OCR

RECOGNISING ACHIEVEMENT

TRANSITION ELEMENTS

Mark Scheme 2815/06
January 2002

ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the **final** version of the Mark Scheme.
   You are advised to destroy all draft versions.

2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks (½) should never be used.

3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.

   x = incorrect response (errors may also be underlined)
   ^ = omission mark
   bod = benefit of the doubt (where professional judgement has been used)
   ecf = error carried forward (in consequential marking)
   con = contradiction (in cases where candidates contradict themselves in the same response)
   sf = error in the number of significant figures

4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.

5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.

6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

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)	the number of lone pairs / co-ordinate bonds	1
	bonded to the metal ion / atom	1
	Do not accept number of ligands	
(b) (i)	$[CoCl_4]^{2-}$	1
	tetrahedral	1
	$[Ni(en)_3]^{2+}$	1
	octahedral	1
	$[Ni(NH_3)_2Cl_2]$	1
	square planar	1
	Accept correct projection formulae for shape	
(ii)	$[Ni(en)_3]^{2+}$	1
	the only one to exist as mirror images	1

[Total: 10]

Question			Expected Answers	Marks
2	(a)	(i)	Fe electrode + $Fe^{2+}(aq)$	1
			1 mol dm^{-3} solution $Fe^{2+}(aq)$	1
			Pt electrode + $V^{3+}(aq)$ + $V^{2+}(aq)$	1
			salt bridge + voltmeter	1
		(ii)	E^{θ}_{cell} = 0.18 (V)	1
	(b)	(i)	VO_2^+ V(+5)	1
			VO^{2+} V(+4)	1
			VO^{2+} blue	1
			V^{2+} violet/lavender/lilac/mauve but NOT purple	1
		(ii)	1st half equation has the least positive E^{θ} / is more negative	1
			So reaction will go from right to left / releases electrons to reduce MnO_4^- 1	
			Allow calculation of E^{Θ}_{cell} related to reaction feasibility	
		(iii)	$MnO_4^- + 5VO^{2+} + H_2O \rightarrow Mn^{2+} + 5VO_2^+ + 2H^+$	2
			Allow 1 mark if balanced but H_2O and H^+ not cancelled	

[Total: 13]

Question			Expected Answers	Marks
3	(a)		2 levels up, 3 levels down	1
	(b)		correct shapes	2
	(c)		electrons go from a lower to a higher level	1
			by absorbing visible / red and blue light	1
			(green) light transmitted / complementary colour is the colour seen	1
	(d)		Diagrams (Allow only 1 mark if charge not included)	2
			cis and trans correctly identified	1
	(e)	(i)	stainless steel / other example	1
		(ii)	prevents rusting	1

[Total: 11]

Question	Expected Answers	Marks
4 (a)	**copper:**	
	most common oxidation states are +1 and +2	1
	aqueous copper (I) ions are unstable wrt aqueous copper (II) ions and copper	1
	copper (I) oxide disproportionates in sulphuric acid	1
	to give $[Cu(H_2O)_6]^{2+}$ / copper (I) disproportionates	
	$Cu_2O + H_2SO_4 \rightarrow Cu + Cu^{2+} + SO_4^{2-} + H_2O$	1
	aqueous copper (II) reacts with I^-	1
	to give a white precipitate / CuI	
	$2Cu^{2+} + 4I^- \rightarrow 2CuI + I_2$	1
	because I^- is a powerful reducing agent	1
	copper (I) chloride can be made from copper (II) chloride	1
	$Cu + CuCl_2 + 2Cl^- \rightarrow 2CuCl_2^-$	1
	Copper (II) compounds/ions are blue	1
	Copper (I) compounds/ions are colourless	1
	maximum	8
	cobalt:	
	most common oxidation states are +3 and +2	1
	aqueous cobalt (III) is a strong oxidising agent / oxidises water	1
	oxygen produced	1
	$4Co^{3+} + 2H_2O \rightarrow 4Co^{2+} + O_2 + 4H^+$	1
	+3 oxidation state stable when complexed with ammonia	1
	$[Co(H_2O)_6]^{2+} + 6NH_3 \rightarrow [Co(NH_3)_6]^{2+} + 6H_2O$	1
	$[Co(NH_3)_6]^{2+}$ on oxidation $\rightarrow [Co(NH_3)_6]^{3+}$	1
	+2 O.S. more stable than +3	1
	Ex of +2 ion with colour	1
	Ex of +3 ion with colour	1
	maximum	8
(b)	2 × (name + use)	2
	name and use to go together	
	QWC	1
	[Total: 11]	