THIS IS A LEGACY SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

CHEMISTRY

Transition Elements

2815/06

Candidates answer on the question paper
A calculator may be used for this paper

OCR Supplied Materials:
- *Data Sheet for Chemistry* (Inserted)

Other Materials Required:
- Scientific calculator

Friday 23 January 2009
Morning

Duration: 50 minutes

2815061

CUP/T76258

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **45**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- This document consists of **12** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**8**	
2	**6**	
3	**14**	
4	**6**	
5	**11**	
TOTAL	**45**	

Answer **all** the questions.

1 A student wanted to measure the standard electrode potential of:

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$$

(a) (i) What is the oxidation number of Cr in the $Cr_2O_7^{2-}$ ion?

..... **[1]**

(ii) Draw a labelled diagram of the apparatus he could use. State the conditions required.

[5]

(b) The standard electrode potential of the $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$ half-cell is +1.33 V.

The solution in the student's half-cell contained 1 mol dm^{-3} Cr^{3+} and H^+ but less than 1 mol dm^{-3} $Cr_2O_7^{2-}$.

Would the student's measured value be higher, lower or the same as the standard electrode potential?

Explain your answer.

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..... **[2]**

[Total: 8]

2 The following standard electrode potential data refers to different reactions involving cobalt complexes in the +2 and +3 oxidation states.

$$[Co(H_2O)_6]^{3+} + e^- \rightleftharpoons [Co(H_2O)_6]^{2+} \qquad E^{\ominus} = +1.81\,V$$

$$[Co(NH_3)_6]^{3+} + e^- \rightleftharpoons [Co(NH_3)_6]^{2+} \qquad E^{\ominus} = +0.11\,V$$

(a) Which cobalt complex is the strongest oxidising agent? Explain your answer.

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..... **[3]**

(b) What is the colour of $[Co(H_2O)_6]^{2+}$?

..... **[1]**

(c) $[Co(NH_3)_6]^{3+}$ ions may be reduced to $[Co(NH_3)_6]^{2+}$ by metallic iron, which is oxidised to Fe^{2+}.

$$Fe^{2+} + 2e^- \rightleftharpoons Fe \qquad E^{\ominus} = -0.44\,V$$

Write a balanced chemical equation for this reaction and show that the reaction is feasible.

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..... **[2]**

[Total: 6]

3 In its ions or compounds, copper exists in two main oxidation states, Cu^{+} and Cu^{2+}.

(a) (i) Complete the electron configuration for a Cu^{+} ion.

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

(ii) Use your electron configuration to explain why Cu^{+} ions are **not** coloured.

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..... **[2]**

(b) The $[Cu(H_2O)_6]^{2+}$ complex is blue but the $[Cu(NH_3)_4(H_2O)_2]^{2+}$ complex is dark blue. Explain why different ligands give different colours.

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..... **[3]**

(c) When copper(I) chloride is added to water it forms a blue-green solution and a reddish-pink solid.

Explain these observations and write an equation for the reaction occurring.

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..... **[3]**

(d) Copper is widely used to make alloys such as brass. The % of copper in a sample of brass can be determined by titration.

- 1.65 g of brass were reacted with nitric acid and the resulting solution was neutralised and made up to 250 cm^3 in a standard flask;
- Excess KI was added to 25.0 cm^3 of this solution;
- The resulting solution required 19.80 cm^3 of 0.100 mol dm^{-3} $Na_2S_2O_3$ solution to react with the iodine produced.

The equations for the reactions involved are;

$$2Cu^{2+} + 4I^- \rightarrow 2CuI + I_2$$

$$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$$

Determine the % of copper in the sample of brass.

% copper in sample ..... % **[5]**

[Total: 14]

4 The complex ion, $[Co(NH_3)_4Cl_2]^+$ shows a form of stereoisomerism.

(a) What type of stereoisomerism does $[Co(NH_3)_4Cl_2]^+$ show?

..... **[1]**

(b) Draw 3-D diagrams to show the two isomers of $[Co(NH_3)_4Cl_2]^+$.

[2]

(c) The complex ion $[Co(en)_2Cl_2]^+$ shows a different type of stereoisomerism.

Name this type of stereoisomerism and draw 3-D diagrams of the two isomers.

name of type of stereoisomerism ..... **[1]**

[2]

[Total: 6]

5 In this question, one mark is available for the quality of use and organisation of scientific terms.

Transition metal complexes typically show four-fold and six-fold co-ordination.

Using suitable examples:

- State what is meant by co-ordination number;
- Discuss the possible shapes and bond angles of four and six co-ordinated complexes;
- Show how ligand exchange can result in a change in the co-ordination number, shape and charge of a complex ion.

Diagrams and equations should be used to illustrate your answer.

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[10]

Quality of Written Communication **[1]**

[Total: 11]

END OF QUESTION PAPER

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