OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

CHEMISTRY 2815/01

Trends and Patterns

Wednesday **29 JANUARY 2003** Afternoon 1 hour

Candidates answer on the question paper.
Additional materials:
Data Sheet for Chemistry
Scientific calculator

Candidate Name	Centre Number	Candidate Number

TIME 1 hour

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		
Qu.	Max.	Mark
1	15	
2	8	
3	10	
4	12	
TOTAL	45	

This question paper consists of 10 printed pages and 2 blank pages.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 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.

$NaCl$ $MgCl_2$ $AlCl_3$ $SiCl_4$ PCl_5

.....

.....

..... [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*.

formula of chloride	$NaCl$	$MgCl_2$	$AlCl_3$	$SiCl_4$	PCl_5
bonding					covalent
structure					simple

[4]

(c) Describe and explain, in terms of bonding and structure, the difference between the melting points of $NaCl$ and $SiCl_4$.

.....

.....

.....

.....

.....

.....

..... [4]

For Examiner's Use

(d) Describe the difference in behaviour when NaCl and $SiCl_4$ are added separately to cold water.

You may include in your answer

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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

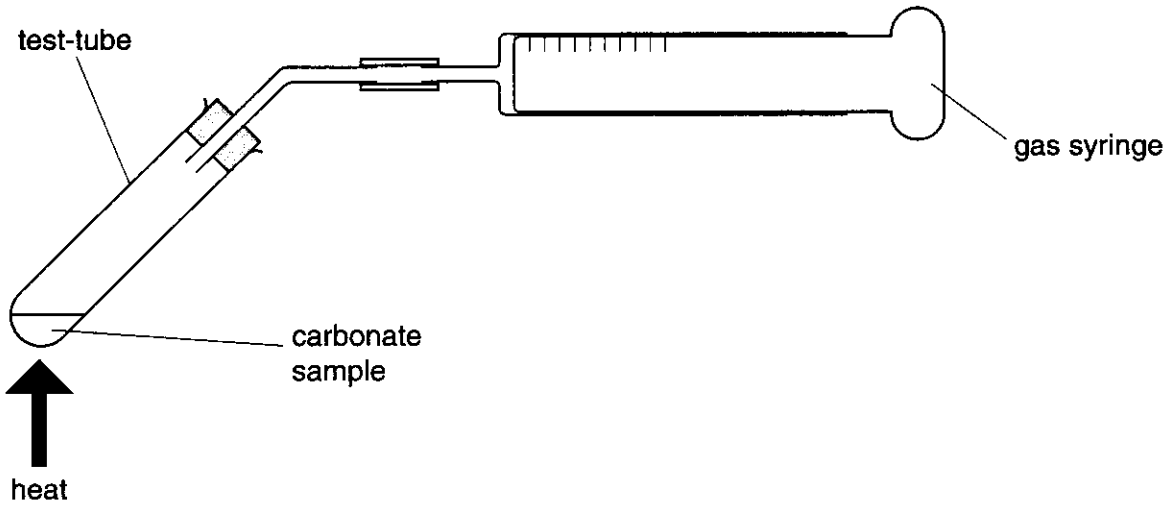
[Total: 15]

[Turn over

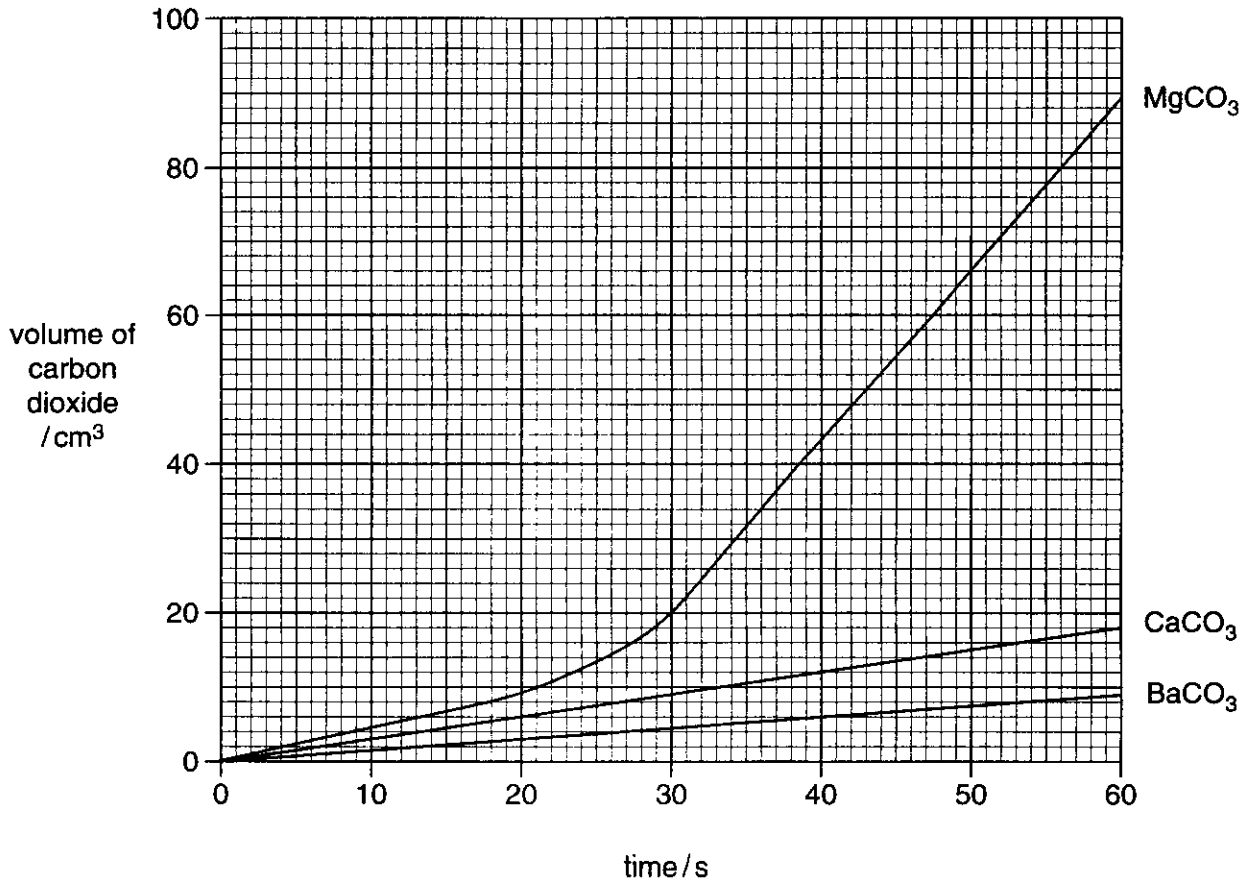
2 A student investigates the thermal decomposition of some of the carbonates of the elements in Group 2.

He separately heats the carbonates of magnesium, calcium and barium. Each time he uses the hottest flame of a Bunsen burner. In each experiment he uses the same amount, in moles, of carbonate.

The diagram shows the apparatus he uses.



The student records the total volume of carbon dioxide collected in the gas syringe every 10 seconds. The graph of his results is given below.



For Examiner's Use

(a) Write the equation to show the thermal decomposition of magnesium carbonate.

..... [1]

(b) The student uses 0.42 g of $MgCO_3$. Calculate the mass of $BaCO_3$ he should use to make the test fair.

answer ..... g [2]

(c) The ionic radius of Ba^{2+} is larger than that of Mg^{2+}.

Explain why.

.....

..... [1]

(d) Use the evidence from the experiments to show that the thermal stability of the carbonates is related to the charge density of the cation.

.....

.....

.....

..... [2]

(e) Explain the trend in thermal stability of the carbonates.

.....

.....

.....

..... [2]

[Total: 8]

[Turn over

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, Fe^{3+}**, and use it to explain why iron is a transition element.

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

explanation .....

..... [2]

(b) State **one** use of iron or one of its compounds as a catalyst. State the name of the catalyst and the reaction catalysed.

name of catalyst .....

reaction catalysed ..... [1]

(c) Under certain conditions iron can be oxidised to form sodium ferrate, Na_2FeO_4. This is a red-purple coloured substance that has properties very similar to that of potassium manganate(VII).

(i) Analysis of a sample of sodium ferrate showed that it contains the following percentage composition by mass,

Na, 27.74%, Fe, 33.66% and O, 38.60%.

Show that these data are consistent with the formula Na_2FeO_4.

[2]

(ii) Deduce the oxidation state of iron in sodium ferrate, Na_2FeO_4.

..... [1]

(d) The half-equation for the reduction of ferrate ions, FeO_4^{2-}, in acidic conditions is shown below.

$$FeO_4^{2-} + 8H^+ + 4e^- \longrightarrow Fe^{2+} + 4H_2O$$

Acidified FeO_4^{2-}(aq) ions oxidise aqueous iodide ions, I^-, to form aqueous iodine, I_2.

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

..... [1]

(ii) Construct the ionic equation for the redox reaction that occurs between aqueous FeO_4^{2-} and aqueous I^- in the presence of H^+.

.....

.....

..... [2]

(iii) Predict the colour change you would see when aqueous FeO_4^{2-} is added to an excess of aqueous I^- in the presence of H^+.

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

[Total: 10]

[Turn over

4 In this question, one mark is available for the quality of written communication.

Iron forms complex ions such as $[Fe(H_2O)_6]^{2+}$ and $[Fe(H_2O)_6]^{3+}$.

- Describe and explain the bonding in, and the shape of, **one** of these complex ions.
- Explain why the H—O—H bond angle in water in an isolated gaseous molecule is different from that in the complex $[Fe(H_2O)_6]^{2+}$.
- Describe, with the aid of suitable equations, how the two complex ions can be distinguished by means of a chemical test.

For Examiner's Use

[11]

Quality of Written Communication [1]

[Total: 12]

BLANK PAGE