

- M1.** (a) (i) **M1** The enthalpy change / heat change at constant pressure when 1 mol of a compound / substance / product 1
- M2** Is formed from its (constituent) elements 1
- M3** With all reactants and products / all substances in standard states
OR
 All reactants and products / all substances in normal states under standard conditions / 100 kPa / 1 bar and specified T / 298 K
Ignore reference to 1 atmosphere 1
- (ii) By definition
OR
 Because they are elements 1
- (iii) **M1** $\Delta H_r = \Sigma \Delta H_f(\text{products}) - \Sigma \Delta H_f(\text{reactants})$ 1
- M2** = -1669 - 3(-558)
 (This also scores M1) 1
- M3** = **(+)** 5 (kJ mol⁻¹)
*Correct answer gains full marks.
 Assume the value is positive unless specifically stated as negative.
 Credit 1 mark if - 5 (kJ mol⁻¹).
 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 3BaO OR a clear statement of M1 which could be in words and scores only M1*
- 1
- (b) (i) *One from*
- Aluminium is expensive (to extract OR due to electrolysis)

- High energy cost
- The cost of heating strongly
This requires a clear statement about cost

1

(ii) *One from*

- increase collision frequency
- OR more collisions
- OR more chance of colliding
*The answer MUST refer to more collisions.
Ignore “more available to collide”*

1

(c) (i) $\text{Ba} + 2\text{H}_2\text{O} \rightarrow \text{Ba}(\text{OH})_2 + \text{H}_2$
*Ignore state symbols
Allow multiples and correct ionic equations*

1

(ii) **M1** $\text{Ba}^{2+} + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4$
(or the ions together)
Allow crossed out Na^+ ions, but penalise if not crossed out

1

M2 White precipitate / white solid
*Ignore state symbols
Ignore “milky”*

1

(iii) **M1** Barium meal or (internal) X-ray or to block X-rays

1

M2 BaSO_4 / 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.*

1

[14]

M2.	(i)	Hydroxide	solubility increases	<i>(need trend)</i>	1
		Sulphate	solubility decreases	<i>(need trend)</i> <i>(If both Mg/Ba salts correctly compared - but no trend- allow 1 max)</i>	1
		Add acid	name/correct formula	HCl	1
	(ii)	<i>(accept HNO₃/CH₃COOH) [NOT hydrogen chloride]</i> <i>[If acid added is H₂SO₄ = CE – allow only M2]</i>			
		Add Ba ²⁺ salt	name/correct formula	BaCl ₂ <i>(accept Ba(NO₃)₂ / Ba(CH₃COO)₂)</i> <i>[If reagent added is BaSO₄ /Ba/Ba(OH)₂ = CE – allow only M1]</i>	1
		MgCl ₂	No change / no ppt / no reaction		1
		MgSO ₄	White ppt / solid / suspension <i>[NOT chalky, milky]</i> <i>Both observations tied to Ba²⁺ ions being added</i>		1
		$MgSO_4 + BaCl_2 \rightarrow BaSO_4 + MgCl_2$ <i>Accept ionic equation</i>			1
		(Reagent mark (M2) can be awarded from full equation)			1
		[Treat incorrect equation for MgCl ₂ as contradiction of correct equation] <i>(Ignore carbonate equations) (Ignore state symbols)</i>			1
	(iii)	Reactivity	increases (down group)	<i>[NOT solubility increases]</i>	1
		$Ba + 2H_2O \rightarrow Ba(OH)_2 + H_2$			1

M3.B

[1]

M4. X = Mg;

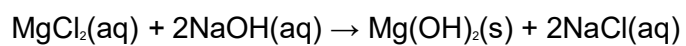
(accept Be, Ca)

1

Y = Ba;

(accept Sr)

1

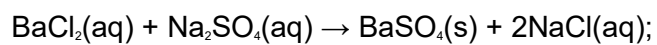


Species;

1

State symbols & balance;

1



Species;

1

State symbols & balance;

(accept ionic equations)

1

[6]

M5.D

[1]

M6. Hydroxide: solubility increases 1

Sulphate: solubility decreases [BOTH inc/dec allow 1/2]

[Allow correct solubilities of top (Mg) and bottom (Ba) cpds] 1

Add: BaCl₂(aq) / Ba(NO₃)₂(aq) / Ba(OH)₂(aq)
[Not solid added]
[Not Ba²⁺ / Ba / Ba + HCl / Pb(NO₃)₂(aq)]

[If BaSO₄ / H₂SO₄ used, M3 to M6 = CE = 0]

[Allow any sensible nitrate test as an alternative to the sulphate test]

1

[Note: If M3 not awarded but test would work, allow correct observations and equations]

Na₂SO₄ white precipitate / solid / suspension
[not cloudy/milky]

1

NaNO₃ no change

1

BaCl₂ + Na₂SO₄ → BaSO₄ + 2NaCl
Accept ionic equation

1

[6]

M7.(a) sulfuric acid / H₂SO₄ 1

(b) hydriodic acid / HI **OR** hydrobromic acid / HBr 1

(c) add **dilute** ammonia solution

Notes

* *do not allow 'concentrated ammonia' or 'ammonia'*

1

precipitate / ppt disappears / dissolves **OR** colourless solution forms

1

(d) would react with the acid / no gas evolved in tests

1

[5]

M8.D

[1]

M9. (a) *Trend:* increases

Wrong trend CE = 0 and in (b)

1

Reason: More electron shells

OR implies more shell / sub-shells / levels

1

(b) *Trend:* decreases

1

Explanation: Metallic bonds weaker
OR weaker attraction between ions (or nuclei) &
delocalised electrons

1

Atoms (ions) larger

*This mark is only scored if previous mark given. **CE if mention molecules, intermolecular forces ionic bonding***

1

(c) *Trend:* increases

1

Equation for magnesium: $\text{Mg} + \text{H}_2\text{O} \rightarrow \text{MgO} + \text{H}_2$

1

Equation for strontium: $\text{Sr} + 2\text{H}_2\text{O} \rightarrow \text{Sr}(\text{OH})_2 + \text{H}_2$

1

(d) *Formula: BaSO_4*

1

*Use: Test for sulfate ion
OR Pigment, for x-rays, barium meal, paint*

1

[10]

M10. Add (hydrochloric) acid to the mixture;

Allow correct acid eg nitric acid.

1

Filter to isolate strontium sulphate;

Do not allow 'drain' or decant'

1

[2]