

**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

Wednesday 27 January 2010
Morning

Duration: 1 hour

Candidate
Forename

Candidate
Surname

Centre Number

Candidate Number

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			



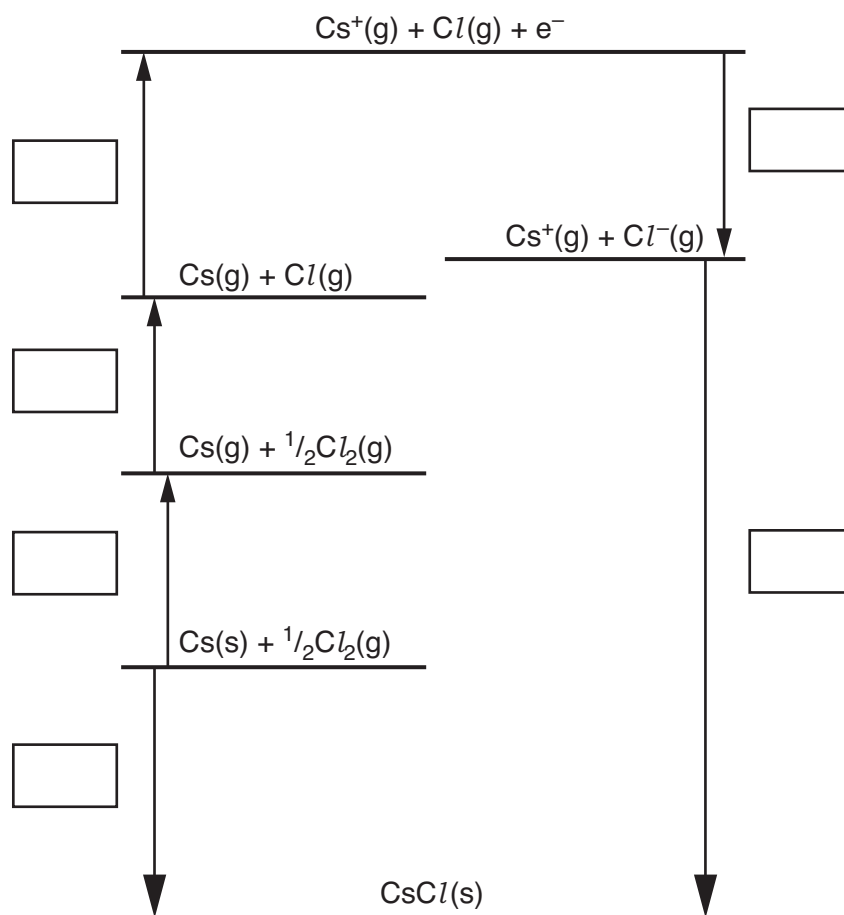
Answer **all** the questions.

- 1 The lattice enthalpy of caesium chloride, CsCl , can be calculated using a Born–Haber cycle.

The table below shows the enthalpy changes and corresponding data for this cycle.

enthalpy change	label	energy/ kJ mol^{-1}
lattice enthalpy of caesium chloride	A	?
1st electron affinity of chlorine	B	–349
1st ionisation energy of caesium	C	+376
atomisation of chlorine	D	+122
formation of caesium chloride	E	–443
atomisation of caesium	F	+76

- (a) On the cycle below, put the letter for each enthalpy change in the appropriate box.



[3]

- (b) Use the Born–Haber cycle to calculate the lattice enthalpy of caesium chloride.

answer = kJ mol^{-1} [2]

- (c) State and explain the relative sizes of the lattice enthalpies in sodium chloride and caesium chloride.

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..... [3]

[Total: 8]

2 The question below relates to chlorides of some of the elements in Period 3 of the Periodic Table.

(a) Explain the trend in the formulae of the chlorides NaCl , MgCl_2 , AlCl_3 and SiCl_4 .

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..... [1]

(b) Complete the table below using the following guidelines.

- Complete the '**bonding**' row using only the words: *covalent*, *ionic* or *metallic*.
- Complete the '**structure**' row using only the words: *giant* or *simple*.

name of chloride	sodium chloride	magnesium chloride	aluminium chloride	silicon chloride
bonding				
structure				

[2]

(c) In terms of bonding and structure, describe and explain the difference between the melting points of NaCl and SiCl_4 .

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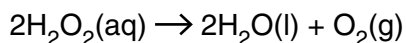
..... [4]

- experimental observations;
- the pH of any resulting solution;
- relevant chemical equations;
- the name of the process taking place.

..... [6]

Turn over

- 3** Aqueous hydrogen peroxide, H_2O_2 , is used to sterilise contact lenses. H_2O_2 decomposes to make oxygen and water, as shown in the equation below.



- (a)** Decomposition of hydrogen peroxide is a redox reaction.

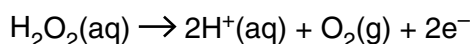
Using oxidation numbers, show that oxidation and reduction take place.

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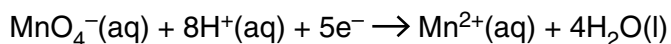
 [2]

- (b)** The concentration of an aqueous solution of hydrogen peroxide can be determined by titration. Aqueous potassium manganate(VII), KMnO_4 , is titrated against a solution of hydrogen peroxide in the presence of acid.

The half-equation for the oxidation of H_2O_2 is as follows.



The half-equation for the reduction of acidified MnO_4^- is as follows.



- (i)** Construct the equation for the reaction between H_2O_2 , MnO_4^- ions and H^+ ions.

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 [2]

(ii) A student followed the procedure below:

- Pipette 25.0 cm^3 of aqueous hydrogen peroxide into a conical flask;
- Add sulphuric acid to acidify the hydrogen peroxide;
- Titrate this sample against a solution containing $0.0150\text{ mol dm}^{-3}$ MnO_4^- (aq) ions.

23.35 cm^3 of the solution containing MnO_4^- (aq) ions is required.

2 mol MnO_4^- reacts with $5\text{ mol H}_2\text{O}_2$.

Calculate the concentration, in mol dm^{-3} , of the aqueous hydrogen peroxide.

concentration = mol dm^{-3} [3]

(c) Acidified hydrogen peroxide oxidises Fe^{2+} (aq) to Fe^{3+} (aq).

Describe a simple chemical test to show the presence of Fe^{3+} (aq).

name of reagent used

observation

..... [2]

[Total: 9]

4 Copper is an example of a transition element.

- (a) Complete the electronic configuration for a copper(II) ion, Cu^{2+} , and use it to explain why copper is a transition element.

Cu^{2+} : $1s^2 2s^2 2p^6$

explanation

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..... [2]

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

Transition elements form complex ions.

- Explain what is meant by the terms *complex ion* and *ligand*.
- Using complex ions of copper, give two examples of ligand substitution reactions that are accompanied by a colour change. Include equations in your answer.
- Describe, using suitable examples and 3-D diagrams, two different shapes of complex ions.

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[Total: 15]

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