



ADVANCED GCE
CHEMISTRY
 Transition Elements

2815/06

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

OCR Supplied Materials:

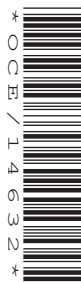
- *Data Sheet for Chemistry* (inserted)

Other Materials Required:

- Scientific calculator

Monday 28 June 2010
Morning

Duration: 50 minutes



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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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.

Examiner's Use Only:			
1			
2			
3			
4			
Total			

Answer **all** the questions.

1 The most common ions of iron are $\text{Fe}^{2+}(\text{aq})$ and $\text{Fe}^{3+}(\text{aq})$.

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

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

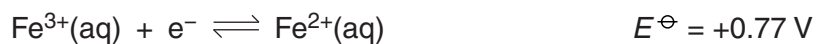
(b) (i) By reference to a suitably labelled diagram, describe how you would measure the electrode potential of a half-cell containing $\text{Fe}^{2+}(\text{aq})/\text{Fe}^{3+}(\text{aq})$.

.....
.....
.....
.....
..... [4]

(ii) State the conditions and concentrations required to measure the **standard** electrode potential of the $\text{Fe}^{2+}(\text{aq})/\text{Fe}^{3+}(\text{aq})$ system.

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

(c) An electrochemical cell was set up based on the following electrode reactions.



(i) Calculate the standard cell potential for the cell made from the half-cells given above.

cell potential = V [1]

(ii) Construct the overall equation for the reaction taking place in this cell.

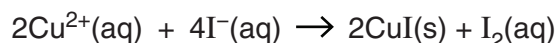
equation: [2]

[Total: 10]

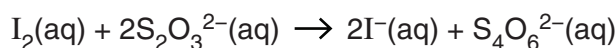
2 A copper-containing alloy is used in making musical instruments.

A sample of the alloy was analysed to find the percentage of copper.

- A solution was prepared by reacting 4.25 g of the copper alloy in dilute nitric acid to give 250 cm³ of solution. Only the copper reacted. Cu²⁺(aq) ions were formed.
- 25.0 cm³ of this solution was reacted with excess potassium iodide, KI(aq).



- The iodine produced was titrated with 0.200 mol dm⁻³ sodium thiosulphate, Na₂S₂O₃(aq).



- Starch was added near the end-point to make the colour change easier to observe.
- The average titre was 32.60 cm³ of Na₂S₂O₃(aq).

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

..... [1]

(ii) Calculate the amount, in moles, of S₂O₃²⁻ ions in the average titre.

answer = mol [1]

(iii) Calculate the percentage of copper present in the sample of the alloy.

Give your answer to an appropriate number of significant figures.

answer = % [5]

(b) A student carried out the titration but forgot to add the starch.

(i) What colour change would the student see at the end-point **without** starch?

from to [1]

(ii) Why is the colour change at the end-point easier to see if starch is used?

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

(c) Name a common alloy of copper and give one use for this alloy.

name

use [1]

[Total: 10]

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

Stereoisomerism is very common in transition metal complexes.

- (a)** Some complexes are used in the treatment of cancer.

(i) Name a transition metal complex used in the treatment of cancer.

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

(ii) Describe how this complex helps in the treatment of cancer.

.....

.....

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

- (b)** What is meant by the term *stereoisomerism*?

Describe, using suitable examples, the types of stereoisomerism found in transition metal complexes.

Diagrams of the isomers should show shapes and bond angles.

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[Total: 12]

4 This question is about some complex ions of several transition metals.

(a) The transition metal rhodium forms the complex ion $[\text{RhCl}(\text{NH}_3)_5]^{2+}$.

State the coordination number and the oxidation number of rhodium in $[\text{RhCl}(\text{NH}_3)_5]^{2+}$.

coordination number [1]

oxidation number [1]

(b) A student dissolved some cobalt(II) chloride crystals in water.

A pink solution was formed.

She then added concentrated hydrochloric acid to this solution.

A blue solution was formed.

(i) Give the formula of the complex ion in each solution.

complex ion in the pink solution [1]

complex ion in the blue solution [1]

(ii) Write a balanced equation to illustrate the equilibrium that exists between these two complex ions in solution.

..... [1]

(iii) The student added an excess of aqueous silver nitrate, $\text{AgNO}_3(\text{aq})$, to the blue solution. A white precipitate formed and the solution turned pink.

Suggest an explanation for these observations.

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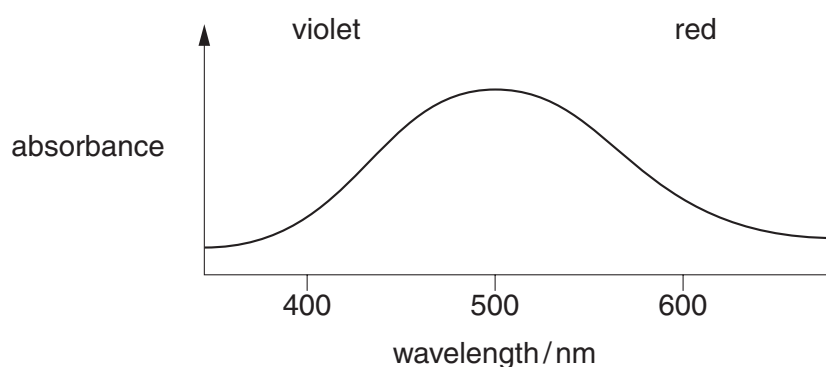
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..... [2]

(c) The absorption spectrum for a complex is shown below.



Suggest the colour of this complex.

Explain your answer.

.....

 [2]

(d) Titanium(IV) oxide, TiO_2 , is white, but titanium(III) chloride, TiCl_3 , is coloured.

(i) Suggest why TiO_2 is white, whereas TiCl_3 is coloured.

.....

 [3]

(ii) State **one** use of titanium(IV) oxide.

..... [1]

[Total: 13]

END OF QUESTION PAPER

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