



# Separating MIXTURES

## Learning Objectives

By the end of the lesson, students sbat:

- Describe methods of separation and purification for the components of the following types of mixtures:
  1. Solid-solid
  2. Solid-liquid
  3. Liquid-liquid (miscible and immiscible)

# Learning Objectives

- Techniques to be covered for separations and purification include:
  - i. Use of a suitable solvent, filtration and crystallisation or evaporation
  - ii. Distillation and fractional distillation
  - iii. Paper chromatography
- Describe paper chromatography and interpret chromatograms
- Deduce from the given melting and boiling point, the identities of substances and their purity

## Purity of Substances

- **Pure** substances are made up of only **one** substance.
- Mixtures are substances that contain **two or more** substances that are not chemically combined.

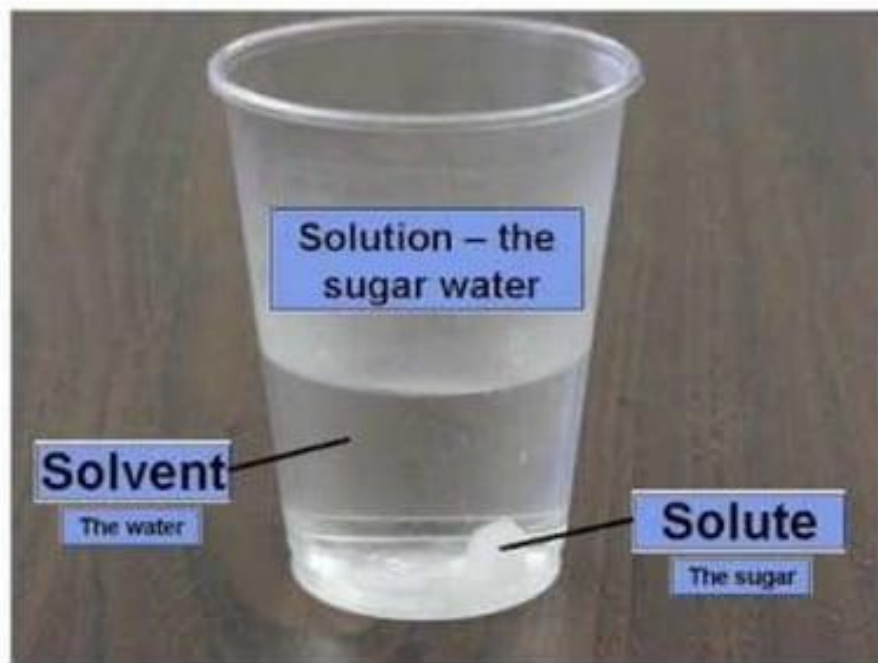
# Purity of Substances

- Pure solids have a fixed (i.e. exact and constant) boiling point and melting point.
- In the case of pure water, ice will melt at  $0\text{ }^{\circ}\text{C}$  and water boils at  $100\text{ }^{\circ}\text{C}$

## Classification of Mixtures

- Mixtures can be classified as a solution or a suspension.
- When the solid dissolves in a liquid, a solution is obtained.
- The solid that dissolves is known as the solute.
- The substance that dissolves the solid is known as the solvent.





Sugar dissolves in the solvent  
Therefore resulting mixture is a SOLUTION.

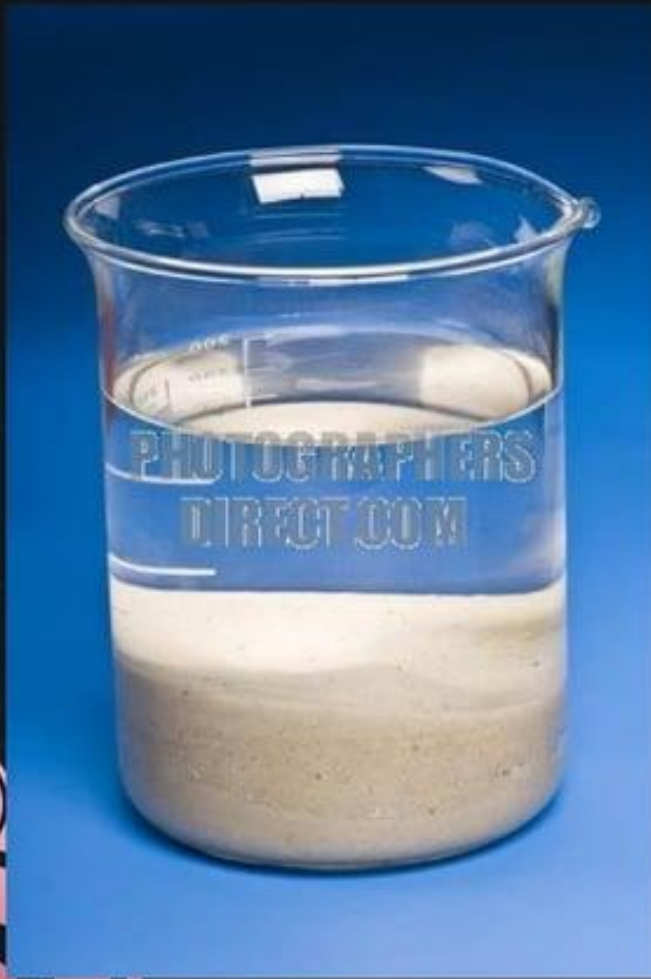
## Classification of Mixtures

### Example

- When salt dissolves in water, a salt solution is obtained.

salt + water → salt-water mixture  
(solute) (solvent) (solution)

- When the solid does not dissolve in the liquid, a suspension is obtained.



Sand does NOT  
dissolve in the  
solvent  
Therefore  
resulting mixture is  
a **SUSPENSION**

## Methods of Purification

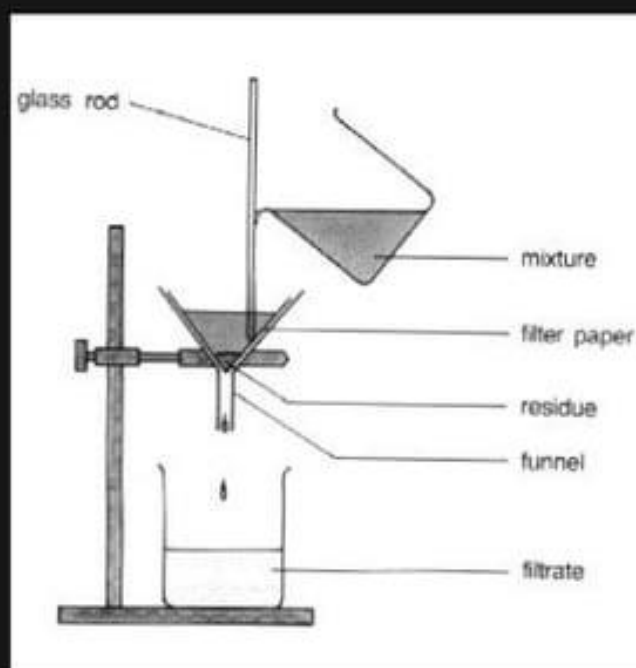
# Magnetic Separation

- To separate a magnetic substance from a mixture.



# Filtration

- To separate an insoluble solid from a mixture.
- E.g. sand from seawater.
- Upon filtration the mixture is separated into residue and filtrate.
- **Residue** – the insoluble solid that remains on the filter paper.
- **Filtrate** – the liquid that passes through the filter paper.





# Evaporation to Dryness

- To evaporate solvent from the solution, obtaining the soluble salt from the mixture.
- E.g. to obtain salt from seawater.

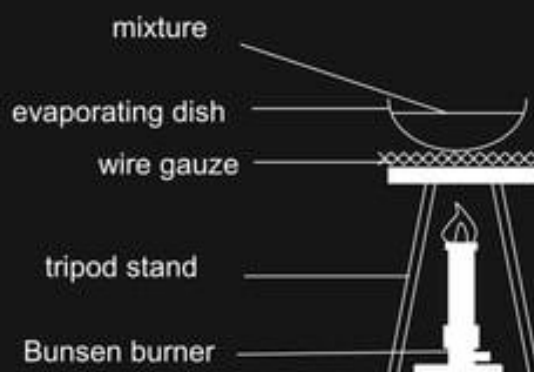


Figure 3 Setup for evaporation

## Crystallisation



- Steps include:
  - Evaporate until a **saturated** solution is obtained.
  - Cool, crystals will form.
  - Filter to obtain crystals.
  - Rinse with cold distilled water.
  - Dry by pressing between filter paper.

# Wake Up Call 1

1. Which method is most suitable for obtaining a pure, dry sample of sodium chloride from a mixture of solid sodium chloride and sand?
  - A. Heat the mixture gently and collect the substance which boils off.
  - B. Heat the mixture gently and collect the substance which melts.
  - C. Shake the mixture with water and distil off the liquid.
  - D. Shake the mixture with water, filter and evaporate the filtrate.

# Wake Up Call 1

2. A mixture contains two compounds, copper(II) sulfate crystals and calcium carbonate. They have the following properties:

Name	Properties
Copper(II) sulfate	<ul style="list-style-type: none"><li>•Soluble in water</li><li>•Low melting point</li></ul>
Calcium carbonate	<ul style="list-style-type: none"><li>•Insoluble in water</li><li>•High melting point</li></ul>



## Wake Up Call 2

List the steps that should be taken to separate the mixture to obtain dry samples of copper(II) sulfate and calcium carbonate.

## Simple Distillation

- To obtain a solvent from a mixture

# Simple Distillation

- How it works:
  - Water in the distilling flask boils.
  - Water vapour rises, enters the condenser.
  - Water vapour is condensed back to water.
  - Pure water (distillate) is collected in a receiver.

To separate a solvent from a mixture.

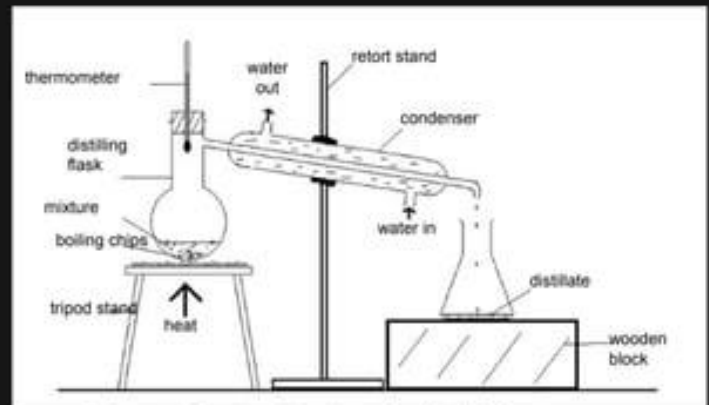


Figure 4 Setup for simple distillation

## Things to note

Thermometer: bulb is placed at the **opening** of the distilling flask (to measure the temperature of the pure vapour)

Condenser: water enters the condenser from the bottom and exits through the top.

Boiling chips: ensures smooth boiling