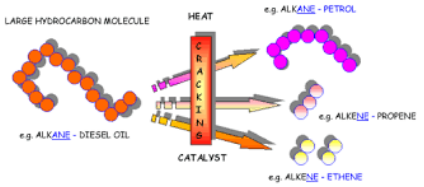
Crude oil can be used to make thousands of useful things but first the different 'fractions' need to be separated out. This is done by fractional distillation.



Video

Method and uses

Cracking



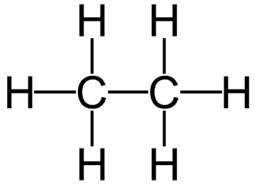
- This is the process of breaking long chain hydrocarbons down into shorter ones.
- Shorter chains are more flammable and therefore make better fuels.
- Cracking will produce alkanes and alkenes.

Alkanes

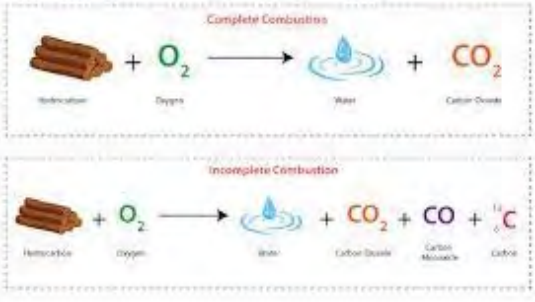
Contain only single c-c bonds.

Have the general formulc C_nH_{2n+2}

Are 'saturated' – each carbon forms 4 single covalent bonds.

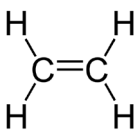


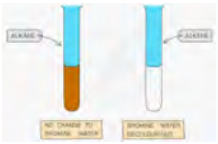
Combustion



Alkenes

- An alkene will contain at leas one c=c double bond.
- Have the general formula C_nH_{2n}.
- Are 'unsaturated'.





Bromine water is used to test for alkenes.

Required Practical

Equations for this topic

Quantitative chemistry

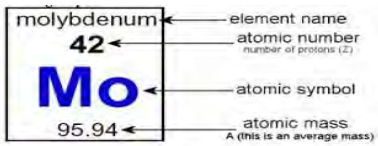
Threshold Concept

To understand that total mass of reactants equals total mass of products

Keywords

Conservation – the mass of the reactants must equal the mass of the products in a chemical reaction
Formula mass – the combined mass numbers of an element or compound
Concentration – the amount of substance dissolved in a solution
Equation – symbol representation of a chemical reaction
Loss – the process of losing something
Gain – the process of gaining something

RFM

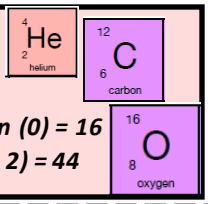


RAM is atomic mass of an element

RFM is the combination of all elements **Ar** in a compound or Molecule

Work example

Helium (He) Ar = 4
Carbon dioxide = CO_2
Carbon (C) = 12 Oxygen (0) = 16
Mr of CO_2 = 12 + (16 x 2) = 44



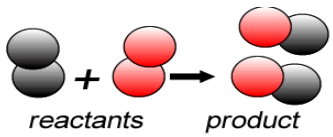
Balancing Equations

As the same number of elements are at the start and the end of reactions. The Equation needs to be balanced.

$Mg + O_2 \rightarrow MgO$ **(Unbalanced)**

2$Mg + O_2 \rightarrow$ **2**MgO **(Balanced)**

Conservation of Mass



The reactants mass must always equal the mass of the products

2g + 2g —> 4g

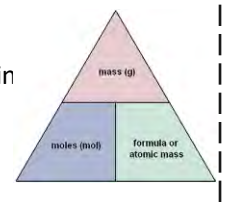
We can not destroy atoms.

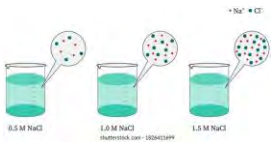
Moles

Chemical amounts are measured in moles. One mole of a substance contains **6.02×10^{23} particles (Avagadro's number)**

Concentration

Concentration is the amount of substance in a certain volume of solution (g/dm3)





Percentage by mass

The amount of an element in a compound is called its percentage composition. It can be calculated using the mass of the given element in the compound and the **RFM** of the Compound.

$$\text{Mass \%} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100\%$$

Limiting reactions

The reactant that gets used up first in a reaction is called the limiting reactant. This reactant is not in EXCESS

Reacting masses

The mass of a product or reactant can be determined from having a balanced symbol equation. Once balanced, the equation tells you how many moles of each substance react with each other : Mg + **2**HCl —> **$MgCl_2$ + H_2** **(Balanced)**

This equation states that: 1 : Mg 2 : HCl to form 1 : $MgCl_2$ 1 : H_2

Using the formula and moles you can use this information to work out how much product you will make

Making salts

Threshold Concept

How do metals and acids react to make salts and water

Keywords

Reactivity – the ability for an atom or molecule to undergo a chemical reaction
Salt – a substance made of positive and negative ions
Sulphuric acid – an acid that contains sulphate ions
Nitric acid – an acid that contains nitrate ions
Hydrochloric acid – an acid that contains chloride
Balanced – equal on both sides
Symbol equation – a chemical equation using chemical symbols
Acidic – a solution that contains H^+ ions
Alkaline – a solution that contains OH^- ions

Neutralisation

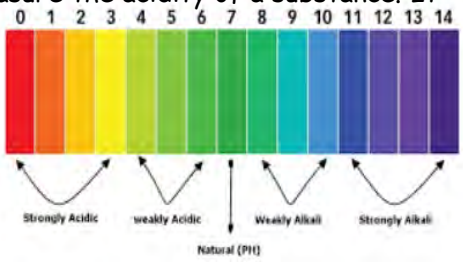
When an acid and alkali react they form neutral product water.
The H+ ions from the acid react with the OH- ions from the alkali to form water.
This can be represented using the following ionic equation:

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

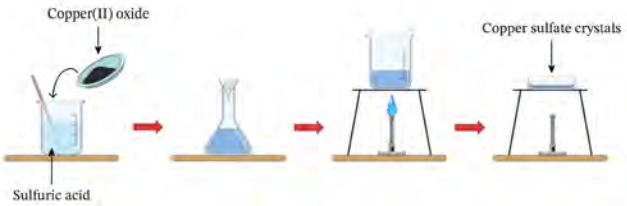
The pH scale

Acids contain H^+ ion and alkalis contain OH^- ions. The pH scale is used to measure the acidity of a substance. It ranges from 0-14.

Acidic = pH < 7
Neutral = pH 7
Alkaline = pH > 7



Making salts required pract



$$CuO(s) + H_2SO_4(aq) \longrightarrow CuSO_4(aq) + H_2O(l)$$

Reactions of acids

Acids react with metals, alkalis and carbonates to form a salt and either hydrogen, water or water and carbon dioxide. Each acid forms a different salt.

Acid Used	Salt Produced
hydrochloric	chloride
nitric	nitrate
sulfuric	sulfate

acid + metal → salt + hydrogen

hydrochloric acid + zinc → zinc chloride + hydrogen

$2HCl + Zn \rightarrow ZnCl_2 + H_2$

acid + alkali → salt + water

nitric acid + sodium hydroxide → sodium nitrate + water

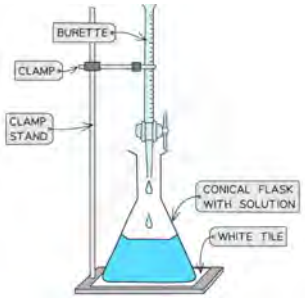
$HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$

acid + carbonate → salt + water + carbon dioxide

sulfuric acid + zinc oxide → zinc sulfate + water

$H_2SO_4 + ZnO \rightarrow ZnSO_4 + H_2O$

Titration req prac (triple)



Redox reactions (higher tier)

Redox reactions are when oxidation and reduction (in terms of electron transfer) take place at the same time.

For example:

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

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

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

Oxidation is loss of electrons.

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

Reduction is gaining of electrons.

Strong and weak acids

Strong acids are acids that fully ionise in water

$$HCl \longrightarrow H^+ + Cl^-$$

Weak acids are acids that partially ionise in water

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

Electrolysis

Threshold Concept

Know ionic compounds can be split into separate elements

Keywords

Compound…… a substance made from two or more different elements that have been chemically joined

Ionic…… an atom or small group of atoms that has an electrical charge because it has added or lost one or more electrons

Electrolysis ……. a process that uses the power of electricity to split elements and compounds into their ions

Molten ……. **melted or made liquid by being heated to very high temperatures**

Aqueous ……. Dissolved in water

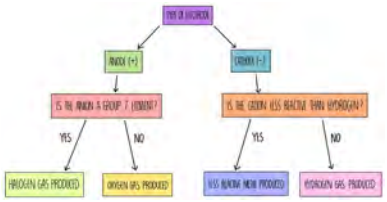
Electrolysis

Electrolysis uses electricity to break down ionic compounds that are made up of positive and negative ions

When using electrolysis to extract metals, the metal needs to be melted or dissolved.

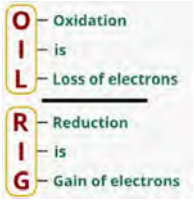
Positive ions in the electrolyte move towards the cathode, gain electrons and are reduced to form an uncharged element.
Negative ions move towards the anode, lose electrons and are oxidised.

Rules at the electrodes



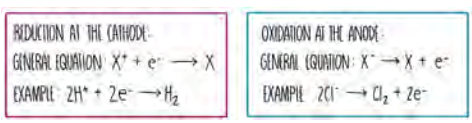
Oxidation and reduction

- Oxidation means gain of oxygen. Reduction means loss of oxygen.
- When we are referring to electrons, we refer to them as redox reactions.
- This is where electrons are lost or gained.
- A redox reaction is where **RED**uction and **OX**idation happen at the same time.

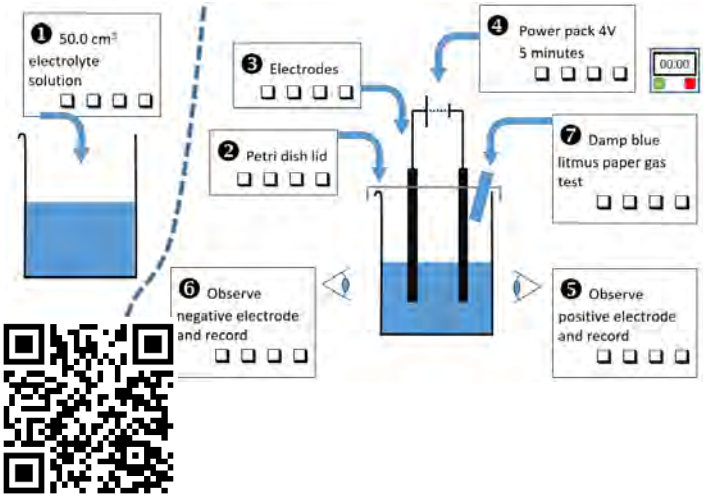


Half equations

A half equation is used to represent the reaction that happens at an electrode during electrolysis. It shows what happens when ions gain or lose electrons

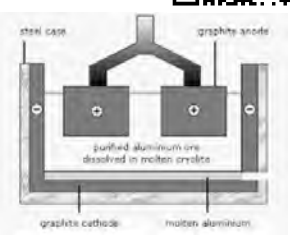


Required Practical



Extraction of metals

Metals higher than carbon on the reactivity series need to be extracted using electrolysis. For example aluminium needs to be extracted from it's ore, bauxite, using electrolysis



Equations for this topic

Energy changes

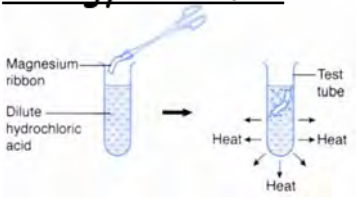
Threshold Concept

Know that reactions absorb or release energy

Keywords

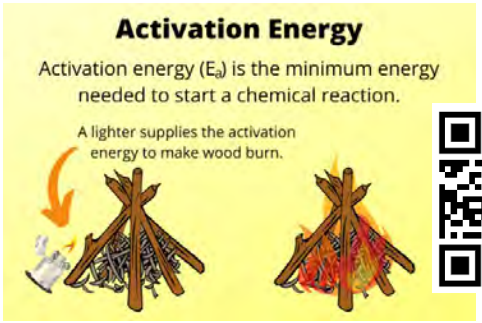
Energy……. Energy is stored in the bonds of chemical compounds, that is absorbed or released in chemical reactions
Bond……. an attraction between atoms or ions and allows for the formation of compounds or molecules
Activation energy ……. The minimum amount of energy required to start a reaction and turn a reactant into a product
Energy change……. The energy absorbed or released when bonds are made or broken
Reaction profile ……. A diagram that shows the energy changes in a reaction.
.

Energy transfer

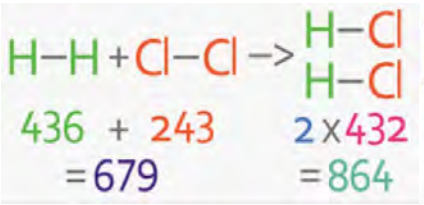


During a chemical reaction, energy is transferred to or from the surroundings

Activation energy



Bond energy

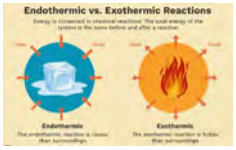


Bond	Bond energy (kJ/mole)
H–H	436
Cl–Cl	243
H–Cl	432

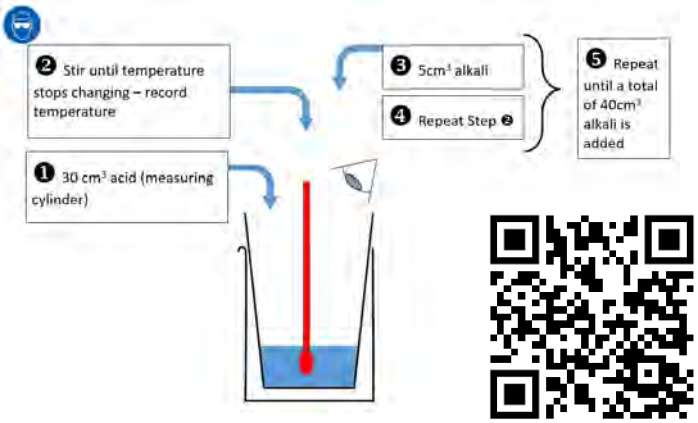
The energy change in a reaction can be calculated using **bond energies**. A bond energy is the amount of **energy** needed to break one **mole** of a particular **covalent bond**.
Energy change = total bond energy of reactants – total bond energy of products

Endothermic / Exothermic reactions

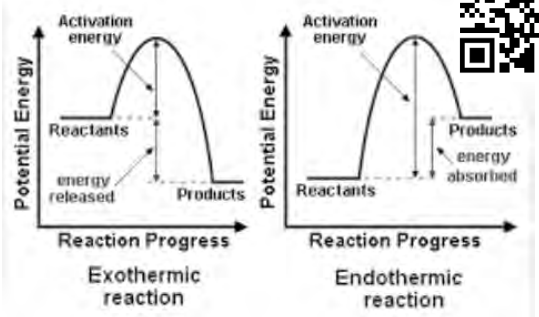
- Exothermic reactions transfer energy to the environment
- Endothermic reactions transfer energy from the environment



Required Practical



Reaction profiles



Equations for this topic

Chemical analysis

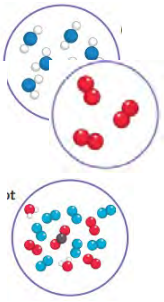
Threshold Concept

How do we identify a substance?

Keywords

Pure – a substance made from just one element of compound
Impure – a substance made from more than one element or compound
Analyse – to find the chemical composition of a substance
Sample – a portion of a substance taken from a larger amount

Pure and impure



Pure substances are made up of just one type of element or compound. They will have one set melting or boiling point.

Impure substances are a mixture of elements or compounds and have a range of melting/boiling points.

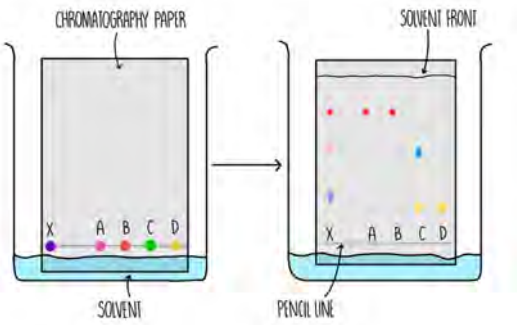
Formulations

A formulation is a mixture which has been designed as a useful product.

- Fuels
- Cleaning products
- Paints

Chromatography required practical

Chromatography is a method used to separate the substances in a mixtures.

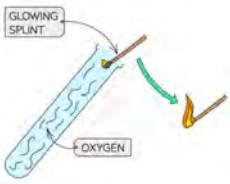


Stationary phase – where the molecules can't move (chromatography paper)
Mobile phase – where the molecules can move (the solvent)

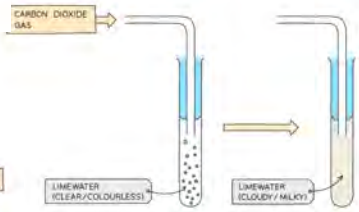
Test for gases

Test for Hydrogen

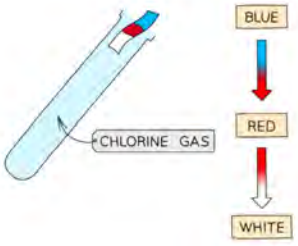
Test for Oxygen



Test for Carbon Dioxide

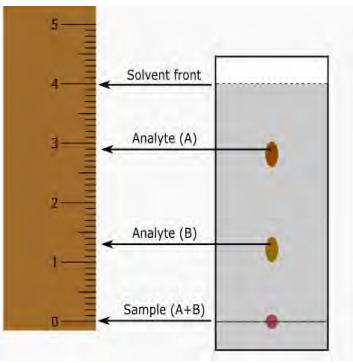


Test for Chlorine



Rf Value

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



Chemical analysis Triple

Threshold Concept

How do we identify a substance?

Keywords

Pure – a substance made from just one element of compound

Impure – a substance made from more than one element or compound

Analyse – to find the chemical composition of a substance

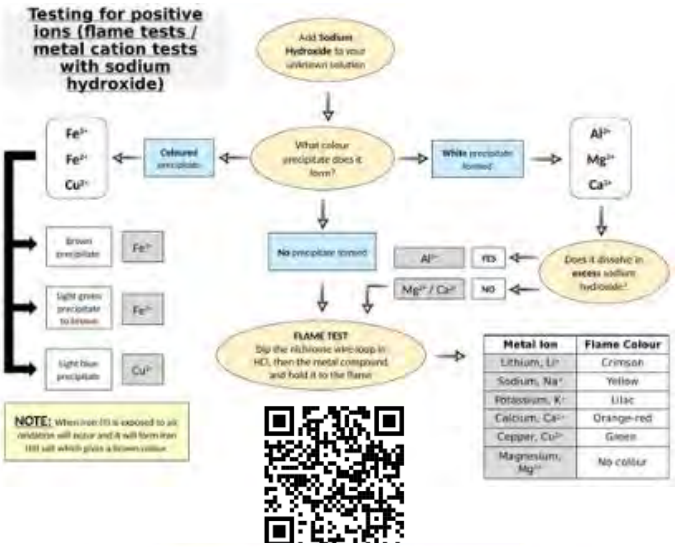
Sample – a portion of a substance taken from a larger amount

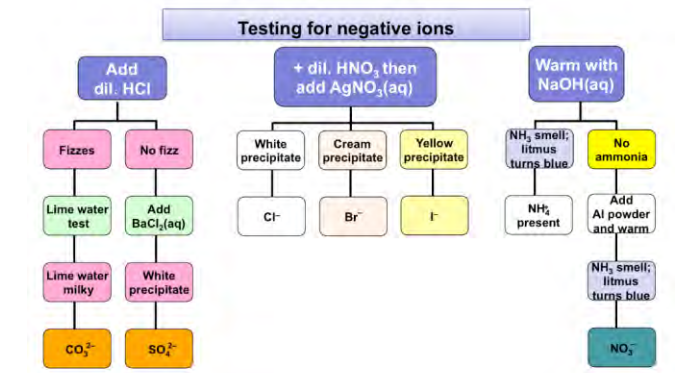
Testing for metal ions

Metal ions will form coloured precipitates when they react with sodium hydroxide.

Metal Cation	Effect of adding NaOH
Aluminium (Al^{3+})	White precipitate, dissolves in excess NaOH to form a colourless solution
Magnesium (Mg^{2+})	White precipitate, incoluble so remains in excess NaOH
Calcium (Ca^{2+})	White precipitate, insoluble so remains in excess NaOH
Copper (II) (Cu^{2+})	Light blue precipitate, insoluble in excess
Iron (II) (Fe^{2+})	Green precipitate, insoluble in excess
Iron (III) (Fe^{3+})	Red–brown precipitate, insoluble in excess

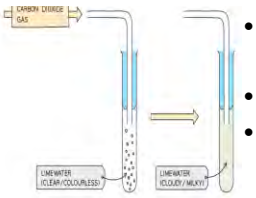
Identifying ions required practical





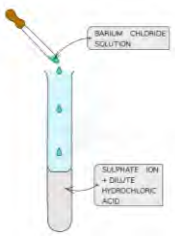
Testing for carbonate ions CO_3^{2-}

$K_2CO_3 + 2HCl \rightarrow 2KCl + CO_2 + H_2O$



- Metal carbonate and hydrochloric acid
- Forms Carbon dioxide
- Turns lime water cloudy

Testing for Sulphate ions (SO_4^{2-})



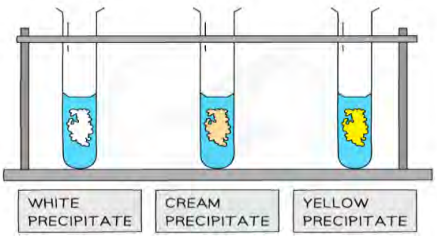
$Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$

- Add barium chloride
- White precipitate formed

Flame emission spectroscopy

An instrumental technique used to identify metal ions.

Testing for Halide ions (Cl^-, Br^-, I^-)



$Ag^+ + Cl^- \rightarrow AgCl$

- Add nitric acid
- Add a few drops of silver nitrate
- Chloride forms a white precipitate
- Bromide forms a cream precipitate
- Iodide forms a yellow precipitate

English Language

Threshold Concept- Year 10- Language- Reading:

TC1 -Understanding texts: identifying explicit and implicit information; selecting accurate and precise quotations.

TC2 – Demonstrate and appreciation of the writer's craft through analysis and critically evaluative comments.

TC4 – Evaluate writer's craft including comparison skills.

Showing your understanding of texts- use PEEZL to structure your answers.

Component 1, Question 2 response- 5/5 marks.

Point- rephrase key words from question to start your answer.

Evidence- introduce quotation(s).

Mention techniques here!

Explanation- explain what quotations shows.

Zoom- pick a single word choice made by the writer and explain what it implies.

Link to reader – mention how reader may react and why.

You should use this info to get the base knowledge needed to confidently answer the different types of question on component 1 and 2.

Frequent, short quotations weaved into your answers and explained will make your work even more successful!

The writer creates the impression that there is a misunderstanding between the characters of Emma and Robbie. For example the writer describes how Robbie "was well known for his grumpiness", yet "Emma mistook it for shyness". The fact that Emma mistakes his grumpy attitude for being shy emphasises how the couple do not fully understand each other as they misinterpret each other's behaviour.

The writer also creates the impression that Emma and Robbie are both very different people. Whilst Robbie is "twenty years older than her" and quite grumpy, Emma is impressionable and slightly naive as she believes "he was more mature than he was" as a result of his sulking attitude. This impression is reiterated when the writer explains how after a week "Emma was feeling the need for some time apart from Robbie". This highlights the distant nature of their relationship and suggests it may not be as strong or loving as she believes.

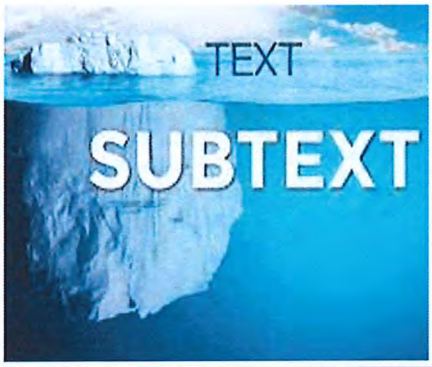
Expressing higher order ideas in explanations (for analysis/evaluation).

Text = what is directly written in a piece of Literature.

(Don't include in your explanations- you'll just be repeating yourself/ retelling the story.)

Subtext = the meanings beneath the surface of what is written.

These are the thing that show you are thinking deeply about the writer's choices.



What happens.

Connotations of words.

Implied emotions of characters.

Alternative interpretations.

Writer's intentions.

Use this to transform your responses from this...

The quotation: "as strong as a bull" reflects that the man is like a strong cow. X

To this...

The quotation "as strong as a bull" shows that the man in question is a powerful physical specimen. It may also reflect the man is mentally tough, perhaps even stubborn. The noun "bull" might reflect the writer's intention to show that the man is aggressive, perhaps foreshadowing harm he does to others later in the story. ✓

Identifying language and structural features.

0 2 Read lines 7-16.

What impressions does the writer create of Emma and Robbie in these lines? [5]

You must refer to the language used in the text to support your answer, using relevant subject terminology where appropriate.

Whenever you see the highlighted words, try to identify and mention the writer's technique choices in your essays.

Common language techniques	Common structural features
Simile Metaphor Personification Adjective Adverb	Lists Repetition of words Lexical (word) patterning Repetition of a technique Tone shift

Make sure you can confidently identify these!

Use this to transform your responses from this...

The quotation: "as strong as a bull" shows...

To this...

The quotation: "as strong as a bull" is a simile, which shows...

Comparing successfully- using comparative connectives.

Words that signal a comparison	Words that signal a contrast
As	however
Also	Although
Like	Whereas
Alike	In contrast
Likewise	Yet
Resembles	Differs from
Similar	Instead
Just as	Unlike
Just like	On the contrary
Equally	Different from
Same both	On the other hand

Platinum answers may include: The words "more" "less" regularly AND comparative adjectives.

Words that end in 'er' that compare two things i.e. greater.

Use these frequently when comparing non-fiction texts.

Make sure you clearly mention which specific text you are discussing every time.

Both the `Penny Review` and the Chilean mining article finish with the miners being rescued. This creates a sense of drama as the rest of the texts build up tension and anticipation for their rescue. However, in the Chilean article the day of the rescue is also mentioned at the beginning: the "scenes of jubilation erupted" as the miners were rescued. This dramatic verb `erupted` portrays the excitement and

Threshold Concept- Year 10- Writing:

TC5 - Communicate clearly, effectively, and imaginatively, selecting and adapting tone, style and register for different forms, purposes and audiences.

TC6 - Organise information and ideas, using structural and grammatical features to support coherence and cohesion of texts

TC7 - Use a range of sentence structures for clarity, purpose and effect, with accurate punctuation and spelling.

Vocabulary:

Common word	Better word
Big	Vast
Small	Microscopic
Happy	Elated
Sad	Melancholy
Scary	Blood-curdling
Scared	Petrifying
Loud	Thunderous
Quiet	Soundless
Said	Declared
Red	Vermillion

Ask yourself these questions:

-Do I know, use and spell correctly plenty of better words for common words?

-Do I push myself to use more ambitious words in all my work- not just English?

To be a successful writer, you need to juggle all of these different skills.

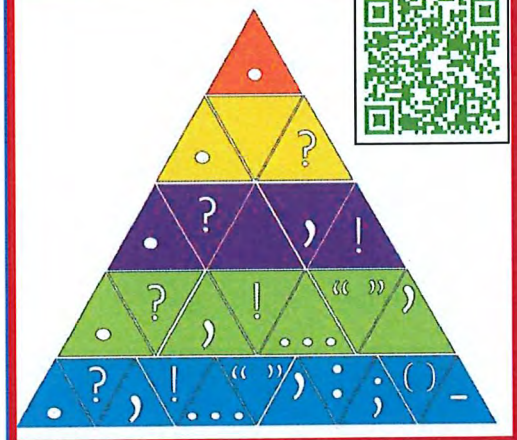
Techniques:

Ask yourself these questions:

-Do I know what all these techniques are?

-Do I use a range of these (and maybe even some others!) in my own writing?

Punctuation:



Ask yourself these questions:

-Am I aware of the function and when to use each of these pieces of punctuation?

-Do I consistently use all these pieces of punctuation in my writing?

Structure:

For fiction texts- SCIT:

40 min successful plot structure- SCIT.

Section 1: Describe the setting.

Section 2: Describe the main character.

Section 3: Describe ONE incident.

Section 4: Describe how the setting/character has now transformed.

For non-fiction texts- PAF:

Purpose	WHY you are writing your non-fiction text.	Inform, persuade, advise, review, entertain.
Audience	WHO you are writing to/for.	Wide audience, council, parents, tourists, teenagers.
Form	WHAT you are writing and HOW it is uniquely laid out.	Letter, magazine article, newspaper article advertisement, speech.

Ask yourself these questions:

- Does my writing achieve what I want it to?
- Do I adapt my writing (i.e. word/language choices) based on the task I am set?

English Literature

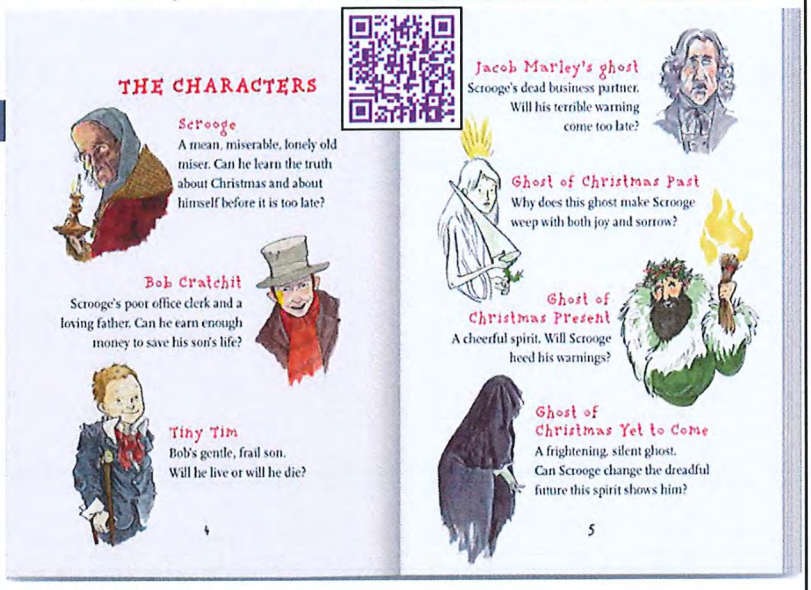
Threshold Concept- Year 10- A Christmas Carol:

TC1 - Understanding texts

TC2 - Demonstrate an appreciation of the writer's craft through analysis and critically evaluative comments.

TC3 - Understanding the relationships between texts and the contexts in which they were written.

A plot and character summary of 'A Christmas Carol:' Full text (if on MS Teams) = A Christmas Carol Audiobook



Using this information can you:

- Recount what happens from start to finish in the novella?
- Explain who the primary characters are, and what makes them unique?

You should use this information to get the base knowledge needed for Chares Dickens' story.

E.g. The Ghost of Christmas Yet To Come shows Scrooge a horrible future where he dies- he is a silent, petrifying ghost.

How to analyse the writer's craft- break the quotation up into smaller chunks. Example on Scrooge.

Golden- adjective = suggests value.

Scrooge is a rare and valuable human being- a nice rich man. He is valued by the people around them, now!

Scrooge also now values the sunlight and the world around him = he is appreciative.

Noun: Sunlight brings life, light and warmth. Scrooge brings life as he gives money to Bob to ensure Tiny Tim continues to live. He brings light as he is a much more jolly and friendly person. He brings warmth as he is a far warmer, more compassionate man.

Golden sunlight; Heavenly sky; sweet fresh air; merry bells.

Adjective- Scrooge sees Heaven above him in the sky. London is now a place he is happy in- it is a heaven to him. It also suggests his new religious side- where he follows God's teachings to treat others well.

Adjective- links to the idea of rebirth. Scrooge is starting afresh- he is reincarnated as a completely new Scrooge. The whole world is fresh to him and he is fresh to the world and the people around him, too.

In order to be successful, **you must know a range of different moments** from the whole story. For example, other moments where Scrooge is important include:

- Scrooge's introduction as a miserable boss. "Bah! Humbug!"
- Scrooge as a child. "Poor boy!"
- Scrooge's reaction to the ghosts. "I will honour Christmas in my heart."

The relationships between A Christmas Carol and the historical context in which they are written.

Prince Albert and Queen Victoria decorating a Christmas tree 1848. Where the tradition started.

Saint Nicholas- patron saint of children, known for his generosity and kindness.

INSPIRED

The Ghost of Christmas Present, who resembles Saint Nicholas and is surrounded by new Victorian Christmas tradition.

Look out for other parts of the novella clearly inspired by the outside world. i.e. poverty, treatment of children, workhouses.

Threshold Concept- Year 10- Poetry:

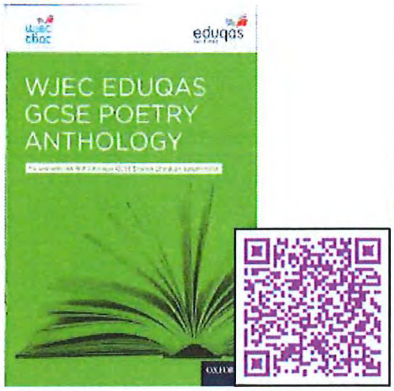
TC1 - Understanding texts

TC2 - Demonstrate an appreciation of the writer's craft through analysis and critically evaluative comments.

TC3 - Show understanding of the relationships between texts, and the contexts in which they were written.

1 sentence summaries of each poem: Full annotations (if on MS Teams) = Annotated 15 poems.

Poem	1 sentence summary
The Manhunt	*The one where a wife writes about her scarred soldier-husband.*
Sonnet 43	*The one about listing ways you love someone.*
London	*The one about hating a city and what it represents.*
The Soldier	*The one about the glory of dying for England.*
She Walks in Beauty	*The one about the beauty of a mourning woman.*
Living Space	*The one about the cramped Indian slums.*
As Impercitibly as Grief.	*The one about fear of time passing away and death.*
Cozy Apolgia	*The one about the specialness of a normal "boring" relationship.*
Valentine	*The one about how love is like an onion*
A Wife in London	*The one about the wife who finds out her husband has died in South Africa.*
Death of a Naturalist	*The one about where frogs teach a child about reproduction.*
Hawk Roosting	*The one about where a bird is compared to humanity.*
To Autumn	*The one where a season is compared to a woman/ goddess.*
Afternoons	*The one where about the restrictions of motherhood.*
Dulce Et Decorum Est	*The one about a WW1 gas attack.*
Ozymandias	*The one about the broken statue of someone who was powerful.*
Mametz Wood	*The one about soldiers' remains in farming fields.*
The Prelude	*The one about the magic of cold winter days.*



You should use this info to get the base knowledge needed for each poem.

Using this information can you:

- Recount the main idea from each poem?
- Begin to recount quotations/words/the background in the poems?

E.g. London is a poem about how horrible the capital of England is to the poet.

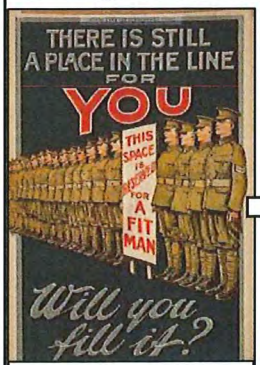
How to analyse the poet's craft- use FLIRT to cover a range of different features in your responses.

Form	Sonnet? Ballad? Free verse? Ode? Narrative poem?
Language	Word choices? Adjectives/adverbs? Verbs? Lexical fields? Connotations?
Imagery	Similes? Metaphors? Personification?Hyperbole? Senses? Alliteration? Onomatopoeia?
Rhyme/structure	Rhyme scheme? Enjambment? Caesura?
Tone	Joyful? Depressed? Angry? Ironic? Nostalgic? Shifting?

Ozymandias example.

Sonnet = love poem = Ozymandias loved his power.
"desert" "boundless" "bare" *lexical field* of loneliness reflects how forgotten Ozymandias is now.
"sneer of cold command" strong sounding *alliteration* suggest violence of Ozymandias to his slaves
"Stand of the desert. Near them..." *Caesura* = isolation of the statue.
"Ozymandias- King of kings" *ironic* tone- Ozymandias' power has faded completely.

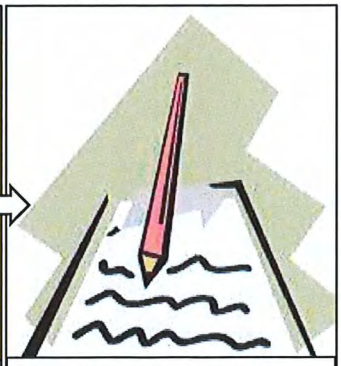
Linking the content of the poem to the writer's life/ the history behind it! *This links to the context of the poem, because...*



1914- Propaganda posters/ poetry persuades men to go to WW1.

1915- Wilfred Owen enlists in the army.

1915- 1918- Wilfred Owen experiences the horrors of war (including gas attacks).



1917- 1918- Wilfred Owen writes a response to the propaganda that persuaded men to go to war.

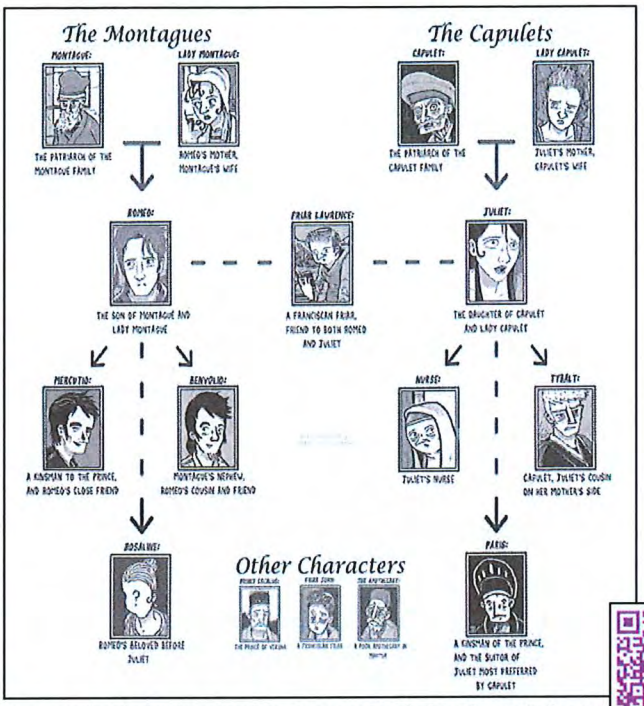
Each of the poems have stories behind them that inspired the writers- make sure you know them and mention them to showcase your knowledge!

Threshold Concept- Year 10- Romeo and Juliet:

TC1 - Understanding texts

TC2 - Demonstrate an appreciation of the writer's craft through analysis and critically evaluative comments.

A plot and character summary of 'Romeo and Juliet:' Full text (if on MS Teams) = Romeo and Juliet Audiobook



Using this information can you:

- Recount what happens from start to finish in the play?
- Explain who the primary characters are, and what makes them unique?

You should use this information to get the base knowledge needed for Shakespeare's play.

E.g. Juliet is instructed to marry Paris by Capulet and Lady Capulet, but fakes her death to avoid this.

How to analyse the writer's craft- mention the writer's name and all of the choices they make. Example on Tybalt (focus on trying to write explanations like you see in the green box below.)

The character of Tybalt is presented purposely by Shakespeare to be aggressive and deadly: "turn, Benvolio and look upon thy death". Shakespeare has Tybalt use an imperative here to command the Montague characters to do what he says as he feels superior to them. His use of the metaphor "death" to describe his sword, shows that he often uses the object with theintention of killing his opponents. The original audience may celebrate Tybalt being like this, as it reflects his masculinity and strength in a world which promoted warrior culture, but a modern audience would more likely see his language as overly violent and completely unnecessary, as conflict is looked down upon more so now.

Key quote written down

Technique identified.

What it shows

Audience reaction(s).

In order to be successful, **you must know a range of different moments** from the whole play. For example, other moments where violence is important include:

- Romeo and Juliet's suicide. "Stabs herself"
- Mercutio's death "a plague on both your houses.
- Romeo kills Tybalt. "They fight; TYBALT falls"

Developing this further- discussing audience reaction.

A really effective way to showcase your understanding of the text is by comparing how an original audience might react vs. how a modern audience might react (see the blue part of the WAGOLL above). This is how we do this:

ORIGINAL AUDIENCE MIGHT THINK

Juliet is ungrateful for refusing to marry a suitable man they've selected for her. They may dislike her for trying to resist the male-dominated society that she (and they) are part of.

MODERN AUDIENCE MIGHT THINK

Juliet is right to do what she does. She should pursue the man she loves and should not bow down to the pressure of her parents. They may celebrate her power, in spite of her youth.

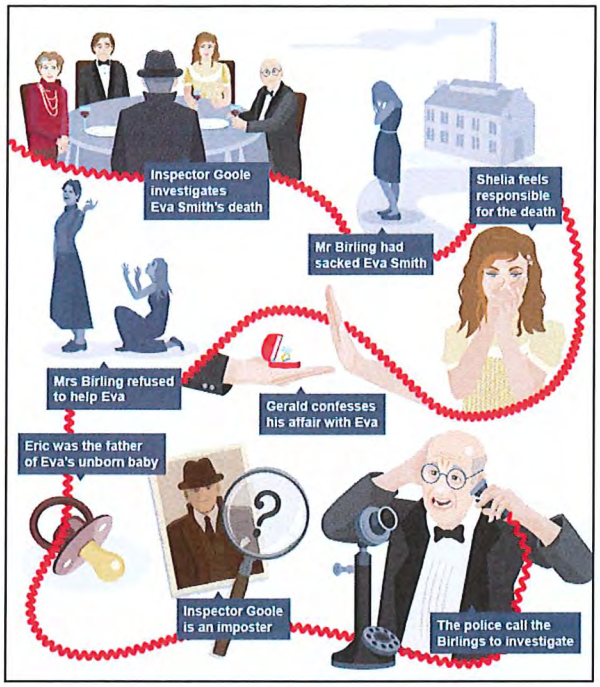
Try to consider, as you read the play, your own reactions to characters/ events. Then compare this to how an audience in the 1590s (with very different views to us) would react.

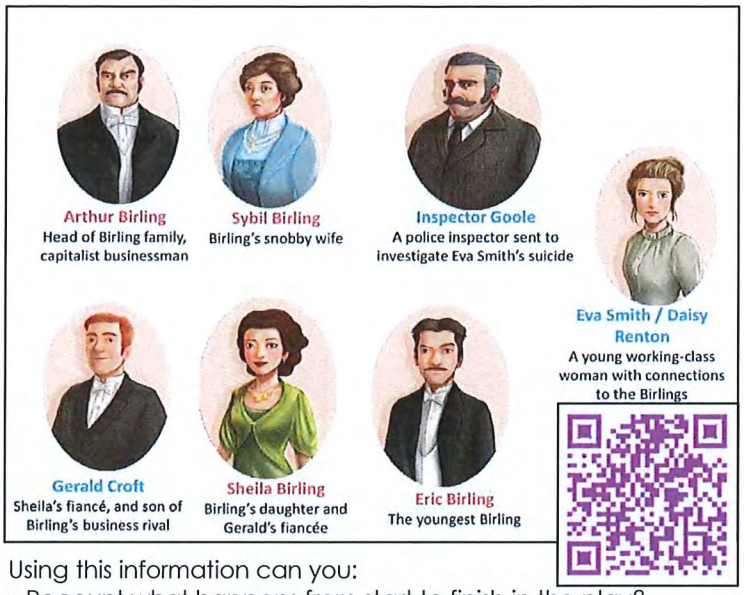
Threshold Concept- Year 10- An Inspector Calls:

TC1 - Understanding texts

TC2 - Demonstrate an appreciation of the writer's craft through analysis and critically evaluative comments.

A plot and character summary of 'An Inspector Calls:' Full text (if on MS Teams) = An Inspector Calls audiobook





Using this information can you:

- Recount what happens from start to finish in the play?
- Explain who the primary characters are, and what makes them unique?

You should use this information to get the base knowledge needed for J.B. Priestley's play. → **E.g. Mr Birling is an ignorant Capitalist who sacked Eva Smith for demanding equal pay.**

How to analyse the writer's craft- mention the writer's name and all of the choices they make. Example on Sheila (focus on trying to write explanations like you see in green here.)

The character of Sheila Birling is used to reflect that the younger generation have a chance to be different to their elders. The quotation: "these girls aren't cheap labour, they're people" shows Sheila's new understanding that women (regardless of class) should be treated more equally to men. J.B. Priestley has her criticise her male relatives who treat females as lower beings. The adjective "cheap" is used by the writer to show that she feels they are worth more than how society sees them. The original audience may dislike a woman challenging a man at this time as it is not the norm at all, though Sheila would be celebrated by a more modern audience as she is seen more so as a strong feminist figure, similar to the suffragettes.

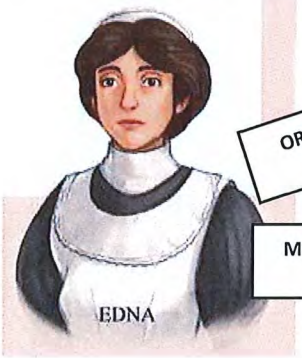
- Key quote written down
- Technique identified.
- What it shows
- Audience reaction(s).

In order to be successful, **you must know a range of different moments** from the whole play. For example, other moments where Sheila is important include:

- Sheila's introduction as Sheltered and childish "mummy" "daddy"
- Sheila's new-found power in her speech and interruptions "(cutting in)"
- Sheila's change and refusal to accept Gerald's engagement ring. "No…I must think"

Developing this further- discussing audience reaction.

A really effective way to showcase your understanding of the text is by comparing how an original audience might react vs. how a modern audience might react (see the blue part of the WAGOLL above). This is how we do this:



ORIGINAL AUDIENCE MIGHT THINK

Edna is lucky to work for the Birlings. She has a stable job and an opportunity to live in a beautiful house. (Original theatre-goers more likely to have maids and be Capitalists.)

MODERN AUDIENCE MIGHT THINK

Edna is unlucky to work for the Birlings. She would earn very little indeed and has to wait on a whole family at all hours of the day. (Modern audiences more sympathetic to working-class)

Try to consider, as you read the play, your own reactions to characters/ events. Then compare this to how an audience in 1946 (with very different views to us) would react.

Maths

Year 11 – Reasoning...

Multiplicative reasoning

What do I need to be able to do?

By the end of this unit you should be able to:

- Understand and use scale factors
- Understand direct and inverse proportion
- Calculate with pressure and density
- Complete ratio problems

Keywords

Scale factor: the multiplier of enlargement
Proportion: a comparison between two numbers
Direct proportion: as one variable is multiplied by a scale factor the other variable is multiplied by the same scale factor.
Inverse proportion: as one variable is multiplied by a scale factor the other is divided by the same scale factor.
Pressure = Force ÷Area
Density= Mass ÷ Volume
Ratio: a ratio shows the relative size of two variables

Direct Proportion

As one variable changes the other changes at the same rate

4 cans of pop = £2.40

This is a multiplicative change

4 cans of pop = £2.40 → 2 cans of pop = £1.20 (× 0.5)

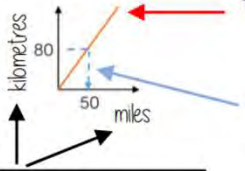
4 cans of pop = £2.40 → 12 cans of pop = £7.20 (× 3)

This multiplier is the same in the same way that this would be for ratio

Sometimes this is easiest if you work out how much one unit is worth first
e.g. 1 can of pop = £0.60

Conversion Graphs

Compare two variables



This is always a straight line because as one variable increases so does the other at the same rate

Labelling of both axes is vital

To make conversions between units you need to find the point to compare – then find the associated point by using your graph
Using a ruler helps for accuracy
Showing your conversion lines help as a "check" for solutions

Inverse Proportion

As one variable is multiplied by a scale factor the other is divided by the same scale factor

Examples of inversely proportional relationships

Time taken to fill a pool and the number of taps running

Time taken to paint a room and the number of workers

T is inversely proportional to G. When T=2 then G=20

T	1	2	8
G	40	20	5

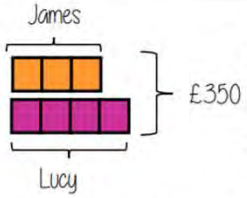
(÷ 2, × 4 across T; × 2, ÷ 4 across G)

Sharing a whole into a given ratio

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

Model the Question

James : Lucy
3 : 4



Find the value of one part

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

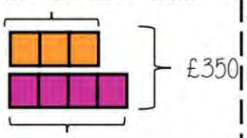
£350 ÷ 7 = £50

□ = one part = £50

Put back into the question

James : Lucy
3 : 4 (× 50 / × 50)
£150 : £200

James = 3 x £50 = £150



Lucy = 4 x £50 = £200

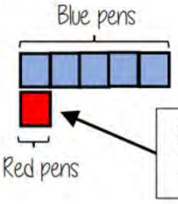
Finding a value given 1:n (or n:1)

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

Model the Question

Blue : Red
5 : 1

□ = one part = 10 pens

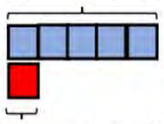


One unit = 10 pens

Put back into the question

Blue : Red
5 : 1 (× 10 / × 10)
50 : 10

Blue pens = 5 x 10 = 50 pens



Red pens = 1 x 10 = 10 pens

There are 50 Blue Pens

Direct and inverse proportion equations

g is directly proportional to h.
When $g = 120$, $h = 40$

1) Work out the constant of proportionality

$$g = kh$$
$$120 = 40k$$
$$k = \frac{120}{40} = 3$$
$$\boldsymbol{g = 3h}$$

2) Work out the value of g when $h = 25$

$$g = 3h$$
$$g = 3 \times 25$$
$$\boldsymbol{g = 75}$$

3) Work out the value of h when $g = 25$

$$g = 3h$$
$$25 = 3h$$
$$\boldsymbol{h = \frac{25}{3}}$$

g is inversely proportional to h.
When $g = 12$, $h = 4$

1) Work out the constant of proportionality

$$g = \frac{k}{h}$$
$$12 = \frac{k}{4}$$
$$k = 12 \times 4 = 48$$
$$\boldsymbol{g = \frac{48}{h}}$$

2) Work out the value of g when $h = 3$

$$g = \frac{48}{h}$$
$$g = \frac{48}{3}$$
$$\boldsymbol{g = 16}$$

3) Work out the value of h when $g = 6$

$$g = \frac{48}{h}$$
$$6 = \frac{48}{h}$$
$$h = \frac{48}{6}$$
$$\boldsymbol{h = 8}$$

Year 11 – Reasoning...

Geometric reasoning

What do I need to be able to do?

By the end of this unit you should be able to:

- Understand angles facts
- Calculate exterior/interior angles of polygons
- Proving geometric facts
- Problem solving with angles
- **Circle Theorems (H)**

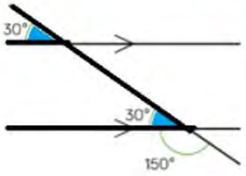
Keywords

Angle: the amount of turn between two lines around their common point
Parallel: straight lines always the same distance apart and never touch. They have the same gradient
Bearing: the angle in degrees measured clockwise from North. Given as 3 digits
Interior angles: angles inside the shape
Exterior angles: angles outside the shape on a straight line. Int +ext = 180
Polygon: A 2D shape made with straight lines
Regular: when a shape is regular all sides are the same length and all angles are the same
Irregular: shape with sides of different lengths and angles of different sizes
Sum: total, add all the angles together

Alternate angles (R)

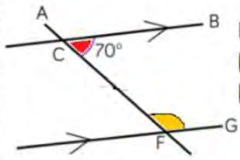
Because alternate angles are equal the highlighted angles are the same size

Corresponding angles (R)



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

Co-interior angles (R)



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

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

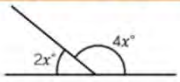
Solving angle problems

Angles on a straight Line
180°

Vertically opposite angles
Equal

Angles around a point
360 °

Link angle facts to algebra



Form an equation

$$2x + 4x = 180°$$

State the reason

The sum of angles on a straight line is 180 °

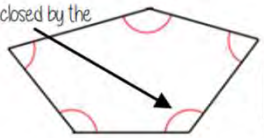
Solve

$$2x + 4x = 180°$$
$$6x = 180°$$
$$x = 30°$$

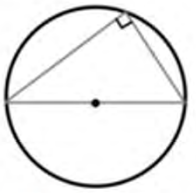
Triangles
Sum of angles is 180 °

Isosceles have the same base angles

Interior Angles
The angles enclosed by the polygon



(number of sides – 2) x 180

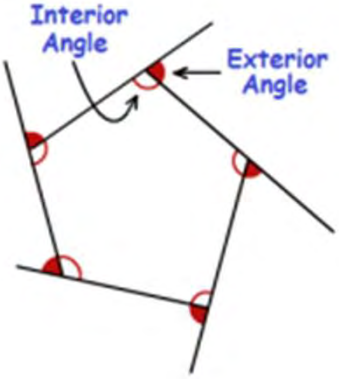


Interior and exterior angles

The sum of exterior angles in any polygon is 360°

The size of each exterior angle in a regular polygon is 360° ÷ number of sides

Interior + exterior angle = 180°



Year 11 – Reasoning...

Algebraic reasoning

What do I need to be able to do?

By the end of this unit you should be able to:

- Simplify expressions
- Nth term for linear sequences
- **Nth term for quadratic sequences**
- Solve simultaneous equations

Keywords

Expression:
Sequence: items or numbers put in a pre-decided order
Term: a single number or variable
Position: the place something is located
Linear: the difference between terms increases/decreases by a constant each time
Non-Linear: the difference between terms increases/decreases in different amounts
Quadratic: where the highest power of the variable is squared (x^2)
Difference:
Co-efficient: number in front of the variable

Linear and Non Linear Sequences

Linear Sequences – increase by addition or subtraction and the same amount each time

Non-linear Sequences – do not increase by a constant amount – quadratic, geometric and Fibonacci

- Do not plot as straight lines when modelled graphically
- The differences between terms can be found by addition, subtraction, multiplication or division

Fibonacci Sequence – look out for this type of sequence

0 1 1 2 3 5 8 ...

Each term is the sum of the previous two terms

Sequences from algebraic rules

This is substitution!

$3n + 7$ — This will be linear - note the single power of n. The values increase at a constant rate

$3n^2 + 7$ — This is not linear as there is a power for n

$2n - 5$ → Substitute the number of the term you are looking for in place of 'n'

e.g.
1st term = 2 (1) – 5 = -3
2nd term = 2 (2) – 5 = -1
100th term = 2 (100) – 5 = 195

Checking for a term in a sequence

Form an equation

Is 201 in the sequence 3n – 4?

$3n - 4 = 201$ ← Term to check

Algebraic rule

Solving this will find the position of the term in the sequence. ONLY an integer solution can be in the sequence.

Solve Simultaneous Equations

1. Linear

$$\begin{aligned} (1)\quad & 2a + c = 34.45 \\ (2)\quad & 2a + 3c = 52.35 \\ (2) - (1)\quad & 2c = 17.90 \\ & c = 8.95 \end{aligned}$$

2. With one quadratic

$y = x^2$
$y = x + 2$

y
x^2

y
$x + 2$

$$\begin{aligned} x^2 &= x + 2 \\ x^2 - x - 2 &= 0 \\ (x-2)(x+1) &= 0 \\ x &= 2, x = -1 \end{aligned}$$

$y = x^2$
$y = (2)^2$ $\quad y = (-1)^2$
$y = 4$ $\quad y = 1$

$x = 2$ and $y = 4$ $\quad$ $x = -1$ and $y = 1$

More details on the next page ☺

Finding the algebraic rule

This is the 4 times table → 4, 8, 12, 16, 20....

4n

7, 11, 15, 19, 22 ← This has the same constant difference – but is 3 more than the original sequence

4n + 3

4n + 3

This is the constant difference between the terms in the sequence

This is the comparison (difference) between the original and new sequence

Year 11 – Reasoning...

@whisto_maths

Simultaneous Equations

What do I need to be able to do?

By the end of this unit you should be able to:

- Determine whether (x,y) is a solution
- Solve by substituting a known variable
- Solve by substituting an expression
- Solve graphically
- Solve by subtracting/ adding equations
- Solve by adjusting equations
- Form and solve linear simultaneous equations

Keywords

Solution: a value we can put in place of a variable that makes the equation true
Variable: a symbol for a number we don't know yet
Equation: an equation says that two things are equal – it will have an equals sign =
Substitute: replace a variable with a numerical value
LCM: lowest common multiple (the first time the times table of two or more numbers match)
Eliminate: to remove
Expression: a maths sentence with a minimum of two numbers and at least one math operation (no equals sign)
Coordinate: a set of values that show an exact position
Intersection: the point two lines cross or meet

Is (x, y) a solution?

x and y represent values that can be substituted into an equation

Does the coordinate (1,8) lie on the line y=3x+5?

This coordinate represents x=1 and y=8

$y = 3x + 5$

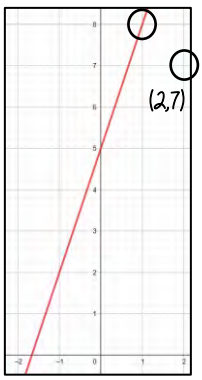
$8 = 3(1) + 5$

Os the substitution makes the equation correct the coordinate (1,8) IS on the line y=3x+5

Is (2,7) on the same line?

$7 \neq 3(2) + 5$

No 7 does NOT equal 6+5



Substituting known variables

A line has the equation 3x + y = 14

Stephanie knows the point x = 4 lies on that line. Find the value for y

$3x + y = 14$

$3(4) + y = 14$

$12 + y = 14$

$-12 \quad -12$

$y = 2$

Two different variables, two solutions

$x = 4$

Substituting in an expression

x = 2y

x + y = 30

Pair of simultaneous equations (two representations)

Substitute 2y in place of the x variable as they represent the same value

$x = 2y$

$x + y = 30$

$3y = 30$

$\div 3 \quad \div 3$

$y = 10$

$x = 2y$

$x = 20$

Solve graphically

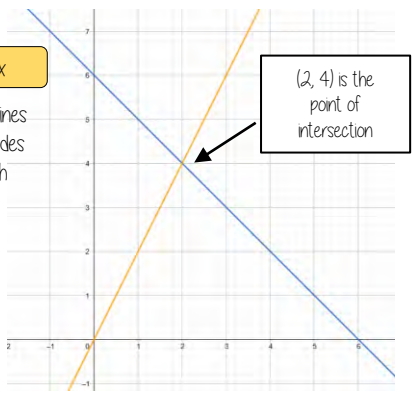
x + y = 6

y = 2x

Linear equations are straight lines
The point of intersection provides the x and y solution for both equations

The solution that satisfies both equations is

$x = 2$ and $y = 4$



Solve by subtraction

$3x + 2y = 18$

$-\ x + 2y = 10$

$2x = 8$

$\div 2 \quad \div 2$

$x = 4$

$x + 2y = 10$

$(4) + 2y = 10$

$-4 \quad -4$

$2y = 6$

$\div 2 \quad \div 2$

$y = 3$

$x = 4$

$y = 3$

Solve by addition

$3x + 2y = 16$

$+\ 6x - 2y = 2$

$9x = 18$

$\div 9 \quad \div 9$

$x = 2$

$3x + 2y = 16$

$3(2) + 2(y) = 16$

$6 + 2y = 16$

$-6 \quad -6$

$2y = 10$

$y = 5$

Addition makes zero pairs

$= 16$

$= 2$

$= 18$

$x = 2$

$y = 5$

Solve by adjusting one

$h + j = 12$

$2h + 2j = 29$

No equivalent values

12

29

$2h + 2j = 24$

$2h + 2j = 29$

24

29

By proportionally adjusting one of the equations – now solve the simultaneous equations choosing an addition or subtraction method

Solve by adjusting both

$2x + 3y = 39$

$5x - 2y = -7$

$= 39$

$= -7$

Use LCM to make equivalent x OR y values. Because of the negative values using zero pairs and y values is chosen choice

$4x + 6y = 78$

$15x - 6y = -21$

Now solve by addition

$= 78$

$= -21$

Addition makes zero pairs

Year 11 – Reasoning...

Transforming & Constructing

What do I need to be able to do?

By the end of this unit you should be able to:

- Draw and measure angles
- Construct scale drawings
- Find locus of distance from points, lines, two lines
- Construct perpendiculars from points, lines, angles
- Identify congruence
- Identify congruent triangles

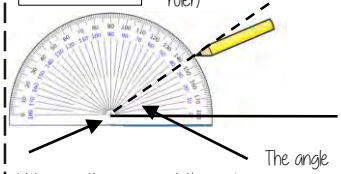
Keywords

Protractor: piece of equipment used to measure and draw angles
Locus: set of points with a common property
Equidistant: the same distance
Discorectangle: (a stadium) – a rectangle with semi circles at either end
Perpendicular: lines that meet at 90°
Arc: part of a curve
Bisector: a line that divides something into two equal parts
Congruent: the same shape and size

Draw and measure angles (R)

Draw a 35° angle

Make a mark at 35° with a pencil and join to the angle point (use a ruler)



The angle

Make sure the cross is at the end of the line (where you want the angle)

Scale drawings (R)

A picture of a car is drawn with a scale of 1:30

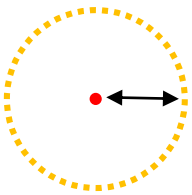
For every 1cm on my image is 30cm in real life

The car image is 10cm

Image	Real life
1cm	30cm
10cm	300cm

(×10 / ×10)

Locus of a distance from a point



All points are equidistant (the same distance) from the fixed point in the middle

Equipment needed
The radius is the distance from the fixed point

If the point is in the corner it can only make a quarter circle

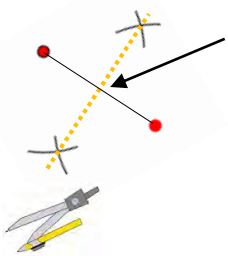
Locus of a distance from a straight line

All points are equidistant (the same distance) from line

The ends of the line are fixed points

Equipment needed
The line is straight so a ruler is used for the straight lines parallel to your original line

Locus equidistant from two points



Also a perpendicular bisector
Because if the points are joined, this new line intersects it at a 90°

Join the intersections with a ruler.
All points on this line are equidistant from both points

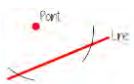
Keep the compass the same size and draw two arcs from each point

Construct a perpendicular from a point

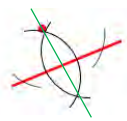
Point

Line

Use a compass and draw an arc that cuts the line. Use the point to place the compass



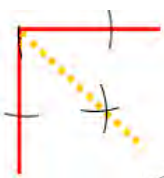
Keep the compass the same distance and now use your new points to make new interconnecting arcs



Connecting the arcs makes the bisector

If P is a point on the line the steps are the same

Locus of a distance from two lines



Also an angle bisector
This cuts the angle in half

From the angle vertex draw two arcs that cut the lines forming the angle

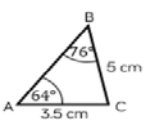
Keep the compass the same size and use the new arcs as centres to draw intersecting arcs in the middle

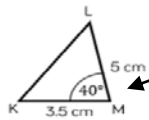
Join the vertex to the intersection

Congruent figures

Congruent figures are identical in size and shape – they can be reflections or rotations of each other

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





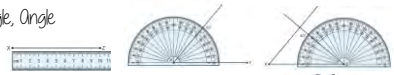
$A\hat{C}B = K\hat{M}L$

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

Constructing Triangles

Link to steps (R)

Side, Angle, Angle



Side, Angle, Side

Side, Side, Side

Congruent triangles

Side-side-side

All three sides on the triangle are the same size

Angle-side-angle

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

Side-angle-side

Two sides and the angle in-between them are equal in two triangles (it will also mean the third side is the same size on both shapes)

Right angle-hypotenuse-side

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

Year 11 – Listing & describing...

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Collecting, representing and interpreting

What do I need to be able to do?

By the end of this unit you should be able to:

- Construct and interpret frequency tables and polygon, two-way tables, line, bar, & pie charts
- Find and interpret averages from a list and a table
- Construct and interpret time series graphs, stem and leaf diagrams and scatter graphs

Keywords

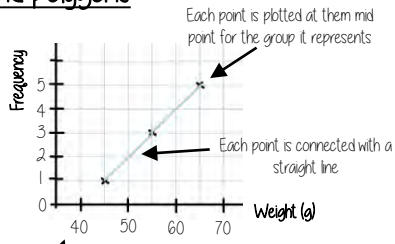
Population: the whole group that is being studied
Sample: a selection taken from the population that will let you find out information about the larger group
Representative: a sample group that accurately represents the population
Random sample: a group completely chosen by change. No predictability to who it will include.
Bias: a built-in error that makes all values wrong by a certain amount
Primary data: data collected from an original source for a purpose.
Secondary data: data taken from an external location. Not collected directly.
Outlier: a value that stands apart from the data set

Frequency tables and polygons

x Weight(g)	Frequency
$40 < x \leq 50$	1
$50 < x \leq 60$	3
$60 < x \leq 70$	5

We do not know from grouped data where each value is placed so have to use an estimate for calculations

MID POINTS
Mid-points are used as estimated values for grouped data. The middle of each group



Mid-point
Start point + End point
2

Two way tables R

60 people visited the zoo one Saturday morning. 26 of them were adults. 13 of the adult's favourite animal was an elephant. 24 of the children's favourite animal was an elephant.

Extract information to input to the two-way table

Subgroups each have their own heading

	Adult	Child	Total
Elephant	13	24	37
Other	13	10	23
Total	26	34	60

Needs subgroup totals

Overall total

Draw and interpret Pie Charts R

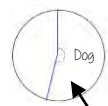
Type of pet	Dog	Cat	Hamster
Frequency	32	25	3

There were 60 people asked in this survey (Total frequency)

$\frac{32}{60}$ "32 out of 60 people had a dog"

This fraction of the 360 degrees represents dogs

$\frac{32}{60} \times 360 = 192°$



Use a protractor to draw. This is 192°

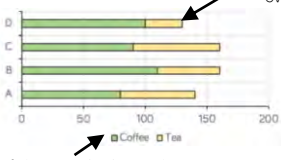
Multiple method
60 goes into 360 – 6 times.
Each frequency can be multiplied by 6 to find the degrees (proportion of 360)

Comparing Pie Charts
You NEED the overall frequency to make any comparisons

Bar and line charts

Compare the bars green compared to yellow. The size of each bar is the frequency. Overall total easily comparable

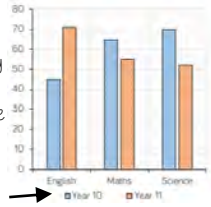
Composite bar charts



Categories clearly indicated

Dual bar charts

Bars are compared side by side
Easier to compare subgroups



Categories clearly indicated

Averages from a table R

Non-grouped data

Number of Siblings	0	1	2
Frequency	6	8	6
Subtotal	0	8	12

Overall Frequency: 20

Total number of siblings: 20

The data in a list: 0,0,0,0,0,0,1,1,1,1,1,1,1,1,2,2,2,2,2,2

Mean: $\frac{\text{total number of siblings}}{\text{Total frequency}} = 1$

Grouped data

x Weight(g)	Frequency
$40 < x \leq 50$	1
$50 < x \leq 60$	3
$60 < x \leq 70$	5

Mid Point	MP x Freq
45	45
65	195
65	325

Overall Frequency: 9
Overall Total : 565
Mean: 62.8g

The data in a list: 45, 55, 55, 55, 65, 65, 65, 65, 65

Averages from lists R

The Mean

A measure of average to find the central tendency… a typical value that represents the data

24, 8, 4, 11, 8,

Find the sum of the data (add the values)
55
Divide the overall total by how many pieces of data you have
55 ÷ 5
Mean = 11

The Mode (The modal value)

This is the number OR the item that occurs the most (it does not have to be numerical)

24, 8, 4, 11, 8,

This can still be easier if it the data is ordered first

Mode = 8

The Median

The value in the center (in the middle) of the data

24, 8, 4, 11, 8,

Put the data in order: 4, 8, 8, 11, 24
Find the value in the middle: 4, 8, 8, 11, 24

Median = 8

NOTE: If there is no single middle value find the mean of the two numbers left

For Grouped Data

The modal group – which group has the highest frequency

YEAR 10 – DELVING INTO DATA...

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Collecting, representing and interpreting

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Stem and leaf

A way to represent data and use to find averages

This stem and leaf diagram shows the age of people in a line at the supermarket

0	7 9
1	4 5 6 8 8
2	1 3
3	0

Key: 1|4 Means 14 years old

Stem and leaf diagrams:
Must include a key to explain what it represents
The information in the diagram should be ordered

Back to back stem and leaf diagrams

Girls		Boys
5	14	
7, 5, 5, 5, 4	15	3, 8, 9
8, 4, 2, 1, 0	16	2, 5, 7, 7, 7, 8, 8, 9
9, 8, 7, 6, 6, 4, 2, 1, 1, 0, 0	17	0, 2, 3, 6, 6, 7, 7
	18	0, 1, 4, 5

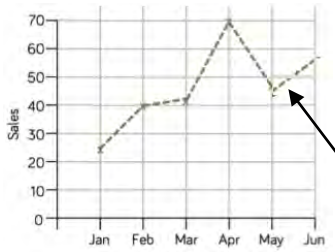
15 | 3,
Means 153 cm tall

Back to back stem and leaf diagrams
Allow comparisons of similar groups
Allow representations of two sets of data

Time-Series

R

This time-series graph shows the total number of car sales in £1000 over time



Look for general trends in the data. Some data shows a clear increase or a clear decrease over time.

Readings in-between points are estimates (on the dotted lines). You can use them to make assumptions.

Comparing distributions

Comparisons should include a statement of average and central tendency, as well as a statement about spread and consistency.

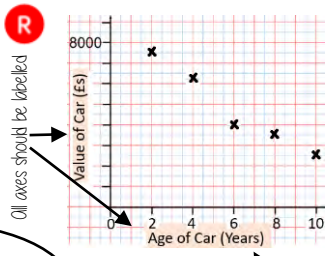
Mean, mode, median – allows for a comparison about more or less average
Range – allows for a comparison about reliability and consistency of data

Draw and interpret a scatter graph

R

Age of Car (Years)	2	4	6	8	10
Value of Car (£s)	7500	6250	4000	3500	2500

- This data may not be given in size order
- The data forms information pairs for the scatter graph
- Not all data has a relationship



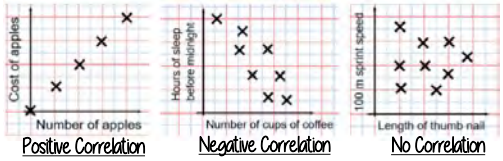
"This scatter graph show as the age of a car increases the value decreases"

The link between the data can be explained verbally

The axis should fit all the values on and be equally spread out

Linear Correlation

R



Positive Correlation
As one variable increases so does the other variable

Negative Correlation
As one variable increases the other variable decreases

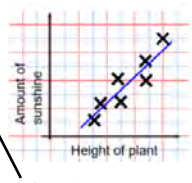
No Correlation
There is no relationship between the two variables

The line of best fit

R

The Line of best fit is used to make estimates about the information in your scatter graph

Things to know:
- The line of best fit **DOES NOT** need to go through the origin (The point the axes cross)
- There should be approximately the same number of points above and below the line (It may not go through any points)
- The line extends across the whole graph



It is only an estimate because the line is designed to be an average representation of the data

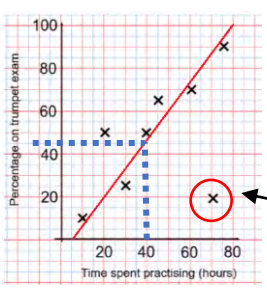
It is always a **straight line.**

Using a line of best fit

R

Interpolation is using the line of best fit to estimate values inside our data point.

e.g. 40 hours revising predicts a percentage of 45.



Extrapolation is where we use our line of best fit to predict information outside of our data.
This is not always useful – in this example you cannot score more that 100%. So revising for longer can not be estimated

This point is an "**outlier**"
It is an outlier because it doesn't fit this model and stands apart from the data

Year 11 - Listing & describing

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Probability

What do I need to be able to do?

By the end of this unit you should be able to:

- Add, Subtract and multiply fractions
- Find probabilities using likely outcomes
- Use probability that sums to 1
- Estimate probabilities
- Use Venn diagrams and frequency trees
- Use sample space diagrams
- Calculate probability for independent events
- Use tree diagrams

Keywords

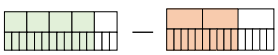
Event: one or more outcomes from an experiment
Outcome: the result of an experiment.
Intersection: elements (parts) that are common to both sets
Union: the combination of elements in two sets.
Expected Value: the value/ outcome that a prediction would suggest you will get
Universal Set: the set that has all the elements
Systematic: ordering values or outcomes with a strategy and sequence
Product: the answer when two or more values are multiplied together.

Add, Subtract and multiply fractions

R

Addition and Subtraction

$$\frac{4}{5} - \frac{2}{3}$$



$$\frac{12}{15} - \frac{10}{15} = \frac{2}{15}$$

Use equivalent fractions to find a common multiple for both denominators

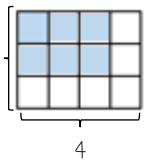
Multiplication

$$\frac{3}{4} \times \frac{2}{3}$$

$$\frac{3}{4} \times \frac{2}{3} = \frac{6}{12}$$ ← Parts shaded

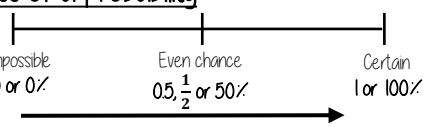
Total number of parts in the diagram

Modelled:



Likeliness of a probability

R



The more likely an event the further up the probability it will be in comparison to another event (It will have a probability closer to 1)

Sum to 1

R

Probability is always a value between 0 and 1

The probability of getting a blue ball is $\frac{1}{5}$

∴The probability of **NOT** getting a blue ball is $\frac{4}{5}$

The sum of the probabilities is 1

Experimental data

Theoretical probability	What we expect to happen
Experimental probability	What actually happens when we try it out

The more trials that are completed the closer experimental probability and theoretical probability become

The probability becomes more accurate with more trials.
Theoretical probability is proportional

Sample space

The possible outcomes from rolling a dice

R

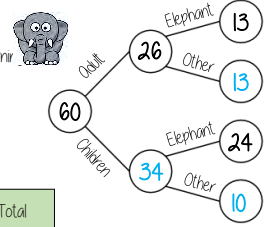
The possible outcomes from tossing a coin	1	2	3	4	5	6
H	1,H	2,H	3,H	4,H	5,H	6,H
T	1,T	2,T	3,T	4,T	5,T	6,T

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

Tables, Venn diagrams, Frequency trees

Frequency trees

60 people visited the zoo one Saturday morning. 26 of them were adults. 13 of the adult's favourite animal was an elephant. 24 of the children's favourite animal was an elephant.



Two-way table

	Adult	Child	Total
Elephant	13	24	37
Other	13	10	23
Total	26	34	60

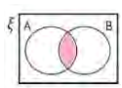
Frequency trees and two-way tables can show the same information

The total columns on two-way tables show the possible denominators

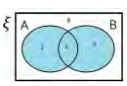
P(adult) = $\frac{26}{60}$

P(Child with favourite animal as elephant) = $\frac{13}{37}$

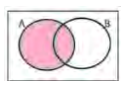
Venn diagram



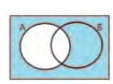
in set A AND set B
$P(A \cap B)$



in set A OR set B
$P(A \cup B)$



in set A
$P(A)$



NOT in set A
$P(A')$

Independent events

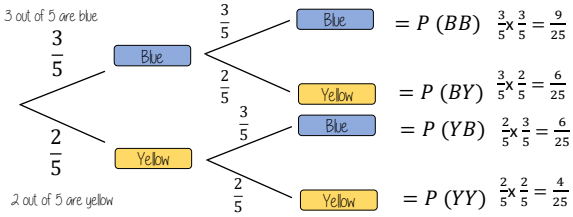
The outcome of two events happening. The outcome of the first event has no bearing on the outcome of the other

$$P(A \text{ and } B) = P(A) \times P(B)$$

Tree diagram for independent event

Isobel has a bag with 3 blue counters and 2 yellow. She picks a counter and replaces it before the second pick.

Because they are replaced the second pick has the same probability

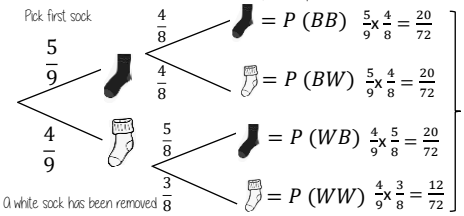


Dependent events

The outcome of the first event has an impact on the second event

Tree diagram for dependent event

A sock drawer has 5 black and 4 white socks, Jamie picks 2 socks from the drawer.



NOTE: as "socks" are removed from the drawer the number of items in that drawer is also reduced ∴ the denominator is also reduced for the second pick.

PSHE

Physics

Energy

Threshold Concept

Energy can't be created or destroyed, it can only be transferred from one store to another in a closed system

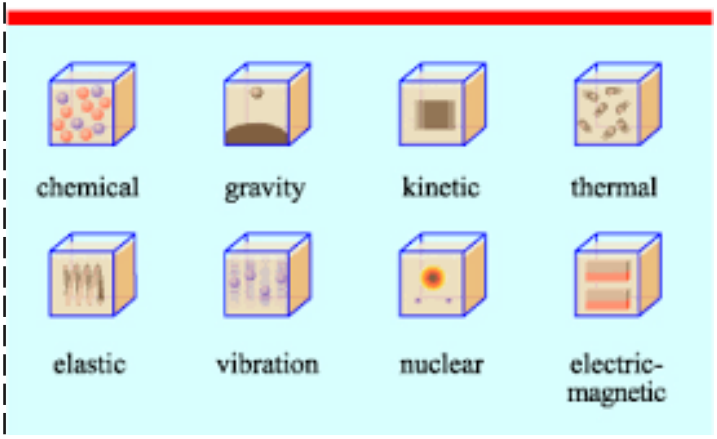
Keywords

Energy – moved between stores during transfers
Store – A temporary housing for energy
Transfer – The movement of energy between stores
Useful – The energy store that you wish for the energy to flow into
Dissipated – The store that energy flows into that is not useful or wasted

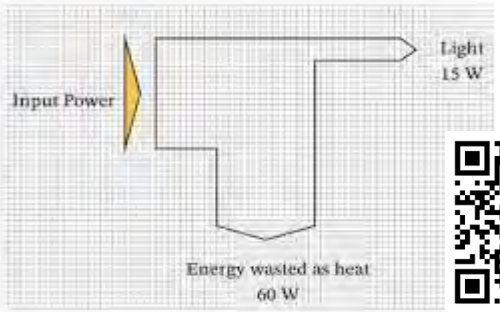
Movement between stores

Energy Transfer	Description
Mechanical	When a force acts on a body e.g. a collision
Electrical	Electricity can transfer energy from a power source, such as a cell, delivering it to components within a circuit
Heating	Thermal energy can be transferred by conduction, convection or radiation
Radiation	Light and sound carry energy and can transfer this between two points

Energy Stores

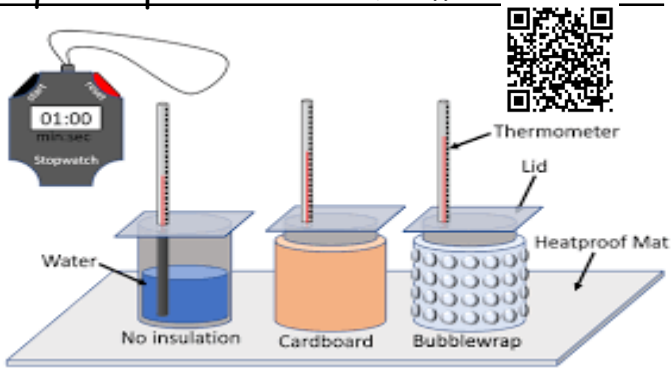


Sankey Diagrams

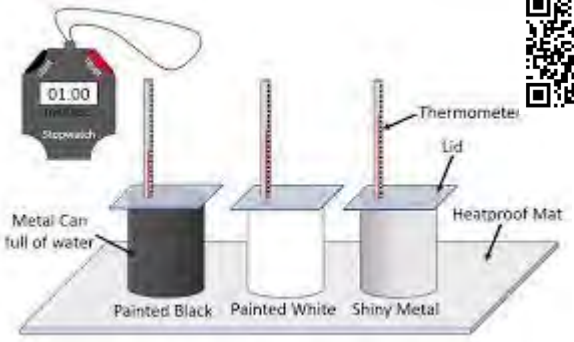


Conservation of energy

Required practical – Thermal Insulation



Required Practical - Radiation



Equations for this topic

Work = Force x Distance

Power = Work done/ time

Efficiency = useful energy output/total energy input

Forces

Threshold Concept

Every action has an equal and opposing action .

Keywords

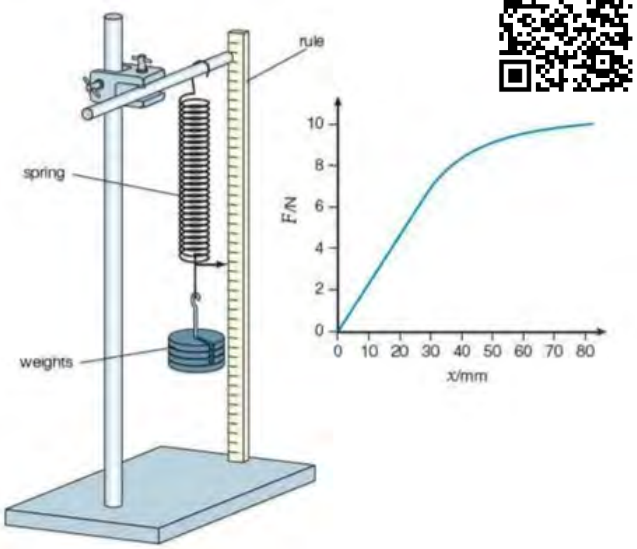
- **Contact:** Contact forces are forces that act between two objects that are physically touching each other.
- **Non contact:** Non-contact forces are forces that act between two objects that are not physically touching each other.
- **Balanced:** When the total force in opposite directions are equal in magnitude.
- **Unbalanced:** When the total force in opposite directions aren't equal in magnitude.
- **Force:** A push or a pull. The unit of force is the newton (N).

Contact and non contact forces

Contact Force	Non-Contact Force
A **contact force** involves a force between two objects in contact.	A **non-contact force** involves a force between objects not touching. You can't 'see' anything physically touching, but there is still an attraction or repulsion.
For example, **friction** between your feet and the ground can be present.	For example, **magnetic** forces between two magnets can happen when the magnets are near but not touching.

Required practical

When you apply a force to a material it can extend. The extension is the amount the length has increased by.



Scalar and vector quantities

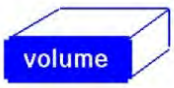
A scalar quantity has only magnitude.
A vector quantity has both magnitude and direction.

Scalar Quantities

length, area, volume
speed
mass, density
pressure
temperature
energy, entropy
work, power

Vector Quantities

displacement
velocity
acceleration
momentum
force
lift , drag , thrust
weight

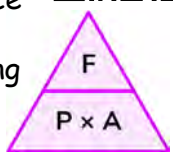


Free body diagrams

A free body diagram models the forces acting on an object.
The object or 'body' is usually shown as a box or a dot. The forces are shown as thin arrows pointing away from the centre of the box or dot.

Pressure:

Pressure is the amount of force applied to a specific area. It is caused when objects exert a force on another object. It can be on a visible level (pushing a door, rolling out cake icing) or at a molecular level (gas particles in a can)



Equations for this topic

weight = mass × gravitational field strength	$W = m\,g$
work done = force × distance (moved along the line of action of the force)	$W = Fs$
force = spring constant × extension	$F = ke$
moment of a force = force × distance (perpendicular to the direction of the force)	$M = Fd$
pressure = $\frac{\text{force normal to a surface}}{\text{area of that surface}}$	$p = \frac{F}{A}$
distance travelled = speed × time	$s = vt$
resultant force = mass × acceleration	$F = ma$

Space

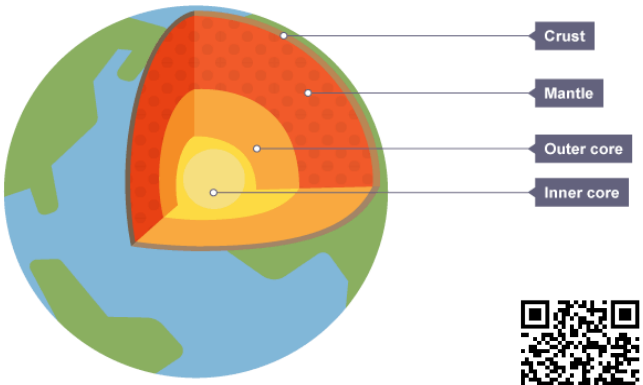
Threshold Concept

The Sun is the centre of the Solar system

Keywords

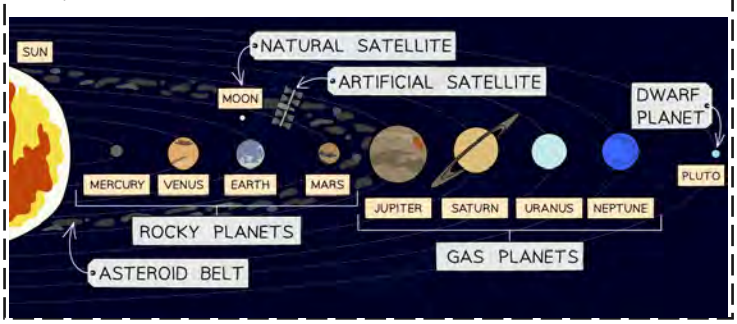
- **Earth**: The Earth is a planet and is roughly the shape of a sphere. There are three layers that make up the Earth's structure.
- **Planet**: A sphere of rock or gas orbiting a star.
- **Sun**: The Sun is our nearest star. It is a relatively small star when compared to other stars in the universe. Our Solar System contains the Sun and everything that orbits it.
- **Gravity**: Gravity is an attractive force that acts on all matter.

The earth:



Solar system:

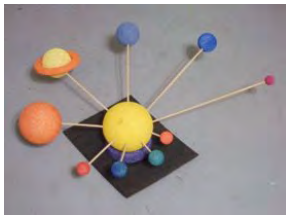
Our solar system consists of eight planets orbiting a star, our sun. Most planets have at least one moon orbiting it. In addition, there is an asteroid belt between Mars and Jupiter. Numerous comets also orbit the sun in elongated elliptical orbits



The earths rotation and revolution:

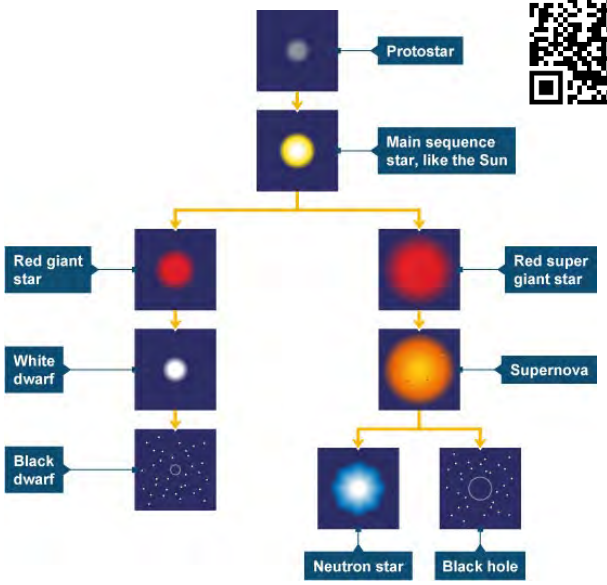
rotate	revolve
To Spin or Turn	Go Around
TAKES: 24 hours or 1 day	TAKES: 365 days or 1 year
CAUSES: Day & Night	CAUSES: The Seasons

Modelling the solar system:



A scale model is a copy of something that is much larger or smaller than the object itself but one which maintains the original's proportions.

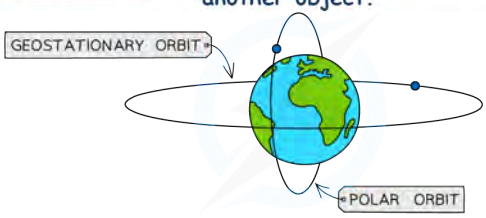
Stars and lifecycle:



The universe:

An orbit: a curved path that an object takes around another object.

A satellite: an object that orbits around another object.



Equations for this topic

Electricity (Part 1)

Threshold Concept

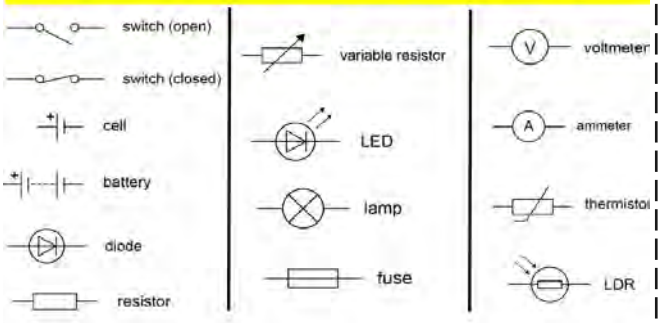
Electricity is the flow of electrons.

Keywords

- **Electron:** a stable subatomic particle with a charge of negative electricity, found in all atoms and acting as the primary carrier of electricity in solids.
- **Electricity:** is the presence or flow of charged particles.
- **Charge:** is a property of a body which experiences a force in an electric field. Charge is measured in coulombs (C).
- **Current:** Current is the rate of flow of electric charge around a circuit.

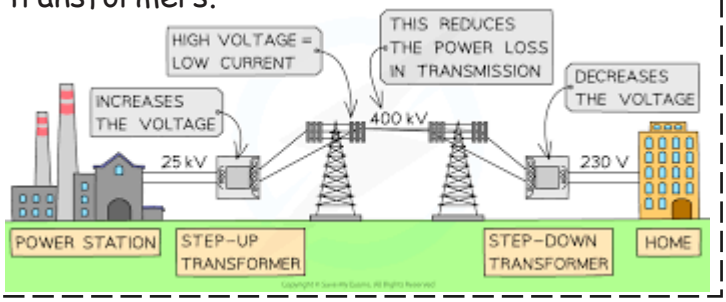
Circuit Symbols

An electronic circuit can include lots of different components. All of which can be represented with a symbol:

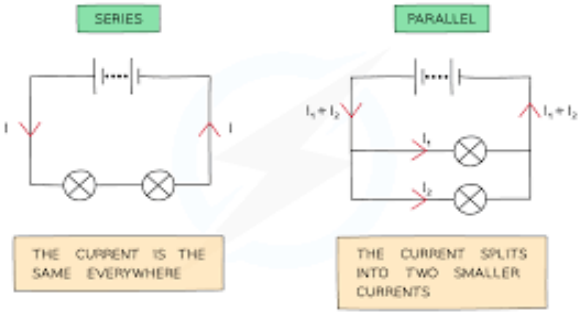


National Grid

The **National Grid** distributes electricity across the country. The National Grid connects power stations to homes, workplaces and public buildings all around the country through a system of cables and transformers.

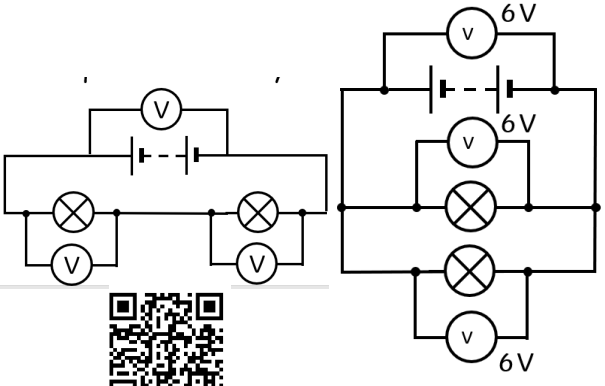


Series and Parallel circuits



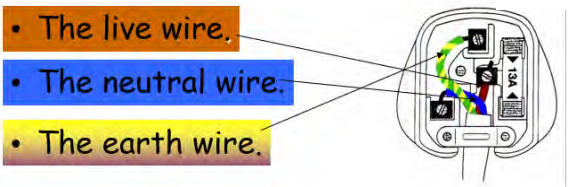
In a series circuit, the potential difference/voltage supplied by the battery is **shared** by the components.

In a parallel circuit, the potential difference across each bulb is the **same** as the potential difference across the battery.

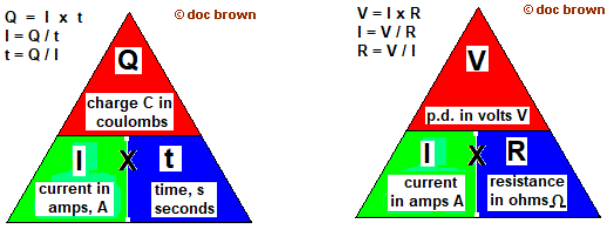


Practical

Wiring a plug



Equations for this topic



Waves

Threshold Concept

Waves transfer energy, **NOT** matter.

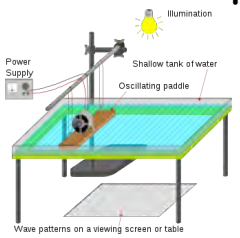
Link to information on the whole topic, consisting of slides, videos, and quizzes **Trilogy pupils ignore tasks 5,6 & 7.**

Keywords

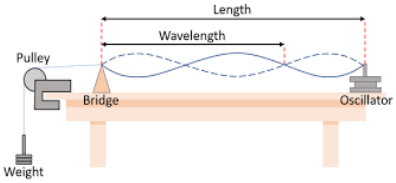
Wave - a disturbance/vibration in matter, which transfers the energy through the matter.
Energy – a property of a substance that is stored or transferred in order for things to be done.
Transverse – vibrations are perpendicular (at right angles) to the direction of energy transfer.
Longitudinal – vibrations are parallel (same direction) to the direction of energy transfer.

Required Practicals

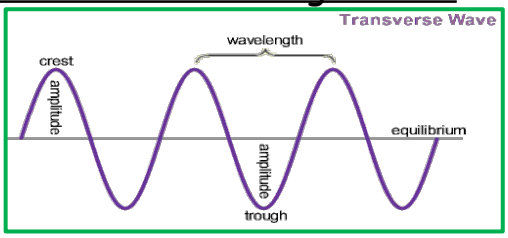
Waves in a liquid



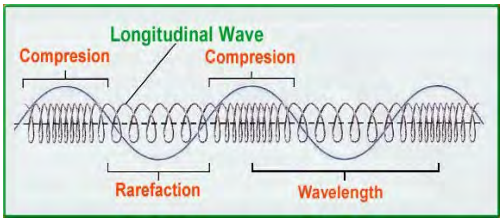
Waves in a solid



Transverse vs Longitudinal



Vibrations are **perpendicular** to the direction of energy transfer

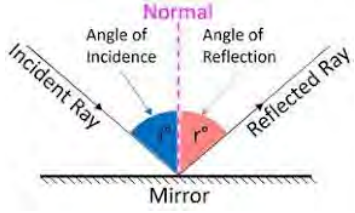


Vibrations are **parallel** to the direction of energy transfer

Reflection and refraction (HT only)

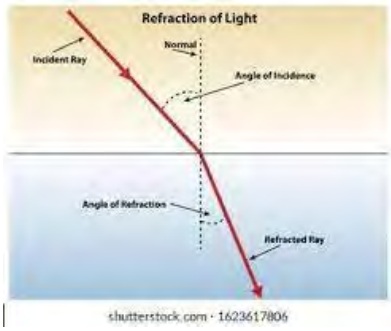
Law of reflection

The angle of incidence = the angle of reflection



Refraction

The change in direction and speed of light, due to passing from one medium into a different medium, of different densities



Equations

Wave speed = distance / time
$v = s / t$

Wave speed = wavelength x frequency
$v = \lambda \times f$

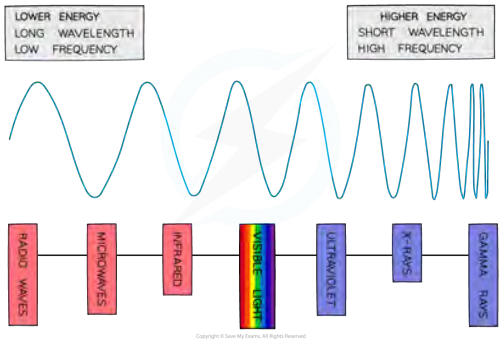
Time Period = 1 / frequency
$T = 1 / f$

EM Spectrum

Threshold Concept

Electromagnetic waves are waves in different frequencies

Types of electromagnetic waves:



Keywords

Frequency: The number of complete waves passing a certain point per second, or the number of waves produced by a source per second. Measured in Hertz, Hz

Wave: An oscillation that transfers energy without transferring any matter.

Spectrum: Used to classify something in terms of its position on a scale between two extreme points.

Energy: Is a key principle in physics, as it allows work to be done.

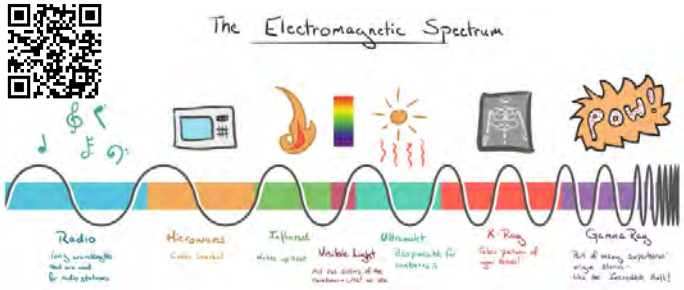
Speed: The maximum rate at which an individual is able to perform a movement or cover a distance in a period of time.

Properties of electromagnetic waves;

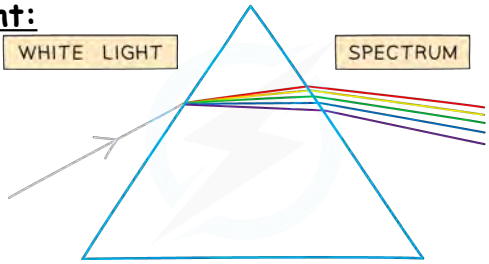
GAMMA RAYS	X RAYS	ULTRA VIOLET	VISIBLE	INFRA RED	MICROWAVES	TELEVISION	RADIO

GAMMA RAYS	Wavelength: around 1 pm Source: Nuclei Detector: Film, Geiger counter Properties/uses: Medical, sterilising food, checking metal castings, checking water flow
X RAYS	Wavelength: around 1 nm Source: Atoms Detector: Film Properties/uses: Medical X rays, defects in metals, checking paintings
ULTRA VIOLET	Wavelength: 0.001 – 0.4 μm Source: Atoms Detector: Skin, film Properties/uses: Sun tan, sun burn, theatre, checking documents, microscopes
VISIBLE	Wavelength: 0.4-0.7 μm Source: Atoms Detector: Eye, film Properties/uses: We use it to see the world around us
INFRA RED	Wavelength: 0.7-10 μm Source: Atoms Detector: Skin, thermometer, film Properties/uses: Physiotherapy, night sight, locating people trapped in smoke or ruins. Remote controls
MICROWAVES	Wavelength: 1 mm – 50 cm Source: Electronics Detector: Aerial Properties/uses: Microwave ovens, radio telescopes, radar
TELEVISION	Wavelength: around 50 cm Source: Electronics Detector: Aerial Properties/uses: Television
RADIO	Wavelength: 1 m – 1500 m Source: Electronics Detector: Aerial Properties/uses: Radio communication

Uses and applications of electromagnetic waves

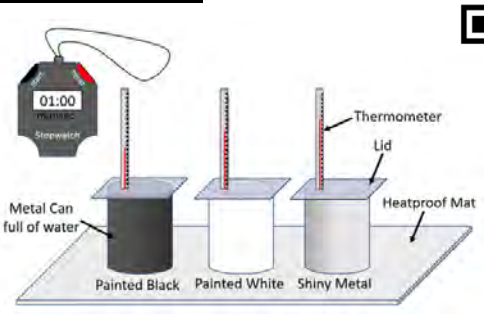


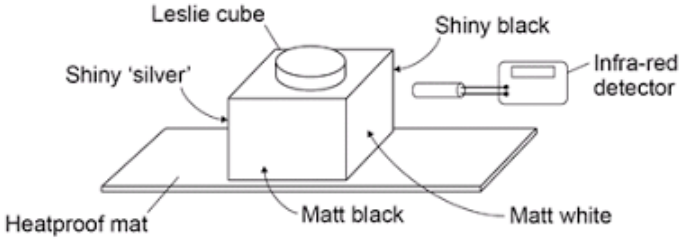
Visible light:



Required practical:

EM infrared RP





Communications:

Electromagnetic radiation is used for communications and transmission of information. The waves that are used in this way are radio waves, microwaves, infrared radiation and light.

Equations for this topic

wave speed = frequency × wavelength	$v = f\lambda$
time period = $\frac{1}{\text{frequency}}$	$T = \frac{1}{f}$

Electricity Part 2

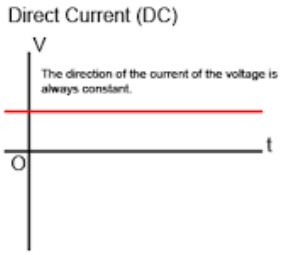
Threshold Concept

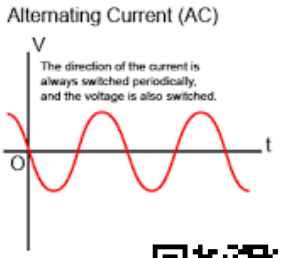
Potential Difference is the push that causes current to flow.

Keywords

- **Energy transfer:** the change of energy from one form to another.
- **Current:** Current is the rate of flow of electric charge around a circuit.
- **Resistance:** is a measure of the opposition to current flow in an electrical circuit.
- **Potential difference (voltage):** is the difference in the amount of energy that charge carriers have between two points in a circuit.

Alternating and Direct current (ACDC)



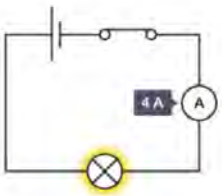


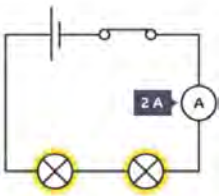
Electricity can flow either as direct or alternating current, and is used in homes to power electrical appliances.

Resistance

Resistance (R) is a measure of how difficult it is for current to flow. Resistance is measured in units called ohms (Ω).

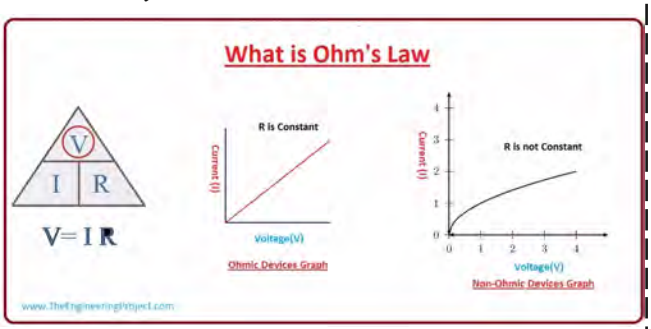
The more resistance there is in a circuit, the less current will flow.





Ohm's Law

Ohm's law states that current is directly proportional to potential difference (providing the temperature remains constant).

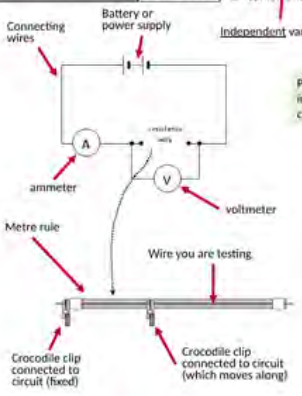


Required Practical's

Resistance

Required practical	Physics 3
Resistance in circuits	Combined Science 15

Use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. This should include:
A - the length of a wire at constant temperature
B - combinations of resistors in series and parallel



Possible sources of significant **error** (which you can attempt to control): inaccurate attachment of crocodile clips; heating effect of electric current; misreading metre rule; misreading ammeter or voltmeter.

Method A steps:

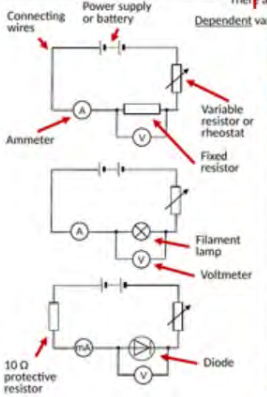
- Connect the circuit as shown
- Record in a table:
  - length of the wire between the crocodile clips
  - the readings on the ammeter
  - the readings on the voltmeter
- Move the crocodile clip and record the new ammeter and voltmeter readings. Note that the voltmeter reading may not change.
- Repeat this to obtain several pairs of meter readings for different lengths of wire
- Calculate and record the resistance for each length of wire using the equation $R = V/I$

I-V characteristics

Required practical	Physics 4
I-V characteristics	Combined Science 16

Use circuit diagrams to construct appropriate circuits to investigate the current–potential difference characteristics of a variety of circuit elements including a filament lamp, a diode and a resistor at constant temperature.

There are three investigations in this required practical.

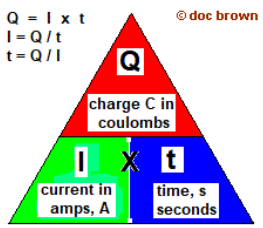


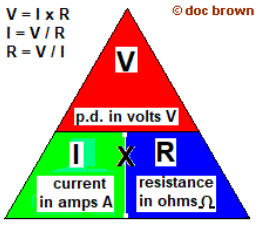
Possible sources of significant **error** (which you can attempt to control): misreading ammeter or voltmeter; inaccurate graphing

Method steps:

- Connect the circuit
- Record the readings on the ammeter and voltmeter in a suitable table.
- Adjust the variable resistor and record the new ammeter and voltmeter readings. Repeat this to obtain several pairs of readings
- Swap the connections on the battery. (the readings on the ammeter and voltmeter should now be negative)
- Continue to record pairs of readings of current and potential difference with the battery reversed
- Swap the leads on the battery back to their original positions
- Replace the resistor with the lamp.
- Repeat the steps above with the lamp in place of the resistor
- Swap the leads on the battery back to their original positions.
- If you can, reduce the battery potential difference to less than 5 V
- Replace the ammeter with a milliammeter (**or** change the setting on the multimeter)
- Replace the lamp with the diode. Connect the positive side of the diode to the milliameter.
- Repeat steps above to obtain pairs of readings of potential difference and current for the diode.

Equations for this topic





Motion

Threshold Concept

Speed equals distance travelled in a given time

Keywords

- **Speed:** Distance travelled in a certain time
- **Distance**: how far an object has travelled. It is a scalar quantity
- **Time**: how long something takes
- **Metres**: a unit measurement of distance (m)
- **Seconds**: a unit measurement of time (s)

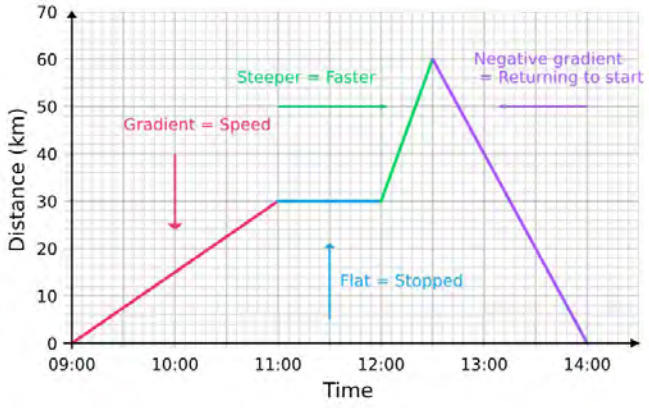
Speed, distance, time

-Speed is measured in metres per second (m/s)
-Distance is measured in metres (m)
-Time is measured in second (s)

Scalar and vector quantities

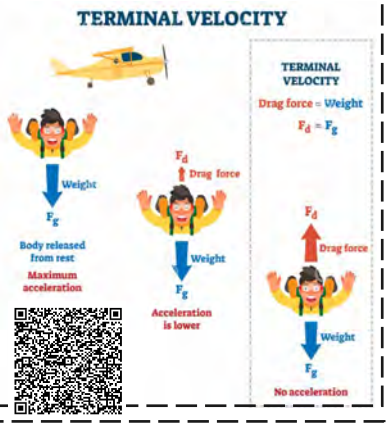
Scalar – a measurement of something. They only have MAGNITUDE (size)
Vector – a measurement of something. They have DIRECTION & MAGNITUDE (size)

Distance – Time Graphs

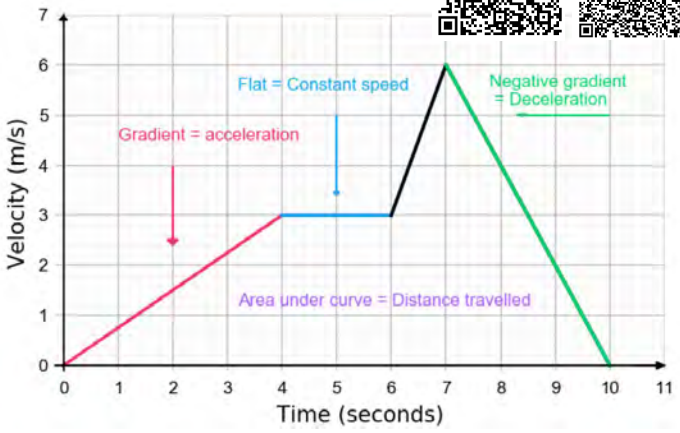


Terminal velocity

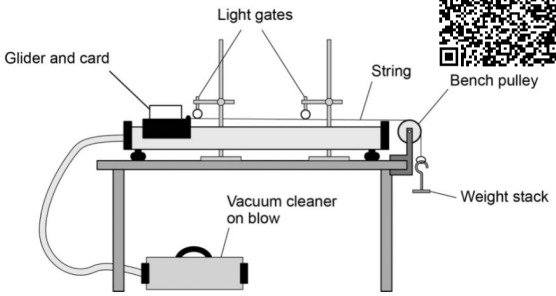
At terminal velocity, the object moves at a steady speed in a constant direction because the **resultant force** acting on it is zero



Velocity – Time graphs



Required practical – Acceleration



Equations for this topic

Speed = Distance ÷ Time
Change in Velocity = Acceleration x Time
Force = Mass X Acceleration

Atomic Structure

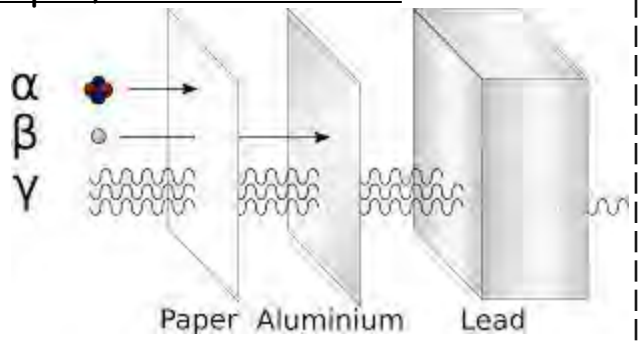
Threshold Concept

Identify that there are three types of radiation

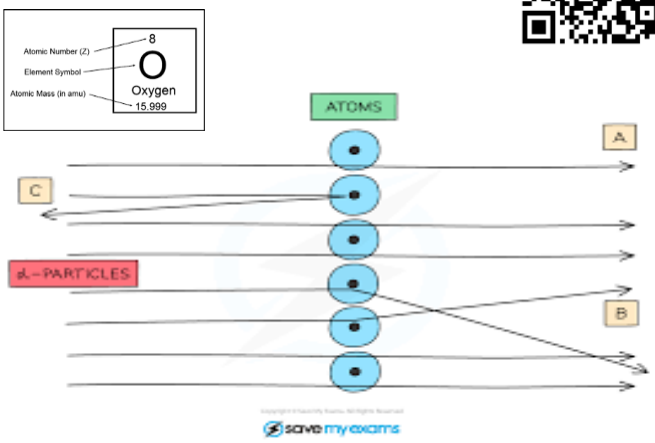
Keywords

Atom – the smallest particle of a chemical element that can exist
Proton – positively charged particle
Neutron – Particle with no charge
Electron – Negatively charged particle
Wave – Energy transfer method

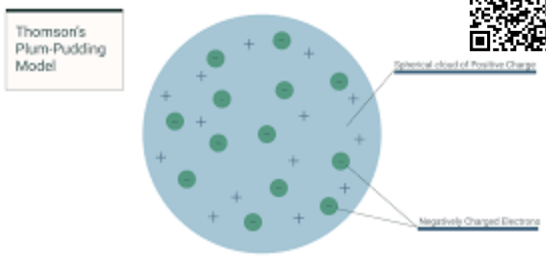
Alpha, Beta and Gamma



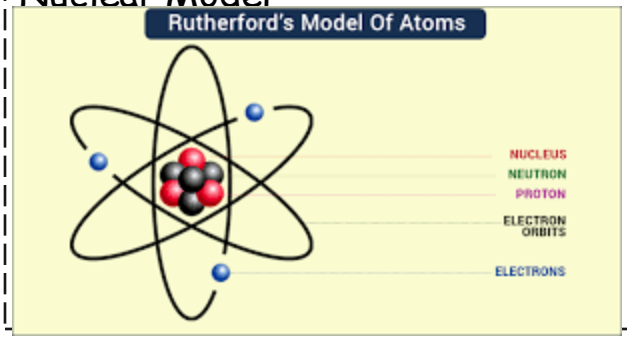
Rutherfords Scattering Experiment



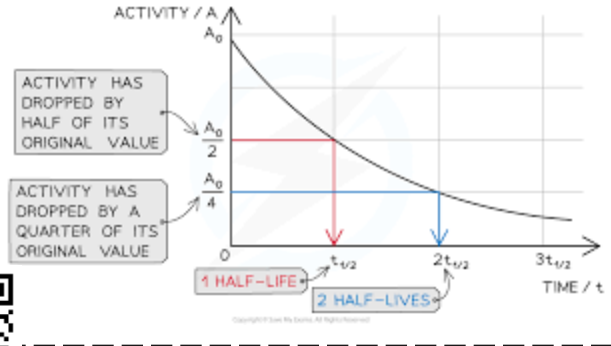
Plum Pudding Model



Nuclear Model



Half Life



Uses and Dangers of Radiation

	Irradiation	Contamination
Description	Object is exposed to radiation but does not become radioactive	Object becomes radioactive and emits radiation
Source	Danger is from radiation emitted outside the object	Danger from radiation emitted within the object
Prevention	Prevented by using shielding, such as lead clothing	Prevented by safe handling of sources and airtight safety clothing
Causes	Caused by the presence of radioactive sources outside the body	Caused by inhalation or ingestion of radioactive sources

uations for this topic

$$^{235}_{92}U \xrightarrow{\text{decay by releasing an alpha particle}} {}^{4}_{2}\alpha + {}^{231}_{90}Th$$

$$^{14}_{6}C \xrightarrow{\text{decay by releasing an beta particle}} {}^{0}_{-1}\beta + {}^{14}_{7}N$$

$$^{235}_{92}U \xrightarrow{\text{decay by releasing a gamma wave}} {}^{0}_{0}\gamma + {}^{235}_{92}U$$

Particle Models of Matter

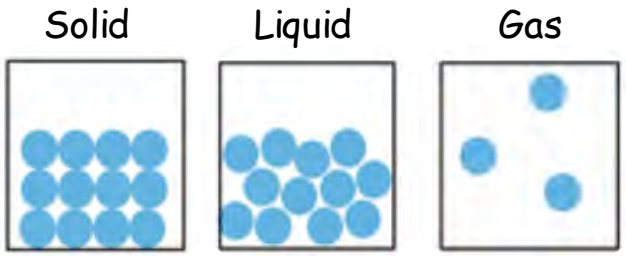
Threshold Concept

Changes of state are caused by energy changes

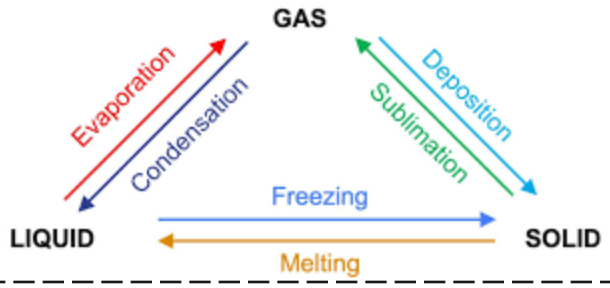
Keywords

States of matter – solid, liquid or gas.
Particles – the smallest part that a substance can be broken down into.
Energy – a property of a substance that is stored or transferred in order for things to be done.
Density – how compact a substance is.
Pressure – continuous force acted on or against an object.

States of matter



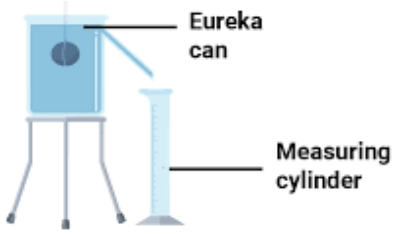
Changes of state



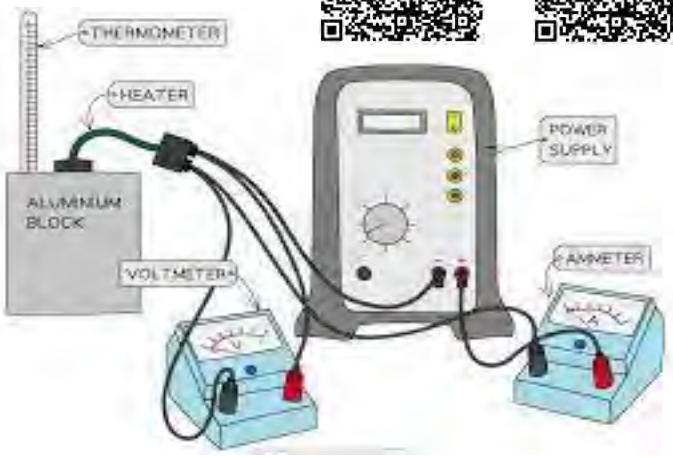
Links to information on the whole topic, consisting of slides, videos, and quizzes

Required Practical

Density



Specific Heat Capacity



Equations for this topic

$P = F/A$ Pressure = Force / Area

$P = m/V$ Density = mass / volume

$\Delta E = m \times c \times \Delta\theta$ Change in Energy = mass x specific heat capacity x change in temperature

$\Delta E = m \times L$ Change in Energy = mass x Specific Latent Heat

$P = \rho \times g \times h$ Pressure in a liquid column = density x gravity x height (TRIPLE ONLY)

For gases: $p \times v$ = constant For Gases: pressure x volume = constant (TRIPLE ONLY)

Electromagnetism

Threshold Concept

Magnets have two poles that attract or repel.

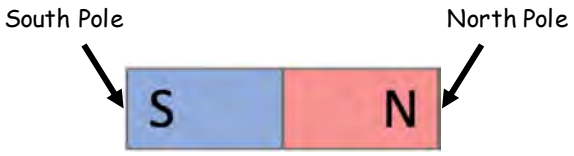
Keywords

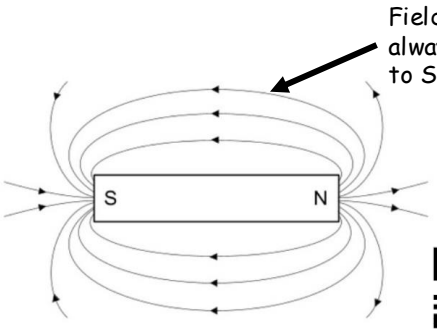
Permanent Magnet - A material that has its own magnetic field without needing to be helped by another magnetic material.
Induced Magnet – a material that only becomes a magnet when placed in another magnetic field.
Magnetic Field – a region around a magnet where the force of magnetism acts.
Solenoid – a coil of wire that carries an electrical current.
Electromagnet – a soft, iron core placed inside a solenoid.

Common magnetic materials

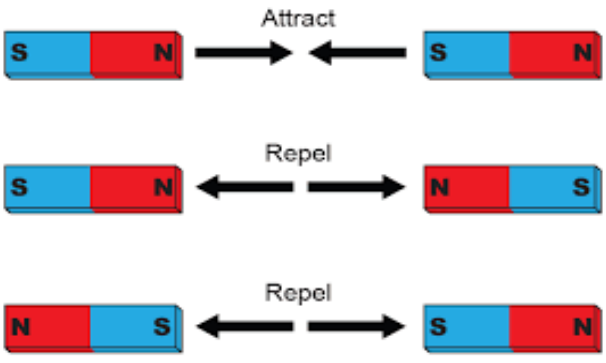
- Iron
- Nickel
- Cobalt
- Steel

A bar magnet and its magnetic field





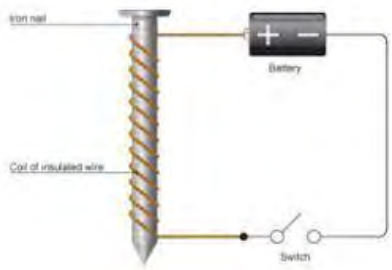
Attraction and repulsion



Electromagnets

Building an electromagnet

Electromagnets



Required Practical

Equations for this topic

Force = Magnetic Flux Density x Current x length of wire

$F = B \times I \times l$

Vehicle Safety

Threshold Concept

Cars have safety features to reduce impact forces

Keywords

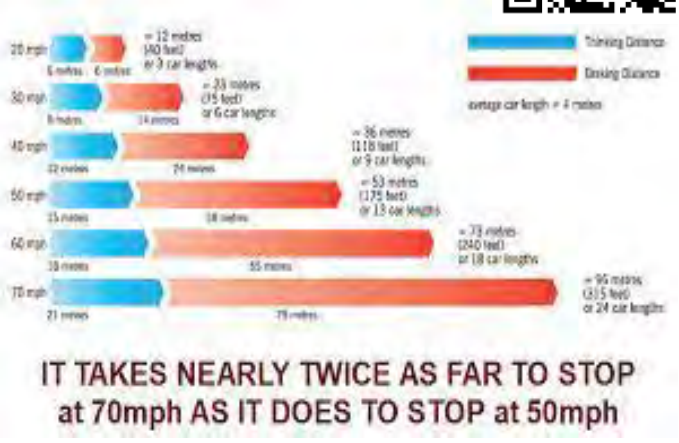
Newtons Laws – Three guiding principles stating the movement and reactions of all things due to physics

Impact forces – The forces occurring when two objects collide

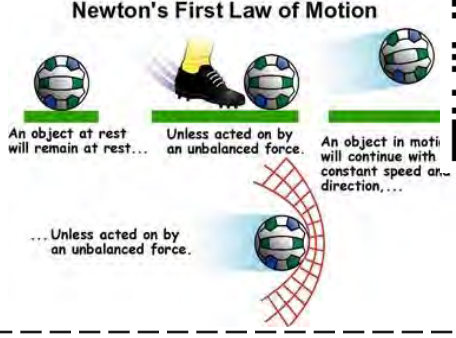
Momentum – A measure of how difficult it is to stop a moving objects

Safety Features in Cars

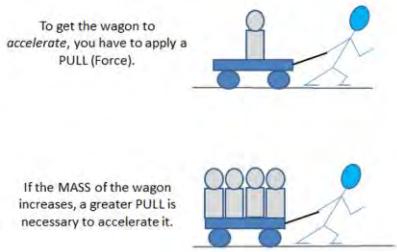
Stopping Distances



Newtons First Law



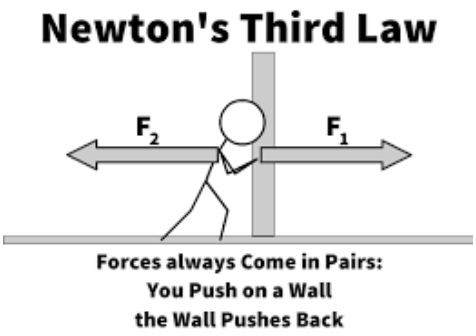
Newtons Second Law



Momentum

Fig 1. The Conservation of Momentum Applies to a Closed System Not an Open System.

Newtons Third Law



Equations for this topic

Force = Mass x Acceleration

Momentum = Mass x Velocity

Energy Recap (E_k, E_p, E_e)

Threshold Concept

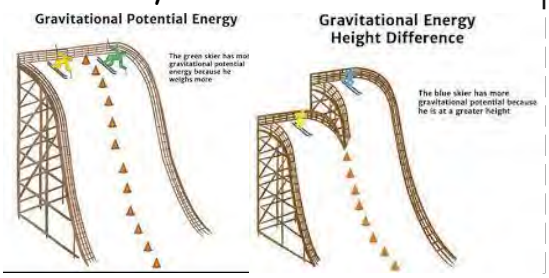
Energy can be transferred between stores depending on an objects motion

Keywords

Energy – a property of a substance that is stored or transferred in order for things to be done.
Work done = energy transferred
Elastic Potential Energy – energy stored in a stretchy or springy object.
Kinetic Energy – energy stored in a moving object
Gravitational Potential Energy – energy stored in an object raised above ground.

Gravitational Potential

Don't forget to click on the worksheet tab and exam question tab to try some tasks.



Equations

Gravitational potential energy = mass x gravitational field strength x height
$E_p = m \times g \times h$

Elastic potential energy = $\frac{1}{2}$ x spring constant x extension^2
$E_e = \frac{1}{2} \times k \times e^2$

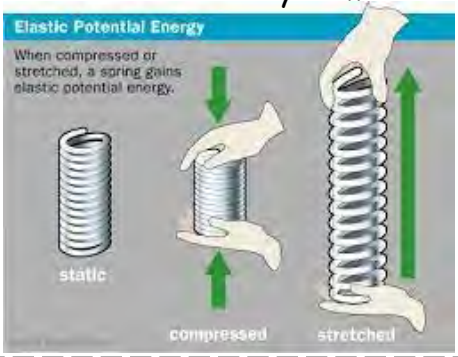
Kinetic energy = $\frac{1}{2}$ x mass x velocity^2
$E_k = \frac{1}{2} \times m \times v^2$

Kinetic Energy

Don't forget to click on the worksheet tab to try some tasks.

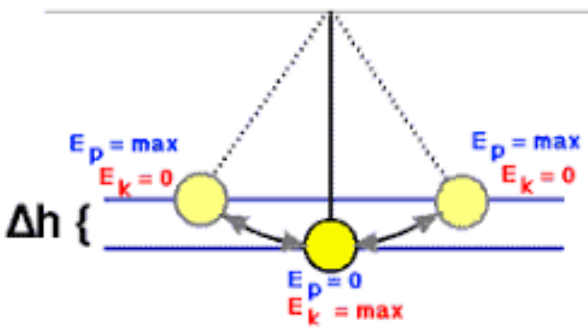
Elastic Potential Energy

Don't forget to click on the worksheet tab to try some tasks.



Conservation of energy

Don't forget to click on the exam questions tab to try some tasks.



E_k = Kinetic Energy
E_p = Potential Energy

Space (TRIPLE)

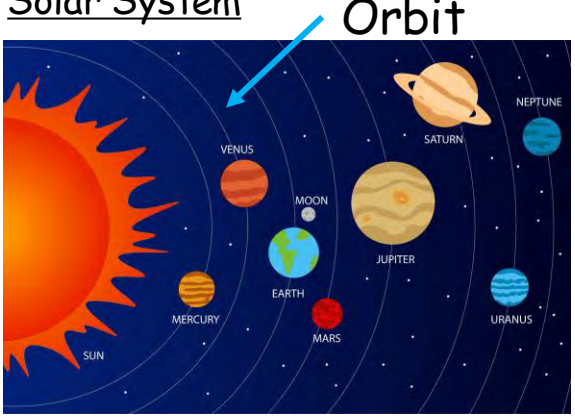
Threshold Concept

The Solar System is made up of many types of objects.

Keywords

Solar System - the collection of eight planets and their moons in orbit round the Sun, together with smaller bodies in the form of asteroids, meteoroids, and comets.
Orbit – the curved path of a celestial object or spacecraft round a star, planet, or moon
Sun – the star around which the 8 planets of the Solar System orbits.
Planet – a celestial body moving in an elliptical orbit round a star.
Moon – a celestial body moving in orbit around a planet. They are natural satellites.
Satellite – an object, either natural (e.g. The Moon), or artificial, that orbits a moon, planet or star. Artificial satellites are for information gathering.

Solar System



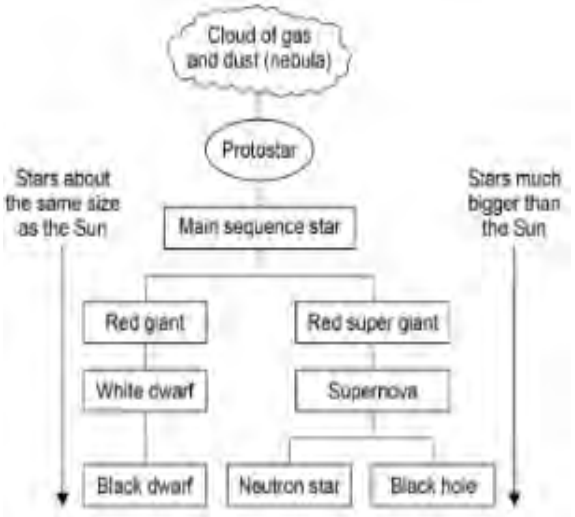
Link to information on the whole topic, consisting of slides, videos, and quizzes

Orbital Motion & Satellites

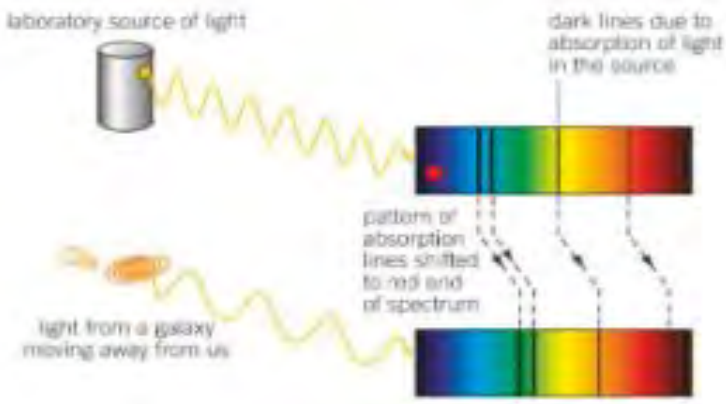
Planets orbit in near-circular orbits: they maintain a constant speed but are always changing direction. This means they have a constant speed but NOT a constant velocity

The Moon is a Natural Satellite. All other satellites of Earth are artificial, such as weather, military, ISS, GPS etc.
Geostationary satellites follow the same point above Earth, so have an orbital period of 24 hours.

Life Cycle of Stars



Red-shift and Big Bang



Equations for this topic

Required Practical

RSE

Triple Science

Year 7 – Cells

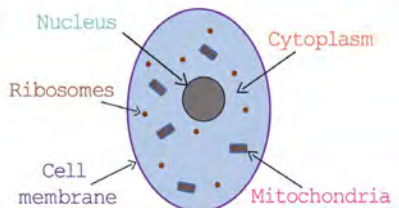
Threshold Concept

Understand that all living things are made of cells

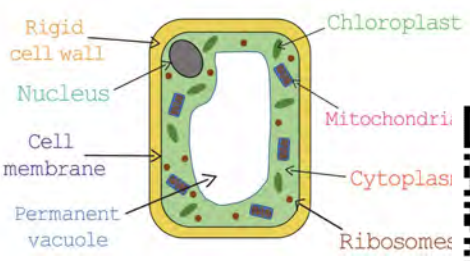
Keywords

Animal Cell - Building block of all animal life
Plant Cell - Building block of plant life
Microscope - Utensil used to enlarge objects
Prokaryote - Cell without nucleus
Eukaryote - Cell containing a nucleus
Cell - Basic building block

Structure of animal cell



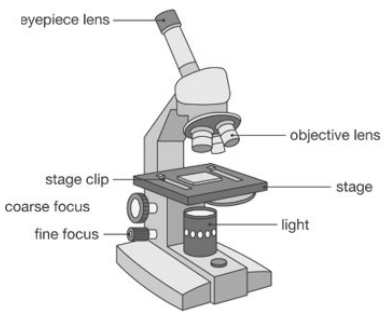
Structure of plant cell



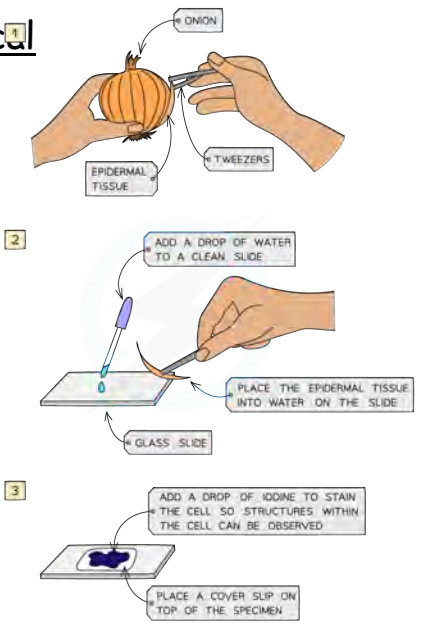
Comparing cells

Organelle	*Responsible for*
Nucleus	Housing DNA, 'brain' of the cell
Mitochondria	Energy production, 'power house' of the cell
Golgi apparatus	Sorting, packaging and transport of proteins
Endoplasmic reticulum	Synthesis and processing of proteins, lipid expression
Chloroplast	Photosynthesis, only present in plants
Flagellum	Locomotion and sensory functions
Vacuole	Storage and maintaining homeostasis
Lysosome	Digestions of larger molecules
Peroxisome	Degradation of hydrogen peroxide
Ribosome	Synthesis of proteins
Proteasome	Break down of proteins with expired func

Microscope



Required practical



Specialised cells

Equations for this topic

Image Size = Actual Size x Magnification

Reproduction

Threshold Concept

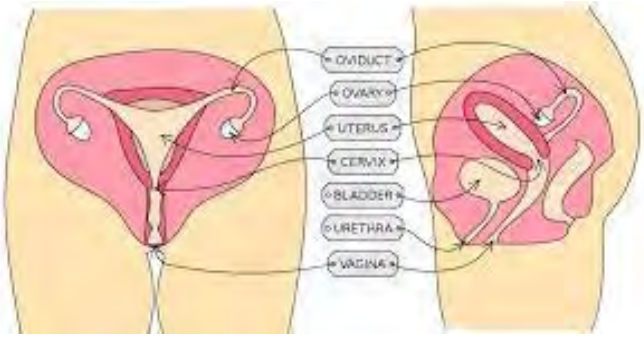
Reproduction can happen sexually and asexually

Keywords

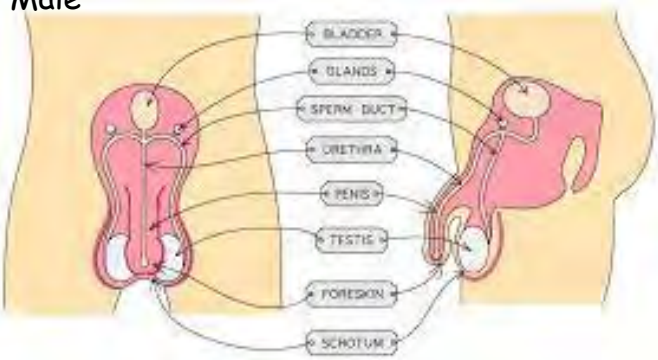
- **Sperm:** male reproductive cell that contains genetic material
- **Egg**: female reproductive cell that contains genetic material
- **Reproduction**: the joining of sex cells (a sperm and egg) to produce offspring
- **Fertilisation:** the joining of a male and female sex cell/genetic material
- **Develop**: build upon given information

Reproductive organs

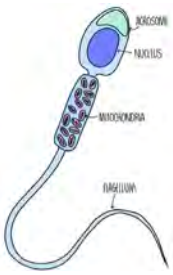
Female



Male



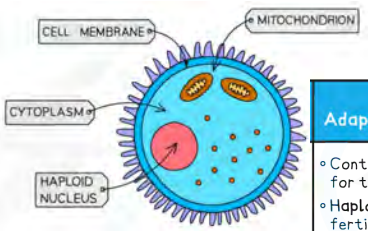
Sperm cell



Adaptations

- The head contains the genetic material for fertilisation in a **haploid nucleus** (containing half the normal number of chromosomes)
- The **acrosome** in the head contains digestive **enzymes** so that a sperm can penetrate an egg
- The mid-piece is packed with **mitochondria** to release **energy** needed to swim and fertilise the egg
- The **tail** enables the sperm to **swim**

Egg cell

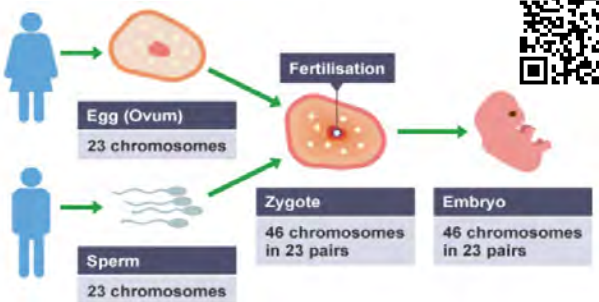


Adaptations

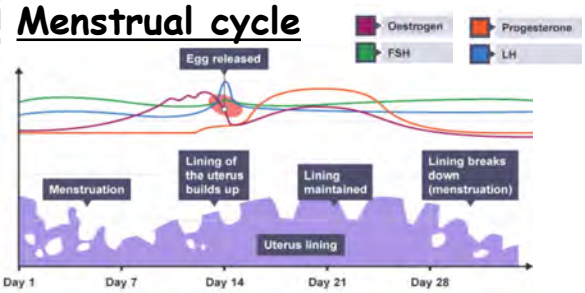
- Contains a **lot of cytoplasm** which has **nutrients** for the growth of the early embryo
- **Haploid nucleus** contains the genetic material for fertilisation
- Cell membrane **changes after fertilisation** by a single sperm so that **no more sperm** can enter

Fertilisation

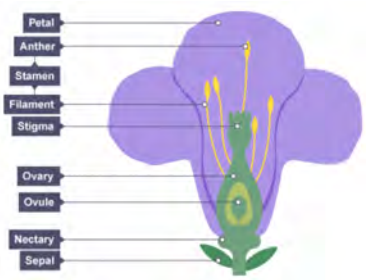
When the sperm and egg nuclei join, they form a ZYGOTE



Menstrual cycle

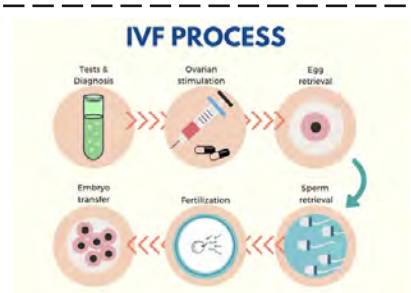


Plant structures



IVF

In Vitro Fertilisation is used to help people with fertility issues conceive



Equations for this topic

Ecology

Threshold Concept

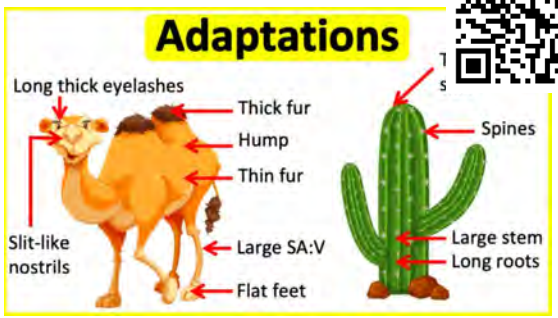
Understand that living things interact with the world around them

Keywords

Living – Undertaking the seven processes of living things
Changes – structural, physiological and behavioural changes that allow species to compete
Animal – Living creature of one of seven domains
Plant – Living tissue that is a producer
Energy – The flow through all organisms and food chains

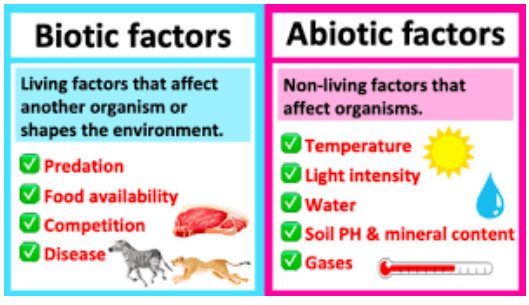
Different Habitat- An area where an organism is at home

Adaptations



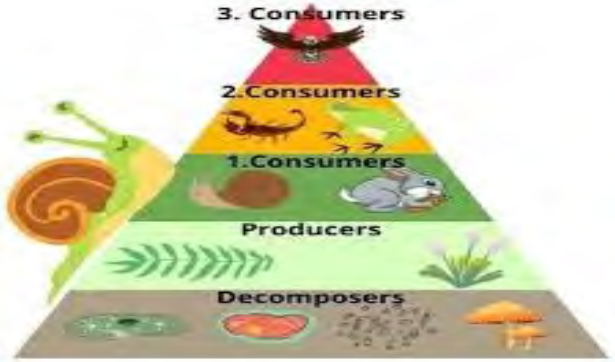
Food Chains/Webs – show the flow of energy

Abiotic and Biotic Factors



Required practical

Producers and Consumers



Equations for this topic

Organisation

Threshold Concept

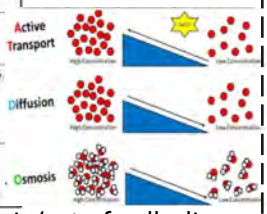
Understand the order of structures and relationships with an organism

Keywords

Organism – any living thing
Organelle – the small, organ-like structures found inside cells
Cell – the structures that make up all living things
Organ system – a group of organs that work together to perform a specific structure
Organ – a group of tissues working together for a specific function
Tissue – a group of cells working together for a shared function

Movement of substances

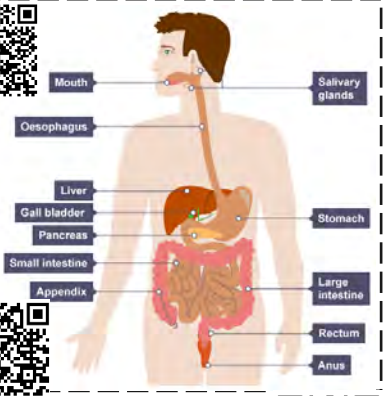
Process	Movement of	Condition	Additional requirements
Diffusion	Molecules/ ions	High conc. to low conc.	Down a conc. gradient
Osmosis	Water molecules	High water potential to low water potential	Across a partially permeable membrane
Active transport	Particles of substances	Low conc. to high conc.	Against a conc. Gradient; Energy required



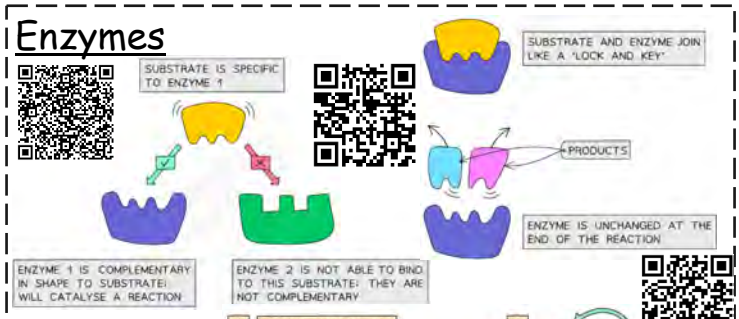
Diffusion –digestion, gas exchange, in/out of cells, liver
Osmosis – water in digestion, in/out of cells, plant roots
Active transport – ions in plant roots, glucose to intestine walls

Digestion

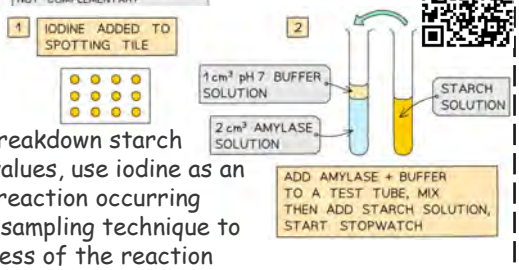
Digestion is the breaking down of the food we eat into other substances that our bodies can absorb and use. There are mechanical and chemical digestive processes.



Enzymes

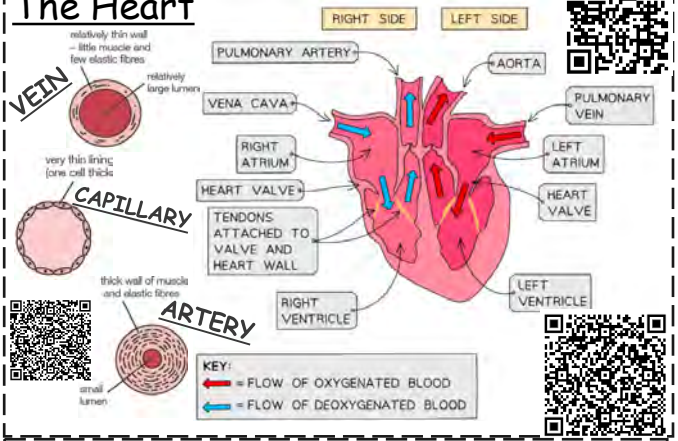


Required practical



- Use amylase to breakdown starch at a range of pH values, use iodine as an indicator for the reaction occurring
- Use a continuous sampling technique to monitor the progress of the reaction

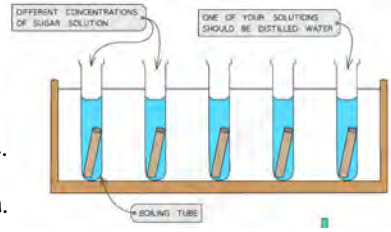
The Heart



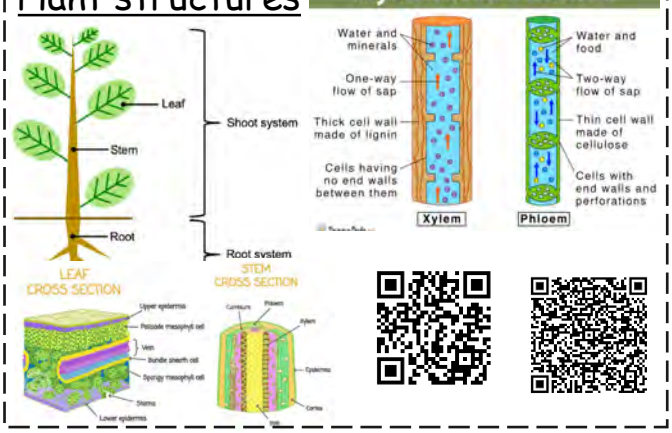
Required practical – Osmosis

Variables

- **Independent** - concentration of sugar solution.
- **Dependent** - Change of mass of plant tissue
- **Controls**
  - Volume of plant tissue.
  - Surface area of plant tissue.
  - Length of time in solution.
  - Temperature of the solution.

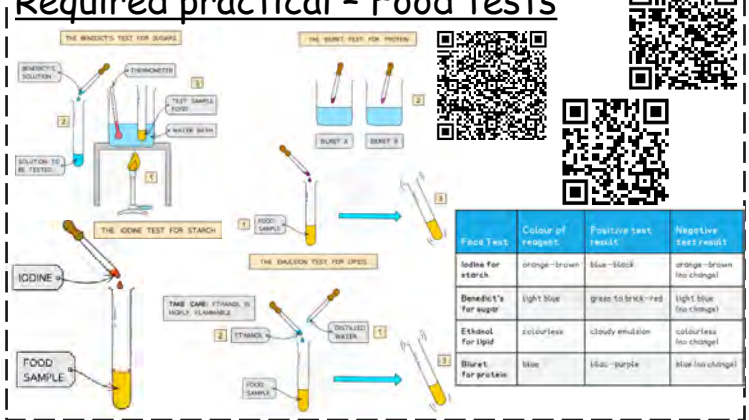


Plant structures



Xylem and Phloem

Required practical – Food tests



Food Test	Colour of reagent	Positive test result	Negative test result
Iodine for starch	orange-brown	blue-black	orange-brown (no change)
Benedict's for sugar	light blue	green to brick-red	light blue (no change)
Ethanol for lipid	colourless	cloudy emulsion	colourless (no change)
Biuret for protein	blue	lilac-purple	blue (no change)

Bioenergetics

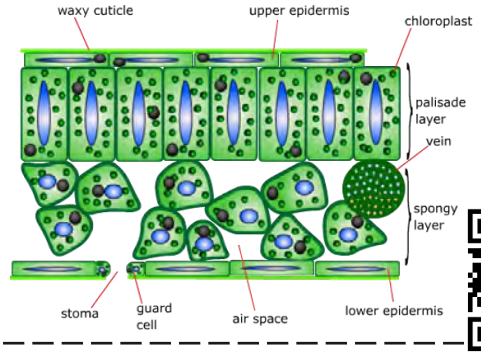
Threshold Concept

Respiration and photosynthesis are chemical processes that provide plants and animals with energy.

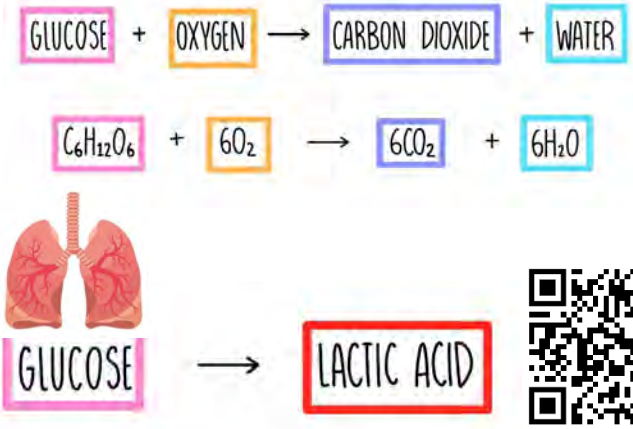
Keywords

- **Respiration:** Respiration is the body's way of producing energy from the food we eat. It involves the breakdown of glucose in the presence of oxygen into carbon dioxide and water with the release of energy-generating molecules called ATP.
- **Photosynthesis:** is a chemical reaction that takes place in the chloroplasts of green plant cells, where light energy is used to convert carbon dioxide and water into glucose and oxygen.
- **Energy:** The ability to do work
- **Limiting factors:** Limiting factors affect the rate of a reaction. A limiting factor is a condition, that when in shortage, slows down the rate of a reaction.
- **Reaction:** A chemical reaction is when one or more substances change and produce one or more new chemical substances.

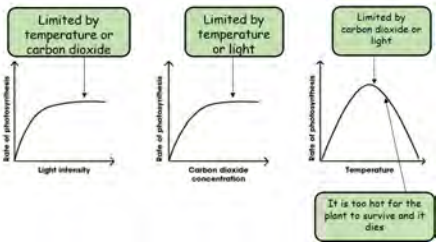
Structure of the leaf



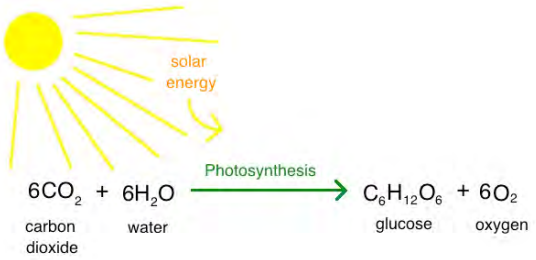
Respiration



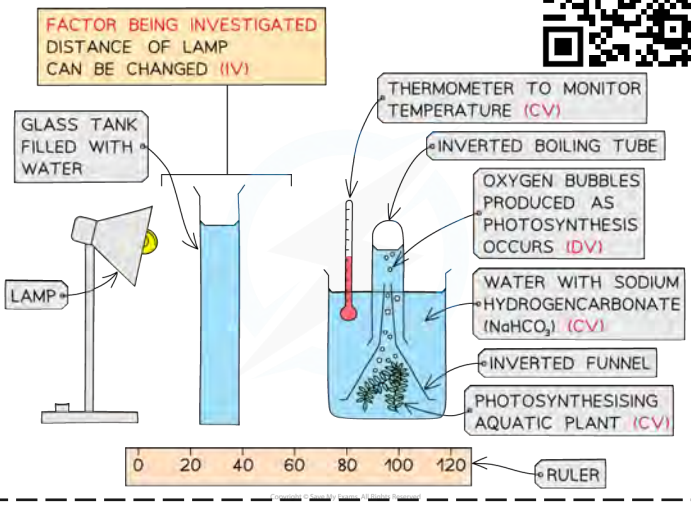
Limiting factors of photosynthesis



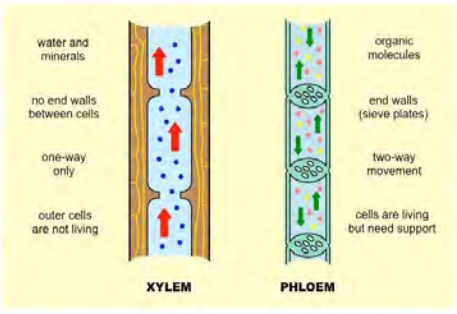
Photosynthesis



Required practical



Xylem and Phloem



Equations for this topic

$$\text{REACTION RATE} = \frac{\text{CHANGE IN MASS OF REACTANT OR PRODUCT}}{\text{TIME}}$$

Homeostasis

Threshold Concept

Homeostasis is organisms maintaining a constant internal environment

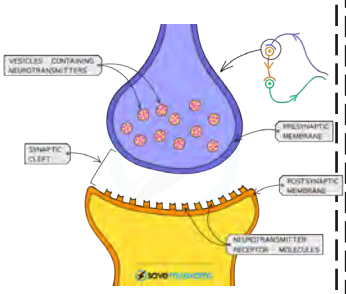
Keywords

- **Nerves:** Specialised cells which carry electrical impulses
- **Hormones**: Chemical messenger produced in glands and carried by the blood to specific organs in the body.
- **Organism:** Living things that are capable of reacting to stimuli, reproduction, growth, and homeostasis.
- **Regulate**: control or maintain the rate or speed of a process so that it operates properly.
- **Response:** as a result of the stimulus that is detected by the receptor a response is caused

The nervous system:

- The central nervous system (CNS) – the brain and spinal cord.
- The peripheral nervous system – nerve cells that carry information to or from the CNS.

Synapse:



Body controls:

Homeostasis maintains optimal conditions for enzyme action throughout the body, as well as all cell functions.

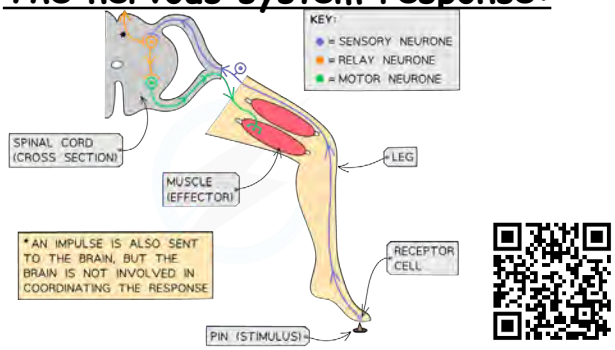
In the human body, these include the control of:

1. Blood glucose concentration
2. Body temperature
3. Water levels

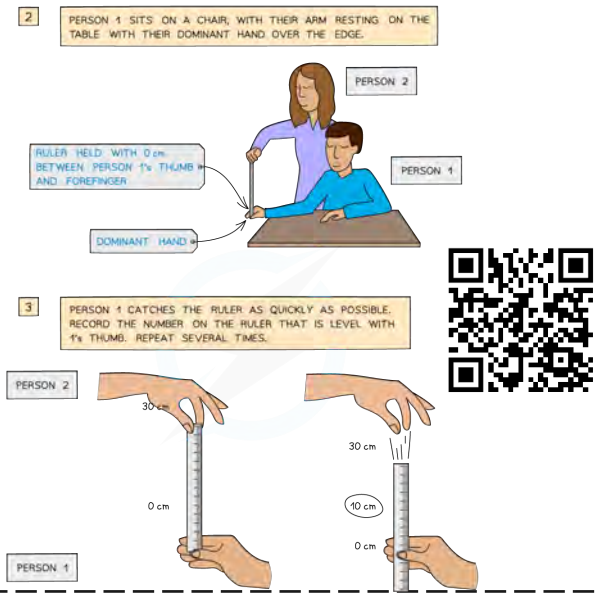
The menstrual cycle:

1. The menstrual cycle is the reproductive cycle in women, which starts with a period (menstruation), if the woman is not pregnant.
2. There are four hormones involved: follicle stimulating hormone, luteinising hormone, oestrogen & progesterone.
3. FSH (released by the pituitary gland) causes eggs to mature in the ovaries.
4. FSH stimulates ovaries to produce oestrogen.
5. Oestrogen inhibits further release of FSH and stimulates release of LH.
6. LH (released by the pituitary gland) stimulates the release of an egg (ovulation) from an ovary.
5. LH stimulates secretion of progesterone by the empty follicle.
6. Progesterone inhibits the release of LH and FSH.
7. Oestrogen and progesterone maintain the lining of the uterus.

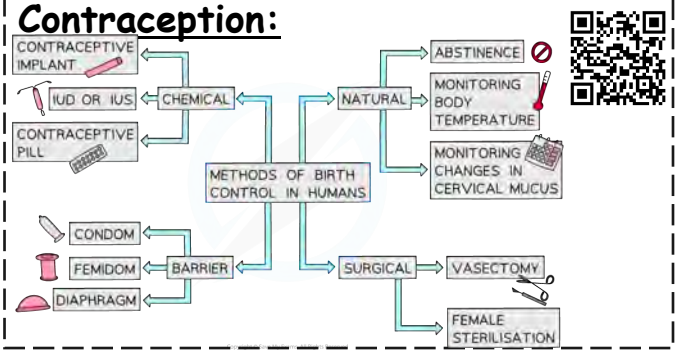
The nervous system response:



Required practical: Reaction time



Contraception:



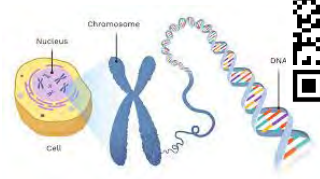
Equations for this topic

Inheritance

Threshold Concept

Organisms pass on their DNA in order to survive.

DNA

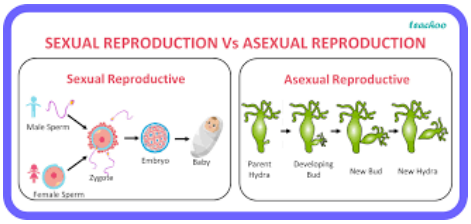


DNA is found in the nucleus of cells and contains all the genetic material to make the organism

Keywords

Cell……. The smallest unit that can live on its own and makes up all living organisms
Nucleus ……. The organelle inside cells that contains the cells genetic material
DNA……. The molecule inside cells that contains all the genetic information responsible for the development and function of an organism
Chromosomes……. A structure made up of proteins and DNA organised into genes inside the nucleus of a cell
Gene ……. Genes carry information that determine what characteristics are inherited from an organism's parents
Reproduction……. The production of offspring

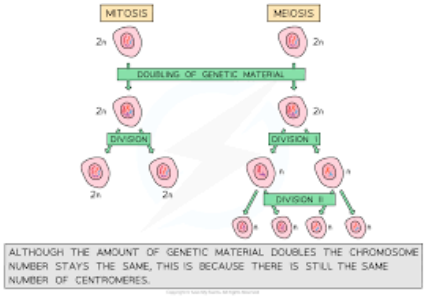
Sexual and asexual reproduction



There are two main forms of reproduction: sexual and asexual reproduction. In sexual reproduction, an organism combines the genetic information from each of its parents and is genetically unique. In asexual reproduction, one parent copies itself to form a genetically identical offspring

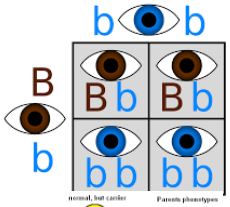
Mitosis / Meiosis

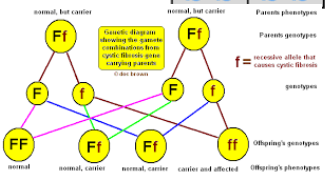
Mitosis is a form of cell division which produces two identical, diploid body cells. Meiosis is a form of cell division which produces four non-identical, haploid sex cells or gametes (sperm and ova in humans



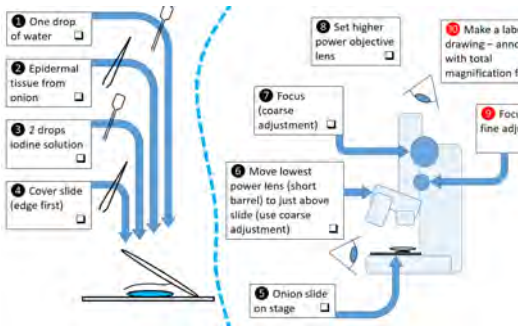
Genetic cross diagrams

Genetic crossing describes breeding two selected individuals so their offspring can be studied to understand how a particular trait is inherited down the generations.





Required Practical



Equations for this topic

Image size = actual size x magnification

Variation

Threshold Concept

All living things need to change to live.

Keywords

Variation……. any difference between the individuals in a species or groups of organisms of any species

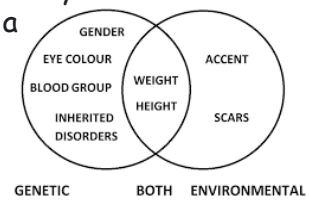
Evolution ……. the change in the characteristics of a species over several generations and relies on the process of natural selection

Adaptation……. the adjustment of organisms to their environment in order to improve their chances at survival in that environment

Natural Selection……. the process through which populations of living organisms adapt and change

Variation

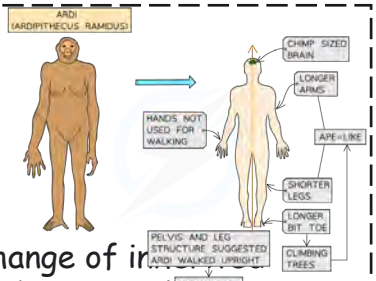
Individuals in a population are usually similar to each other, but not identical. Some of the variation within a species is genetic , some is environmental - the conditions in which they have developed and some is a combination of both



Natural Selection

In any environment, the individuals that have the best adaptive features are the ones most likely to survive and reproduce

Evolution



Evolution is the change of inherited characteristics within a population over time through natural selection, which may result in the formation of a new species

Five main processes that lead to evolution:

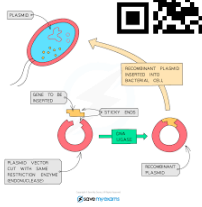
-mutation
-non-random mating
-gene flow
-finite population size (genetic drift)
-natural selection.

Selective Breeding

Selective breeding or artificial selection is when humans breed plants and animals for particular genetic characteristics. Humans have bred food crops from wild plants and domesticated animals for thousands of years

Genetic Engineering

Genetic engineering involves modifying the genome of an organism by introducing a gene from another organism to result in a desired characteristic



Fossils

A fossil is the preserved remains of a dead organism from millions of years ago. **Evidence for early forms of life comes from fossils**. By studying fossils, scientists can learn how much (or how little) organisms have changed as life developed on Earth

Required Practical

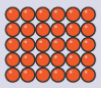
Equations for this topic

Foundations of chemistry

Threshold Concept

All matter is made of particles

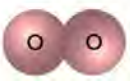
States of matter:

State	Solid	Liquid	Gas
Closeness of particles	Very close	Close	Far apart
Arrangement of particles	Regular pattern	Randomly arranged	Randomly arranged
Movement of particles	Vibrate around a fixed position	Move around each other	Move quickly in all directions
Energy of particles	Low energy	Greater energy	Highest energy
2D diagram			

Atoms and compounds:

Elements contain just **one type of atom**.

Oxygen (O_2)



Compounds contain **different types of atom** bonded together.

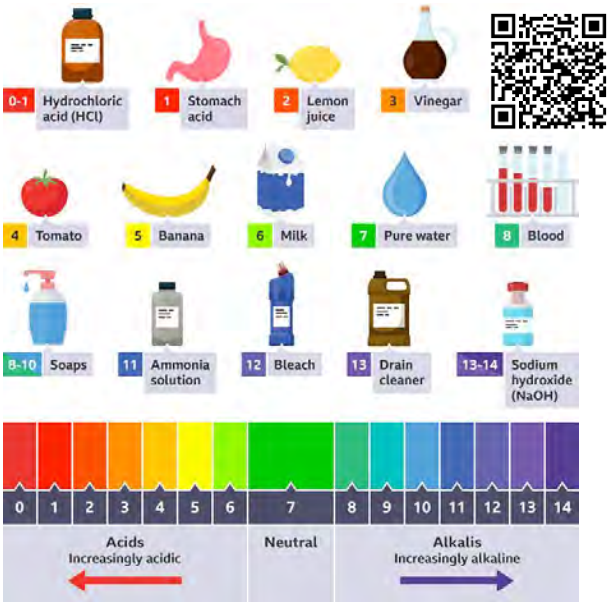
Carbon dioxide (CO_2)

Pure substances:

Pure substances are made from only one chemical element or one compound.

For example, salt is a pure substance made only of sodium chloride.

The pH scale:

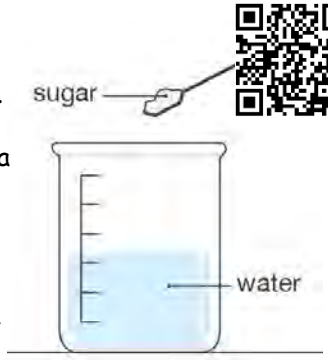


Keywords

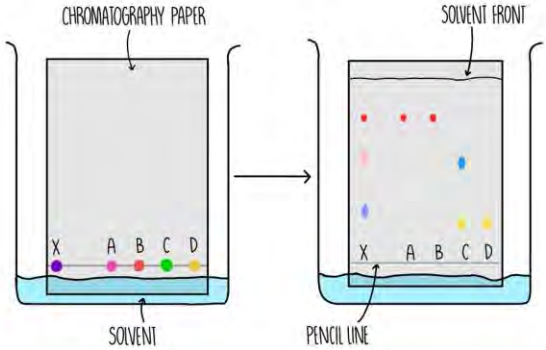
- **Particles:** The tiny things that all materials are made from. The smallest unit of matter.
- **Atom:** Atoms are the building blocks of all matter. Everything is made of atoms - even yourself. They are the smallest particle of an element, which are far too small to see.
- **Solid:** Have a fixed shape and cannot flow, because their particles cannot move from place to place, cannot be compressed (squashed), because their particles are close together and have no space to move into.
- **Liquid:** Flow and take the shape of their container, because their particles can move around each other, cannot be compressed, because their particles are close together and have no space to move into
- **Gas:** Flow and completely fill their container, because their particles can move quickly in all directions, can be compressed, because their particles are far apart and have space to move into

Solubility:

- Some solids dissolve in water to make a solution.
- These solids are soluble.
- A solution is made from a solute (usually a solid) and a solvent (liquid).
- Some gases, such as oxygen and carbon dioxide, can also dissolve in water.



Required practical: Chromatography



Equations for this topic:

$$R_f \text{ value} = \frac{\text{distance travelled by substance } (B)}{\text{distance travelled by solvent } (A)}$$

Periodic Table

Threshold Concept

All elements fit within the Periodic Table

Link to information on most of the topic, consisting of slides, videos, and quizzes

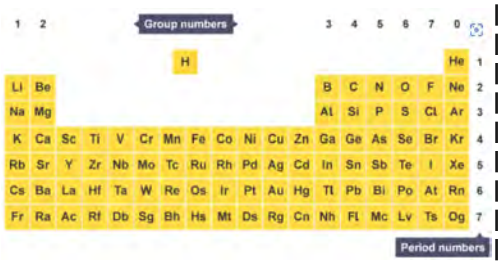
Keywords

Elements - a substance that cannot be broken down into any other substance.
Periodic Table – a table showing every element that is known to exist.
Symbol – a sign/letter/character that is used to represent something

Periodic Table & Developing the Periodic Table

Task 1 & 2

Mendeleev redesigned Newlands periodic table by organising the periodic table by atomic weights and the properties of the elements. Some gaps were left based on his predictions of other elements that hadn't been discovered yet.
As more elements were found, the modern periodic table took from organised by atomic number.

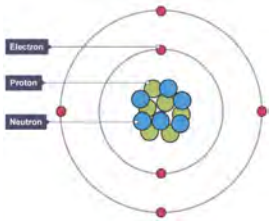


RAM & Isotopes

Task 10

RAM

Atomic Structure



Task 8

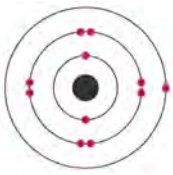
Subatomic particle	Relative mass	Relative charge
Proton	1	+1
Neutron	1	0
Electron	Very small	-1

Electronic Configuration

Task 9

No. of electrons per shell
1st shell: up to 2
2nd shell: up to 8
3rd shell: up to 8
etc

Example, using an atom of sodium



Group 1 – Alkali Metals

Task 4

1

Li
Na
K
Rb
Cs
Fr

All share similar properties:
- Are soft (can be cut)
- Have relatively low MP
- Have low densities

The further down the group you go, the more reactive the elements become.
- They will react will air and tarnish quite quickly.
- They will react with water to produce an alkaline solution (hence the name) and turn universal indicator blue/purple

Group 7 - Halogens

Task 5

7

F
Cl
Br
I
At
Ts

All have 7 electrons in outer shell.
All diatomic (made up of two atoms bonded together.

The further down the group you go, the less reactive the elements become.
The further down the group you go, the higher its MP and BP, because:
- Molecules become larger
- Intermolecular forces become stronger
- More energy is needed to overcome these forces

Group 0 – Noble Gases

Task 3

0

He
Ne
Ar
Kr
Xe
Rn
Og

All have full outer shells.
All unreactive (inert).

All have low boiling points. Lower down the group, the higher it gets.
This is because, going down the group:
- Atoms become larger
- Intermolecular forces between atoms become stronger
- More energy is needed to overcome these forces

Metals

Threshold Concept

Identify most metals have similar properties

Keywords

Metal…….. DEFINITION
Non metal ……. DEFINITION
Property ……. a characteristic of a particular substance
Reaction ……. a process that leads to the change of one set of chemical substances into another
Alloy ……. a mixture of two or more metals, or a metal and a non-metal
Displacement ……. A more reactive metal will displace a less reactive metal from its compound.

Metals and non metals

Most elements on the periodic table are metals. They are grouped together in the middle to the left-hand side of the periodic table.
Non metals are on the right-hand side.

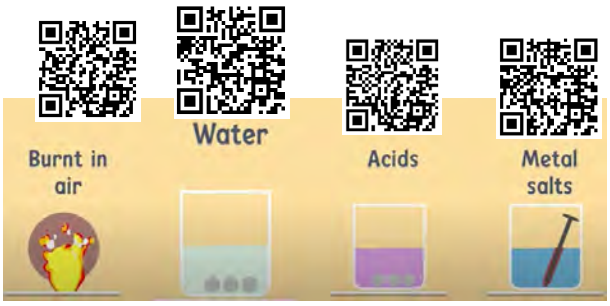
Metals and alloys

Making alloys changes the metals properties by changing its structure. Alloying is done for many reasons, typically to increase strength, increase corrosion resistance, or reduce costs

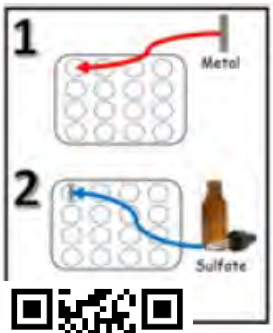
Physical properties of metals

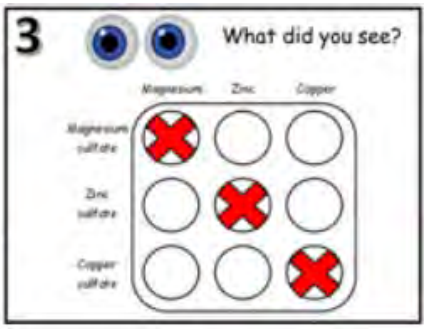
Properties	Metals	Non-metals
Appearance	Shiny	Dull
Hardness	Very hard or hard	
Malleability	Malleable	Non
Ductility	Ductile	No
Heat conduction	Good conductor	Bad
Conduction of electricity	Good conductor	Bad
State	Solid	Solids
Density	Higher	

Chemical properties of metals

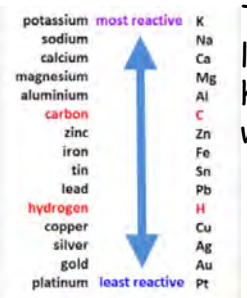


Practical





The reactivity series



The Reactivity Series lists metals in order how easily they react with other substances

Equations for this topic

Metal + acid → salt + hydrogen
Metal + oxygen → Metal oxide
Metal + water → Metal hydroxide + hydrogen

Rock Cycle

Threshold Concept

Understand that rocks change within 3 types over time.

Types of rocks

Sedimentary rocks

Sedimentary rocks are formed from sediments that have settled at the bottom of a lake, sea or ocean, and have been compressed over millions of years.

Metamorphic rocks

Metamorphic rocks are formed from other rocks which change due to **heat** or **pressure**.

Igneous rocks

Igneous rocks are formed from molten (liquid) rock that has cooled and solidified.

Types of weathering

1. Biological weathering

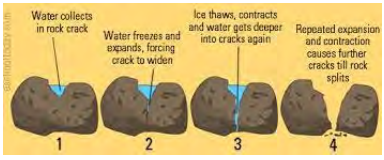
This describes rocks being broken up by the roots of plants, or animals burrowing into them.

2. Chemical weathering

This describes rocks being broken up because substances in rainwater, rivers and seawater or the air, react with the calcium carbonate $CaCO_3$ in the rocks.

3. Physical weathering

This describes rocks being broken up by changes in temperature, freezing and thawing of trapped water or the action of waves and rivers.



Keywords

- **Rock:** The solid mineral material forming part of the surface of the earth and other similar planets, exposed on the surface or underlying the soil.

- **Earth:** The planet on which we live; the world.

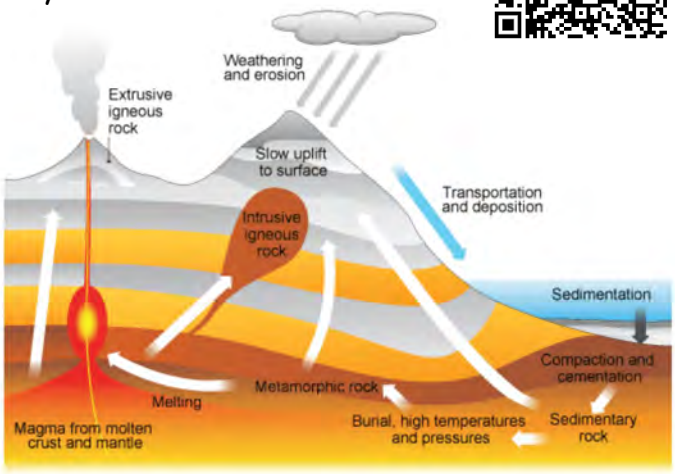
- **Cycle:** Move in or follow a regularly repeated sequence of events.

- **Temperature:** The degree or intensity of heat present in a substance or object.

- **Pressure:** Continuous physical force exerted on or against an object by something in contact with it.

The rock cycle

Rocks on earth do not always stay the same.



Rocks are continually changing due to processes such as, weathering, erosion and large earth movements. The rocks are gradually recycled over millions of years, changing between the different rock types.

Required practical

Equations for this topic

Chemistry of the atmosphere

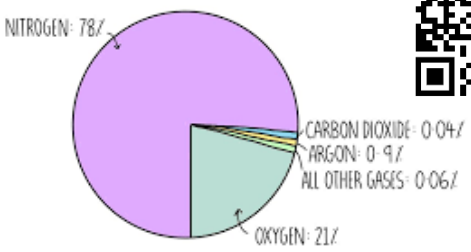
Threshold Concept

The Earth's atmosphere is made of different gases.

Keywords

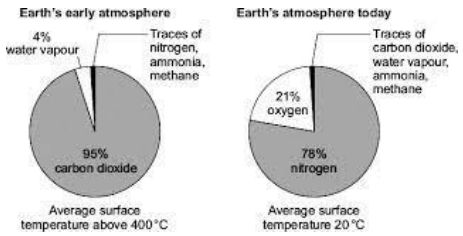
- **Atmosphere**: An atmosphere is the layers of gases surrounding a planet.
- **Pollutants**: A pollutant is a chemical. or biological substance which harms water, air, or land quality.
- **Climate change**: Climate change refers to long-term shifts in temperatures and weather patterns.
- **Combustion**: Combustion is another name for burning. In a combustion reaction, fuel is burned and reacts with oxygen to release energy.
- **Global Warming**: Global warming is the long-term warming of the planet's overall temperature.

The Proportion of gases in the earths atmosphere



History of the earths atmosphere

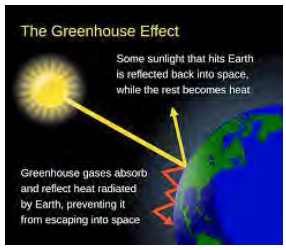
- The proportion of oxygen increased because of **photosynthesis** by plants and algae.
- The proportion of ammonia decreased as it reacted with the newly formed oxygen in the atmosphere to form nitrogen and water vapour.
- The proportion of methane decreased as it reacted with the newly formed oxygen to form carbon dioxide and water.



Greenhouse gases

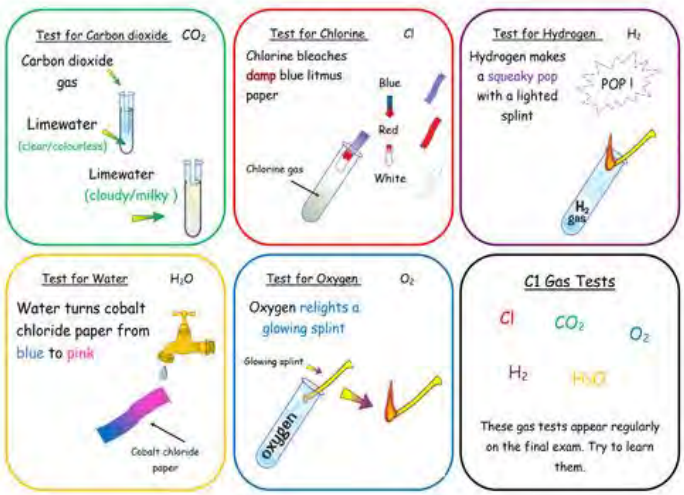
Greenhouse gases present in the atmosphere include:

- water vapour
- carbon dioxide
- methane



Required practical

Testing for gases



Combustion

Complete combustion:

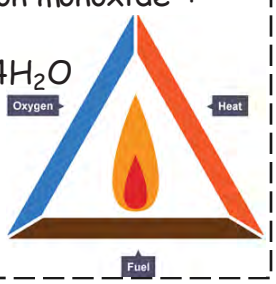
Propane + oxygen → carbon dioxide + water

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

Incomplete combustion:

Propane + oxygen → carbon monoxide + carbon + water

$C_3H_8 + 3O_2 \rightarrow 2CO + C + 4H_2O$



Equations for this topic

Bonding Part 2

Threshold Concept

How do 100 elements make up everything in the universe?

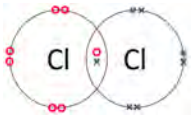
Keywords

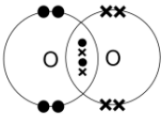
Electron - a subatomic particle with a negative charge
Electrostatic attraction - strong attraction between oppositely charged ions
Weak intermolecular forces - force of attraction between atoms, elements and molecules
Delocalised electron - free moving electron that isn't a part of any atom
Ion – a charged particle

Covalent bonds

Two non-metals will form a covalent bond. The atoms share electrons to make themselves stable.

Cl — Cl





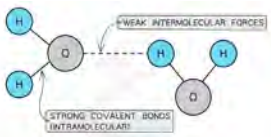
O=O

- 1 shared pair = a single bond
- 2 shared pairs = a double bond
- 3 shared pairs = a triple bond

Simple Covalent compounds

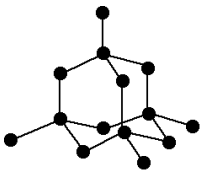
Simple covalent compounds have strong covalent bonds between atoms and weak intermolecular forces between molecules.

Properties – low m.p and b.p
- cannot conduct electricity

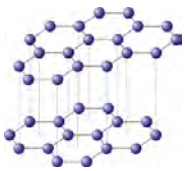


Giant Covalent Structures

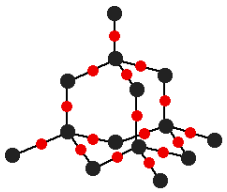
Diamond



Graphite

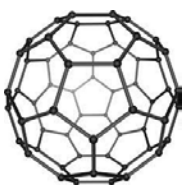


Silicon dioxide



Graphene

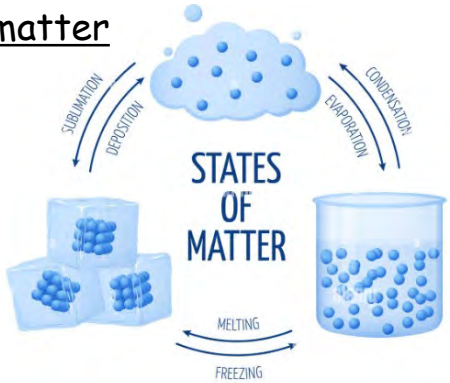
Fullerenes



Metallic bonding

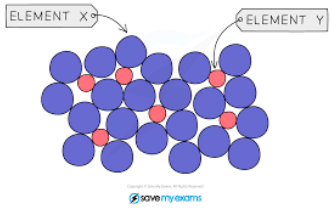
Metals consist of a giant metallic structure. They are positive metal ions surrounded by a sea of delocalised electrons

States of matter



Alloys

Alloys are a mixture of metals and another element.
Alloys are stronger than metals as the different sized atoms distort the layers



Rates of Reaction

Threshold Concept

All particles must collide with a minimum amount of energy in order to react

Keywords

Particle - A particle is the smallest possible unit of matter
Energy - Energy is what holds the atoms in a molecule together
Collision - If the two molecules A and B are to react, they must get close enough to break and make the new bonds that are needed in the products
Reactant - A substance put into a chemical reaction
Product - A substance made in a chemical reaction

Rate of reaction

Rate of reaction is how fast reactants are changed into products

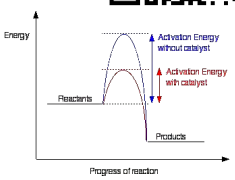
Collision theory and activation energy

The rate of reaction is directly proportional to the number of successful collisions.

- **To react**: particles must first **collide**
- with enough **activation energy** to be successful.

Catalysts

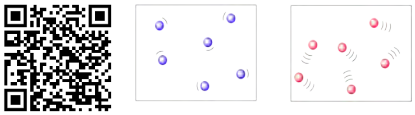
- Catalysts: increase the rate of a reaction without getting used up.
- Catalysts decrease the activation energy required to begin the reaction.
- Catalysts are often used in industry to speed up chemical processes.



Factors affecting rate of reaction

Effect of Temperature:

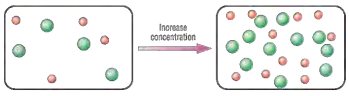
- Increasing the temperature increases the speed that particles are moving
- This means there are more frequent collisions, and those collisions have more energy



Video of all

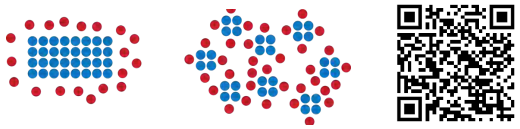
Effect of Concentration:

- Increasing concentration increases the number of reacting particles.
- This increases the frequency of collisions



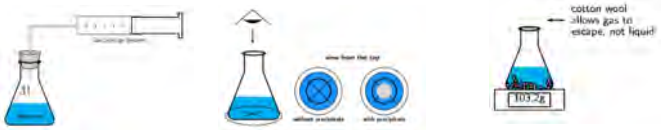
Effect of Surface Area:

- Increasing the surface area increases the proportion of (solid) particles available to react.
- This increases the frequency of collisions.



Measuring rate of reaction

- There are various ways to measure quantity of reactant used or quantity of product formed. Measuring the volume of gas collected can be the easiest way to measure.

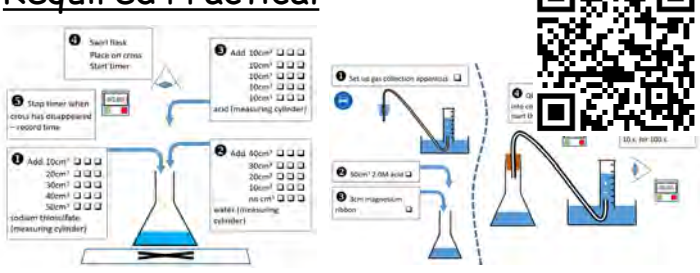


- The units of rate depend on what you are measuring. For example, when measuring gas in cm^3 you will end up with rate units of cm^3/s. When measuring the change in mass (g), you will end up with units of g/s

$$mean\ rate\ of\ reaction = \frac{quantity\ of\ reactant\ used}{time\ taken}$$

$$mean\ rate\ of\ reaction = \frac{quantity\ of\ product\ formed}{time\ taken}$$

Required Practical



Equations for this topic

Using Resources

Threshold Concept

Understand how to reduce, re-use and recycle the Earth's resources.

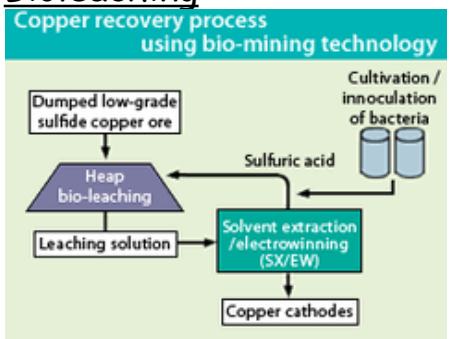
Resources and sustainability

Reducing doesn't just reduce the use of that specific material, but also reduces the use of any materials used to manufacture it in the first place.

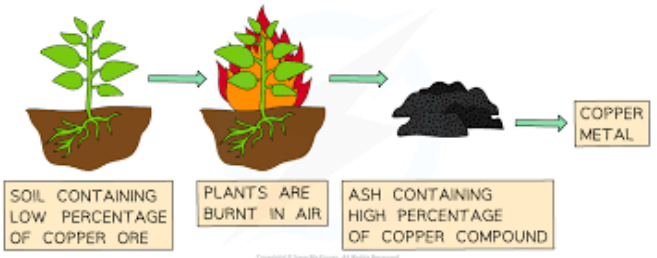
Keywords

Reduce – using materials/resources less
Reuse – using materials/resources again
Recycle – converting waste into reusable material
Renewable – when a resource is produced at least at the same rate that it is being used
Non-renewable – when a resource is being used at a faster rate than it can be made
Sustainable – fulfilling the needs of the current generation without compromising the needs of future generations

Bioleaching

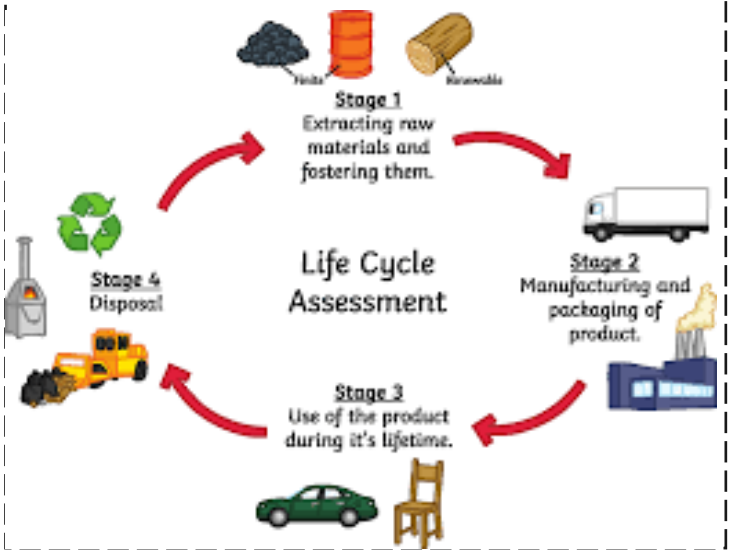


Phytomining



Life Cycle Assessments

A 'cradle to grave' analysis of the impact of a manufactured product on the environment.

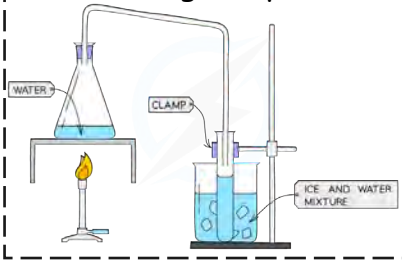


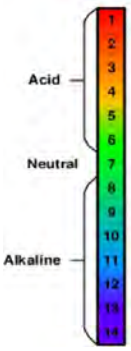
Potable Water (inc Required Practical)

Don't forget to click on the worksheet tab to try some tasks.

Required Practical involves:

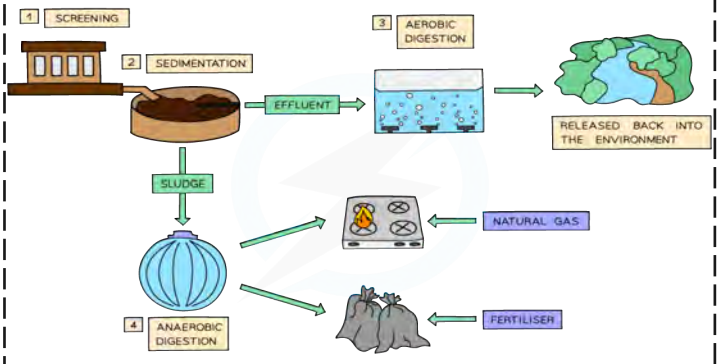
- pH testing using a pH meter, then neutralisation using titration, if needed.
- Ion testing (flame testing)
- Distillation
- Retesting for pH and ions.





Waste Water Treatment

Don't forget to click on the exam questions tab to try some tasks.



Chemical analysis Triple

Threshold Concept

What other organic compounds are made out of?

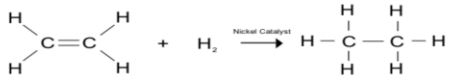
Keywords

Functional group – a group of atoms that are responsible for how a compound reacts
Homologous series – a group of compounds that share a functional group and react similarly
Alcohol – a group of compounds with the functional group OH
Carboxylic acids – a group of compounds with the functional group COOH
Esters – a group of compounds with the functional group COO

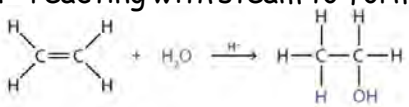
Reactions of Alkenes

Alkenes will go through a number of different addition reactions to form new products.

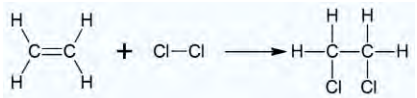
Hydrogenation – reacting with hydrogen to form alkanes



Hydration – reacting with steam to form alcohols

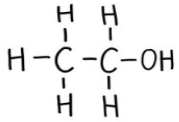


Halogenation – reacting with halogens to form a haloalkane



Alcohols

Alcohols are a group of compounds with the functional group is OH.
The general formula is $C_nH_{2n+1}OH$

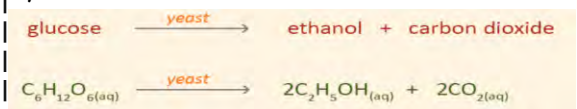


Ethanol

Uses:
- Alcoholic drinks
- Solvents
- Fuels

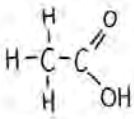
Fermentation

Ethanol can be produced by fermentation.
Glucose is converted into ethanol using enzymes in yeast.



Carboxylic acids

Carboxylic acids are weak acids with the functional group COOH.



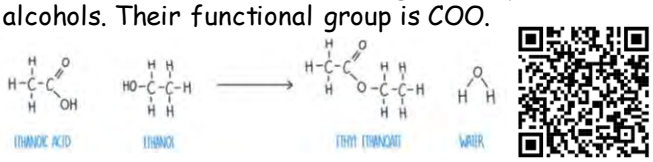
Ethanoic acid

Carboxylic acids behave like other acids and react with metals/metal compounds to form salts.

CARBOXYLIC ACID + METAL ⟶ SALT + HYDROGEN

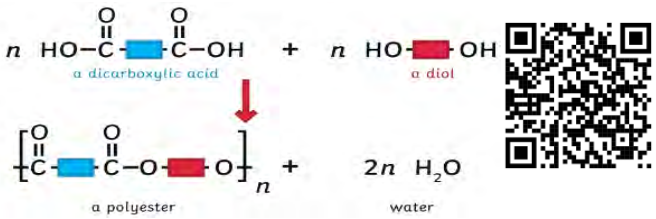
ETHANOIC ACID + CALCIUM ⟶ CALCIUM ETHANOATE + HYDROGEN

Esters are formed from reacting carboxylic acids and alcohols. Their functional group is COO.



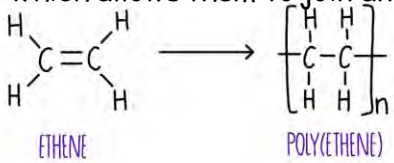
Condensation polymerisation

Condensation polymerisation requires 2 monomers; a diol and a dicarboxylic acid.
Water is always a by-product of this type of polymerisation.



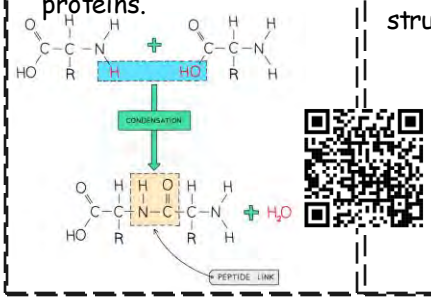
Addition polymerisation

Addition polymerisation involves breaking the carbon-carbon double bond of the monomer which allows them to join and form a polymer.

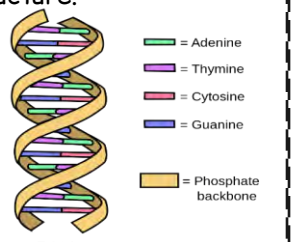


Naturally occurring polymers

Amino acids can join to form a polypeptide. These long chains form proteins.



DNA is a large natural polymer. It's monomers are called nucleotides and the form a double helix structure.



Organic Chemistry

Threshold Concept

Hydrocarbons are chains of hydrogen and carbon

Keywords

Hydrogen - a non-metallic element that is the simplest and lightest of the elements
Carbon - a non metallic chemical element with atomic number 6
Formula - a chemical formula is a way of presenting information about the chemical proportions of atoms that make up a particular chemical compound or molecule
Equation - A word or symbol representation of a reaction.

Crude oil and hydrocarbons

Crude oil is a fossil fuel. It's formed from the remains of plants and animals, mainly plankton, that died millions of years ago.

- It is a non-renewable fuel; one day it will run out.
- Crude oil is a mixture of lots of different hydrocarbons,
- Hydrocarbons are the simplest organic compounds.

There are two types of hydrocarbon:

- Alkane
- Alkene

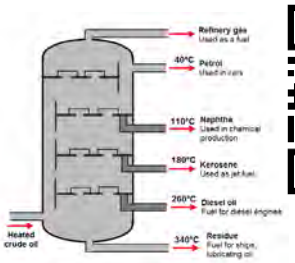
Hydrocarbon properties changes as the chain gets longer.

The shorter the chain the:

1. Less viscous the substance is (this means they are more runny)
2. More volatile the substance is (this means they have a lower boiling point)
3. More flammable the substance is (this means they are easier to ignite)

Fractional distillation

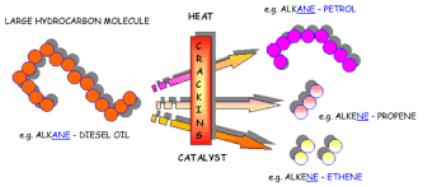
Crude oil can be used to make thousands of useful things but first the different 'fractions' need to be separated out. This is done by fractional distillation.



Video

Method and uses

Cracking



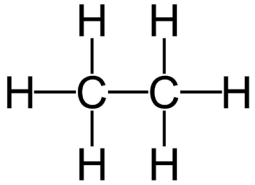
- This is the process of breaking long chain hydrocarbons down into shorter ones.
- Shorter chains are more flammable and therefore make better fuels.
- Cracking will produce alkanes and alkenes.

Alkanes

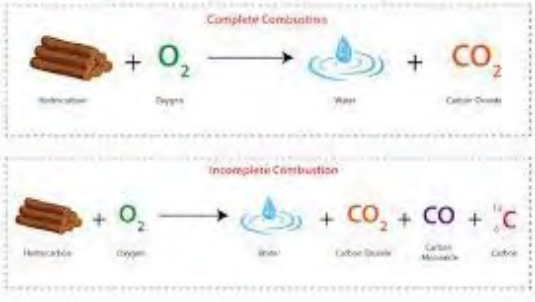
Contain only single c-c bonds.

Have the general formulc C_nH_{2n+2}

Are 'saturated' – each carbon forms 4 single covalent bonds.

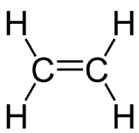


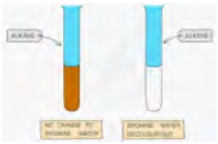
Combustion



Alkenes

- An alkene will contain at leas one c=c double bond.
- Have the general formula C_nH_{2n}.
- Are 'unsaturated'.





Bromine water is used to test for alkenes.

Required Practical

Equations for this topic

Quantitative chemistry

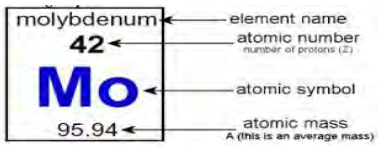
Threshold Concept

To understand that total mass of reactants equals total mass of products

Keywords

Conservation – the mass of the reactants must equal the mass of the products in a chemical reaction
Formula mass – the combined mass numbers of an element or compound
Concentration – the amount of substance dissolved in a solution
Equation – symbol representation of a chemical reaction
Loss – the process of losing something
Gain – the process of gaining something

RFM

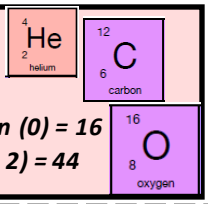


RAM is atomic mass of an element

RFM is the combination of all elements **Ar** in a compound or Molecule

Work example

Helium (He) Ar = 4
Carbon dioxide = CO_2
Carbon (C) = 12 Oxygen (0) = 16
Mr of CO_2 = 12 + (16 x 2) = 44



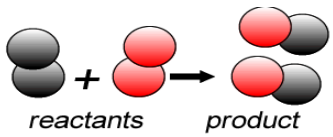
Balancing Equations

As the same number of elements are at the start and the end of reactions. The Equation needs to be balanced.

$Mg + O_2 \rightarrow MgO$ **(Unbalanced)**

2$Mg + O_2 \rightarrow$ **2**MgO **(Balanced)**

Conservation of Mass



The reactants mass must always equal the mass of the products

2g + 2g —> 4g

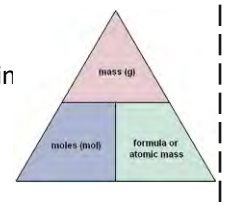
We can not destroy atoms.

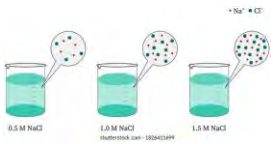
Moles

Chemical amounts are measured in moles. One mole of a substance contains **6.02×10^{23} particles (Avagadro's number)**

Concentration

Concentration is the amount of substance in a certain volume of solution (g/dm3)





Percentage by mass

The amount of an element in a compound is called its percentage composition. It can be calculated using the mass of the given element in the compound and the **RFM** of the Compound.

$$\text{Mass \%} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100\%$$

Limiting reactions

The reactant that gets used up first in a reaction is called the limiting reactant. This reactant is not in EXCESS

Reacting masses

The mass of a product or reactant can be determined from having a balanced symbol equation. Once balanced, the equation tells you how many moles of each substance react with each other : Mg + **2**HCl —> **$MgCl_2$ + H_2** **(Balanced)**

This equation states that: 1 : Mg 2 : HCl to form 1 : $MgCl_2$ 1 : H_2

Using the formula and moles you can use this information to work out how much product you will make

Making salts

Threshold Concept

How do metals and acids react to make salts and water

Keywords

Reactivity – the ability for an atom or molecule to undergo a chemical reaction
Salt – a substance made of positive and negative ions
Sulphuric acid – an acid that contains sulphate ions
Nitric acid – an acid that contains nitrate ions
Hydrochloric acid – an acid that contains chloride
Balanced – equal on both sides
Symbol equation – a chemical equation using chemical symbols
Acidic – a solution that contains H^+ ions
Alkaline – a solution that contains OH^- ions

Neutralisation

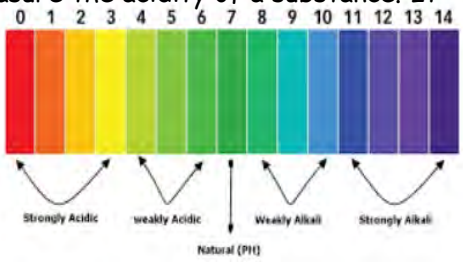
When an acid and alkali react they form neutral product water.
The H+ ions from the acid react with the OH- ions from the alkali to form water.
This can be represented using the following ionic equation:

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

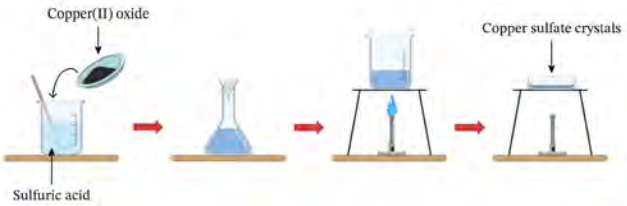
The pH scale

Acids contain H^+ ion and alkalis contain OH^- ions. The pH scale is used to measure the acidity of a substance. It ranges from 0-14.

Acidic = pH < 7
Neutral = pH 7
Alkaline = pH > 7



Making salts required pract



$$CuO(s) + H_2SO_4(aq) \longrightarrow CuSO_4(aq) + H_2O(l)$$

Reactions of acids

Acids react with metals, alkalis and carbonates to form a salt and either hydrogen, water or water and carbon dioxide. Each acid forms a different salt.

Acid Used	Salt Produced
hydrochloric	chloride
nitric	nitrate
sulfuric	sulfate

acid + metal → salt + hydrogen

hydrochloric acid + zinc → zinc chloride + hydrogen

$2HCl + Zn \rightarrow ZnCl_2 + H_2$

acid + alkali → salt + water

nitric acid + sodium hydroxide → sodium nitrate + water

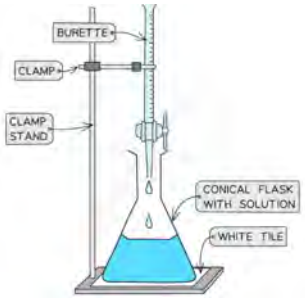
$HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$

acid + carbonate → salt + water + carbon dioxide

sulfuric acid + zinc oxide → zinc sulfate + water

$H_2SO_4 + ZnO \rightarrow ZnSO_4 + H_2O$

Titration req prac (triple)



Redox reactions (higher tier)

Redox reactions are when oxidation and reduction (in terms of electron transfer) take place at the same time.

For example:

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

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

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

Oxidation is loss of electrons.

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

Reduction is gaining of electrons.

Strong and weak acids

Strong acids are acids that fully ionise in water

$$HCl \longrightarrow H^+ + Cl^-$$

Weak acids are acids that partially ionise in water

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

Electrolysis

Threshold Concept

Know ionic compounds can be split into separate elements

Keywords

Compound…… a substance made from two or more different elements that have been chemically joined

Ionic…… an atom or small group of atoms that has an electrical charge because it has added or lost one or more electrons

Electrolysis ……. a process that uses the power of electricity to split elements and compounds into their ions

Molten ……. **melted or made liquid by being heated to very high temperatures**

Aqueous ……. Dissolved in water

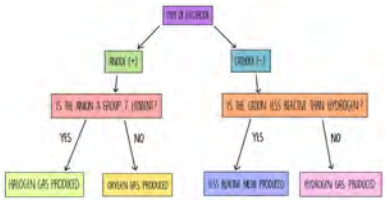
Electrolysis

Electrolysis uses electricity to break down ionic compounds that are made up of positive and negative ions

When using electrolysis to extract metals, the metal needs to be melted or dissolved.

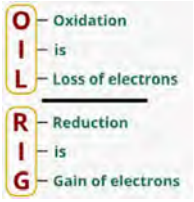
Positive ions in the electrolyte move towards the cathode, gain electrons and are reduced to form an uncharged element.
Negative ions move towards the anode, lose electrons and are oxidised.

Rules at the electrodes



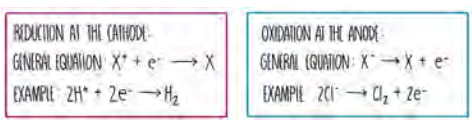
Oxidation and reduction

- Oxidation means gain of oxygen. Reduction means loss of oxygen.
- When we are referring to electrons, we refer to them as redox reactions.
- This is where electrons are lost or gained.
- A redox reaction is where **RED**uction and **OX**idation happen at the same time.

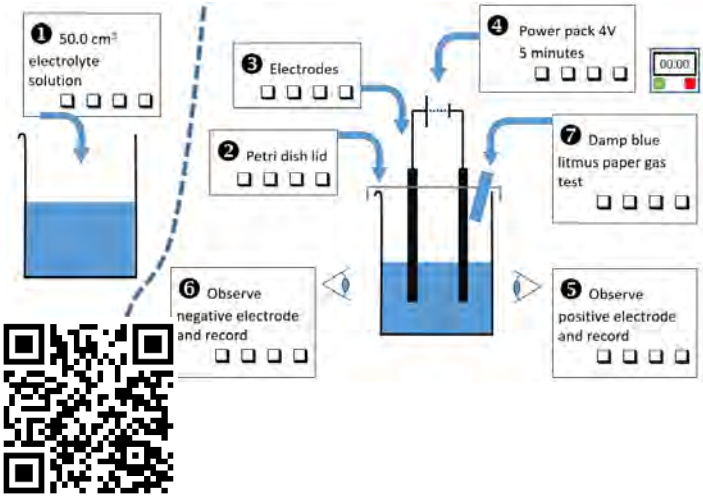


Half equations

A half equation is used to represent the reaction that happens at an electrode during electrolysis. It shows what happens when ions gain or lose electrons

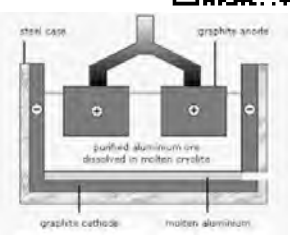


Required Practical



Extraction of metals

Metals higher than carbon on the reactivity series need to be extracted using electrolysis. For example aluminium needs to be extracted from it's ore, bauxite, using electrolysis



Equations for this topic

Energy changes

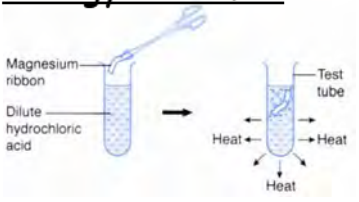
Threshold Concept

Know that reactions absorb or release energy

Keywords

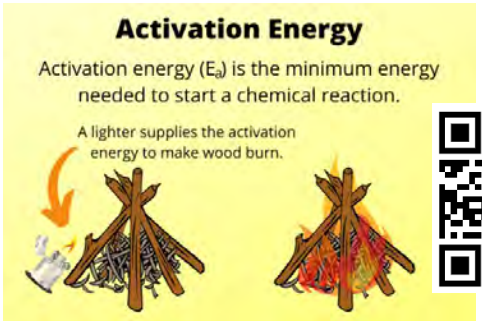
Energy……. Energy is stored in the bonds of chemical compounds, that is absorbed or released in chemical reactions
Bond……. an attraction between atoms or ions and allows for the formation of compounds or molecules
Activation energy ……. The minimum amount of energy required to start a reaction and turn a reactant into a product
Energy change……. The energy absorbed or released when bonds are made or broken
Reaction profile ……. A diagram that shows the energy changes in a reaction.
.

Energy transfer

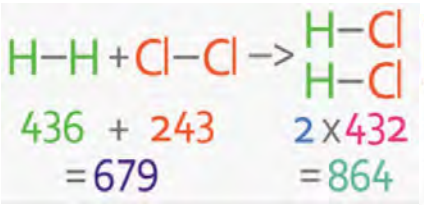


During a chemical reaction, energy is transferred to or from the surroundings

Activation energy



Bond energy

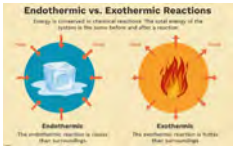


Bond	Bond energy (kJ/mole)
H–H	436
Cl–Cl	243
H–Cl	432

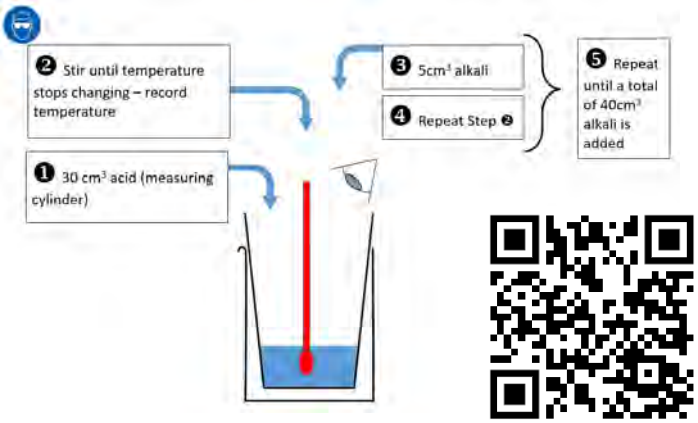
The energy change in a reaction can be calculated using **bond energies**. A bond energy is the amount of **energy** needed to break one **mole** of a particular **covalent bond**.
Energy change = total bond energy of reactants – total bond energy of products

Endothermic / Exothermic reactions

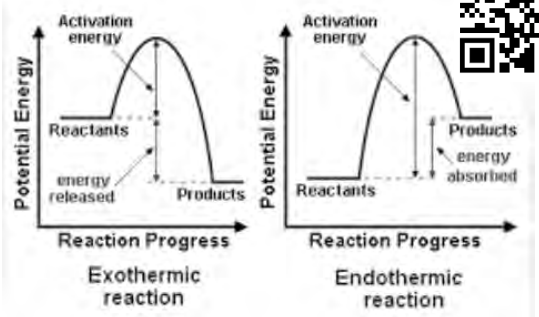
- Exothermic reactions transfer energy to the environment
- Endothermic reactions transfer energy from the environment



Required Practical



Reaction profiles



Equations for this topic

Chemical analysis

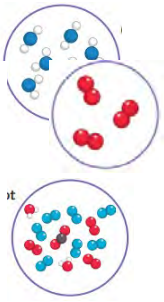
Threshold Concept

How do we identify a substance?

Keywords

Pure – a substance made from just one element of compound
Impure – a substance made from more than one element or compound
Analyse – to find the chemical composition of a substance
Sample – a portion of a substance taken from a larger amount

Pure and impure



Pure substances are made up of just one type of element or compound. They will have one set melting or boiling point.

Impure substances are a mixture of elements or compounds and have a range of melting/boiling points.

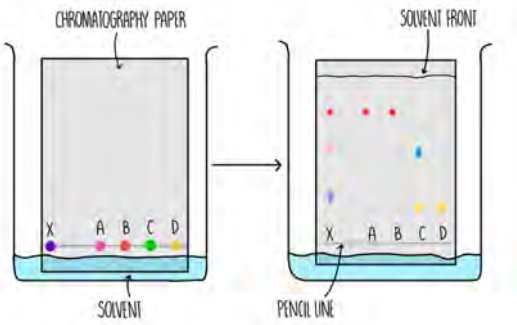
Formulations

A formulation is a mixture which has been designed as a useful product.

- Fuels
- Cleaning products
- Paints

Chromatography required practical

Chromatography is a method used to separate the substances in a mixtures.

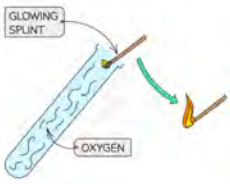


Stationary phase – where the molecules can't move (chromatography paper)
Mobile phase – where the molecules can move (the solvent)

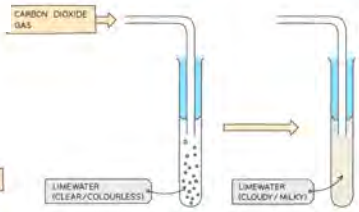
Test for gases

Test for Hydrogen

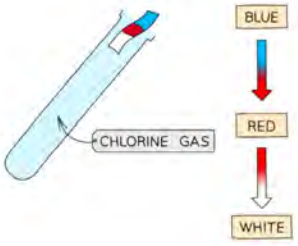
Test for Oxygen



Test for Carbon Dioxide

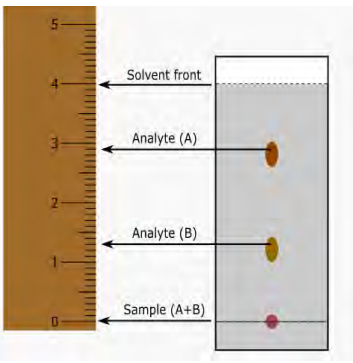


Test for Chlorine



Rf Value

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



Chemical analysis Triple

Threshold Concept

How do we identify a substance?

Keywords

Pure – a substance made from just one element of compound

Impure – a substance made from more than one element or compound

Analyse – to find the chemical composition of a substance

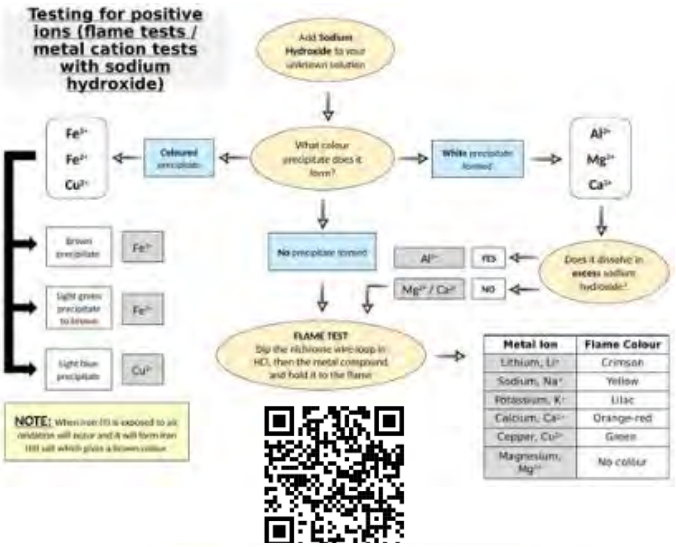
Sample – a portion of a substance taken from a larger amount

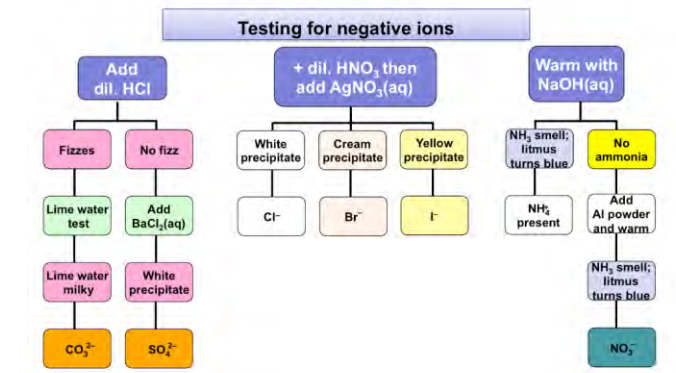
Testing for metal ions

Metal ions will form coloured precipitates when they react with sodium hydroxide.

Metal Cation	Effect of adding NaOH
Aluminium (Al^{3+})	White precipitate, dissolves in excess NaOH to form a colourless solution
Magnesium (Mg^{2+})	White precipitate, incoluble so remains in excess NaOH
Calcium (Ca^{2+})	White precipitate, insoluble so remains in excess NaOH
Copper (II) (Cu^{2+})	Light blue precipitate, insoluble in excess
Iron (II) (Fe^{2+})	Green precipitate, insoluble in excess
Iron (III) (Fe^{3+})	Red–brown precipitate, insoluble in excess

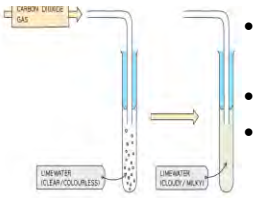
Identifying ions required practical





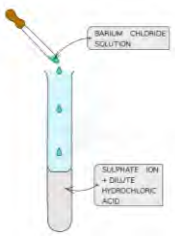
Testing for carbonate ions CO_3^{2-}

$K_2CO_3 + 2HCl \rightarrow 2KCl + CO_2 + H_2O$



- Metal carbonate and hydrochloric acid
- Forms Carbon dioxide
- Turns lime water cloudy

Testing for Sulphate ions (SO_4^{2-})



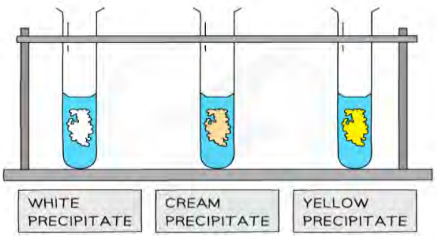
$Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$

- Add barium chloride
- White precipitate formed

Flame emission spectroscopy

An instrumental technique used to identify metal ions.

Testing for Halide ions (Cl^-, Br^-, I^-)



$Ag^+ + Cl^- \rightarrow AgCl$

- Add nitric acid
- Add a few drops of silver nitrate
- Chloride forms a white precipitate
- Bromide forms a cream precipitate
- Iodide forms a yellow precipitate

Energy

Threshold Concept

Energy can't be created or destroyed, it can only be transferred from one store to another in a closed system

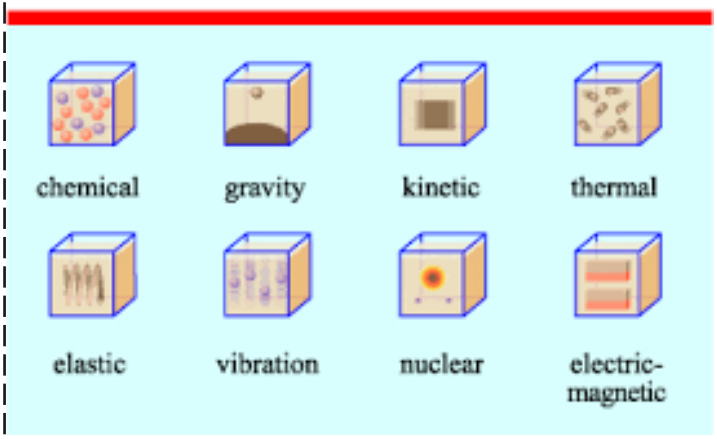
Keywords

Energy – moved between stores during transfers
Store – A temporary housing for energy
Transfer – The movement of energy between stores
Useful – The energy store that you wish for the energy to flow into
Dissipated – The store that energy flows into that is not useful or wasted

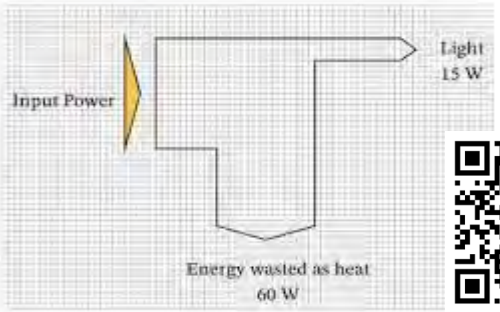
Movement between stores

Energy Transfer	Description
Mechanical	When a force acts on a body e.g. a collision
Electrical	Electricity can transfer energy from a power source, such as a cell, delivering it to components within a circuit
Heating	Thermal energy can be transferred by conduction, convection or radiation
Radiation	Light and sound carry energy and can transfer this between two points

Energy Stores

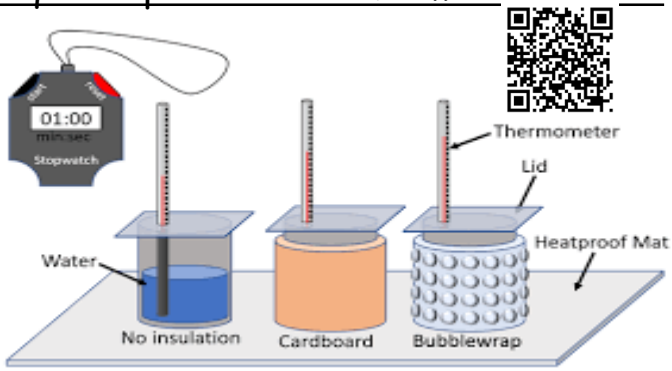


Sankey Diagrams

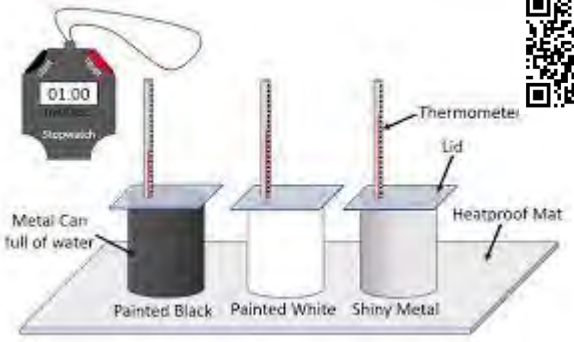


Conservation of energy

Required practical – Thermal Insulation



Required Practical - Radiation



Equations for this topic

Work = Force x Distance

Power = Work done/ time

Efficiency = useful energy output/total energy input

Forces

Threshold Concept

Every action has an equal and opposing action .

Keywords

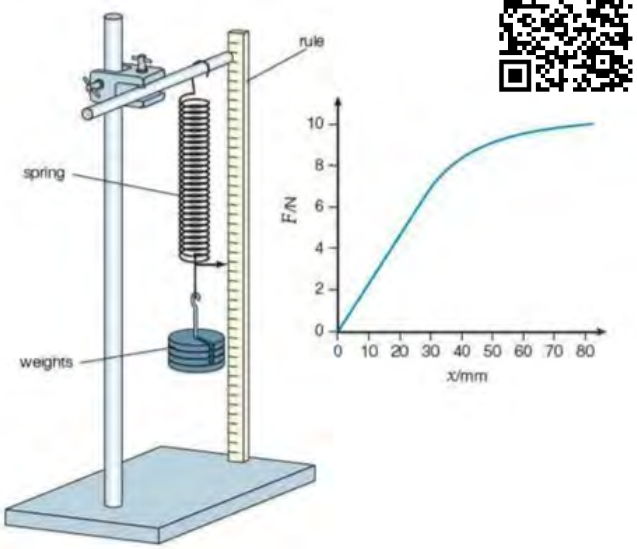
- **Contact:** Contact forces are forces that act between two objects that are physically touching each other.
- **Non contact:** Non-contact forces are forces that act between two objects that are not physically touching each other.
- **Balanced:** When the total force in opposite directions are equal in magnitude.
- **Unbalanced:** When the total force in opposite directions aren't equal in magnitude.
- **Force:** A push or a pull. The unit of force is the newton (N).

Contact and non contact forces

Contact Force	Non-Contact Force
A **contact force** involves a force between two objects in contact.	A **non-contact force** involves a force between objects not touching. You can't 'see' anything physically touching, but there is still an attraction or repulsion.
For example, **friction** between your feet and the ground can be present.	For example, **magnetic** forces between two magnets can happen when the magnets are near but not touching.

Required practical

When you apply a force to a material it can extend. The extension is the amount the length has increased by.



Scalar and vector quantities

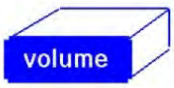
A scalar quantity has only magnitude.
A vector quantity has both magnitude and direction.

Scalar Quantities

length, area, volume
speed
mass, density
pressure
temperature
energy, entropy
work, power

Vector Quantities

displacement
velocity
acceleration
momentum
force
lift , drag , thrust
weight

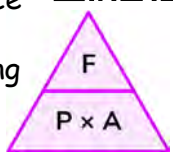


Free body diagrams

A free body diagram models the forces acting on an object.
The object or 'body' is usually shown as a box or a dot. The forces are shown as thin arrows pointing away from the centre of the box or dot.

Pressure:

Pressure is the amount of force applied to a specific area. It is caused when objects exert a force on another object. It can be on a visible level (pushing a door, rolling out cake icing) or at a molecular level (gas particles in a can)



Equations for this topic

weight = mass × gravitational field strength	$W = m\,g$
work done = force × distance (moved along the line of action of the force)	$W = Fs$
force = spring constant × extension	$F = ke$
moment of a force = force × distance (perpendicular to the direction of the force)	$M = Fd$
pressure = $\frac{\text{force normal to a surface}}{\text{area of that surface}}$	$p = \frac{F}{A}$
distance travelled = speed × time	$s = vt$
resultant force = mass × acceleration	$F = ma$

Space

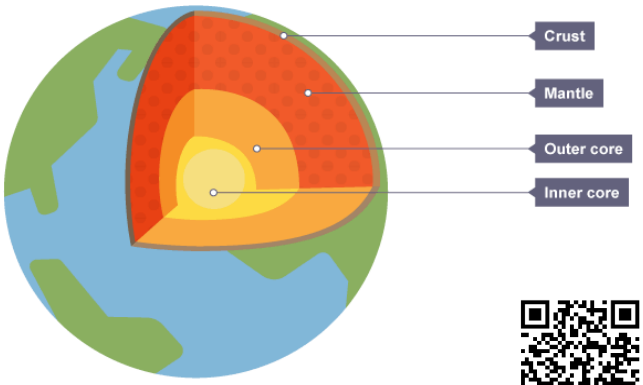
Threshold Concept

The Sun is the centre of the Solar system

Keywords

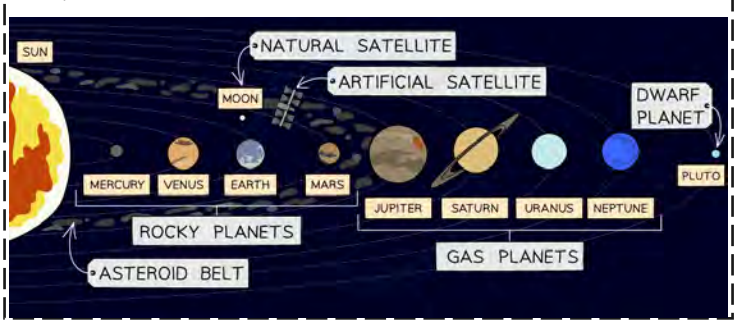
- **Earth**: The Earth is a planet and is roughly the shape of a sphere. There are three layers that make up the Earth's structure.
- **Planet**: A sphere of rock or gas orbiting a star.
- **Sun**: The Sun is our nearest star. It is a relatively small star when compared to other stars in the universe. Our Solar System contains the Sun and everything that orbits it.
- **Gravity**: Gravity is an attractive force that acts on all matter.

The earth:



Solar system:

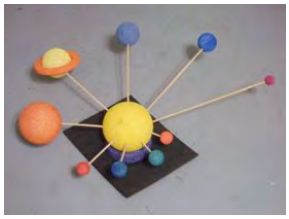
Our solar system consists of eight planets orbiting a star, our sun. Most planets have at least one moon orbiting it. In addition, there is an asteroid belt between Mars and Jupiter. Numerous comets also orbit the sun in elongated elliptical orbits



The earths rotation and revolution:

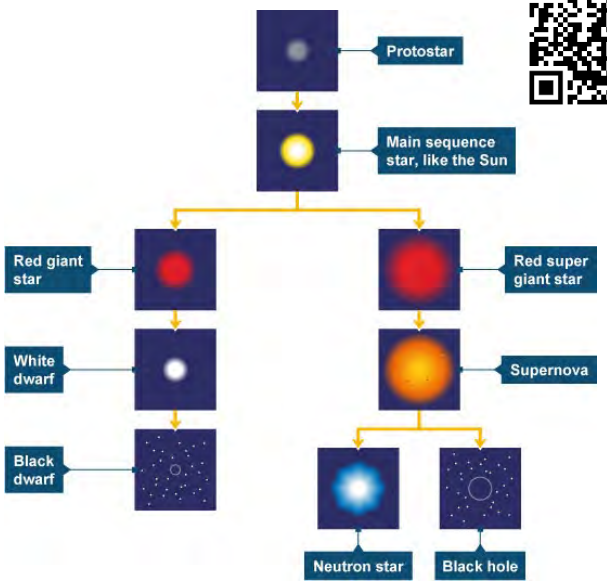
rotate	revolve
To Spin or Turn	Go Around
TAKES: 24 hours or 1 day	TAKES: 365 days or 1 year
CAUSES: Day & Night	CAUSES: The Seasons

Modelling the solar system:



A scale model is a copy of something that is much larger or smaller than the object itself but one which maintains the original's proportions.

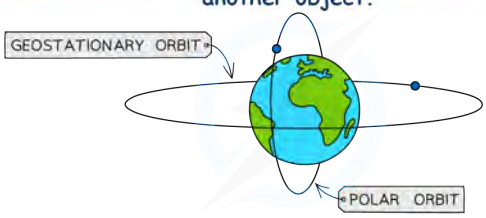
Stars and lifecycle:



The universe:

An orbit: a curved path that an object takes around another object.

A satellite: an object that orbits around another object.



Equations for this topic

Electricity (Part 1)

Threshold Concept

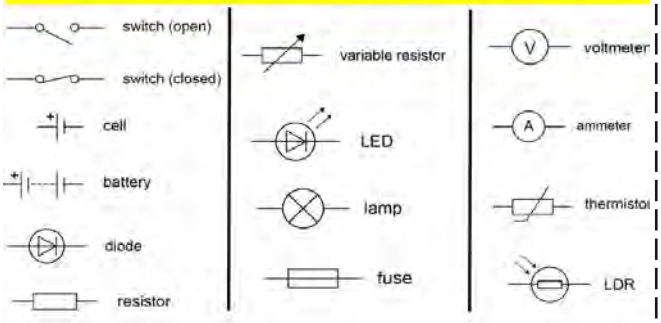
Electricity is the flow of electrons.

Keywords

- **Electron:** a stable subatomic particle with a charge of negative electricity, found in all atoms and acting as the primary carrier of electricity in solids.
- **Electricity:** is the presence or flow of charged particles.
- **Charge:** is a property of a body which experiences a force in an electric field. Charge is measured in coulombs (C).
- **Current:** Current is the rate of flow of electric charge around a circuit.

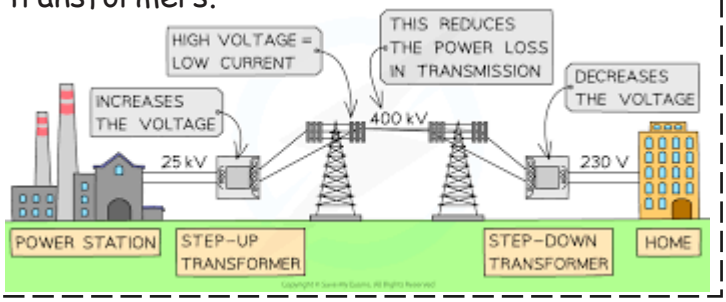
Circuit Symbols

An electronic circuit can include lots of different components. All of which can be represented with a symbol:

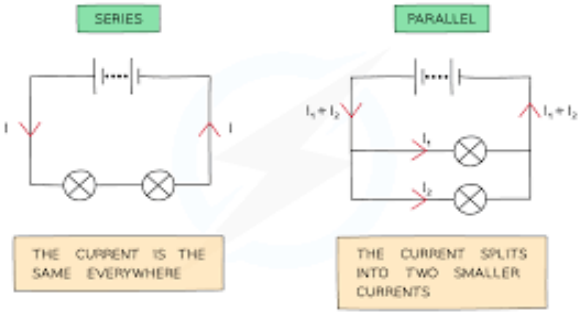


National Grid

The **National Grid** distributes electricity across the country. The National Grid connects power stations to homes, workplaces and public buildings all around the country through a system of cables and transformers.

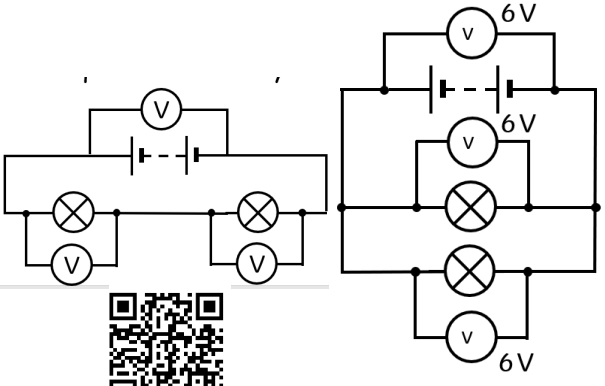


Series and Parallel circuits



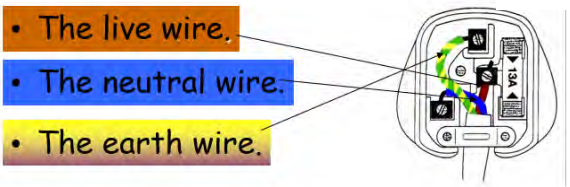
In a series circuit, the potential difference/voltage supplied by the battery is **shared** by the components.

In a parallel circuit, the potential difference across each bulb is the **same** as the potential difference across the battery.

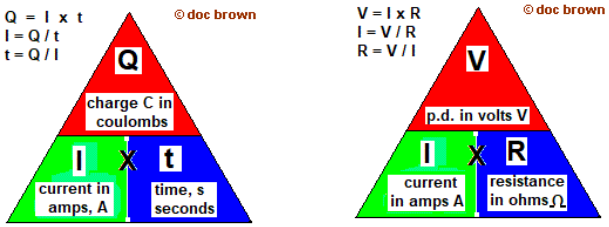


Practical

Wiring a plug



Equations for this topic



Waves

Threshold Concept

Waves transfer energy, **NOT** matter.

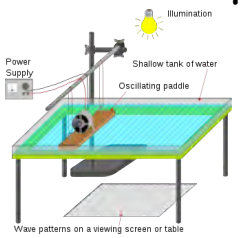
Link to information on the whole topic, consisting of slides, videos, and quizzes **Trilogy pupils ignore tasks 5,6 & 7.**

Keywords

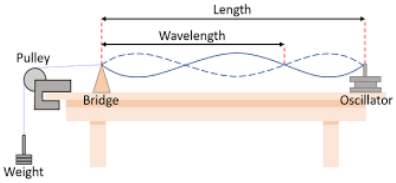
Wave - a disturbance/vibration in matter, which transfers the energy through the matter.
Energy – a property of a substance that is stored or transferred in order for things to be done.
Transverse – vibrations are perpendicular (at right angles) to the direction of energy transfer.
Longitudinal – vibrations are parallel (same direction) to the direction of energy transfer.

Required Practicals

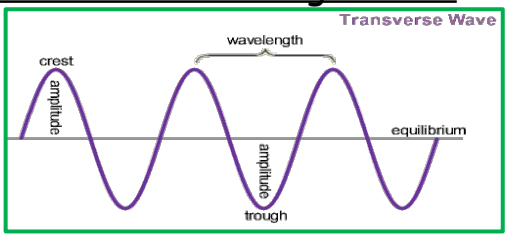
Waves in a liquid



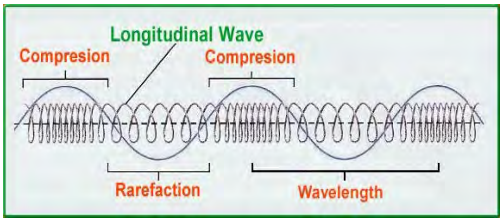
Waves in a solid



Transverse vs Longitudinal



Vibrations are **perpendicular** to the direction of energy transfer

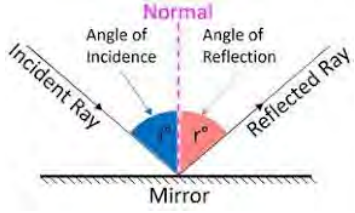


Vibrations are **parallel** to the direction of energy transfer

Reflection and refraction (HT only)

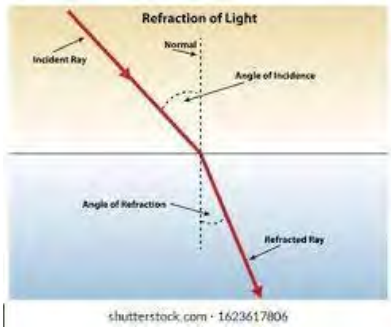
Law of reflection

The angle of incidence = the angle of reflection



Refraction

The change in direction and speed of light, due to passing from one medium into a different medium, of different densities



Equations

Wave speed = distance / time
$v = s / t$

Wave speed = wavelength x frequency
$v = \lambda \times f$

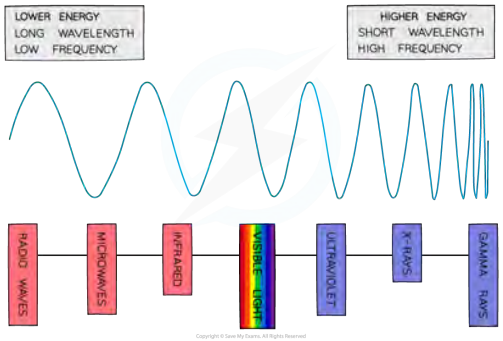
Time Period = 1 / frequency
$T = 1 / f$

EM Spectrum

Threshold Concept

Electromagnetic waves are waves in different frequencies

Types of electromagnetic waves:



Keywords

Frequency: The number of complete waves passing a certain point per second, or the number of waves produced by a source per second. Measured in Hertz, Hz

Wave: An oscillation that transfers energy without transferring any matter.

Spectrum: Used to classify something in terms of its position on a scale between two extreme points.

Energy: Is a key principle in physics, as it allows work to be done.

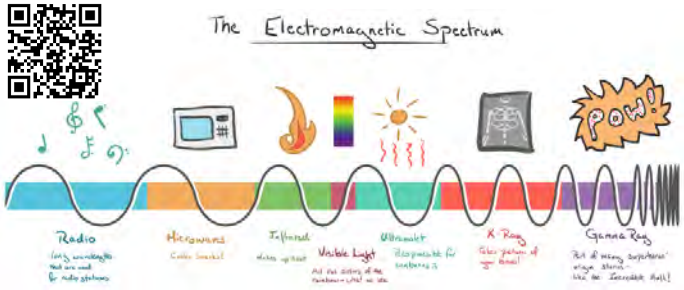
Speed: The maximum rate at which an individual is able to perform a movement or cover a distance in a period of time.

Properties of electromagnetic waves;

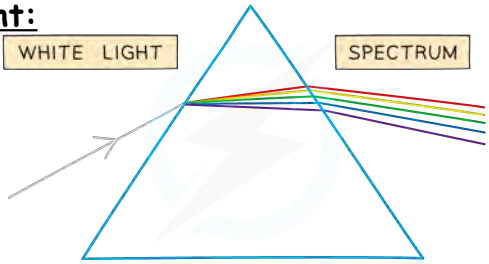
GAMMA RAYS	X RAYS	ULTRA VIOLET	VISIBLE	INFRA RED	MICROWAVES	TELEVISION	RADIO

GAMMA RAYS	Wavelength: around 1 pm Source: Nuclei Detector: Film, Geiger counter Properties/uses: Medical, sterilising food, checking metal castings, checking water flow
X RAYS	Wavelength: around 1 nm Source: Atoms Detector: Film Properties/uses: Medical X rays, defects in metals, checking paintings
ULTRA VIOLET	Wavelength: 0.001 – 0.4 μm Source: Atoms Detector: Skin, film Properties/uses: Sun tan, sun burn, theatre, checking documents, microscopes
VISIBLE	Wavelength: 0.4-0.7 μm Source: Atoms Detector: Eye, film Properties/uses: We use it to see the world around us
INFRA RED	Wavelength: 0.7-10 μm Source: Atoms Detector: Skin, thermometer, film Properties/uses: Physiotherapy, night sight, locating people trapped in smoke or ruins. Remote controls
MICROWAVES	Wavelength: 1 mm – 50 cm Source: Electronics Detector: Aerial Properties/uses: Microwave ovens, radio telescopes, radar
TELEVISION	Wavelength: around 50 cm Source: Electronics Detector: Aerial Properties/uses: Television
RADIO	Wavelength: 1 m – 1500 m Source: Electronics Detector: Aerial Properties/uses: Radio communication

Uses and applications of electromagnetic waves

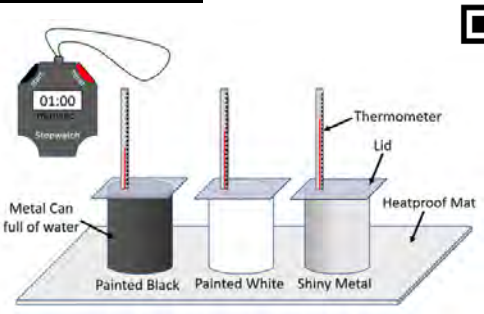


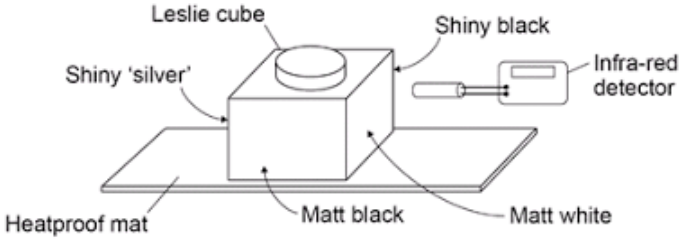
Visible light:



Required practical:

EM infrared RP





Communications:

Electromagnetic radiation is used for communications and transmission of information. The waves that are used in this way are radio waves, microwaves, infrared radiation and light.

Equations for this topic

wave speed = frequency × wavelength	$v = f\lambda$
time period = $\frac{1}{\text{frequency}}$	$T = \frac{1}{f}$

Electricity Part 2

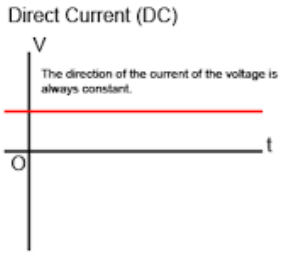
Threshold Concept

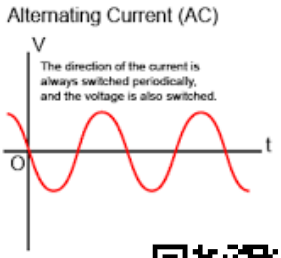
Potential Difference is the push that causes current to flow.

Keywords

- **Energy transfer:** the change of energy from one form to another.
- **Current:** Current is the rate of flow of electric charge around a circuit.
- **Resistance:** is a measure of the opposition to current flow in an electrical circuit.
- **Potential difference (voltage):** is the difference in the amount of energy that charge carriers have between two points in a circuit.

Alternating and Direct current (ACDC)



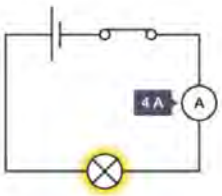


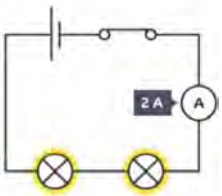
Electricity can flow either as direct or alternating current, and is used in homes to power electrical appliances.

Resistance

Resistance (R) is a measure of how difficult it is for current to flow. Resistance is measured in units called ohms (Ω).

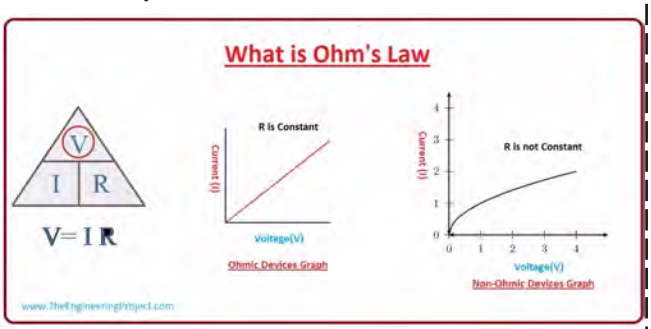
The more resistance there is in a circuit, the less current will flow.





Ohm's Law

Ohm's law states that current is directly proportional to potential difference (providing the temperature remains constant).

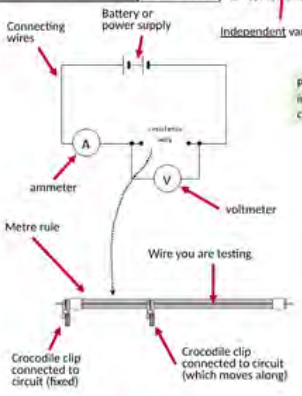


Required Practical's

Resistance

Required practical	Physics 3
Resistance in circuits	Combined Science 15

Use circuit diagrams to set up and check appropriate circuits to investigate the factors affecting the resistance of electrical circuits. This should include:
A - the length of a wire at constant temperature
B - combinations of resistors in series and parallel



Possible sources of significant **error** (which you can attempt to control): inaccurate attachment of crocodile clips; heating effect of electric current; misreading metre rule; misreading ammeter or voltmeter.

Method A steps:

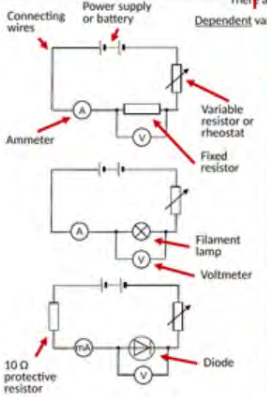
- Connect the circuit as shown
- Record in a table:
  - length of the wire between the crocodile clips
  - the readings on the ammeter
  - the readings on the voltmeter
- Move the crocodile clip and record the new ammeter and voltmeter readings. Note that the voltmeter reading may not change.
- Repeat this to obtain several pairs of meter readings for different lengths of wire
- Calculate and record the resistance for each length of wire using the equation $R = V/I$

I-V characteristics

Required practical	Physics 4
I-V characteristics	Combined Science 16

Use circuit diagrams to construct appropriate circuits to investigate the current–potential difference characteristics of a variety of circuit elements including a filament lamp, a diode and a resistor at constant temperature.

There are three investigations in this required practical.

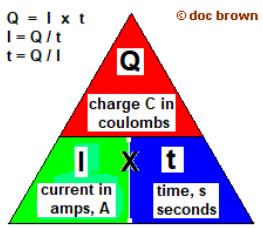


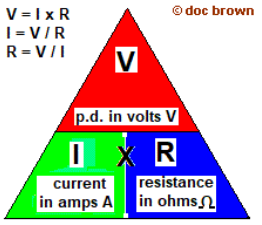
Possible sources of significant **error** (which you can attempt to control): misreading ammeter or voltmeter; inaccurate graphing

Method steps:

- Connect the circuit
- Record the readings on the ammeter and voltmeter in a suitable table.
- Adjust the variable resistor and record the new ammeter and voltmeter readings. Repeat this to obtain several pairs of readings
- Swap the connections on the battery. (the readings on the ammeter and voltmeter should now be negative)
- Continue to record pairs of readings of current and potential difference with the battery reversed
- Swap the leads on the battery back to their original positions
- Replace the resistor with the lamp.
- Repeat the steps above with the lamp in place of the resistor
- Swap the leads on the battery back to their original positions.
- If you can, reduce the battery potential difference to less than 5 V
- Replace the ammeter with a milliammeter (**or** change the setting on the multimeter)
- Replace the lamp with the diode. Connect the positive side of the diode to the milliameter.
- Repeat steps above to obtain pairs of readings of potential difference and current for the diode.

Equations for this topic





Motion

Threshold Concept

Speed equals distance travelled in a given time

Keywords

- **Speed:** Distance travelled in a certain time
- **Distance**: how far an object has travelled. It is a scalar quantity
- **Time**: how long something takes
- **Metres**: a unit measurement of distance (m)
- **Seconds**: a unit measurement of time (s)

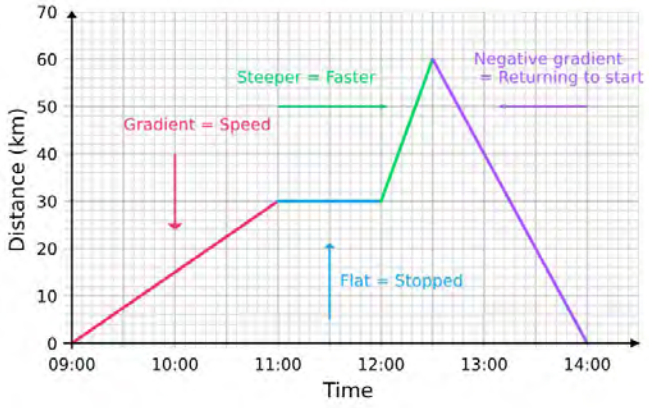
Speed, distance, time

-Speed is measured in metres per second (m/s)
-Distance is measured in metres (m)
-Time is measured in second (s)

Scalar and vector quantities

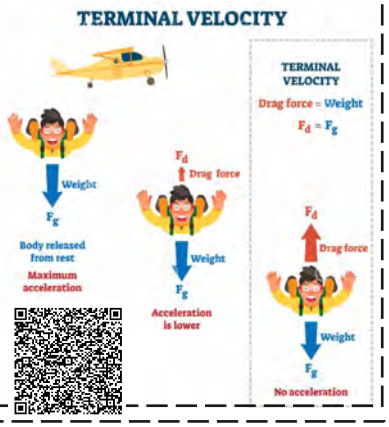
Scalar – a measurement of something. They only have MAGNITUDE (size)
Vector – a measurement of something. They have DIRECTION & MAGNITUDE (size)

Distance – Time Graphs

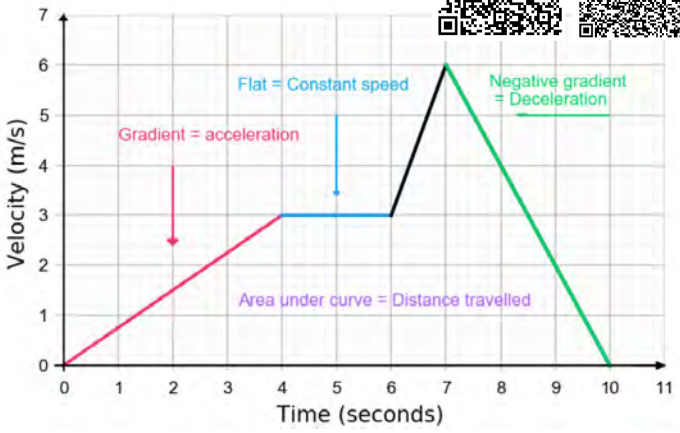


Terminal velocity

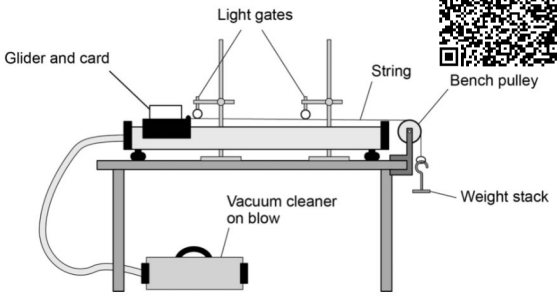
At terminal velocity, the object moves at a steady speed in a constant direction because the **resultant force** acting on it is zero



Velocity – Time graphs



Required practical – Acceleration



Equations for this topic

Speed = Distance ÷ Time
Change in Velocity = Acceleration x Time
Force = Mass X Acceleration

Atomic Structure

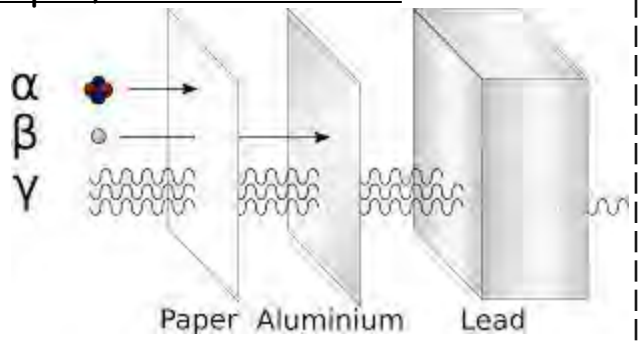
Threshold Concept

Identify that there are three types of radiation

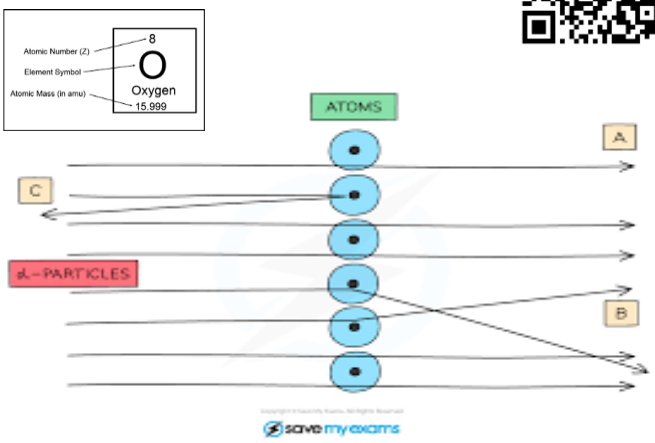
Keywords

Atom – the smallest particle of a chemical element that can exist
Proton – positively charged particle
Neutron – Particle with no charge
Electron – Negatively charged particle
Wave – Energy transfer method

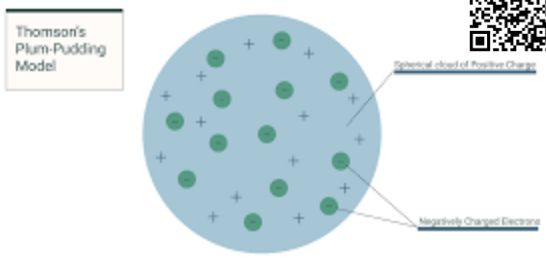
Alpha, Beta and Gamma



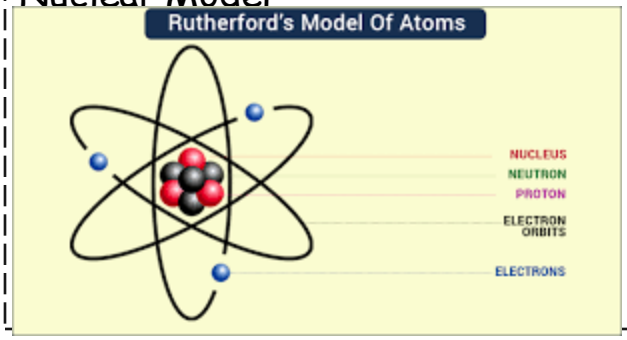
Rutherfords Scattering Experiment



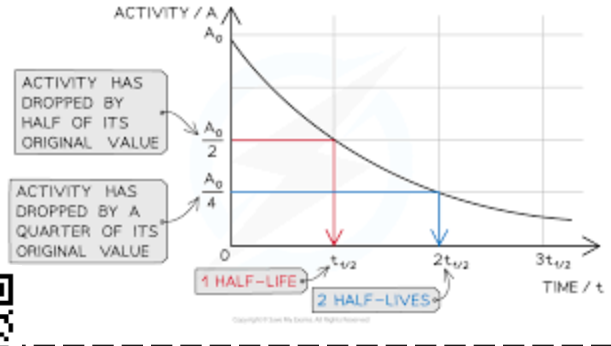
Plum Pudding Model



Nuclear Model



Half Life



Uses and Dangers of Radiation

	Irradiation	Contamination
Description	Object is exposed to radiation but does not become radioactive	Object becomes radioactive and emits radiation
Source	Danger is from radiation emitted outside the object	Danger from radiation emitted within the object
Prevention	Prevented by using shielding, such as lead clothing	Prevented by safe handling of sources and airtight safety clothing
Causes	Caused by the presence of radioactive sources outside the body	Caused by inhalation or ingestion of radioactive sources

uations for this topic

$$^{235}_{92}U \xrightarrow{\text{decay by releasing an alpha particle}} {}^{4}_{2}\alpha + {}^{231}_{90}Th$$

$$^{14}_{6}C \xrightarrow{\text{decay by releasing an beta particle}} {}^{0}_{-1}\beta + {}^{14}_{7}N$$

$$^{235}_{92}U \xrightarrow{\text{decay by releasing a gamma wave}} {}^{0}_{0}\gamma + {}^{235}_{92}U$$

Particle Models of Matter

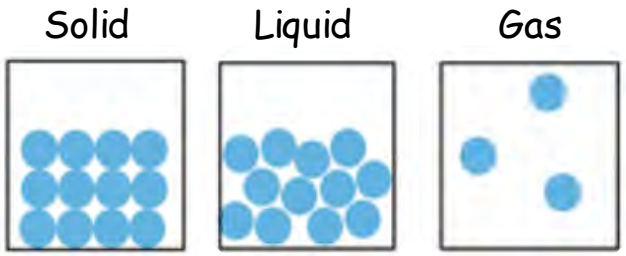
Threshold Concept

Changes of state are caused by energy changes

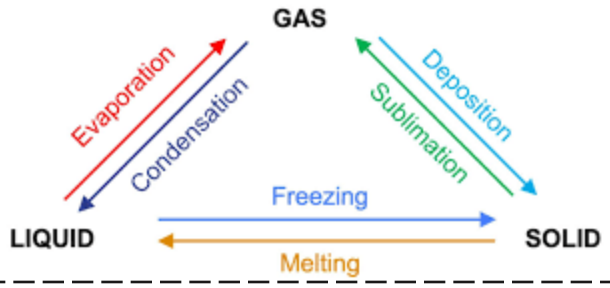
Keywords

States of matter – solid, liquid or gas.
Particles – the smallest part that a substance can be broken down into.
Energy – a property of a substance that is stored or transferred in order for things to be done.
Density – how compact a substance is.
Pressure – continuous force acted on or against an object.

States of matter



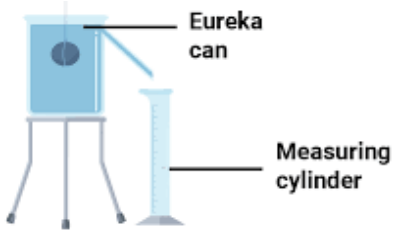
Changes of state



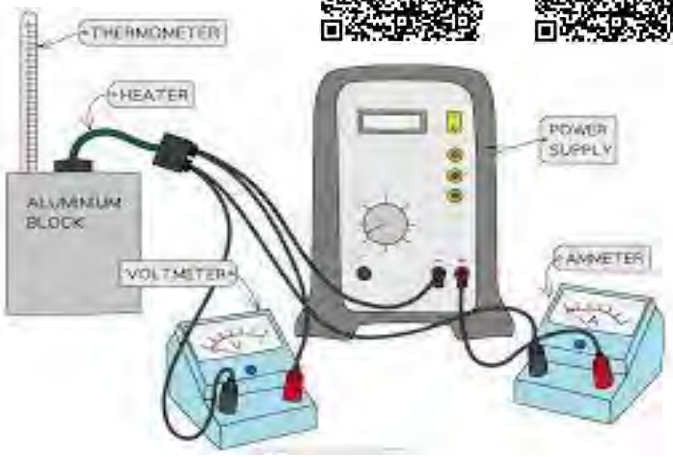
Links to information on the whole topic, consisting of slides, videos, and quizzes

Required Practical

Density



Specific Heat Capacity



Equations for this topic

$P = F/A$ Pressure = Force / Area

$P = m/V$ Density = mass / volume

$\Delta E = m \times c \times \Delta\theta$ Change in Energy = mass x specific heat capacity x change in temperature

$\Delta E = m \times L$ Change in Energy = mass x Specific Latent Heat

$P = \rho \times g \times h$ Pressure in a liquid column = density x gravity x height (TRIPLE ONLY)

For gases: $p \times v$ = constant For Gases: pressure x volume = constant (TRIPLE ONLY)

Electromagnetism

Threshold Concept

Magnets have two poles that attract or repel.

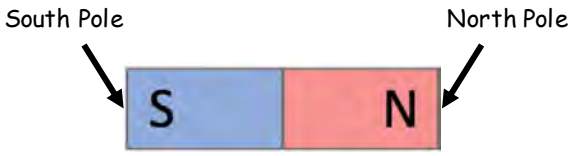
Keywords

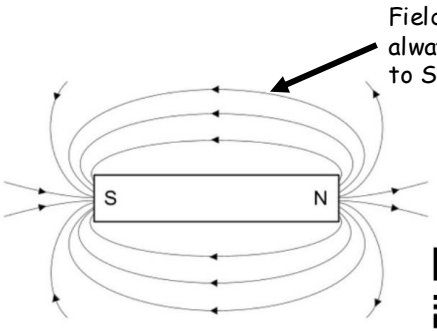
Permanent Magnet - A material that has its own magnetic field without needing to be helped by another magnetic material.
Induced Magnet – a material that only becomes a magnet when placed in another magnetic field.
Magnetic Field – a region around a magnet where the force of magnetism acts.
Solenoid – a coil of wire that carries an electrical current.
Electromagnet – a soft, iron core placed inside a solenoid.

Common magnetic materials

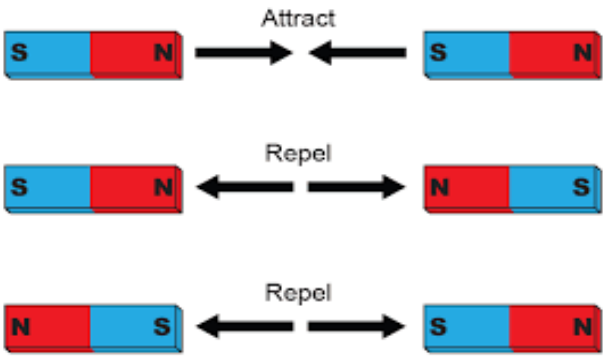
- Iron
- Nickel
- Cobalt
- Steel

A bar magnet and its magnetic field





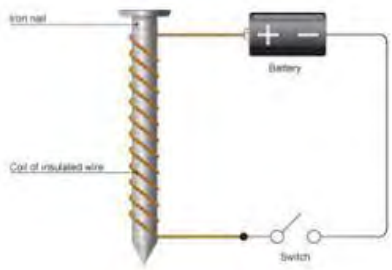
Attraction and repulsion



Electromagnets

Building an electromagnet

Electromagnets



Required Practical

Equations for this topic

Force = Magnetic Flux Density x Current x length of wire

$F = B \times I \times l$

Vehicle Safety

Threshold Concept

Cars have safety features to reduce impact forces

Keywords

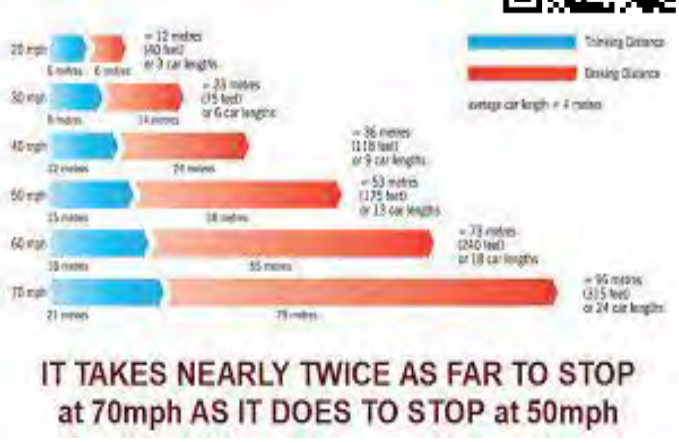
Newtons Laws – Three guiding principles stating the movement and reactions of all things due to physics

Impact forces – The forces occurring when two objects collide

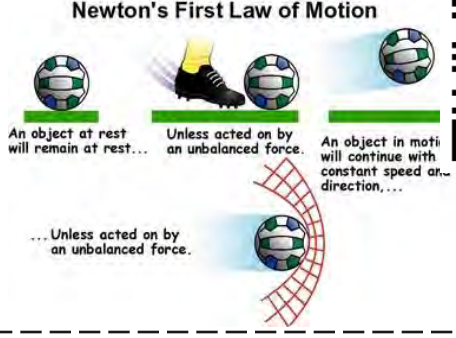
Momentum – A measure of how difficult it is to stop a moving objects

Safety Features in Cars

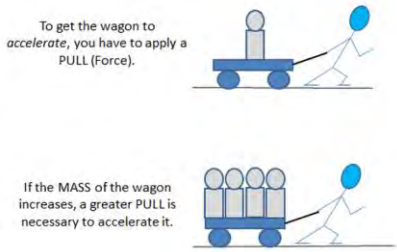
Stopping Distances



Newtons First Law



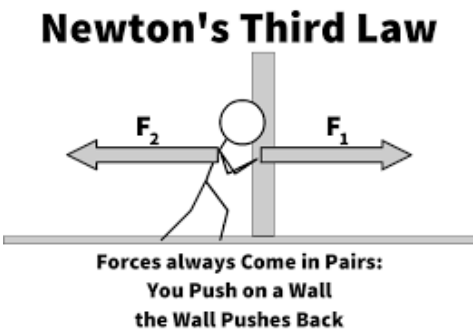
Newtons Second Law



Momentum

Fig 1. The Conservation of Momentum Applies to a Closed System Not an Open System.

Newtons Third Law



Equations for this topic

Force = Mass x Acceleration

Momentum = Mass x Velocity

Energy Recap (E_k, E_p, E_e)

Threshold Concept

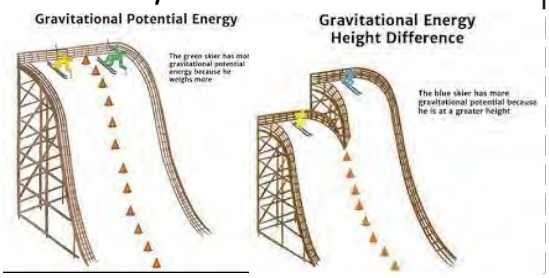
Energy can be transferred between stores depending on an objects motion

Keywords

Energy – a property of a substance that is stored or transferred in order for things to be done.
Work done = energy transferred
Elastic Potential Energy – energy stored in a stretchy or springy object.
Kinetic Energy – energy stored in a moving object
Gravitational Potential Energy – energy stored in an object raised above ground.

Gravitational Potential

Don't forget to click on the worksheet tab and exam question tab to try some tasks.



Equations

Gravitational potential energy = mass x gravitational field strength x height
$E_p = m \times g \times h$

Elastic potential energy = $\frac{1}{2}$ x spring constant x extension^2
$E_e = \frac{1}{2} \times k \times e^2$

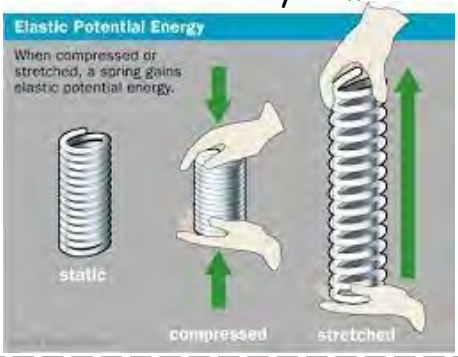
Kinetic energy = $\frac{1}{2}$ x mass x velocity^2
$E_k = \frac{1}{2} \times m \times v^2$

Kinetic Energy

Don't forget to click on the worksheet tab to try some tasks.

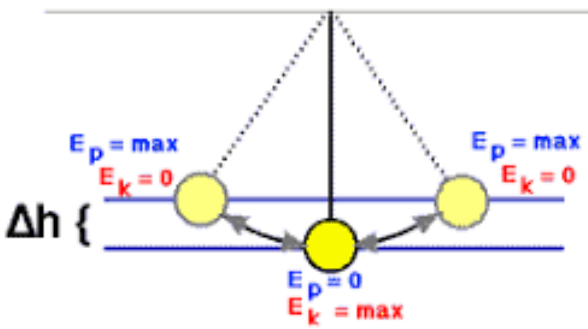
Elastic Potential Energy

Don't forget to click on the worksheet tab to try some tasks.



Conservation of energy

Don't forget to click on the exam questions tab to try some tasks.



E_k = Kinetic Energy
E_p = Potential Energy

Space (TRIPLE)

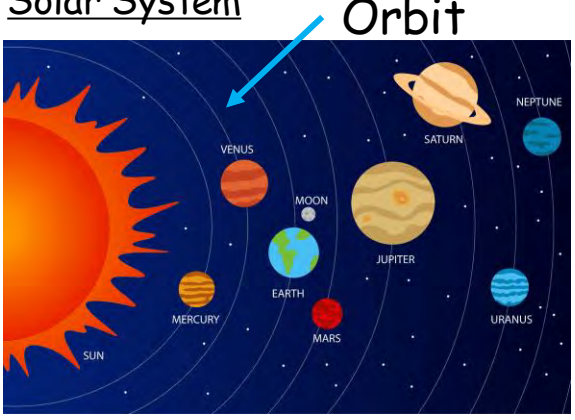
Threshold Concept

The Solar System is made up of many types of objects.

Keywords

Solar System - the collection of eight planets and their moons in orbit round the Sun, together with smaller bodies in the form of asteroids, meteoroids, and comets.
Orbit – the curved path of a celestial object or spacecraft round a star, planet, or moon
Sun – the star around which the 8 planets of the Solar System orbits.
Planet – a celestial body moving in an elliptical orbit round a star.
Moon – a celestial body moving in orbit around a planet. They are natural satellites.
Satellite – an object, either natural (e.g. The Moon), or artificial, that orbits a moon, planet or star. Artificial satellites are for information gathering.

Solar System



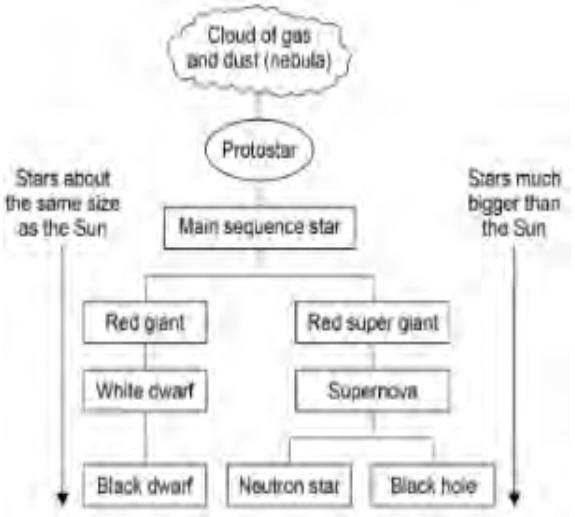
Link to information on the whole topic, consisting of slides, videos, and quizzes

Orbital Motion & Satellites

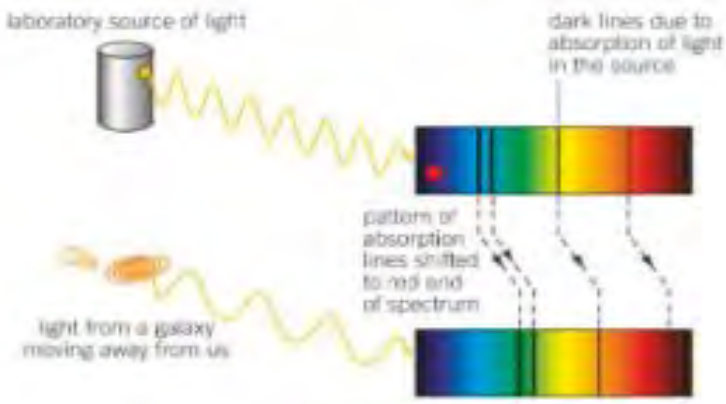
Planets orbit in near-circular orbits: they maintain a constant speed but are always changing direction. This means they have a constant speed but NOT a constant velocity

The Moon is a Natural Satellite. All other satellites of Earth are artificial, such as weather, military, ISS, GPS etc.
Geostationary satellites follow the same point above Earth, so have an orbital period of 24 hours.

Life Cycle of Stars



Red-shift and Big Bang



Equations for this topic

Required Practical