Topic 8: Chemical Analysis

Purity, formulations and chromatography

Pure Substances:

- A pure substance = a single element or compound, not mixed with any other substance
- They melt and boil at specific temperatures
  - This melting and boiling points data can be used to distinguish pure substances from mixtures
- In everyday language, a pure substance = substance that has had nothing added to it, so it is unadulterated and in its natural state, e.g. pure milk

Topic 8: Chemical Analysis

Purity, formulations and chromatography

Formulations:

- A formulation = mixture that has been designed as a useful product
- Many products are complex mixtures in which each chemical has a particular purpose
- They are made by mixing the components in carefully measured quantities to ensure that the product has the required properties
- Examples are fuels, cleaning agents, paints, medicines, alloys, fertilisers and foods

Topic 8: Chemical Analysis

Purity, formulations and chromatography

Chromatography:

- Used to separate mixtures and give information to help identify substances
- Involves a stationary phase and a mobile phase
- Separation depends on the distribution of substances between the phases

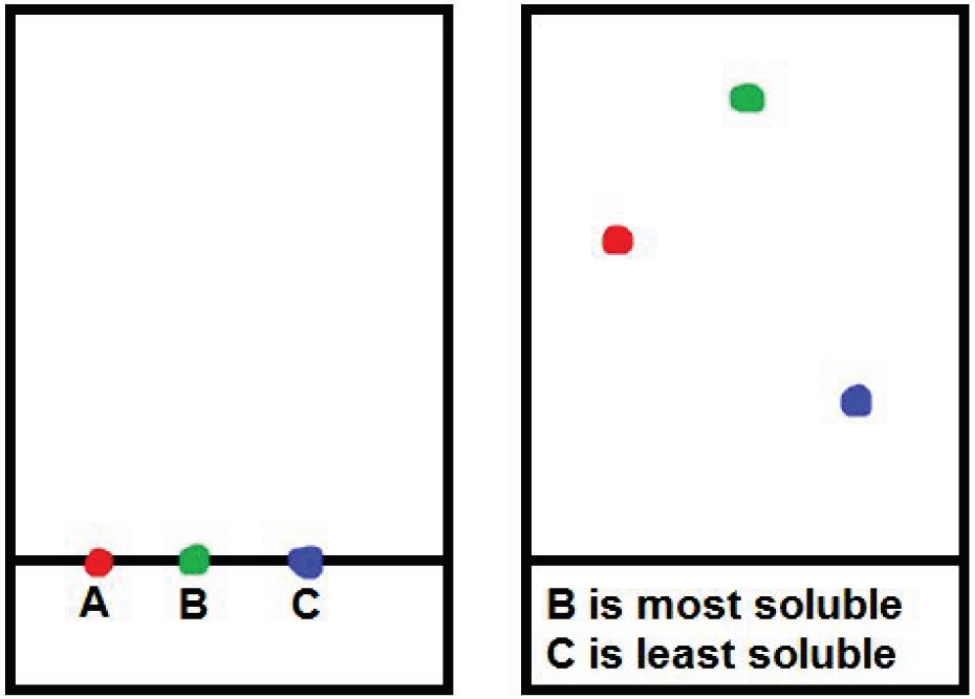
$$Rf = \frac{distance\ moved\ by\ substance}{distance\ moved\ by\ solvent}$$

- Different compounds have different Rf values in different solvents, which can be used to help identify the compounds
- Compounds in a mixture may separate into different spots depending on the solvent but a pure compound will produce a single spot in all solvents

Topic 8: Chemical Analysis

Purity, formulations and chromatography

Chromatography:



- Analytical technique separating compounds by their relative speeds in a solvent as it spreads through paper.
- The more soluble a substance is, the further up the paper it travels.
- Separates different pigments in a coloured substance.

Topic 8: Chemical Analysis

Identification of ions

Flame Tests:

Flame tests can be used to identify metal ions.

Lithium	Crimson
Sodium	Yellow
Potassium	Lilac
Calcium	Orange- Red
Copper	Green

However, if a sample containing a mixture of ions is used some flame colours can be masked (you won't be able to see them)

Topic 8: Chemical Analysis

Identification of ions

Metal hydroxides:

- Aluminium, calcium and magnesium ions form a white precipitate with NaOH.
- Only aluminium's precipitate dissolves when excess NaOH is added.
- Copper(II) produces a blue precipitate
- Iron(II) produces a green precipitate
- Iron(III) produces a brown precipitate
- equations: e.g. $Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2$
  - you need as many OH^- ions as the charge on the metal ion
  - the Na from the NaOH and whatever the metal ion was bonded to will react to form a compound together: e.g. $CuCl_2 + 2NaOH \rightarrow Cu(OH)_2 + 2NaCl$

Topic 8: Chemical Analysis

Identification of ions

Carbonates:

- Carbonates react with dilute acids to create carbon dioxide.
- This gas can be bubbled through limewater, if the limewater goes cloudy, the gas is CO_2

Halides:

- First add dilute nitric acid, followed by silver nitrate solution
- Chloride gives a white precipitate
- Bromide gives a cream precipitate
- Iodide gives a yellow precipitate
- (cats with brains can ideally yodel)

Topic 8: Chemical Analysis

Identification of ions

Sulfates:

- First add dilute hydrochloric acid, followed by barium chloride solution
- A white precipitate will form when sulfate ions are in this solution

Instrumental methods:

- Elements and compounds can be detected and identified using instrumental methods
- These are: accurate, sensitive and rapid, making them advantageous compared to chemical tests

Flame emission spectroscopy

- Example of an instrumental method used to analyse metal ions in solutions
- Sample is put into a flame and the light given out is passed through a spectroscope
- Output is a line spectrum that can be analysed to identify the metal ions in the solution and measure their concentrations

Topic 8: Chemical Analysis

Identification of common gases

Test for hydrogen

- Use a burning splint held at the open end of a test tube of the gas
  - Creates a ‘squeaky pop’ sound (hydrogen burns rapidly)

Test for oxygen

- Uses a glowing splint inserted into a test tube of the gas
  - Splint relights in oxygen

Test for carbon dioxide

- Bubble the gas through the limewater (calcium hydroxide (aq))
  - it will turn milky (cloudy)

Test for chlorine

- Use damp litmus paper
  - When damp litmus paper is put into chlorine gas the litmus paper is bleached and turns white