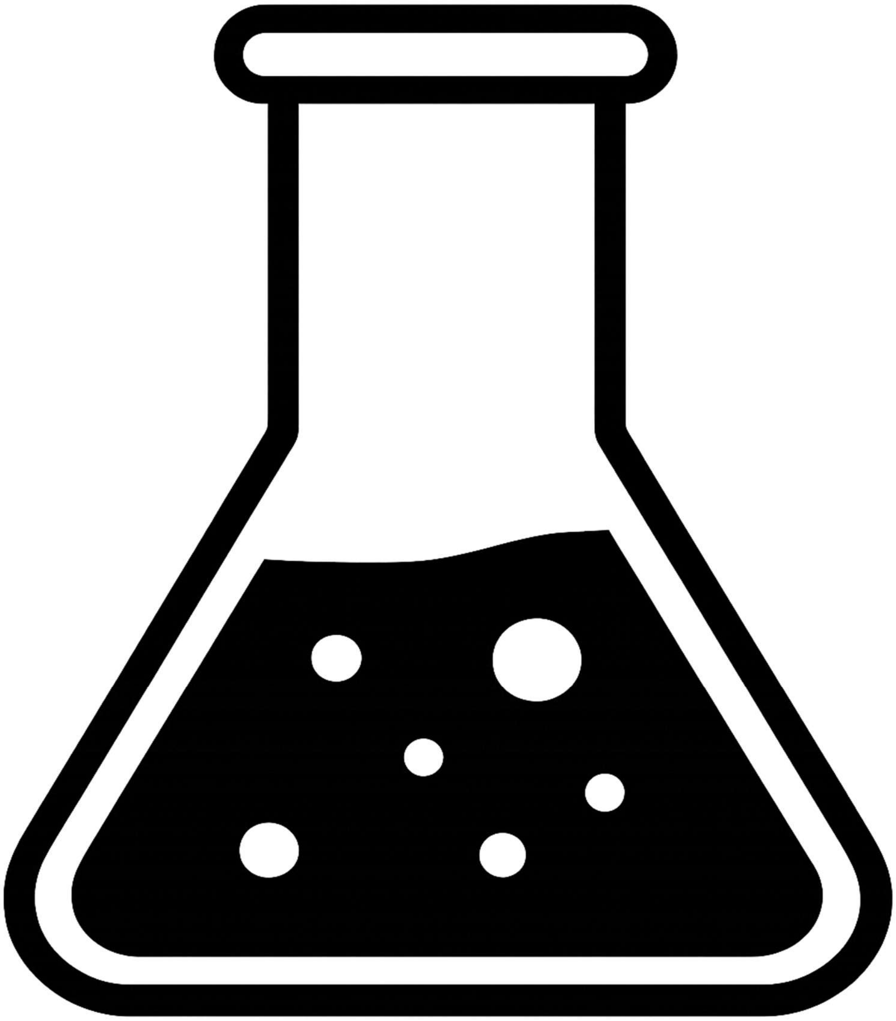
0620 IGCSE Chemistry
Summary Sheet
Assessment Test Prep



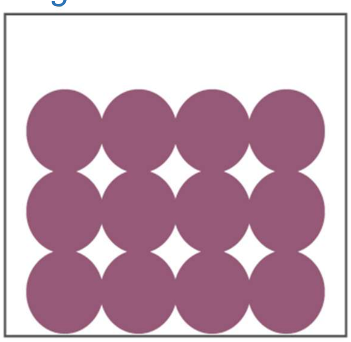
Prepared by:
The ReviseRoom Educator Team

Chapter 1 – States of Matter

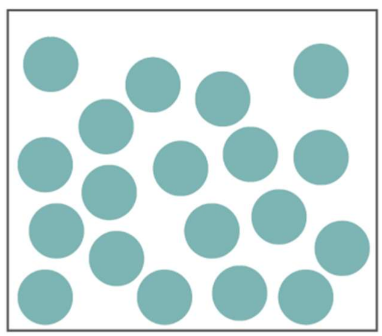
Properties of Solids, Liquids and Gases

Property	Solid	Liquid	Gas
Arrangement	Closely packed in a regular, fixed pattern	Closely packed but randomly arranged	Far apart and randomly arranged
Motion	Vibrate in fixed positions	Slide past each other	Move rapidly in all directions
Forces between particles	Very strong	Moderate	Very weak
Shape	Fixed shape	No fixed shape (takes shape of container)	No fixed shape (fills container completely)
Volume	Fixed volume	Fixed volume	No fixed volume (expands to fill container)
Compressibility	Not easily compressed	Not easily compressed	Easily compressed
Energy of particles	Lowest	Moderate	Highest
Diffusion	Does not occur	Occurs slowly	Occurs rapidly

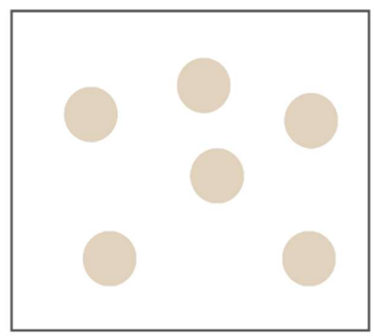
Diagrams of the States of Matter



SOLID

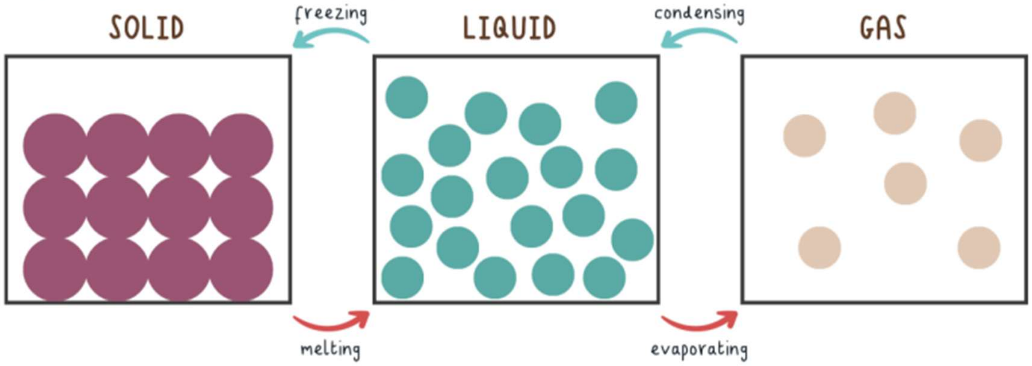


LIQUID



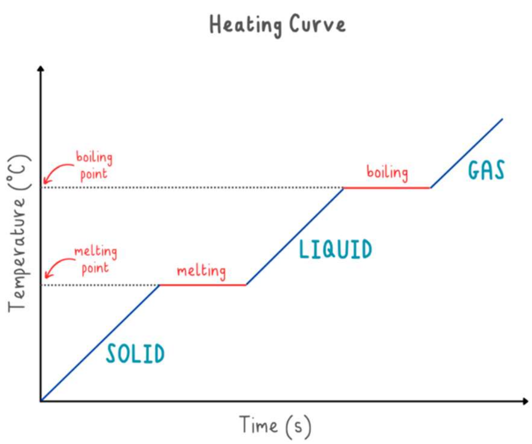
GASES

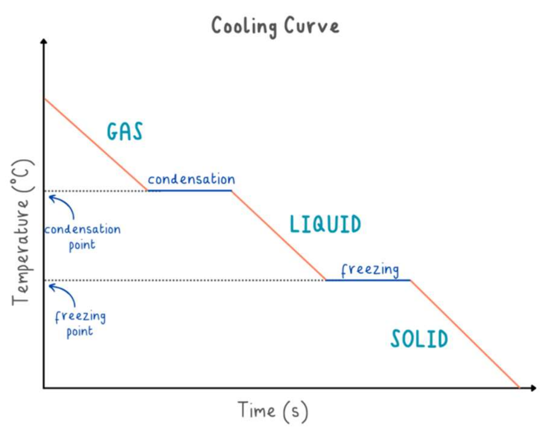
Changes of State (With Diagrams)



In Terms of the Kinetic Particle Theory:

- **Basically, explain things in terms of particles:**
    - **Melting:** solid particles gain heat energy, there is an increase in kinetic energy, particles vibrate much faster, they overcome the forces of attraction and form liquid particles.
    - **Evaporation:** liquid particles gain heat energy, there is an increase in kinetic energy, particles slide around more rapidly, the highest energy particles escape the liquid as gas.
    - **Condensing:** gas particles lose heat energy, kinetic energy of particles decrease, particles slow down, intermolecular forces of attraction are formed.
    - **Freezing:** liquid particles lose heat energy, kinetic energy of particles decrease, particles slow down, intermolecular forces of attraction are formed.





Both graphs stay horizontal during state change: the temperature stays constant because all the heat energy is used to overcome or form intermolecular forces. During the state change, both states will be present.

- E.g. Condensation: both gas and liquid, Melting: both solid and liquid

Diffusion:

- **Definition:** The net movement of particles from an area of high concentration to an area of low concentration
- **Conditions:** Diffusion can only occur in liquids and gases.
- **Effect of Molecular Mass:** The larger the molecular mass (Mr), the slower the rate of diffusion/particles spreading out.
  - **As molecular mass increases,** particles get “heavier” with more neutrons; hence, it takes longer for them to move.

Brownian Motion (bonus):

- **Definition:** Random motion of particles in a liquid or gas caused by the random bombardment of other fast-moving particles.
- **Example:** Smoke particles in air under a microscope.

Sublimation (bonus):

- **Definition:** A physical change where a substance changes **directly from solid to gas** without becoming a liquid.
- Example: **Iodine** and **dry ice (solid CO_2)** undergo sublimation.

Chapter 2 – Atomic Structure

Atoms, Elements, Compounds, Molecules, and Mixtures

- **Atom:** The smallest particle consisting of protons, neutrons, and electrons of an element that retains the chemical properties of that element.
- **Element:** a pure substance made from only one type of atom. It cannot be broken down further by chemical means.
- **Compounds:** A substance made when two or more elements are chemically bonded together in fixed proportions.
- **Molecules:** A group of two or more atoms chemically bonded together. The atoms can be the same (e.g. O_2) or different (e.g. H_2O).
- **Mixtures:** A combination of two or more substances **physically mixed**. They can be separated by physical methods and retain their individual properties.

Difference Between Compounds and Molecules

Molecule

A group of **two or more atoms chemically bonded** together.
The atoms can be **the same element** or **different elements**.

Example

O_2 (oxygen) — same atoms
H_2O (water) — different atoms

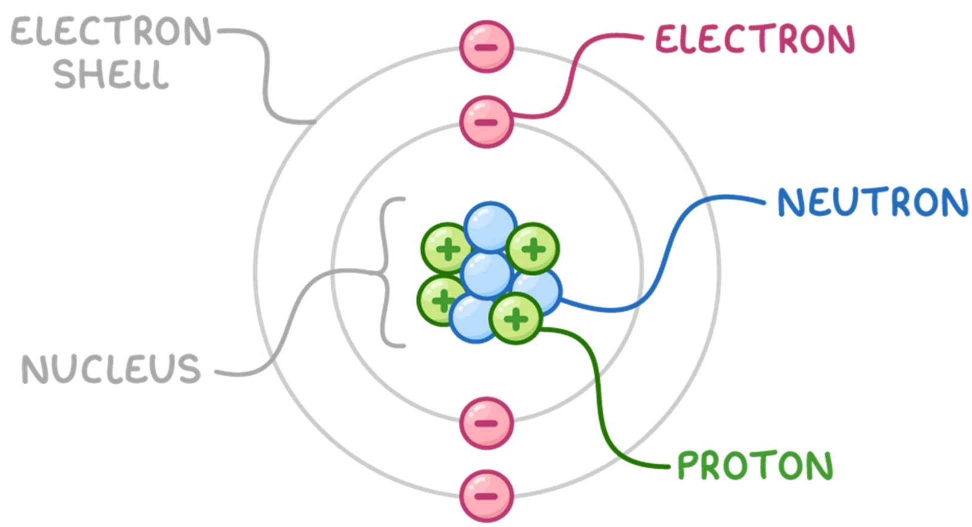
Compound

A substance made out of **2 or more DIFFERENT elements** chemically bonded together.
All compounds are molecules, but **not all molecules are compounds**.

Example

H_2O (water) — compound
CO_2 (carbon dioxide) — compound
O_2 is **not a compound**, just a **molecule**

Atomic Structure



Electronic Configuration

Electrons fill shells in order:

- 1st shell = 2, 2nd = 8, 3rd = 8 (IGCSE level)

Notation example:

- Oxygen (8 electrons): 2.6
- Sodium (11 electrons): 2.8.1
- Calcium (20 electrons): 2.8.8.2

Periodic Table Connections

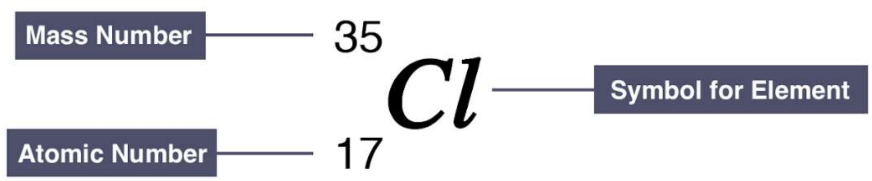
Period (row): Number of electron shells

- E.g. All elements in Period 3 have 3 shells

Group (column): Number of electrons in the outer shell

- E.g.
    - Group 1 = 1 outer electron (like Na, Li)
    - Group 7 = 7 outer electrons (like Cl, Br)

Atomic and Mass Number



Subatomic Particle Properties

Particle	Relative Mass	Relative Charge	Location
Proton	1	+1	Nucleus
Neutron	1	0	Nucleus
Electron	1/1836	-1	Electron shells

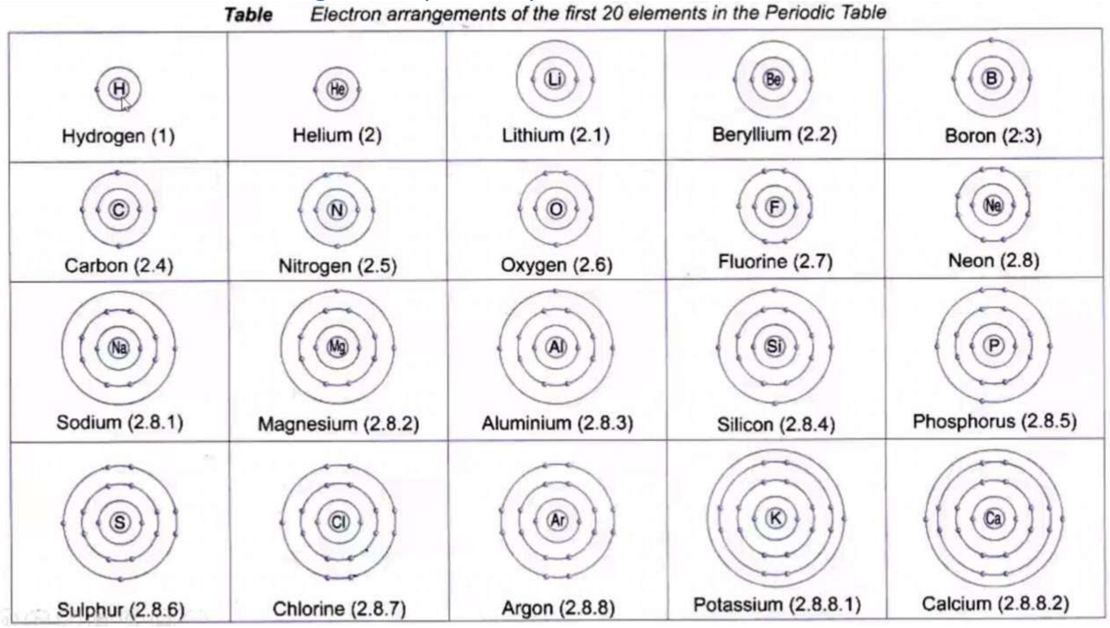
Isotopes

- **Definition:** Two or more atoms of the same element with the same proton number but a different neutron number.
    - E.g. Carbon-12 has 12 protons and 12 neutrons but carbon-13 has 12 protons and 13 neutrons in the nucleus of each atom.
- **Chemical Properties:** Isotopes have identical chemical properties because they have the same **outer shell electrons**.

Relative Atomic Mass (Ar) = $\frac{(isotope\ 1\ mass \times abundance) + (isotope\ 2\ mass \times abundance)}{100}$

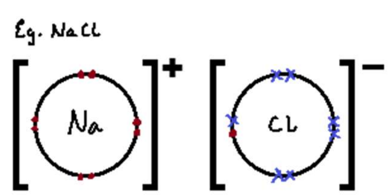
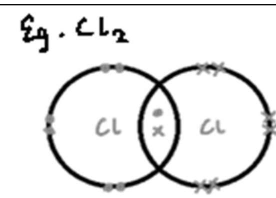
Atomic Structure Diagrams (Bonus)

Table *Electron arrangements of the first 20 elements in the Periodic Table*



Chapter 3 – Chemical Bonding

Ionic and Covalent Bonding

Feature	Ionic Bonding	Covalent Bonding
Definition	**Electrostatic attraction** between positive and negative **ions** with a **complete transfer** of electrons.	Sharing pairs of electrons between non-metal atoms.
Particles Involved	Metal + Non-metal	Non-metal + Non-metal
Electron Movement	Electrons are **completely** transferred from metal to non-metal	Pairs of electrons are shared between atoms
Melting/Boiling Pt	High, due to strong **electrostatic forces of attraction** between **oppositely charged ions.**	Low, due to weak **intermolecular forces between molecules.**
Electrical Conductivity	Conducts electricity when in **liquid or aqueous** state (molten or dissolved)	Does **not conduct** electricity, no free electrons or ions
Solubility	**Soluble** in water	**Insoluble** in water, soluble in organic solvents (ethanol)
Examples	NaCl, $MgCl_2$	H_2O, CO_2, CH_4, Cl_2
Diagram Type		

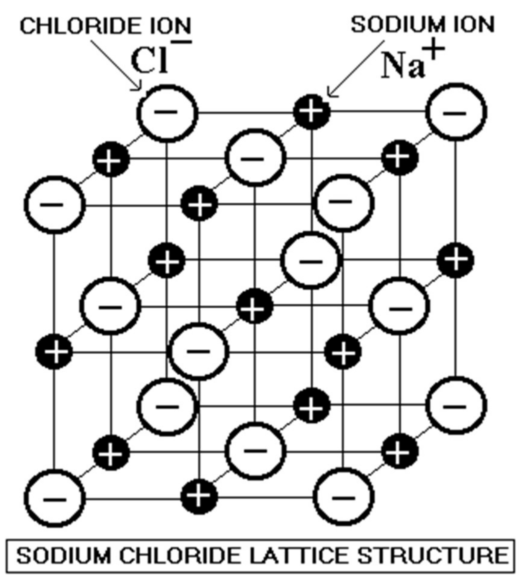
Octet Rule: Atoms tend to **gain, lose, or share electrons** to achieve a **full outer shell of 8 electrons (a noble gas structure).**

Bonus points:

- Ionic compounds are usually crystalline solids at room temperature, while covalent compounds are gases.
- Ions occur when an atom loses or gains electrons.
- **Ionic compounds** cannot conduct electricity when solid, as ions are locked in place, but they can when they're liquid, because ions are free to move around.
- **Ionic compounds follow the valency rules when writing equations:**
    - **$2Na + Cl_2 \rightarrow 2NaCl$** (as valency for both Na and Cl are 1)
    - **$Mg + Cl_2 \rightarrow MgCl_2$** (as valency for Mg is 2 and Cl is 1)

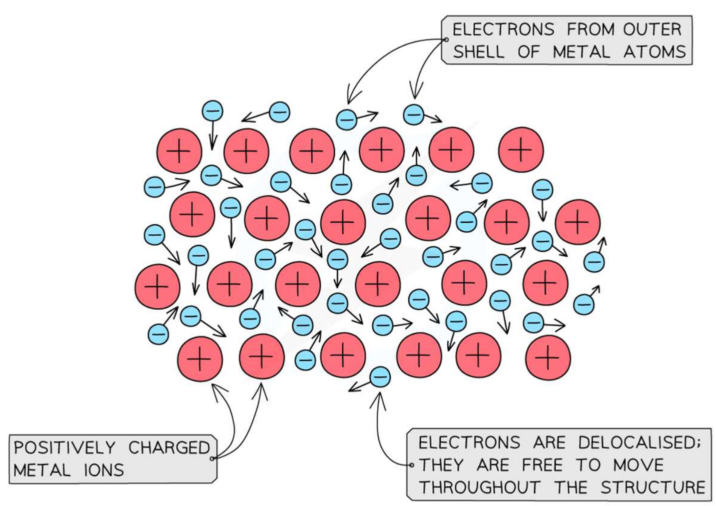
Giant Ionic Lattice

Definition: A giant, repeating structure of ions held together by strong electrostatic forces of attraction between oppositely charged ions.

Property	Description
Structure	Giant 3D lattice of alternating positive and negative ions
Bonding	Strong electrostatic attraction between oppositely charged ions
Melting/Boiling Point	High; a large amount of energy is required to break strong electrostatic forces of attraction between oppositely charged ions.
Electrical Conductivity	Conducts electricity when molten or dissolved (ions are free to move); does **not** conduct when solid
Solubility	Usually soluble in water
Hardness/Brittleness	Hard but brittle. If layers shift, **like charges (+ and + or - and -)** repel and structure shatters
Special Notes	Forms crystals; ions form by gaining or losing electrons
Diagram	

Giant Metallic Lattice

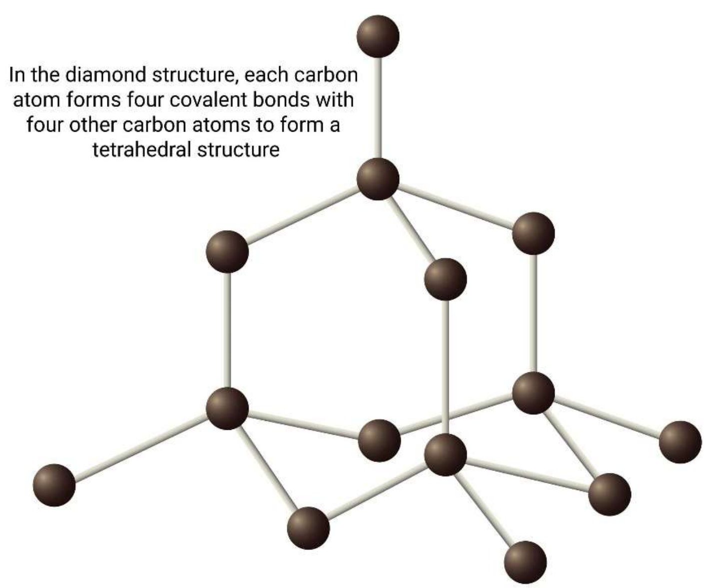
Definition: A giant structure of positive metal ions surrounded and held together by a sea of delocalised electrons through electrostatic forces of attraction.

Property	Description
Structure	Giant lattice of positive metal ions in a sea of delocalised electrons
Bonding	Strong electrostatic attraction between metal ions and delocalised electrons
Melting/Boiling Point	High; metallic bonds are strong and need a lot of energy to overcome.
Electrical Conductivity	Conducts electricity in both solid and liquid states: delocalised electrons can move freely throughout the layered structure.
Solubility	Insoluble in water; some metals may react with water.
Hardness/Malleability	Hard and malleable; layers of ions can slide without breaking the metallic bond
Extra Notes	Good conductors of heat; shiny; ductile (can be drawn into wires)
Diagram	

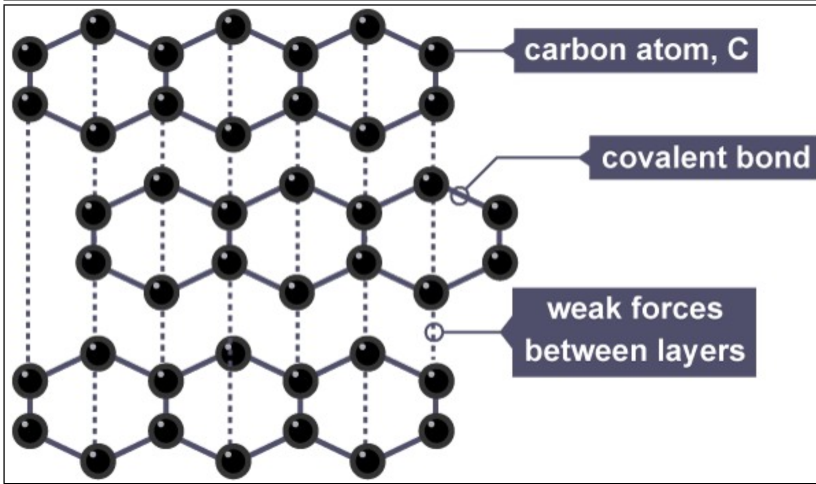
Giant Covalent Structure (Diamond, Silicon (IV) Oxide, Graphite)

Definition: A giant structure consisting of **strong covalent bonds** repeating throughout the entire structure.

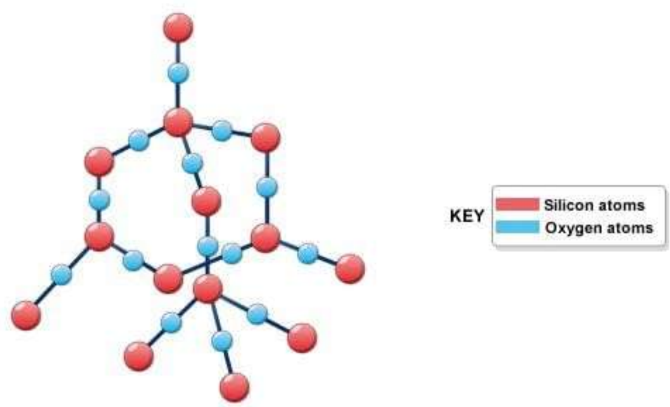
Diamond (Carbon)

Property	Description
Structure	Every carbon atom is chemically bonded to 4 other carbon atoms in a repeating tetrahedral structure.
Bonding	Strong covalent bonds throughout the entire structure
Hardness	Extremely hard (hardest natural substance)
Melting Point	Very high – due to strong covalent bonds
Electrical Conductivity	Does not conduct electricity – no free electrons or ions
Uses	Cutting tools, drills, jewellery
Extra Notes	Shiny, see-through
Diagram	

Graphite (Carbon)

Property	Description
Structure	Each carbon atom bonded to 3 others in layers of hexagonal rings; layers held by weak forces
Bonding	Strong covalent bonds in layers, weak intermolecular forces between layers
Electrical Conductivity	Conducts electricity between carbon layers – each atom has 1 delocalised electron that carries charge.
Melting Point	Very high due to strong covalent bonds
Lubrication	Layers can slide over each other – soft and slippery
Uses	Pencils, lubricants, electrodes in electrolysis
Diagram	

Silicon IV Oxide (SiO_2)

Property	Description
Structure	Repeating tetrahedral structure with each silicon atom bonded to 4 oxygen atoms; each oxygen to 2 silicon atoms. (Structure is very similar to diamond)
Bonding	Strong covalent bonds throughout the lattice
Hardness	Very hard and brittle
Melting Point	Very high
Electrical Conductivity	Does not conduct electricity as it has no delocalised electrons
Uses	Glassmaking, sand, ceramics, electronics
Diagram	

Chapter 13 – The Periodic Table

Group Properties (G1, G7, G8)

Property	Group I: Alkali Metals	Group VII: Halogens	Group VIII: Noble Gases
Type	Metals	Non-metals	Non-metals
Outer Shell Electrons	1 electron	7 electrons	Full outer shell (8 electrons, except He = 2)
Reactivity Trend	Increases down the group	Decreases down the group	Very unreactive
Typical Reactions	React with water to form metal hydroxide + hydrogen	React with metals to form salts	Do not react (inert)
State at Room Temp	Solid	Solid, liquid, or gas (varies by element)	Gas
Colour	Silvery (shiny when cut)	Coloured (e.g. Cl = green, Br = red-brown, I = purple)	Colourless
Other Notes	Stored in oil, soft, low density	Usually diatomic gases	Monoatomic gases

Transition Metals

Aspect	Details
Physical Properties	- High melting points - High density - Hard and strong - Good conductors of heat and electricity - Shiny appearance
Chemical Properties	- Variable oxidation states - Form coloured compounds - Act as catalysts - Can form complex ions
Examples	Iron (Fe) → Fe^{2+} (green), Fe^{3+} (yellow/brown) → Catalyst in Haber Process Copper (Cu) → Cu^{2+} (blue) → Used in electroplating Manganese (Mn) → Mn^{2+} (pink) → Catalyst in H_2O_2 decomposition
Extra Notes	- Transition metals are in the central block - Known for coloured ions and useful in industrial catalysts - Required knowledge includes ion colours and uses in processes

Metals vs Non-Metals

Property	Metals	Non-Metals
Type of Element	Usually solids (except mercury)	Solids, liquids, or gases
Appearance	Shiny (lustrous)	Dull
Malleability	Malleable and ductile	Brittle when solid
Electrical Conductivity	Good conductors	Poor conductors (except graphite)
Thermal Conductivity	Good thermal conductors	Poor thermal conductors
Boiling/Melting Points	Generally high	Generally low
Density	Usually high	Usually low
Oxide Nature	Basic oxides (e.g. Na_2O)	Acidic or neutral oxides (e.g. CO_2)
Tendency in Reactions	Lose electrons to form positive ions	Gain or share electrons to form negative ions or covalent bonds
Position in Periodic Table	Left and center blocks	Top Right
Type of Bonding	Metallic Bonding	Covalent or Ionic Bonding

Trends Across a Period (Left to Right)

Property	Trend
Atomic number	Increases
Number of outer electrons	Increases
Metal → Non-metal	Elements change from metallic to non-metallic
Atomic radius	Decreases (more protons pulling electrons closer)
Nuclear charge	Increases (more protons in nucleus)
Electrical conductivity	Decreases (as you go from metal to non-metal)
Melting/Boiling Point	Generally increases then decreases (depends on structure)
Oxide type	Basic → Amphoteric → Neutral → Acidic
Bonding	Metallic → Covalent (giant) → Covalent (simple)

Key Example – Period 3 (Na to Ar):

- **Na, Mg** → Metals, conduct electricity, basic oxides
- **Al** → Amphoteric oxide, metalloid properties
- **Si** → Giant covalent, semiconductor
- **P, S, Cl** → Non-metals, simple covalent, acidic oxides
- **Ar** → Noble gas, inert
-

Metalloids (Semi-metals)

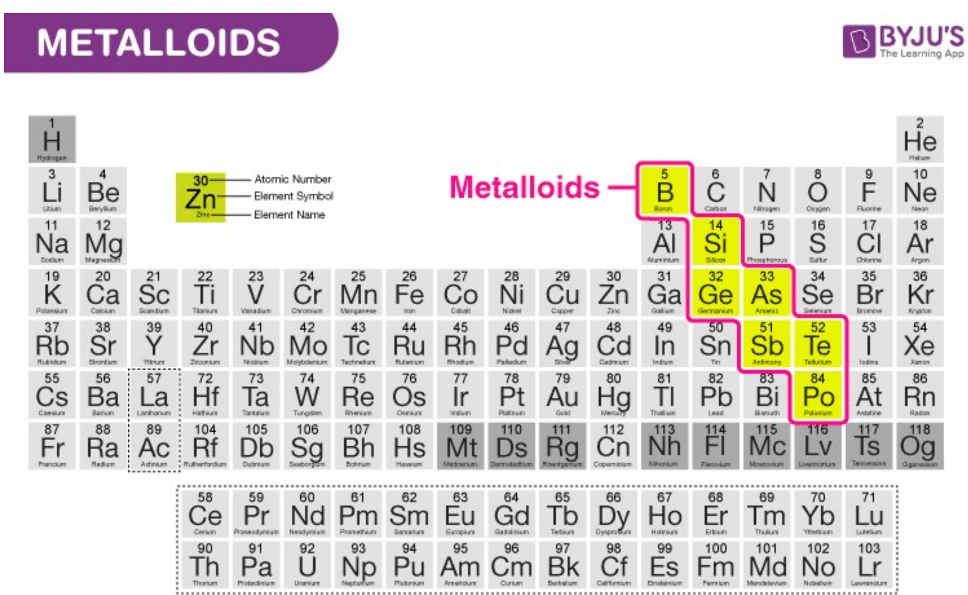
Definition: Metalloids are elements that have **some properties of metals and some of non-metals**. They lie **along the "stair-step" line** in the Periodic Table between metals and non-metals.

Examples of Metalloids (you may need to mention in the assessment):

- Silicon (Si)
- Boron (B)
- Arsenic (As)
- Antimony (Sb)
- Tellurium (Te)

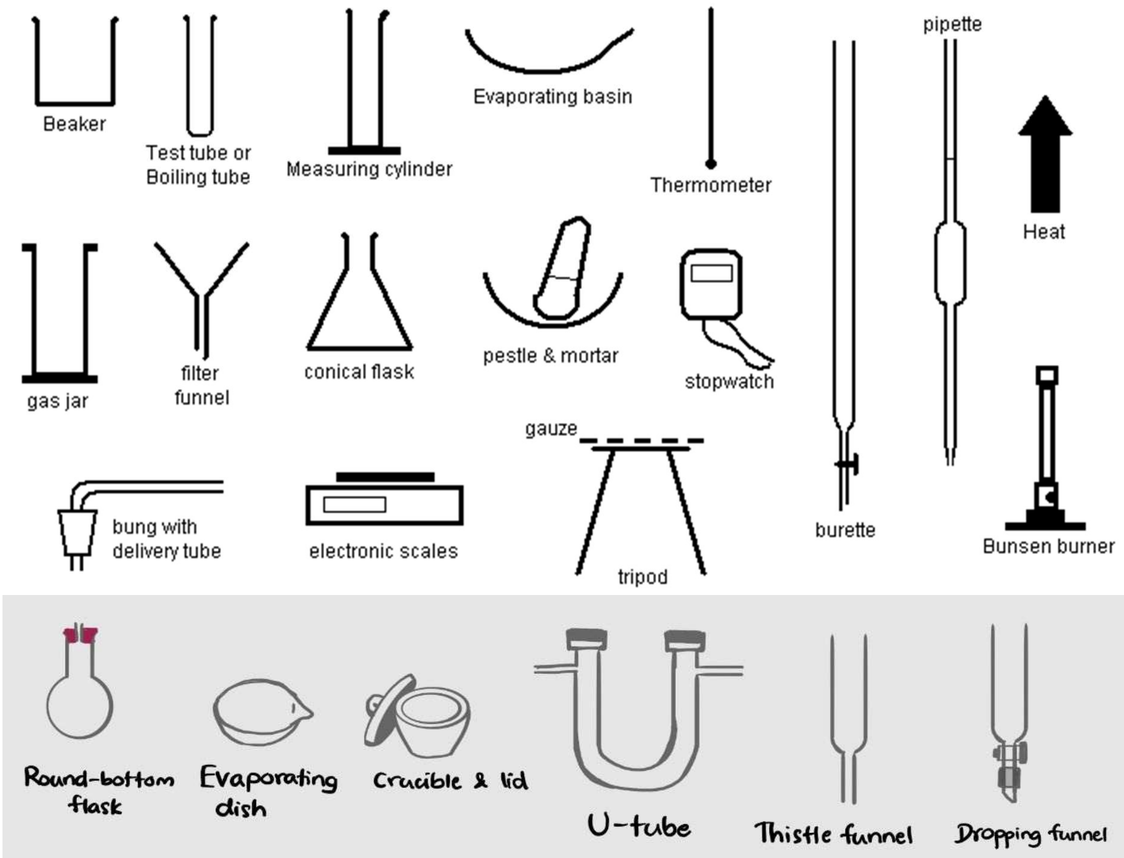
Property	Description
Appearance	Generally **shiny** like metals
Electrical Conductivity	**Poor to moderate conductors** — better than non-metals, worse than metals
Reactivity	Varies — may behave like metals or non-metals depending on the element they react with
State at Room Temp	All are **solids**
Chemical Behavior	Forms **covalent compounds**, sometimes acts like non-metals in reactions
Position in Periodic Table	Found along the **stair-step line** (between Groups 13–17)

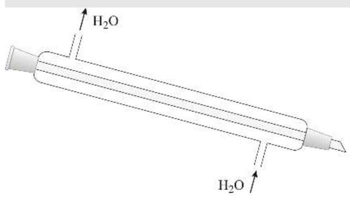
Where they're found in the periodic table (staircase):



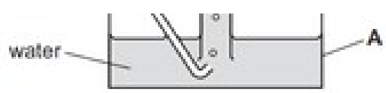
Chapter 21 – Separation Techniques

Apparatuses





Condenser

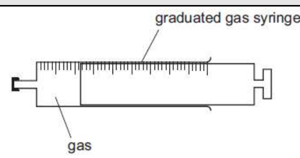
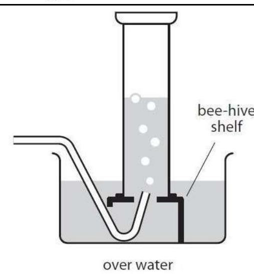
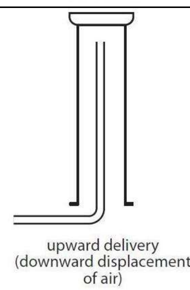
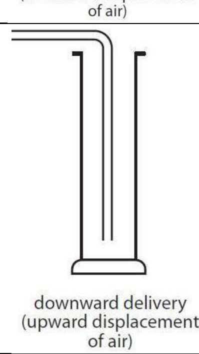


A: Trough

Liquid Volume Measurement

Apparatus	Advantage	Disadvantage	Accuracy
Burette	- Can measure variable volumes - More accurate than measuring cylinder		Most accurate
Volumetric pipette	- Can accurately measure a fixed volume of liquid 10 cm^3 or 25 cm^3	- Can only measure fixed volumes - Slow to add the liquid	Accurate
Measuring cylinder	- Can measure variable volumes	- Less accurate (due to large scales)	Least accurate

Gas Volume Measurement

Method	Image	Details
Gas syringe		- Most precise and accurate - Can measure any gas - heavier/lighter than air - soluble/insoluble in water - coloured/colourless gases
Downward displacement of water (over water)		- Measuring cylinder inverted in water to collect gas produced - Does not work with gases soluble in water
Downward displacement of air		- ***Collect*** gases lighter than air - Cannot use if the gas is poisonous
Upward displacement of air		- ***Collect*** gases heavier than air - Cannot use if the gas is poisonous

Chromatogrpahy (Paper chromatography)

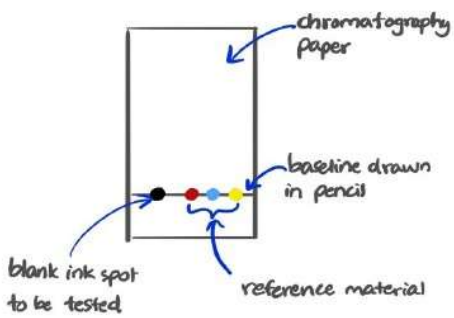
The process of separating components of a chemical mixture.

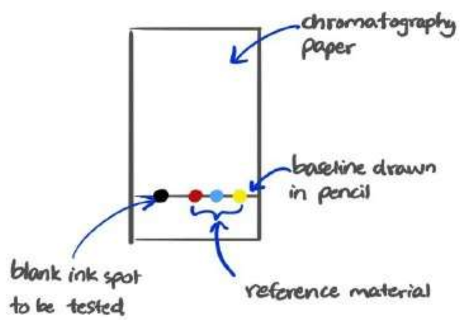
Apparatus needed:

- Chromatography Paper
- Pencil
- Ruler
- Suitable solvent
- Beaker
- Soluble coloured substance

Procedure (In order)

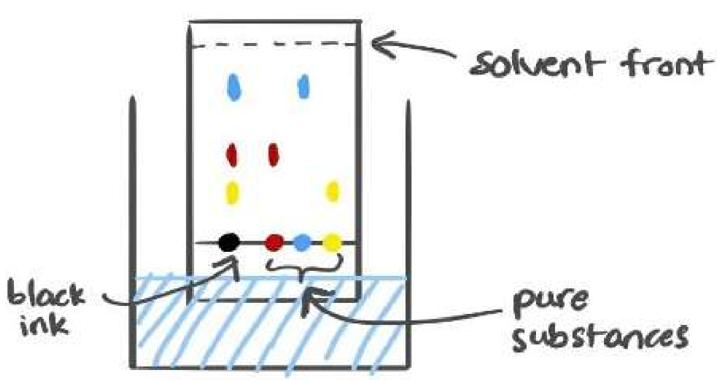
1. Draw a baseline with a **pencil**, about 1 cm above the base of the chromatography paper
2. Drop a spot of the soluble coloured substance **on the baseline** – use a dropping pipette if it is liquid/solution
3. Place the chromatography paper into the beaker with the solvent.
   - the solvent level **must be below the pencil line** (so the samples do not wash into the solvent)
4. Remove the paper when the solvent is almost at the top.
5. Dry the paper.
6. Interpret the chromatogram.





Interpreting chromatograms

1. Pure substances -- **only one spot**
2. Impure substances – **more than one spot**
3. If 2 or more substances are the same, they will produce identical chromatograms.



Locating agents

To see colourless spots:

Technique	Used to separate	Key facts	Physical or chemical	Example
Filtration	Insoluble solid from liquid	Uses filter funnel and filter paper to trap particles	Physical	Sand from water
Crystallisation	Soluble solid from a solution	Evaporate solvent, then cool to obtain crystals	Physical	Salt from seawater
Simple distillation	Liquid from a solution (pure solvent)	Boiling and condensing (based on boiling points)	Physical	Pure water from salt water
Fractional distillation	Miscible liquids with close boiling points	Uses fractionating column for repeated condensation	Physical	Ethanol & water, crude oil fractions

Assessing purity

Pure substances -- **sharp, fixed melting and boiling points**.

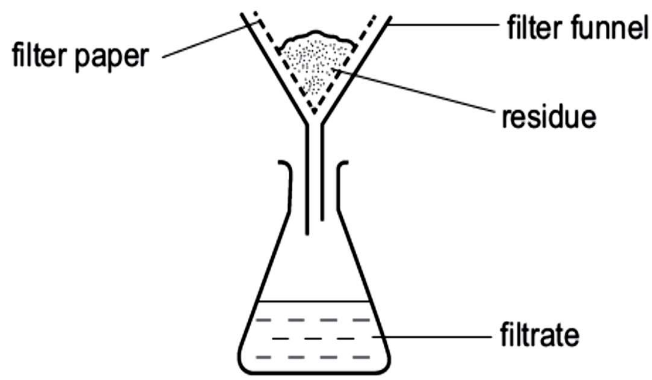
- Example: Pure water boils at 100°C and melts at 0°C (at standard pressure).

Mixtures (impure substances) – **lower melting points & higher boiling points**

- Example: Saltwater boils above 100°C and melts below 0°C.

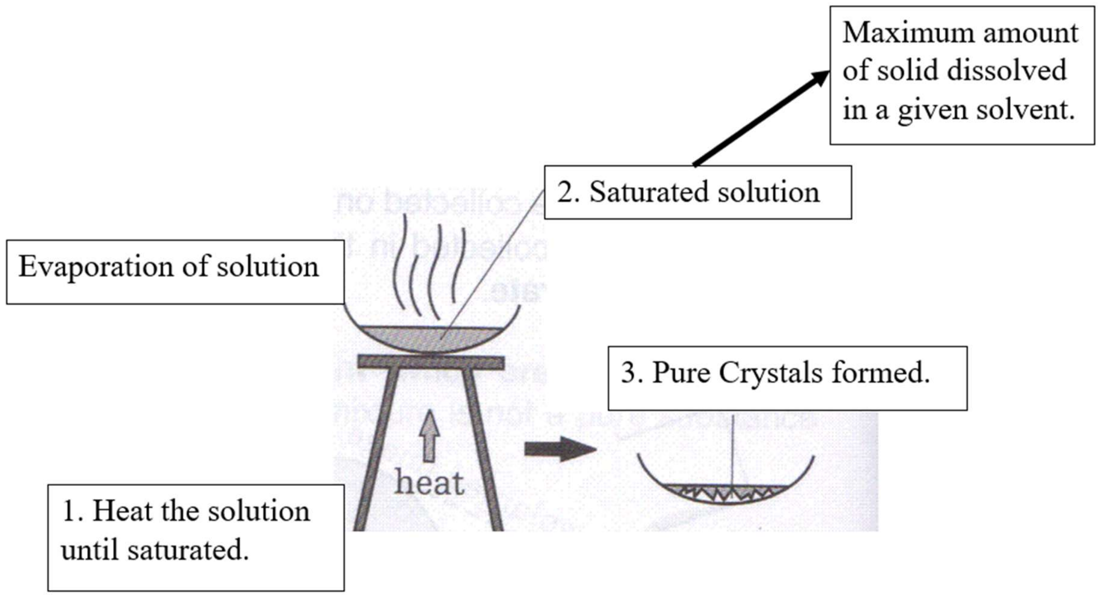
Filtration

The process of separating a mixture consisting of a **solid** and a **liquid.**



Crystallisation

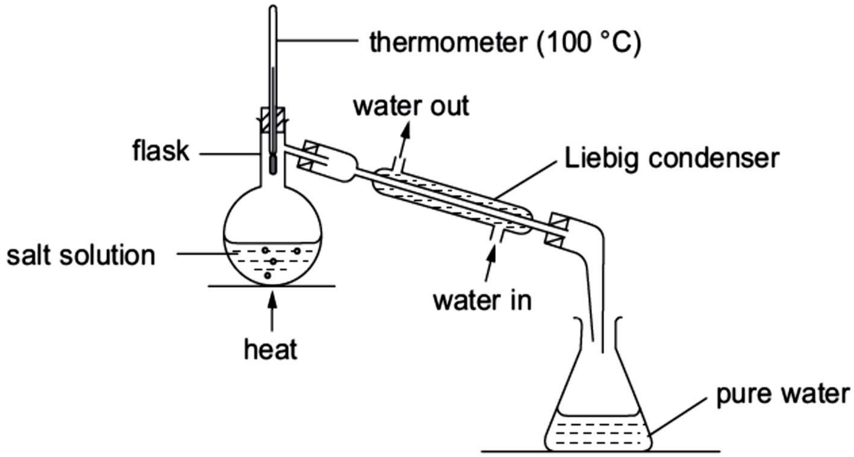
The process of separating a mixture consisting of a liquid and a soluble solid dissolved in it.



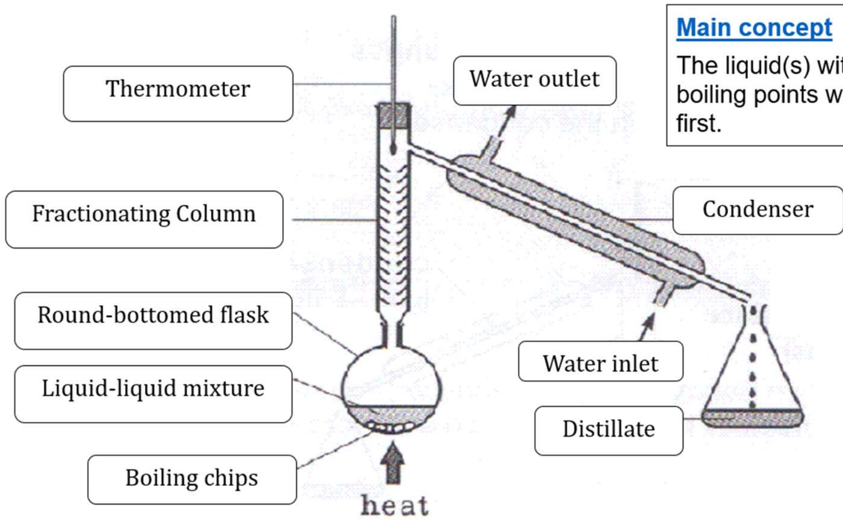
Simple Distillation

The process of separating two liquids of different boiling points.

<u>Do NOT use when the difference in boiling points of the liquids are **less than 20'C.**</u>



Fractional Distillation



Main concept

The liquid(s) with the lower boiling points will distill first.

Fractional distillation is used for liquids that are **miscible** and having **different boiling points**.

- Miscible – mix together completely to form a solution. E.g. water and ethanol
- Liquids with <u>**lower boiling points**</u> distill over first.
- Liquids with higher boiling points will return back into the round-bottomed flask.

🎓 Stay Connected with ReviseRoom!

Subscribe to ReviseRoom on YouTube for:

- *Bite-sized videos explaining ALL IGCSE topics*
- *IGCSE Past Paper Walkthroughs*
- *Tips & Tricks for Exam Success*
- *Topic-by-Topic Revision Guides*

🔔 **Enable notifications so you never miss a new upload!**

🌐 Visit Our Upcoming Website

Get access to:

- *1-on-1 Tutoring via a Credit-Based System*
- *Topical Past Paper Compilations*
- *Exclusive Mock Tests & Resources*
- *Full IGCSE Revision Materials, All in One Place*

📅 Upcoming Releases

- June 2025 IGCSE Paper Solved Videos
- Subject-by-subject Exam Predictions
- Understanding the IGCSE Marking Scheme

📬 Got Questions, Feedback, or Requests?

Drop a comment on any of our socials or email us at reviseroom.official@gmail.com!