Question	Expected Answers	Marks
1 (a)	coordination number 4	1
	oxidation state +2	1
(b)	$[Cu(NH_3)_4(H_2O)_2]^{2+}$	
	colour dark blue / deep blue / Royal blue	1
	shape octahedral	1
	$[Cu(H_2O)_6]^{2+}$	
	colour blue	1
	shape octahedral	1
	$[CuCl_4]^{2-}$	
	colour yellow / green	1
	shape tetrahedral	1
(c) (i)	$[CuCl_4]^{2-}$	1
(ii)	the ion transmits yellow/green light / complementary colour	1
(d) (i)	concentrated / excess	1
	NH_3 (not NH_4^+)	1
	Allow from equation	
(ii)	concentrated	1
	HCl / NaCl	1
	Allow from equation	
		[Total 14]

Question			Expected Answers	Marks
2	(a)		$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^2$	1
	(b)	(i)	octahedral	1
		(ii)	oxidises easily/reacts with air	1
	(c)	(i)	Ti^{4+} has no electrons in the d-orbital	1
			Ti^{3+} has 1 electron in the d-orbital	1
			colour is associated with partly filled d-orbital / d-orbital electron absorbs energy from the visible/coloured region	1
		(ii)	white paint / pigment. Accept paint but **NOT** dyes	1
			[Total: 7]	

Question		Expected Answers	Marks
3	(a)	+2	1
	(b)	0.0022 mol	1
	(c)	0.0011 mol	1
	(d)	0.0022 mol	1
	(e)	8.8×10^{-2} mol dm^{-3} (allow ecf on parts c, d and e)	1
		[Total: 5]	

Question			Expected Answers	Marks
4	(a)	(i)	Cr electrode + $Cr^{3+}(aq)$	1
			Cd electrode + $Cd^{2+}(aq)$	1
			salt bridge + 1 mol dm^{-3} solutions + complete circuit	1
		(ii)	Cr → Cd (on wire, not through salt bridge)	1
		(iii)	oxidation takes place at Cr/Cr loses electrons	1
			because it has the most negative E^{θ} value/is the anode/is negatively charged	1
			Allow reverse idea relating to cadmium. Don't accept reference to electronegativity	
	(b)		$2Cr + 3Cd^{2+} \rightarrow 3Cd + 2Cr^{3+}$	1
	(c)	(i)	0.34 (V)	1
		(ii)	non-standard conditions / concentration is no longer 1mol.dm^{-3}	1
			Don't accept concentration is decreased	
			[Total: 9]	

Question	Expected Answers	Marks
5 (a)	optical isomerism/chirality/description of non super-imposable mirror images	1
	showing the two isomers	1
	example	1
	geometrical isomerism / cis & trans isomerism	1
	showing the two isomers	1
	example	1
(b)	add acid to CrO_4^{2-} to get $Cr_2O_7^{2-}$ or visa versa	1
	correct colours for both	1
	$2\ CrO_4^{2-} + H^+ \rightarrow Cr_2O_7^{2-} + OH^- / 2\ CrO_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{2-} + H_2O$	1
	QWC – SPAG?	1
		[Total: 10]