Question	Expected Answers	Marks

1 (a) (i) has at least one ion with a partially filled d-orbital — **1**

(ii) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$ — **1**

(b) (i) $Fe(OH)_2$ green — **2**

$Fe(OH)_3$ / $Fe_2O_3.xH_2O$ brown/red-brown/rust coloured/orange-brown — **2**

both solid — **1**

(ii) $[Cu(H_2O)_6]^{2+} + 2OH^- \rightarrow Cu(OH)_2 + 6H_2O$ / $Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2$ — **1**

$Cu(OH)_2$ obtains 1 mark if not part of balanced equation — **1**

$[Cu(H_2O)_6]^{2+} + 4NH_3 \rightarrow [Cu(NH_3)_4(H_2O)_2]^{2+} + 4H_2O$ — **1**

$[Cu(NH_3)_4(H_2O)_2]^{2+}$ / $[Cu(NH_3)_4]^{2+}$ =1mark if not part of balanced equation — **1**

N.B. Correctly balanced equations obtain both marks

[Total: 11]

Question	Expected Answers	Marks

2 (a) absorbs violet/blue / 400 nm - 450 nm
No other absorbance below 650 nm — **1**

(b) absorbs the complementary colour it transmits — **1**

(c) K : Cr : F = 0.818 : 0.410 : 2.46 (correct ratios obtain this mark) — **1**

2K : 1Cr : 6F / K_2CrF_6 — **1**

(d) F^- / fluoride — **1**

Don't accept fluorine or F

[Total: 5]

Question	Expected Answers	Marks
3 (a)	*correctly labelled:* atomisation of chlorine + atomisation of caesium	1
	1st ionisation energy + 1st electron affinity	1
	formation of CsCl + LE	1
(b)	$-443 = + 76 + (+122) + (+376) + (-349) + LE$	1
	$LE = -668$ kJ mol^{-1} (allow ecf here if 1 mistake only in step 1)	1
(c)	Na^+ smaller than Cs^+ (don't accept sodium smaller first time)	1
	Na^+ has a larger charge density	1
	attracts the anion/Cl^- more strongly/ sodium chloride has the stronger bonding	1
(d)	dissolves / no reaction *do not accept "nothing"*	1
	colourless / neutral / pH 7	1
(e)	add aqueous $AgNO_3$	1
	chloride gives a white ppt	1
	iodide gives a yellow ppt	1
	Alternative answer	
	Pass chlorine/use NaOCl & HCl	
	No change with CsCl	
	Iodine displaced/brown solution with CsI	

[Total: 13]

Question	Expected Answers	Marks
4 (a)	$2MnO_4^- + 16H^+ + 5C_2O_4^{2-} \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$	2
	1 mark for correct species, 1 mark for correct balancing including electrons if present	
(b)	amount of $C_2O_4^{2-} = (25.0/1000) \times 0.0400 = 0.001$ mol	1
	amount of MnO_4^- required $= 0.001 \times (2/5) = 0.0004$ mol	1
	vol of MnO_4^- required $= 0.0004/0.0200 \times 1000 = 20$ cm^3 / 0.02 dm^3	1
	(Allow ecf on parts 2 & 3)	

[Total 5]

Question	Expected Answers	Marks
5 (a)	$2Al + \frac{3}{2}O_2 \rightarrow Al_2O_3$	1
	$2P + 3Cl_2 \rightarrow 2PCl_3$ / $2P + 5Cl_2 \rightarrow 2PCl_5$ / $P_4 + 6Cl_2 \rightarrow 4PCl_3$ / $P_4 + 10Cl_2 \rightarrow 4PCl_5$	1
	correct oxidation numbers in 2 equations	2
	show oxidation or reduction by increase/decrease in oxidation numbers	1
	Credit electron transfer if used for Al_2O_3	
	QWC for good organisation?	1
(b)	Al_2O_3 does not react / does not dissolve	1
	PCl_5 exothermic reaction/vigorous reaction	1
	White fumes/steamy fumes/misty fumes	1
	HCl produced/acidic solution produced	1
	$PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$ / $PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$ / $PCl_5 + H_2O \rightarrow POCl_3 + 2HCl$	1
	not a redox reaction	1

N.B. max 5 marks

[Total: 11]