



TRANSITION ELEMENT

Mark Scheme 2815/06

June 2002

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
(c) (i)	$[CuCl_4]^{2-}$	
	colour yellow / green	1
	shape tetrahedral	1
(c) (ii)	the ion transmits yellow/green light / complementary colour	1
		1
(d) (i)	concentrated / excess	1
	NH_3 (not NH_4^+)	1
	Allow from equation	
(d) (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)	$8.8 \times 10^{-2} \text{ mol dm}^{-3}$ (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 ⁰ value/is the anode/is negatively charged	1
	Allow reverse idea relating to cadmium. Don't accept reference to electronegativity	
(b)	$2\text{Cr} + 3\text{Cd}^{2+} \rightarrow 3\text{Cd} + 2\text{Cr}^{3+}$	1
(c) (i)	0.34 (V)	1
(ii)	non-standard conditions / concentration is no longer 1 mol.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 $\text{Cr}_2\text{O}_7^{2-}$ or visa versa	1
	correct colours for both	1
	$2 \text{CrO}_4^{2-} + \text{H}^+ \rightarrow \text{Cr}_2\text{O}_7^{2-} + \text{OH}^-$ / $2 \text{CrO}_4^{2-} + 2\text{H}^+ \rightarrow \text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{O}$	1
	QWC – SPAG?	1

[Total: 10]