

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

CHEMISTRY

2815/06

Transition Elements

Tuesday

25 JUNE 2002

Morning

50 minutes

Candidates answer on the question paper

Additional materials:

Data sheet for Chemistry

Scientific calculator

Candidate Name	Centre Number	Candidate Number												
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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	14	
2	7	
3	5	
4	9	
5	10	
TOTAL	45	

This question paper consists of 7 printed pages and 1 blank page.

Answer all questions.

1 Copper forms a number of complex ions.

(a) State the co-ordination number and oxidation state of copper in $[\text{CuCl}_4]^{2-}$.

co-ordination number[1]

oxidation state[1]

(b) Complete the following table.

	$[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$	$[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$	$[\text{CuCl}_4]^{2-}$
colour			
shape			

[6]

(c) One of these ions strongly absorbs light in the blue/violet region of the spectrum at wavelengths of 400–450 nm.

(i) Suggest the identity of this ion.

.....[1]

(ii) Explain how you made your choice.

.....

[1]

(d) Outline how, starting with $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ in aqueous solution, you could make solutions containing:

(i) $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$,

.....

(ii) $[\text{CuCl}_4]^{2-}$.

.....

[4]

[Total : 14]

- 2 (a) Complete the electronic configuration of a titanium atom.

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

- (b) (i) Suggest the shape of the $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ ion.

.....[1]

- (ii) Suggest a reason why solutions of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ must be stored in a sealed container.

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

- (c) (i) Titanium(IV) oxide, TiO_2 , is white whereas titanium(III) chloride, TiCl_3 , is coloured. Suggest an explanation for this difference in colour.

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

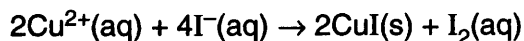
- (ii) State **one** use of TiO_2 .

.....[1]

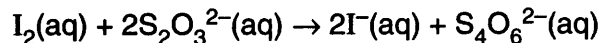
[Total : 7]

3 The following is an account of a laboratory experiment.

- A solution was prepared by dissolving some copper(II) sulphate to give 250 cm³ of aqueous solution.
- 25.0 cm³ of this solution was treated with an excess of aqueous potassium iodide, KI.



- The iodine produced was titrated with 0.100 mol dm⁻³ sodium thiosulphate.



- The average titre obtained was 22.0 cm³ of the thiosulphate solution.

(a) State the oxidation number of S in S₂O₃²⁻.

.....[1]

(b) Calculate the amount of S₂O₃²⁻ ions in the titre.

Answer.....mol [1]

(c) Calculate the amount of I₂ produced.

Answer.....mol [1]

(d) Calculate the amount of Cu²⁺ ions in 25.0 cm³ of solution.

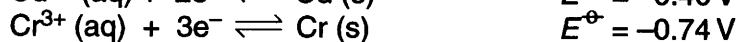
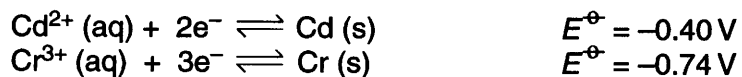
Answer.....mol [1]

(e) Calculate the concentration of the aqueous copper(II) sulphate in mol dm⁻³.

Answer.....mol dm⁻³ [1]

[Total : 5]

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



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

[3]

- (ii) Show on the diagram the direction of electron flow in the external circuit. [1]

- (iii) Explain your answer to (ii).

.....

[2]

- (b) Write a full ionic equation for the reaction taking place in this cell.

.....[1]

- (c) (i) Calculate the standard cell potential of this cell.

[1]

- (ii) When water is added to the chromium half cell, the cell potential changes. Suggest **one** reason for this observation.

.....[1]

[Total : 9]

