OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

CHEMISTRY 2815/06

Transition Elements

Wednesday **30 JANUARY 2002** Afternoon 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.
- Write your answers in the spaces on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You will be awarded marks for the quality of written communication where this is indicated in the 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		
Question Number	Mark	Mark
1	10	
2	13	
3	11	
4	11	
TOTAL	45	

This question paper consists of 8 printed pages.

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[Turn over

For Examiner's Use

Answer **all** questions.

1 **(a)** Explain what is meant by the *co-ordination number* of a complex ion.

.....

.....[2]

(b) **(i)** State the **formula** (including any charge), and **shape** of the complex containing

- Co^{2+} and 4 Cl^- ligands,

- Ni^{2+} and 3 ($NH_2CH_2CH_2NH_2$) ligands,

- Ni^{2+}, 2 NH_3 ligands and 2 Cl^- ligands.

[6]

(ii) State and explain which of these complexes exists as optical isomers.

.....[2]

[Total : 10]

For Examiner's Use

2 An electrochemical cell was set up based on the following electrode reactions.

$Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe(s)$ $\quad E^{\ominus} = -0.44\,V$

$V^{3+}(aq) + e^- \rightleftharpoons V^{2+}(aq)$ $\quad E^{\ominus} = -0.26\,V$

(a) (i) Sketch a diagram of this cell working under standard conditions.

[4]

(ii) Calculate the standard cell potential of this cell.

[1]

[Question 2 continues on page 4

[Turn over

For Examiner's Use

(b) Vanadium has several oxidation states in its aqueous ions.

(i) Complete the table below.

	$VO_2^+(aq)$	$VO^{2+}(aq)$	$V^{3+}(aq)$	$V^{2+}(aq)$
oxidation state of vanadium			+3	+2
colour	yellow		green	

[4]

(ii) Use the data below to explain why VO^{2+} can be used to reduce MnO_4^- in acidic solution.

$$VO_2^+ + 2H^+ + e^- \rightleftharpoons VO^{2+} + H_2O \qquad E^{\ominus} = +1.00\,V$$

$$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O \qquad E^{\ominus} = +1.51\,V$$

.....

.....

.....[2]

(iii) Construct the overall equation for this reaction.

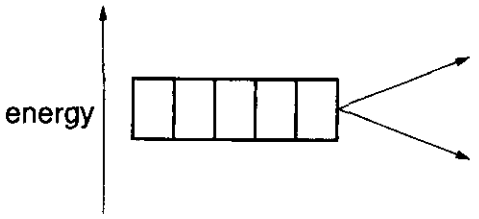
[2]

[Total : 13]

For Examiner's Use

3 The production of colour in transition metal compounds is associated with d-orbitals.

(a) Complete the diagram to show the splitting of the d-orbital energy levels in an octahedral complex ion.



[1]

(b) On the axes below sketch the shapes of one d-orbital from the higher level and one d-orbital from the lower level.

higher	lower

[2]

(c) An octahedral complex ion of chromium is green Explain how this colour arises from the splitting of the d-orbital energy levels.

.....

.....

.....

.....[3]

[Question 3 continues on page 6

[Turn over

For Examiner's Use

(d) Sketch the two isomers of $[Cr(H_2O)_4Cl_2]^+$. Name each **type** of isomer.

[3]

(e) Chromium can be made into the alloy nichrome (60% Ni, 40% Cr), which is useful because its electrical resistance does not vary with temperature.

(i) Name one other alloy containing chromium.

.....[1]

(ii) State the effect chromium has in the alloy you have named.

.....[1]

[Total : 11]

For Examiner's Use

4 *(In this question, 1 mark is available for the quality of written communication.)*

(a) Describe the relative stabilities of the two most common oxidation states in compounds of **either** copper **or** cobalt

Include examples of suitable compounds and aqueous ions, including their colour. [8]

(b) Many transition metals and their compounds are used as catalysts. State **two** uses, other than as catalysts, of named transition metals or transition metal compounds. [3]

[Total : 11]