

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced Subsidiary GCE

CHEMISTRY

2811

Foundation Chemistry

Friday

9 JANUARY 2004

Morning

1 hour

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 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 provided 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	12	
2	15	
3	11	
4	13	
5	9	
TOTAL	60	

This question paper consists of 12 printed pages.

Answer **all** the questions.

- 1 The Group 7 element bromine was discovered in 1826. Bromine gets its name from the Greek *brōmos* meaning stench because of its strong smell.

(a) Bromine consists of a mixture of two isotopes, ^{79}Br and ^{81}Br .

(i) What is the difference between the atomic structures of ^{79}Br and ^{81}Br ?

.....
[2]

(ii) State **two** similarities between the atomic structures of ^{79}Br and ^{81}Br .

.....
[2]

(b) The electronic configuration of a bromine atom can be written in terms of sub-shells.

(i) Complete the electronic configuration of a bromine atom.

$1s^2 2s^2 2p^6 3s^2 3p^6$ [2]

(ii) Why is bromine classified as a p-block element?

.....
[1]

(c) Bromine forms three compounds with phosphorus. The compounds have the molecular formulae PBr_3 , PBr_5 and P_2Br_4 .

(i) Explain what is meant by the term *molecular formula*.

.....
[1]

(ii) PBr_3 can be prepared by heating bromine with phosphorus, P_4 .

Write a balanced equation for this reaction.

.....[1]

- (iii) Compound **A** is one of the three bromides of phosphorus above. It has the following percentage composition by mass: P, 16.2%; Br, 83.8%.

Use this percentage composition to calculate the empirical formula and to determine the identity of compound **A**.

empirical formula

identity of compound **A**

[3]

[Total: 12]

2 Water and carbon dioxide both consist of covalent molecules.

(a) State what is meant by a *covalent* bond.

.....
[2]

(b) Draw 'dot-and-cross' diagrams for a molecule of water and a molecule of carbon dioxide. Show outer electron shells only.

water	carbon dioxide

[3]

(c) The shape of a water molecule is different from the shape of a carbon dioxide molecule.

(i) Draw the shapes of these molecules and state the bond angles.

water	carbon dioxide
bond angle in water =	bond angle in carbon dioxide =

[4]

(ii) Explain why a water molecule has a different shape from a carbon dioxide molecule.

.....

[2]

(d) An understanding of electronegativity helps to explain why some covalent bonds are polar.

(i) Define the term *electronegativity*.

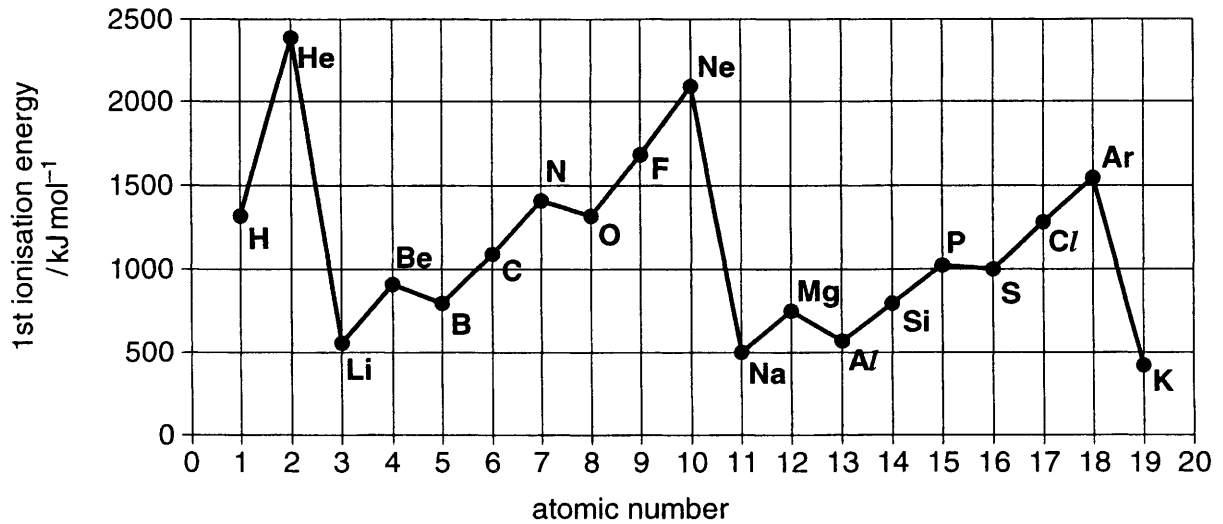
.....
.....
.....[2]

(ii) Water and carbon dioxide both have polar bonds. Explain why water has polar molecules but carbon dioxide has non-polar molecules.

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

[Total: 15]

- 3 The first ionisation energies of the elements H to K are shown below. Use this diagram to help with your answers to this question.



- (a) Define the term *first ionisation energy*.

.....

[3]

- (b) Explain why the first ionisation energies show a **general** increase across Period 2 (Li to Ne).

.....

[2]

- (c) Explain why the first ionisation energy of O is **less** than that of N.

.....

[2]

(d) State and explain the trend in first ionisation energies shown by the elements with the atomic numbers 2, 10 and 18.

.....

.....

.....

.....

.....

.....

.....[4]

[Total: 11]

4 The Group 2 metal strontium, Sr, is very reactive.

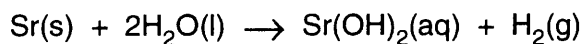
- (a) Strontium metal is stored under oil and, when exposed to air, the shiny surface of the strontium becomes dull.

Predict, with an equation, what reaction takes place when strontium is exposed to air.

.....

[2]

- (b) The reaction of strontium with water is a redox reaction. A student reacted 0.438 g of strontium with 200 cm³ of water.



- (i) Use oxidation numbers to show that strontium has been oxidised in this reaction.

.....

[2]

- (ii) Calculate how many moles of Sr were reacted.

A_r : Sr, 87.6

answer mol [1]

- (iii) Calculate the volume, in dm³, of H₂(g) produced. You can assume that, under the experimental conditions, 1.00 mol of H₂(g) has a volume of 24.0 dm³.

answer dm³ [1]

- (iv) Calculate the concentration, in mol dm⁻³, of the Sr(OH)₂ produced.

answer mol dm⁻³ [1]

(c) An ore of strontium contains strontium carbonate, SrCO_3 .

To obtain metallic strontium,

- the SrCO_3 is converted into strontium oxide, SrO ;
- SrO is then reduced to produce strontium.

(i) Suggest how strontium carbonate is converted into strontium oxide.

.....[1]

(ii) Aluminium can be used to reduce strontium oxide.

Balance the equation below for this conversion.



(iii) A chemical company receives an order to supply 100 tonnes of strontium. The company needs to work out how much ore to process.

The ore typically contains 2% by mass of SrCO_3 .

Calculate the mass of ore that the company would need in order to produce 100 tonnes of strontium.

$$1 \text{ tonne} = 10^6 \text{ g}$$

[3]

(iv) Suggest how the company could minimise the environmental impact of strontium production from the ore.

.....

.....[1]

[Total: 13]

