Compounds, Mixtures and Chemical Reactions

Compounds vs Mixtures

COMPOUNDS

1. Compounds are formed from elements in **chemical reactions**
2. A chemical change happens and at least one **new product** is formed
3. Elements are combined in **fixed proportions**
4. Compounds can only be separated by **chemical means**

MIXTURES

1. Mixtures are formed from elements or compounds combined by **non-chemical means**
2. The elements/compounds are **unchanged**
3. Elements/compounds in mixtures can be combined in **any proportions**
4. Mixtures can be separated by **physical means**

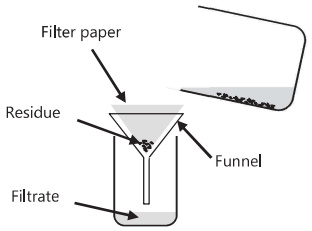
COMMON EXAMPLES

COMPOUNDS	MIXTURES
Combining acid and base	Combining sand and water
Burning a fuel	Combining two coloured paints
Making a polymer	Combining gases in the air
Heating a metal with chlorine	Dissolving salt in water

MIXTURE SEPARATION TECHNIQUES

There are different methods of separation available for different types of mixture. You should be able to recognise what type a certain mixture is, and what equipment you need to separate it.

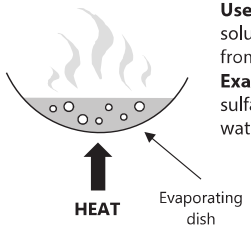
Filtration



Used to separate: insoluble solid (residue) from a liquid (filtrate)

Example: separating sand from water

Crystallisation

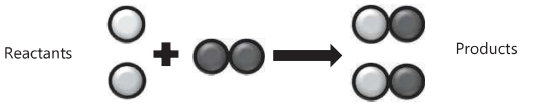


Used to separate: soluble solid (solute) from a solvent
Example: copper sulfate crystals from water

The mixture is heated until the solvent starts to boil and a **saturated solution** is formed. As it cools, the solute becomes less soluble and some of it starts to **crystallise**. The remaining solvent can be left to evaporate, leaving behind solid crystals.

Chemical Reactions

To form new compounds, chemical reactions must occur. These involve new chemical bonds being formed or broken and there is often a temperature change.



Chemical reactions can be described in several different ways.

WORD EQUATIONS

The transformation from reactants to products is indicated by an arrow symbol (→).

EXAMPLE!

magnesium + oxygen → magnesium oxide
sodium + chlorine → sodium chloride
potassium + water → potassium hydroxide + hydrogen

SYMBOL EQUATIONS

Symbol equations must be balanced so that the number of each type of atom is equal on both sides. This can be done by adding multipliers to some of the species involved.

Exam Tip!
When balancing equations, only change the multiplier (big number in front) – changing subscripts will change the identity of the compound!

$2Mg + O_2 \rightarrow 2MgO$
$2Na + Cl_2 \rightarrow 2NaCl$
$2K + 2H_2O \rightarrow 2KOH + H_2$

$2H_2O$

This is a **multiplier** – it tells you the proportions in which the elements/ compounds react

This is a **subscript** – it tells you how many of each atom is within one molecule of a compound. It can't be changed during balancing.

HT ONLY

HALF-EQUATIONS

These equations only show the loss or gain of electrons of a **single species** during a reaction.

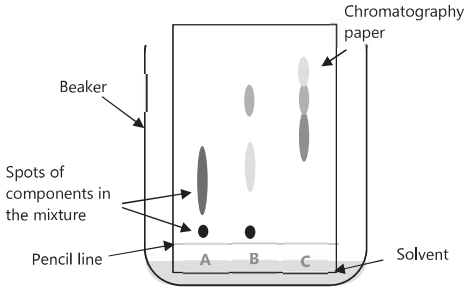
$Mg(s) + 2e^- \rightarrow Mg^{2+}(aq)$

IONIC EQUATIONS

These equations only show species that **lose or gain electrons** – any that don't change are called 'spectator ions' and are ignored.

Full equation: $Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$
Ionic equation: $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

Chromatography

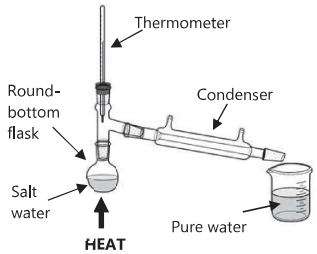


Used to separate: multiple soluble substances in the same solvent
Example: inks in food dye

A drop of the mixture is placed on chromatography paper, which is placed in a **solvent**. Over time the solvent soaks up the paper, and the different substances in the mixture move at **different speeds** depending on how strongly they interact with the paper. This causes them to separate.

Distillation

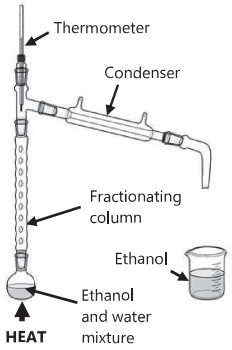
SIMPLE DISTILLATION



Used to separate: solvent from solution
Example: pure water from a salt solution

The mixture is heated and the solvent **boils**. The vapour passes through the condenser, cools and **condenses** as a liquid in a collection vessel. The solute is left in the original flask.

FRACTIONAL DISTILLATION



The liquids are separated in the column as they boil at **different temperatures**. One liquid boils at a lower temperature so will **condense** into the container while the other stays in the column.

Used to separate: two miscible (mixable) liquids with different boiling points
Example: water and alcohol