

2(b)(iii)	(acts as a homogeneous) catalyst OR oxidising agent	1
	$\text{SO}_2 + \text{NO}_2 \rightarrow \text{SO}_3 + \text{NO}$	1
	$\text{NO} + \frac{1}{2}\text{O}_2 \rightarrow \text{NO}_2$ OR $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$	1

May/June 2017 9701/22 · Q2 (b)(iii)

1(e)	$\text{H}_2\text{S}_2\text{O}_7 + \text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$	1
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Page 4 of 9

Question	Answer	Marks
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May/June 2018 9701/21 · Q1 (e)

3(a)(i)	increasing attraction between nucleus and (outer) electrons	1
	increasing nuclear charge with similar shielding / (electrons in) same (outer) shell	1
3(a)(ii)	(ions of Na to Si have) lost outer shell / outer electrons OR atoms have one more shell than (corresponding) ions OR effective nuclear charge is greater for the ion	1

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Page 6 of 9

Question	Answer	Marks									
3(a)(iii)	(P to Cl form ions by) gaining electrons (to the same outer shell / p sub-shell)	1									
	Increased repulsion between electrons in same / outer shell / p sub-shell	1									
3(c)(ii)	$\text{NaCl} \rightarrow \text{Na}^+ + \text{Cl}^-$	1									
	$\text{SiCl}_4 + 2\text{H}_2\text{O} \rightarrow \text{SiO}_2 + 4\text{HCl}$	1									
3(c)(iii)	<table border="1"> <tr> <td></td><td>structure</td><td>bonding</td></tr> <tr> <td>sodium chloride</td><td>giant / ionic</td><td>ionic</td></tr> <tr> <td>silicon(IV) chloride</td><td>simple / molecular</td><td>covalent</td></tr> </table>		structure	bonding	sodium chloride	giant / ionic	ionic	silicon(IV) chloride	simple / molecular	covalent	2
	structure	bonding									
sodium chloride	giant / ionic	ionic									
silicon(IV) chloride	simple / molecular	covalent									

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Page 7 of 9

Question	Answer	Marks
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May/June 2018 9701/21 · Q3 (a)(i), (a)(ii), (a)(iii), (c)(ii), (c)(iii)

3(a)(i)	$\text{SiCl}_4(l) + 2\text{H}_2\text{O}(l) \rightarrow \text{SiO}_2(s) + 4\text{HCl}(aq/g)$ (state symbols required)	1
3(a)(ii)	hydrolysis	1
3(a)(iii)	NaCl – ionic	1
	SiCl_4 – covalent	1
3(b)(ii)	disproportionation	1
3(b)(iii)	kills micro-organisms	1

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Page 8 of 12

Question	Answer	Marks
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May/June 2019 9701/22 · Q3 (a)(i), (a)(ii), (a)(iii), (b)(ii), (b)(iii)

2(a)	Na ₂ O	MgO	Al ₂ O ₃	SiO ₂	SO ₃	2
	ionic	ionic	ionic	covalent	covalent	
	giant	giant	giant	giant / macro-molecular	simple / molecular	
Award one mark for each correct row.						
2(b)(ii)	M1: reacts with both acid and base / alkali M2: use any equation with Al ₂ O ₃ and an acid, e.g. Al ₂ O ₃ + 6HCl → 2AlCl ₃ + 3H ₂ O M3: use any equation with Al ₂ O ₃ and a base / alkali, e.g. Al ₂ O ₃ + 2NaOH + 3H ₂ O → 2NaAl(OH) ₄					3
2(b)(iii)	solid dissolves / disappears OR gets warm / hot					1
2(c)(iii)	SeO ₂ + 2NaOH → Na ₂ SeO ₃ + H ₂ O					1

Question	Answer	Marks
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Oct/Nov 2019 9701/21 · Q2 (a), (b)(ii), (b)(iii), (c)(iii)

2(a)	<table><tr><td>Na₂O</td><td>Al₂O₃</td><td>SiO₂</td><td>P₄O₁₀/P₄O₆ /P₂O₃ / P₂O₅</td><td>SO₃</td></tr><tr><td>basic</td><td>amphoteric</td><td>acidic</td><td>acidic</td><td>acidic</td></tr></table>	Na ₂ O	Al ₂ O ₃	SiO ₂	P ₄ O ₁₀ /P ₄ O ₆ /P ₂ O ₃ / P ₂ O ₅	SO ₃	basic	amphoteric	acidic	acidic	acidic	2
	Na ₂ O	Al ₂ O ₃	SiO ₂	P ₄ O ₁₀ /P ₄ O ₆ /P ₂ O ₃ / P ₂ O ₅	SO ₃							
	basic	amphoteric	acidic	acidic	acidic							
M1: all formulae correct												
M2: all acid / base behaviour correctly stated												
2(b)(iii)	reaction with strontium / reaction 1 will effervesce / fizz / bubble OR no fizzes / bubbles / effervescence with SrO				1							
2(c)(i)	M1: correct conversion of quantities V = 5(.00) × 10 ⁻⁴ (m ³) T = 293 (K) p = 5.37(0) × 10 ³ (Pa) M2: calculation to find n using n = PV / RT (n) = 1.1 × 10 ⁻³ (mol)				2							
2(c)(ii)	(i) × 78 = 0.0860 g				1							

Oct/Nov 2019 9701/22 · Q2 (a), (b)(iii), (c)(i), (c)(ii)

2(b)(i)	M1: proton / H ⁺ donor	2
	M2: partially dissociates (in solution)	
2(b)(ii)	$\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_3$	1

Oct/Nov 2020 9701/21 · Q2 (b)(i), (b)(ii)

2(a)	more acidic / less basic (from Na to S across period)		1
2(c)	reaction	name of product	2
	sodium oxide with water	sodium hydroxide	
	phosphorus(V) oxide with water	phosphoric(V) acid	

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Page 6 of 11

Question	Answer	Marks
2(e)(i)	$\text{Al}_2\text{O}_3 + 6\text{HCl} \rightarrow 2\text{AlCl}_3 + 3\text{H}_2\text{O}$	1
2(f)	M1: giant	2
	M2: covalent AND tetrahedral / four Si—O bonds	

Oct/Nov 2020 9701/22 · Q2 (a), (c), (e)(i), (f)

3(b)(ii)	SiO_2	1
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Page 7 of 9

Question	Answer	Marks
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May/June 2021 9701/23 · Q3 (b)(ii)

2(a)(ii)	$\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{NaOH}$	1
2(c)(iv)	$\text{P}_4\text{O}_{10} + 6\text{H}_2\text{O} \rightarrow 4\text{H}_3\text{PO}_4$	1

March 2022 9701/22 · Q2 (a)(ii), (c)(iv)



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Page 7 of 12

Question	Answer			Marks
2(a)(ii)		sodium chloride	phosphorus (V) chloride	3
	state at room temperature	solid	solid	
	name of change which occurs on addition of water	dissolves	hydrolysis	
	pH of final solution	7	1–2	
2(b)(ii)	element	chlorine	bromine	2
	melting point / °C	–101	–7.2	
	lattice structure of crystalline solid	simple molecular	simple molecular	
			tennessine	
			> 250	
			giant metallic	

Question	Answer	Marks
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May/June 2022 9701/23 · Q2 (a)(i), (a)(ii), (b)(ii)

2(a)(ii)	silicon(IV) chloride / silicon tetrachloride	1
	ALLOW phosphorus(III) chloride / phosphorus trichloride	

May/June 2024 9701/21 · Q2 (a)(ii)

1(d)(i)	large amount of energy required to break bonds in giant covalent structure	1
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Page 6 of 14

Question	Answer			Marks
1(e)(i)	Na	solid	10–14	2
	S	gas	0–4	
	4 correct = 2 marks 2 or 3 correct = 1 mark 0 or 1 correct = 0 marks			
1(e)(iii)	$\text{P}_4\text{O}_{10} + 6\text{H}_2\text{O} \rightarrow 4\text{H}_3\text{PO}_4$			1

May/June 2024 9701/22 · Q1 (d)(i), (e)(i), (e)(iii)

2(b)(i)	Period 3 oxide	product of rxn with water	pH of solution formed	2
	• MgO	Mg(OH) ₂	• 8 ≤ pH ≤ 12	
	P ₄ O ₁₀	• H ₃ PO ₄	• 1 ≤ pH ≤ 4	

•✓•✓

Oct/Nov 2024 9701/22 · Q2 (b)(i)

1(c)(ii)	Al ₂ O ₃	1
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May/June 2025 9701/22 · Q1 (c)(ii)

2(a)	Na ₂ O	1
2(b)	P ₄ O ₁₀ + 12NaOH → 4Na ₃ PO ₄ + 6H ₂ O	1
2(c)(ii)	• false • Al₂O₃ melting point is lower than MgO • (but) charge on Al ion is greater than that on Mg Any 2 points = 1 mark , all 3 points = 2 marks	2
2(e)(i)	NaAl(OH) ₄	1

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Page 7 of 11

Question	Answer	Marks
2(e)(ii)	Al ₂ (SO ₄) ₃	1

May/June 2025 9701/23 · Q2 (a), (b), (c)(ii), (e)(i), (e)(ii)

1(b)	M1 Na to Al have (delocalised) electrons that can move (through the structure / lattice) AND (P / S / Cl) do not (have delocalised electrons / mobile charge carriers) M2 Na to Al increasing number of delocalised electrons	2
1(d)(i)	P ₄ + 5O ₂ → P ₄ O ₁₀	1

May/June 2025 9701/24 · Q1 (b), (d)(i)

2(a)(i)	M1 nuclear charge increases (across period) AND similar shielding M2 greater / stronger attraction to nucleus	2
2(a)(ii)	M1 Al loses (3) electrons / Al is 3+, and P gains (3) electrons / P is 3– M2 Al ⁽³⁺⁾ has (one) fewer shell (than P ^(3–))	2
2(b)(ii)	they are insoluble	1
2(c)(ii)	Al ₂ O ₃ + 2NaOH → 2NaAlO ₂ + H ₂ O	1

Oct/Nov 2025 9701/21 · Q2 (a)(i), (a)(ii), (b)(ii), (c)(ii)

2(b)	M1 Si has (lots of) strong covalent bonds broken M2 P / S / Cl (only) has weak Van der Waals' (forces) broken	2
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Page 7 of 10

Question	Answer	Marks
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Oct/Nov 2025 9701/22 · Q2 (b)

2(a)(ii)	M1 Al loses (3) electrons / Al is 3+, and P gains (3) electrons / P is 3– M2 Al ⁽³⁺⁾ has (one) fewer shell (than P ^(3–))	2
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Oct/Nov 2025 9701/23 · Q2 (a)(ii)

2(c)(iii)	$\text{P}_4\text{O}_{10} + 6\text{H}_2\text{O} \rightarrow 4\text{H}_3\text{PO}_4$	1
Question	Answer	Marks

Oct/Nov 2025 9701/24 · Q2 (c)(iii)