

**ADVANCED GCE****CHEMISTRY**

Trends and Patterns

**2815/01**

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

**OCR Supplied Materials:**

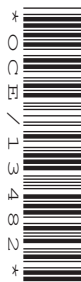
- *Data Sheet for Chemistry* (inserted)

**Other Materials Required:**

- Scientific calculator

**Monday 28 June 2010**  
**Morning**

Duration: 1 hour



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.

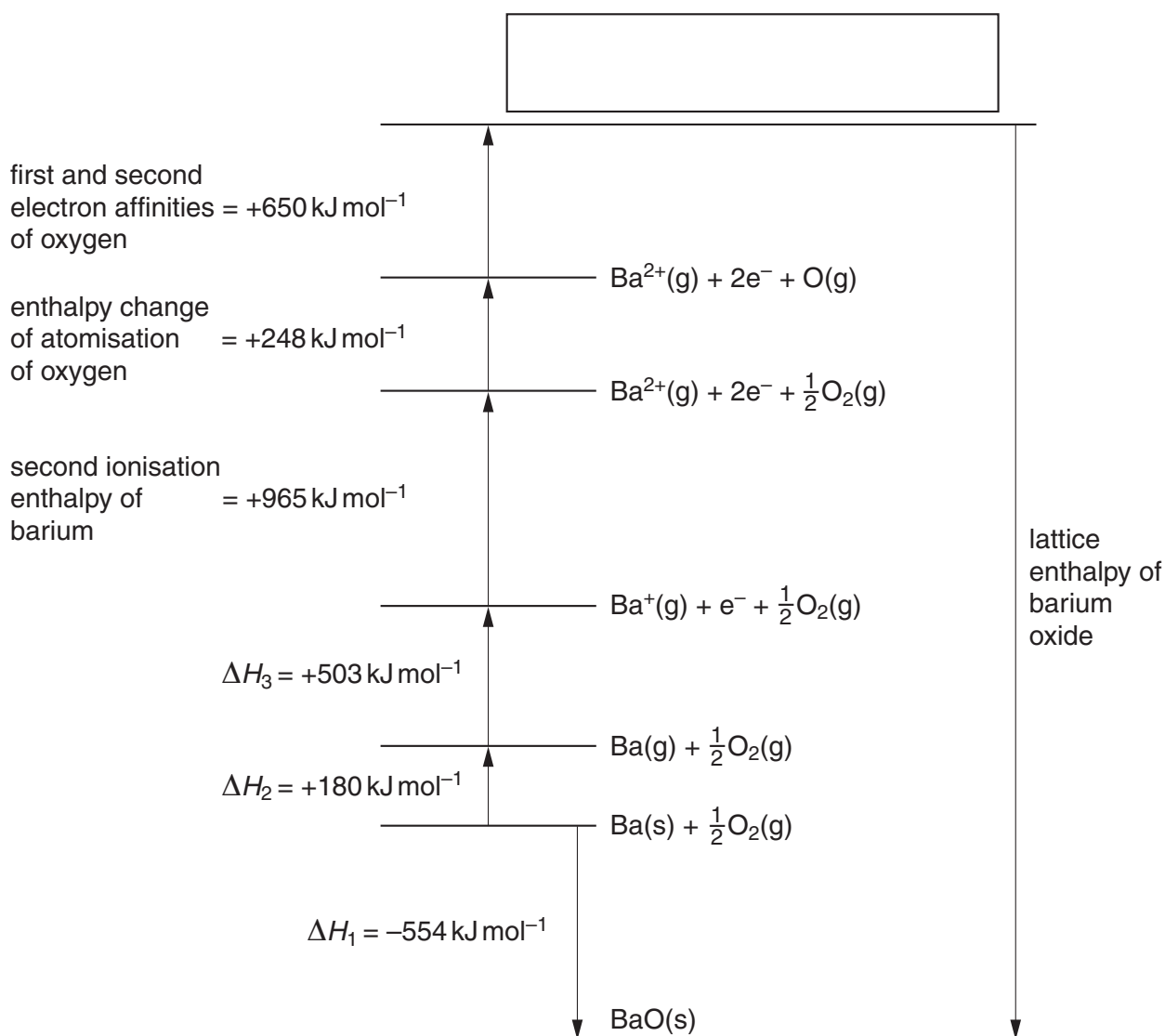
**INFORMATION FOR CANDIDATES**

- 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			
<b>Total</b>			

Answer **all** the questions.

- 1 The Born-Haber cycle below can be used to calculate the lattice enthalpy for barium oxide.



- (a) (i) Write down the name for each of the following enthalpy changes in the Born-Haber cycle above.

$\Delta H_1$  .....

$\Delta H_2$  .....

$\Delta H_3$  ..... [3]

- (ii) Write down the missing formulae in the box at the top of the Born-Haber cycle.

Include state symbols.

[1]

- (b) (i) Use the Born-Haber cycle to calculate the lattice enthalpy of barium oxide.

answer = .....  $\text{kJ mol}^{-1}$  [2]

- (ii) The lattice enthalpy of barium oxide is different from that of magnesium oxide.

Explain why these lattice enthalpies differ.

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

- (c) Give **one** reason why magnesium oxide is a good material to use for the lining of a furnace.

..... [1]

(d) Barium carbonate and magnesium carbonate both decompose when heated.

(i) Write the equation for the decomposition of barium carbonate when heated.

..... [1]

(ii) Describe and explain the difference between the temperature at which barium carbonate and magnesium carbonate decompose.

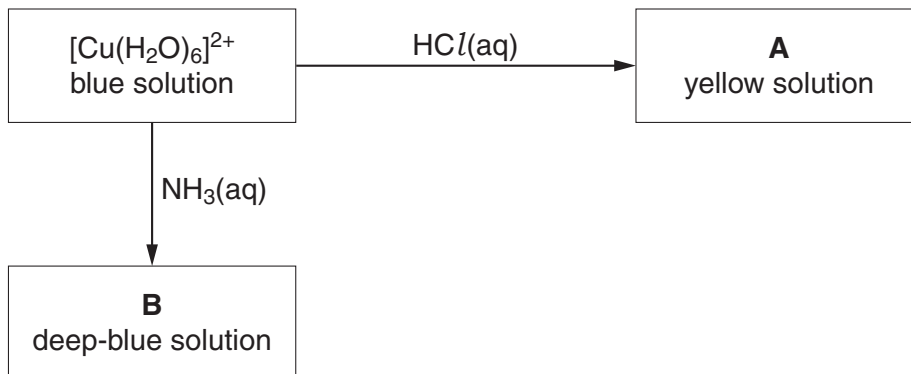
.....  
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..... [3]

[Total: 14]

2 Dilute aqueous copper(II) sulphate is a blue solution containing  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  complex ions.

Two ligand substitution reactions involving  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  are shown below.

**A** and **B** are two other complex ions of copper.



(a) (i) Draw a diagram showing the shape of the  $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$  complex ion.

Include the bond angles in your diagram.

[2]

(ii) Write the formula for:

complex ion **A** .....

complex ion **B** ..... [2]

(b) (i) What is meant by the term *ligand*?

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

(ii) Explain, with the aid of a balanced equation, what is meant by the term *ligand substitution*.

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

[Total: 7]

**3** Iron is a typical transition element.

- Iron shows more than one oxidation state in its compounds.
- Iron and its compounds are used as catalysts.

**(a)** Complete the electronic configuration for an iron(III) ion,  $\text{Fe}^{3+}$ , and use it to explain why iron is a transition element.

$\text{Fe}^{3+}$ :  $1s^2 2s^2 2p^6$  .....

explanation .....

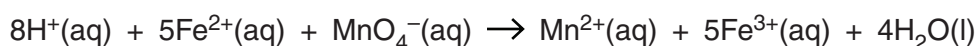
.....

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

**(b)** State **one** use of iron as a catalyst.

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

**(c)** Aqueous manganate(VII) ions were titrated against  $25.0\text{ cm}^3$  of  $0.0500\text{ mol dm}^{-3}$   $\text{Fe(II)}$  ions in acid solution.



The volume of aqueous manganate(VII) ions required to reach the end point was  $12.30\text{ cm}^3$ .

**(i)** State the colour change observed at the end point.

from ..... to ..... **[1]**

**(ii)** Calculate the concentration of the aqueous manganate(VII) ions used in the titration.

Give your answer to **three** significant figures.

answer = .....  $\text{mol dm}^{-3}$  **[3]**

- (d) Aqueous ferrate ions,  $\text{FeO}_4^{2-}(\text{aq})$ , have oxidising properties very similar to manganate(VII) ions.

The half-equation for the reduction of aqueous ferrate ions,  $\text{FeO}_4^{2-}(\text{aq})$ , in acidic conditions is shown below.



Acidified  $\text{FeO}_4^{2-}(\text{aq})$  ions oxidise aqueous iodide ions,  $\text{I}^-(\text{aq})$ , to form aqueous iodine,  $\text{I}_2(\text{aq})$ .

- (i) Deduce the oxidation state of iron in the ferrate ion,  $\text{FeO}_4^{2-}$ .

..... [1]

- (ii) Construct the half-equation for the oxidation of iodide ions to form iodine.

..... [1]

- (iii) Construct the ionic equation for the redox reaction that occurs between  $\text{FeO}_4^{2-}(\text{aq})$  ions and  $\text{I}^-(\text{aq})$  ions in the presence of  $\text{H}^+(\text{aq})$ .

[2]

- (e) A student added aqueous sodium thiocyanate,  $\text{NaSCN}(\text{aq})$ , to a solution containing  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$  complex ions.

- (i) State the change in colour when the solutions were mixed together.

..... [1]

- (ii) Write an ionic equation for the reaction that takes place.

..... [1]

[Total: 13]

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

Chemists use their understanding of structure and bonding to explain the physical and chemical properties of substances.

Discuss this statement for  $\text{MgO}$  and  $\text{SiCl}_4$ .

In your answer, you should refer to:

- electrical conductivity and melting point as physical properties;
- reaction with water as a chemical property.

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**[10]**

**[Total: 11]**

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