OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

CHEMISTRY

Foundation Chemistry

2811

| Wednesday | **7 JUNE 2006** | 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.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Pencil may be used for diagrams and graphs **only**.
- Do not write in the bar code. Do not write in the grey area between the pages.
- **DO NOT** WRITE IN THE AREA **OUTSIDE** THE BOX BORDERING EACH PAGE. ANY WRITING IN THIS AREA WILL NOT BE MARKED.

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	11	
3	11	
4	11	
5	12	
TOTAL	60	

This question paper consists of 12 printed pages.

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[Turn over

1 Antimony, Sb, is a metal used in alloys to make lead harder. Bullets contain about 1% of antimony for this reason.

(a) Antimony has two main isotopes.

(i) What do you understand by the term *isotopes*?

....

.... [1]

(ii) Complete the table below to show the properties of particles that make up isotopes.

	proton	neutron	electron
relative mass			
relative charge			

[2]

(b) Relative atomic mass, A_r, can be used to compare the masses of atoms of different elements.

(i) Explain what you understand by the term *relative atomic mass*.

....

....

.... [3]

(ii) The antimony in a bullet was analysed by a forensic scientist to help solve a crime. The antimony was found to have the following percentage composition by mass: ^{121}Sb, 57.21%; ^{123}Sb, 42.79%.

Calculate a value for the relative atomic mass of the antimony. Give your answer to 4 significant figures.

A_r .... [2]

(c) Antimony is in Group 5 of the Periodic Table. It forms a compound with hydrogen that has the formula SbH_3.

(i) Predict the bond angle in SbH_3.

.... [1]

(ii) Explain why a molecule of SbH_3 has this bond angle.

....

....

....

.... [2]

(d) Antimony is found naturally in a number of minerals including stibnite. Stibnite typically contains 5% of Sb_2S_3. Antimony can be obtained by reducing Sb_2S_3 with scrap iron.

$$Sb_2S_3 + 3Fe \longrightarrow 2Sb + 3FeS$$
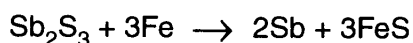
(i) How many moles of Sb_2S_3 are in 500 kg of a typical sample of stibnite containing 5% by mass of Sb_2S_3?

molar mass of Sb_2S_3 = 340 g mol^{-1}; relative atomic mass of Sb = 122

.... mol [2]

(ii) Calculate the mass of antimony that could be obtained by processing 500 kg of stibnite.

mass = ... kg [2]

[Total: 15]

[Turn over

2   The elements calcium and strontium in Group 2 of the Periodic Table both react with water.

   (a) A student reacted 0.20 g of calcium and 0.20 g of strontium separately with 250 cm^3 of water. The student measured the volume of gas produced from each reaction.

   The student's results are shown below.

metal	calcium	strontium
volume of gas / cm^3	120	55

   (i) Name the gas produced.

   .... [1]

   (ii) Write a balanced equation for the reaction of strontium with water.

   .... [1]

   (iii) Explain why the student obtained different volumes of gas by reacting water with the same mass of calcium and strontium.

   ....

   ....

   ....

   .... [2]

   (iv) Predict the pH of the solutions formed in each of these reactions.

   .... [1]

(b) In their reactions, calcium and strontium each lose electrons to form ions with a 2+ charge. The first and second ionisation energies of calcium and strontium are shown below.

	1st ionisation energy / kJ mol^{-1}	2nd ionisation energy / kJ mol^{-1}
calcium	590	1145
strontium	550	1064

(i) Write an equation, with state symbols, to represent the **second** ionisation energy of calcium.

.... [2]

(ii) Why are the second ionisation energies of calcium and strontium greater than their first ionisation energies?

....

....

.... [1]

(iii) Explain why the first and second ionisation energies of strontium are less than those of calcium.

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.... [3]

[Total: 11]

3 Limestone contains the ionic compound, $CaCO_3$. Limestone decomposes when it is heated strongly, forming an ionic compound, CaO and a covalent compound, CO_2.

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

(a) State what is meant by *ionic bonding*.

....

.... [1]

(b) Draw '*dot and cross*' diagrams to show the bonding in CaO and CO_2. Show outer electron shells only.

CaO	CO_2

[3]

(c) Complete the electronic configuration in terms of sub-shells for calcium in CaO.

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

(d) Calcium oxide neutralises acids such as nitric acid. A student neutralised 1.50 g of CaO with 2.50 mol dm^{-3} nitric acid, HNO_3. The equation for this reaction is shown below.

$$CaO(s) + 2HNO_3(aq) \rightarrow Ca(NO_3)_2(aq) + H_2O(l)$$
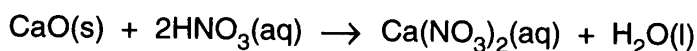
(i) How many moles of CaO were reacted?

.... mol [2]

(ii) Calculate the volume of 2.50 mol dm^{-3} HNO_3 needed to exactly neutralise 1.50 g of CaO.

volume = ... cm^3 [2]

(e) The nitrate ion, NO_3^-, in $Ca(NO_3)_2$ contains both covalent and dative covalent bonds.

(i) What is the difference between a covalent bond and a dative covalent bond?

....

....

.... [1]

(ii) Calcium nitrate decomposes on heating to form calcium oxide, oxygen and nitrogen(IV) oxide, NO_2.

Construct a balanced equation for this reaction.

.... [1]

[Total: 11]

[Turn over

4 Aqueous silver nitrate can be used as a test for halide ions. A student decided to carry out this test on a solution of magnesium chloride. The bottle of magnesium chloride that the student used showed the formula $MgCl_2.6H_2O$.

(a) The student dissolved a small amount of $MgCl_2.6H_2O$ in water and added aqueous silver nitrate to the aqueous solution.

(i) What is the molar mass of $MgCl_2.6H_2O$?

molar mass = ……………… $g\,mol^{-1}$ [1]

(ii) What would the student see after adding the aqueous silver nitrate, $AgNO_3(aq)$?

.... [1]

(iii) Write an ionic equation for this reaction. Include state symbols.

.... [2]

(iv) Using aqueous silver nitrate, it is sometimes difficult to distinguish between chloride, bromide and iodide ions.

How can aqueous ammonia be used to distinguish between these three ions?

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.... [3]

(b) Domestic tap water has been chlorinated.

Chlorine reacts with water as shown below.

$$Cl_2(g) + H_2O(l) \longrightarrow HOCl(aq) + HCl(aq)$$
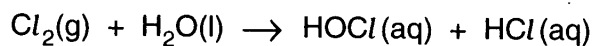
(i) State the oxidation number of chlorine in

Cl_2 ....

HOCl ....

HCl .... [3]

(ii) When carrying out halide tests with aqueous silver nitrate, it is important that distilled or deionised water is used for all solutions, rather than tap water.

Suggest why.

....

.... [1]

[Total: 11]

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

Many physical properties can be explained in terms of bonding and structure. The table below show some properties of elements in Period 2 of the Periodic Table.

element	Li	C (graphite)	N
electrical conductivity of solid	good	good	poor
boiling point / °C	1342	4000	−196

Explain these properties in terms of bonding and structure.

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Quality of Written Communication [1]

[Total: 12]

END OF QUESTION PAPER