OCR

RECOGNISING ACHIEVEMENT

A2

TRENDS + PATTERNS

Mark Scheme 2815/1
January 2004

Question	Expected answers	Marks	Additional guidance
1 (a) (i)	(Enthalpy change of) formation (of magnesium oxide) (1); (Enthalpy change of) atomisation (of magnesium) (1); First ionisation enthalpy (of magnesium) (1)	3	 **Allow** (enthalpy change of) sublimation (of magnesium) **Allow** first ionisation energy
(ii)	$Mg^{2+}(g)$ and $O^{2-}(g)$ (1)	1	State symbols **essential**
(iii)	Electron being gained is repelled by the negative charge of the ion / aw (1)	1	
(b) (i)	Lattice enthalpy = –149 – 736 – 1450 – 248 – 650 – 602 (1); = –3835 ($kJ\ mol^{-1}$) (1)	2	**Allow** ecf from one error (1)
(ii)	Lattice enthalpy of barium oxide is less exothermic than that of magnesium oxide / lattice enthalpy is smaller in magnitude / ora (1); Mg^{2+} has a smaller ionic radius than Ba^{2+} / Mg^{2+} has a higher charge density than Ba^{2+} / ora (1); So stronger attraction between the positive and negative ion (1)	3	**Not** bigger or smaller lattice enthalpy Correct particles must be used e.g. **not** Mg has a smaller radius **Allow** so has stronger ionic bonds
(c)	High melting point / (very) large lattice enthalpy / aw (1)	1	**Not** resistant to heat
(d) (i)	$BaCO_3 \rightarrow BaO + CO_2$ (1)	1	State symbols **not** essential
(ii)	Decomposition temperature higher for $BaCO_3$ / ora (1) Polarising ability of cation decreases from Mg^{2+} to Ba^{2+} (1); Polarisation causes distortion of the charge cloud around the carbonate ion / polarisation weakens the covalent bonds within the carbonate ion (1)	3	Particles used must be correct e.g. not Mg is more polarising **Allow** marks via a diagram
		Total = 15	

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2 (a)	Often are catalysts (1)	1	**Allow** compounds are often paramagnetic **Not** metallic properties
(b) (i)	Tetrahedral / or a clear drawing of a tetrahedral ion (1); Bond angle of 109.5 ± 0.5° (1)	2	**Allow** square planar (1) with bond angle of 90° (1) Tetrahedral structure must have at least one wedge
(ii)	Cl^- (1)	1	
(iii)	(Concentrated) hydrochloric acid / (concentrated) solution of an ionic chloride (1)	1	**Allow** correct formula
(iv)	Suitable equation e.g. $[Cu(H_2O)_6]^{2+} + 4Cl^- \rightarrow [CuCl_4]^{2-} + 6H_2O$ Or $[Cu(H_2O)_6]^{2+} + 4NH_3 \rightarrow [Cu(H_2O)_2(NH_3)_4]^{2+} + 4H_2O$; Reaction in which a ligand is swapped or displaced by another ligand / aw (1)	2	**Not** ligand is substituted
		Total = 7	

Question	Expected answers	Marks	Additional guidance
3 (a)	Oxidation - Oxidation number of oxygen changes from –1 to 0; Reduction – oxidation number of oxygen changes from -1 to –2 (1)	2	**Allow** one mark if all the oxidation numbers for oxygen (and hydrogen) are correct
(b) (i)	$2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$ Correct reactants and products (1); Balancing (1)	2	**Ignore** electrons for the first mark
(ii)	Moles of MnO_4^- = $17.5 \times 10^{-3} \times 0.0200 / 3.5 \times 10^{-4}$ (1); Moles of H_2O_2 = 2.5 x moles of $MnO_4^- / 8.75 \times 10^{-4}$ (1); Conc of $H_2O_2 = \frac{8.75 \times 10^{-4}}{0.025}$ = 0.0350 (mol dm^{-3}) (1)	3	**Allow** ecf within question **Allow** 0.035 **Not** 0.04 / 0.03
(c)	Aqueous sodium hydroxide / potassium thiocyanate / ammonium thiocyanate (1); Appropriate observation e.g. orange-red / brown / brown-red / foxy-red ppt with NaOH(aq) or (blood) red with KSCN (1)	2	**Allow** hydroxide (ions) or thiocyanate (ions)
		Total = 9	

Question	Expected answers	Marks	Additional guidance
4	**Chemical formula** Correct formula of all chlorides (1); Number of outer electrons per atom increases / oxidation number increases (1); **Structure and bonding** NaCl or $MgCl_2$ are ionic and $AlCl_3$ or $SiCl_4$ are covalent (1) NaCl or $MgCl_2$ are giant and $AlCl_3$ or $SiCl_4$ are simple (1) **And any two from** Correct 'dot-and-cross' diagram for one of the ionic chlorides (1); Correct 'dot-and-cross' diagram for one of the covalent chlorides (1); Correct structure/bonding for Al_2Cl_6 showing the dative bonding (1); Drawing of NaCl lattice (1); **Action of water** **Any four from** Ionic chlorides dissolve in water / NaCl or $MgCl_2$ dissolve in water (1): Ionic chlorides give a neutral solution / NaCl gives a neutral solution or pH 7 / $MgCl_2$ gives a slightly acidic solution or pH 6-7 (1); Covalent chlorides are hydrolysed / covalent chlorides react / $SiCl_4$ or $AlCl_3$ react or are hydrolysed (1); Covalent chlorides give acidic solutions / $SiCl_4$ or $AlCl_3$ give acidic solutions or pH less than 6 (1) Suitable equation e.g. $SiCl_4 + 2H_2O \rightarrow SiO_2 + 4HCl$ (1) **Melting points** NaCl, $MgCl_2$ or ionic chlorides have electrostatic attraction between ions / attraction between positive and negative ions (1); $AlCl_3$, $SiCl_4$ or simple molecular lattice have van der Waals force of attraction (1); Strong ionic bonds and weak intermolecular forces (1) **QWC** – one mark for technical terms Award one mark if the candidate has illustrated the answers correctly using at least three of the technical terms (1) - hydrolysis, hydration, intermolecular, ionic covalent, lattice, electrostatic, van der Waals, polarisation, dative bonding.	14	**Allow** $AlCl_3$ or Al_2Cl_6 Do **not** award mark if one bonding or one structure is wrong **Do not** penalise incorrect answers in these two marks **Allow** dissociate in water **Allow** polarisation of water molecules by Al^{3+} As alternative to hydrolysis mark **Allow** other species such as $Si(OH)_4$ **Not** weak covalent bonds
		Total = 14	