

Chemistry

Advanced GCE **2815/06**

Transition Metals

Mark Scheme for June 2010

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Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

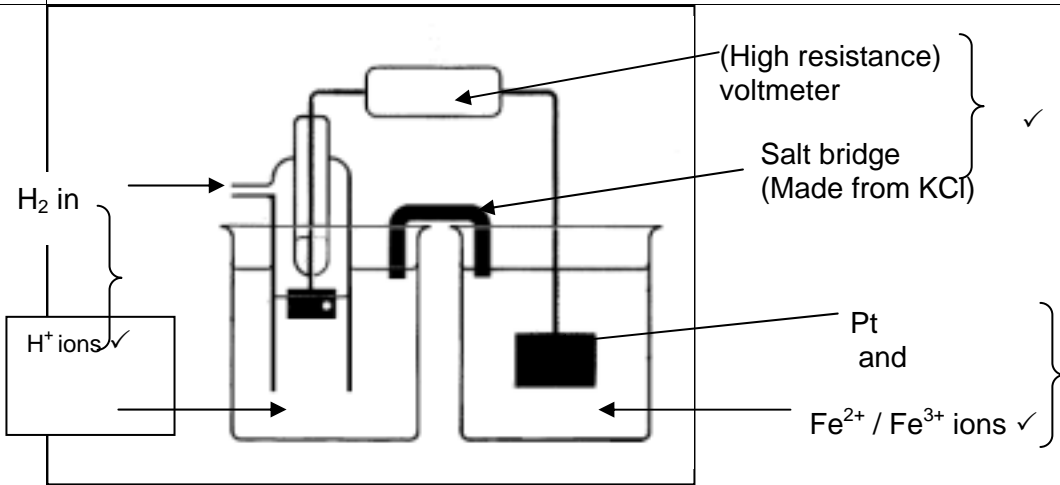
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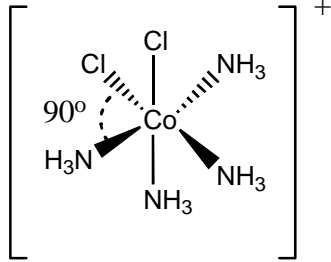
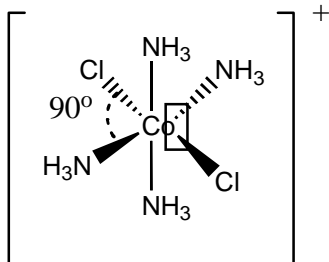
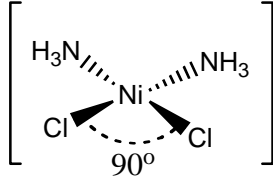
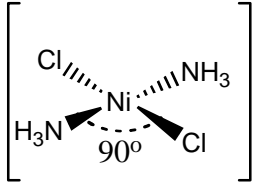
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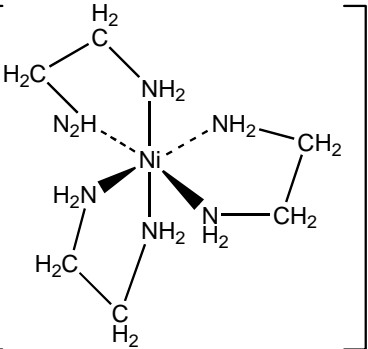
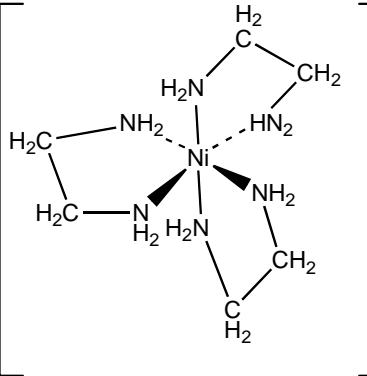
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Question	Expected answers	Marks
1(a)	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$ ✓	1
1(b)(i)	 <p>Cell set up as in the diagram with complete circuit ✓</p>	4
1(b)(ii)	All three of the following: ✓✓ Two of the following: ✓ Pressure 1 Atm/ 100/101 kPa Concentration of solutions = 1 mol dm^{-3} / equimolar solutions of $\text{Fe}^{2+}/\text{Fe}^{3+}$ Temperature = 25°C / 298 K These marks could be obtained from the diagram	2
1(c)(i)	$E_{\text{cell}} = (+)0.56 \text{ V}$ ✓	1
1(c)(ii)	$\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 14\text{H}^+(\text{aq}) + 6\text{Fe}^{2+}(\text{s}) \longrightarrow 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l}) + 6\text{Fe}^{3+}(\text{aq})$ Correct reactants and products ✓ (Ignore electrons for this mark) Balanced ✓ (with electrons cancelled out)	2
Total		10

Question	Expected answers	Marks
2(a)(i)	+2 ✓	1
2(a)(ii)	Amount in moles = $cv/1000$ Amount of $S_2O_3^{2-}$ in moles = $\frac{0.2 \times 32.60}{1000} = 0.00652 \text{ mol}$ ✓	1
2(a)(iii)	Ratio is 2:1 Amount of I_2 in moles = $0.00652/2 = 0.00326 \text{ mol}$ ✓ ecf = 2b/2	1
	Ratio is 2:1 Amount of Cu^{2+} in moles = $0.00326 \times 2 = 0.00652 \text{ mol}$ ✓ ecf = 2cx2	1
	Mass of copper in $25 \text{ cm}^3 = 0.00652 \times 63.5 = 0.414 \text{ g}$ ✓ ecf = 2(d) $\times 63.5$	1
	% Copper = $\frac{4.140}{4.250} \times 100 = 97.42 \%$ ✓ Answer to 3 sig figs = 97.4% ✓ Answer 9.74% is worth 1 mark but 9.742% is worth zero	1 1
2(b)(i)	Brown / yellow / straw coloured to colourless / white ✓	1
2(b)(ii)	Change blue/purple/black to colourless/white (is a more significant colour change) ✓	1
2(c)	Brass ✓ used for musical instruments / plumbing and electrical applications, rifle and pistol ammunition ✓ or Bronze ✓ used to make coins / statues / door furniture ✓ or Cupronickel ✓ used to make coins ✓	1
	Total	10

Question	Expected answers	Marks
3(a)(i)	<u>cis</u> -platin ✓	1
3(a)(ii)	cis-platin binds to the DNA in fast growing cells ✓ In the presence of cis-platin fast growing cancer cells have incorrectly copied DNA and therefore die / prevents replication ✓	1 1
3(b)	<p>Stereoisomers are compounds with the same structural formula but have a different arrangement of the atoms in space ✓ Accept same order of atoms and bonds but a different arrangement in space cis-trans isomerism</p> <p>EITHER</p> <p>Octahedral – Six monodentate ligands – two of one type and four of another or alternatively a complex with two bidentate ligands and two others of the same type 90° angle ✓ e.g.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>cis-isomer</p> </div> <div style="text-align: center;">  <p>trans-isomer</p> </div> </div> <p>90° is the only essential bond angle Two correct 3-D diagrams ✓✓ Correct formula of complexes – charges / ligands ✓ All 4 marks could be on the diagrams in the either or cases</p> <p>OR</p> <p>Square planar arrangement</p> <p>90° angle ✓</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>cis-isomer</p> </div> <div style="text-align: center;">  <p>trans-isomer</p> </div> </div> <p>90° is the only essential bond angle</p> <p>Two correct 3-D diagrams ✓✓ Correct formula of both complexes – charges / ligands ✓</p>	1

Question	Expected answers	Marks
	<p>Optical isomerism Two non-superimposable mirror images are formed ✓</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p>Two correct diagrams ✓✓</p> <p>Alternative answer could be the <i>cis</i> form of the complex with two bidentate ligands shown as two non-superimposable object / mirror images</p>	1 2
QWC	At least two complete sentences in which the meaning is clear and keywords such as optical, <i>cis</i> , <i>trans</i> , octahedral, square planar, mirror images, non-superimposable are spelled correctly ✓	1
Total		12

Question	Expected answers	Marks
4(a)	Co-ordination number = 6 ✓ Oxidation state = +3 ✓	1 1
4(b)(i)	$[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ ✓	1
	$[\text{CoCl}_4]^{2-}$ ✓	1
4(b)(ii)	$[\text{Co}(\text{H}_2\text{O})_6]^{2+}(\text{aq}) + 4\text{Cl}^-(\text{aq}) \rightleftharpoons [\text{CoCl}_4]^{2-} + 6\text{H}_2\text{O}$ ✓ Could be written either way round	1
4(b)(iii)	White precipitate is silver chloride/AgCl ✓ Chloride ions are removed/chloride concentration reduced so equilibrium moves to the left/towards $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ ✓ Accept idea that adding aq silver nitrate adds water which pushes equilibrium to the left / towards $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$	2
4(c)	The complex would be purple / red–purple / red–violet ✓ The solution absorbs in the yellow orange green and blue areas of the visible spectrum / red and violet are transmitted ✓	2
4(d)(i)	TiO_2 has no d electrons ✓ TiCl_3 has one d electron ✓ colour associated with partially filled d-orbitals / absorption of (specific parts of) visible light occurs with partially filled d-orbitals ✓	3
4(d)(ii)	white paint / sunscreens / food colour / white lines on tennis courts etc	1
	Total	13

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