

School Number	Candidate Number
Surname and Initials	

CHEMISTRY

PAPER 3 3051/3

Wednesday 11 JUNE 2003 12.30 – 2.00 P.M.

- Additional materials:
- Answer Booklet
 - Graph paper
 - Periodic table

**MINISTRY OF EDUCATION
NATIONAL EXAMINATIONS**

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 16 printed pages and 4 blank pages.

-2-

SECTION A

Answer ALL questions in this section.

1. The table shows information about calcium and several common calcium compounds.

name	occurrence	physical property	chemical property	use
calcium	always in compound	silvery metal	reacts slowly with water	making alloys
calcium carbonate	most abundant calcium compound	white solid (pure)	reacts with acid to produce a gas	building material
calcium oxide (quick lime)	obtained from limestone	does not melt; high temperature produces limelight	basic anhydride	making slaked lime, bleaching powder
calcium hydroxide (slaked lime)	obtained by adding water to quicklime	white solid, slightly soluble in water	when dry, reacts with chlorine to produce bleaching powder	limewater in medicine adds calcium to the diet
bleaching powder	chlorine gas reacts with dry slaked lime	not a pure compound	reacts with air to produce chlorine	source of chlorine for bleaching

Using the information supplied in the table, answer the following questions.

- (a) Define the term *alloy* and name an example.

[2]

(b) State ONE chemical and ONE economic reason for recycling metals. .

chemical _____

_____ [1]

economic _____

_____ [1]

(c) State ONE commercial use of copper and suggest a property that makes it suitable for its use.

use _____ [1]

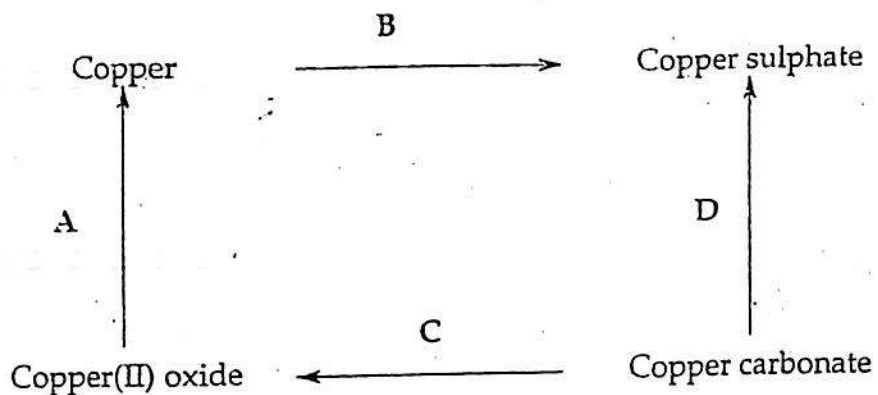
property _____ [1]

(d) By what process is aluminium obtained from its ore?

_____ [1]

Total marks [10]

In the scheme below letters A to D represent conversions.



(a) Name

(i) the reagent needed for reaction B;

(ii) the process needed for reaction C.

_____ [2]

(b) State briefly how the reaction can be carried out and name the reagents required for

(i) reaction A _____

(ii) reaction D _____

_____ [4]

(c) (i) What group of metals form coloured compounds?

The information given in the tables relates to hydrogen bromide gas and two of its solutions.

Table 1

Gas	Dry Litmus	Moist Litmus
HBr	No effect	Blue turns red

Table 2

Solvent	Solution with HBr		
	Produces Heat	Conducts Electricity	EFFECT on Litmus
X	No	No	None
Water	Yes	Yes	Blue to red

- (a) What type of bonding is present in hydrogen bromide gas?
- _____
- _____ [1]
- (b) According to the heat change results, what kind of reaction occurs when HBr dissolves in water?
- _____
- _____ [1]
- (c) Explain why the solution formed with solvent X does not conduct electricity?
- _____
- _____ [1]

- (ii) Titanium is used in the manufacturing of artificial hips, jewellery and aircraft wings.

What properties of titanium make it suitable to be included in the manufacture of these products?

_____ [2]

- (d) Zinc bars are attached to the hulls of ships made of an alloy of iron.

- (i) What is an alloy?

_____ [1]

- (ii) Explain the chemical reason for attaching zinc bars to the ship's hull.

_____ [1]

Total marks [10]

(d) What type of particles must be present in the aqueous solution?

_____ [1]

(e) Use the colours of the indicator to deduce information about the solution of HBr in X and in water.

_____ [2]

(f) Suggest what would be seen when a ribbon of magnesium metal was placed in each solution?

HBr in X _____

HBr in water _____ [2]

(g) Write a balanced equation for the reaction of magnesium metal in the aqueous solution.

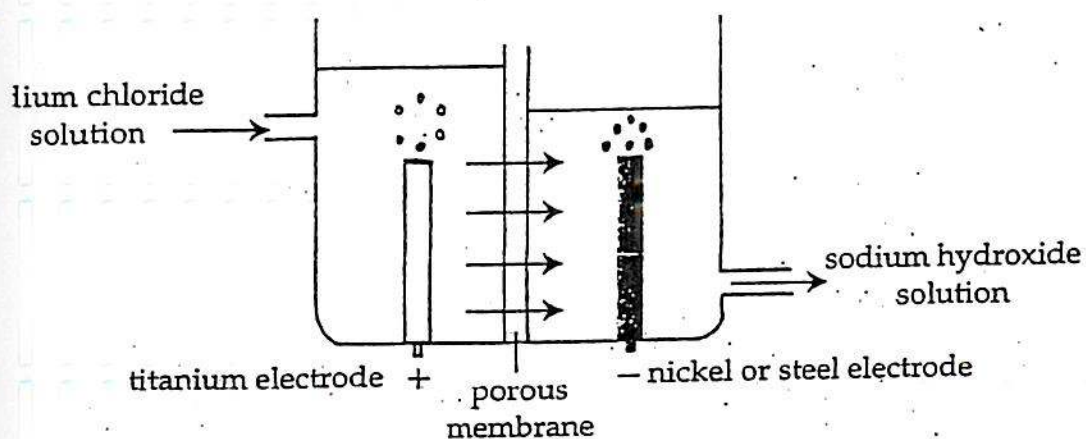
[2]

Total marks [10]

A source of sodium chloride is Halite, a mineral found in rocks. The sodium chloride is extracted as brine by pumping water into the rock.

Electrolysis of a saturated brine solution is a major industrial process. Three important substances are produced. These are chlorine gas, hydrogen gas and sodium hydroxide solution.

The apparatus to obtain these substances is illustrated in the diagram.



- (a) (i) What is the anode made from? _____ [1]
- (ii) What are the symbols of the ions present in brine (sodium chloride solution)?

_____ and _____ [2]

- (iii) Write the ionic half-equations that take place at the anode and the cathode and state whether the reaction is an oxidation or reduction.

Anode half-equation

The reaction is _____

Cathode half-equation

The reaction is _____ [5]

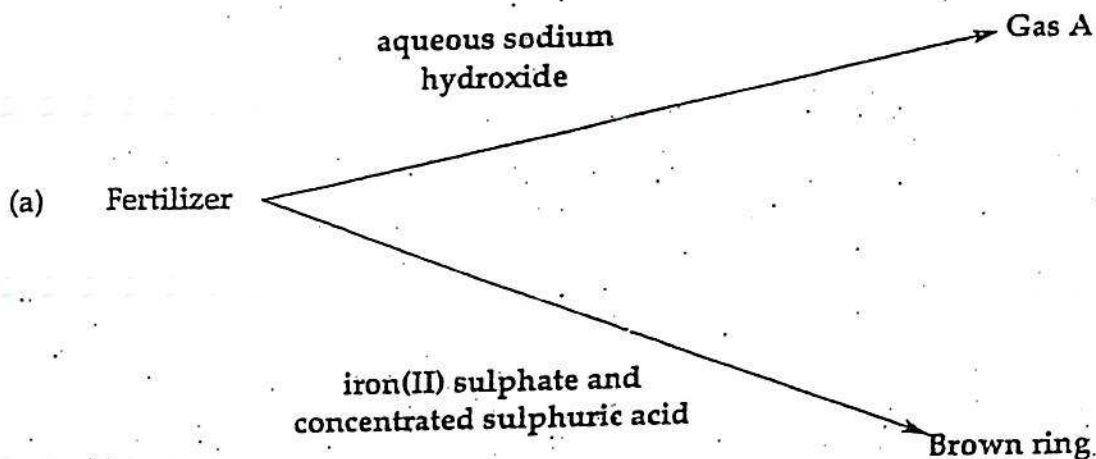
(b) Explain why the brine solution gradually becomes alkaline during the electrolysis.

[2]

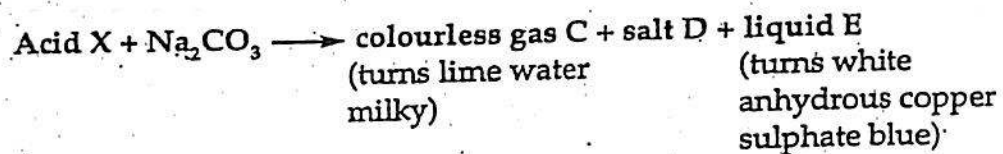
Total marks [10]

SECTION B

Artificial fertilizers were used carelessly on a farm in Andros causing problems to a nearby lake. The fertilizer was analyzed to identify the chemical present.



- (i) Identify Gas A
 - (ii) Name the Chemical in the fertilizer.
 - (iii) Write the formula of the compound. [3]
- (b) The fertilizer is made by reacting an acid X, with a base. Acid X reacts with sodium carbonate as follows:



Identify:

- (i) Colourless Gas C
- (ii) Salt D
- (iii) Liquid E
- (iv) Acid X

[4]

- (c) Plants can be grown in soil-less gardens using water solutions of essential chemicals. Some of these contain nitrate, ammonium phosphate, magnesium sulphate and potassium nitrate.

Write the symbols of the ions in the essential chemicals that would give

- (i) brick red flame test,
- (ii) lilac flame test,
- (iii) white precipitate with barium nitrate and dilute nitric acid. [3]

- (d) The Bahamas Fertilizer Company manufactures potassium hydrogen phosphate, K_2HPO_4 , which could be used as a fertilizer.

- (i) Calculate the percentage of potassium in potassium phosphate.
- (ii) Give the formula of the phosphate ion including the electrical charge on it.
- (iii) What is the formula of phosphoric acid? [4]

- (e) (i) Name a nitrogen fertilizer that the company could manufacture using phosphoric acid, and state its formula.

- (ii) Calculate the percentage of nitrogen in the fertilizer you have named in (e) (i). [3]

- (f) Eutrophication is the name given to the deterioration of water quality by excessive plant growth and decay. The abusive use of fertilizer results in eutrophication.

Name the ions that cause this overgrowth and state the effect the overgrowth has on a river. [3]

Total marks [20]

0.1 g of calcium turnings was reacted with 25 cm³ (an excess) of cold water at room temperature. The volume of hydrogen given off was measured every 30 seconds for 4 minutes. The results were:

Time/s	0	30	60	90	120	150	180	210	240
Volume/cm ³ at r.t.p.	0	20	32	42	50	56	59	60	60

- (a) Plot the results on graph paper. Label the graph A.
(Time on x axis) [6]
- (b) What is meant by excess water? [1]
- (c) (i) At what time did the reaction stop? [2]
(ii) Why did the reaction stop at that time? [2]
(iii) Calculate the number of moles of hydrogen, H₂, produced in the first 60 seconds. [2]
- (d) (i) What would be the colour of the indicator phenolphthalein in the resulting solution? [1]
(ii) Write a balanced chemical equation for the reaction. [2]
(iii) From the equation, calculate the volume of hydrogen produced at r.t.p. from 2 g of calcium. [2]
- (e) (i) What would happen to the rate of the reaction and the total volume of hydrogen finally produced if 0.05 g of calcium turnings was used with 25 cm³ of warm water? [2]
(ii) On the same axes as the original graph A, sketch the curve you would obtain by using 0.05 g of calcium turnings and 25 cm³ of warm water. Label the curve graph B. [2]

Total marks [20]

7. The table gives the heat of combustion and the relative molecular masses of some alkanes.

Alkane	relative molecular mass	heat of combustion $\Delta H/\text{kJ mol}^{-1}$
methane	16	890
ethane		1,560
	44	2,200
butane	58	
pentane	72	3,509

- (a) (i) Calculate the relative molecular mass of ethane
(ii) Give the name of the third member of the alkane.
(iii) Estimate the heat of combustion of butane. [3]
- (b) The equation represents the production of ethanol
- $$\text{C}_2\text{H}_{12}\text{O}_6(\text{aq}) \longrightarrow 2\text{C}_2\text{H}_5\text{OH}(\text{aq}) + 2\text{CO}_2(\text{g})$$
- (i) Give the name of an organism needed for the reaction to occur. [1]
(ii) How will you show that the gas produced in the reaction is carbon dioxide? [2]
(iii) State ONE social or economic effect resulting from the abuse of alcohol. [1]
- (c) (i) Determine the empirical formula of an organic hydrocarbon compound which contains 82.76% carbon and 17.24% of hydrocarbon. [5]
(ii) If the molecular mass of the compound is 58, what is its molecular formula? [2]
(iii) Draw the structural formulae of the two isomers of this compound. [2]

- (d) (i) One mole of cooking gas (propane) is completely burned in air. [2]
Write a balanced equation for the reaction.
- (ii) Calculate the volume of gas produced when the products are cooled to room temperature (r.t.p.). [2]

Total marks [20]

End]