

Reactivity trends in group 2 and the halogens

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Test answers (mark scheme)

Use these model answers and the marking points to check your work. Award marks for correct method even when the final number is wrong, and note which trend or equation you need to revise.

Level: Chemistry grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** A Level 3.2.2-3.2.3

Question 1 Calcium and water (2 marks)

- a. Any two: **bubbles of gas (hydrogen)**; the metal dissolves/disappears; the solution turns cloudy white as sparingly soluble $\text{Ca}(\text{OH})_2$ forms; the test tube warms.

Marking: 1 mark each observation.

Question 2 Ionisation energy trend (2 marks)

- a. Barium's first ionisation energy (503 kJ mol^{-1}) is lower than magnesium's (738), so its outer electrons are lost more easily; the outer electrons are further from the nucleus and better shielded.

Marking: 1 mark for lower ionisation energy, 1 for distance or shielding.

Question 3 Testing for sulfate (3 marks)

- a. Add dilute hydrochloric acid, then barium chloride solution; a **white precipitate** forms.
b. **$\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$**

Marking: 1 for acid then BaCl_2 , 1 for white precipitate, 1 for equation with state symbols.

Question 4 Magnesium and acid (2 marks)

- a. $n(\text{Mg}) = 2.43 \div 24.3 = 0.100 \text{ mol} = n(\text{H}_2)$; $V = 0.100 \times 24.0 = \mathbf{2.40 \text{ dm}^3}$.

Marking: 1 for the amount, 1 for the volume.

Question 5 Halogen displacement (2 marks)

- a. The solution turns **brown** (iodine forms): **$\text{Br}_2 + 2\text{I}^- \rightarrow 2\text{Br}^- + \text{I}_2$** .

Marking: 1 for the colour, 1 for the balanced equation.

Question 6 Trend in boiling points (2 marks)

- a. Br₂ molecules have more electrons, so the London forces are stronger and more energy is needed to overcome them.

Marking: 1 for more electrons, 1 for stronger London forces.

Question 7 Making bleach (3 marks)

- a. **0, -1 and +1.**
b. Chlorine is reduced (0 → -1) and oxidised (0 → +1) in the same reaction.

Marking: 1 for oxidation states, 1 for reduced and oxidised named, 1 for the same element.

Question 8 Limewater concentration (4 marks)

- a. $\text{Ca(OH)}_2 + 2\text{HCl} \rightarrow \text{CaCl}_2 + 2\text{H}_2\text{O}$.
b. $n(\text{HCl}) = 0.02000 \times 0.0500 = 1.00 \times 10^{-3} \text{ mol}$; $n(\text{Ca(OH)}_2) = 5.00 \times 10^{-4} \text{ mol}$; $c = 5.00 \times 10^{-4} \div 0.0250 = \mathbf{0.0200 \text{ mol dm}^{-3}}$.
c. $0.0200 \times 74.1 = \mathbf{1.48 \text{ g dm}^{-3}}$.

Marking: 1 equation, 1 amount of HCl and ratio, 1 concentration, 1 solubility.