Elements, compounds and mixtures

Element: a pure substance that cannot be broken down into any simpler substance by chemical means. Elements contain only one type of atoms, e.g. Cl_2, S, Ag, N_2

Mixture: two or more substances mixed together (not chemically combined). The components of a mixture can be separated by physical means such as filtration, distillation etc.

Compound: two or more elements chemically combined and cannot be separated by physical means.

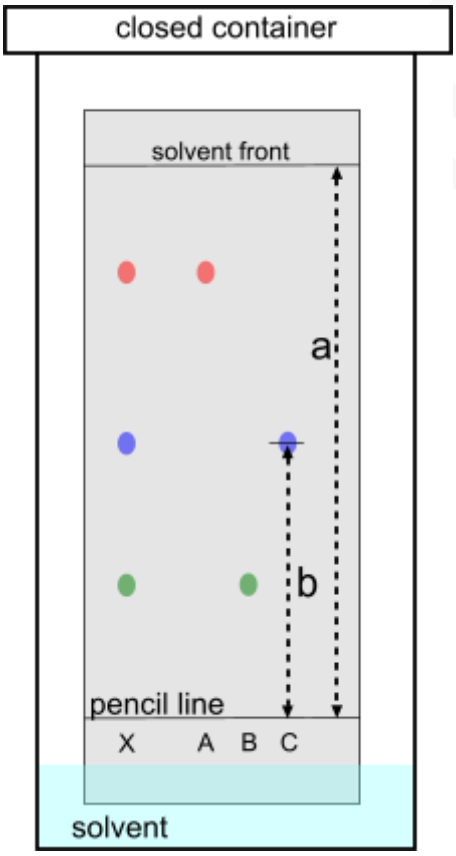
Criteria of purity

A pure substance has a fixed melting point and boiling point (e.g. water boils at 100 °C and freezes at 0 °C).

A mixture/impure substance melts or boils over a range of temperature – the melting point is usually lower than that of the pure substance and the boiling point higher.

Methods of purification

Crystallisation	Separate a solute from a solution, e.g. sodium chloride from sodium chloride solution	Heat solution to boil off some water until the solution is saturated. Allow to cool so that crystals form. Filter off crystals.
Filtration	Separate a solid from a liquid, e.g. excess copper(II) oxide from a copper(II) sulfate solution	Use filter funnel and filter paper – solid is the residue, liquid is the filtrate
Simple distillation	Separate the solute and solvent from a solution, e.g. water and sodium chloride form a sodium chloride solution	Heat the solution in a flask with a condenser attached. The water boils, is condensed and can be collected, the solid remains in the flask.
Fractional distillation	Separate a mixture of 2 liquids, e.g. ethanol and water or the fractions in crude oil.	A fractionating column and a condenser used. The lower boiling point liquid distils over and the higher boiling point liquid remains in the flask.
Paper Chromatography	Separating a mixture of coloured inks/food dyes.	



Paper chromatography a pencil line (*pen – ink may dissolve/move with the solvent*) is drawn near the bottom of a piece of chromatography paper. A substance is spotted onto this line. Bottom of the paper is placed in a solvent (*solvent below the pencil line otherwise dyes will dissolve into the solvent*). The solvent rises up the paper until it is just below the top – the position of the solvent front (*furthest point solvent has reached*) is marked. The solvent is allowed to evaporate and the position of the spots identified.

Paper chromatography may be used to determine whether a substance is pure or not. If a substance is pure only one spot will appear on the chromatogram (A, B and C are pure) but if it is impure there will be two or more spots (X is a mixture/impure).

R_f value = $\frac{\text{distance moved by spot}}{\text{distance moved by solvent front}}$

measure from pencil line

R_f value of dye C is b/a

R_f must be <1

Substances may be identified by chromatography by comparing the positions of spots (or R_f values) on the chromatogram with those of pure known substances (must use same solvent etc)

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