Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

- $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$

2.2

- reactivity increases
- the outer electrons are further from the nucleus and more shielded, so they are lost more easily

2.3

- $Mg + H_2O \rightarrow MgO + H_2$

2.4

- to neutralise acidic soil
- it is a base / alkaline

3.1

- $2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$ (species B1, balanced B1)
- brown gas given off

3.2

- Ba^{2+} is larger, so it has a lower charge density
- it polarises (distorts) the carbonate ion less
- so more energy (a higher temperature) is needed to break the C–O bond

3.3

- the limewater turns milky (cloudy)
- $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$
- with excess, it turns clear again (soluble calcium hydrogencarbonate forms)

3.4

- $n(Ca) = 0.20/40.0 = 5.0 \times 10^{-3}$ mol
- $n(H_2) = 5.0 \times 10^{-3}$ mol
- $V =$ **120 cm³**

3.5

- add acidified barium chloride solution
- a white precipitate of barium sulfate forms
- antacid, to neutralise excess stomach acid

3.6

(a) $48.0/24\,000 =$ **2.00×10^{-3} mol**

(b) $n(M) = 2.00 \times 10^{-3}$ mol, $A_r = 0.274/2.00 \times 10^{-3} = 137$; **barium**

(c) $Ba + 2H_2O \rightarrow Ba(OH)_2 + H_2$

(d) higher pH: barium hydroxide is much more soluble than magnesium hydroxide, so more OH^- in solution

(e) a white precipitate of insoluble barium sulfate

(f) **higher**: Ba^{2+} is larger with lower charge density, so it polarises the carbonate ion less

(g) the outer electrons are further from the nucleus and more shielded, so less energy is needed