

Question Number	Correct Answer	Reject	Mark
1(a)	<p>The salt dissolves in the water (of crystallization) / the salt dissolves in (its) water of crystallization</p> <p>NOTE:</p> <p>For M1 it needs to be clear that the water came from the initial solid (1)</p> <p>M2: Water boils/water evaporates (1)</p> <p>M3: (Anhydrous) magnesium nitrate / $\text{Mg}(\text{NO}_3)_2$ crystallizes OR (Anhydrous) magnesium nitrate / $\text{Mg}(\text{NO}_3)_2$ is formed</p> <p>ALLOW for M3: (White) solid formed as the concentration becomes too high / as water is driven off</p> <p>OR Solid reforms/forms (1)</p>	Any mention of 'melt(s)'	(3)

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1(b)(i)i)	<p>NO 1: The chemicals identified MUST correspond to the correct Stage number</p> <p>NOTE 2: Award mark in each case for either the correct name or the correct formula. HOWEVER if both a name AND a formula are given, BOTH must be correct.</p> <p>Stage 5: Nitrogen dioxide / NO₂ / N₂O₄ (is the brown gas) (1)</p> <p>Stage 6: Oxygen / O₂ (relights a glowing splint) (1)</p> <p>Stage 7: Magnesium oxide / MgO (is the white solid) (1)</p>	Just "O" for oxygen's formula	(3)

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1(b)(ii)	<p>$2\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O} \rightarrow 2\text{MgO} + 4\text{NO}_2 + \text{O}_2 + 12\text{H}_2\text{O}$ Ignore state symbols even if incorrect</p> <p>ALLOW multiples ALLOW 2N₂O₄ for 4NO₂</p> <p>M1 Correct entities (1)</p> <p>M2 Balancing (1) M2 depends on M1</p> <p>Special case</p> <p>If the anhydrous salt equation is given: $2\text{Mg}(\text{NO}_3)_2 \rightarrow 2\text{MgO} + 4\text{NO}_2 + \text{O}_2$ scores 1 max</p>		(2)

Question Number	Correct Answer	Reject	Mark
1 (c) (i)	(Magnesium chloride) Colourless / no colour (1)	UV/white/bright white	(2)
	(Calcium chloride) Yellow-red OR brick-red OR red ALLOW Orange-red (1)	Crimson Just 'orange' Just 'yellow'	

Question Number	Correct Answer	Reject	Mark
1 (c) (ii)	– for idea of electrons being promoted (Heating) promotes electrons / excites electrons (to higher energy levels) (1)	Just molecules gain energy	(3)
	M2 – for idea of electrons falling back down Electrons fall back (to lower levels / ground states) (1)		
	M3 – for idea of emission of light Emitting (visible) light / emitting photons (1)	No M3 if mention of energy / light absorbed	

Question Number	Correct Answer	Reject	Mark
1(c)(iii)	<p>EITHER</p> <p>In magnesium the energy levels are further apart / the energy levels are different</p> <p>OR</p> <p>In calcium the energy levels are closer / the energy levels are different</p> <p>IGNORE</p> <p>Any comparison of the relative numbers of energy levels</p> <p>M2:</p> <p>For magnesium, the energy released is outside the visible spectrum / visible region</p> <p>OR</p> <p>For calcium, the energy released is inside the visible spectrum / visible region</p> <p>OR</p> <p>the energy released is in the red region (of the spectrum)</p> <p>OR</p> <p>Different amounts of energy are released</p> <p>OR</p> <p>Different frequencies / wavelengths emitted</p> <p style="text-align: right;">(1)</p> <p>Mark these points independently</p>	<p>Just "no transitions for magnesium"</p>	(2)

Question Number	Acceptable Answers	Reject	Mark
2(a)(i)	$\text{Ba(s)} + 2\text{H}_2\text{O(l)} \rightarrow \text{Ba(OH)}_2\text{(aq)} + \text{H}_2\text{(g)}$ <p>OR</p> $\text{Ba(s)} + 2\text{H}_2\text{O(l)} \rightarrow \text{Ba}^{2+}\text{(aq)} + 2\text{OH}^-\text{(aq)} + \text{H}_2\text{(g)}$ <p>Correct products (1)</p> <p>State symbols and balancing (1)</p>	Ba_2 $\text{H}_2\text{O(aq)}$ BaO_2	2

Question Number	Acceptable Answers	Reject	Mark
2(a)(ii)	<p>Ba (increases in ON) from 0 to +2 (1)</p> <p>H (decreases in ON) from +1 to 0 (1)</p> <p>TE from (a)(i)</p> <p>Stand-alone marks</p>	<p>Inclusion of oxygen changes will lose 1 mark</p>	2

Question Number	Acceptable Answers	Reject	Mark
2(b)	$\text{Ba(OH)}_2 + 2\text{HCl} \rightarrow \text{BaCl}_2 + 2\text{H}_2\text{O}$ <p>IGNORE state symbols even if incorrect</p> <p>ALLOW</p> $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$ <p>TE from (a)(i):</p> $\text{BaO} + 2\text{HCl} \rightarrow \text{BaCl}_2 + \text{H}_2\text{O}$		1

Question Number	Acceptable Answers	Reject	Mark
2(c)	<p>White precipitate / white solid / white crystals (rather than colourless solution) (1)</p> <p>Barium sulfate is insoluble (whereas barium chloride is soluble) (1)</p> <p>Stand-alone marks</p>	'Cloudy' alone	2

Question Number	Acceptable Answers	Reject	Mark
2(d)(i)	<p>If flame test is described in (d)(i) then award appropriate marks for (d)(ii). A correct decomposition equation given in (d)(i) would score 1 mark.</p> <p>Allow valid discussion of thermal stability appearing in (d)(ii) for mark in (d)(i)</p> <p>Barium carbonate is more thermally stable (than magnesium carbonate) / requires more heating / needs a higher temperature / decomposes more slowly / produces carbon dioxide more slowly</p> <p>OR</p> <p>Reverse argument (MgCO₃ decomposes faster)</p> <p>ALLOW BaCO₃ doesn't decompose on heating but MgCO₃ does (1)</p> <p>MCO₃ → MO + CO₂ Where M stands for Mg or Ba (1)</p> <p>IGNORE state symbols even if incorrect</p>	<p>Just 'barium'</p> <p>Just 'produces more carbon dioxide'</p> <p>Just 'magnesium'</p>	2

Question Number	Acceptable Answers	Reject	Mark
2(d)(ii)	<p>Flame test or description of: Mg does not colour flame (1) ALLOW colourless / clear</p> <p>Ba: (pale / apple) green flame (1)</p> <p>Stand-alone marks</p>	<p>Magnesium gives white / bright flame</p> <p>'blue-green'</p> <p>Instrument analysis</p>	2

Question Number	Acceptable Answers	Reject	Mark
3 (a) (i)	$2\text{KNO}_3 \rightarrow 2\text{KNO}_2 + \text{O}_2$ Or multiples or equation divided by 2 ALLOW O_2 on LHS if balanced by additional O_2 on RHS IGNORE state symbols even if incorrect		1

Question Number	Acceptable Answers	Reject	Mark
3 (a) (ii)	$2\text{Ca}(\text{NO}_3)_2 \rightarrow 2\text{CaO} + 4\text{NO}_2 + \text{O}_2$ Or multiples or equation divided by 2 ALLOW O_2 on LHS if balanced by additional O_2 on RHS IGNORE state symbols even if incorrect		1

Question Number	Acceptable Answers	Reject	Mark
3 (b)	Brown gas (ALLOW fumes or vapour) evolved (1) IGNORE Effervescence/bubbles EITHER (White) solid melts (and then solidifies/freezes) OR (Colourless) liquid forms (1) IGNORE white solid formed		2

Question Number	Acceptable Answers	Reject	Mark
3 (c)	<p>Penalise any omission of reference to ion in MP 1 only but calcium ions or Ca^{2+} and potassium ions or K^+ are equivalent</p> <p><u>Marking Point 1</u> Calcium ions have greater positive charge (than potassium ions) OR Calcium ions $2+$ but potassium ions $1+$ OR Ca^{2+} but K^+ OR calcium ions are smaller (than potassium ions) OR calcium ions have greater charge density (1)</p> <p><u>Marking Point 2</u> \therefore Calcium (ions) more polarising or cause greater distortion (1)</p> <p><u>Marking Point 3</u> Of... nitrate (ion) OR anion OR $\text{N}-\text{O} / \text{N}=\text{O}$(bond) OR nitrate electron cloud (1)</p> <p>Reverse argument for K^+ gains full marks</p>		3

Question Number	Correct Answer	Reject	Mark
4 (a)(i)	Use of heat (1) To break down (a reactant)/one reactant into more than one product (1)		2

Question Number	Correct Answer	Reject	Mark
4 (a)(ii)	$\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ Allow correct multiples		1

Question Number	Correct Answer	Reject	Mark
4 (a)(iii)	<p>Group 2 carbonates are more (thermally) stable as you go down the group (1)</p> <p>as the cations get bigger/charge density gets less/cation has more shells (1)</p> <p>So have less of a polarising effect/distortion on the carbonate (ion)/less of a weakening effect on C-O (1)</p> <p>2nd and 3rd marks cq on first</p>	<p>Metal gets bigger/element gets bigger</p> <p>Carbonate molecule</p>	3

Question Number	Correct Answer	Reject	Mark
4 (b)(i)	orange	<p>Yellow</p> <p>Any colour in conjunction with orange</p>	1

Question Number	Correct Answer	Reject	Mark
4 (b)(ii)	$(18.0/1000 \times 0.100) = 1.8 \times 10^{-3}$ $/0.0018/2 \times 10^{-3}/0.002$ <i>IGNORE</i> sf and units even if incorrect		1

Question Number	Correct Answer	Reject	Mark
4 (b)(iii)	$(50/1000 \times 0.100) = 5 \times 10^{-3}$ (1) [If candidate fails to divide by 1000 in both (b)(ii) and b(iii) penalise only once] Moles HCl reacted = 3.2×10^{-3} (can get first mark here if 5×10^{-3} not shown above) So moles CaO = 1.6×10^{-3} (1) <i>IGNORE</i> sf Allow TE from b (ii)		2

Question Number	Correct Answer	Reject	Mark
4 (b)(iv)	<p>Mass CaO = $(1.6 \times 10^{-3} \times 56.1)$ = 0.0898 g (1)</p> <p>% purity = $0.0898/0.121 \times 100 = 74.2\%$ (1)</p> <p>OR</p> <p>Allow % calculated in terms of moles e.g moles of CaO should be $0.121 \times 56.1 = 0.0021568$ (mol) (1)</p> <p>% purity = $0.0016/0.0021568 = 74.2\%$ (1)</p> <p>Accept = $(1.6 \times 10^{-3} \times 56)$ = 0.0896 g (1)</p> <p>% purity = $0.0896/0.121 \times 100 = 74.0\%$ (1)</p> <p>Allow TE of incorrect moles of CaO from (b)(iii)</p> <p>Allow TE from incorrect mass of CaO if answer is $\leq 100\%$</p> <p>0.09 g and 74.4% is 1 out of 2 (rounding too soon)</p>	Any % purity without 3 sf for second mark	2

Question Number	Correct Answer	Reject	Mark
4 (c)(i)	<p>(Clean) nichrome/platinum wire/ceramic rod/silica/nickel/chrome rod (1)</p> <p>(In conc.) HCl/HCl(aq)/dilute HCl (1)</p> <p>Heat/place in (blue Bunsen) flame (1)</p>	<p>Metal loop/inoculating loop/glass rod/silver/spatula</p> <p>Place in yellow Bunsen flame/burn</p>	3

Question Number	Correct Answer	Reject	Mark
4 (c)(ii)	Barium/Ba/Ba ²⁺		1