Chap 1 : Experimental Chemistry

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Measurements

- **Mass**
  - → SI unit : Kilogram
  - → Other units : mg, g, t
  - → Instruments : Beam balance, electronic balance
- **Length**
  - → the distance between two points
  - → SI unit : Metre (M)
  - → Other units : centimetre (cm), milimeter (mm)
  - → Instruments : Metre rule, measuring tape
- **Time**
  - → the duration of an event.
  - → SI unit : Second (s)
  - → Other units : Minute (min), hour (h)
  - → Instruments : Mechanical stopwatch, digital stopwatch, hourglass
- **Temperature**
  - → is a measurement of hotness or coldness of an object
  - → SI unit : Kelvin (K)
  - → Other units : Celsius (°C), Farenheit (°F)
  - → Instruments : alchohol thermometer, digital lab thermometer, oral digital thermometer
- SI for volume : Cubic metre
- **Gas**
  - → Gas syringe
- **Liquid**
  - → burette
  - → measuring cylinder
  - → pipette
  - → volumetric flask
- Meniscus is the upward or downward curve at the top of the liquid in a container.
  - → Our eye must be at the same level as the meniscus to avoid parallax error.

Methods for collecting gases

- Gases can be collected using:

→ **Displacement of air**

- Used to collect gases of densities higher or lower than air.
- Two types of displacement of air:

∴ **Downward delivery** — Cl_2, CO_2

Δ Used to collect gases more dense than air

Δ The test tube is placed upright, thus the gas produced sinks down and displaces air.

∴ **Upward delivery** — NH_3, H_2

Δ Used to collect a gas less dense than air.

Δ The test tube is placed inverted, so the gas produced rises up and displaces air.

→ **Displacement of water** — CO_2, H_2, N_2, O_2

- Method only suitable for gases:

∴ Insoluble or only slightly soluble in water

∵ Has the density almost the same as air

Drying agents

- Can be used to obtain a dry sample of gas by removing its moisture content
- Drying agents that are used:

→ **fused calcium chloride**

- All gases except ammonia

→ **Concentrated sulfuric acid**

- All gases except alkaline gases

→ **Calcium oxide (quicklime)**

- All gases except acidic gases

Pure Substances

- A pure substance contains only one type of substance.
- For a substance to be pure, it must have:

→ A fixed melting point

→ A fixed boiling point

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- The greater the amount of impurities in a substance, the lower the melting point.

Physical methods of seperation

- When two or more substances are present and not chemically joined together, it is called a mixture.
- A mixture is not a pure substance.

Seperating solid-solid mixtures

- **Magnetic attraction**
  - → Magnets attract magnetic substances to seperate them from non-magnetic substances.
  - → Common magnetic substances:
    - Iron
    - Nickel
    - Cobalt
    - Steel
- **Sieving**
  - → A sieve seperates substances based on their particle size.
    - Only particles smaller than the pores of the sieve can pass through
- **Using soluble solvents**
  - → When a mixture contains only one soluble solid, a suitable solvent is used to dissolve the soluble solid
- **Sublimation**
  - → It is used to seperate a solid that can change into gas directly without melting
  - → When a mixture contains a solid that sublimes, heating is carried out to seperate it.

Seperating solid-liquid mixtures

- **Filtration**
  - → A filter paper is used to seperate the mixtures as it has tiny pores
  - → Only substances with particle size smaller than the pore size of the filter paper can pass through the pores.

- Evaporation to dryness
→ If the solid is heat-stable, evaporation can be used by heating the solution to dryness. The solid crystals remains as residue after the solid has evaporated.
- Crystallisation
→ A compound which is not heat-stable will be decomposed by evaporation to dryness.
→ When the solid is not heat-stable, the solution is heated until it is saturated
→ The saturated solution is then allowed to cool.
- Simple distillation
→ The liquid is heated to reach its boiling point so it changes into a vapour.
→ The vapour is then cooled by a condenser and is collected as a distillate
→ Boiling chips are added for smooth boiling

Seperating liquid-liquid mixtures

- Chromatography
→ When a substance dissolves in a solvent, it will be carried along by solvent on the paper
→ The more soluble the substance in the solvent, the further the distance it travels on paper
→ The solvent front should not travel to the edge of the paper
→ The solvent front should be as high as possible.
→ The starting line should be drawn in graphite pencil instead of an ink
→ The sample is applied as small as possible
→ The starting line should be above the solvent
→ The beaker containing the solvent is covered by a lid
→ The number of spots indicates the number of substances in a sample
→ Any spots which are horizontally matched are likely to be the same substance
→ Advantages:
• Gives a quick and accurate analysis of sample

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- Requires only a small amount of sample
- Able to seperate complex mixtures

→ Rf value:

$$\frac{\text{distance travelled by spot}}{\text{distance travelled by solvent}}$$

- **Fractional distillation**

→ A tall fractionating column is used in the fractional distillation to ensure the seperation of different liquids more efficiently.

→ The fractionating column is packed with glass beads and glass rings that increase the surface area for evaporation and condensation.

- **Seperating funnel**

→ Certain liquid-liquid mixtures are immiscible. They seperate into different layers called phases when left undisturbed.

→ A seperating funnel is used to seperate immiscible liquids

- The liquid with a higher density forms the lower layer and the liquid with a lower density forms the upper layer.

→ Process:

- The mixture forms two layers.
- The tap is opened and the lower layer is drained into a beaker first.
- The tap is closed once the lower layer has been drained off completely.