Q	uestion	Expected answers	Marks	Additional guidance
1	(a)	MgCO <sub>3</sub> (s) → MgO(s) + CO <sub>2</sub> (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)  Any two from Aluminium ion is very small / aluminium ion is highly	2	Allow use of correct formulae for ions Not oxygen is smaller than carbonate Not Mg is smalle than Ba Not Mg <sup>2+</sup> has a smaller atomic radius  Allow mention of Al <sup>3+</sup>
	270	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)	Total	Allow lattice enthalpy of aluminium oxide is extremely exothermic (1) and this drives th reaction to the right hand side (1)
			= 9	
2	(a)	P <sub>2</sub> O <sub>5</sub> / P <sub>4</sub> O <sub>10</sub> (1)	1	
	(b)	$M_r$ of KCIO <sub>3</sub> = 122.5 Moles of KCIO <sub>3</sub> = 3.00 x 10 <sup>-3</sup> (1); Moles of oxygen = 4.50 x 10 <sup>-3</sup> (1); Volume of oxygen = 108 cm <sup>3</sup> / 0.108 dm <sup>3</sup> (1)	3	Allow ecf from wrong moles of KCIO <sub>3</sub> Allow ecf from wrong number of moles of oxygen Unit essential fo 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	<b>Allow</b> gives a pH value less than 7
			Total = 8	15]

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	As.
(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
		Total = 7	above 100%
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	

Question	Expected answers	Marks	Additional guidance
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 + Cl₂ → 2NaCl (1);  Aluminium makes a white solid (1);  2Al + 3Cl₂ → 2AlCl₃ or Al₂Cl₆ (1);  (In excess chlorine) Phosphorus give a white flame / makes a white or pale yellow solid (1);  P₄ + 10Cl₂ → 4PCl₅ / 2P + 5Cl₂ → 2PCl₅ (1)  (In limited supply of chlorine) gives a white flame / makes a soloupless (fuming) liquid (1);	12	Allow a white flame
	makes a colourless (fuming) liquid (1); P <sub>4</sub> + 6Cl <sub>2</sub> → 4PCl <sub>3</sub> / 2P + 3Cl <sub>2</sub> → 2PCl <sub>3</sub> (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)		Allow ecf from a wrong equation
	Action of water – six marks  Sodium chloride dissolves in water / NaCl + aq → Na <sup>+</sup> (aq) + Cl <sup>-</sup> (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		Allow equations showing polarisation by Al <sup>3+</sup> or equation o AlCl <sub>3</sub> with water  Allow PCl <sub>3</sub> is hydrolysed / reacts with water (1)
	Phosphorus(V) chloride is hydrolysed by water / reacts with water (1); PCl <sub>5</sub> + 4H <sub>2</sub> O → H <sub>3</sub> PO <sub>4</sub> + 5HCl (1); Acidic solution is formed / steamy fumes produced (1)	1	PCI <sub>3</sub> + 3H <sub>2</sub> O → H <sub>3</sub> PO <sub>3</sub> + 3HCI (1) Acidic solution is formed / steamy
bid maken know ovi gyco leugi jacon ekone	And QWC  One mark for correct spelling, punctuation and grammar in at least two sentences (1)	Total	fumes produced (1) Allow P(OH) <sub>3</sub> O etc