OCR B GCSE Chemistry

Topic 5: Chemical analysis

How are chemicals separated and tested for purity?

Notes

1. 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.

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

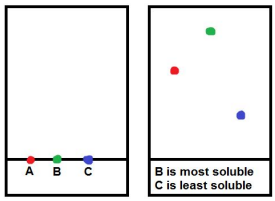
- A mixture
    - Consists of 2 or more elements or compounds not chemically combined together
    - Chemical properties of each substance in the mixture are unchanged
- A pure substance = a single element or compound, not mixed with any other substance
- In everyday language, a pure substance = substance that has had nothing added to it, so it is unadulterated and in its natural state, e.g. pure milk

3. Use melting point data to distinguish pure from impure substances

- Pure substances melt and boil at specific temperatures
    - This melting and boiling points data can be used to distinguish pure substances from mixtures (which melt over a range of temperatures due to them consisting of 2 or more elements or compounds)

4. Recall that chromatography involves a stationary and a mobile phase and that separation depends on the distribution between the phases

- in paper chromatography, the stationary phase is the paper and the mobile phase is the solvent used.

Paper 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.
Pigment	Solid, coloured substance

5. Interpret chromatograms, including calculating Rf values

- Rf value = 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

6. Suggest chromatographic methods for distinguishing pure from impure substances including the use of: paper chromatography, aqueous and non-aqueous solvents, locating agents

- Compounds in a mixture will separate into different spots but a pure compound will produce a single spot in all solvents
- locating agents are used when a substance forms a colourless spot. examples include ninhydrin and iodine, or the chromatogram can be placed under UV light
- The mobile phase may either be an aqueous (water-based) liquid or a non-aqueous organic (carbon-based) solvent

7. 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:
  - Used to separate a pure liquid from a mixture of liquids
    - Works when the liquids have different boiling points
    - Commonly used to separate ethanol from water
    - (Taking the example of ethanol…) ethanol has a lower bp than water so it evaporates first. The ethanol vapour is then cooled and condensed inside the condenser to form a pure liquid.
    - Sequence of events in distillation is as follows: heating → evaporating → cooling → condensing
- Fractional distillation:
  - 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.

8. Suggest suitable purification techniques given information about the substances involved

- use above information to do so