OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

CHEMISTRY

Transition Elements

2815/06

Monday **26 JUNE 2006** Morning 50 minutes

Candidates answer on the question paper.
Additional materials:
Data Sheet for Chemistry
Scientific calculator

Candidate Name

Centre Number

Candidate Number

TIME 50 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Pencil may be used for diagrams and graphs **only**.
- Do not write in the bar code. Do not write in the grey area between the pages.
- **DO NOT** WRITE IN THE AREA **OUTSIDE** THE BOX BORDERING EACH PAGE. ANY WRITING IN THIS AREA WILL NOT BE MARKED.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry*.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu	Max.	Mark
1	10	
2	6	
3	10	
4	10	
5	9	
TOTAL	45	

This question paper consists of 11 printed pages and 1 blank page.

[Turn over

Answer **all** the questions.

1 Some standard electrode potentials are shown below.

	$E^{\ominus}$/ V
$Ag^+ + e^- \rightleftharpoons Ag$	+ 0.80
$\frac{1}{2}Cl_2 + e^- \rightleftharpoons Cl^-$	+ 1.36
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+ 0.34
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+ 0.77
$\frac{1}{2}I_2 + e^- \rightleftharpoons I^-$	+ 0.54

(a) Define the term *standard electrode potential.*

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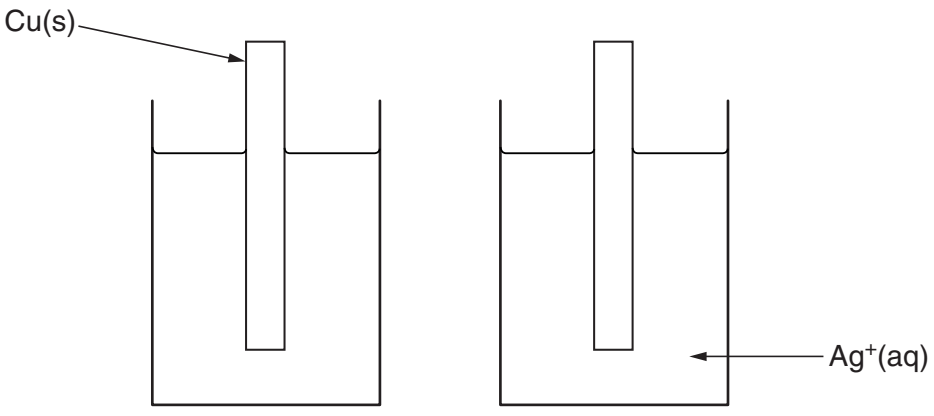
..... [3]

(b) The diagram below shows an incomplete cell consisting of Cu/Cu^{2+} and Ag/Ag^+ half-cells.



(i) Complete and label the diagram to show how the cell potential of this cell could be measured. [2]

(ii) On the diagram, show the direction of **electron** flow in the circuit if a current was allowed. [1]

(iii) Calculate the standard cell potential.

standard cell potential = ……V [1]

(iv) Write the overall cell reaction.

..... [1]

(c) Chlorine will oxidise Fe^{2+} to Fe^{3+} but iodine will not. Explain why, using the electrode potential data.

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..... [2]

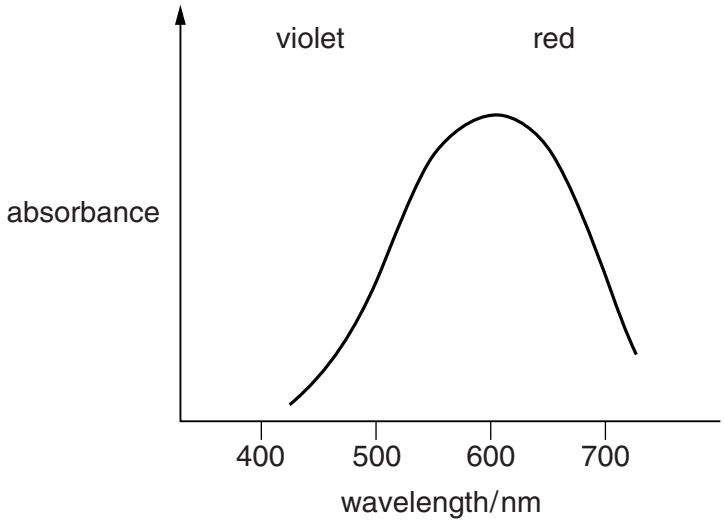
[Total: 10]

2 The $edta^{4-}$ ion forms complex ions with $Ni^{2+}(aq)$.

(a) Complete the electronic configuration of the Ni^{2+} ion.

$1s^2 2s^2 2p^6$ ..... [1]

(b) The visible spectrum of the complex formed between Ni^{2+} and $edta^{4-}$ is shown below.



What colour is the complex? Explain.

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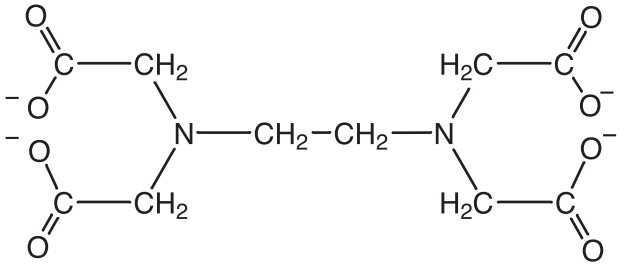
..... [2]

(c) The $edta^{4-}$ ion has the following structure.



(i) Put a ring around two different types of atom in the $edta^{4-}$ ion that are capable of forming a dative covalent bond with the Ni^{2+} ion. [2]

(ii) What feature of these atoms allows them to form a bond with Ni^{2+}?

..... [1]

[Total: 6]

3 Platinum forms complexes with a co-ordination number of 4.

(a) (i) Explain the term *co-ordination number*.

.....

..... [1]

(ii) State the shape of these platinum complexes.

..... [1]

(b) The tetrachloroplatinate(II) ion readily undergoes the following reaction.

$$[PtCl_4]^x + 2NH_3 \rightleftharpoons [Pt(NH_3)_2Cl_2]^y + 2Cl^-$$

(i) What type of reaction is this?

..... [1]

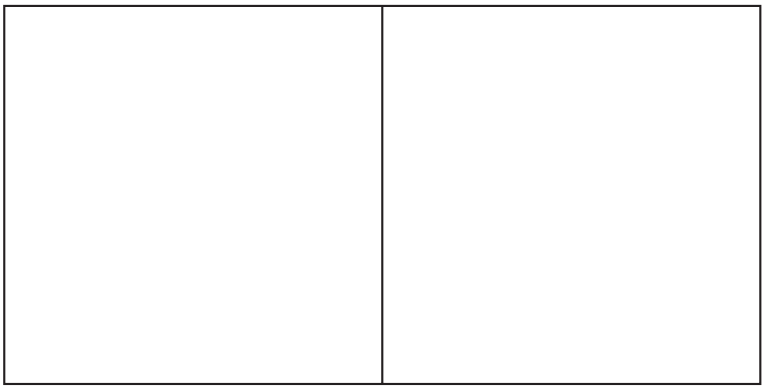
(ii) Suggest values for x and y in the equation.

x = ...

y = ... [2]

(c) The complex $[Pt(NH_3)_2Cl_2]^y$ exists in two isomeric forms.

(i) Draw diagrams to show the structure of these isomers.



[2]

(ii) What type of isomerism is this?

..... [1]

(iii) One of the isomers of $[Pt(NH_3)_2Cl_2]^y$ is an important drug used in the treatment of cancer.

How does this drug help in the treatment of cancer?

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..... [2]

[Total: 10]

4 Vanadium can exist in a number of different oxidation states. One compound of vanadium is ammonium vanadate(V) and this contains the ion VO_3^-. This can be reduced to V^{2+} in several steps, using zinc metal and aqueous sulphuric acid.

(a) Describe the colour changes during the stepwise reduction of VO_3^- to V^{2+}.

State the formula of the ions responsible for each colour.

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..... [4]

(b) 25.0 cm^3 of 0.100 mol dm^{-3} ammonium vanadate(V) is completely reduced to $V^{2+}(aq)$ using zinc and aqueous sulphuric acid. The resulting solution is titrated with 0.0500 mol dm^{-3} $MnO_4^-(aq)$ and 30.0 cm^3 is required to oxidise the $V^{2+}(aq)$ back to $VO_3^-(aq)$.

The half equation for acidified MnO_4^- acting as an oxidising agent is shown below.

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$$

Show that the vanadium has changed oxidation state from +2 to +5 in this titration.

[4]

(c) Suggest an equation for the oxidation of $V^{2+}(aq)$ to $VO_3^-(aq)$ by $MnO_4^-(aq)$ under acid conditions.

..... [2]

[Total: 10]

5 In this question, one mark is available for the quality of spelling, punctuation and grammar.

Cobalt forms aqueous ions with oxidation states of +2 and +3.

Illustrate the chemistry of cobalt ions, in both oxidation states, by referring to the following.

- colour
- geometry
- ligand substitution
- the relative stability of each oxidation state with different ligands

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Quality of Written Communication [1]

[Total: 9]

END OF QUESTION PAPER

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