OCR

RECOGNISING ACHIEVEMENT

TRANSITION ELEMENTS

Mark Scheme 2815/06
January 2005

Abbreviations, annotations and conventions used in the Mark Scheme	/ = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit ( ) = words which are not essential to gain credit ____ = (underlining) key words which **must** be used to gain credit ecf = error carried forward AW = alternative wording ora = or reverse argument

Question	Expected Answers	Marks
1 (a)	Vanadium used in alloys for strength Vanadium(V) oxide used as a catalyst (Don't accept just the word catalyst)	1
(b)	Diagram to show: V/V^{2+} system Hydrogen electrode (Pt, H_2 and H^+ must be labelled) Salt bridge + voltmeter + complete circuit Temp 298K, concentration 1 mol.dm^{-3}, pressure 1 atm All 3 = 2 marks; any 2 = 1 mark	1 1 1 2
(c) (i) (ii)	<table><tr><td></td><td>V^{2+}</td><td>VO_2^+</td><td>VO^{2+}</td><td>V^{3+}</td></tr><tr><td>Oxidation Number</td><td>+2</td><td>**+5**</td><td>**+4**</td><td>+3</td></tr><tr><td>Colour</td><td>lilac</td><td>yellow</td><td>**blue**</td><td>**Green**</td></tr></table>	4
	Correct calculation of cell potential as –0.44 V Because it is –ve, reaction not feasible Alternative: V better reducing agent than Zn Because the $E^\ominus$ for V/V^{2+} is more -ve	1 1 **Total: 12**

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Question	**Expected Answers**	**Marks**
2 (a) (i)	Central ion surrounded by molecules/ions/ligands	1
(ii)	Molecule/ion with a lone pair of electrons	1
	Able to form a dative covalent or co-ordinate bond / which can be donated	1
(b)	Two lone pairs/ able to form two dative covalent / co-ordinate bonds	1
(c)	Stereoisomerism – same atoms with same order of bonds but a different spatial arrangement / same structure but different arrangement of atoms	1
	Both isomers drawn for cis / trans	2
	Both isomers drawn for optical (must be mirror images) (all diagrams to show 3-D arrangement)	2
	Enantiomers/non superimposable mirror images	1
	Rotate plane polarised light in opposite direction by same number of degrees (any two for 1 mark)	1
		Total: 11

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Question	**Expected Answers**	**Marks**
3 (a) (i)	Two orbital boxes higher and 3 orbital boxes lower	1
	Correct arrangement of electrons	1
	(see additional sheet)	
(ii)	One lower energy and one higher energy d-orbital shown	2
	(see additional sheet)	
(b)	Electrons promoted from low to high energy d-orbitals	1
	Energy involved lies in visible region of spectrum / needs visible light	1
	Some of the visible light is transmitted / absorbed	1
	Idea that colour depends upon the actual wavelengths transmitted / energy gap	1
	Need at least one unpaired d-orbital or Cu^{+} $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$	1
	Only Cu^{2+} has an unpaired electron or Cu^{2+} $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9$	1
	QWC: communicates by using at least 3 terms from the following list	
	d-orbitals, visible, spectrum, transmitted, wavelength, energy gap, unpaired electron, high or low energy, absorbed, d-sub shell	1
(c)	Compound absorbs green/yellow	1
	Blue and red transmitted (to give purple)	1
	(allow all colours absorbed except violet/blue and red for 1 mark)	
		Total: 13

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Question	**Expected Answers**	**Marks**
4 (a) (i)	$Cr_2O_7^{2-} + 14H^+ + 6I^- \rightleftharpoons 2Cr^{3+} + 3I_2 + 7H_2O$	
	All species correct (ignore electrons for this mark)	1
	Equation balanced (penalise if electrons not cancelled out)	1
(ii)		1
	Brown colour disappears	1
	$S_2O_3^{2-}$ reacts with I_2 (to form colourless I^-)	
	Green colour remains due to Cr^{3+} (must say what gives green colour)	1
(b) (i)		1
	Oxidation Number of Cr on both sides = +6	1
	Oxidation Number does not change therefore not redox	
(ii)		1
	Orange to yellow (both needed for 1 mark)	
(iii)		1
	Any suitable **named** acid or correct formula eg H_2SO_4	
		Total: 9