

M1.(a) M1 (could be scored by a correct mathematical expression)

Correct answer to the calculation gains all of M1, M2 and M3

$$\text{M1 } \underline{\Delta H = \sum \Delta H_f(\text{products}) - \sum \Delta H_f(\text{reactants})}$$

Credit 1 mark for - 101 (kJ mol⁻¹)

OR a correct cycle of balanced equations

$$\text{M2} = - 1669 - 3(- 590)$$

$$= - 1669 + 1770$$

(This also scores M1)

$$\text{M3} = + 101 \text{ (kJ mol}^{-1}\text{)}$$

Award 1 mark ONLY for - 101

For other incorrect or incomplete answers, proceed as follows

- *check for an arithmetic error (AE), which is either a transposition error or an incorrect multiplication; this would score 2 marks (M1 and M2)*
- *If no AE, check for a correct method; this requires either a correct cycle with 3Sr and 2Al OR a clear statement of M1 which could be in words and scores **only M1***

M4 - Using powders

Any **one** from

- To increase collision frequency / collisions in a given time / rate of collisions
- To increase the surface contact / contact between the solids / contact between (exposed) particles
Ignore dividing final answer by 3
Penalise M4 for reference to molecules.

5

M5 Major reason for expense of extraction

Any **one** from

- Aluminium is extracted by electrolysis OR aluminium extraction uses (large amounts of) electricity
- Reaction / process / It / the mixture requires heat
- It is endothermic

- (b) Calcium has a higher melting point than strontium, because
Ignore general Group 2 statements.

Correct reference to size of cations / proximity of electrons

M1 (For Ca) delocalised electrons closer to cations / positive ions / atoms / nucleus

OR cations / positive ions / atoms are smaller

OR cation / positive ion / atom or it has fewer (electron) shells / levels

Penalise M1 if either of Ca or Sr is said to have more or less delocalised electrons OR the same nuclear charge.

Ignore reference to shielding.

Relative strength of metallic bonding

M2 (Ca) has stronger attraction between the cations / positive ions / atoms / nucleus and the delocalised electrons

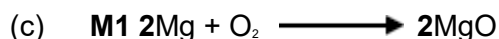
OR

stronger metallic bonding

(assume argument refers to Ca but credit converse argument for Sr)

CE= 0 for reference to molecules or Van der Waals forces or intermolecular forces or covalent bonds.

2



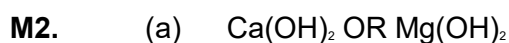
Credit multiples of the equations.

M3 Magnesium hydroxide is used as an antacid / relieve indigestion (heartburn) / neutralise (stomach) acidity / laxative

Not simply "milk of magnesia" in M3

3

[10]



Ignore name

Could be ionic

1

- (b) NaF or sodium fluoride

OR

NaCl or sodium chloride

Either formula or name can score

Do not penalise the spelling "fluoride"

When both formula and name are written,

- penalise contradictions*
- if the attempt at the correct **formula** is incorrect, ignore it and credit **correct name** for the mark unless contradictory*
- if the attempt at the correct name is incorrect, ignore it and credit **correct formula** for the mark unless contradictory*

1

(c) NaClO OR NaOCl

Ignore name (even when incorrect)

The correct formula must be clearly identified if an equation is written

1

(d) **Br₂** (ONLY)

Only the correct formula scores;

penalise lower case "b", penalise upper case "R", penalise superscript

Ignore name

The correct formula must be clearly identified if an equation is written

1

(e) **M1 S** OR **S₈** OR **S₂**

M2 I₂ (ONLY)

Ignore names

penalise lower case "i" for iodine,

penalise superscripted numbers

Mark independently

The correct formula must be clearly identified in each case if an equation is written

2

(f) (i) CH₃CH₂CH=CH₂

Structure of but-1-ene. Ignore name

Credit "sticks" for C-H bonds

1

- (ii) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
Structure of butan-1-ol. Ignore name
Credit "sticks" for C-H bonds

1

- (iii) $\text{CH}_3\text{CH}_2\text{CH}_3$
Structure of propane. Ignore name
Ignore calculations and molecular formula
Credit "sticks" for C-H bonds
Ignore the molecular ion

1

- (iv) $\text{CH}_3\text{CH}_2\text{Br}$ OR $\text{C}_2\text{H}_5\text{Br}$
Structure of bromoethane.
Ignore name and structure of nitrile
Credit "sticks" for C-H bonds

1

[10]

- M3.** (a) (i) $\text{Ba} + 2\text{H}_2\text{O} \longrightarrow \text{Ba}(\text{OH})_2 + \text{H}_2$
Ignore state symbols
Credit multiples and correct ionic equations

1

- (ii) (Reactivity with water) increase(s) / increasing / increased (down the Group / from Mg to Ba)
Accept "greater" or "gets more" or similar words to that effect.
Ignore reference to "increase in solubility / gets more soluble"

1

- (b) $\text{Mg}(\text{OH})_2$

Accept $Mg^{2+}(OH)_2 / Mg(HO)_2$
Insist on brackets and correct case

1

(c) **M1** Barium meal / barium swallow / barium enema or (internal) X-ray or to block X-rays

M2 BaSO₄ / barium sulfate is insoluble (and therefore not toxic)

Accept a correct reference to M1 written in the explanation in M2, unless contradictory

For M2 NOT barium ions

NOT barium

NOT barium meal and NOT "It"

Ignore radio-tracing

2

[5]

M4.(a) (i) Increases

1

(ii) Decreases

1

(iii) Increases

1

(b) Calcium has a higher melting point than strontium, because
CE = 0 for reference to molecules or intermolecular forces or covalent bonds

Correct reference to size of cations/proximity of electrons

M1 (For Ca) delocalised electron(s) closer to cations / positive ions / nucleus
Ignore "Van der Waals forces (between atoms)" but penalise if between "molecules"

OR cations / positive ions / atoms are smaller

OR cation / positive ion / atom or it has fewer (electron) shells / levels

Ignore general Group 2 statements

Answers must be specific

Relative strength of metallic bonding

M2 (For Ca) has stronger attraction between the cations / positive ions / nucleus and the delocalised electron(s)

Penalise M1 if Ca or Sr is said to have more or less delocalised electrons

OR

stronger metallic bonding

(assume argument refers to Ca but accept converse argument for Sr)

Ignore reference to shielding

2

(c) (i) Sulfuric acid / it contains sulfate ions / SO₄²⁻

OR

Do not penalise an additional but incorrect formula for sulfate ion.

Sulfuric acid would form a (white) precipitate

If only the formula of the sulfate ion is given, it must be correct

1

(ii) $\text{Ba}^{2+} + \text{SO}_4^{2-} \longrightarrow \text{BaSO}_4$ ONLY

Ignore state symbols

No multiples

1

[7]

M5.(a) As concentration increases the amount of heat given out increases / temperature increases (**M1**)

Any order.

Ignore references to an exothermic reaction.

1

More successful collisions or reactions in a given time **OR** more particles have the activation energy **(M2)**

Allow could be a second / n^{th} order reaction.

1

(An increase in temperature or more heat given out) increases the rate of a reaction **(M3)**

1

(b) The magnesium is coated with an oxide / MgO **(M1)**

Allow magnesium hydroxide.

1

MgO / the coating / the corrosion product has to be removed before Mg will react

OR Mg and MgO / the coating / the corrosion product react at different rates

OR Initially MgO / the coating / the corrosion product reacts not Mg **(M2)**

Ignore inert coating.

1

(c) Any **two** from:

Any order.

Slower with hot water or faster with steam

The hot water produces $\text{Mg}(\text{OH})_2$ / the hydroxide **OR** steam produces MgO / the oxide

(Slow) bubbling with hot water **OR** bright white light / flame / white solid with steam

2 max

(d) Magnesium sulfate is soluble and calcium sulfate is insoluble / slightly soluble / magnesium sulfate is more soluble / calcium sulfate is less soluble / correct trend in solubility **(M1)**

Any order.

M1 requires a comparison of the two solubilities.

Calcium sulfate coats the surface of the calcium **(M2)**

Coating prevents further contact with / reaction by the acid **(M3)**

'Calcium sulfate forms a protective coating' scores **M2** only.

3

[10]

M6.(a) (i) Change in concentration (of a substance / reactant / product) in unit time / given time / per (specified) unit of time

*This may be written mathematically **OR** may refer to the gradient of a graph of concentration / volume against time*

OR

Amount of substance formed / used up in unit time / given time / per (specified) unit of time

Ignore additional information including reference to collisions

1

(ii) **At W**

M1 (QoL)

The rate / it is zero

M2

The magnesium has all reacted / has been used up

Ignore reference to the acid being used up

OR

No more collisions possible between acid and Mg

OR

Reaction is complete / it has stopped

OR

No more hydrogen / product is produced

2

(iii) **M1**

Twice / double as many particles / hydrogen ions (in a given volume)

*Penalise reference to (hydrochloric acid) molecules in **M1***

*Penalise reference to "HCl particles" in **M1***

OR

Twice / double as much hydrochloric acid

M2

Twice / double as many effective / successful collisions (in a given time)

OR

Twice / double as many collisions with either sufficient energy to react

OR with $E \geq E_a$

OR

double the successful / effective collision frequency

2

- (b) (i) The activation energy is the minimum energy for a reaction to go / start

OR

Minimum energy for a successful/ effective collision

1

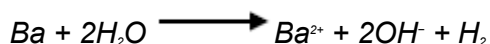
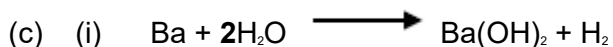
- (ii) M1 Products lower than reactants on the profile

Mark independently

M2 Activation energy (E_a) shown and labelled correctly from reactants to peak of curve

Mark independently

2



Allow multiples

Ignore state symbols

1



Ignore state symbols in M1

Not multiples in M1

M2 White precipitate / solid

Extra ions must be cancelled
Penalise contradictory observations in M2

2

- (iii) M1 Barium meal / barium swallow / barium enema
Accept a correct reference to M1 written in the explanation in M2, unless contradictory
- OR** used in X-rays **OR** to block X-rays **OR** X-ray contrast medium **OR** CT scans
- M2 BaSO₄ / barium sulfate is insoluble (and therefore not toxic)
For M2 NOT barium ions
NOT barium
NOT barium meal and NOT "It"
Ignore radio-tracing

2

[13]

M7.Mg²⁺ and Cl⁻

Do not allow names.

[1]