

School Number	Candidate Number
Surname and Initials	

**CHEMISTRY**

PAPER 3 3051/3

Monday **9 JUNE 2004** 12.30 – 2.00 P.M.

Additional materials:

Lined paper

Graph paper

Periodic table

<b>MINISTRY OF EDUCATION</b> <b>NATIONAL EXAMINATIONS</b>
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BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION

**INSTRUCTIONS AND INFORMATION TO CANDIDATES****Do not open this booklet until you are told to do so.**

Write your school number, candidate number, surname and initials at the top of this page as well as at the top of all lined paper used.

Answer **ALL** the questions in Section A in the spaces provided on the question paper and any **TWO** questions from Section B on the lined paper provided.

Equations and diagrams should be given wherever they are helpful.

Essential working must be shown.

The intended marks for each question or part question are given in brackets [ ].

Relative atomic masses are given in the Periodic Table of elements provided.

**ADDITIONAL INFORMATION**s.t.p. ( $t = 0\text{ }^{\circ}\text{C}$ ,  $p = 760\text{ mm Hg}$ )The volume of one mole of gas at room temperature and pressure (r.t.p.) is  $24,000\text{ cm}^3$ .This question paper consists of 14 printed pages and 2 blank pages.

SECTION A

1. Germanium, Ge, is an element in group IV of the Periodic Table. Its properties were predicted before its discovery by comparing it with group IV elements above and below it, silicon and tin.

Property	Silicon	Germanium	Tin
appearance	grey solid		silvery solid
electrical conductivity	poor		good
density in g/cm <sup>3</sup>	2.33		7.31
formula and properties of oxides	SiO <sub>2</sub> , dissolves in hot alkali but not in acid	GeO <sub>2</sub> , dissolves in both acid and alkali	SnO <sub>2</sub> , dissolves in both acid and alkali

- (a) Predict the appearance, the electrical conductivity and the density of germanium to complete the table. [3]
- (b) Use information in the table to classify the oxides of
- (i) silicon \_\_\_\_\_
- (ii) germanium \_\_\_\_\_ [2]
- (c) When chlorine is bubbled into a solution of potassium bromide a reaction takes place and bromine is displaced.
- (i) State the change of colour of the solution that is observed.  
\_\_\_\_\_ [1]
- (ii) Write a balanced equation for the reaction.  
\_\_\_\_\_ [2]

(iii) Name another halogen that can displace bromine from potassium bromide.

\_\_\_\_\_ [1]

(iv) Arrange the three named halogens in order of their reactivity from least to most.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [1]

Total marks [10]

2. (a) Two isotopes of carbon are known as carbon-12 (C-12) and carbon-14 (C-14).

Complete the table about the atomic composition of these isotopes. [2]

atom	proton number	neutron number	electronic configuration
C-12	6		
C-14	6		

- (b) (i) Name two allotropes of carbon. State a property of each allotrope and a use of the allotrope directly related to the property chosen.

Allotrope 1 \_\_\_\_\_ [1]

property and use \_\_\_\_\_

\_\_\_\_\_ [1]

Allotrope 2 \_\_\_\_\_ [1]

property and use \_\_\_\_\_

\_\_\_\_\_ [1]

- (c) Chlorine has two isotopes, chlorine-35 and chlorine-37. Their relative abundance in nature is listed in the table.

atom	percentage abundance
Cl-35	75
Cl-37	25

Use the information to calculate the relative atomic mass ( $A_r$ ) of a sample of chlorine atoms.

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[3]

- (d) Aragonite is an ore containing carbon that is exported from The Bahamas.

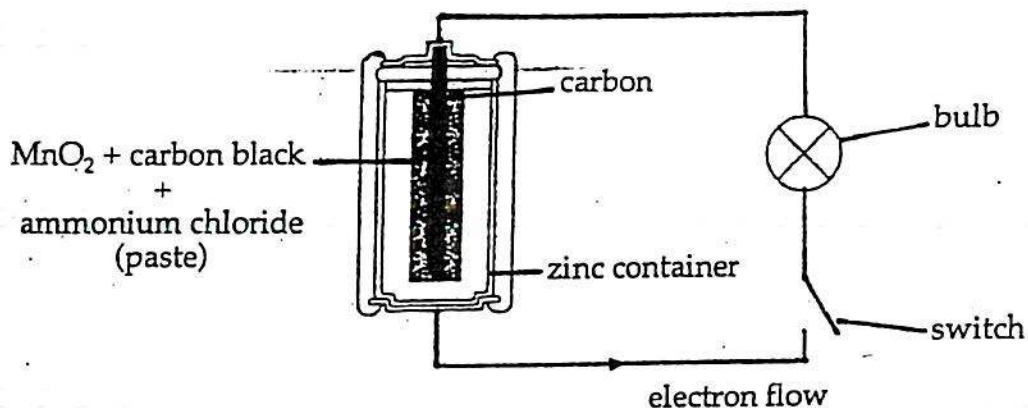
Write its chemical formula.

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[1]

Total marks [10]

3. More than a billion flashlight batteries or dry cells are produced annually.



Section of a commercial dry cell

(a) On the diagram label the

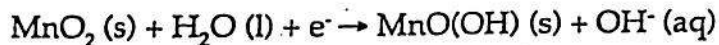
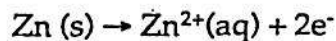
(i) cathode,

(ii) anode,

(iii) electrolyte.

[3]

(b) The reactions in the cell are shown.



When the current is allowed to flow through the bulb, one of the substances in the cell is oxidized and one is reduced. State which substance is oxidized and which is reduced, giving reasons.

(i) Name the substance which is oxidized.

\_\_\_\_\_

Reason \_\_\_\_\_

\_\_\_\_\_

[2]

- (ii) Name the substance which is reduced.

\_\_\_\_\_

Reason \_\_\_\_\_

\_\_\_\_\_ [2]

- (c) One way of preventing iron from rusting is to coat it with zinc.

- (i) Give one reason why zinc coating prevents the rusting of iron.

\_\_\_\_\_

\_\_\_\_\_ [1]

- (ii) Instead of using a zinc coating, the steel hull of a large cruise ship is connected to the negative terminal of a d.c. supply.

Explain how this will prevent the steel from rusting.

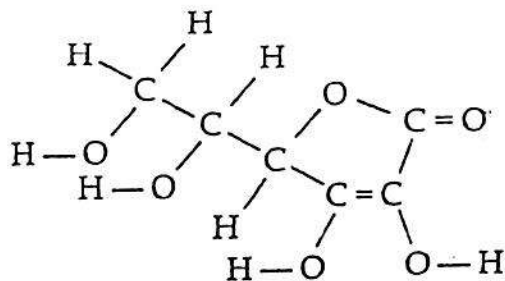
\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [2]

Total marks [10]

4. -The diagram represents a molecule of ascorbic acid (vitamin C).



- (a) Name one good source of ascorbic acid that is not a citrus fruit.

\_\_\_\_\_ [1]

- (b) (i) Write the molecular formula for ascorbic acid.

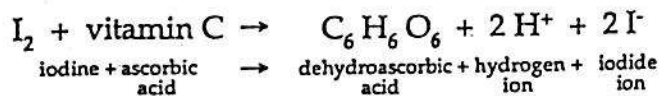
\_\_\_\_\_ [1]

- (ii) Calculate how many moles of vitamin C molecules are contained in 17.6 g of vitamin C.

\_\_\_\_\_  
\_\_\_\_\_ [2]

- (c) The reaction between ascorbic acid and iodine can be used to determine the amount of vitamin C in fruit juices with the addition of starch solution.

The reaction is:



- (i) Identify the reducing agent.

\_\_\_\_\_ [1]



(ii) State the colour change you would expect when all the iodine has reacted.

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[1]

(d) Explain how the sodium salt of ascorbic acid can be obtained, using a named alkali and a solution of ascorbic acid as starting materials.

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[4]

Total marks [10]

SECTION B

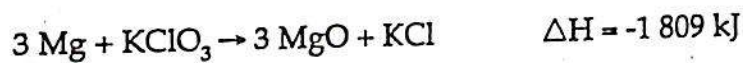
Answer any two questions in this section.

5. The formulae for making pyrotechnic mixtures (fireworks) are closely guarded secrets. The dazzling colours observed when a fireworks canister explodes in the night sky are products of high temperature chemical processes.

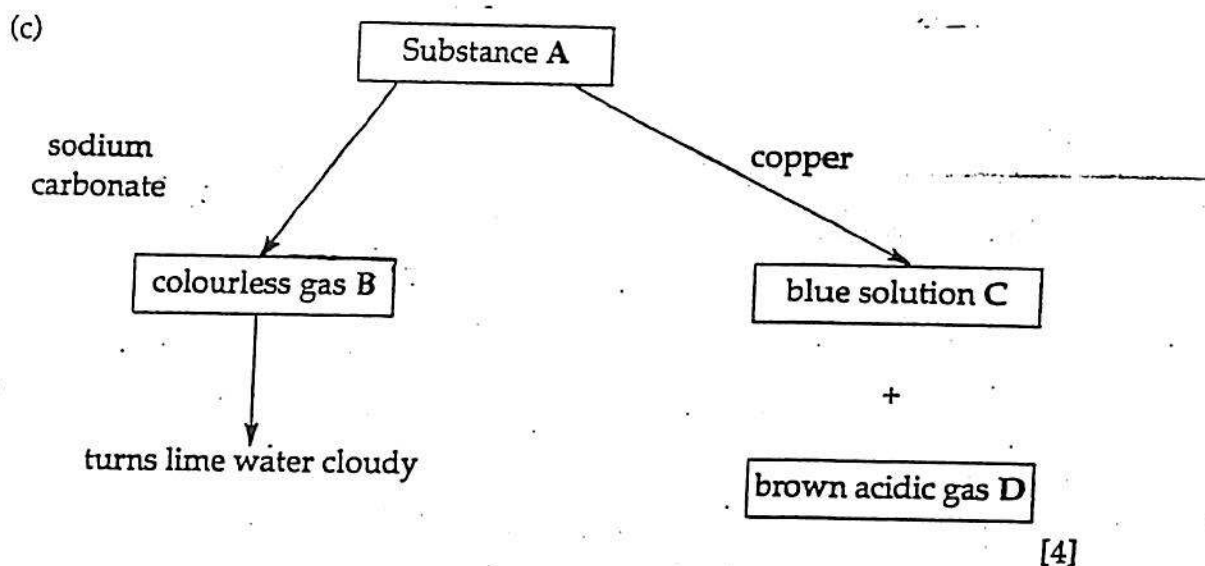
- (a) Write the symbols of the positive ions that produce the flame colours blue-green and brick red. [2]
- (b) Many firework mixtures depend on the combustion of magnesium, which is mixed with an oxidizing agent.

A typical mixture might contain potassium chlorate,  $\text{KClO}_3$ , and magnesium powder.

They will react according to the equation



- (i) Briefly explain what the negative value of  $\Delta H$  tells you about this type of reaction. [2]
- (ii) A firework contains 4 g of magnesium. Calculate the mass of the potassium chlorate that must be used. [3]
- (iii) Calculate the number of kilojoules of energy associated with this firework. [2]
- (iv) Use the results of (iii) to comment on the safety precautions that must be taken when using fireworks. [1]



- (i) Identify substances A, B, C and D.
- (ii) Write a complete equation, including state symbols, for one of the reactions of substance A. [2]
- (d) Two different solutions E and F are given. For each solution two tests (1 and 2) are described.

**Solution E** 1 Addition of sodium hydroxide and warming the mixture produces a gas which turns red litmus paper blue.

2 Addition of dilute nitric acid followed by a solution of silver nitrate gives a white precipitate that turns purple when exposed to light.

**Solution F** 1 Addition of sodium hydroxide gives a dirty green precipitate.

2 Addition of dilute hydrochloric acid followed by a solution of barium chloride gives a white precipitate.

Identify the cations and anions present in solutions E and F. [4]

Total marks [20]

6. Two samples of copper(II) oxide, A and B were prepared by different methods. Sample A was prepared by heating solid copper(II) carbonate. Sample B was prepared by heating solid copper(II) nitrate. Both samples were reduced to copper by heating in a stream of propane in a combustion tube.

- (a) (i) Write a balanced equation for the decomposition of copper(II) carbonate. [2]
- (ii) Find the mass of copper oxide produced from 200 g of carbonate. [2]
- (iii) Describe a test and the positive result for the gas, liberated in the decomposition of copper carbonate. [2]
- (b) (i) Write a word equation for the decomposition of copper nitrate. [2]
- (ii) Describe chemical tests for the gases given off and give the positive results. [2]
- (c) Write an equation for the reaction of copper oxide with hydrogen. State the colour change you would observe. [3]
- (d) The table shows the results of the analysis of the two samples (A and B) of copper(II) oxide. [3]
- (i) Fill in the blanks to complete the table.

	A	B
mass of combustion boat	2.60 g	2.80 g
mass of combustion boat + copper(II) oxide	3.75 g	4.24 g
mass of combustion boat + copper	3.52 g	3.95 g
mass of copper oxide		
mass of copper		
mass of oxygen		

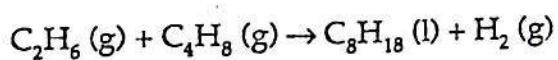
- (ii) Use the results to calculate the percentage of copper in sample A and sample B. [2]
- (iii) Find out what percentage of sample A is oxygen. [1]
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- (iv) State the law that is illustrated by this experiment. [1]

Total marks [20]

7. The results in the table were obtained when 0.15 mole of magnesium ribbon was added to 40 cm<sup>3</sup> of HCl (aq) and the time taken for all the magnesium to react was noted.

time/s	0	10	20	30	40	50	60	70	80	90	100
volume of H <sub>2</sub> /cm <sup>3</sup>	0	9	18	27	36	44	50	54	56	57	57

- (a) (i) Plot a suitable graph of this data. [5]  
 (ii) State how much hydrogen was collected in the first 25 seconds. [1]
- (b) Calculate the mass of magnesium use in the experiment. [2]
- (c) State the effects of using magnesium powder instead of magnesium ribbon on the  
 (i) rate of evolution of hydrogen;  
 (ii) total volume of hydrogen evolved. [2]
- (d) Natural supplies of hydrogen gas are far too small to satisfy the needs of industry, so commercial hydrogen is obtained as a by-product of the processing and refining of hydrocarbons in petroleum.



- (i) Balance the chemical equation. [1]  
 (ii) Name the saturated hydrocarbon on the left side of the equation. [1]  
 (iii) Draw the graphical formula for octane [1]
- (e) In industry ammonia is made in huge quantities by the Haber process.  
 (i) Write the equation for the overall reaction [3]

State and explain the effect on the equilibrium concentration of ammonia if the

- (ii) pressure is increased;  
 (iii) concentration of nitrogen is increased. [4]

Total marks [20]

End]