

GCE

Chemistry

Advanced GCE **2815/01**

Trends and Patterns

Mark Scheme for June 2010

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Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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Question	Expected Answers	Marks	Additional Guidance
1 a(i)	(Enthalpy change of) formation (of barium oxide) ✓ (Enthalpy change of) atomisation (of barium) ✓ First ionisation energy (of barium) ✓	3	
a(ii)	$\text{Ba}^{2+}(\text{g})$ and $\text{O}^{2-}(\text{g})$ ✓	1	State symbols essential
b(i)	Lattice enthalpy = $-180 - 503 - 965 - 248 - 650 - 554$ ✓ = $-3,100 \text{ (kJ mol}^{-1}\text{)}$ ✓	2	
b(ii)	Lattice enthalpy of BaO is less exothermic than that of MgO / lattice enthalpy is smaller in magnitude / ORA ✓ Mg^{2+} (has a) smaller (ionic radius) than Ba^{2+} / Mg^{2+} has a higher charge density than Ba^{2+} / ORA ✓ So stronger attraction between the positive and negative ion / ORA ✓	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
1c	High melting point / (very) large lattice enthalpy / AW ✓	1	
1d(i)	$\text{BaCO}_3 \longrightarrow \text{BaO} + \text{CO}_2$ ✓	1	State symbols not essential
1d(ii)	Decomposition temperature higher for BaCO_3 / ORA ✓ Polarising ability of cation decreases from Mg^{2+} to Ba^{2+} ✓ Distortion of the charge cloud around the carbonate ion / weakens the covalent bonds within the carbonate ion ✓	3	Particles used must be correct e.g. not Mg is more polarising ALLOW marks via a diagram
	Total	14	

Question	Expected Answers	Marks	Additional Guidance
2 a(i)	A clear 3D drawing of an octahedral ion ✓ Bond angle of 90° ✓	2	2 bonds in plane, 2 bonds out and 2 bonds into plane 4 in plane, 1 into and 1 out charge not required
a(ii)	A: CuCl_4^{2-} ✓ B: $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$ ✓	2	
b(i)	a species that bonds by a dative covalent bond/donates an electron or lone pair to a metal ion/cation ✓	1	
b(ii)	Suitable equation: e.g. $[\text{Cu}(\text{H}_2\text{O})_6]^{2+} + 4\text{Cl}^- \longrightarrow [\text{CuCl}_4]^{2-} + 6\text{H}_2\text{O}$ Or $[\text{Cu}(\text{H}_2\text{O})_6]^{2+} + 4\text{NH}_3 \longrightarrow [\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+} + 4\text{H}_2\text{O}$ ✓ Reaction in which a ligand is swapped or replaced or displaced by another ligand / AW ✓	2	
Total		7	

Question	Expected Answers	Marks	Additional Guidance
3 a	$(1s^2 2s^2 2p^6) 3s^2 3p^6 3d^5$ ✓ Fe is a transition element since Fe^{3+} ion has an incomplete d sub-shell/ AW ✓	2	
b	Haber process / production of ammonia ✓	1	
c(i)	From colourless/pale green to pink/purple ✓	1	
c(ii)	moles $Fe^{2+} = 25.0 / 1000 \times 0.0500 (= 0.00125 \text{ mol})$ ✓ moles $MnO_4^- = 0.00125 / 5 (= 0.00025 \text{ mol})$ ✓ conc $MnO_4^- = 1000 \times 0.00025 / 12.3 = 0.0203 \text{ mol dm}^{-3}$ ✓	3	ecf through correct answer with units = 3 marks 3 sf
d(i)	$(+)6$ ✓	1	ALLOW 6+
d(ii)	$2I^-(aq) \longrightarrow I_2(aq) + 2e^-$ ✓	1	IGNORE state symbols
d(iii)	$8H^+(aq) + FeO_4^{2-}(aq) + 4I^-(aq) \longrightarrow 2I_2(aq) + Fe^{2+}(aq) + 4H_2O(l)$ Correct reactants and products ✓ Balancing ✓	2	IGNORE state symbols IGNORE electrons here no electrons ALLOW multiples
e(i)	From yellow to blood-red ✓	1	ALLOW orange yellow
e(ii)	$[Fe(H_2O)_6]^{3+} + SCN^- \longrightarrow [Fe(H_2O)_5(SCN)]^{2+} + H_2O$ ✓	1	
Total		13	

Question	Expected Answers	Marks	Additional Guidance
4 a	<p>Physical properties</p> <p>MgO (giant) ionic structure ✓ (so it has a) high melting point (because there is a) strong interaction between the positive ions and the negative ions / because there is a strong electrostatic attraction between ions ✓</p> <p>does not conduct electricity because (there are) no free ions / all ions fixed in solid / conducts when liquid or in solution as ions move ✓</p> <p>SiCl₄ simple molecular structure / simple covalent ✓ (so it has a) low melting point (because) molecules are held together by weak intermolecular forces / van der Waals forces ✓</p> <p>does not conduct electricity because (there are) no free electrons / all electrons localised in covalent bonds ✓</p> <p>Reaction with water</p> <p>MgO Magnesium oxide is basic / magnesium oxide reacts with water to form an alkaline solution / magnesium oxide is slightly soluble in water giving an alkaline solution or solution of pH >7 but less than or equal to 12 ✓ $\text{MgO} + \text{H}_2\text{O} \longrightarrow \text{Mg}(\text{OH})_2$ ✓</p> <p>SiCl₄ Silicon chloride forms an acidic solution/ solution with pH < 7 ✓ $\text{SiCl}_4 + 4\text{H}_2\text{O} \longrightarrow \text{Si}(\text{OH})_4 + 4\text{HCl}$ / $\text{SiCl}_4 + 4\text{H}_2\text{O} \longrightarrow \text{SiO}_2 \cdot 2\text{H}_2\text{O} + 4\text{HCl}$ / $\text{SiCl}_4 + 2\text{H}_2\text{O} \longrightarrow \text{SiO}_2 + 4\text{HCl}$ ✓</p>	10	ALLOW basic
QWC	At least 2 complete sentences in which the meaning is clear ✓	1	
	Total	11	

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