Chemistry with Chloe

AQA A Level Chemistry — 3.1 Physical Chemistry

3.1.2 Amount of Substance

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3.1.2.1 *Relative atomic mass and relative molecular mass in terms of ^{12}C. Relative formula mass for ionic compounds.*

Relative atomic mass (Ar): weighted mean mass of an atom compared to 1/12 the mass of ^{12}C.

Relative molecular mass (Mr): sum of Ar values for all atoms in the molecular formula (covalent compounds).

Relative formula mass: sum of Ar values in a formula unit (ionic compounds, e.g. NaCl).

3.1.2.2 *The Avogadro constant and the mole. Concentration (mol dm■³). Calculations using mass, Mr, moles and concentration.*

Avogadro constant (NA): 6.022×10^{23} mol■¹ — given in exams.

n = m / M (moles = mass / molar mass)

n = c × V (moles = concentration × volume in dm^3)

Number of particles = n × NA

Always convert cm^3 to dm^3 by dividing by 1000.

3.1.2.3 *The ideal gas equation pV = nRT with variables in SI units.*

pV = nRT

p in Pa, V in m^3, n in mol, R = 8.314 J K■¹ mol■¹ (given), T in K.

Unit conversions: kPa × 1000 = Pa; $cm^3 \div 10$■ = m^3; $dm^3 \div 1000 = m^3$; °C + 273 = K.

Use to find Mr of a volatile liquid given mass, T, P, V.

3.1.2.4 *Empirical and molecular formula. Calculate from composition by mass or percentage composition.*

Empirical formula: simplest whole number ratio of atoms.

Molecular formula: actual number of atoms in one molecule.

Method: (1) Divide each mass/% by Ar. (2) Divide all by the smallest. (3) Multiply up to whole numbers if needed.

Molecular formula: Mr ÷ empirical formula mass = multiplier.

3.1.2.5 *Balanced equations (full and ionic). Atom economy. Calculations: masses, gas volumes, percentage yields, concentrations.*

Atom economy = (Mr desired product / ΣMr all reactants) × 100% — AQA uses REACTANTS in denominator.

% yield = (actual yield / theoretical yield) × 100%

Yield < 100%: incomplete reactions, side reactions, losses during purification.

High atom economy = economically and environmentally desirable (less waste).

Titration: concordant titres → mean titre → moles of known → mole ratio → moles of unknown → concentration.

★ REQUIRED PRACTICAL RP1

Make Up a Volumetric Solution and Carry Out a Simple Acid–Base Titration

Method: Weigh solid acid accurately → dissolve in beaker → transfer to 250 cm^3 volumetric flask → make up to mark with dropping pipette → stopper and invert to mix (standard solution). Pipette 25.0 cm^3 NaOH into conical flask + indicator. Titrate with standard acid. Repeat for concordant titres (within 0.10 cm^3).

Uncertainties: balance ±0.001 g; volumetric flask ±0.10 cm^3; pipette ±0.06 cm^3; burette ±0.05 cm^3/reading.

Common errors: solid not fully transferred; overshoot end point; parallax error on meniscus; rinsing conical flask with NaOH.

Improvements: weigh by difference; rinse glassware; dropping pipette for final approach; white tile; concordant titres.