SEC 1 G3 SCIENCE REVISION NOTES: Courtesy of OM MAHTO

Chapter 1: Scientific Endeavour

(Part 1)
Data can be collected from experiments in two forms:

1) **qualitative** data - “quality” - able to sense using **taste**, **sight**, **hearing** etc.
2) **quantitative** data - “quantity” - able to be **measured** using certain instruments and has a numerical value.

(Part 2)
Hypothesis:

- A scientific question is accompanied by a proposed explanation, called a hypothesis.
- The purpose of a hypothesis is to **explain a phenomenon** and/or **propose solutions to a problem.**

Variables:

- independent variable: changed variable
- dependant variable: measured variable
- controlled variable: constant variable

3. Lab Apparatus

Apparatus	Function	Apparatus	Function
Bunsen burner 	To raise a flame above the table surface high enough for heating	Retort stand 	To support apparatus during experiments
Tripod stand 	To support apparatus during heating	Test tube 	To contain small amounts of chemicals for heating. To mix solutions/ liquids.
Round-bottomed flask 	To mix and heat chemicals and liquids evenly	Beaker 	To contain chemicals. To collect liquids.

Apparatus	Function	Apparatus	Function
Boiling tube 	To contain chemicals for strong heating. To collect and hold liquids.	Filter funnel 	To transfer liquids into containers with a small opening. To separate solids from liquids.
Conical flask 	To contain and mix chemicals and liquids.	Gas jar 	To collect gas.
Bell jar 	To separate the set-up of an experiment from its surroundings.	Evaporating dish 	To evaporate the liquid in its solution over a Bunsen burner.
Wire gauze 	Placed on the support ring attached to the retort stand. To support glassware during heating.	Filter paper 	To separate solid particles from liquids.

SI UNITS:

- Volume: **m^3** (measuring cylinder)
- Mass: **kg** (electronic balance)
- Time: **s** (digital stopwatch)
- Length: **m** (digital calipers)
- Temp: **K** (thermometer)
- Density = Mass/Vol = **kg/m^3**

Errors in measurements:

- **Zero** Error: a measuring instrument value shows a reading when the true value at the time is zero.
- **Parallax** Error: When the marking of the instrument is not viewed correctly from the right angle (e.g. not eye-level)

Precision VS Accuracy:

- **Accuracy**: When the reading is very close or the same to the true value.
- **Precision**: When multiple readings taken are close to one another or the same (may not be accurate however)

(Part 3)
Attitudes in Science:

- Being **curious**: willing to explore and find out more
- Being **objective**: being fair and not letting opinions affect your work
- Being **responsible**: showing care and concern for the organisms and environment.
- Showing **perseverance**: working on a problem until a solution is found.
- Being **open-minded**: willing to accept new ideas.

Hazard symbols are used to label harmful chemicals. (Images in OneNote)

- **Corrosive**: May cause severe damage on contact with body parts, e.g concentrated acids and alkalis

- **Harmful / Irritant**: Can lead to irritation or inflammation of the skin, eyes or respiratory system, e.g dilute acids and alkalis

- **Environmental toxicity**: Can cause harmful effects to the environment, e.g. industrial waste products, pesticides

- **Oxidising substance**: Releases oxygen easily which can cause fire or explosion, e.g. hydrogen peroxide

- **Gases under pressure**: Stored in pressurized cylinders and may explode when heated, e.g. propane gas tanks, oxygen tanks

- **Acute toxicity**: Can cause toxic or harmful effects to body when breathed in, swallowed, or on contact with skin, e.g. mercury, lead oxide

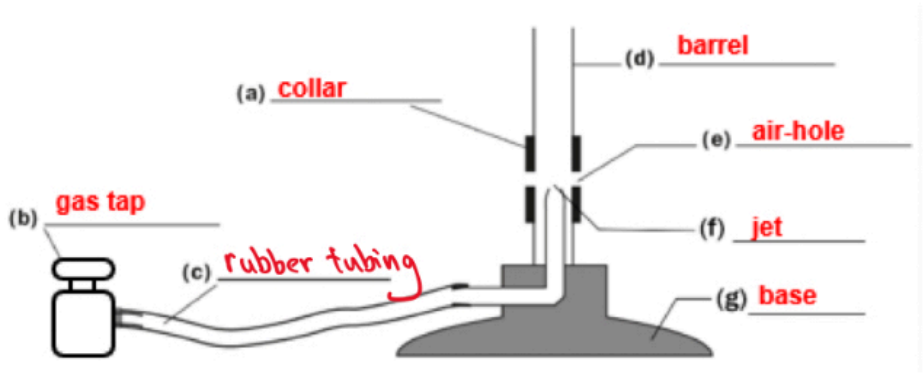
- **Explosive**: May cause fire, explosion, e.g. TNT, ammonium nitrate

- **Flammable**: May cause fire or produce poisonous gas when reacted with air, water or chemicals, e.g. alcohol, petrol

- **Carcinogenicity**: Can cause breathing difficulties, Can cause infertility, birth defects, damage to organs or cancer, e.g. UV ray, tobacco smoke

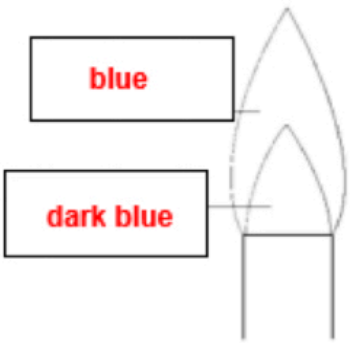
BUNSEN BURNER:

- Parts of a Bunsen burner:

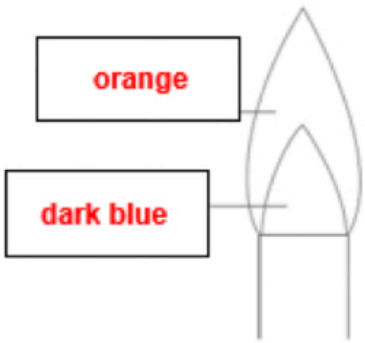


- How to light a Bunsen burner:
  1. Turn the collar to **close** the air-hole of the Bunsen burner.
  2. Hold the lighter just **above the barrel** of the Bunsen burner.
  3. Turn on the gas tap and click the lighter.
  4. **Open** the air-hole. When not using the Bunsen burner, turn off the gas tap to put out the flame.

- A **strike back** occurs when you light a Bunsen burner with the air-hole **open**.
- Excess air enters the air-hole and the flame burns at the ~~air-hole~~ jet.
- The air-hole of a Bunsen burner can be opened or closed to obtain two types of flame.



Flame with opened air-hole



Flame with closed air-hole

Non-luminous flame	Luminous flame
Steady	Unsteady
Produces little no soot	Produces soot
Very hot	Less hot
Cannot be seen from afar	Visible from afar

- Soot is created because of incomplete combustion of fuel gas
- Non-luminous flame is the correct flame used for heating
- After a strike-back, turn off the gas tap immediately.

Chapter 2: Diversity of Matter thru Physical Properties?

(Part 1) Physical properties: (You must remember the properties of some basic materials) ***Malleable → can be moulded. Homogeneous → evenly distributed / mixed about (for solutions.) Ductile → can be bent (to form wires).***

1) **ELECTRICAL CONDUCTIVITY:** The measure of how easily an electric current flows through a material. (Definition) Electrical conductors allow electrical current to flow through them easily while Electrical insulators do not allow electrical current to flow through them easily.

2) **THERMAL CONDUCTIVITY:** The measure of how easily heat flows through a material (Definition)

3) MELTING AND BOILING POINT:

- The melting point of a material is the **temperature** at which it changes from the solid state to the liquid state (Definition)
- The boiling point of a material is the **temperature** at which it changes from the liquid state to the gaseous state (Definition)

4) **STRENGTH:** The strength of a material is its ability to support a heavy load **without changing its shape permanently**. (Definition)

5) ****HARDNESS**: The hardness of a material is its resistance to wear and tear, and scratches. (Definition) A hard material can scratch another material that is softer than itself.

6) **FLEXIBILITY:** The flexibility of a material is its ability to bend without breaking, and return to its initial shape and size after bending. (Definition)

7) **DENSITY**: Density refers to the amount of matter an object has (mass) in proportion to its volume. (Definition) - **Density = mass/volume**

(Part 2) Density

KEY IDEAS

1) The density of an object depends on its mass and volume.
2) SI unit of mass is **kg**.
3) SI unit of volume is **m^3**.

4) The volume of irregular objects can be determined by **volume displacement**.
5) The volume of objects with regular shapes can be calculated using mathematical formulae (cylinder → pi . r^2 . h, sphere → 4/3 . pi . r^3…)
6) SI unit of length is **m**.
7) The density of an object is **its mass per unit volume**
8) The SI unit of density is **kg/m^3.**

Mass
—----------
Density x Volume

(MDV triangle)

Measuring SI units.

Mass: ***kg (SI unit) or g or mg or t***, We use **electronic balance** to measure the **mass** of a substance.

Volume: m^3 (SI unit) or cm^3 or l or ml,

- Volume of liquids: we use beaker, measuring cylinder, syringe, volumetric flask, pipette or burette.
- Volume of regular objects (solids): we use mathematical formulae to calculate volume of cuboid, sphere, cylinder etc.
- Volume of irregular objects (solids): We use volume displacement. The object causes the water to be displaced and the displaced volume (the object's volume) causes the water to rise. If an object floats on water, a sinker should be used.

Length: m (SI unit) or km or cm or mm,

- We can use a measuring tape to measure lengths of curved surfaces or longer lengths. (Metric ruler for small lengths)
- Calipers are used to measure short lengths and diameters of small objects.

Density = mass/volume
Mass = density x volume
Volume = mass/density
Si unit for Density → kg/m^3. Another unit used is g/cm^3.

The density of an object affects its ability **to float or sink in a substance.**
A less dense object **floats** on a denser medium.

Chapter 3: Diversity of Matter and its Chemical Composition:

KEY IDEAS: (Elements and Compounds)

- **ELEMENT**

1) Elements are **pure** substances that **cannot be broken down into simpler substances by chemical methods** (Definition)
2) Elements only contain **one type** of particle / atom.
3) In the periodic table, elements are arranged in order of increasing **atomic / proton** number.

- **PERIODIC TABLE**

4) Periodic table.
    - The vertical columns are called **Groups** while the horizontal rows are called **Periods**.
    - The Hays-McDaniel line separates the **metals** from **non-metals**. (The elements right next to the line are metalloids, which means they have properties from both)

- **COMPOUND**

5) Compounds are **pure** substances that **consist of two or more elements that are chemically combined.** (Definition)
6) The chemical formula tells us the **types of atoms** (or elements) present in the compound and the **ratio** of the different atoms.
7) Compounds do not have the same properties as their constituent elements.
8) The constituent elements of a compound are **chemically** combined in a **fixed** proportion by **mass**.
9) A compound **cannot be separated** into its constituent elements easily.

KEY IDEAS: (Mixture - Solution or Suspension?)

- **MIXTURES**

1) A mixture is made up of **two or more elements and/or compounds that are not chemically combined (i.e. physically mixed)** . (Definition)
2) A mixture is not pure.
3) Mixtures can be made up of:
    - Elements
    - Compounds

- Elements and Compounds.

4) A mixture has the **same** characteristics as its constituents.
5) The constituents of mixtures are **not** in any **fixed** proportion.
6) The constituents of mixtures can be separated easily through **physical separation methods**.

- **SOLUTIONS**

(Different solutes have different solubilities in the same solvent.)
(Different solvents dissolve the same solute to different extent.)

7) A solution (is homogenous) is **a mixture in which one substance dissolves completely in another substance** (Definition).
8) The substance that dissolves is called the **solute**.
9) The substance in which the solute dissolves is called the **solvent**.
10) Property of solutions:
    - Particles of the solute in a solution can no longer be seen.
    - Light can **pass through** a solution
    - Solute particles **do not settle** to the bottom to form solid deposits.
    - Components **cannot** be separated by filtration.
11) Types of solutions:
    - **Dilute** solution: has **very little** solute dissolved in solvent, can dissolve a lot more solute.
    - **Concentrated** solution: has **a lot of** solute dissolved in solvent, can dissolve a little bit more solute.
    - **Saturated** solution: has the **maximum** amount of solute dissolved in it. Cannot dissolve any more solute.

12) Rate of dissolving refers to **how quickly a solute dissolves in a solvent.** (Definition)
13) Factors affecting rate of dissolving:
    - **Size of solute particles** (the smaller the solute particle size, the faster the rate of dissolving)
    - **Temperature** of solvent (the higher the temperature of the solvent, the faster the rate of dissolving)
    - Rate of **stirring** (the faster rate of stirring, the faster rate of dissolving)

14) Solubility refers to the **maximum amount of solute that can dissolve in a fixed volume of a particular solvent at a given/specific temperature.** (Definition)
15) Factors affecting solubility:
    - Type of solute
    - Type of solvent

- **SUSPENSIONS**

16) A suspension is a mixture that **contains insoluble substances in a solvent.** (Definition)
17) Properties of suspensions:

- Insoluble substances can be seen.
- Light **cannot pass through** a suspension fully.
- Insoluble substances can **settle** to form solid deposits.
- Components can be separated by **filtration**.

Chapter 4: Separation Techniques

KEY IDEAS:

- **MAGNETIC ATTRACTION**

1) It is used to separate magnetic materials from non-magnetic materials. Magnetic materials include **iron, steel, nickel and cobalt.**

- **FILTRATION**

2) It is used to separate a mixture of substances with **different** particle sizes. / separates insoluble substances from solvent.
3) The **pores** of the filter paper allow small particles to pass through.
4) The solid particles that are left on the filter paper is called the **residue**.
5) The liquid that passes through the filter paper is called the **filtrate**.

- **EVAPORATION**

6) It is used to separate the **solute** from the **solution**.
7) It removes all the solvent in the solution, leaving behind the solute as the **residue**.
8) If the solution contains a **flammable** solvent (alcohol) or a solute with **low melting point** (sugar), the solution should be heated **indirectly** over a **water bath**.

- **DISTILLATION**

9) It is used to obtain a liquid from a mixture of substances with **different boiling points**.
10) A mixture is **boiled** and the **vapour** of the substance with the **lowest** boiling point in the mixture enters the condenser first.
11) This vapour then **condenses** and is collected (as **distillate**), leaving behind the other substances in the mixture.

Precaution: *Rationale.*

- **If the mixture consists of 2 liquids, the liquids should have boiling points that are far apart:** *so that the vapour entering the condenser is really pure and the mixture can be separated fully.*
- **The bulb of the thermometer should be placed at the entrance of the condenser:** *to measure the temperature of the vapour entering the condenser, so that the identity of the distillate can be confirmed (by boiling point)*
- **The coolant water should enter the condenser from the bottom and exit from the top:** *to fully fill the condenser with cool water for a more efficient cooling system.*

- **PAPER CHROMATOGRAPHY**

12) It is used to separate **small** amounts of substances that dissolve to **different** extents in a particular solvent (can also identify their relative **solubilities** in the solvent)

Precaution: *Rationale.*

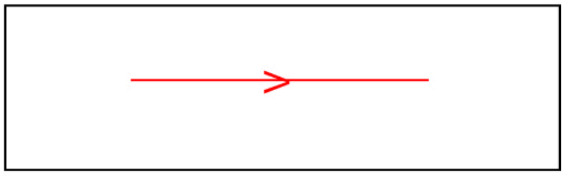
- **The mixture should be able to dissolve in the chosen solvent:** *so that we can analyze what components are found in the mixture.*
- **The starting line should be drawn with a pencil:** *pencil marking does not dissolve in the solvent and would not interfere with the results of the experiment.*
- **If more than 1 sample is tested, the samples should be placed far apart:** *to prevent the samples from mixing with each other and affecting the accuracy of the results.*
- **The starting line should be placed above the solvent level:** *so that the samples would not dissolve and disappear in the solvent.*
- **The chromatogram should be held upright during the experiment:** *so that the components of the mixture can separate properly along the whole length of the paper.*
- **Sufficient time should be given for the solvent to travel up to the other end of the chromatography paper:** *so that the more soluble substances in the mixture (which travels further up the paper) can be properly separated.*

Chapter 5: Ray Model of Light

(Part 1)

Light travels in a **straight** line.

4. Light can be represented using the ray diagram:



Concept Application

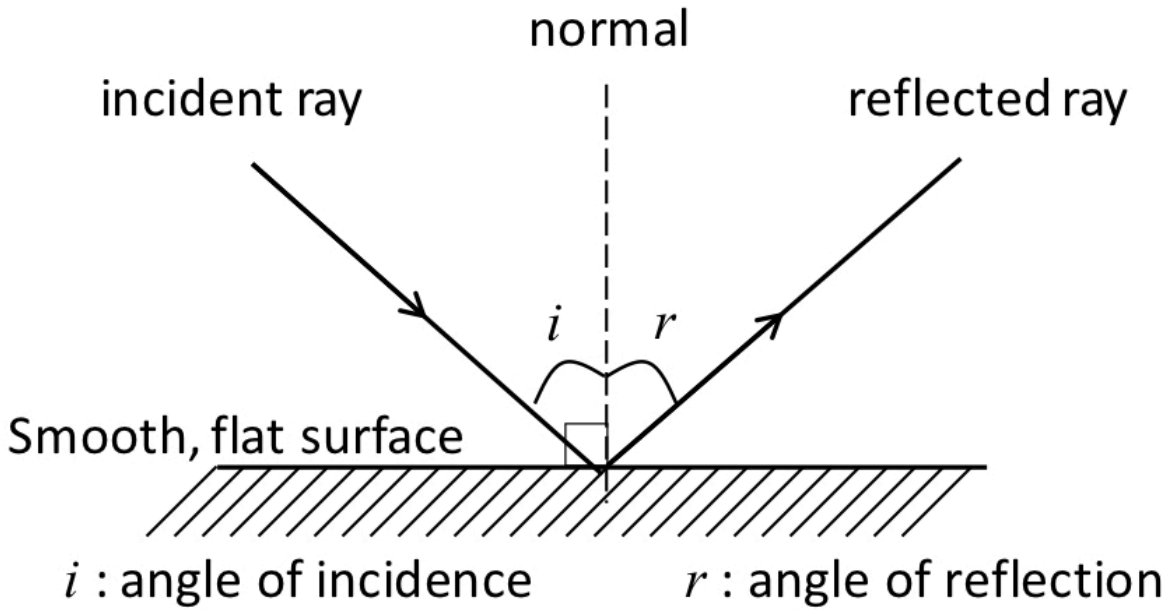
1 The table below shows how three students represent light. Complete the table to evaluate the usefulness and limitations of each representation.

Student	How the student represents light	Usefulness of the representation	Limitation of the representation
1		**Shows a ray of light and shows that light travels in a straight line.**	**Does not show the direction of light.**
2		**Shows the direction of light.**	**Does not show whether the path of light is straight or curved.**
3		**Shows the direction of light.**	**Does not represent a continuous ray of light.**

(Part 2)

- Reflection is the **bouncing of light off a surface**
- Law of reflection states that the angle of incidence is **equal** to the angle of reflection

Diagram:

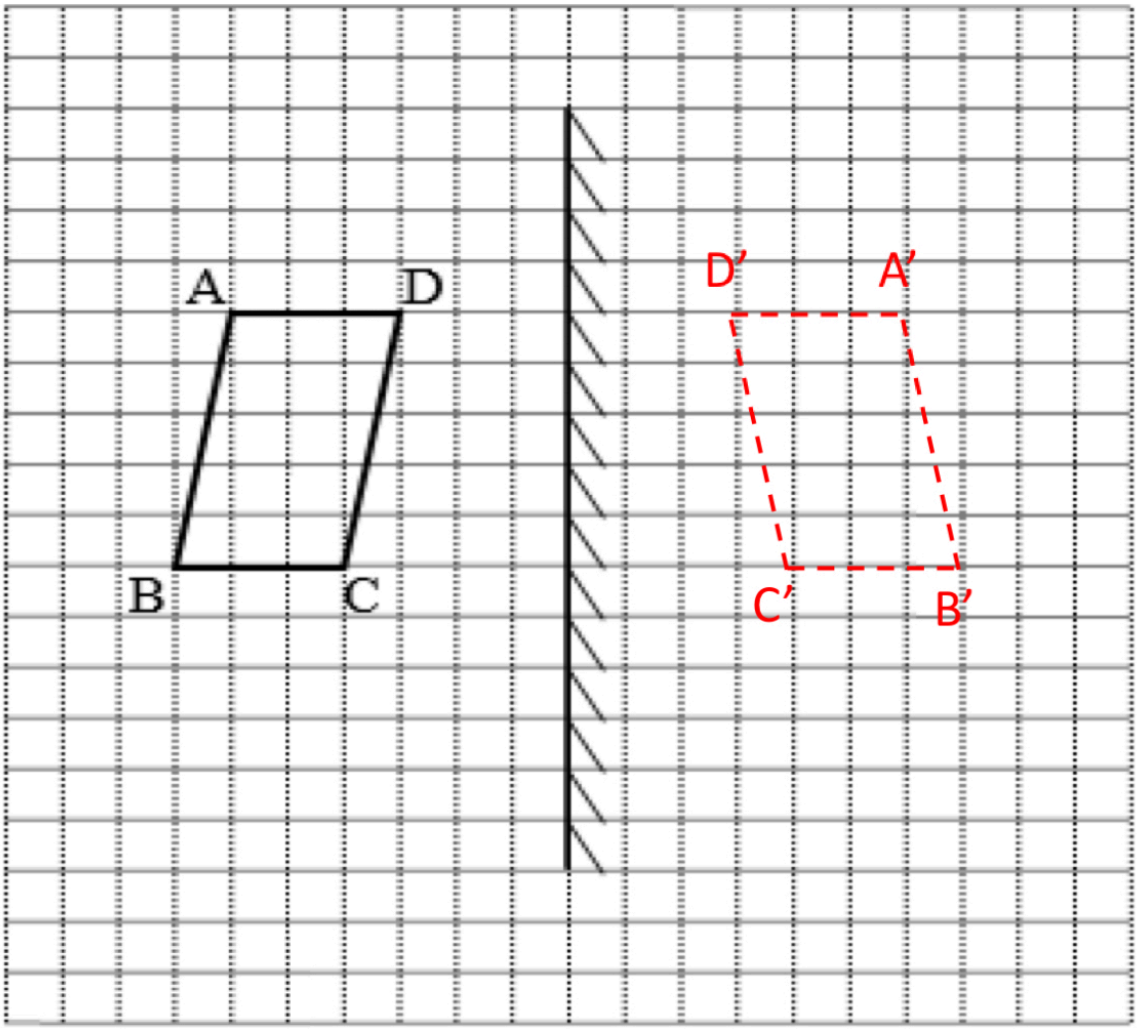


- incident ray: light ray traveling **towards** the surface
- reflected ray: light ray traveling **away** from surface
- normal: **imaginary** line **perpendicular** to the surface

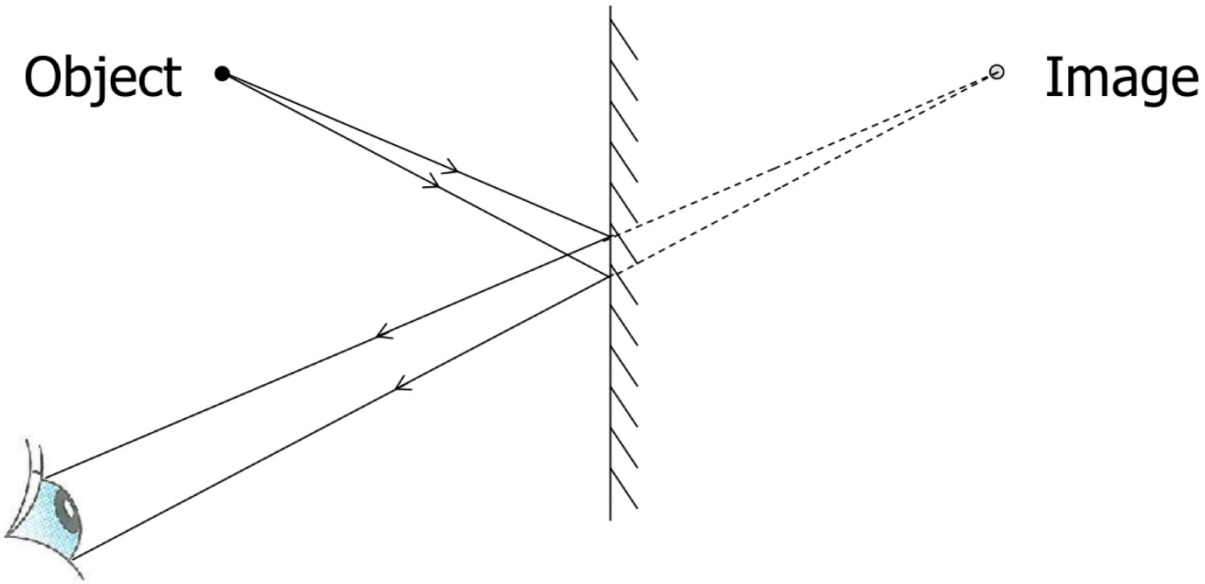
Characteristics of images formed by plane mirror:

- The image is the **same size** of the object
- The image is **upright**
- The image is **laterally inverted**
- The distance between the mirror and the object is the **same** as the distance between the mirror and the image
- The image is **virtual**

Drawing plane mirror images:



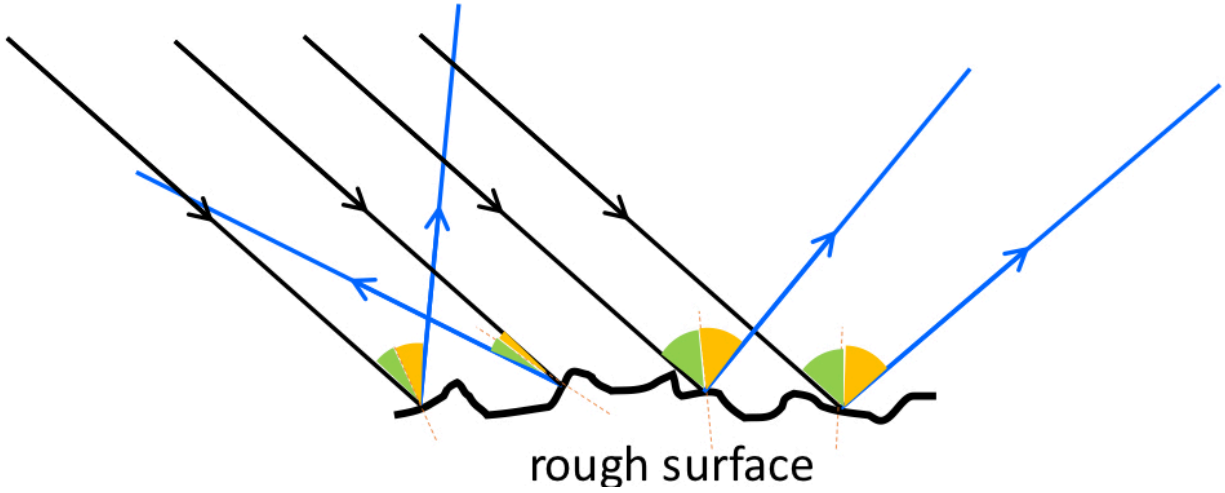
Drawing of ray diagram from image to eye on plane mirror:



Type of mirror	**Characteristics of Mirrors**	**Uses of Mirrors**
Plane Mirror	refer above	• to check our **appearance** • to make a room look **bigger** • used in **periscope** • used in optical testing to make the chart appear further away
Convex mirror (Surface is COMING OUT)	Allows us to see a **wider** area and the image appears **smaller**. (To remember "convex" has lesser letters than "concave", so the image is smaller)	• used as **rear view mirrors** to enable drivers to see large area of traffic behind them • used at **road junctions** to allow drivers to see around **blind corners** • used in shops to allow shopkeepers to see a large area of the shop
Concave mirror (Surface is *CAVING* IN)	Image is **magnified** (bigger because "concave" has more letters than "convex")	• used by dentists to form **magnified** image of the teeth • used in **headlights** to form strong beams of

		light to light up the road

DIFFUSE REFLECTION:
When parallel rays of light fall on a **rough** surface, each ray is reflected in a different direction, this is known as **diffuse reflection**. For each pair of rays, *i* still = *r*, but the normal lines are **not parallel** to one another. When diffuse reflection occurs, you cannot see the image clearly, it is **blurry**, **distorted**, **unclear**.

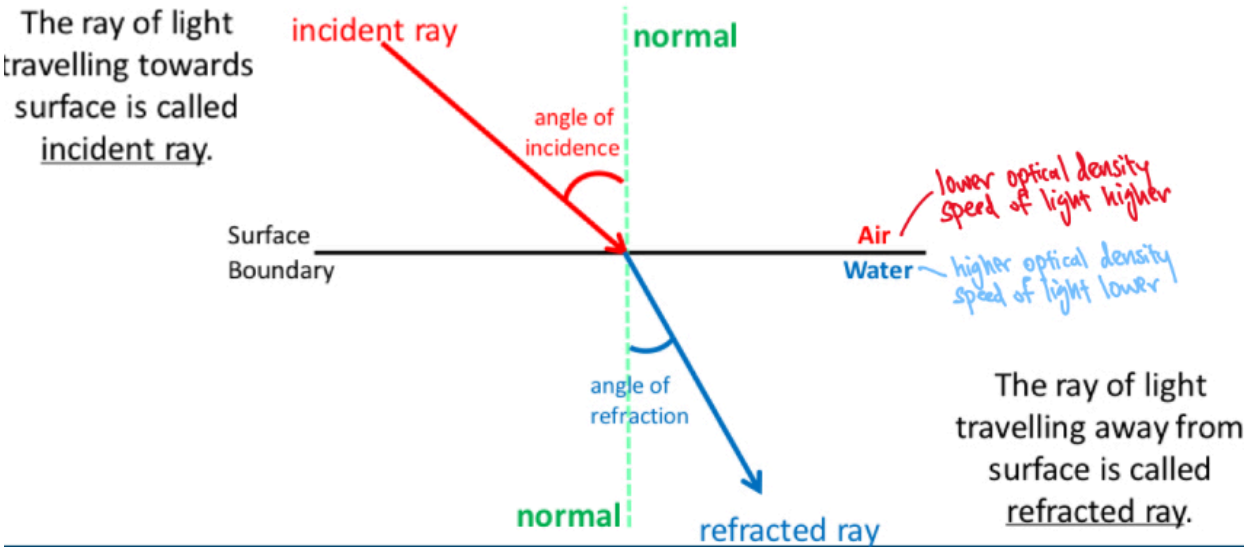


(Part 3)
Refraction is the **bending of light** at the **boundary** between two **different transparent** mediums (ie optical mediums) due to a **change in the speed of light** as it passes from one medium to another.

An optical medium has a physical property called optical density that affects the speed at which light travels through the medium. (More optical density = less speed of light)

Let Speed of Light be SoL and Optical Density be OD.

- SoL in gas > SoL in liquid > SoL in solid. (SoL is the highest in gas)
- OD in gas < OD in liquid < OD in solid. (OD is the highest in solid)



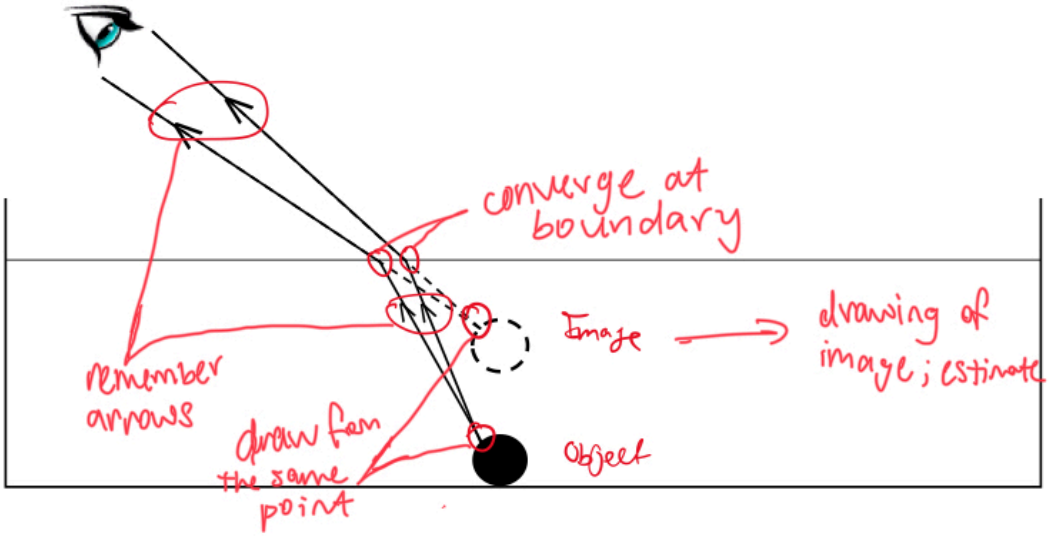
Refraction:

- From lower optical density to higher optical density, e.g. air to water, speed of light **slows** down, bending **towards** the normal.
- However, from higher optical density to lower optical density, e.g. diamond to water, speed of light **increases**, bending **away** from the normal.
- When the incident light is **perpendicular** to the medium surface, it **changes speed without bending** (still goes straight)

Phenomena of Refraction

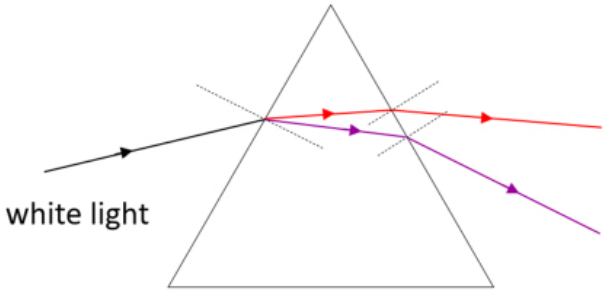
- Objects appear **bent** in liquids
- Object appears **higher** than it is, magnified, **closer** to the surface, because an observer will think that an object will be at the **apparent depth** instead of its actual position at the **real depth.**

Ray Diagram of Refraction



Dispersion of Light

- is the splitting of white light into its component colours
- **Violet** light bends the most and **red** light bends the least (rainbow colours)



Chapter 6: Model of Cells

(Part 1)
Cell parts

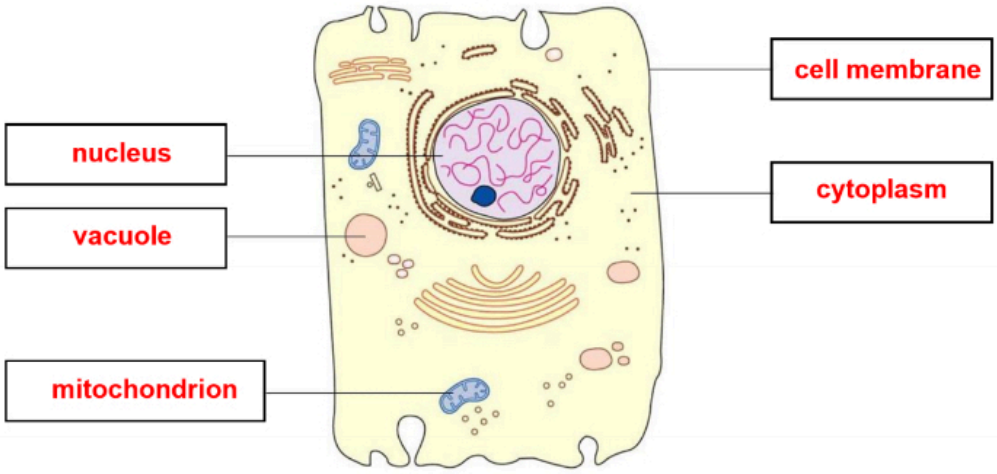


Fig. 1: A typical animal cell

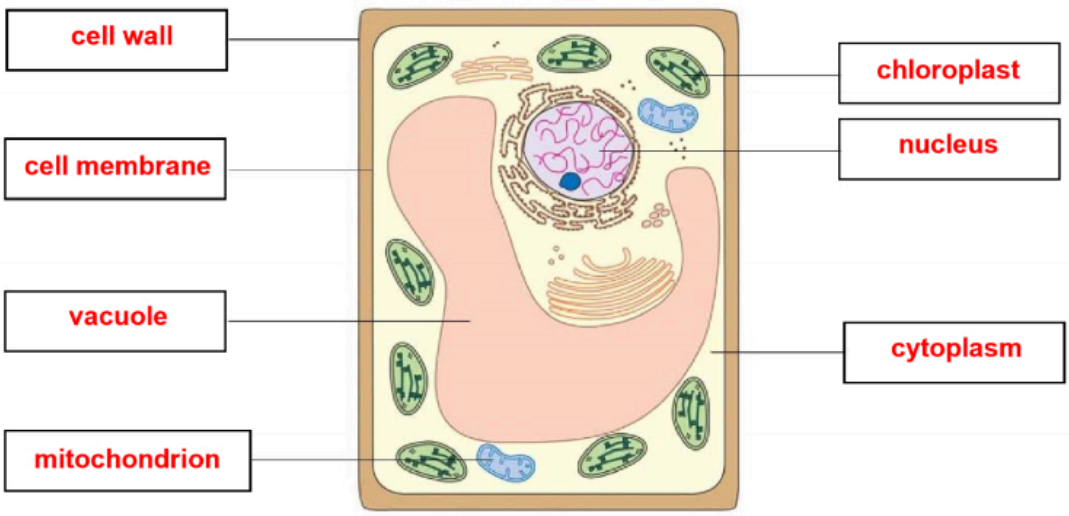


Fig. 2: A typical plant cell

Cell Structure	**Description and function**
Nucleus	• **controls all activities** within a cell • contains **DNA** which is passed down from parents to offspring • will cause the cell to die if removed
Vacuole	• stores **water, food, and waste materials**

	• **small** and **numerous** in animal cell • **single**, **large** and **central** in plant cell
Mitochondria	• carries out **aerobic respiration** which releases energy • (**Not viewable** under light microscope)
Cell membrane	• **controls the movement** of substances into and out of the cell • **partially** permeable (allow **specific** substances in and out)
Cytoplasm	• site where most chemical reactions take place • about 80% water; contains dissolved salts, sugars and enzymes
Cell wall	• **protects** and supports the entire cell • **rigid** and gives the cell a **regular shape** • **fully** permeable (allows all substances in and out of the cell)
Chloroplast	• site where **photosynthesis** takes place • chlorophyll in chloroplast **traps light energy** for photosynthesis • sugar is produced from CO_2 and water, with the release of oxygen gas

Microscope:

- Course and fine adjustment knobs - obtain a focused image
- Objective lens - produce a magnified image
- Eyepiece - observe the specimen

State two advantages of using the light microscope to view cells:

1. **It allows us to view living cells.**
2. **It allows us to color the cells or cell structures by using stains.**

State a disadvantage of using the light microscope to view cells.

- **The highest magnification is quite low so there are many details we cannot see. (Application question)**

(Part 2)
Plant VS Animal:

Plant Cell	Animal Cell
Have cell wall	Does not have a cell wall
Usually have chloroplasts	Does not have chloroplasts
Has a large central vacuole	Has small and numerous vacuoles

Specialized Cells: Images in OneNote

Specialized Cell	Description
Red blood cells	Red blood cells do not have nuclei. They transport oxygen from the lungs to other parts of the body
Sperm cell	A sperm cell carries genetic material for heredity. It fertilizes the egg to form a zygote which then develops into a foetus.
White blood cell	A white blood cell destroys invading microorganisms in blood.
Nerve cell	A nerve cell conducts electrical signals throughout our bodies.
Guard cells	A pair of guard cells form the stoma (plural: stomata). Guard cells control the movement of gases into and out of the leaves.
Xylem cells	Xylem cells are dead. They only have the cell wall and do not have any cell contents. Xylem cells form the xylem vessel which transport water from the roots to other parts of the plant.
Root hair cell	Root hair cells have a long protrusion which increases the surface area to absorb water. They do not contain chloroplasts.

(Part 3)
Division of Labour

Least complex

Most complex

Level of organisation	Definition
Cell	Basic building block of life.
Tissue	A **group of cells** working together to perform the same function.
Organ	Made up of **different tissues** working together to do a particular job.
System	Made up of **different organs** working together to perform a particular job.

Division of Labour

- is dividing the work of the organism among different cells.

Advantages of DoL

- The organism can perform **more tasks** than a unicellular organism
- It increases **efficiency**.
- The cells live **longer**.

- *For this topic, try to remember the organs of all your systems, go revise primary school Systems. And also the specialized cells above which may come out in application questions.*

Chapter 7: Particulate Model of Nature

(Part 1)
Properties of solid, liquids and gases:

Solid	Liquid	Gas
has a definite volume	has a definite volume	does not have a definite volume
has a definite shape	does not have a definite shape	does not have a definite shape
cannot be compressed	cannot be compressed	can be compressed

Particulate model of solids:

Forces of attraction	**Movement**	**Arrangement**

Solid particles are held together by **very strong forces of attraction.**	Can only **vibrate about fixed positions.**	Packed **very closely** together in an **orderly manner**.

A solid has a fixed shape because the particles of a solid are **held together by very strong forces of attraction.** They can only **vibrate about fixed positions** and **cannot move about freely**.

A solid has a fixed volume because the particles of a solid are **packed very close** to one another. There is **no empty space** for the particles to move closer. Hence, a solid cannot be compressed.

Particulate model of liquids:

Forces of attraction	**Movement**	**Arrangement**
Liquid particles are held together by **strong forces of attraction.**	Able to **slide past one another.**	**Closely packed** in a **disorderly** manner.

A liquid does not have a fixed shape because the particles of a liquid have **weaker forces of attraction** than particles of a solid. They are **not held in fixed positions** and can **slide past one another**.

A liquid has a fixed volume because the particles of a liquid are **packed closely together.** There is **little space** between particles for them to move closer. Hence, a liquid cannot be compressed.

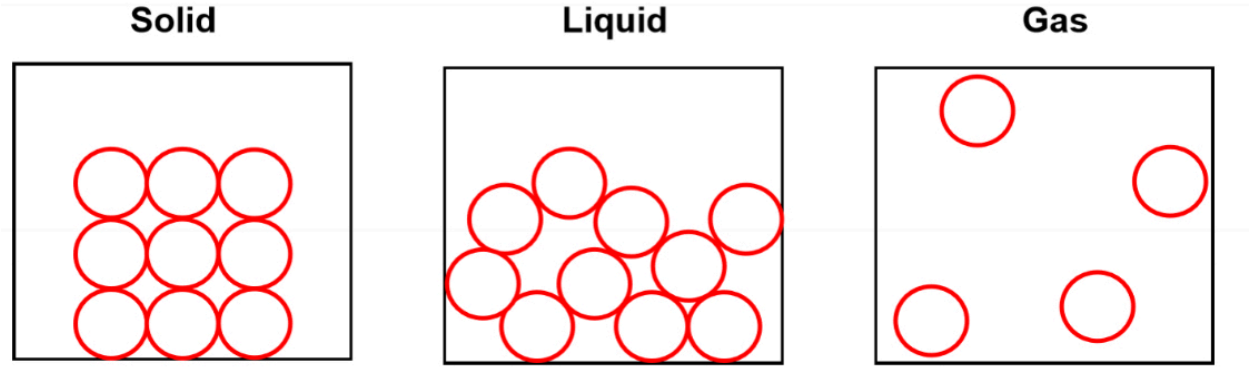
Particulate model of gases:

Forces of attraction	**Movement**	**Arrangement**
Gas particles are held together by **weak forces of attraction.**	Move at **high speed in all directions.**	**Far apart** from one another in a **disorderly** manner.

A gas does not have a fixed shape because the particles of a gas have **weak forces of attraction** between them. They are **not held in fixed positions** and can **move about at high speed in all directions.**

A gas does not have a fixed volume because there is **a lot of space** between the gas particles. The gas particles **can move closer together to occupy a smaller space**. Hence, a gas can be compressed.

Arrangement of particulate model of gas, liquid, and solid.



Hard Questions:

For the same rise in temperature, the volume of a gas increases more than the volume of a solid.

The gas particles have very weak forces of attraction between them which can be easily overcome when the particles gain heat energy. So the gas particles can move at higher speeds and more freely to occupy more space. The solid particles have very strong forces of attraction between them which are difficult to overcome. The solid particles only can vibrate more vigorously about fixed position so the volume does not increase a lot.

When 50 g of salt dissolves in 250 cm^3 of water, the volume of the salt solution remains at 250 cm^3.

There are spaces between the water particles. The salt particles are small enough to fill the spaces between the water particles.

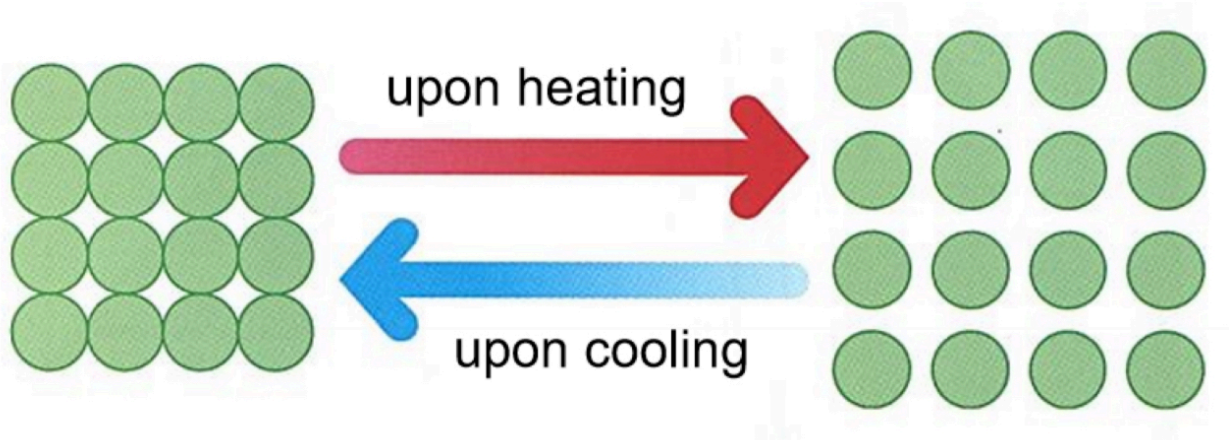
(Part 2)

Expansion:

- When a substance in the solid state is heated, its particles **gain energy** and vibrate **more vigorously** about their fixed positions.
- The distances between the particles **increases**.
- The volume of the substances increases, and the substance **expands**.

Contraction:

- When a substance in the solid state is cooled, its particles **lose energy** and vibrate **less vigorously** about their fixed positions.
- The distances between the particles **decrease**.
- The volume of the substance decreases, and the substance **contracts**.



The number and size of the particles in a substance **do not change** during expansion and contraction. There is **conservation of mass.**

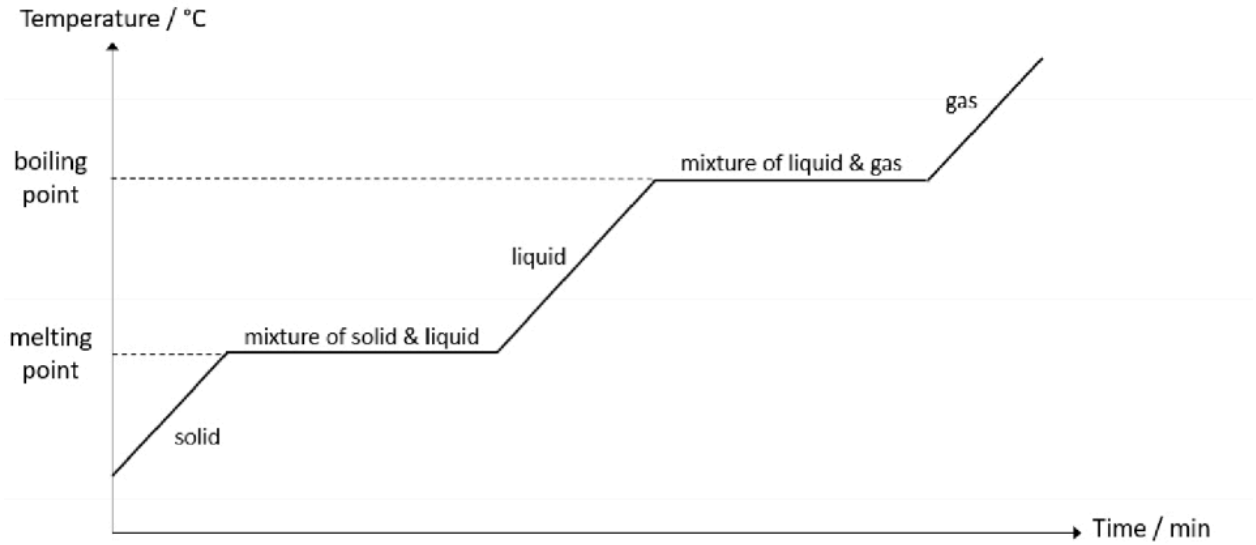
Melting:

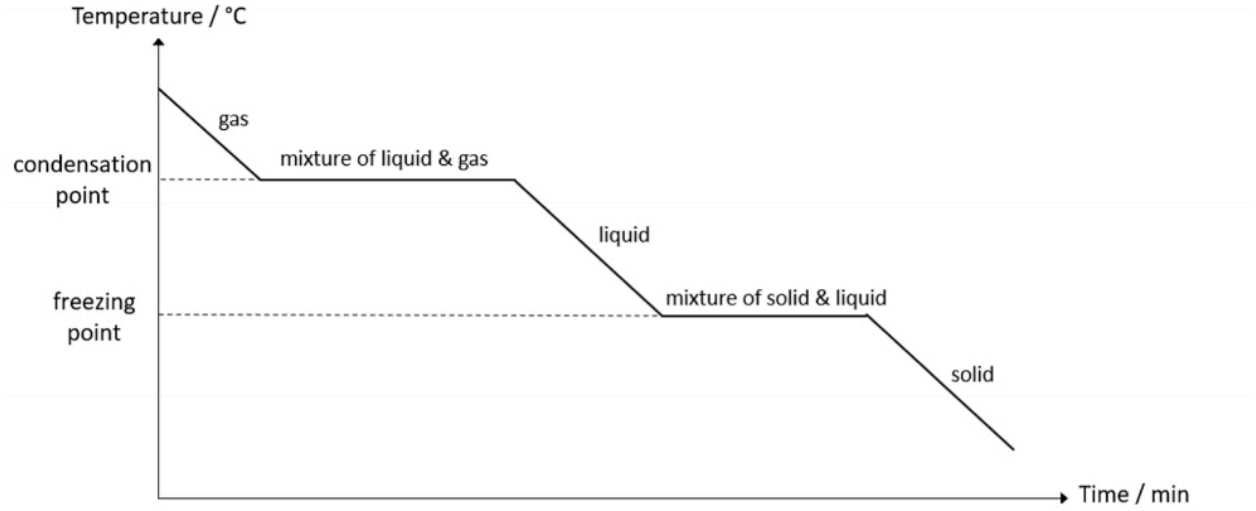
- When a solid is heated, its particles **gain energy** and **vibrate more vigorously.**
- Particles gain enough energy to **overcome the very strong forces of attraction between them.**
- The particles start to slide past one another and the substance melts.

Boiling/Evaporation:

- When a liquid is heated, its particles **gain energy** and **move faster and further apart**.
- Particles gain enough energy to **overcome the strong forces of attraction** between them.
- The particles move at high speeds in all directions. The substance boils.

Heating and Cooling Curve:





Condensation:

- When a gas is cooled, its particles **lose energy** and **move slower.**
- **Stronger forces of attraction** develop between the particles.
- Particles are pulled closer to one another. The substance condenses.

Freezing:

- When a liquid is cooled, its particles **lose energy** and **move slower.**
- **Stronger forces of attraction develop** between the particles.
- Particles are pulled closer and settle into fixed positions. The substance freezes.

Hard Questions:

Explain, in terms of kinetic particle theory, what happens to ethanol at 78C (boiling point of ethanol)

When ethanol is heated, its particles gain energy and move faster and further apart (liquid to gas explanation) **The particles gain enough energy to overcome the strong forces of attraction between them. They can move at high speed in all directions. Ethanol then boils and becomes a gas.**

(Part 3)

Particles, which are in constant and random motion, move from a region of **higher** concentration to a region of **lower** concentration (until uniformly spread)
This is known as **diffusion**.

E.g. aroma from bakery shop @ level 1 can travel to level 2.

Chapter 8: Atoms and Molecules

(Part 1)

Sub-atomic particles in an atom:

Subatomic particle	relative mass	relative charge
proton	**1**	**+1**
neutron	**1**	**0 (neutral because it's a neutron)**
electron	**1/1840**	**-1**

In an atom, the number of protons is **equal** to the number of electrons.

The positive and negative charges in the atom are **balanced**, hence the atom is said to be **electrically neutral**.

Elements are arranged in the periodic table in order of **increasing** `number of protons in their atoms. **No** two elements can have the **same number of protons**.

Some elements have atoms with different number of neutrons. Hence, an atom can only be identified by the number of protons.

The total number of protons and neutrons in an atom is known as the **mass** number or **nucleon** number. (Atomic mass)

(Part 2)
The electronic configuration describes how electrons are distributed in the electron shell(s). First Period —> One Shell etc.

The maximum number of electrons each shell can hold:
1st —> 2
2nd —> 8
3rd —> 8
4th —> 2
(learn only until Calcium)

Elements that belong to Group 18 of the Periodic Table are known as **noble** gases, which have a **full** / complete valence shell, so they are stable and unreactive (**inert**)

Atoms that do not have fully filled valence electron shell will lose, gain or share valence electrons to attain the noble gas electronic configuration.

Ions are formed when atoms gain or lose electrons.

Positively charged ions (**cations**) are formed when electrons are lost.
Negatively charged ions (**anions**) are formed when electrons are gained

[Their relative charges make them cations / anions]

A molecule is made up of 2 or more atoms chemically joined together.

The chemical formula helps us to identify each constituent element in a molecule by its chemical symbol, and indicates the number of atoms of the element.

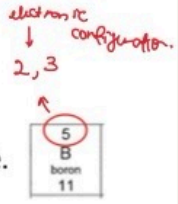
Drawing electronic structure of atoms

- Every diagram must have a legend that indicates the electrons of each atom using X or •.
- Circle template should always be used to draw the diagram in pencil.
- Electron shells should be neatly spaced apart so that the electrons can be clearly seen.
- The chemical symbol should be in the centre. Do not draw a circle around the chemical formula as it looks like an empty first electron shell.
- Electrons after the first shell should be drawn singly first up to 4 electrons, then in pairs.

Drawing electronic structure of atoms

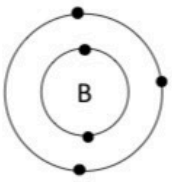
Draw the electronic structure of boron atom.

1. Find out the proton number ~~of magnesium~~ from the periodic table.
2. Number of electrons = Number of protons
3. Deduce the electronic configuration of ~~magnesium~~ atom (2,3).
4. Write the chemical symbol.
5. Draw two electron shells.
6. Fill in the electrons. First shell's electrons should be drawn singly. Second shell's electrons should be drawn singly first up to 4 electrons, then in pairs if required.



Drawing electronic structure of atoms

Draw the atomic structure of boron atom.



Legend
• Electron of B atom

Drawing electronic structure of ions

Draw the electronic structure of a fluoride ion.

1. Deduce the electronic configuration of the fluorine atom.
2. If the number of valence electrons is less than 4, all the electrons will be lost. Draw 1 less electron shell for the ion.
3. If the number of valence electrons is more than 4, electrons will be gained until the valence shell is fully-filled. The number of electron shells is the same as the atom.
4. Draw the square bracket and write the charge at the top right corner.
5. Write the legend.

Drawing electronic structure of ions