



OCR A GCSE Chemistry

Topic 2: Elements, compounds and mixtures

Purity and separating mixtures

Notes



C2.1a explain what is meant by the purity of a substance, distinguishing between the scientific and everyday use of the term 'pure'

- A pure substance = a single element or compound, not mixed with any other substance
- 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

C2.1b use melting point data to distinguish pure from impure substances

- Pure substances melt and boil at specific temperatures
- impure substances melt and boil over a range of temperatures
- This melting and boiling points data can be used to distinguish pure substances from mixtures

C2.1c calculate relative formula masses of species separately and in a balanced chemical equation

- Relative formula mass
 - Relative formula mass (M_r) of a species separately: sum of the relative atomic masses of the atoms in the numbers shown in the formula
 - In a balanced chemical equation:
sum of M_r of reactants in quantities shown = sum of M_r of products in quantities shown
- Definitions
 - Relative atomic mass = ratio of the average mass of one atom of an element to $1/12^{\text{th}}$ of the mass of an atom of carbon-12
 - Relative molecular mass = ratio of the average mass of one molecule of an element or compound to $1/12^{\text{th}}$ of the mass of an atom of carbon-12
 - Relative formula mass = weighted average of the masses of the formula units relative to $1/12^{\text{th}}$ of the mass of a carbon-12 atom





C2.1d deduce the empirical formula of a compound from the relative numbers of atoms present or from a model or diagram and vice versa

- empirical formula: simplest whole number ratio of atoms of each element in a molecule
- from relative number of atoms present/diagram, you can form the molecular formula, which just tells you how many atoms of each element are in a molecule e.g. if you had 2 atoms of iron (Fe) and 6 of oxygen (O), you would have the molecular formula Fe_2O_6
- to then find the empirical formula, divide the number of each element by any common factors e.g. for Fe_2O_6 there is a common factor of 2, so if you divide the number of each element by 2 to give you FeO_3

C2.1e explain that many useful materials are formulations of mixtures

- 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 food and drink products, medicines, sunscreens, perfumes and paints
- Most metals in everyday uses are alloys. Pure copper, gold, iron and aluminium are all too soft for everyday uses and so are mixed with small amounts of similar metals to make them harder for everyday use.

C2.1f describe, explain and exemplify the processes of filtration, crystallisation, simple distillation and fractional distillation

- Filtration
 - If you have produced e.g. a precipitate (which is an insoluble salt), you would want to separate the salt/precipitate from the salt solution.
 - You would do this by filtering the solution, leaving behind the precipitate
- Crystallisation
 - If you were to have produced a soluble salt and you wanted to separate this salt from the solution that it was dissolved in
 - You would first warm the solution in an open container, allowing the solvent to evaporate, leaving a saturated solution
 - Allow this solution to cool
 - The solid will come out of the solution and crystals will start to grow, these can then be collected and allowed to dry

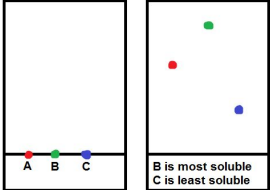




- Simple distillation
 - Simple distillation is used to separate a solvent from a solution. It is useful for producing water from salt solution.
 - Simple distillation works because the dissolved solute has a much higher boiling point than the solvent.
 - When the solution is heated, solvent vapour evaporates from the solution. The gas moves away and is cooled and condensed.
 - The remaining solution becomes more concentrated in solute as the amount of solvent in it decreases.
- Fractional distillation
 - Used to separate a pure liquid from a mixture of liquids
 - Works when the liquids have different boiling points
 - The oil is heated in the fractionating column and the oil evaporates and condenses at a number of different temperatures.
 - The many hydrocarbons in crude oil can be separated into fractions each of which contains molecules with a similar number of carbon atoms
 - The fractionating column works continuously, heated crude oil is piped in at the bottom. The vaporised oil rises up the column and the various fractions are constantly tapped off at the different levels where they condense.
 - The fractions can be processed to produce fuels and feedstock for the petrochemical industry.

C2.1g describe the techniques of paper and thin layer chromatography

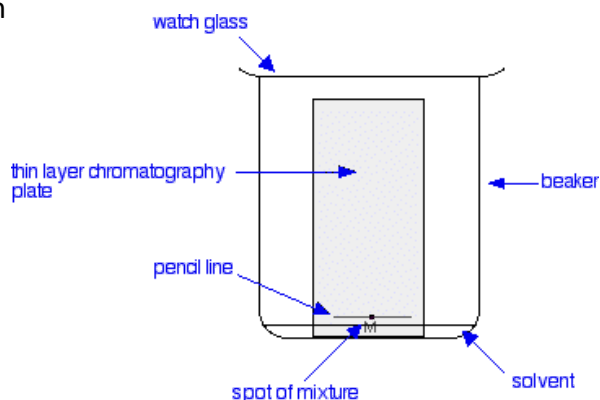
- Chromatography:
 - Used to separate mixtures and give information to help identify substances
 - Involves a stationary phase and a mobile phase
 - Separation depends on the distribution of substances between the phases
- Paper chromatography:
 - stationary phase= paper
 - mobile phase= solvent

<p>Paper Chromatography</p>  <p>A B C</p> <p>B is most soluble C is least soluble</p>	<p>Analytical technique separating compounds by their relative speeds in a solvent as it spreads through paper.</p> <p>The more soluble a substance is, the further up the paper it travels.</p> <p>Separates different pigments in a coloured substance.</p>
<p>Pigment</p>	<p>Solid, coloured substance</p>





- Thin layer chromatography (TLC):
 - stationary phase= thin layer of an inert substance supported on a flat, unreactive surface
 - mobile phase= solvent



C2.1h recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases

- see C2.1g

C2.1i interpret chromatograms, including measuring R_f values

$R_f \text{ value} = \text{distance moved by substance} \div \text{distance moved by solvent}$

- Different compounds have different R_f values in different solvents, which can be used to help identify the compounds

C2.1j suggest suitable purification techniques given information about the substances involved

- select the appropriate technique from C2.1f

C2.1k suggest chromatographic methods for distinguishing pure from impure substances

- Compounds in a mixture separate into different spots but a pure compound will produce a single spot
- Gas chromatography (must be aware of this type of chromatography as well as PC & TLC)
 - Mobile phase = inert carrier gas
 - Stationary phase = liquid / solid on a solid support (lining the walls of the column)
 - Solubility dependent on how soluble a substance is in the gas

