OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

CHEMISTRY 2811

Foundation Chemistry

Tuesday **11 JANUARY 2005** Morning 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 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	**17**	
2	**14**	
3	**17**	
4	**12**	
TOTAL	**60**	

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

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[Turn over

Answer **all** the questions.

1 Carbon is in the p-block of the Periodic Table. Naturally occurring carbon contains a mixture of two isotopes, ^{12}C and ^{13}C.

(a) Complete the table below for the atomic structure of the isotopes ^{12}C and ^{13}C.

isotope	protons	neutrons	electrons
^{12}C			
^{13}C			

[2]

(b) A sample of carbon was found to contain 95% of ^{12}C and 5% of ^{13}C.

(i) How could this information be obtained experimentally?

.....[1]

(ii) The ^{13}C isotope has a relative isotopic mass of 13.00.
Define the term *relative isotopic mass*.

.....

.....

.....[2]

(iii) Calculate the relative atomic mass of this sample of carbon to three significant figures.

A_r = ... [2]

(c) Complete the electronic configuration of carbon.

$1s^2$ .....[1]

(d) The burning of fossil fuels containing carbon produces carbon dioxide.
Draw a '*dot-and-cross*' diagram of carbon dioxide, showing outer shell electrons only.

[2]

(e) Lime water is used as the common laboratory test for carbon dioxide.

(i) State the name or formula of the chemical that is dissolved in water to make lime water.

.....[1]

(ii) Write the chemical equation that takes place in this test for carbon dioxide. Include state symbols.

.....[2]

(f) Carbon dioxide can be prepared easily in the laboratory by the action of heat on most carbonates.
Construct an equation to illustrate this reaction.

.....[1]

(g) In 2000, the mass of CO_2 emitted in the UK was equivalent to 1 kg per person in every hour.

(i) Calculate the volume of 1 kg of carbon dioxide. Assume that 1 mole of CO_2 occupies 24 dm^3.

volume = ... dm^3 [2]

(ii) The UK has set a target to cut CO_2 emissions by 60% of the 2000 value by 2050. Calculate the reduction needed in the volume of CO_2 emissions each hour per person if the target is to be met.

answer: ..... dm^3
[1]

[Total: 17]

[Turn over

2 A student prepared an aqueous solution of calcium chloride by reacting calcium with hydrochloric acid. Calcium chloride contains Ca^{2+} and Cl^- ions.

(a) Complete and balance the following equation for this reaction.

……Ca(s) + ……HCl(aq) ⟶ …….$CaCl_2$(aq) + ……

[2]

(b) This is a redox reaction.
Use oxidation states to show that calcium has been oxidised.

.....

.....

.....[2]

(c) Draw a '*dot-and-cross*' diagram for $CaCl_2$.

[2]

(d) Aqueous silver nitrate was added to the solution of $CaCl_2$.

(i) State what you would expect to **see**.

.....

.....[1]

(ii) Write an ionic equation for this reaction.

.....[1]

(e) To prepare the aqueous calcium chloride, the student added the exact amount of calcium so that all the hydrochloric acid had reacted. She used 50 cm^3 of 2.0 mol dm^{-3} HC*l*.

(i) How many moles of HC*l* had she used?

[1]

(ii) Calculate the mass of calcium that she used.

[2]

(iii) The student added some more calcium and she was surprised that a reaction still took place.

- Explain this observation.
- Write a balanced equation for this reaction.

.....

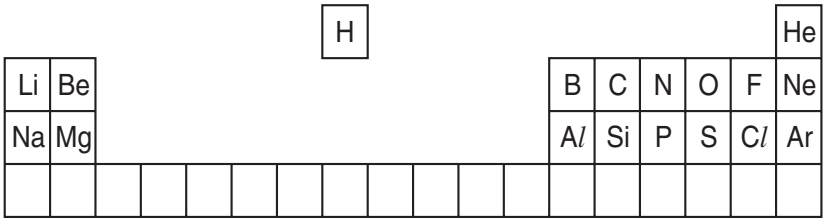
.....

.....

.....[3]

[Total: 14]

3 This question refers to the elements in the first three periods of the Periodic Table:



(a) Identify an element from the first three periods that fits each of the following descriptions.

(i) The element that forms a 2– ion with the same electronic configuration as Ne.

..... [1]

(ii) The element that forms a 3+ ion with the same electronic configuration as Ne.

..... [1]

(iii) The element that has the electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^3$.

..... [1]

(iv) An element that forms a compound with hydrogen with tetrahedral molecules.

..... [1]

(v) An element that forms a compound with hydrogen with pyramidal molecules.

..... [1]

(vi) The element that forms a chloride XCl_2 with a molar mass of 95.3 g mol^{-1}.

..... [1]

(vii) The element with the largest atomic radius.

..... [1]

(viii) The element in Period 3 with the highest boiling point.

..... [1]

(b) The diagram below shows the variation in the first ionisation energies of elements across Period 2 of the Periodic Table.

A diagram has been removed due to third party copyright restrictions

Details: A diagram showing the variation in the first ionisation energies of elements across Period 2 of the Periodic Table

(i) Define the term first ionisation energy .

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.....[3]

(ii) Explain why the first ionisation energies show a general increase across Period 2.

.....

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.....[2]

(iii) Explain why the first ionisation energy of B is less than that of Be.

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.....[2]

(iv) Estimate a value for the first ionisation energy of the element with atomic number 11. Explain how you made your choice.

First ionisation energy = ... kJ mol $^{-1}$

.....

.....

.....[2]

[Total: 17]

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

The halogens chlorine, bromine and iodine each exist as diatomic molecules at room temperature and pressure.

(a) The halogens all have van der Waals' forces.

- Explain how van der Waals' forces are formed.
- Explain the trend in volatilities of the halogens chlorine, bromine and iodine.

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(b) Describe and explain the relative reactivity of the halogens chlorine, bromine and iodine in displacement reactions involving halides, using reactions on a test tube scale.

Include equations and observations in your answer.

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.....[5]

Quality of Written Communication [1]

[Total: 12]

END OF QUESTION PAPER

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