

**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	
<b>TOTAL</b>	<b>45</b>	

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**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,  $\text{TiO}_2$ , is white whereas titanium(III) chloride,  $\text{TiCl}_3$ , is coloured. Suggest an explanation for this difference in colour.

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

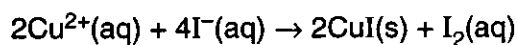
(ii) State one use of  $\text{TiO}_2$ .

.....[1]

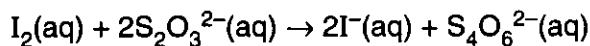
[Total : 7]

3 The following is an account of a laboratory experiment.

- A solution was prepared by dissolving some copper(II) sulphate to give 250 cm<sup>3</sup> of aqueous solution.
- 25.0 cm<sup>3</sup> of this solution was treated with an excess of aqueous potassium iodide, KI.



- The iodine produced was titrated with 0.100 mol dm<sup>-3</sup> sodium thiosulphate.



- The average titre obtained was 22.0 cm<sup>3</sup> of the thiosulphate solution.

(a) State the oxidation number of S in S<sub>2</sub>O<sub>3</sub><sup>2-</sup>.

.....[1]

(b) Calculate the amount of S<sub>2</sub>O<sub>3</sub><sup>2-</sup> ions in the titre.

Answer.....mol [1]

(c) Calculate the amount of I<sub>2</sub> produced.

Answer.....mol [1]

(d) Calculate the amount of Cu<sup>2+</sup> ions in 25.0 cm<sup>3</sup> of solution.

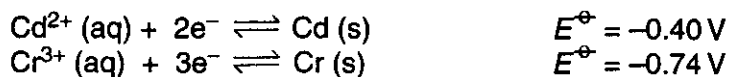
Answer.....mol [1]

(e) Calculate the concentration of the aqueous copper(II) sulphate in mol dm<sup>-3</sup>.

Answer.....mol dm<sup>-3</sup> [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]

