Year 9 Summary Sheets

Biology: Topic 1-3

Chemistry: Topic 1-4, 17

Physics: Topic 1-4

Name: _____

Class: _____

BIOLOGY

CB1 Biology Cheat Sheets

Microscopes:

Total magnification = Eye piece lens x objective lens

Example: An eye piece lens has a magnification of x5 and an objective lens has a magnification of x 10

Total = 5 x 10 = x50

Electron microscopes vs light microscopes

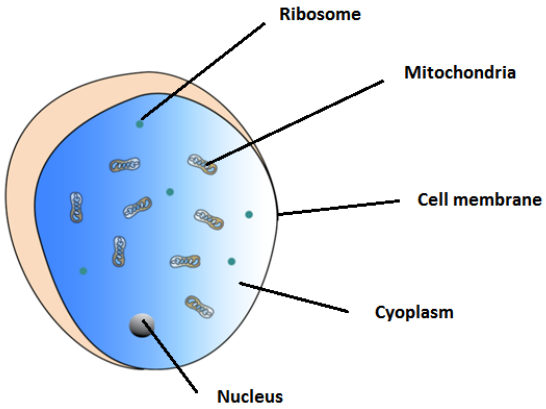
- *Greater magnification*
- *Greater resolution*
- *Show more detail*

SI Units

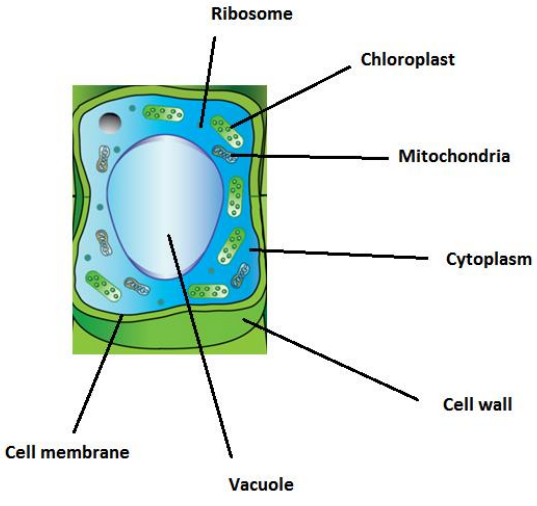
Unit	Example
Metres (m)	1
Millimetres (mm)	1000
Micrometres (μm)	1, 000, 000
Nanometres (nm)	1, 000, 000, 000
Picometres (pm)	1, 000, 000, 000, 000

Cells

Animal cell:



Plant cell:



Organelle	Function
Nucleus	Contains DNA and controls the cell's activities
Cell membrane	Controls what enters and leaves the cell
Cytoplasm	Where chemical reactions take place
Mitochondria	Site of aerobic respiration which releases energy
Ribosomes	Where protein synthesis happens
Cell wall	Made of cellulose and supports and protects the cells
Vacuole	Contains cell sap which keeps the cell rigid
Chloroplasts	Contain chlorophyll and is where photosynthesis occurs producing glucose

Specialised Cells

Egg cell:

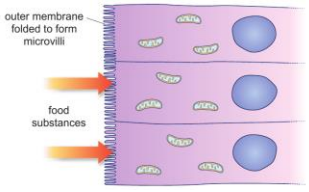
- Jelly coat – protects the egg
- Large cytoplasm – packed with nutrients to supply fertilised egg with energy to grow

Sperm cell:

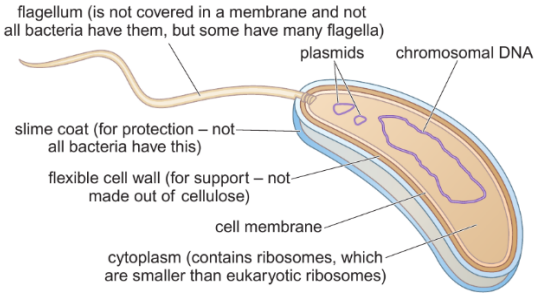
- Streamlined shape
- Tip of the head has a vacuole called an **acrosome** which contains enzymes to break down jelly coat of the egg
- Tail used for swimming
- Lots of mitochondria – release lots of energy to power the tail

Ciliated epithelial cell:

- Digestion: Large surface area due to microvilli
- Oviduct: Cilia move to push the egg towards the uterus



Bacteria:

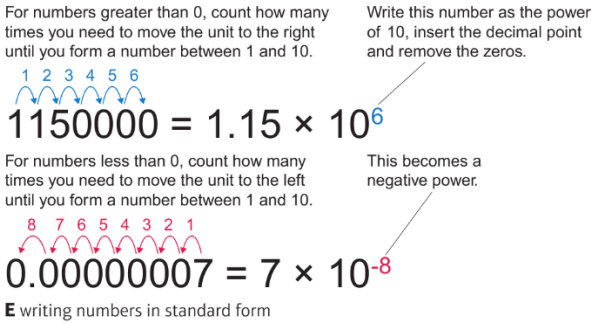


Bacteria contain two types of DNA:

- Chromosomal DNA
- Plasmid DNA

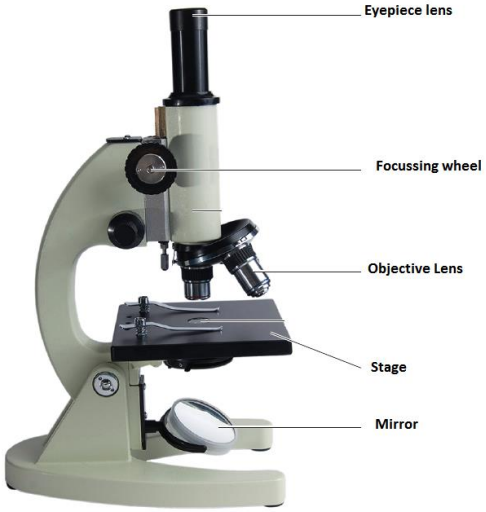
Exam Tip: Make sure you know the similarities between animal, plant and bacterial cells

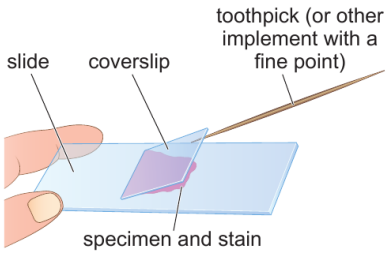
Standard Form:



E writing numbers in standard form

Core Practical: Using Microscopes



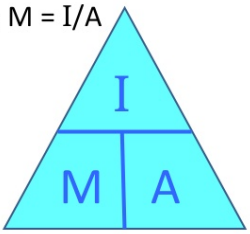


B Lowering a coverslip slowly and carefully means a slide is less likely to contain air bubbles.

Stains are used to make structures visible in the slides so that they can be viewed under the microscope

Calculating Magnification:

- Calculated using the formula M = I/A



I = size of image

A = actual size of object

M = magnification

BUT you must remember to convert values to the same unit FIRST

Worked examples:

Sasha draws a palisade cell from a star anise plant. The cell has a length of 0.45 mm.

a Sasha's drawing is magnified ×500. Calculate the length of the cell in Sasha's drawing. *(1 mark)*

We have the actual size and the magnification:

Image = Magnification x Actual size
= 500 x 0.45
= 225mm

b Sasha adds a scale bar to show 0.1 mm. Calculate the length of the scale bar. *(1 mark)*

Now we have the actual size of the scale bar = 0.1 mm and the magnification
= 0.1 x 500
= 50mm

A heart muscle cell is 20 µm wide. It has been drawn 1 cm wide. Calculate the magnification of the drawing. *(2 marks)*

We need to make sure the units are the same
Actual size = 20µm
Image size = 1cm = 10mm = 10,000µm

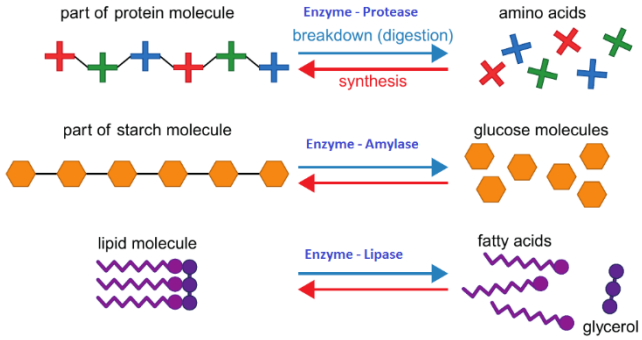
Now the units are the same we can just work out the magnification

Magnification = 10,000/20 = x 500

A magnification of x 500 means the image is 500 times bigger.

Enzymes

- Proteins – made up of amino acids joined together
- Biological catalysts – speed up the rate of a reaction without being used up

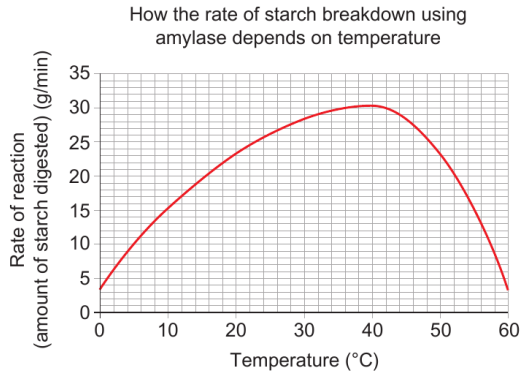


Examples of enzymes and what they do:

Enzyme name	Where found	Reaction catalysed
amylase	saliva and small intestine	breaking down starch to small sugars, such as maltose
catalase	most cells, but especially liver cells	breaking down hydrogen peroxide made in many cell reactions to water and oxygen
starch synthase	plant	synthesis of starch from glucose
DNA polymerase	nucleus	synthesis of DNA from its monomers

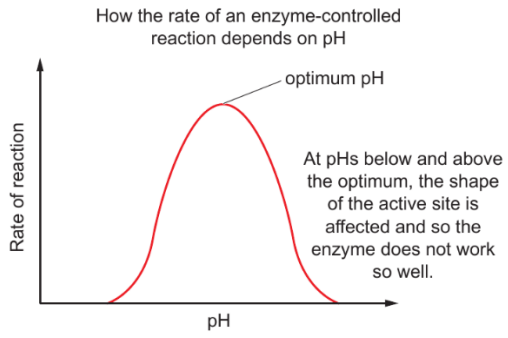
3 factors affect enzyme activity:

1. Temperature



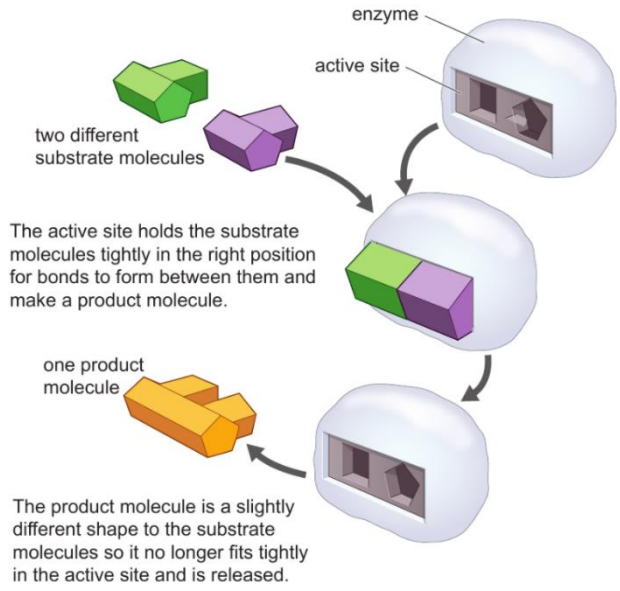
B the data in graph A shown as a rate of reaction graph

2. pH



How enzymes work:

One model of how enzymes works is by the lock and key hypothesis:

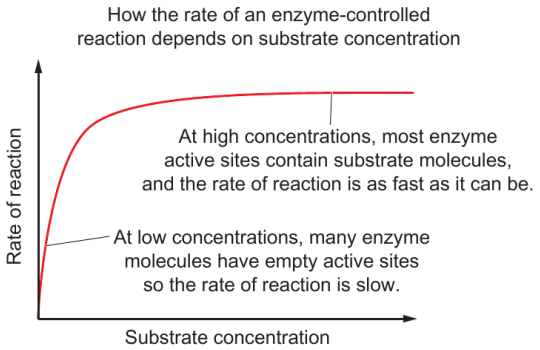


Enzymes have an active site which is a **specific shape** to the substrate

For example the substrate starch is specific to the active site of amylase only.

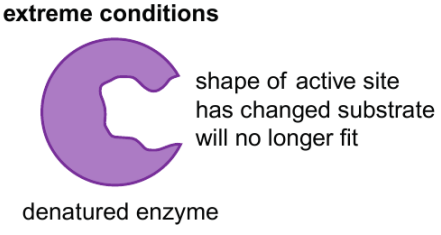
Enzyme activity:

3. Substrate concentration



Enzymes have an optimum temperature and pH at which they work best at and the rate of reaction is the fastest.

Above the optimum temperature the enzyme's active site changes shape and the substrate no longer fits. We say the enzyme becomes denatured.



Calculating rate of reaction:

Hint: Make sure you look at the units in the question!

starch took 6 minutes to get broken down

5/6 = 0.83g/min

Example: It takes an average of 15 seconds for starch to get broken down. Calculate the rate of reaction (s^{-1})

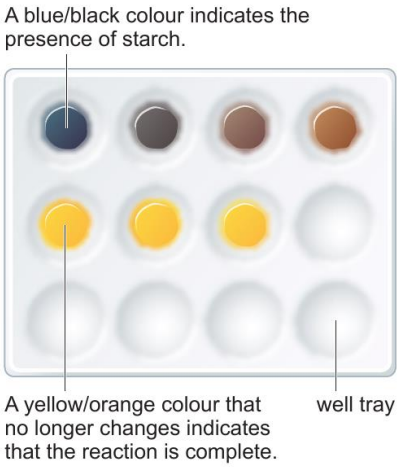
1/ 15 = 0.067s^{-1}

Core Practical: pH and Enzymes

In this experiment you looked at how pH affects the enzyme amylase.

To ensure the results were valid made sure that the volume of starch and amylase was the same

You kept the temperature the same as temperature affects enzyme activity.

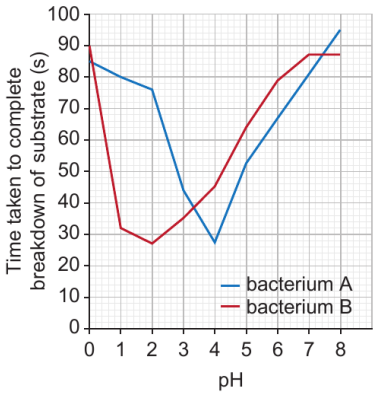


B iodine solution is used to indicate the presence of starch

When starch is present the iodine turns black.

When there is no starch present the iodine no longer changes colour. This is because amylase has broken down all of the starch.

Example: Calculate the rate of reaction (g/min) when 5g of

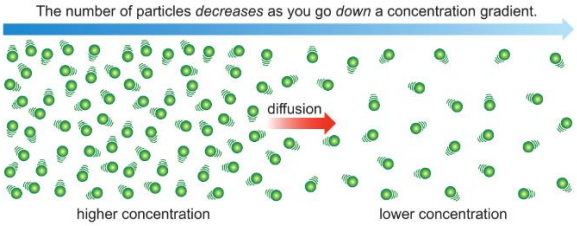


D Graph to show the effect of pH on glucose oxidase. This enzyme catalyses a reaction in which glucose is broken down to form hydrogen peroxide. Hydrogen peroxide can help obtain metals from mine waste.

The results from the experiment show that bacterium A and B have different optimum pH's. Bacterium A works best at pH 2 but Bacterium B works best at pH 4.

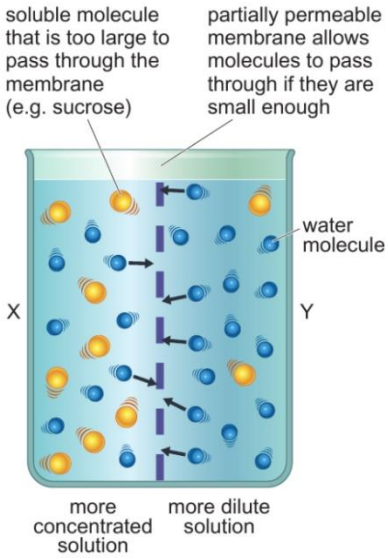
Transporting Substances:

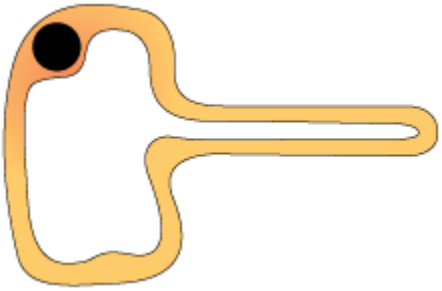
Diffusion is the movement of particles from a high to a low concentration down a concentration gradient.



B diffusion occurs down a concentration gradient

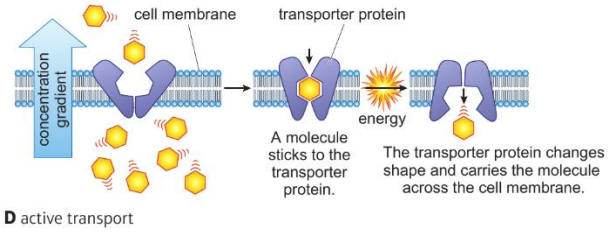
Osmosis is the movement of water molecules from a high concentration to a low concentration down a concentration gradient across a partially permeable membrane.





Osmosis occurs in root hair cells in plants to get water into the plant

Active transport is the movement of particles from a low concentration to a high concentration against a concentration gradient using energy.



D active transport

Both diffusion and osmosis are passive processes as they do not require energy.

Active transport is an active process because it requires energy

Core Practical: investigating osmosis in potatoes

Osmosis can cause tissues to gain or lose mass. To calculate the mass change:

- work out the difference between the mass of tissue at the start and at the end (final mass – initial mass)
- divide this difference by the initial mass
- multiply by 100.

So, percentage change in mass = $\frac{\text{(final mass – initial mass)}}{\text{initial mass}} \times 100$

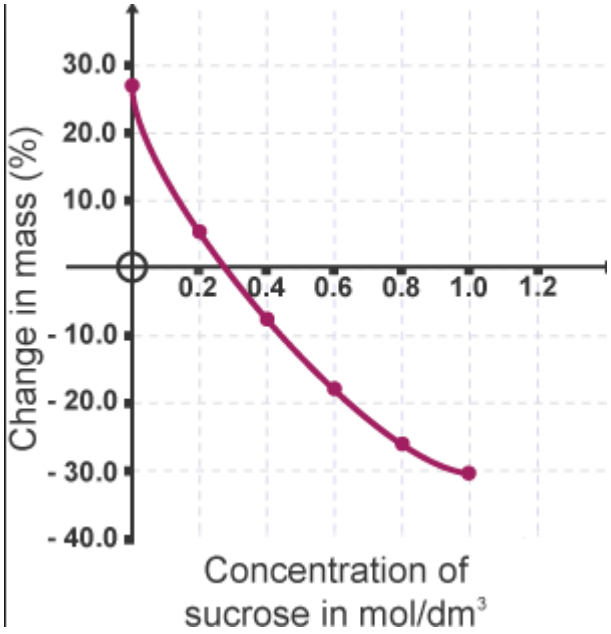
A negative answer is a percentage *loss* in mass.

In this experiment you changed the concentration of solution and measured the percentage change in mass

You had to control the following to make you experiment valid:

- Size of the potato cubes
- Same age of potato
- Same type of potato
- Same amount of drying

Once you had left the potatoes in the solution you had to dry them. This ensured **accurate readings** of the end mass.



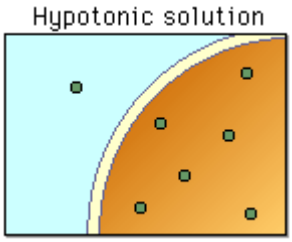
The point at which the graph crosses the X axis is where the percentage change in mass was zero.

At this concentration, we can say that the concentration of water inside and out was equal and no osmosis occurred: **isotonic concentration**

To get a more accurate concentration we could repeat the experiment at intermediate concentrations between 0.2 and 0.4 mol/dm^3

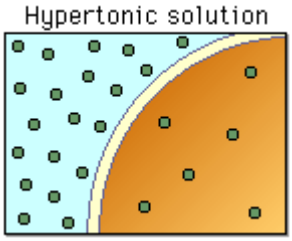
Solutions can be either hypotonic or hypertonic.

Hypotonic solutions have **low concentrations** of solute in the solution.



The result would be water **moving from the solution into the material by osmosis**

Hypertonic solutions have **high concentrations** of solute in the solutions.



Water would move by **osmosis from the material into the solution**

CB2 Biology Cheat Sheets

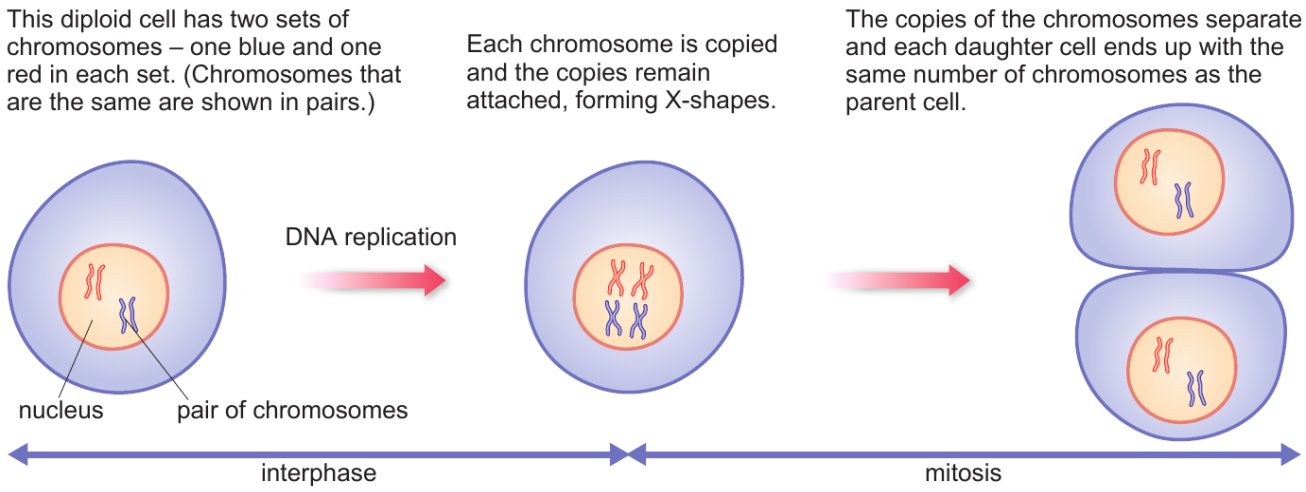
Mitosis:

Mitosis produces **2 genetically identical diploid cells**

Think MiTWOsis

- Used in growth and repair

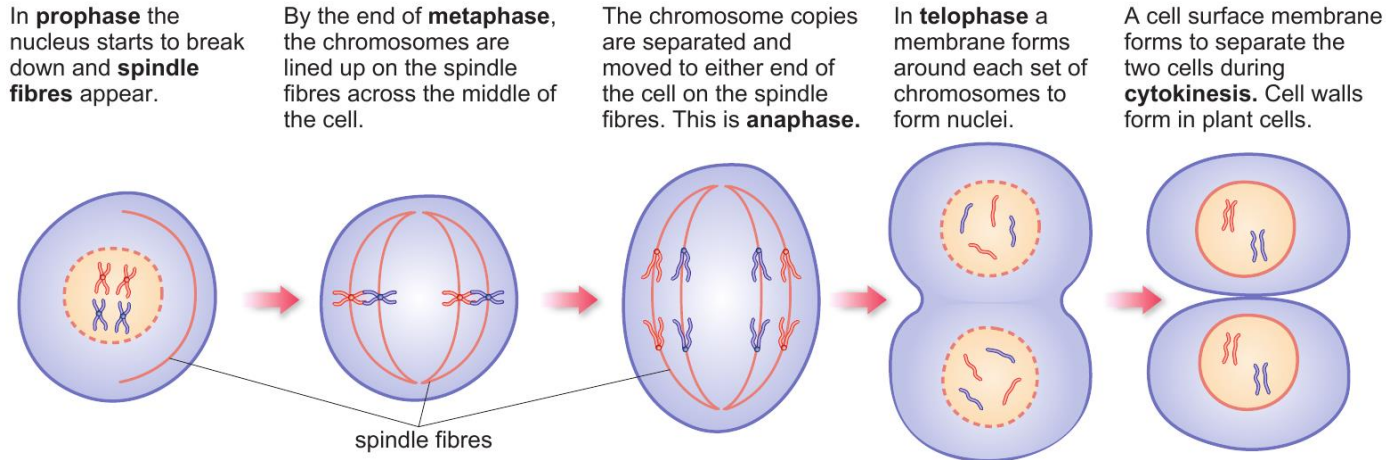
All body cells are diploid (2 sets of chromosomes) except the gametes (sex cells) which are haploid (one set of chromosomes)



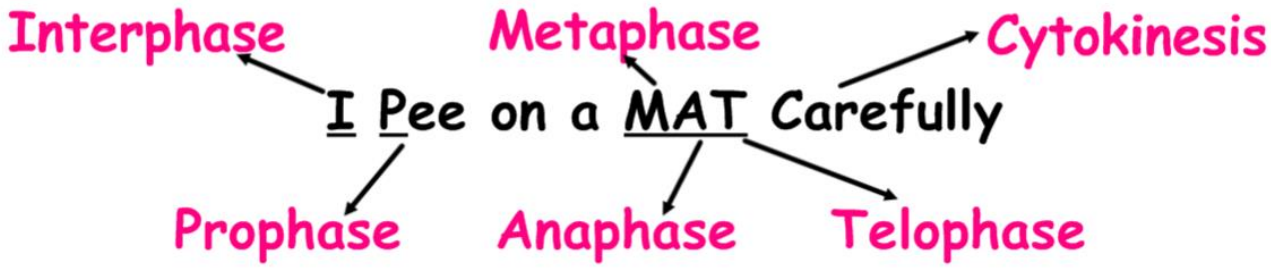
A During the cell cycle two identical daughter cells are formed from a parent cell.

Before mitosis occurs the cell has to replicate its DNA and make extra organelles such as mitochondria. This stage is called **interphase**.

Stages of mitosis:



REMEMBER:



Asexual vs Sexual reproduction:

- Sexual reproduction: Producing new individuals from two parents
- Asexual reproduction: Producing new individuals from one parent.

Asexual reproduction relies on **mitosis**

Cancer Tumours:

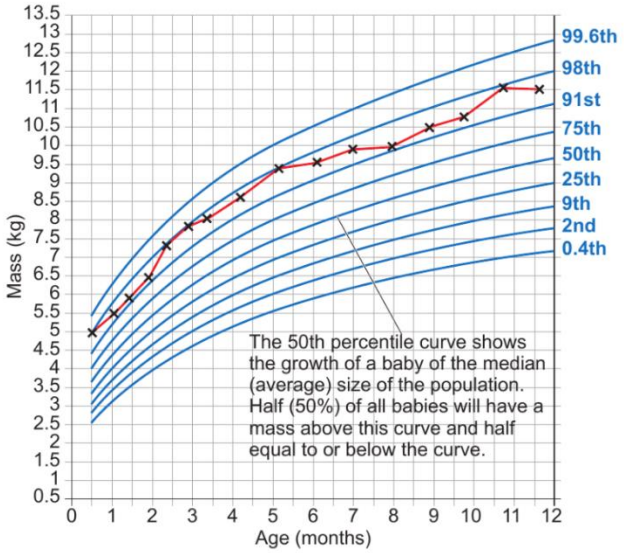
Cancer is uncontrolled cell division. This can form tumours which can damage the body and cause death

Growth in animals:

- Growth is an increase in size and number of cells.
- Cells increase in number by **mitosis**.
- Cells differentiate to become specialised.

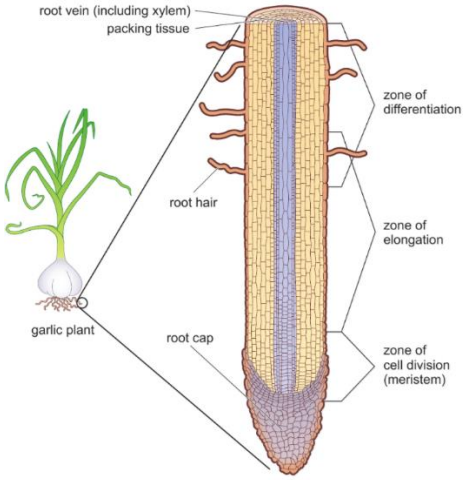
Specialised cell	Function
Red blood cell	No nucleus allowing more space for haemoglobin to carry oxygen Large surface area for oxygen to diffuse out and in quickly
Nerve cell	Long to carry electrical impulses around the body
Fat droplet	Cytoplasm filled with fat droplets which is stored until the body needs energy
Muscle cell	Contains contractile proteins that can shorten the cell

Percentile Charts.



If you are on the 95th percentile for mass. 5% have a higher mass than you, 95% have a lower mass than you.

Growth in plants:



- Mitosis happens in the meristems (found in the roots and shoots)
- Cells with then elongate (become longer) and differentiate.

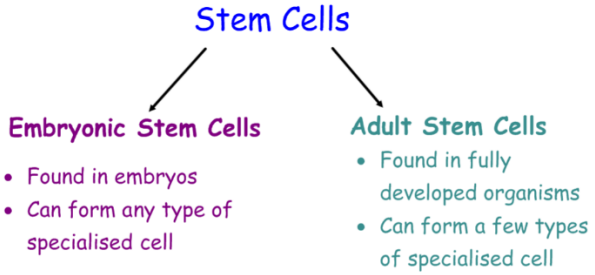
Specialised cells in plants include xylem vessels which transport water and root hair cells which take in water by osmosis.

Stem cells:

Stem cells are unspecialised or undifferentiated cells.

In plants stem cells are found in meristems in the shoots and roots

In animals:



Problems with using stem cells:

- They can cause cancer if used for replacing tissues
- Body can reject them if the immune system sees them as 'foreign'

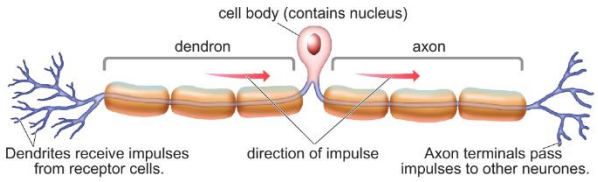
The Nervous System:

Central nervous system consists of:

- Brain
- Spinal Cord

Changes in the environment (stimuli) cause electrical impulses which are sent to the brain which can initiate a response.

Structure of a sensory neurone:



D a sensory neurone

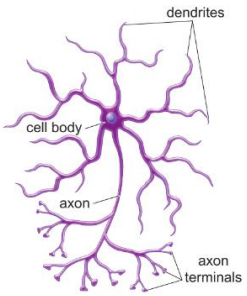
A fatty layer called the **myelin sheath** surrounds dendrons and axons. It's role is to insulate the neurone speeding up neurotransmission.

Dendrites receive impulses from receptor cells which have detected the stimulus.

Dendrons and axons are long to allow fast neurotransmission over long distances

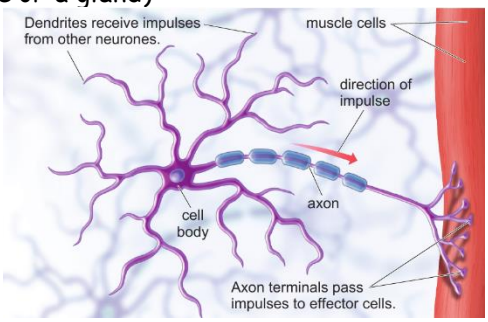
Two other neurones you need to know are the motor and the relay neurone.

Relay Neurone: Found in the spinal cord. Link sensory and motor neurones.



B a relay neurone

Motor Neurone: Carry impulses to effectors (muscle or a gland)



Synapses:

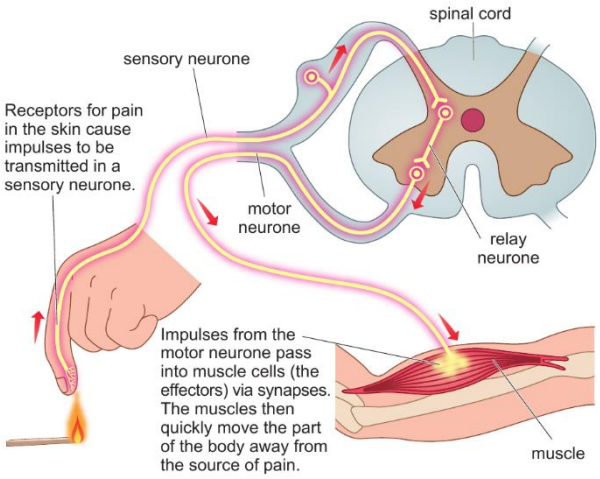
- Gaps between 2 neurones
- When an impulse reaches an axon terminal neurotransmitters are released into the gap.

Synapses slow down neurotransmission but ensure that impulses flow in one direction

Reflex arc:

Reflex arcs are automatic and quick because they do not involve the brain.

This helps to prevent further damage.



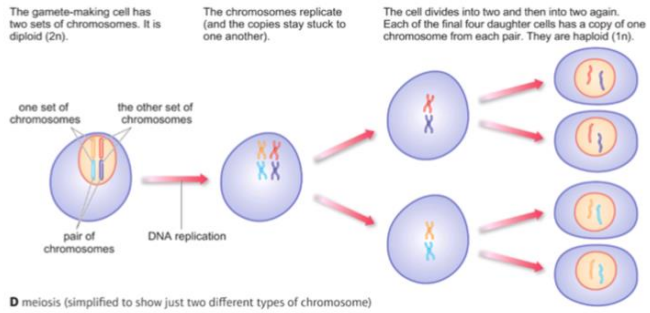
E a reflex arc

CB3 Biology Cheat Sheet

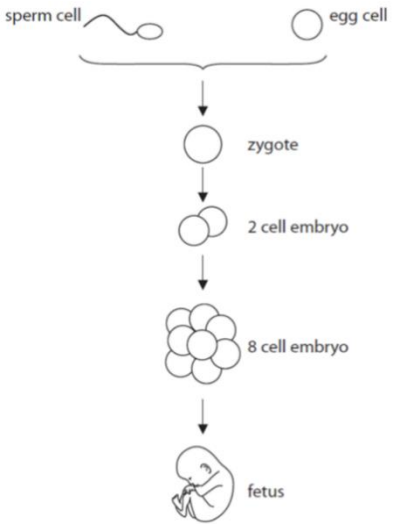
Meiosis:

- Produces 4 genetically different haploid cells
- Involved in the production of gametes (egg and sperm) for fertilisation.

Stages of meiosis:



D meiosis (simplified to show just two different types of chromosome)

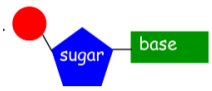


During fertilisation the egg and sperm cell fuse together to form a diploid zygote. The zygote then divides by mitosis before the cells differentiate to form an embryo.

DNA:

DNA is a polymer made up of monomers called nucleotides.

Nucleotides consist of a phosphate group, sugar and a base.



Structure of DNA

- Double helix
- 4 bases: Adenine, Cytosine, Guanine and Thymine
- Complementary base pairs: A with T, C with G
- Bases are held together by weak hydrogen bonds

Worked example: Part of a DNA sequence is

ATTCGCAT

What is the complementary base sequence?

We know that A pairs with T and C bases with G.

So the complementary sequence must be **TAAGCGTA**

DNA Extraction:

Method:

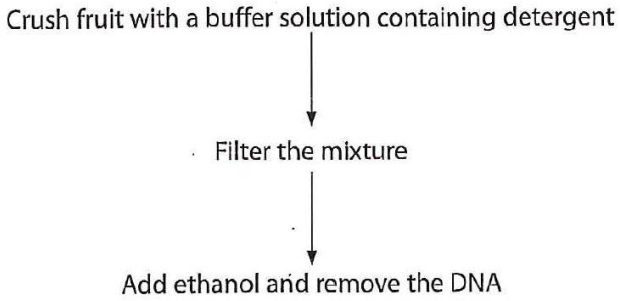
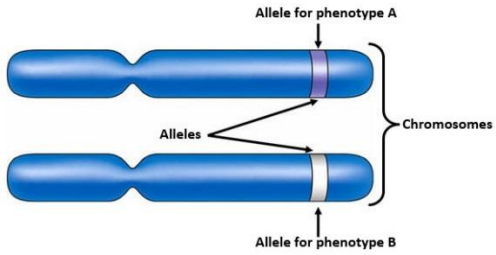


Figure 3

- Detergent is used to disrupt the cell membranes allowing the contents of the cell to come out.
- The mixture is filtered to remove insoluble material
- Ethanol is used to precipitate the DNA

Alleles:

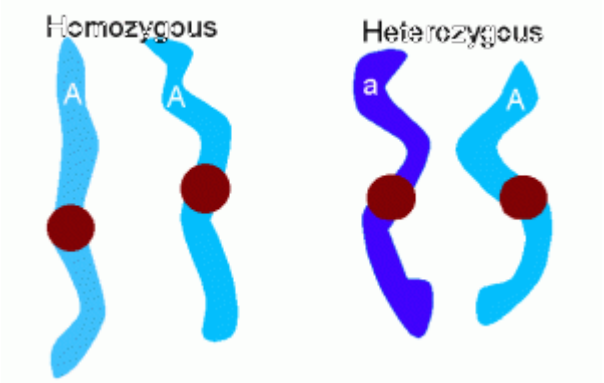
Alleles are different forms of the same gene



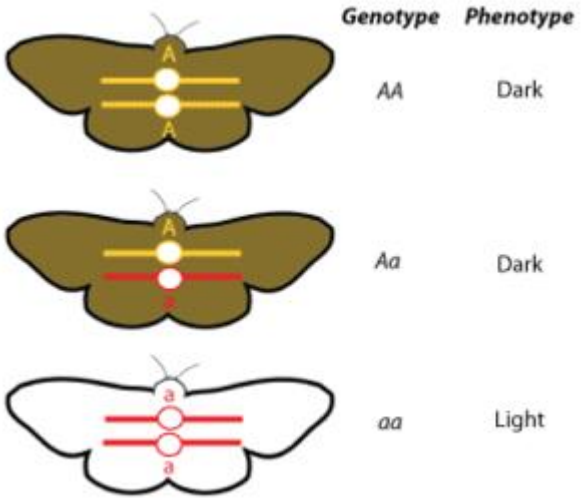
If both alleles are the same an individual is **homozygous** for a particular gene

If the alleles are different for a gene the individual is **heterozygous**

Remember: Homo means the same and hetero means different



- If one allele is needed for a particular characteristic we say the allele is **dominant**.
- If two alleles are needed for a characteristic the alleles are **recessive**.



Genotype are the alleles present

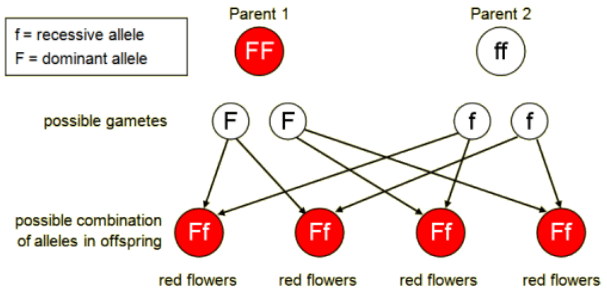
Phenotype is the characteristic displayed

Example:

Brown eyes is caused by a dominant allele (B) but blue eyes is caused by recessive alleles (b).

The genotype for brown eyes could be BB or Bb however because blue eyes is recessive we would need two b's to have the phenotype blue eyes.

Genetic diagrams: Show the possible combinations of alleles when organisms breed.



We can also use Punnett squares to work out the probability of offspring having particular characteristics.

f is the cystic fibrosis allele

		mother	
		F	**f**
father	**F**	FF	Ff
	f	Ff	ff

¼ are homozygous recessive and so would have cystic fibrosis which could also be written as 25%.

75% of offspring would not have the disease because they have a healthy allele (F).

Sex chromosomes:

Women have the sex chromosomes XX

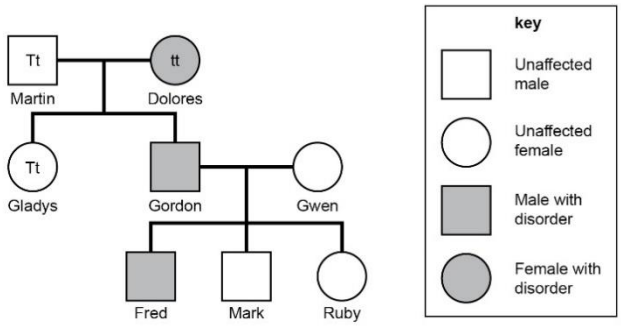
Men have the sex chromosomes XY

Gender determination		mother	
		X	X
father	X	XX	XX
	Y	XY	XY

The probability of having a girl or a boy is 50%

Family pedigree charts.

Shows how genotypes and resulting phenotypes are inherited in families.



The disorder is caused by recessive alleles.

Gordon and Fred both have the disease so their genotype must be tt.

Gene mutation:

A mutation is a change in the sequence of DNA for a gene

Mutations can have no effect in the protein formed, some effect of a large effect

Explain how a mutation can lead to a non-functioning enzyme

A mutation is a change in the sequence of bases that code for a gene. This will produce a different protein. The enzyme's active site will be a different shape and therefore no enzyme-substrate complexes will form

Human Genome project

Project that sequenced the whole of the human genome

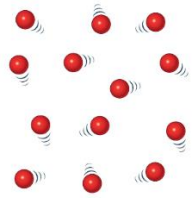
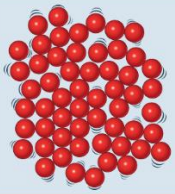
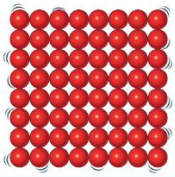
Advantages:

- ✓ Personalised medicines
- ✓ Identifying people who are at risk of particular diseases allowing people to make necessary adjustments to lifestyle

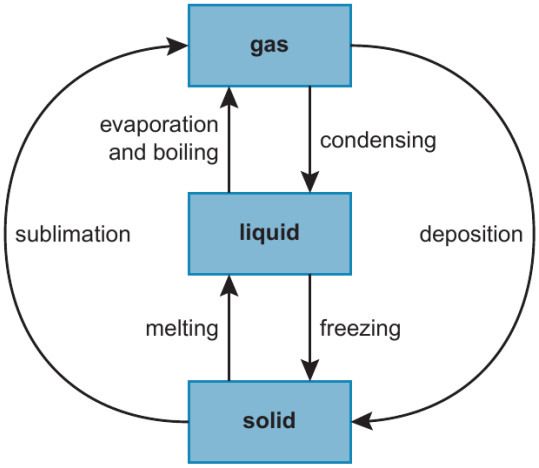
CHEMISTRY

CC1-2 Chemistry Cheat Sheet

States of Matter:

State	Particle diagram	Arrangement of particles	Movement of particles
Gas		random far apart	fast in all directions
Liquid		random close together	move around each other
Solid		regular close together	vibrate about fixed positions

State changes are physical changes so can be reversed. The particles do not change in a physical change only the arrangement.

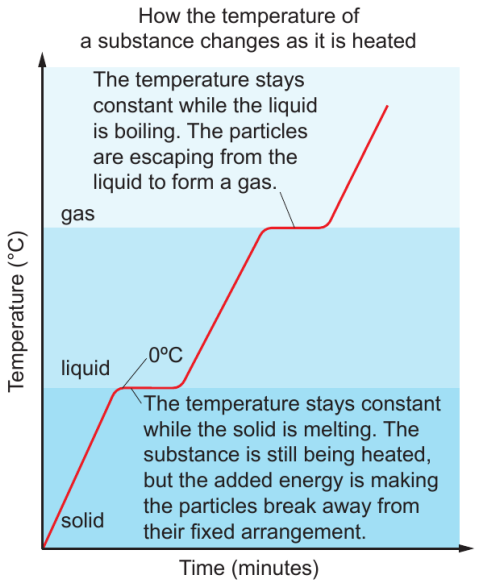


Particles are held together by weak forces of attraction.

During melting and evaporation the weak forces of attraction are overcome because energy is transferred to the particles

When particles lose energy to their surroundings in condensing and freezing and so they form weak forces of attraction.

Heating curve:



D a heating curve for water

Predicting state:

- Below the melting point the substance is solid
- Between melting and boiling point the substance is liquid
- Above the boiling point the substance is a gas

Example:

Water has a melting point of 0°C and a boiling point of 100°C.

Predict the state at 20°C.

*20°C is between the melting and boiling point so the state must be a **liquid***

Mixtures:

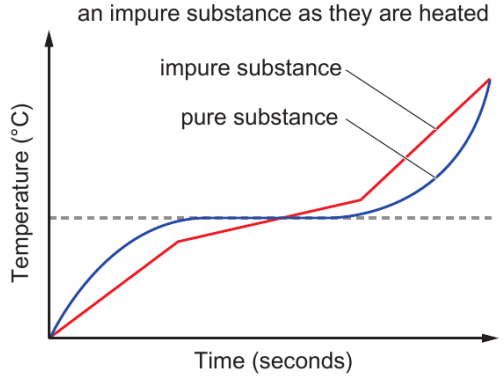
Pure substances have a fixed composition and does not have anything mixed with it.

- Cannot be changed
- Same physical properties

For example elements such as gold and compounds such as carbon dioxide.

Mixtures contain elements and/or compounds that are not chemically joined together.

How temperature changes in a pure substance and an impure substance as they are heated



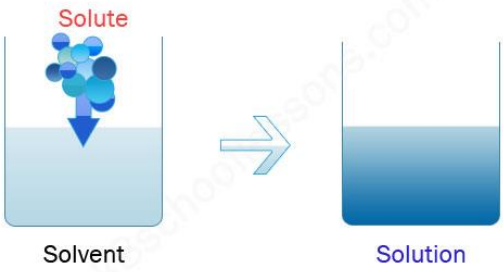
D heating curves for a pure substance and a mixture

Mixtures are impure substances and do not have fixed, sharp melting and boiling points like pure substances do.

Filtration and Crystallisation:

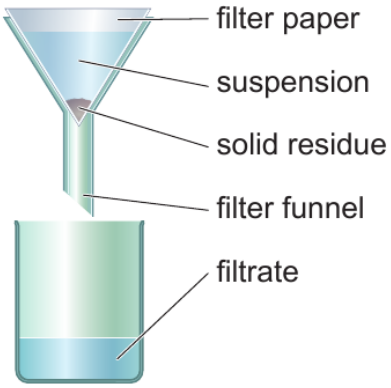
A solution is a mixture of solutes in a liquid called a solvent.

A saturated solution is one that contains the maximum amount of solute that you can dissolve in the solvent at that temperature.



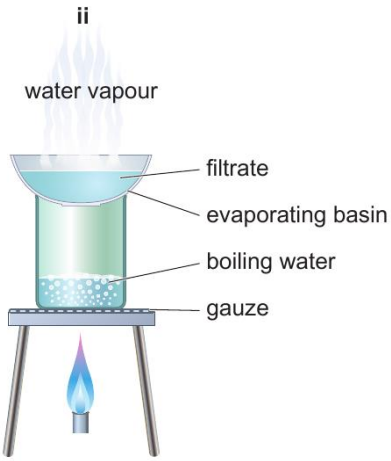
Filtration removes insoluble materials from a solution.

This is because they cannot fit through the tiny holes in the filter paper.



Crystallisation evaporates the solvent to leave behind the solutes.

The longer the time for crystals to form the bigger they are.

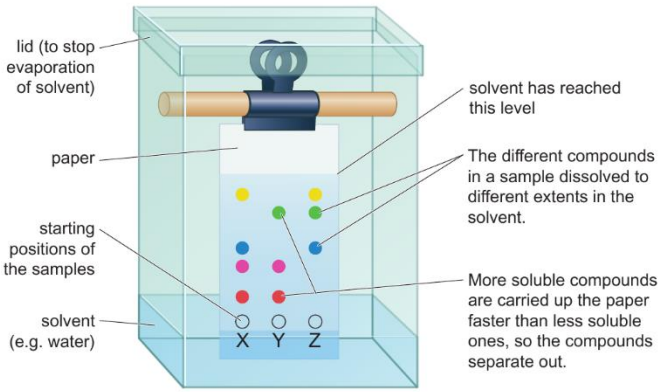


Hazards and safety in crystallisation:

- Spitting from solution – wear eye protection and remove Bunsen Burner before solution is completely dry
- Burns from Bunsen Burner/ evaporating basin – use tongs or wait until it is completely cool.

Chromatography

Chromatography is a technique used to separate the components of a mixture.



The baseline is drawn in pencil as it is insoluble.

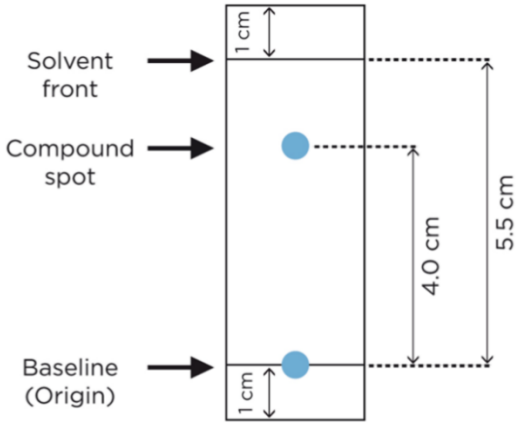
The baseline must be above the solvent when first placed into the beaker so that the samples do not get washed off.

There are 2 phases in chromatography:

- Mobile phase: Solvent
- Stationary phase: Paper

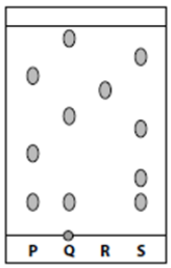
Calculating Rf Values:

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



Rf = 4/5.5 = 0.72

Hint: If your answer is not between 0 and 1 then you have made an error.



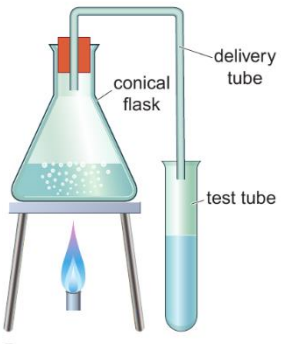
Insoluble inks will not move up the chromatography paper. You can use a **different solvent** to see if you can get results.

The more soluble a substance is the further it will travel up the chromatography paper.

Less soluble substances do not travel as far.

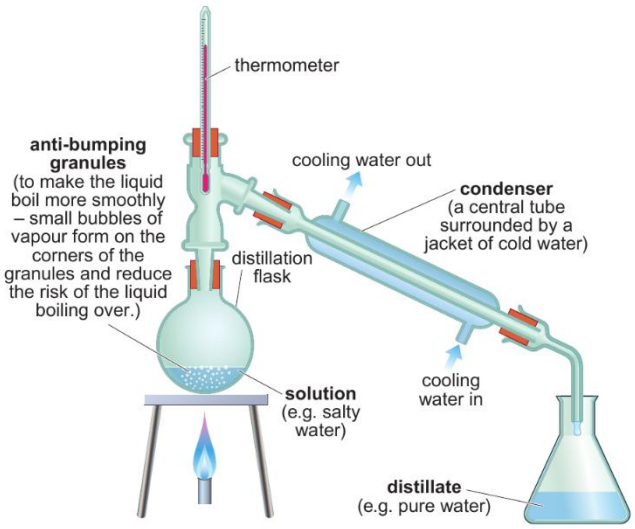
Distillation:

Process of separating a liquid from a mixture by evaporating the liquid and condensing it

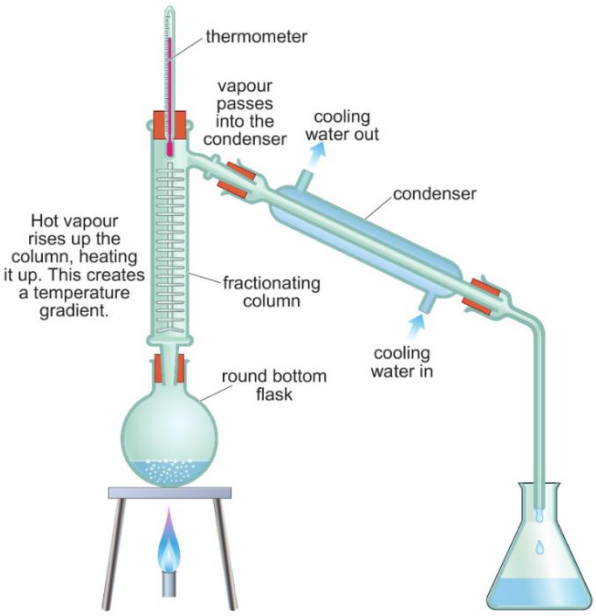


B a simple still

Simple distillation is not very efficient as a lot of the vapour is lost



Fractional distillation is used to separate 2 or more liquids. It is used in separating crude oil, air and making alcohol.

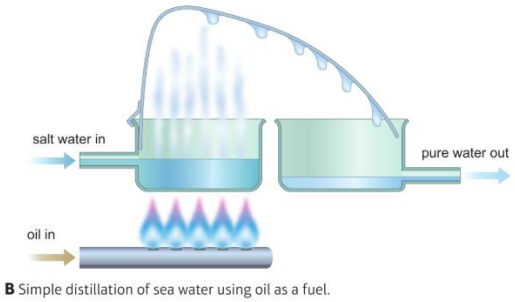


A temperature gradient is established – hottest at the bottom and coolest at the top.

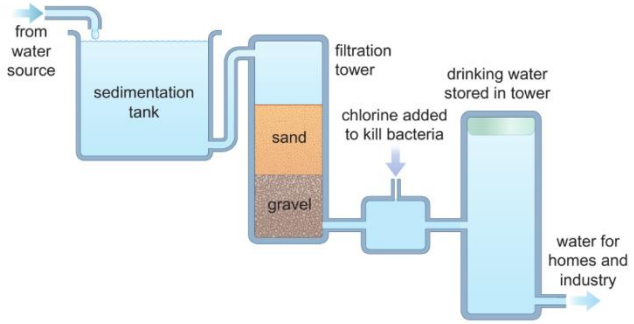
The liquid with the lowest boiling point will reach the top first and passes into the condenser.

Drinking water:

Desalination is the process in which pure water is obtained from sea water.



B Simple distillation of sea water using oil as a fuel.



D These are the main stages in treating fresh water to make it safe to drink.

Water we drink undergoes 3 main processes: Sedimentation, filtration and chlorination before it is safe to drink

1) Sedimentation: Particles are allowed to settle at the bottom
2) Filtration: Contains sand and gravel to remove insoluble particles
3) Chlorination: Chlorine is added to kill micro-organisms

Chemical analysis of water

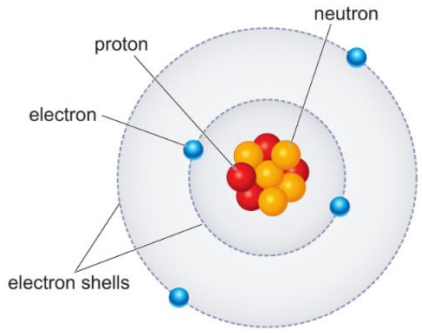
Water being analysed should not contain any dissolved substances as they can form precipitates and give incorrect results.

CC3-4 Chemistry Cheat Sheet

Structure of an atom

An early model of an atom was proposed by John Dalton. He said that atoms are tiny spheres and cannot be broken down.

The current model:



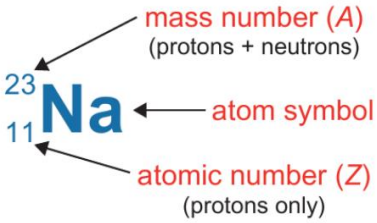
The centre of an atom is called the **nucleus** and contains protons and neutrons.

Electrons are found in shells surrounding the nucleus.

Subatomic particle	Relative charge	Relative mass
proton	+1 (positive)	1
electron	−1 (negative)	1/1835 (negligible)
neutron	0 (no charge)	1

Atoms have no overall charge because they have the same number of protons and neutrons

Atomic number and mass number:



We can use the mass and atomic number to work out the number of subatomic particles:

Na has 11 electrons and 11 protons (this is from the atomic number)

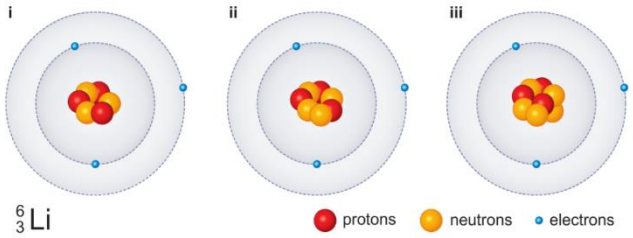
We know the number of electrons and protons are the same because an atom has no overall charge

We can work out the number of neutrons by subtracting the mass number from the atomic number.

23 – 11 = 12 neutrons

Isotopes:

Isotopes are elements that have the same number of protons (atomic number) but different numbers of neutrons.



Calculating relative atomic mass (RAM): *(Higher)*

Mean mass of an atom of an element compared with carbon-12.

H

The abundances (overall proportions) of the two isotopes of chlorine are 75% of $^{35}_{17}Cl$ and 25% of $^{37}_{17}Cl$. We calculate the relative atomic mass of chlorine as follows.

If we take 100 atoms,

$$\text{the relative atomic mass} = \frac{\text{total mass of the atoms}}{\text{the number of atoms}} = \frac{(75 \times 35) + (25 \times 37)}{100}$$

$$= \frac{2625 + 925}{100} = \frac{3550}{100}$$

$$A_r = 35.5$$

Elements and the periodic table:

Series	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8
1	H 1							
2	Li 7	Be 9.4	B 11	C 12	N 14	O 16	F 19	
3	Na 23	Mg 24	Al 27.3	Si 28	P 31	S 32	Cl 35.5	
4	K 39	Ca 40	? 44	Ti 48	V 51	Cr 52	Mn 55	Fe 56 Co 59 Ni 59 Cu 63
5	(Cu 63)	Zn 65	? 68	? 72	As 75	Se 78	Br 80	
6	Rb 85	Sr 87	Y 88	Zr 90	Nb 94	Mo 96	? 100	Ru 104 Rh 104 Pd 106 Ag 108
7	(Ag 108)	Cd 112	In 113	Sn 118	Sb 122	Te 125	I 127	
8	Cs 133	Ba 137	Di 138	Ce 140				
9								
10			Er 178	La 180	Ta 182	W 184		Os 195 Ir 197 Pt 198 Au 199
11	(Au 199)	Hg 200	Tl 204	Pb 207	Bi 208			
12				Th 231		U 240		

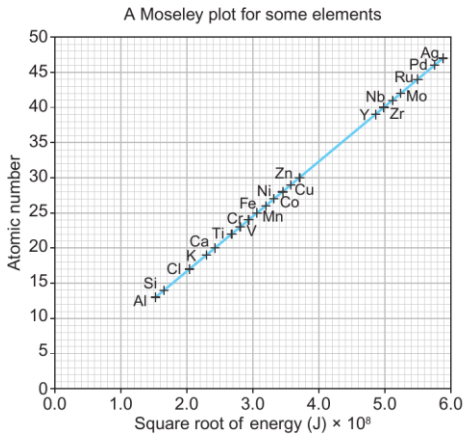
Mendeleev's periodic table is different from the modern periodic table

- He left gaps for undiscovered elements
- Arranged elements in order of relative atomic mass

He swapped positions of some elements based on similar chemical properties. For example Tellurium and Iodine.

Atomic number and the periodic table

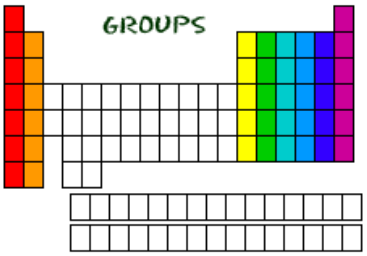
The modern periodic table is arranged in increasing atomic number (number of protons).



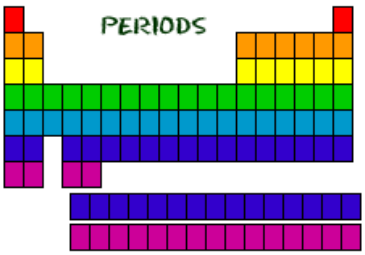
B There is a linear relationship between atomic number and the square root of the energy of emitted X-rays.

Groups are columns in the periodic table

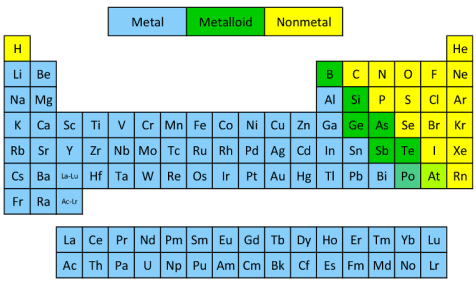
- Elements in the same group have similar chemical properties



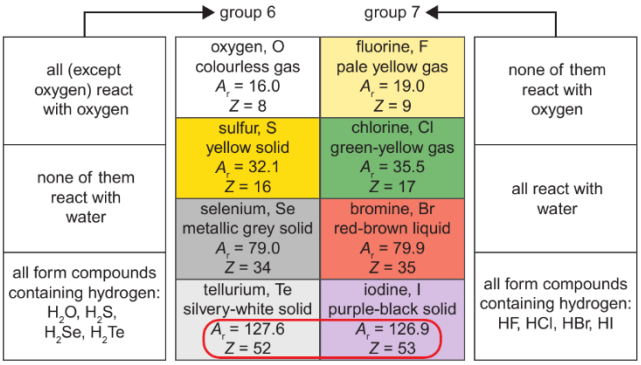
Periods are rows in the periodic table



Metals are found on the left of the periodic table and non-metals are found on the right.



Elements when arranged in order of atomic number meant that elements changed position



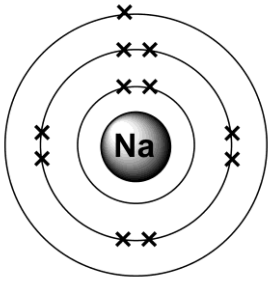
C These are the elements in groups 6 and 7, each with its relative atomic mass, A_r, and atomic number, Z.

Electronic configuration:

Rules:

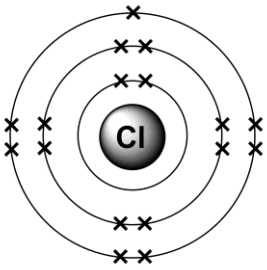
- The first shell can hold up to 2 electrons
- The second and third shell can contain up to 8 electrons

Example: Sodium has 11 electrons



Can be written as 2.8.1

Chlorine has 17 electrons. It has the electronic configuration of 2.8.7



Connections:

- Period number is equal to the number of shells
- Group number is equal to the number of electrons in the outer shell

Sodium has the electronic configuration of 2.8.1.

This means it is in group 1 and period 3

CC17 Cheat Sheet

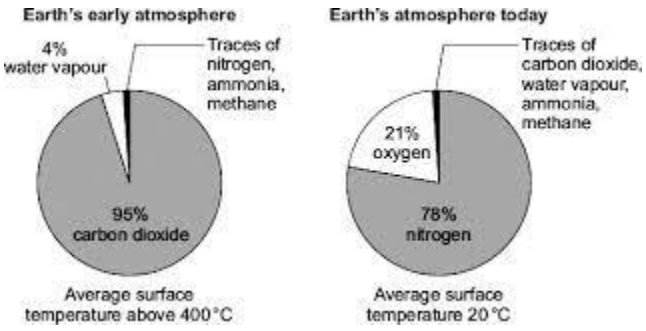
The Early Atmosphere

2 main gases that made up the Earth's early atmosphere:

1) Carbon Dioxide
2) Water Vapour

Atmosphere was due to **volcanoes**.

Changing atmosphere



Water vapour decreased:

- As the Earth cooled water vapour condensed
- Formed the oceans and seas

Carbon Dioxide decreased:

- Carbon dioxide dissolved in the oceans. Marine organisms used the carbon dioxide to make calcium carbonate shells
- Plants evolved and carried out photosynthesis. Plants take in carbon dioxide and release oxygen.

Oxygen levels increased:

- Plants evolved and carried out photosynthesis
- Plants take in carbon dioxide and release oxygen

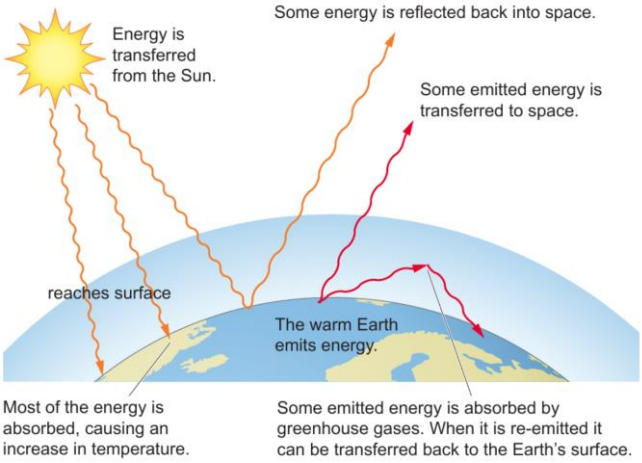
Atmosphere today:

Gases	% in atmosphere today
Nitrogen	78%
Oxygen	21%
Argon	0.9%
Carbon dioxide	0.04%

Greenhouse gases:

1) Carbon dioxide
2) Water vapour
3) Methane

Greenhouse gases are able to absorb energy and re-emit them back to the Earth's surface = greenhouse effect



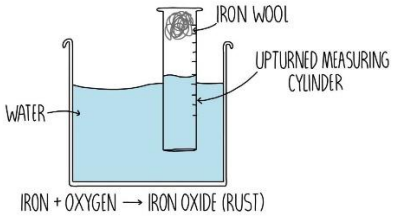
Data shows there is a **correlation** between carbon dioxide levels increasing and the mean surface temperature.

This does not mean that the link is causal (one thing causes the other).

Practical Skills: Determining the volume of oxygen in air

There are 2 practical methods to investigate determining volume of oxygen:

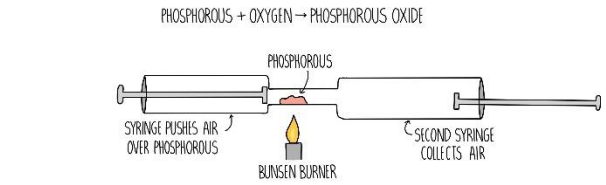
1) Iron wool and water:



As the iron reacts with oxygen in the air, water will move up the measuring cylinder. Take the start and end volume of air in the measuring cylinder and use the equation below.

$$\text{PERCENTAGE OF OXYGEN (\%)} = \frac{\text{DIFFERENCE IN VOLUME}}{\text{VOLUME AT START}} \times 100$$

2) Passing air over an element i.e. phosphorus or copper



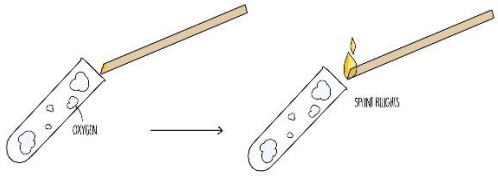
You have 2 gas syringes either end and you pass air over element between the syringes. Take the start and end volume.

i.e. 200cm^3 of air is passed over phosphorus. At the end there is 160cm^3 of air remaining in the gas syringe. Calculate the % of oxygen in air.

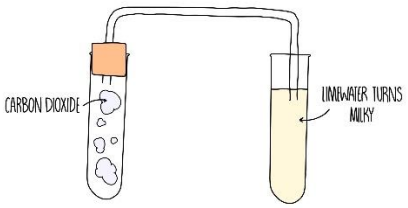
200-160 = 40cm^3
40/200 x 100 = 20%

Gas Tests:

Gas test for oxygen: Glowing splint relights



Gas test for carbon dioxide: Limewater turns milky/cloudy.



Climate change:

Human activity	Effect
Burning of fossil fuels	Increased carbon dioxide levels which is a greenhouse gas.
Livestock farming	Increased levels of methane which is a greenhouse gas
Deforestation	Increased carbon dioxide levels as trees are not taking carbon dioxide in for photosynthesis

Effects of climate change

- Ice caps melting and rising sea levels
- More extreme weathers i.e. storms and heat waves
- More CO_2 released will cause the oceans and seas to become more acidic affecting organisms living in the sea

Limiting the impact

- Using renewable energy resources (Links with CP3)

PHYSICS

CP1 Physics Cheat Sheet

Vectors and Scalars

Scalar quantities have magnitude only (size)

- Mass
- Distance
- Speed
- Energy
- Time

Vector quantities have magnitude and direction

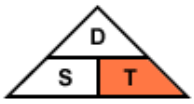
- Velocity
- Forces – Weight, Friction, Air resistance
- Displacement (shortest distance from A to B)

Speed is how far something moves in a certain time.

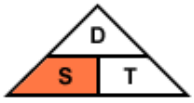
Velocity is how far something moves in a certain time in a given direction

Speed

Distance = Speed x Time



$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$



$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

Don't forget the units:

- Speed = metres per second (m/s)
- Time = seconds (s)
- Distance = metres (m)

Don't get caught out by units in your exam!

1km = 1000m

1 minute = 60 seconds

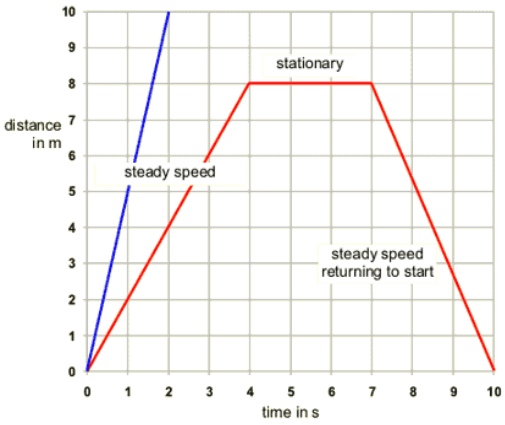
Measuring speed:

- Use a tape measure to measure the distance
- Use a stop watch to time how long it takes to move the distance
- Speed = distance/time
- Repeat to get a more accurate speed

Typical speeds

- **Walking = 1.4m/s**
- **Cycling = 6m/s**
- **Motorway speed limit = 31m/s**
- **High speed train = 90m/s**

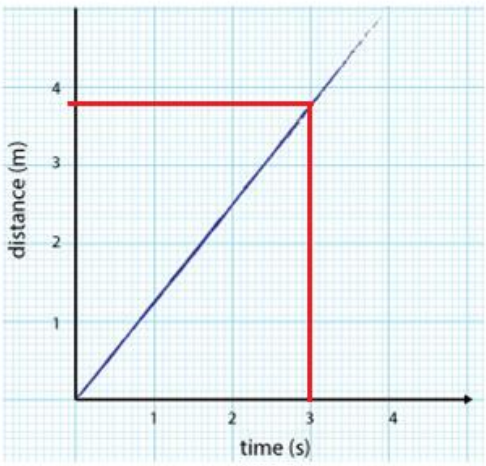
Distance- Time Graphs



The steeper the line the faster the object is travelling.

You can calculate the speed using distance time graphs

Worked example:



Distance travelled = 3.8m

Time taken = 3 seconds

Speed = 3.8/3 = 1.3m/s

Acceleration:

Acceleration tells you the change in velocity per second.

Acceleration is a **vector** quantity as it has **magnitude (size) and direction**.

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

v = final velocity

u = initial velocity

Worked example:

An aeroplane's velocity changes from 0m/s to 50m/s in 10 seconds. Calculate the acceleration.

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

a= 50-0 / 10

a = 5m/s^2

Worked example 2:

A car's velocity decreases from 40m/s to 10m/s in 6 seconds. Calculate the acceleration.

a = 10 – 40 / 6

a = -30 / 6

a = -5 m/s^2

The minus sign means that the object is decelerating (slowing down)

Worked example 3:

A car accelerates by 1.5m/s^2 from rest in 20 seconds. Calculate the final velocity.

This time we need to rearrange the equation:

1.5 = v – 0 / 20

1.5 x 20 = v-0

30 = v – 0

v = 30 m/s

Linking initial velocity, final velocity, acceleration and distance:

$$v^2 - u^2 = 2 \times a \times x$$

(final velocity)^2 - (initial velocity)^2 = 2 x acceleration x distance

Example 1:

A car travelling at 15 m/s accelerates at 1.5 m/s^2 over a distance of 50 m. Calculate its final velocity.

$v^2 = (2 \times a \times x) + u^2$

$= (2 \times 1.5\ m/s^2 \times 50\ m) + (15\ m/s \times 15\ m/s)$

$v^2 = 375\ (m/s)^2$

$v = \sqrt{375}\ (m/s)^2$

$= 19.4\ m/s$

Example 2:

A cyclist accelerates from 2 m/s to 8 m/s with an acceleration of 1.5 m/s^2. How far did she travel while she was accelerating?

Use the equation $x = \frac{v^2 - u^2}{2 \times a}$.

x = 8^2 - 2^2 / 2 x 1.5

x = 20m

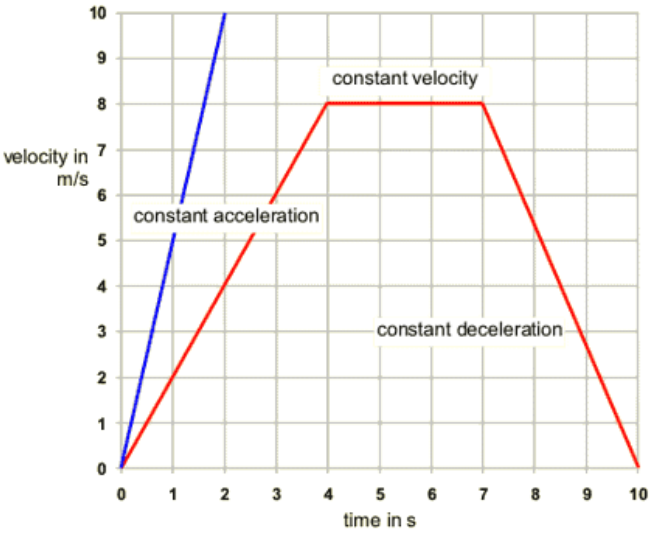
Acceleration due to gravity:

When no other forces (i.e. air resistance) are acting on a falling object the **acceleration due to gravity is 9.8m/s^2**

Velocity Time Graphs

Key features:

- Horizontal lines represent constant speed
- Sloping line shows the object is accelerating
  - Steeper the line the greater the acceleration



Calculating acceleration from velocity time graphs:

In the first 4 seconds the red line travels from 0m/s to 8 m/s.

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

a = 8 – 0 / 4

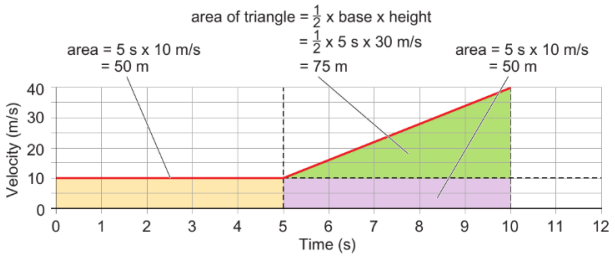
a = 2 m/s^2

Between 7 and 10 seconds the object travels from 8m/s to 0 m/s

a = 0 – 8 / 3

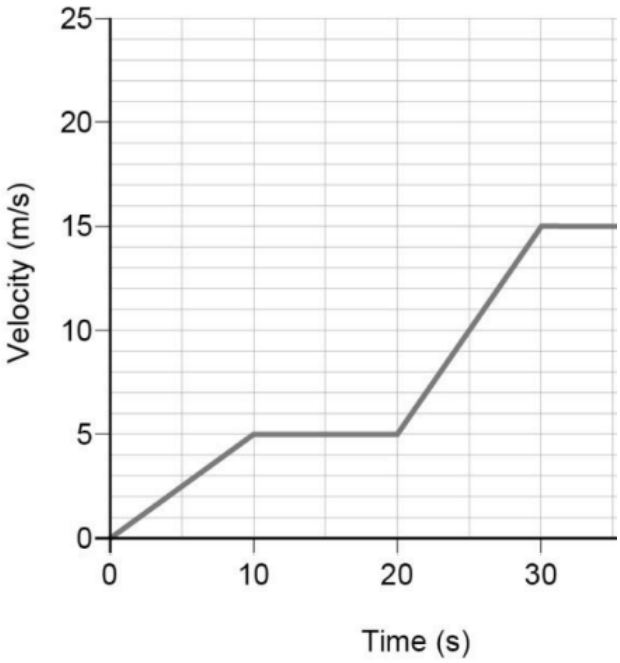
$a = -2.7 m/s^2$

Calculating distance travelled from a graph:



The total distance travelled would be: 50 + 75 + 50 = 175m

Worked examples:



Calculate the distance travelled in the first 10 seconds.

The area under the graph is a triangle:

$\frac{1}{2} \times 5 \times 10 =$ **25m**

Calculate the distance travelled between 20 and 30 seconds.

The area under the graph can be split into a **triangle and a rectangle**

Area of the triangle:

$\frac{1}{2} \times 10 \times 10 = 50m$

Area of rectangle:

$10 \times 5 = 50m$

Distance = 50 + 50 = 100m

CP2 Physics Cheat Sheet

Resultant Forces

Forces are **vector** quantities (they have magnitude and direction).

To work out the **resultant force**

- If they are in opposite directions, subtract one from the other
- If they are in the same direction, add them

Example:

Resultant forces can be **balanced or unbalanced.**

Newton's First Law

If the forces are balanced and the object is stationary, it will stay stationary.

If the forces are balanced and the object is moving, it will continue moving at the same speed and direction

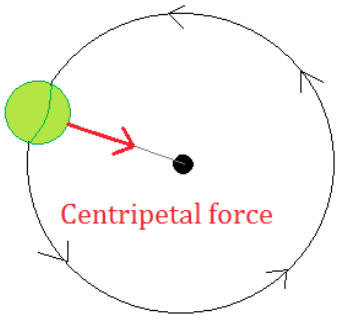
If the forces are unbalanced the object will speed up or slow down.

H – Circular motion

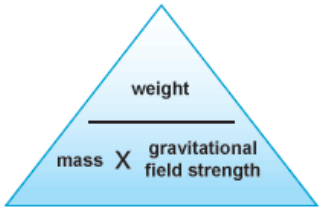
An object moving in a circle at the same speed will have different velocities

This is because velocity is a vector and the direction is constantly changing

Centripetal force is the force that acts towards the centre of a circle



Mass and Weight



Weight = Newtons (N)

Mass = kilograms (kg)

Gravitational field strength = Newtons per kilogram (N/kg)

Example:

Calculate the mass of a 75kg man on Earth.

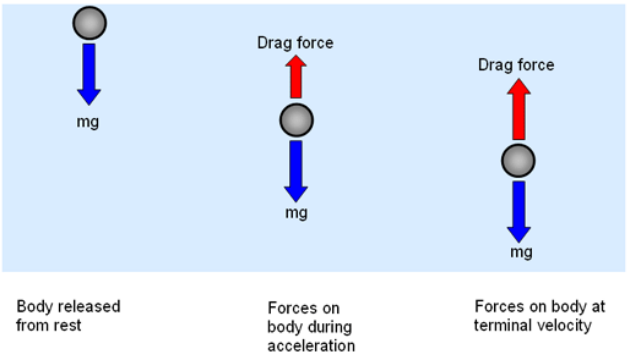
Earth's gravitational field strength = 10N/kg

$$W = m \times g$$

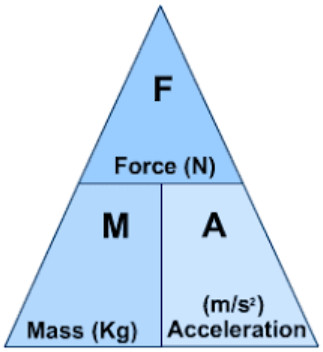
$$W = 75 \times 10 = 750N$$

Terminal velocity: Air resistance = Weight

Forces are balanced



Newton's Second Law



Example:

Calculate the force on a motorcycle with a mass of 200kg and accelerating at $7m/s^2$

$$F = m \times a$$

$$F = 200 \times 7 = 1400N$$

Example:

Calculate the mass of an object that is accelerating $1.2m/s^2$ with a force of 1.5kN

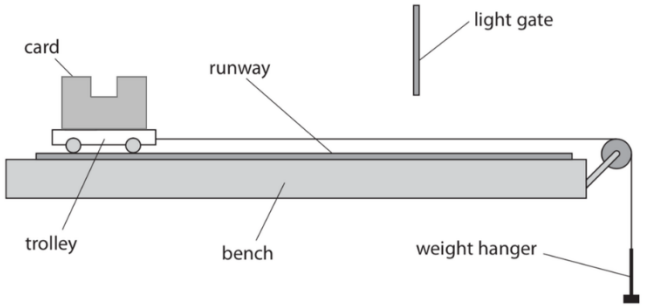
$$F = m \times a$$

$$m = F/a$$

Force is in kN so 1.5kN = 1500N

1500/1.2 = 1250kg

Core practical: Investigating acceleration

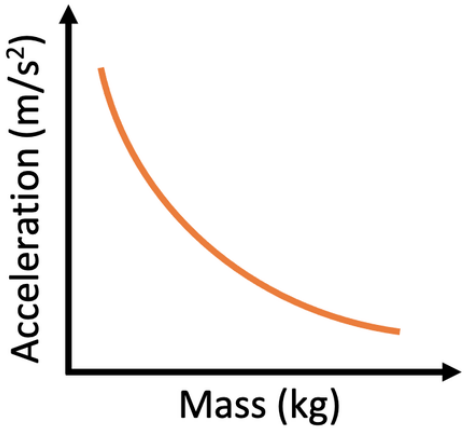


Independent variable: Mass of the trolley

Dependent variable: Acceleration

Control variables:

- Force of the weight hanger
- Height of the ramp

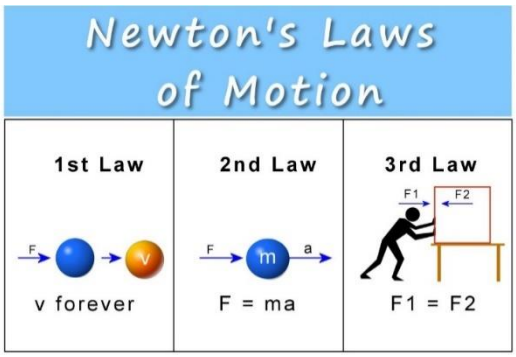


As the mass increases, the acceleration decreases

This is because a = F/m. The force has not changed in the investigation (from the weight on the hanger) however the mass of the trolley has increased.

To get a larger acceleration you would need a larger force.

Newton's Third Law

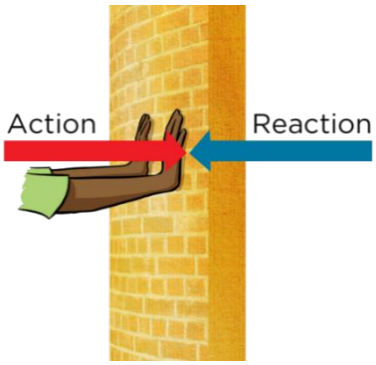


Newton's third law states that there is a pair of forces acting on **two interactive objects**. They are the same size and in opposite directions.

This is different to balanced forces as this is only **one object**.

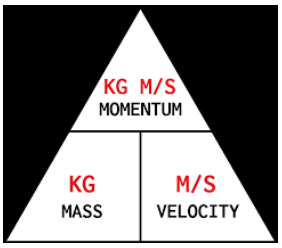
Newton's third law:

- Act on two different objects
- Equal and opposite forces
- Same type of force



Momentum (Higher Tier Only)

Momentum = mass x velocity



Example: An object has a mass of 1.5kg and travels at a velocity of 12m/s. Calculate the momentum

Momentum = mass x velocity

= 1.5 x 12

= 18kg m/s

Momentum and Acceleration

We have looked at two equations to calculate acceleration:

Acceleration = change in velocity / time taken

Force = mass x acceleration

We can therefore combine the two equations to give:

Force = mass x change in velocity / time taken

Mass x velocity = momentum

Therefore:

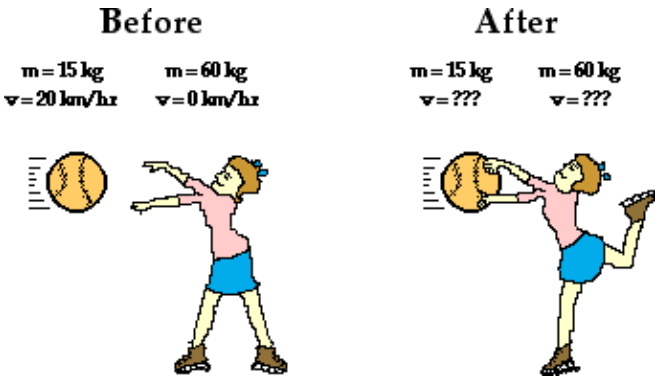
Force = Change in momentum / time taken

Momentum and collisions

In collisions momentum is **conserved**

Therefore

momentum before = momentum after a collision



Worked example:

Before:

Total momentum = (15 x 20) + (60 x 0)

= 300 kg m/s

The total momentum after = 300 kg m/s as momentum is conserved

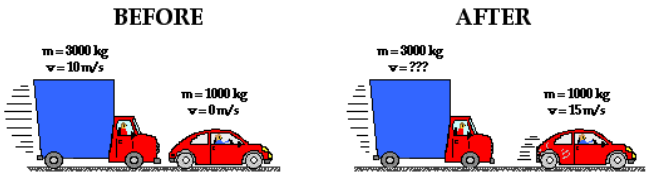
Momentum = mass x velocity

Velocity = Momentum / mass

The girl and the ball are together so the mass is 15 + 60 = 75kg

Velocity = 300/75 = 4m/s

Worked example



Calculate the velocity of the truck after the collision

Momentum before = (3000 x 10) + (1000 x 0)

= 30,000 kg m/s

Momentum is conserved in a collision therefore the momentum after = 30,000 kg m/s

30,000 = (3000 x v) + (1000 x 15)

30,000 = (3000 x v) + (15,000)

15,000 = 3000 x v

V = 15,000 / 3000 = 5000 m/s

Stopping distances

Stopping distance = thinking distance + braking distance

Worked example:

Calculate the stopping distance when a driver takes 15m to react and the braking distance is 10m.

Stopping distance = 15 + 10 = 25m

Thinking distance – the distance it takes the driver to react to a situation

Braking distance – the distance taken for the brakes to cause the vehicle to stop

Factors that affect **thinking distance:**

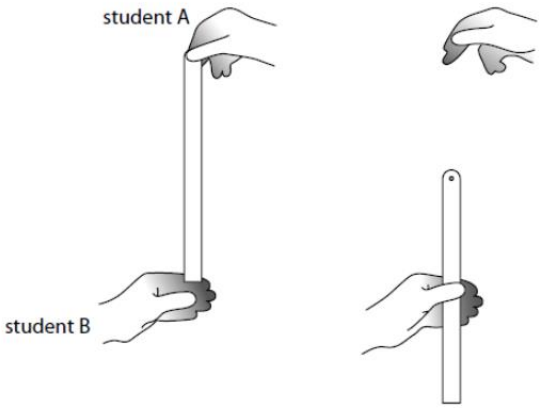
- Tiredness – will increase thinking distance
- Alcohol/Drugs – will increase thinking distance
- Caffeine – will decrease thinking distance
-

Factors that affect **braking distance:**

- Weather such as rain/snow – increase the braking distance
- Worn tyres – increase the braking distance
- Worn brakes – increase the braking distance

Weather, worn tyres and brakes increasing the braking distance because there is **less friction**

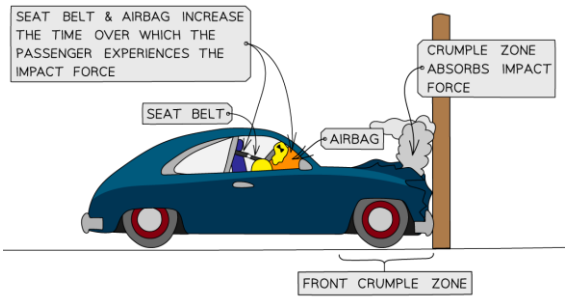
Investigating reaction times:



Crash hazards

Safety features on cars are designed to **increase the time taken** for the change in momentum and therefore the force on the driver/passenger is smaller.

1. Crumple zones
2. Seat belts
3. Airbags



Crumple zones are built at the front and back of cars so if they are involved in a collision the crumpling takes time, reducing the force and deceleration of the car.

Higher Tier: Linked to equation F = mv-mu/t

Worked example:

A 1500kg car is travelling at 15m/s when it collides with a wall. It comes to a stop in 0.07s. Calculate the force acting on the car

F = change in momentum / time taken

F = mv-mu /t

F = (1500x0 – final velocity) – (1500x 5) / 0.07s

F = 321,429N

CP3 Physics Cheat Sheet

Energy stores and transfers

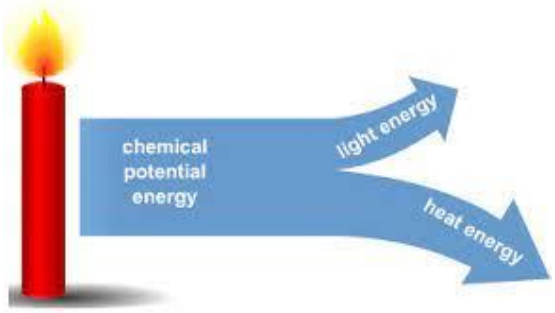
Type of energy	Example
Chemical energy	Batteries, food, fuels
Kinetic energy	Moving object
Thermal energy	Hot objects
Strain/Elastic potential energy	Elastic bands, stretched materials
Gravitational potential energy (GPE)	Objects in high positions
Nuclear energy	Radioactive atoms
Light energy	Bulbs
Electrical	Objects that are plugged in using electricity

Conservation of energy:

Law of conservation of energy states that energy cannot be created or destroyed but can be transferred from one form to another.

Unit of energy is JOULES (J)

Example of energy transfers:



Energy transfers when a car brakes

Kinetic → Thermal (caused from the friction of the brakes)

Energy transfers in a light bulb

Electrical → Light

Describe the energy transfer that occurs when a student lifts a mass from the floor and places on top of a slope

Chemical (muscles of student) → Kinetic (as the student moves the mass) → GPE (on a slope)

Energy efficiency

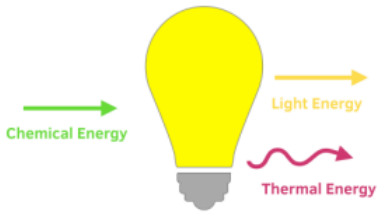
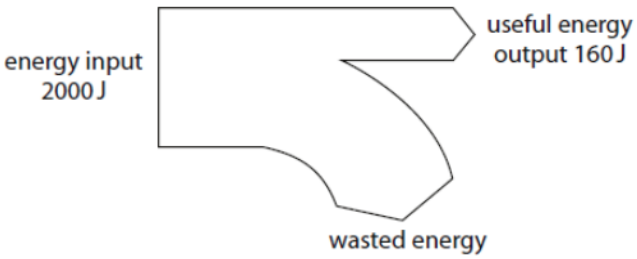


Fig 1. Energy Transfer When a Light Bulb Is Switched on. The input energy (chemical energy) is transferred into light energy and some energy is 'wasted' as thermal energy.

Not all energy is transferred from one form to another and sometimes energy is **wasted**. It is transferred to the surroundings usually as thermal energy- **dissipated**.

Calculating efficiency:

$$\text{EFFICIENCY} = \frac{\text{USEFUL ENERGY OUTPUT}}{\text{TOTAL ENERGY OUTPUT}} \times 100$$



The wasted energy can be calculated by energy input – useful energy

So in the above example: 2000 – 160 = 1840J

To calculate the efficiency:

Useful/total energy x 100

= 160/2000 x 100 = 8%

To **reduce unwanted wasted energy transfers** particularly when objects have moving parts.

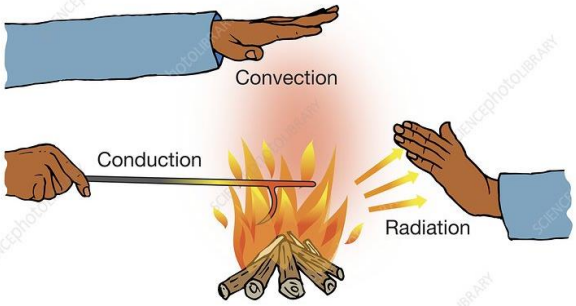
Friction causes energy to be transferred to the surroundings as thermal energy

Lubricatiion will reduce friction and therefore less energy will be wasted

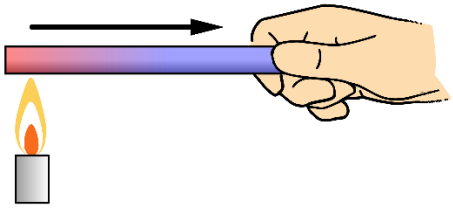
Keeping warm

Insulation reduces energy transfers to the surroundings

Energy can be transferred to the surroundings by heating in **3 different ways**

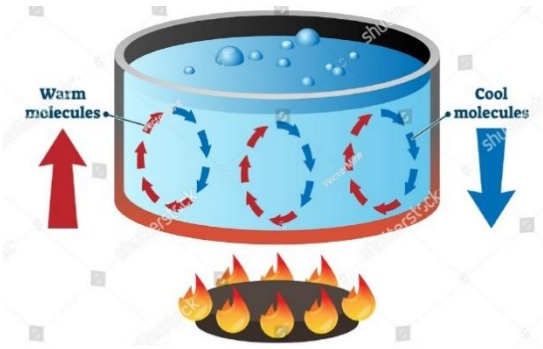


1. **Conduction:** Occurs in solids



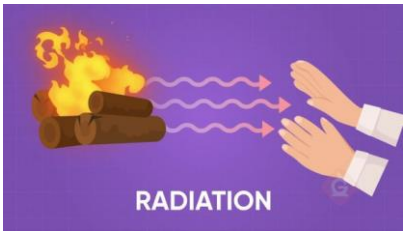
Particles **vibrate** and are passed on. Metals are good thermal conductors

2. **Convection:** Occurs in fluids (liquids and gases)



Fluids that are warmer will rise and fluids that are cooler will fall creating a convection current.

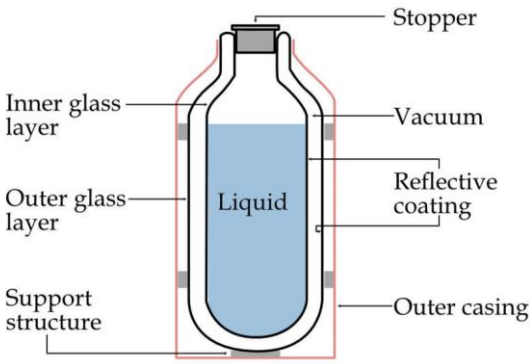
3. **Radiation:** This type of radiation can pass through a vacuum. Radiation can be absorbed or emitted



Thermal conductivity measures how easily energy can pass through a material by heating.

Metals have good thermal conductivity.

Insulators have poor thermal conductivity.



Feature	How it prevents energy transfer by heating
Plastic stopper	Plastic is an insulator and has poor thermal conductivity
Vacuum	Stops conduction and convection
Glass walls with reflective coating	Reflective coating will reflect radiation back into the liquid. Glass is a poor conductor of heat reducing energy loss by conduction

Stored energies

Remember:

Mass is measured in kilograms (kg)

Height is measured in metres (m)

Velocity is measured in metres per second (m/s)

Gravitational field strength on earth is 10N/kg

Gravitational potential energy

Worked example:

Calculate the gravitational potential energy when a 1.2kg ball is lifted 1.6m high.

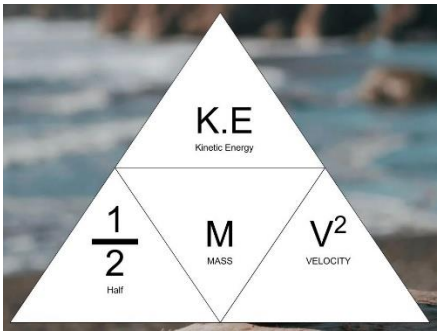
Gravitational field strength is 10N/kg

GPE = m x g x h

GPE = 1.2 x 10 x 1.6

GPE = 19.2J

Kinetic energy



Worked example:

Calculate the kinetic energy when a 75kg man is running at 2.5m/s

KE = $\frac{1}{2}$ x m x v^2

KE = $\frac{1}{2}$ x 75 x 2.5^2

KE = 234.4J

You may be given the kinetic energy and need to work out the velocity.

Worked example:

A moving object has 1500J of kinetic energy and has a mass of 3kg. Calculate the velocity.

KE = $\frac{1}{2}$ x m x v^2

1500 = $\frac{1}{2}$ x 3 x v^2

V^2 = 1500 / $\frac{1}{2}$ x 3 = 1000

To get v we need to square root

V= √1000 = 31.6m/s

If an object has 1500J of gravitational potential energy and is then released we would assume the GPE is transferred into kinetic energy

<u>Non-renewable resources</u>

Non-renewable means that it will run out one day

Examples of non-renewable resources:

1. Coal
2. Oil
3. Gas
4. Nuclear fuels

Fossil fuels such as coal, oil and gas are harmful to the environment

- Release carbon dioxide when burnt which is a greenhouse gas
- Produce carbon monoxide or soot
- Coal when burnt produces sulfur dioxide

<u>Renewable resources</u>

Renewable means it will not run out

Examples of renewable resources:

1. Solar
2. Wind
3. Hydroelectricity
4. Tidal
5. Bio-fuels

Advantages:

- Do not produce carbon dioxide
- Save fossil fuels

Disadvantages:

- Solar and wind are weather dependent
- Hydroelectricity requires reservoirs which could damage the environment
- Tidal – may affect birds and other wildlife

CP4 Physics Cheat Sheet

Describing waves

Waves transfer energy. There are two types of waves:

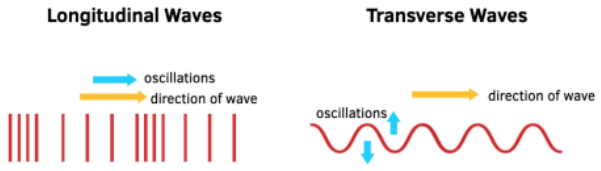


Fig 1. Transverse and Longitudinal Waves.

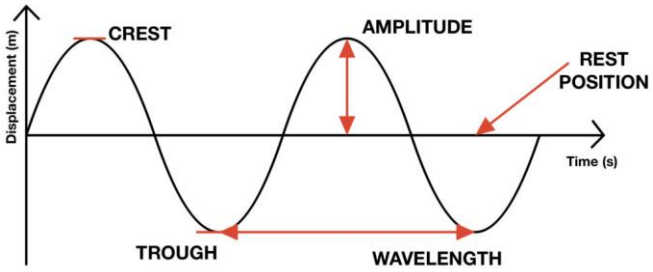
1) Longitudinal

- Example: Sound waves
- Oscillations (vibrations) are parallel to the direction of travel

2) Transverse

- Example: Water waves, Electromagnetic waves i.e. light, radio, microwaves
- Oscillations (vibrations) are at right angles to the direction of travel

Key terms associated with waves:



Keyword	Definition
Frequency (Hz)	Number of waves passing a point per second. Measured in hertz (Hz)
Wavelength	Distance from a point on one wave to the same point on the next wave. Measured in metres
Amplitude	Maximum distance of a point on one wave away from its rest position
Period	Length of time it takes one wave to pass a given point

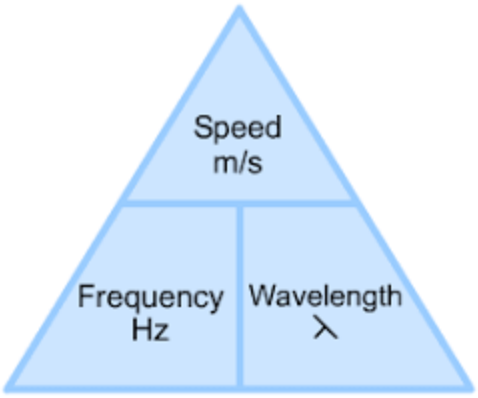
Calculating frequency:

To calculate frequency you would measure the number of waves passing a point in 10 seconds i.e. 40 waves in 10 seconds.

Frequency is the number of waves per second.

Therefore 40 / 10 = 4 waves per second = 4Hz

Wave speeds

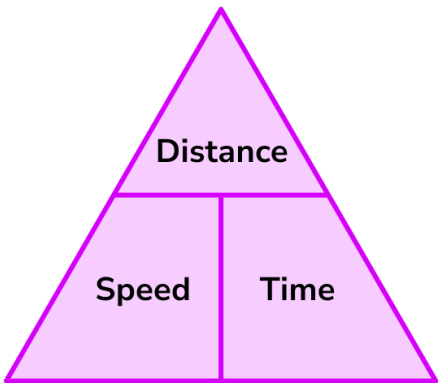


Worked example:

A wave has a frequency of 4Hz and a wavelength of 1.2m. Calculate the wavespeed.

= frequency x wavelength

= 4 x 1.2 = 4.8m/s



Worked example

A wave travels 52m in 8 seconds. Calculate the speed of the wave

Speed = distance/time

Speed = 52 / 8

= 6.5m/s

Describe how you would measure the wave speed on water:

- Measure the distance from A – B
- Time how long it takes a wave to travel from A-B and calculate the speed = distance/time

Sound travelling through solids

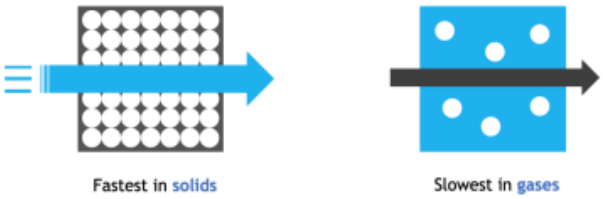
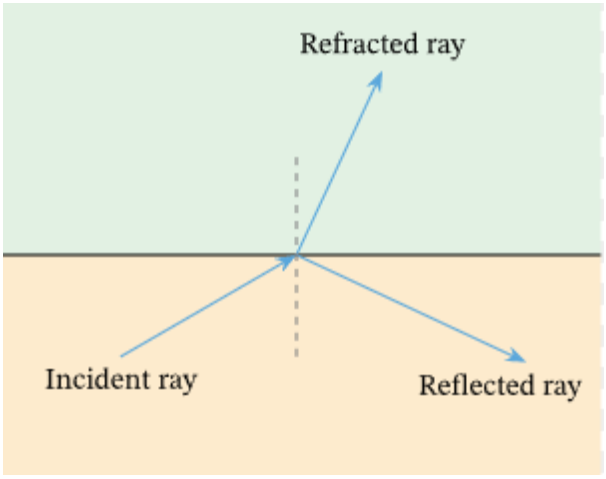


Fig 2. Sound Waves Travel at Different Speeds in Different Substances.

Particles vibrate and will cause neighbouring particles to vibrate passing the sound along.

Refraction:

When waves hit an interface (boundary) between two media i.e. air and glass waves can be reflected or refracted



Refraction is the change in direction when a wave goes from one transparent material to another.

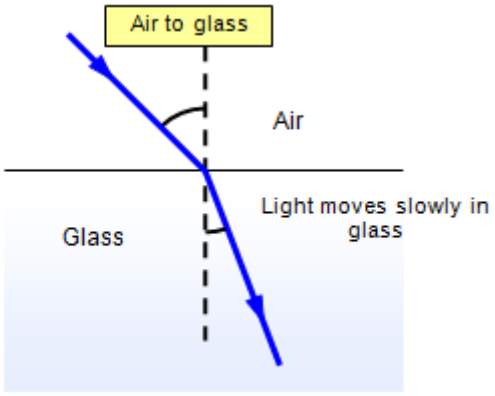
Keyterms:

Normal: Dashed line drawn at 90o to the interface

Incident ray: Light ray that is going towards the interface

Refracted ray: Light ray that is moving away from the interface

Refraction when light travels from air into glass

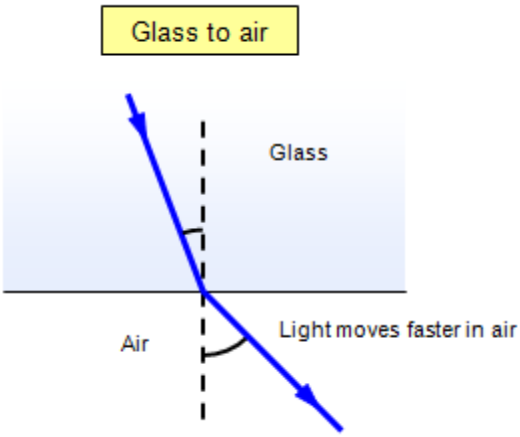


Glass is more dense than air. So light waves will slow down when they hit the interface.

Light is refracted towards the normal.

The angle of incidence is greater than the angle of refraction

Refraction when light travels from glass to air

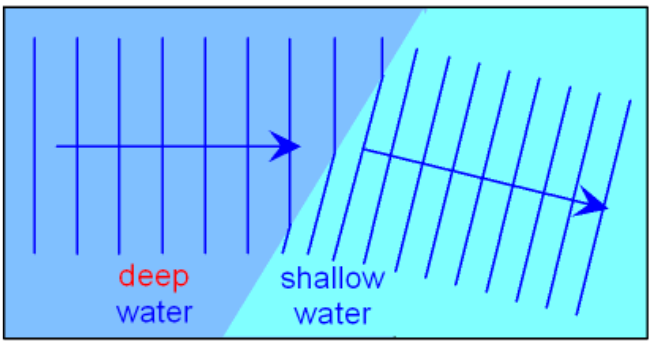


Air is less dense than glass. So light waves will speed up when they hit the interface

Light is refracted away from the normal

The angle of incidence is less than the angle of refraction

Water waves change direction when the depth changes



In deep water water travels faster than in shallow water.

As a result when water waves move from deep to shallow the wave slows down and bends towards the normal.