IQM3012 A2 Teacher marking exercise

IQM3012 A2 Synthetic Chemistry Paper 1 Responses

The selected synthetic extracts below form an unmarked exercise. Apply the supplied assessment criteria, record evidence and propose marks or bands before consulting the separate teacher reference.

Controlling sources: IQM3012_2026_Sample_Assessment_2_Paper_1 Candidate Question Paper, Candidate Answer Booklet, Chemistry Data and Formulae Booklet, and current Staff Mark Scheme and Marking Map v3. Sample 2026–27; all items compulsory; 2 hours; 20 Section A + 50 Section B marks.

Four exact synthetic response extracts include source context, prompt, subpart maximum and source criteria; no applied awards are shown. Each selected part is assessed separately and cannot establish a whole-paper result.

Teacher practice instructions

Staff-only, unmarked practice using four exact candidate-response excerpts. Read the contextual stem and prompt, then record proposed subpart points and one focused feedback point before using the separate reference. The stated maximum applies to that subpart only; extracts do not establish a full question or paper result.

All profiles are generated examples. The live Chemistry examination prohibits AI and unauthorised electronic assistance.

Extract A S1 B1 b carbonate concentration

A learner dissolves 2.65 g of pure anhydrous Na_2CO_3 and makes the solution up to 250.0 cm^3. A 25.00 cm^3 aliquot requires a mean titre of 20.00 cm^3 hydrochloric acid for complete neutralisation. Use $M(Na_2CO_3)$ = 106.0 g mol^{-1}.

Question B1b: Calculate the concentration of the sodium carbonate solution in mol dm^{-3}.

Maximum 3 marks. Source criteria: amount 2.65/106.0 = 0.0250 mol; use 250.0 cm^3 = 0.2500 dm^3 and c=n/V; answer 0.100 mol dm^{-3} with units. Relevant working is required for method credit.

First find the amount of sodium carbonate, then use the prepared volume in dm^3 to calculate concentration.

$$n = \frac{2.65\ \text{g}}{106.0\ \text{g}\ \text{mol}^{-1}} = 0.0250\ \text{mol}$$

$$V = 250.0\ \text{cm}^3 = 0.2500\ \text{dm}^3$$

$$c = \frac{0.0250}{0.2500} = 0.100\ \text{mol}\ \text{dm}^{-3}$$

Extract B S2 B1 c acid concentration follow through

A learner dissolves 2.65 g of pure anhydrous Na_2CO_3 and makes the solution up to 250.0 cm^3. A 25.00 cm^3 aliquot requires a mean titre of 20.00 cm^3 hydrochloric acid for complete neutralisation. Use $M(Na_2CO_3)$ = 106.0 g mol^{-1}.

Question B1c: Calculate the concentration of the hydrochloric acid in mol dm^{-3}.

Maximum 3 marks. Source criteria: correct carbonate amount in the 25.00 cm^3 aliquot; 2:1 HCl:Na_2CO_3 stoichiometry; 0.250 mol dm^{-3} acid concentration with units. Carry-forward from (b) only if the later method remains valid.

The 25.00 cm^3 aliquot contains 0.100×0.02500=0.00250 mol sodium carbonate. I used a 1:1 acid-to-carbonate ratio, giving 0.00250 mol HCl in 0.02000 dm^3.

$$n(\mathrm{Na_2CO_3}) = 0.100 \times 0.02500 = 0.00250 \ \ \mathrm{mol}$$

$$n(\mathrm{HCl}) = 0.00250 \ \ \mathrm{mol}$$

$$c = \frac{0.00250}{0.02000} = 0.125 \ \ \mathrm{mol} \ \ \mathrm{dm^{-3}}$$

Extract C S3 B4 a redox half equations

Chlorine water is added to an aqueous potassium bromide solution. Bromine forms. In a separate comparison, magnesium carbonate decomposes more readily on heating than barium carbonate.

Question B4a: Write the oxidation and reduction half-equations for the chlorine/bromide reaction.

Maximum 4 marks. Source criteria: oxidation relationship $2Br^- \rightarrow Br_2$; balanced oxidation electrons $2Br^- \rightarrow Br_2 + 2e^-$; reduction relationship $Cl_2 \rightarrow 2Cl^-$; balanced reduction electrons $Cl_2 + 2e^- \rightarrow 2Cl^-$.

The oxidation and reduction equations are shown.

$$Br^- \rightarrow Br_2 + 2e^-$$

$$Cl_2 + 2e^- \rightarrow 2Cl^-$$

Extract D S3 B5 c bond enthalpy estimate

The standard enthalpy of combustion of ethanol is −1367 kJ mol^{-1}. Use M(ethanol) = 46.0 g mol^{-1}. In a separate calculation, use these mean bond enthalpies: H–H 436, Cl–Cl 243 and H–Cl 432 kJ mol^{-1}.

Question B5c: Use the mean bond enthalpies to estimate ΔH for $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$.

Maximum 3 marks. Source criteria: 436+243=679 kJ mol^{-1} to break bonds; 2×432=864 kJ mol^{-1} released on formation; signed result ΔH = −185 kJ mol^{-1}.

The bond energies are 679 to break and 864 to form, so ΔH=+185 kJ mol^{-1}.

$$E_{\text{break}} = 436 + 243 = 679$$

$$E_{\text{form}} = 2 \times 432 = 864$$

$$\Delta H = 864 - 679 = +185 \ \text{kJ mol}^{-1}$$