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Mark Scheme 2815/01
January 2006

TRENDS + PATTERNS

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Question	Expected answers	Marks	Additional guidance
1 (a)	$MgCO_3(s) \rightarrow MgO(s) + CO_2(g)$ Equation (1); State symbols (1)	2	State symbols mark dependent on correct formulae
(b)	Decreases down the group / decomposition temperature increases down the group / ora (1)	1	
(c)	Magnesium oxide, barium oxide and barium carbonate (1); Magnesium ion has a smaller ionic radius than barium ion / magnesium ion has a larger charge density than barium ion / ora (1); Oxide ion has a smaller ionic radius than carbonate ion / oxide ion has a higher charge density than a carbonate ion / ora (1); Link between stronger attraction between ions and the smaller ionic radii / link between stronger attraction between ions and higher charge density / ora (1)	4	**Allow** use of correct formulae for ions **Not** oxygen is smaller than carbonate **Not** Mg is smaller than Ba **Not** Mg^{2+} has a smaller atomic radius
(d)	**Any two from** Aluminium ion is very small / aluminium ion is highly charged / aluminium ion has a large charge density (1); Aluminium ion is highly polarising (1); So aluminium ion polarises the electron cloud around carbonate ion (very easily) / aluminium ion distorts the electron cloud around carbonate ion (very easily) (1)	2	**Allow** mention of Al^{3+} **Allow** lattice enthalpy of aluminium oxide is extremely exothermic (1) and this drives the reaction to the right hand side (1)
		Total = 9	
2 (a)	P_2O_5 / P_4O_{10} (1)	1	
(b)	M_r of $KClO_3$ = 122.5 Moles of $KClO_3$ = 3.00×10^{-3} (1); Moles of oxygen = 4.50×10^{-3} (1); Volume of oxygen = 108 cm^3 / 0.108 dm^3 (1)	3	**Allow** ecf from wrong moles of $KClO_3$ **Allow** ecf from wrong number of moles of oxygen **Unit essential** for full marks
(c)	Provides oxygen / as an oxidant / aw (1)	1	
(d)	$S + O_2 \rightarrow SO_2$ (1)	1	
(e) (i)	Does not conduct electricity / low melting point / low boiling point (1)	1	
(ii)	Acidic oxide / reacts with bases / forms an acid with water (1)	1	**Allow** gives a pH value less than 7
		Total = 8	

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3	(a)	Add (aqueous) sodium hydroxide which will give a brown/rusty ppt (1)	1	**Allow solid for precipitate or (s) in equation Allow Use *aqueous* thiocyanate ions which gives a (blood) red colouration**
	(b) (i)	$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 7H_2O + 6Fe^{3+}$ Correct reactants and products (1); Correct balancing (electrons cancelled out) (1)	2	
	(ii)	Moles of dichromate(VI) = 3.53 x 10-4 (1); Moles of iron(II) = 2.12 x 10-3 (1): Moles of impure iron(II) sulphate = 2.36 x 10-3 (1); Percentage purity = 89.8 / 89.8 – 90.0 (1)	4	**Allow alternative working out via mass instead of moles e.g. mass of iron in *hydrated FeSO4* from percentage composition compared to mass of iron *from moles of* iron(II). Allow ecf throughout unless *percentage is* above 100%**
			Total = 7	
4	(a) (i)	(Blue to) yellow (solution) / (blue to) green (solution) (1)	1	
	(ii)	Lone pair on chloride ion (1); Donated to copper(II) ion (1)	2	**Allow dative bond / coordinate bond (1) Allow marks via a diagram that must show lone pairs and the dative bond**
	(b)	(Light) blue precipitate / blue solid (1); With excess (dark) blue solution (1)	2	**Not just goes blue**
	(c)	Any three from Ammonia molecule 1 lone pair (and 3 bond pairs) (1); Ammonia ligand 4 bond pairs / lone pair is now a bond pair / ligand does not have a lone pair (1); Lone pairs repel more than bond pairs (1): In complex equal repulsion between electron pairs (1)	3	**Not bonds repel / atoms repel**
			Total = 8	

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5	**Reaction of elements** **Any two elements reaction with chlorine – maximum four marks** Sodium burns with a yellow flame / gives a white solid formed (1); $2Na + Cl_2 \rightarrow 2NaCl$ (1); Aluminium makes a white solid (1); $2Al + 3Cl_2 \rightarrow 2AlCl_3$ or Al_2Cl_6 (1); (In excess chlorine) Phosphorus give a white flame / makes a white or pale yellow solid (1); $P_4 + 10Cl_2 \rightarrow 4PCl_5$ / $2P + 5Cl_2 \rightarrow 2PCl_5$ (1) (In limited supply of chlorine) gives a white flame / makes a colourless (fuming) liquid (1); $P_4 + 6Cl_2 \rightarrow 4PCl_3$ / $2P + 3Cl_2 \rightarrow 2PCl_3$ (1) **Chosen redox reaction – two marks** Correct electron loss for oxidation / correct change in oxidation number for oxidation (1); Correct electron gain for reduction / correct change in oxidation number for reduction (1) **Action of water – six marks** Sodium chloride dissolves in water / NaCl + aq → $Na^+(aq) + Cl^-(aq)$ (1); NaCl gives a solution which is neutral (1); **Any two from** Aluminium chloride is hydrolyses / reacts with water / aluminium ion polarises water molecules (1); Makes an acidic solution (1); **Any two from** Phosphorus(V) chloride is hydrolysed by water / reacts with water (1); $PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$ (1); Acidic solution is formed / steamy fumes produced (1) **And QWC** One mark for correct spelling, punctuation and grammar in at least two sentences (1)	12 1	**Allow** a white flame **Allow** ecf from a wrong equation **Allow** equations showing polarisation by Al^{3+} or equation of $AlCl_3$ with water **Allow** PCl_3 is hydrolysed / reacts with water (1) $PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$ (1) Acidic solution is formed / steamy fumes produced (1) **Allow** $P(OH)_3O$ etc
		Total = 13	