Answers to examination-style questions

Answers	Marks	Examiner's tips
1 a) The charge on the oxide ion is bigger than on the chloride ion. Therefore the electrostatic attraction between the ions is stronger.	**2**	Accept the answer that the size of the oxide ion is smaller than the chloride ion.
b) MgO, which is a white solid, is slightly soluble in water: $MgO + H_2O \rightarrow Mg(OH)_2$ The pH is 8 to 10. SO_2 dissolves: $SO_2 + H_2O \rightarrow H_2SO_3$ The pH is 1 to 4.	**6**	In the equation, you could have $Mg^{2+} + 2OH^-$. Oxides of metals are basic or alkaline if dissolved in water. Oxides of non-metals are acidic if dissolved in water.
c) $Al(OH)_3 + OH^- \rightarrow Al(OH)_4^-$ $Al(OH)_3 + 3H^+ + 3H_2O \rightarrow Al(H_2O)_6^{3+}$	**4**	One mark given for the $Al(OH)_4^-$ and one for the balanced equation. One mark given for the $Al(H_2O)_6^{3+}$ and one for the balanced equation.
2 Na_2O: vigorous or exothermic reaction; or forms a colourless solution, pH of solution formed is 13 or 14. $Na_2O + H_2O \rightarrow 2NaOH$ P_4O_{10} or P_2O_5: vigorous or exothermic reaction; or forms a colourless solution, pH of solution formed is 0 or 1. $P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$	**6**	You can write an ionic equation if you prefer. You could write an equation from P_2O_5.
3 a) i) ionic	**3**	
ii) sodium		
iii) $Na_2O + H_2O \rightarrow 2NaOH$		
b) i) covalent	**3**	
ii) phosphorus		
iii) H_3PO_4		

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c)	i)	macromolecular	4	Accept: giant covalent or giant molecular.
	ii)	silicon		
	iii)	e.g. $CaO + SiO_2 \rightarrow CaSiO_3$		One mark for the base used, i.e. CaO, and one mark for the balanced equation.
4 a)	i)	P_4O_{10} or SO_3	2	This means it will be an acidic solution and therefore an oxide of a non-metal.
	ii)	Na_2O		This means it will be an alkaline solution and therefore an oxide of a metal.
b)	i)	$MgO + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2O$	3	You could also have an ionic equation, i.e. $MgO + 2H^+ \rightarrow Mg^{2+} + H_2O$
		$2NaOH + SiO_2 \rightarrow Na_2SiO_3 + H_2O$		You could also have an ionic equation, i.e. $SiO_2 + 2OH^- \rightarrow 2Na^+ + H_2O$
		$3Na_2O + 2H_3PO_4 \rightarrow 2Na_3PO_4 + 3H_2O$		You could also have an ionic equation, i.e. $Na_2O + 2H^+ \rightarrow 2Na^+ + H_2O$
c)		P_4O_{10} is molecular or simple covalent. This means that there are weak intermolecular forces between molecules.	4	These forces are van der Waals forces.
		SiO_2 is a macromolecule or giant covalent molecule.		
		Many strong covalent bonds must be broken.		These bonds must be stated to be covalent and remember they are between the atoms in the giant molecule.
5		$Na_2O + H_2O \rightarrow 2NaOH$ pH = 14 $SO_2 + H_2O \rightarrow H_2SO_3$ pH 1–3	4	Remember oxides of metals give alkaline solutions when dissolved and oxides of non-metals give acidic solutions when dissolved.

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6 a) i) **P** is Na_2O or sodium oxide. ionic Ions are not free to move in the solid state. Ions are free to move when molten or in aqueous solution. $Na_2O + H_2O \rightarrow 2NaOH$	**9**	Since the identity is asked for, you can give a formula or a name. If a formula is given this must be correct.
ii) **Q** is SO_2 or sulfur dioxide. covalent Intermolecular forces are weak or van der Waals forces are weak. $SO_2 + H_2O \rightarrow H_2SO_3$		Since the identity is asked for, you can give a formula or a name. If a formula is given this must be correct. The intermolecular forces are not hydrogen bonds.
b) i) amphoteric	**6**	This is because it reacts with acids and alkalis.
ii) $Al(OH)_3 + NaOH \rightarrow NaAl(OH)_4$		In this equation one mark is for stating that **R** is $Al(OH)_3$ and the other for a balanced equation. You could also have ionic equations, e.g. $Al(OH)_3 + OH^- \rightarrow [Al(OH)_4]^-$ You could start with the identity of **R** as $Al(OH)_3(H_2O)_3$ and so the equation would be $Al(OH)_3(H_2O)_3 + OH^- \rightarrow [Al(OH)_4(H_2O)_2]^- + H_2O$
$2Al(OH)_3 + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 6H_2O$		You could start with $Al(OH)_3(H_2O)_3$ and have H^+ as the acid, so the equation would be $Al(OH)_3(H_2O)_3 + H^+ \rightarrow [Al(OH)_2(H_2O)_4]^+ + H_2O$ In the equation there is one mark for the correct product and one mark for the balanced equation.
iii) There is only one mark here and any of the following answers are acceptable: ■ large lattice energy ■ strong covalent bonds ■ ΔH_{soln} is very positive. ■ ΔG is very positive. ■ The sum of the hydration energies is less than the covalent bond energies.		