Edexcel GCSE Chemistry

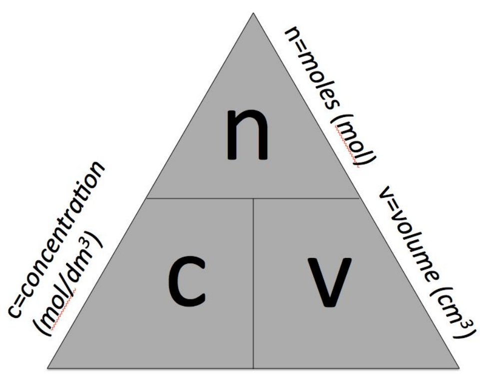
Topic 5: Separate chemistry 1

Quantitative analysis

Notes

5.8C (HT only) Calculate the concentration of solutions in mol dm^{-3} and convert concentration in g dm^{-3} into mol dm^{-3} and vice versa

- Concentration of a solution can be measured in moles per given volume of solution e.g. moles per dm^3 (mol/dm^3)
- To calculate moles of solute in a given volume of a known concentration use moles = conc x vol i.e. mol = mol/dm^3 x dm^3 (think about the units)
- a smaller volume or larger number of moles of solute gives a higher concentration
- a larger volume or smaller number of moles of solute gives a lower concentration



- g dm^{-3} -> mol dm^{-3} divide by molar mass in grams
- mol dm^{-3} → g dm^{-3} multiply by molar mass in grams

5.9C Core Practical: Carry out an accurate acid-alkali titration, using burette, pipette and a suitable indicator

- method:
  - add acid to burette using a funnel, record the volume in the burette to start
  - add known volume of alkali to a conical flask and add some indicator
  - place conical flask on white tile (so you can see colour change clearly)
  - add acid to alkali until you reach the end point
  - calculate how much acid has been added (titre)
  - repeat until you get concordant titres

5.10C (HT only) Carry out simple calculations using the results of titrations to calculate an unknown concentration of a solution or an unknown volume of solution required

- once you have carried out a titration, you know the exact volume of an acid that reacts with the exact volume of an alkali
- if you only knew the concentration of the acid and wanted to calculate the concentration of the alkali:
    - calculate moles of acid using moles = concentration x volume
    - calculate the mole ratio of acid to alkali using the equation for the reaction
    - work out how many moles of alkali you have using the mole ratio and moles of acid (e.g. if you have 5 moles of acid and the ratio of acid to alkali is 1:2, you will have 10 moles of alkali)
    - calculate the concentration of the alkali using concentration = mol ÷ volume
- follow the same method for if you have both concentrations but only one volume

5.11C Calculate the percentage yield of a reaction from the actual yield and the theoretical yield

$$\text{Percentage yield} = \frac{\text{Amount of product produced}}{\text{Maximum amount of product possible}} \times 100$$

- Amount of product obtained is known as yield

5.12C Describe that the actual yield of a reaction is usually less than the theoretical yield and that the causes of this include: incomplete reactions, practical losses during the experiment, and competing, unwanted reactions (side reactions)

- causes of actual yield being less than theoretical yield:
    - incomplete reactions (not all of the reactants have reacted)
    - practical losses during the experiment (some product has been left in the weighing boat etc)
    - side reactions (some of the products react to form other products than those you wanted)

5.13C Recall the atom economy of a reaction forming a desired product

- atom economy- a measure of the amount of starting materials that end up as useful products
- Important for sustainable development and for economic reasons to use reactions with high atom economy

5.14C Calculate the atom economy of a reaction forming a desired product

- atom economy = (Mr of desired product from reaction / sum of Mr of all reactants) x 100

5.15C (HT only) Explain why a particular reaction pathway is chosen to produce a specified product, given appropriate data such as atom economy, yield, rate, equilibrium position and usefulness of by-products

- look for a high atom economy, high yield, fast rate, equilibrium position to the right (towards products) and useful by-products – be prepared to look for these within given information for the question and present them as an answer

5.16C (HT only) Describe the molar volume, of any gas at room temperature and pressure, as the volume occupied by one mole of molecules of any gas at room temperature and pressure (The molar volume will be provided as 24 dm^3 or 24000 cm^3 in calculations where it required)

- Equal amounts in mol. of gases occupy the same volume under the same conditions of temperature and pressure (e.g. RTP)
- Volume of 1 mol. of any gas at RTP (room temperature and pressure: 20 degrees C and 1 atmosphere pressure) is 24 dm^3
- This sets up the equation:

Volume (dm^3) of gas at RTP = Mol. x 24
Volume (cm^3) of gas at RTP = mol x 24,000

- Use this equation to calculate the volumes of gaseous reactants and products at RTP
    - e.g. if you had 6 moles of O_2, at RTP you would have a volume of 6 x 24 = 144 dm^3 of O_2

5.17C (HT only) Use the molar volume and balanced equations in calculations involving the masses of solids and volumes of gases

- if you are given a balanced equation, the mass/volume of a reactant and are asked to calculate the mass/volume of a product:
    - calculate moles of the reactant
      if given a mass: moles=mass ÷ molar mass
      if given a volume: moles = volume ÷ 24
    - work out the mole ratio and so work out how many moles of the product you have
    - calculate mass/volume using moles
      for calculating mass, mass=moles x molar mass
      for calculating volume, volume=moles x 24

5.18C (HT only) Use Avogadro's law to calculate volumes of gases involved in a gaseous reaction, given the relevant equation

- avogadro's law: one mole of a substance contains 6.02×10^{23} particles (this is why we use moles in calculations- the number of particles is massive)
- this means if you had 10 moles of a substance, you would have $10 \times 6.02 \times 10^{23}$ particles = 6.02×10^{24}