

3(b)(i)	(strong) heating	1
	(to provide / overcome) <u>high</u> activation energy	1
3(c)(i)	$2\text{Mg}(\text{NO}_3)_2 \rightarrow 2\text{MgO} + 4\text{NO}_2 + \text{O}_2$	1
3(c)(ii)	$\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$	1
	$\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2$	1
3(d)(i)	reduce acidity in soil / increase pH of soil	1
	(both) basic / base(s)	1
3(d)(ii)	$\text{CaCO}_3 + 2\text{H}^+ \rightarrow \text{Ca}^{2+} + \text{CO}_2 + \text{H}_2\text{O}$ OR $\text{CaCO}_3 + 2\text{H}^+ \rightarrow \text{Ca}^{2+} + \text{H}_2\text{CO}_3$	1
Total:		16

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Question	Answer	Marks
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May/June 2017 9701/21 · Q3 (b)(i), (c)(i), (c)(ii), (d)(i), (d)(ii)

1(b)(i)	<i>any two from:</i> (from Mg to Ba) larger (atomic) radius / more shells / more shielding - electron(s) are less tightly held (by nucleus) / less attracted (to nucleus) - ionisation energy / ies decrease(s) / electron(s) lost (more) easily (down the group) - lower activation energy (for the reactions down the group)	2
1(b)(iv)	<i>any two from:</i> - increasing (cation) size / (cat)ionic radius increases / increasing size of atoms - overall charge on (cation) is constant / (+)2 / decreasing charge density of (+2 charged cation) - number of delocalised / outer / valence electrons (per atom) remains the same / 2 - increased shielding	2
	decreasing (strength of) attraction between (cat)ion / nucleus / nuclear charge AND delocalised electron(s)	1

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Question	Answer	Marks
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May/June 2018 9701/22 · Q1 (b)(i), (b)(iv)

1(d)(ii)	M1 $\frac{1}{2}\text{N}_2 + \text{O}_2 \rightarrow \text{NO}_2$ M2 $\text{Mg}(\text{NO}_3)_2 \rightarrow \text{MgO} + 2\text{NO}_2 + \frac{1}{2}\text{O}_2$	2
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March 2019 9701/22 · Q1 (d)(ii)

2(a)(iv)	$\text{CaCO}_3(\text{s}) + 2\text{HF}(\text{aq}) \rightarrow \text{CaF}_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$ M1 species and balancing M2 state symbols	2
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March 2019 9701/22 · Q2 (a)(iv)

1(a)(i)	M1 (one) fewer (inner) shell of electrons / less shielding (effect) <i>ORA</i>	1
	M2 smaller distance of the outer electrons (from the nucleus) / stronger nuclear attraction to the (outer) electrons <i>ORA</i>	1
1(a)(ii)	$\text{Sr(s)} + 2\text{H}_2\text{O(l)} \rightarrow \text{Sr(OH)}_2\text{(aq)} + \text{H}_2\text{(g)}$	1
	M1 species AND balancing	
	M2 state symbols	1
1(a)(iii)	M1 strontium AND forms a more soluble hydroxide	1
	M2 strontium hydroxide is a stronger base / produces more OH^- / it dissociates more	1
1(a)(iv)	(white) solid dissolves / effervescence	1
1(b)(ii)	XO	1
1(b)(iii)	$\text{XCO}_3 \rightarrow \text{XO} + \text{CO}_2$	1

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Question	Answer	Marks
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May/June 2019 9701/21 · Q1 (a)(i), (a)(ii), (a)(iii), (a)(iv), (b)(ii), (b)(iii)

3(a)	white light / flame AND (produces a) white / grey solid / ash / powder / smoke	1
3(b)(i)	$\text{MgO} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\text{O}$	1
3(b)(ii)	neutralisation	1
3(c)	M1 giant (structure / lattice)	2
	M2 (so) lots of energy needed to break the bonds OR strong bonds	
3(d)(i)	$\text{MgCO}_3\text{(s)} \rightarrow \text{MgO(s)} + \text{CO}_2\text{(g)}$	1
3(d)(ii)	(thermal) decomposition	1

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Question	Answer	Marks
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May/June 2019 9701/23 · Q3 (a), (b)(i), (b)(ii), (c), (d)(i), (d)(ii)

2(b)(i)	reacts with both acid and base	1
2(b)(ii)	$\text{OH}^- + \text{H}^+ \rightarrow \text{H}_2\text{O}$	1
2(b)(iv)	increases	1

Oct/Nov 2019 9701/22 · Q2 (b)(i), (b)(ii), (b)(iv)

1(a)(i)	$\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$	1
1(a)(ii)	OH^- / hydroxide	1
1(b)	M1 (decreasing melting point down the group because) lower forces of attraction / weaker bonds (between cations and anions / oxide / O^{2-}) M2 larger cations and constant charge OR decreasing charge density of cation (down group)	2
1(c)	high(er) activation energy / heating overcomes activation energy	1
1(e)(i)	reacts with / behaves as both acid and base	1
1(e)(ii)	$\text{BeO} + 2\text{OH}^- + \text{H}_2\text{O} \rightarrow \text{Be(OH)}_4^{2-}$	1

March 2020 9701/22 · Q1 (a)(i), (a)(ii), (b), (c), (e)(i), (e)(ii)

1(b)(i)	M1 heat (followed by) add water M2 $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ M3 $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$	3
1(b)(ii)	thermal decomposition.	1
1(b)(iii)	neutralise acid soil / reduce the acidity in soil / increase the pH in soil	1

May/June 2020 9701/23 · Q1 (b)(i), (b)(ii), (b)(iii)

2(g)(i)	$\text{Na}_2\text{O} + \text{SiO}_2 \rightarrow \text{Na}_2\text{SiO}_3$	1
2(g)(ii)	$\text{Na}_2\text{CO}_3 \rightarrow \text{Na}_2\text{O} + \text{CO}_2$	1

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Question	Answer	Marks
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Oct/Nov 2020 9701/22 · Q2 (g)(i), (g)(ii)

1(b)(iii)	calcium carbonate / CaCO_3	1
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Question	Answer	Marks
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May/June 2021 9701/21 · Q1 (b)(iii)

3(a)(i)		state at room temp	observations on add'n of sample to water	identity of sample	4
	R	solid	alkaline, colourless solution is made but some white solid remains	M1 Ba(OH) ₂ OR barium hydroxide	
	S	solid	white solid disappears, solution is neutral	M2 NaCl OR sodium chloride	
	T	liquid	misty fumes, white solid is made in vigorous reaction	M3 SiCl ₄ OR silicon(IV) chloride	
	U	solid	acidic, colourless solution is made in vigorous reaction	M4 P ₄ O ₁₀ OR phosphorus(V) oxide	
3(a)(ii)	SiO ₂				1
3(a)(iii)	phosphoric acid / phosphoric(V) acid				1
3(b)(i)	<i>any one physical property typical of ceramic materials from:</i> - strong / retain strength (over certain temperatures / conditions) - non-conductors of electricity / electrical insulators - high melting points				1

May/June 2021 9701/23 · Q3 (a)(i), (a)(ii), (a)(iii), (b)(i)

2(a)(iii)	(thermal stability) increases	1
2(b)	reduces acidity of soil	1

Oct/Nov 2021 9701/21 · Q2 (a)(iii), (b)

1(b)(i)	Ca(NO ₃) ₂ → CaO + 2NO ₂ + ½O ₂	1
1(b)(ii)	radium (nitrate) as thermal stability increases down group / has the greatest thermal stability	1

May/June 2022 9701/21 · Q1 (b)(i), (b)(ii)

2(b)(ii)	Ba(OH) ₂ is soluble (in aqueous solution) / solubility of Group 2 hydroxides increases down group	1
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Oct/Nov 2022 9701/23 · Q2 (b)(ii)

2(c)(ii)	Mg ₃ N ₂ + 6H ₂ O → 3Mg(OH) ₂ + 2NH ₃	1
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May/June 2024 9701/21 · Q2 (c)(ii)

2(c)	Ca(NO ₃) ₂ → CaO + 2NO ₂ + ½O ₂ M1 correct formula for calcium nitrate: Ca(NO ₃) ₂ M2 correct balanced equation	2
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Question	Answer	Marks
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May/June 2024 9701/22 · Q2 (c)

3(b)(i)	MgCO ₃ + 2HCl → MgCl ₂ + CO ₂ + H ₂ O	1
3(b)(ii)	thermal stability increases down the group	1

Oct/Nov 2024 9701/21 · Q3 (b)(i), (b)(ii)

2(a)	electrostatic attraction between positive metal ions / cations and delocalised electrons	2
2(b)(i)	ionic radius increases / ions larger (down the group) extra shell (of electrons)	2
2(c)(i)	most of the mass is in the nucleus because protons and neutrons / nucleons are found in the nucleus	2
2(c)(iii)	neutron beam horizontal straight line from same source electron beam downwards curving line from same source line deflected more than proton beam	3
2(d)(ii)	$\text{Sr} + 2\text{H}_2\text{O} \rightarrow \text{Sr}(\text{OH})_2 + \text{H}_2$	1
2(d)(iii)	decreases (down the group)	1

Question	Answer	Marks
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March 2025 9701/22 · Q2 (a), (b)(i), (c)(i), (c)(iii), (d)(ii), (d)(iii)

2(d)(i)	(thermal stability) increases (down the group)	1
2(d)(ii)	NO_2 AND O_2	1

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Question	Answer	Marks
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Oct/Nov 2025 9701/21 · Q2 (d)(i), (d)(ii)

2(f)(iii)	(thermal stability) increases (down the group)	1
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Question	Answer	Marks
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Oct/Nov 2025 9701/22 · Q2 (f)(iii)

2(d)(ii)	NO_2 AND O_2	1
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Question	Answer	Marks
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Oct/Nov 2025 9701/23 · Q2 (d)(ii)