Edexcel IGCSE Chemistry

Topic 1: Principles of chemistry

Chemical formulae, equations and calculations

Notes

1.25 write word equations and balanced chemical equations (including state symbols): for reactions studied in this specification, for unfamiliar reactions where suitable information is provided

- (g) means gas, (s) means solid, (l) means liquid, (aq) means aqueous
- Example of word equation: hydrochloric acid + sodium hydroxide -> sodium chloride + water
- Example of balanced chemical equation: HCl + NaOH -> NaCl + H_2O
- to balance an equation: you need to make sure there are the same number of each element on each side of the equation and if there isn't use big numbers at the front of a compound to balance it e.g. $3H_2O$

1.26 calculate relative formula masses (including relative molecular masses) (Mr) from relative atomic masses (Ar)

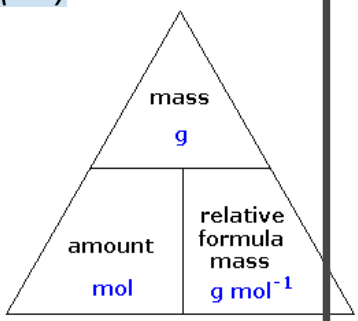
- Relative formula mass (Mr) of a compound: sum of the relative atomic masses of the atoms in the numbers shown in the formula
- In a balanced chemical equation:
  sum of Mr of reactants in quantities shown = sum of Mr of products in quantities shown

1.27 know that the mole (mol) is the unit for the amount of a substance

- Chemical amounts are measured in moles (therefore it is the amount of substance). The symbol for the unit mole is mol.
- The mass of one mole of a substance in grams is numerically equal to its relative formula mass.
- For example, the Ar of Iron is 56, so one mole of iron weighs 56g.
- The Mr of nitrogen gas (N_2) is 28 (2x14), so one mole is 28g.
- One mole of a substance contains the same number of the stated particles, atoms, molecules or ions as one mole of any other substance

1.28 understand how to carry out calculations involving amount of substance, relative atomic mass (Ar) and relative formula mass (Mr)

- You can convert between moles and grams by using this triangle or the equation:
  moles = mass ÷ relative atomic mass
  mass = moles x relative atomic mass
  - E.g how many moles are there in 42g of carbon?
    - Moles = Mass / Mr = 42/12 = 3.5 moles



1.29 calculate reacting masses using experimental data and chemical equations

- Chemical equations can be interpreted in terms of moles
  - E.g. $Mg + 2HCl \rightarrow MgCl_2 + H_2$ shows that 1 mol. Mg reacts with 2 mol. HCl to produce 1 mol. $MgCl_2$ and 1 mol. H_2
- Masses of reactants & products can be calculated from balanced symbol equations. If you are given the reacting mass of one reactant and asked to find the mass of one product formed:
  - Find moles of that one substance: moles = mass /molar mass
  - Use balancing numbers to find the moles of desired reactant or product (e.g. if you had the equation:$2NaOH + Mg \rightarrow Mg(OH)_2 + 2Na$, if you had 2 moles of Mg, you would form 2x2=4 moles of Na)
  - Mass = moles x molar mass(of the product) to find mass

1.30 calculate percentage yield

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

- It is not always possible to obtain the calculated amount of a product for 3 reasons...
  - Reaction may not go to completion because it is reversible
  - Some of the product may be lost when it is separated from the reaction mixture
  - Some of the reactants may react in ways different to the expected reaction
- Amount of product obtained is known as yield

1.31 understand how the formulae of simple compounds can be obtained experimentally, including metal oxides, water and salts containing water of crystallisation

example experiment to find formula of magnesium oxide:

- weigh some pure magnesium
- Heat magnesium to burning in a crucible to form magnesium oxide, as the magnesium will react with the oxygen in the air
- weigh the mass of the magnesium oxide
- Known quantities: mass of magnesium used & mass of magnesium oxide produced
- Required calculations:
  - mass oxygen = mass magnesium oxide - mass magnesium
  - moles magnesium = mass magnesium ÷ molar mass magnesium
  - moles oxygen = mass oxygen ÷ molar mass oxygen

- calculate ratio of moles of magnesium to moles of oxygen
- use ratio to form empirical formula

1.32 know what is meant by the terms empirical formula and molecular formula

- molecular formula- the number of atoms of each element in a compound
- empirical formula- the simplest whole number ratio of atoms of each element in a compound

1.33 calculate empirical and molecular formulae from experimental data

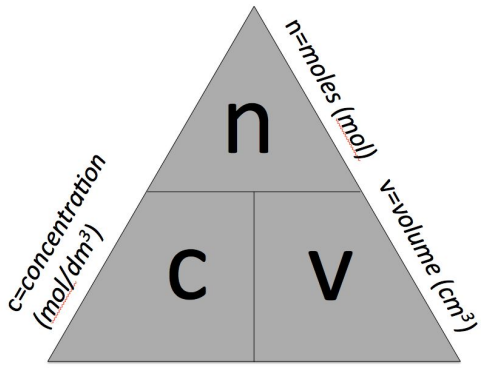
- Empirical formula from the formula of molecule:
  - if you have a common multiple e.g. Fe_2O_4, the empirical formula is the simplest whole number ratio, which would be FeO_2
  - if there is no common multiple, you already have the empirical formula
- Molecular formula from empirical formula and relative molecular mass
  - Find relative molecular mass of the empirical formula
  - Divide relative molecular mass of compound by that of the empirical formula
  - Multiply the number of each type of atom in the empirical formula by this number
  - e.g. if answer was 2 and the empirical formula was Fe_2O_3 then the molecular formula would be empirical formula x 2 = Fe_4O_6

1.34 (chemistry only) understand how to carry out calculations involving amount of substance, volume and concentration (in mol/dm³) of solution

- Concentration of a solution can be measured in mass per given volume of solution e.g. grams per dm^3 (g/dm^3)
- to calculate concentration of a solution use the equation

concentration ($g\ dm^{-3}$) = mass of solute (g) ÷ volume (dm^3)

- To calculate mass of solute in a given volume of a known concentration use the equation: mass = conc x vol i.e. g = g/dm^3 x dm^3 (think about the units!)



1.35 (chemistry only) understand how to carry out calculations involving gas volumes and the molar volume of a gas (24dm^3 and 24000 cm^3 at room temperature and pressure (rtp))

- 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:

$$\text{Volume (dm}^3\text{) of gas at RTP} = \text{Mol.} \times 24$$

- Use this equation to calculate the volumes of gaseous reactants and products at RTP
    - e.g. 5 moles of H_2 would occupy a volume of 24 x 5 = 120 dm^3 at RTP

1.36 practical: know how to determine the formula of a metal oxide by combustion (e.g. magnesium oxide) or by reduction (e.g. copper(II) oxide)

- see 1.31