

Question	Expected answers	Marks	Additional guidance
1 (a)	$\text{MgCO}_3(\text{s}) \rightarrow \text{MgO}(\text{s}) + \text{CO}_2(\text{g})$ 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 $\text{KClO}_3 = 122.5$ Moles of $\text{KClO}_3 = 3.00 \times 10^{-3}$ (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)	$\text{S} + \text{O}_2 \rightarrow \text{SO}_2$ (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	

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)	$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{Fe}^{2+} \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O} + 6\text{Fe}^{3+}$ Correct reactants and products (1); Correct balancing (electrons cancelled out) (1)	2	
	(ii)	Moles of dichromate(VI) = 3.53×10^{-4} (1); Moles of iron(II) = 2.12×10^{-3} (1); Moles of impure iron(II) sulphate = 2.36×10^{-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 FeSO_4 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	

