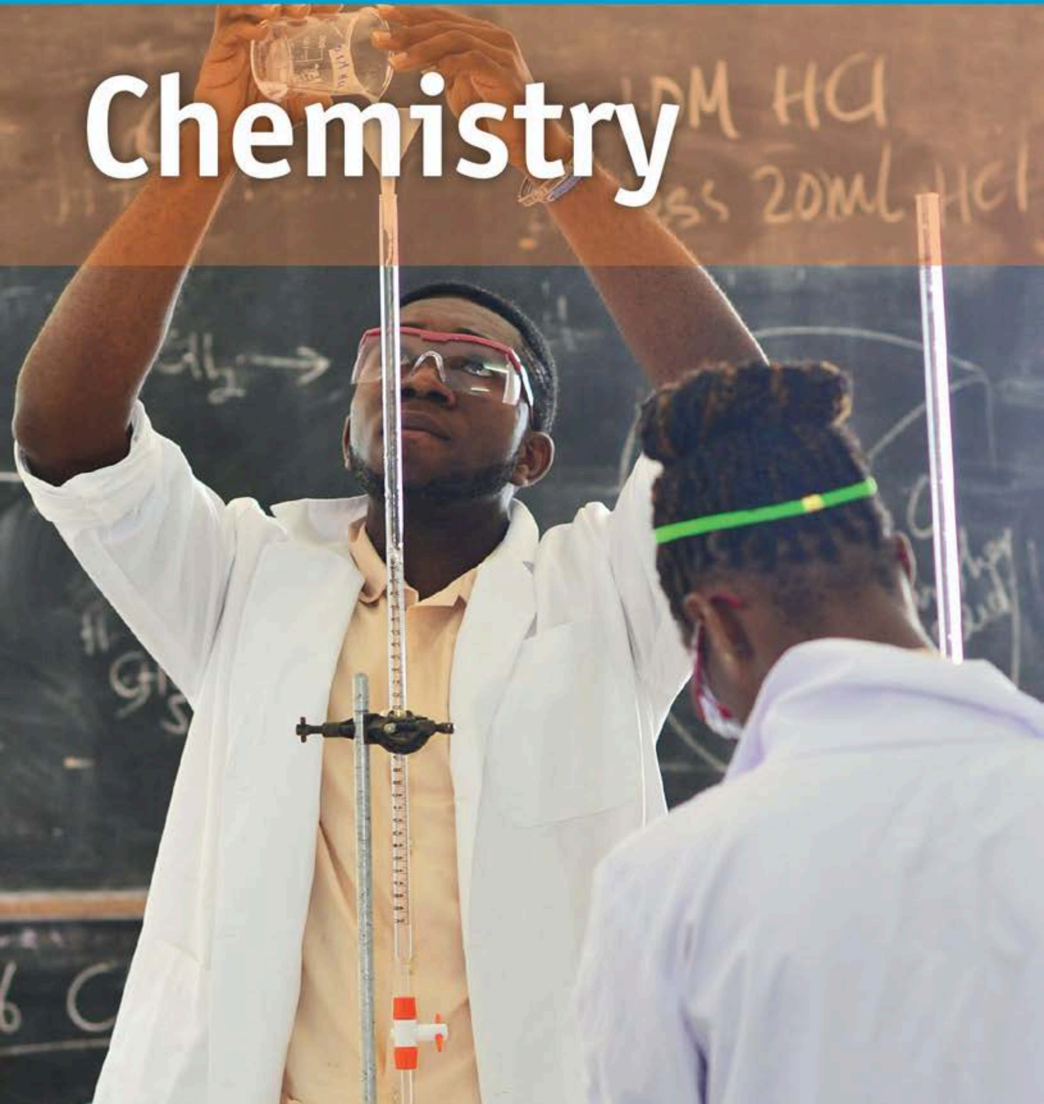
CARIBBEAN EXAMINATIONS COUNCIL

Chemistry



CSEC® PAST PAPERS

Macmillan Education
4 Crinan Street, London, N1 9XW
A division of Macmillan Publishers Limited
Companies and representatives throughout the world

www.macmillan-caribbean.com

ISBN 978-0-230-48266-1 AER

First published 2014

This revised edition published 2016

Designed by Macmillan Publishers Limited
Cover design by Macmillan Publishers Limited
Cover photograph © Caribbean Examinations Council (CXC®)
Cover photograph by Mrs Alberta Williams
With thanks to the students of the Sir Arthur Lewis Community College, St. Lucia:
Kerrone Stanislaus and Nalini Albertson

CSEC® Chemistry Past Papers

LIST OF CONTENTS

TEST CODE **01212020**

FORM TP 2005006

JANUARY 2005

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

1 hour 45 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. **There are FIVE questions in this booklet. Answer ALL questions.**
2. **You MUST use this answer booklet when responding to the questions. For each question, write your answer in the space provided and return the answer booklet at the end of the examination.**
3. **Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.**
4. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

You should NOT spend more than 30 minutes on Question 1.

1. (a) A student is required to investigate the rate of reaction in which a fixed mass of magnesium metal (0.12 g) is added to different volumes of 1.5 M hydrochloric acid. The acid is added from a burette and **water added to make the final volume of 50 cm³**. The time taken for the magnesium ribbon to disappear is recorded. Figure 1 below shows the burette readings for the volume of acid added and the time taken for the magnesium to disappear for each reaction. The initial burette reading is always 0.0 cm³.

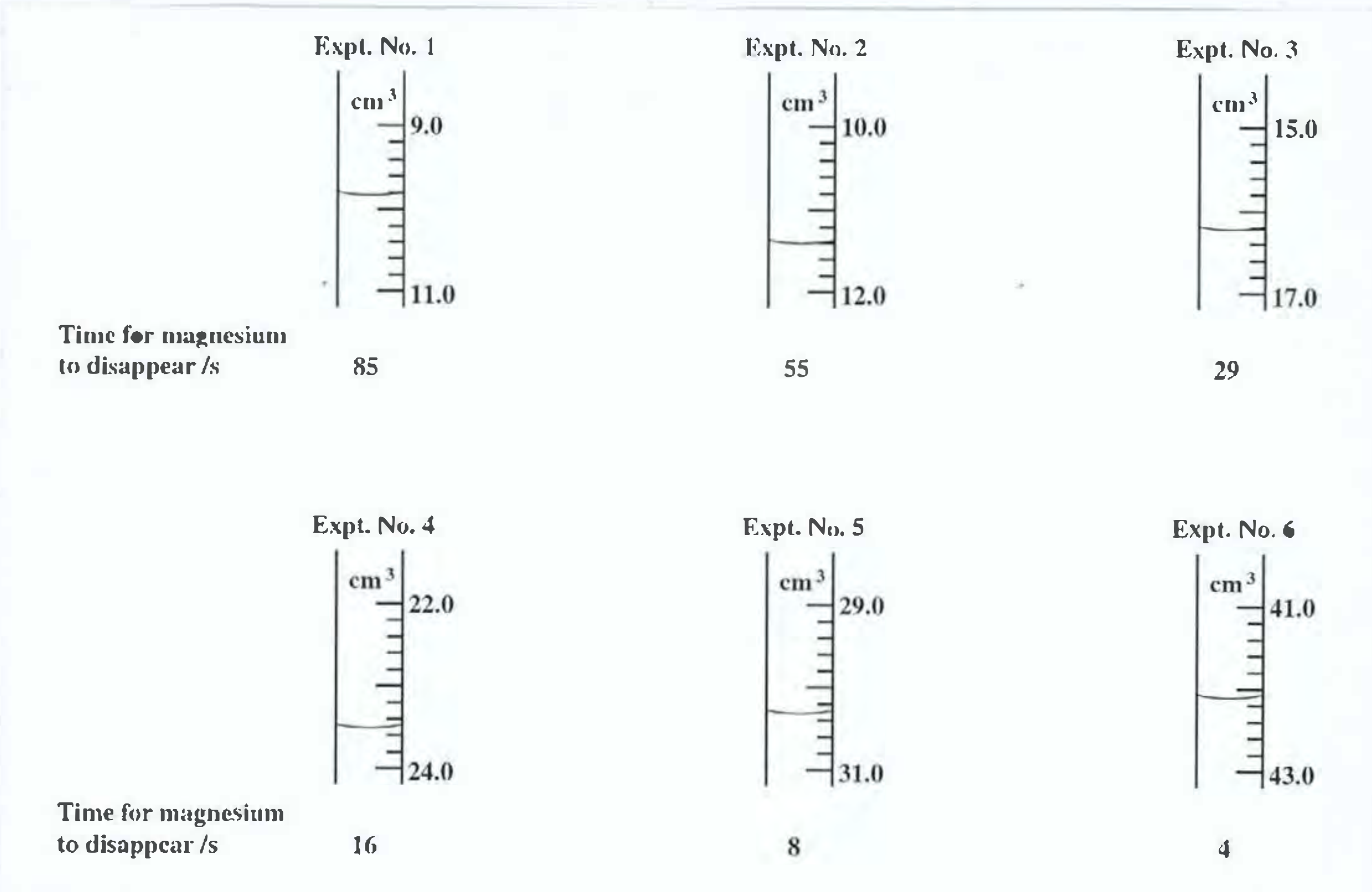


Figure 1. Burette readings and times taken for magnesium metal to disappear

(a) (i) From the results shown in Figure 1 construct a table to show experiment number, volume of acid added from the burette, volume of water added to the acid, and time taken for the magnesium to disappear.

[4 marks]

(ii) Using the graph paper on page 4, plot a graph of time taken for the magnesium ribbon to disappear against volume of acid added from the burette.

[4 marks]

(iii) Explain the shape of the graph.

____

____

[1 mark]

(iv) Using the data from the graph determine the time it would take for 25 cm^3 of the acid to react with the magnesium ribbon.

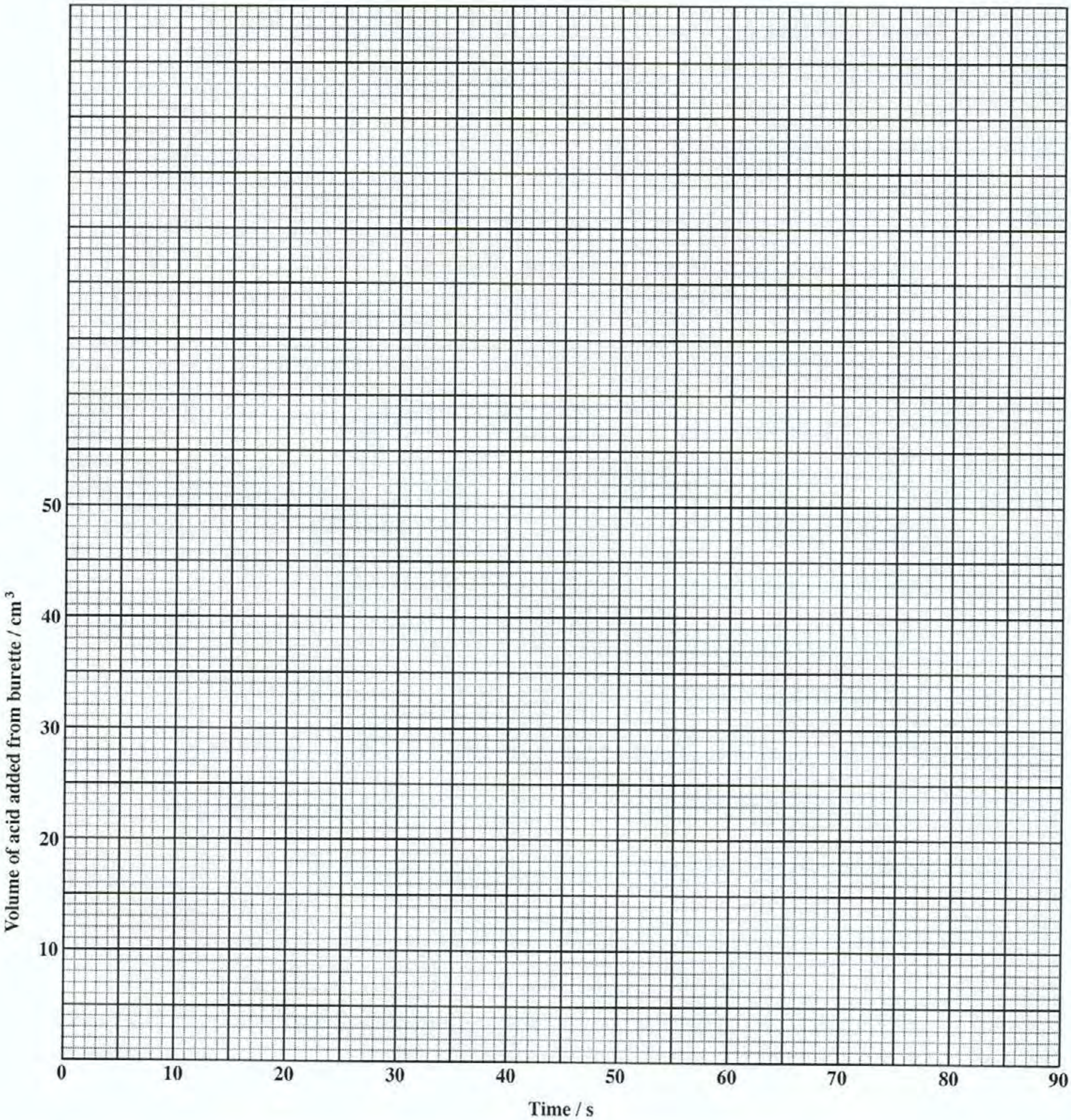
____

[1 mark]

(v) Write a balanced equation for the reaction of magnesium with hydrochloric acid.

____

[2 marks]


Volume of acid added from burette / cm³
50
40
30
20
10
0
10
20
30
40
50
60
70
80
90
Time / s

(vi) Calculate EACH of the following:

a) The number of moles of Mg in 0.12 g
(Relative Atomic Mass of Mg = 24)

(1 mark)

b) The volume of hydrogen gas produced at r.t.p. when all the magnesium ribbon reacts with the acid

(1 mole of gas at r.t.p. occupies 24 dm^3)

(2 marks)

(vii) Explain why it is necessary, for each experiment, to make up the volume of acid to 50 cm^3 by adding water.

____

____

(1 mark)

(b) A student carries out the following tests on Substance Z and makes the observations recorded in Table 1 below. Complete Table 1 to show all possible inferences and write equations where required.

TABLE 1: RESULTS OF TESTS ON SOLID Z

	Test	Observation	Inference
(i)	Heat a small sample of solid Z gently in a dry test tube.	Pungent gas evolves which turns damp red litmus blue.	
(ii)	Add approximately 2 cm^3 of aqueous sodium hydroxide to a sample of solid Z and warm.	A gas evolves which forms dense white fumes with hydrogen chloride.	(equation required)
(iii)	Dissolve a spatula full of solid Z in approximately 10 cm^3 of deionized water. Divide the resulting mixture into 3 portions for tests iv – vi.	A pale green solution is formed.	
(iv)	To one portion of solution Z from (iii) above, add aqueous sodium hydroxide dropwise until in excess.	A green gelatinous precipitate forms. The precipitate is insoluble in excess sodium hydroxide.	(ionic equation required)
(v)	To another portion of solution Z from (iii) above, add dilute nitric acid followed by aqueous silver nitrate solution.	No visible reaction seen	
(vi)	To another portion of solution Z from (iii) above, add barium nitrate followed by dilute nitric acid.	A white precipitate insoluble in dilute acid is produced.	(ionic equation required)

(7 marks)

GO ON TO THE NEXT PAGE

(c) The following instructions are given to students in the laboratory:

> You are provided with 2 mol dm^{-3} solutions of sodium hydroxide and hydrochloric acid, measuring cylinders, a polystyrene cup and a thermometer.
>
> 1. Measure out 50 cm^3 of the 2 mol dm^{-3} sodium hydroxide and 50 cm^3 of the 2 mol dm^{-3} solution of hydrochloric acid.
>
> 2. Pour the sodium hydroxide solution into the polystyrene cup and measure its temperature.
>
> 3. Add the acid to the sodium hydroxide. Stir the mixture and record the highest temperature.
>
> **Note:**
> - Assume 1 cm^3 of water has a mass of 1 g.
> - It takes 4.2 joules of energy to raise the temperature of 1 g of water by 1° C.

Write up the following parts of the report that the student would most likely present after completing the above experiment.

(i) Aim

____

____

(1 mark)

(ii) Method or procedure

____

____

____

(2 marks)

(iii) Discussion of results

- Data to be collected

____

____

____

(1 mark)

- Steps for doing calculations

____

____

____

____

____

____

(2 marks)

- Discussion of results as it relates to aim

____

____

____

____

____

____

(1 mark)

Total 30 marks

2. Figure 2 shows the labels from two bottles containing Suspensions P and Q respectively, showing the formulae and percentage composition of the active ingredients.

Suspension P	Suspension Q
$Al(OH)_3$ – 78%	$CaSO_4$ – 83%

Figure 2. Labels from Suspensions P and Q

(a) Calculate the number of moles of $Al(OH)_3$ in 250 g of Suspension P. (Relative Atomic Mass: Al = 27, O = 16, H = 1)

____

____

____

(3 marks)

(b) A student attempts to prepare a sample of Suspension Q in the laboratory by reacting calcium with dilute sulphuric acid. The reaction stops after a short while with only a small amount of $CaSO_4$ formed and most of the calcium unreacted.

(i) Explain why the reaction stops after a while.

____

____

____

(2 marks)

(ii) Outline a suitable **laboratory** method for preparing a dry sample of calcium sulphate. Include a relevant equation in your answer.

____

____

____

____

____

(4 marks)

GO ON TO THE NEXT PAGE

(c) (i) Which of the Suspensions, P or Q, could serve as an antacid?

____

(1 mark)

(ii) Write a chemical equation to support your answer to (c) (i).

____

(2 marks)

(d) By mixing hot water and a concentrated aqueous solution of iron (III) chloride, a bright yellow colloid is formed.

State THREE ways in which a colloid differs from a suspension.

____

____

____

(3 marks)

Total 15 marks

3. Compounds A and B are two colourless liquids. They both contain the elements carbon, hydrogen and oxygen.

(a) (i) Given that 4.0 g of B contain 60 % carbon, 13 % hydrogen and 27 % oxygen, calculate the empirical formula of B (Relative Atomic Mass: C = 12; O = 16; H = 1).

____

____

____

____

____

____

____

(3 marks)

(ii) The empirical formula for A is CH_2O. Deduce whether or not A and B belong to the same homologous series. Explain your answer.

____

____

____

(2 marks)

GO ON TO THE NEXT PAGE

(b) (i) Calculate the molecular formula for A and B.
(The relative formula mass of both A and B = 60).

(2 marks)

(ii) Compounds A and B both react with sodium. Write the fully displayed structural formulae for A and B.

Fully displayed structural formula of A

Fully displayed structural formula of B

(4 marks)

(c) (i) Describe ONE chemical test that can be used to distinguish between A and B.

(2 marks)

(ii) Will both A and B be soluble in water? Give a reason for your answer.

(2 marks)

Total 15 marks

4. Figure 3 shows the arrangement of an apparatus that can be used for electrolysing a number of electrolytes.

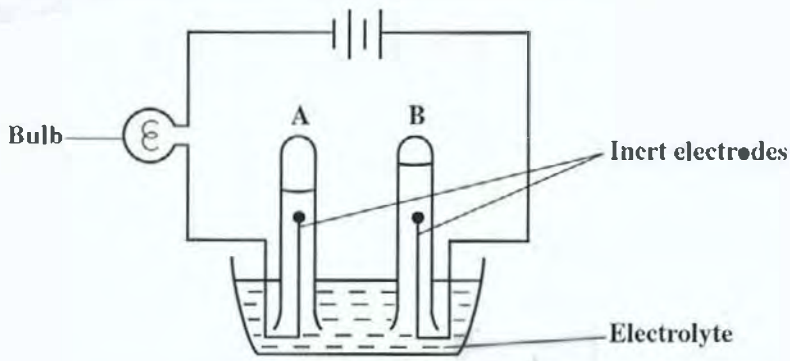


Figure 3

(a) (i) What will happen to the bulb when the electrolyte is replaced with pure water?

____

(1 mark)

(ii) Explain your answer to (a) (i).

____

____

(1 mark)

(b) It is observed that when the electrolyte in the cell in (Figure 3) is dilute sulphuric acid, the ratio of the gases collected in A and B is approximately 2:1.

(i) Identify the gases in tubes A and B.

Gas in A ____________________

Gas in B ____________________

(2 marks)

(ii) By considering the reactions that occur at the electrode surfaces, explain the occurrence of the 2:1 ratio in the gases collected in A and B. Use balanced ionic equations to support your answer.

____

____

____

(5 marks)

(c) (i) If the bulb in Figure 3 is replaced with an ammeter, what will happen to the reading on the ammeter if the electrolyte is changed from dilute sulphuric acid to dilute methanoic acid?

____

(1 mark)

(ii) Explain your answer to (c) (i).

____

____

____

(2 marks)

(d) What adjustments have to be made to Figure 3 in order to copper-plate a spoon?

____

____

(3 marks)

Total 15 marks

5. Dilute hydrochloric acid is added to separate samples of solid sodium sulphite and sodium carbonate.

The gases produced are subjected to tests (i), (ii), (iii) and (iv) in Table 2 below.

TABLE 2

Dilute hydrochloric acid +	**Reactions of gas evolved with**		
	Acidified potassium manganate (VII)	**Aqueous calcium hydroxide**	**Damp blue litmus**
Sodium sulphite	(i)	X	(iii)
Sodium carbonate	X	(ii)	(iv)

(a) Write balanced equations for the reactions between hydrochloric acid and

(i) sodium sulphite

____

(2 marks)

(ii) sodium carbonate.

____

(2 marks)

(iii) State ONE effect that the products from these two reactions could have on the environment.

____

____

(1 mark)

(b) Describe the observations expected from tests (i) – (iv) in Table 2.

Observations from:

(i) ______________________________

(ii) ______________________________

(iii) ______________________________

(iv) ______________________________

(4 marks)

GO ON TO THE NEXT PAGE

(c) With reference to the gas produced when hydrochloric acid reacts with sodium sulphite, account for the observed changes in the acidified potassium manganate (VII) described in (b) (i) on page 14.

____

____

____

(3 marks)

(d) Draw a diagram of the apparatus to show how the products formed from observation (b) (ii) could be separated.

(3 marks)

Total 15 marks

END OF TEST

FORM TP 2005007

JANUARY 2005

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 03 – General Proficiency

1 hour

17 JANUARY 2005 (p.m.)

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. **In addition to the 1 hour, candidates are allowed a reading time of 10 minutes. Writing may begin during the 10-minute period.**
2. **Answer THREE questions on this paper, ONE from Section A, ONE from Section B and ONE from Section C.**
3. **All working MUST be shown for calculations.**
4. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A

Answer ONE question from this section.

1. The apparatus shown in Figure 1 represents two experiments, A and B, conducted by a student in the laboratory.

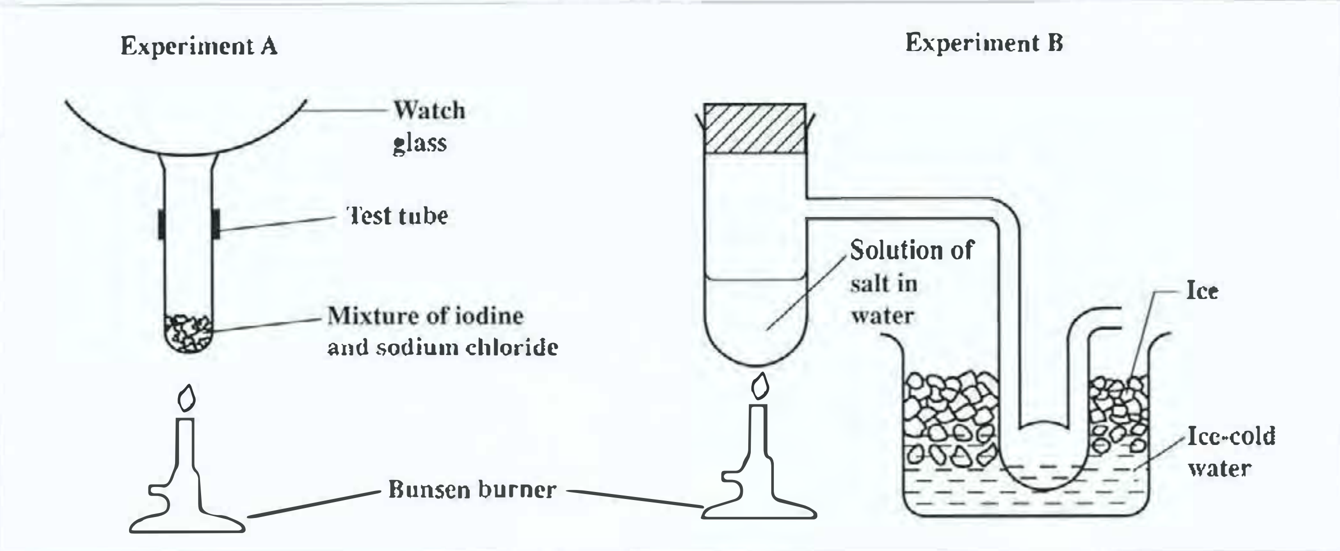


Figure 1. Apparatus used in Experiments A and B

(a) (i) Describe the observations that the student would have made in carrying out Experiments A and B. Indicate the changes of state that take place. **(6 marks)**

(ii) Explain the changes in state, in Experiments A and B, in terms of energy changes and intermolecular forces of the particles present in the substances. **(6 marks)**

(b) Iodine reacts with chlorine to form a brown liquid, iodine monochloride (ICl).

(i) Write a balanced equation for the formation of iodine monochloride. Include state symbols. **(2 marks)**

(ii) Using dot-cross diagrams, show the expected bonding in iodine monochloride. **(2 marks)**

(iii) Suggest TWO properties of iodine monochloride based on the type of bonding indicated in (ii) above. **(2 marks)**

(c) How does the bonding in ICl compare to that in Cl_2 or I_2? Give a reason for your answer. **(2 marks)**

Total 20 marks

GO ON TO THE NEXT PAGE

2. Chlorine is an important industrial chemical and great care must be taken when handling it. It is prepared industrially by electrolysis using a cell such as the one shown in Figure 2.

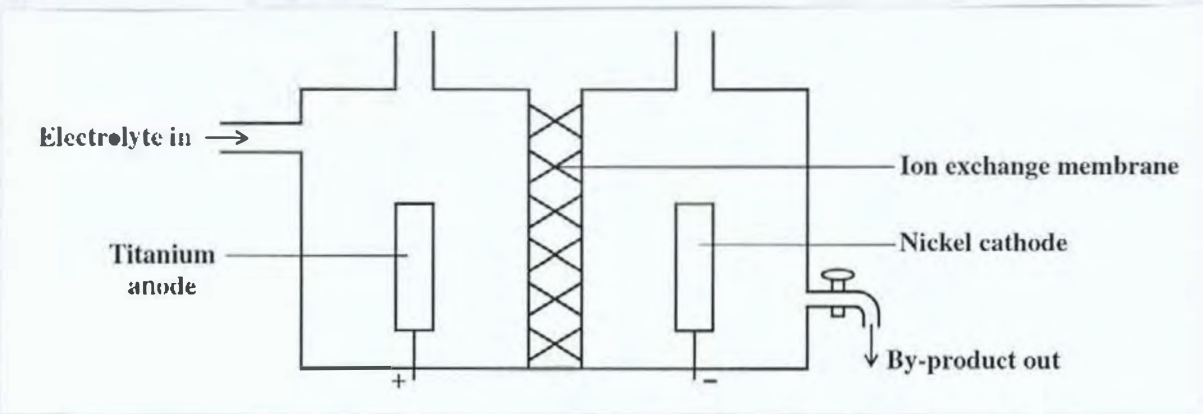


Figure 2. Electrolytic cell for the preparation of chlorine

(a) Outline the industrial preparation of chlorine using a cell such as in Figure 2. Include in your answer

(i) the name of the electrolyte and ions present

(ii) the principles which determine the ions that are preferentially discharged at the electrodes

(iii) reactions occurring at the electrodes, including ionic equations

(iv) the role of the ion exchange membrane

(v) the name of ONE important by-product formed. **(12 marks)**

(b) When chlorine is passed through a colourless solution of potassium iodide a precipitate is formed.

(i) Write a balanced chemical equation for this reaction. **(2 marks)**

(ii) The reaction in (b) (i) is a redox reaction. With reference to oxidation numbers, show why this is a redox reaction and identify the oxidizing and reducing agents. **(6 marks)**

Total 20 marks

SECTION B

Answer ONE question from this section.

3. Account for EACH of the following sets of observations.

(a) A glucose solution is mixed with yeast at about 25 °C and left for some time in a closed container. The pressure in the container builds up and ethanol is produced. The same thing happens when the glucose solution is replaced with juices extracted from sugarcane, waste paper, potato peelings or grass. However, nothing happens when the reaction is carried out at 75 °C.

You should include in your answer:

- the process taking place
- the role of yeast
- what causes the pressure to build up
- a simple equation to show how the compounds present in the various plant extracts give rise to glucose
- any other relevant chemical equations
- the effect of temperature on the process occurring.

(10 marks)

(b) Compound A is a gaseous hydrocarbon with molecular formula $C_3 H_8$. Compound A is generally unreactive. Yet, compound A is a good fuel. Also, it slowly decolourizes gaseous bromine in light but there is no reaction with bromine in the dark.

You should include in your answer:

- the class of hydrocarbons to which A belongs
- why A is generally unreactive
- the type of reaction A undergoes with bromine
- why A reacts with bromine in the presence of light but not in the dark
- why A is a good fuel
- any relevant chemical equations.

(10 marks)

Total 20 marks

4. (a) The method of extraction of a metal from its ore is related to its position in the electrochemical series. Discuss this statement with respect to the method of extraction of aluminium and iron from their oxides. **(3 marks)**

(b) Manganese is just above iron in the electrochemical series. It is extracted from its ore, manganese(III) oxide (Mn_2O_3) using the SAME method as iron.

Based on this information, outline the main steps involved in the extraction of manganese from its ore.

You should include THREE chemical equations to represent the main reactions occurring in the extraction process. **(9 marks)**

(c) Pure manganese has very few uses since it is brittle and is attacked by water. However, industrially it is very important. It is a constituent of the alloy, duralumin. Duralumin contains aluminium (95 %), copper (4 %) and traces of magnesium and manganese.

(i) State TWO uses of duralumin. **(2 marks)**

(ii) Suggest a suitable laboratory method you could employ to extract the copper present in a sample of duralumin.

You should include a chemical equation in your answer to indicate the reaction taking place.

[Clue: copper is below hydrogen whereas aluminium, magnesium and manganese are above hydrogen in the electrochemical series.]

(6 marks)

Total 20 marks

SECTION C

Answer ONE question from this section.

5. In days gone by, cooks used unripe, uncooked fruits such as papaw and pineapple as tenderizers when cooking meat. With the improvement in technology, commercially prepared tenderizers and pressure cookers are used to achieve the same effect.

(a) Explain the principles involved in the functioning of the pressure cooker. **(3 marks)**

(b) Discuss how the pressure cooker and tenderizers are able to make meat soft. You should include an equation involving the partial structure of a protein molecule to illustrate your answer. **(6 marks)**

(c) (i) Discuss TWO advantages and TWO disadvantages of using the pressure cooker to cook meat. **(4 marks)**

(ii) When using the pressure cooker it is recommended that the heat be reduced once the pressure builds up. Explain the basis for this precaution. **(2 marks)**

(d) Vitamin C or ascorbic acid ($C_6H_8O_6$) is an important component of our daily diet. Sometimes foods rich in vitamin C are **cooked** or **treated with baking soda** to improve their appearance and taste. With reference to the chemical nature of vitamin C, discuss the **disadvantages** of this practice. You should include relevant chemical equations in your answer. **(5 marks)**

Total 20 marks

6. (a) Jennifer and her friends plan to leave home on Friday evening and spend the weekend camping and cooking in the woods. There is no refrigeration facility at the camp site. She plans to pack fresh, uncooked chicken so that they can have tasty fried chicken for their Sunday afternoon meal. Her mother insists that she takes the frozen chicken instead.

(i) Discuss the implications of taking the frozen chicken instead of the fresh chicken for the Sunday meal. **(5 marks)**

(ii) What advice would you give to Jennifer for keeping the chicken in an unspoilt state until Sunday? **(2 marks)**

(b) Suggest ONE chemical method that could be used to preserve meat. Include in your discussion

(i) the chemical principles on which this method works

(ii) the advantages and disadvantages of the method. **(8 marks)**

(c) Canning is another method widely used to preserve food. Tin-plated iron cans are used as containers for meats and vegetables.

(i) Using a balanced chemical equation, explain why iron containers are unsuitable for storing substances such as fruit juices. **(4 marks)**

(ii) Suggest ONE material, other than tin, suitable for lining iron cans for storing fruit juices. **(1 mark)**

Total 20 marks

END OF TEST

TEST CODE **01212042**

FORM TP 2005008

JANUARY 2005

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 04/2 – Alternative to SBA

General Proficiency

2 hours

In addition to the 2 hours allowed for the examination, candidates are allowed 10 minutes in order to read through the entire paper.

Writing may begin during the 10-minute period.

1. **Answer ALL questions on this paper.**
2. **Use this answer booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the answer booklet at the end of the examination.**
3. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

1. Hydrogen peroxide (H_2O_2) solutions are available commercially in various concentrations.

In this exercise you will be required to determine the actual concentration of H_2O_2 in a commercial sample. This will be done by titrating a DILUTED sample of the commercial H_2O_2 with aqueous potassium manganate (VII) ($KMnO_4$) in the presence of aqueous sulphuric acid (H_2SO_4).

MATERIALS:

You are provided with each of the following:

- SOLUTION A: 150 cm^3 of an aqueous solution of $KMnO_4$ containing 0.01 mol dm^{-3}.
- SOLUTION B: 150 cm^3 of a DILUTED solution of H_2O_2. This was prepared by accurately diluting 25 cm^3 of the commercial H_2O_2 with distilled water to make 1 dm^3 of solution.
- SOLUTION C: 150 cm^3 of aqueous H_2SO_4 (2 mol dm^{-3}).

PROCEDURE:

A. Rinse the burette provided with a small portion of Solution A and then fill the burette with Solution A.

B. Using a pipette filler, pipette 25 (20) cm^3 of Solution B into a 250 cm^3 conical flask.

C. Using a measuring cylinder, add 25 cm^3 of Solution C to the conical flask. Swirl to ensure thorough mixing of the contents of the flask.

D. Titrate the contents of the flask with Solution A. When titrating, swirl the flask constantly until the first sign of a faint permanent pink colour appears in the flask.

E. Record your burette readings in Table 1 on page 3.

F. Repeat steps B to E until you obtain consistent results.

RESULTS:

TABLE 1: TITRATION READINGS

Burette readings / cm^3	**Titration readings**			
	1	2	3	4
Final reading				
Initial reading				
Volume of Solution A used				

(a) (i) Pipette volume used: ____________ cm^3

(ii) Volume of Solution A to be used in the calculation: ____________ cm^3

(10 marks)

(b) You are required to use your results recorded in Table 1 above to determine the concentration of H_2O_2 in the COMMERCIAL sample.

The ionic equation for the reaction occurring between Solutions A and B in the presence of acid (Solution C) is as follows:

$$2MnO_4^-(aq) + 5H_2O_2(aq) + 6H^+(aq) \rightleftharpoons 2Mn^{2+}(aq) + 5O_2(g) + 8H_2O(l)$$

(i) What is the reacting ratio of H_2O_2 to MnO_4^- ?

Reacting ratio: ______________________________ **(1 mark)**

(ii) Calculate EACH of the following:

a) The number of moles of MnO_4^- in the volume of Solution A used in your titration.

________ cm^3 of Solution A contains ________ moles of MnO_4^-.

(1 mark)

GO ON TO THE NEXT PAGE

b) The number of moles of H_2O_2 in the volume of Solution B used in your titration.

__________ cm^3 of Solution B contains __________ moles H_2O_2.

(1 mark)

c) Number of moles of H_2O_2 present in 1 dm^3 of Solution B.

1 dm^3 of Solution B contains __________ moles of H_2O_2.

(1 mark)

d) The concentration (in mol dm^{-3}) of H_2O_2 present in the COMMERCIAL sample of hydrogen peroxide. Recall from page 2 that Solution B was prepared by accurately diluting 25 cm^3 of the commercial sample to a total volume of 1 dm^3 with distilled water.

The concentration of H_2O_2 in the commercial sample is __________ mol dm^{-3}.

(2 marks)

(iii) The label on the commercial bottle of H_2O_2 reads:

" H_2O_2 concentration = 0.88 mol dm^{-3}"

Give a possible reason for any discrepancy between the value quoted on the label and your answer in d) above.

(1 mark)

Total 17 marks

GO ON TO THE NEXT PAGE

2. You are provided with a sample labelled Y. Y is a mixture of three solids. You are required to carry out the following tests and complete Table 2 below.

TABLE 2: TESTS ON MIXTURE Y

Test	Observations	Inferences
(a) Heat a small portion of solid Y in a dry test tube.		
(b) (i) Divide the remainder of Y into TWO equal portions. Save ONE portion for test (c).		
(ii) To ONE portion of Y add 15 cm^3 of dilute nitric acid, warm for two minutes, filter and divide the filtrate into THREE equal portions.		
(iii) To the first portion of the filtrate from (b) (ii) above, add aqueous sodium hydroxide a little at a time, until in excess.		
(iv) To the second portion of the filtrate from (b) (ii) above, add aqueous ammonia a little at a time, until in excess.	....	....
(v) To the third portion of the filtrate from (b) (ii) above, add aqueous silver nitrate followed by an excess of aqueous ammonia.	....	....
(c) To the second portion of the solid Y from (b) (i) above, add ten drops of conc. sulphuric acid, followed by THREE pieces of copper turnings. Gently warm the resulting mixture.		

(17 marks)

3. The ashes, obtained from the burning of plant material, were used as cleansing agents by the Babylonians more than 4000 years ago. The detergent properties of these plant ashes are due to the presence of alkaline materials such as sodium carbonate and potassium carbonate. Interest in the use of these plant ashes as skin cleansers is now being renewed.

The following shows part labels taken from three plant ash extracts being sold in a herbal shop for use as skin cleansing agents.

HERBAL ASH SKIN CLEANSER FOR EXTERNAL YOUTHFUL COMPLEXION **CONTAINS 2.0 % CARBONATE . . . . .**	**GINSENG ASH SKIN CLEANSER FOR A CANCER FREE SKIN** **CONTAINS 2.5 % CARBONATE . . . . .**	**NEEM ASH SKIN CLEANSER FOR AN INFECTION FREE SKIN** **CONTAINS 1.5 % CARBONATE . . . . .**

Plan and design an experiment to determine whether the carbonate content of the cleansers as advertised is accurate.

Your answer should include the following:

(i) Hypothesis to be tested

____

____

____

(1 mark)

(ii) Apparatus and Materials

____

____

____

(2 marks)

(iii) Method

(5 marks)

(iv) Variables controlled

(2 marks)

(v) Data to be collected

(2 marks)

GO ON TO THE NEXT PAGE

(vi) Discussion of Results as it relates to your hypothesis

(2 marks)

(vii) Possible sources of error

(2 marks)

Total 16 marks

END OF TEST

TEST CODE **01212020**

FORM TP 2005059

MAY/JUNE 2005

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

1 hour 45 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. There are FIVE questions in this booklet. Answer ALL questions.
2. You MUST use this answer booklet when responding to the questions. For each question, write your answer in the space provided and return the answer booklet at the end of the examination.
3. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
4. The use of non-programmable calculators is allowed.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

NOTHING HAS BEEN OMITTED

Answer ALL questions.

DO NOT spend more than 30 minutes on Question 1.

1. (a) One can usually follow the rate of a reaction by monitoring the rate of disappearance of the reactant or appearance of the product. When aqueous sodium thiosulphate ($Na_2S_2O_3$) reacts with hydrochloric acid, a precipitate of sulphur, sulphur dioxide, sodium chloride and water are formed as the only products. The rate of this reaction can be followed by measuring the time taken for a certain amount of sulphur precipitate to be formed.

A student investigates the effect of temperature on the rate of this reaction. Figure 1 below shows the stopwatch times taken for a fixed amount of sulphur precipitate to appear and the corresponding thermometer readings. The concentrations of all the reactants are kept constant in these experiments.

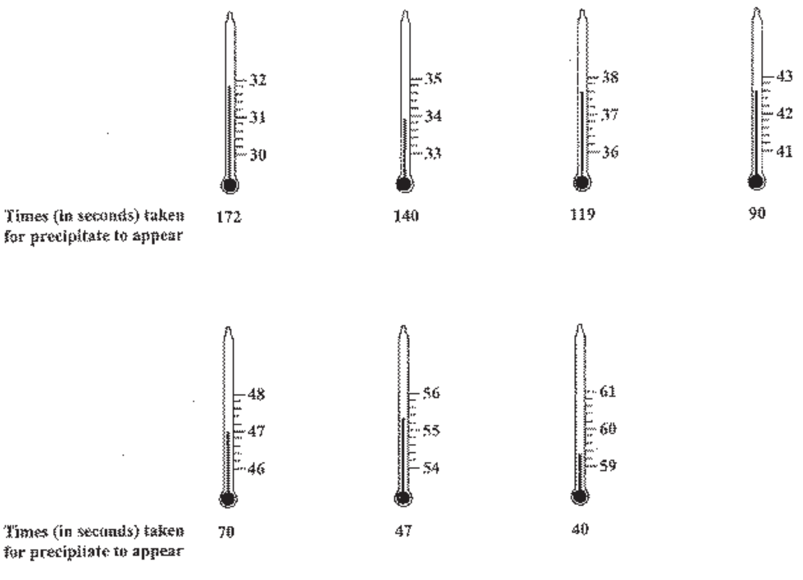


Figure 1: The stopwatch times for the appearance of sulphur and the respective thermometer readings.

(i) In the space below, construct a suitable table and record on it, the temperatures at which the reaction took place with the corresponding times in seconds for the formation of sulphur.

(4 marks)

(ii) Using the graph paper provided on page 5, plot a graph of temperature versus time in seconds. **(3 marks)**

(iii) What conclusion can be drawn about the rate of the reaction from the graph?

....

....

(1 mark)

(iv) From the graph, determine the time expected to be taken for the appearance of the sulphur precipitate if the reaction were carried out at 50°C. Indicate on your graph how you arrived at your answer.

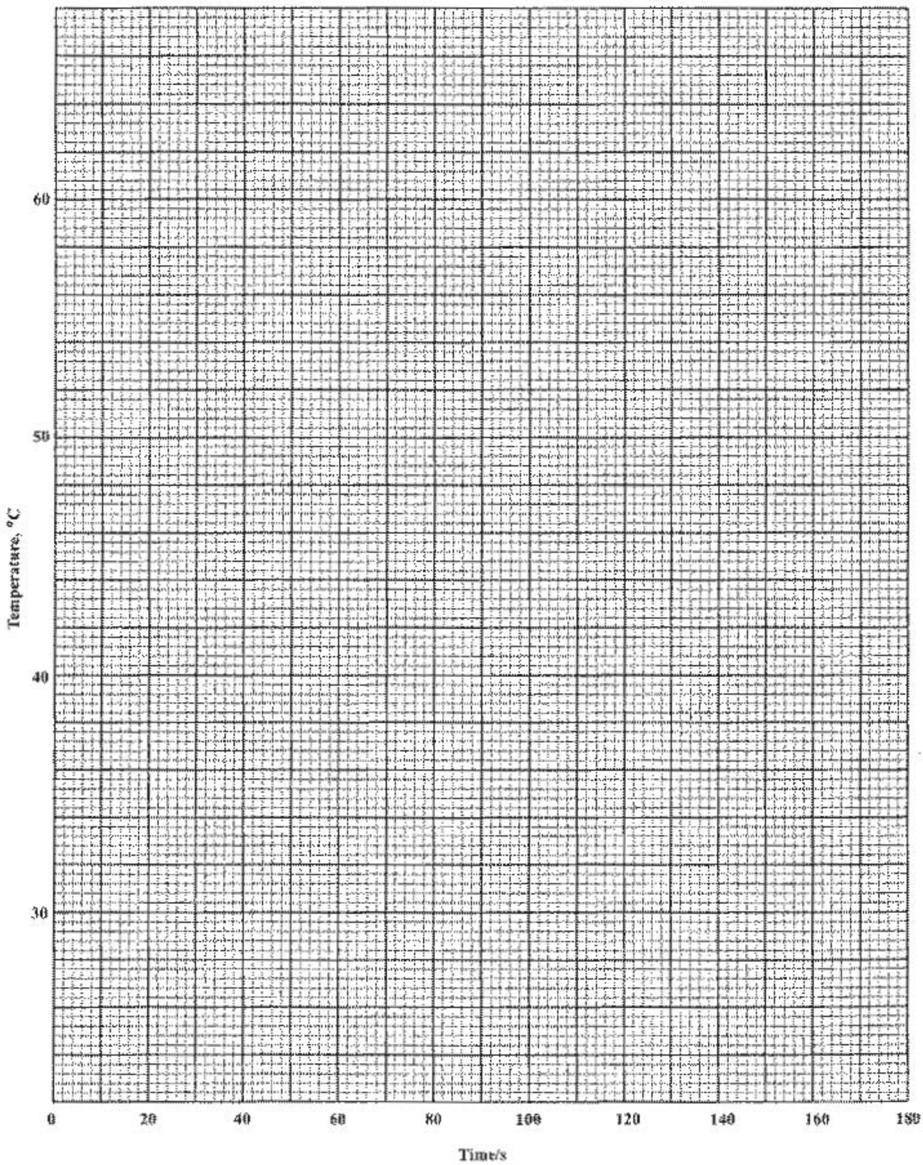
....

(2 marks)

(v) From the information given on page 3 in the introduction to this question, write a balanced chemical equation for the reaction between aqueous sodium thiosulphate and hydrochloric acid.

....

(2 marks)



GO ON TO THE NEXT PAGE

(b) Y is a mixture of two salts. A student carries out a number of tests on a sample of Y. The observations are recorded in Table 1 below. You are required to fill in the inferences that can be made based on the observations recorded.

TABLE 1: RESULTS OF VARIOUS TESTS ON SAMPLE Y

Test	Observations	Inferences
(i) Heat a small portion of solid Y in a test tube, gently at first and then strongly.	• colourless gas evolved with a choking odour • turns acidified potassium dichromate solution from orange to green	
(ii) To the remaining portion of solid Y, add 20 cm^3 of distilled water, stir to dissolve and filter.. Collect the filtrate and divide into three (3) equal portions.	• filtrate is pale green in colour	
(iii) To the first portion of the filtrate from (b) above, add aqueous sodium hydroxide slowly until in excess.	• a green precipitate is formed • insoluble in excess aqueous sodium hydroxide	(ionic equation required)
(iv) To the second portion of the filtrate from (b) above, add aqueous silver nitrate followed by aqueous ammonia.	• white precipitate is formed • insoluble in aqueous ammonia	
(v) To the third portion of the filtrate from (b) above, add aqueous barium nitrate followed by aqueous nitric acid.	• a white precipitate is formed • precipitate readily dissolves in aqueous nitric acid with the evolution of a colourless gas with a choking odour.	

(10 marks)

(c) A group of students synthesizes ethanoic acid (acetic acid) by three different routes in the laboratory. Each route involves a different number of steps as shown in Figure 2.

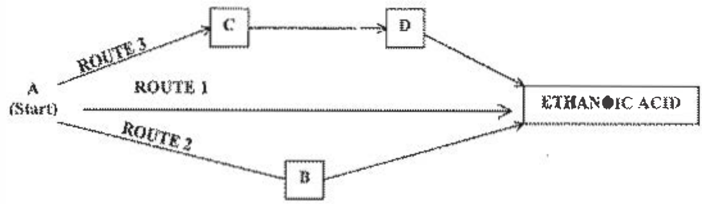


Figure 2: Steps in synthesizing ethanoic acid.

Route 1 involves one step
Route 2 involves two steps
Route 3 involves three steps

Plan and design an experiment to determine which route yields the highest percentage of ethanoic acid starting from A.

Your answer should include the following:

(i) Hypothesis to be tested

___

___

___

(ii) Materials and apparatus

___

___

___

GO ON TO THE NEXT PAGE

(iii) Method

(iv) Variables controlled

(v) Data to be collected

(vi) Results linked to hypothesis

(8 marks)

Total 30 marks

GO ON TO THE NEXT PAGE

2. Atoms of an element, ${}^{19}_{9}A$, readily combine with those of another element, ${}^{27}_{13}B$.

(a) Draw a labelled diagram to illustrate the number of protons, neutrons and electrons present in an atom of B.

(3 marks)

(b) To which group of the periodic table does element A belong? Give a reason for your answer.

Element A belongs to Group ____________________

Reason: ____________________

____

(2 marks)

(c) What type of chemical bonding will be formed when A combines with B? Give a reason for your answer.

Type of chemical bonding: ____________________

Reason: ____________________

____

____

(3 marks)

(d) Write the chemical formula of the compounds expected to be formed when

(i) atoms of element A combine with those of element B

Chemical formula: ____________________

(1 mark)

(ii) atoms of element A combine with each other.

Chemical formula: ____________________

(1 mark)

GO ON TO THE NEXT PAGE

(iii) Based on your answer in (d) (i) on page 9 and the information given in the question, calculate the mass of compound that will be formed when 54g of B reacts completely with A.

____

____

____

(2 marks)

(e) State THREE likely differences in the properties of the compound formed in (d) (i) when compared to the compound formed in (d) (ii).

THREE differences in properties: ______________________

____

____

____

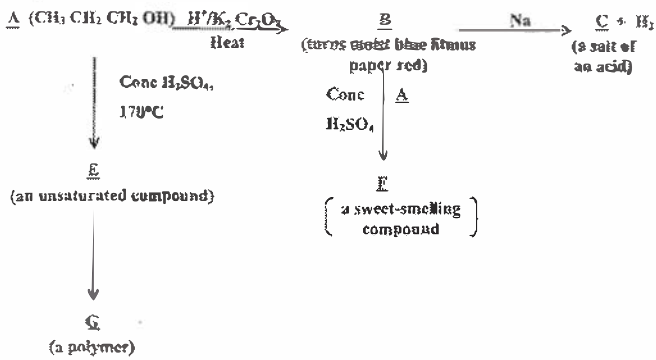
____

(3 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

3. Carefully study the information given in the following reaction scheme and answer the questions which follow. The structure of A has been identified for you.



(a) Draw FULLY DISPLAYED chemical structures for EACH of the following organic compounds identified in the reaction scheme above.

C

E

F

(6 marks)

(b) Draw the partial structure of the polymer G to show THREE repeating units.

(2 marks)

(c) Name the type of reaction involved in the conversion of

(i) A to E: ____________________

(ii) B to F: ____________________

(2 marks)

(d) Describe a chemical test to identify the functional group present in compound E.

In your answer you should indicate the reagent to be used and write a chemical equation for the reaction which occurs.

Reagent: ____________________

Equation: ____________________

(2 marks)

(e) State the reagents and reaction conditions necessary to convert:

(i) E to A

Reagent(s): ____________________

Reaction condition: ____________________

(ii) F to B

Reagent(s): ____________________

Reaction condition: ____________________

(4 marks)

Total 16 marks

4. (a) When chemical reactions occur, heat may be given off or taken in from the environment.

What changes occur during a reaction that can account for this fact?

____

____

____

____

(3 marks)

(b) (i) Define the term 'heat of neutralization'.

____

____

(1 mark)

(ii) It is observed that whenever a strong acid (such as HCl or HNO_3) is completely neutralized by a strong base (such as NaOH or KOH), the heat of neutralization (in kJ mol^{-1}) is the same.

Account for this observation.

____

____

____

____

(2 marks)

(c) When 12.0 g potassium nitrate (KNO_3) is dissolved in 100 cm^3 of water, the temperature drops by 4.20 °C.

Relative atomic mass: K = 39, N = 14; O= 16
Specific heat capacity of water = 4.2 J g^{-1} K^{-1}
Heat change = M x C x ΔT
1 cm^3 of solution = 1 g

(i) Using the above information calculate EACH of the following:

a) The number of moles of KNO_3 used in the experiment

____

____

(1 mark)

b) The heat change for the reaction

____

____

(1 mark)

c) The enthalpy change in kJ mol^{-1} for the reaction

____

____

(2 marks)

(ii) State ONE assumption you made in your calculation.

____

____

(1 mark)

(iii) Draw a labelled energy profile diagram to represent the enthalpy change for the reaction.

(3 marks)

Total 14 marks

GO ON TO THE NEXT PAGE

5. The spacecraft Voyager detected the presence of a new element, Q, on the planet Mars. The following data on this element were transmitted back to earth.

Relative Atomic Mass	333
Melting Point	1280 °C
Number of valence electrons	2

(a) Would Q to be electrically conducting or not? Give a reason for your answer.

____

____

(2 marks)

(b) State the expected reaction of Q with water. Include a chemical equation.

____

____

____

(3 marks)

(c) Further investigations reveal that on exposure to oxygen, the metal Q becomes chemically inert. State a possible reason for this.

____

____

____

(2 marks)

(d) A compound of Q, suspected to be a nitrate, has also been detected on Mars.

How would the effect of heat on this metal nitrate of Q differ from that of sodium nitrate?

Illustrate your answer by means of suitable chemical equations.

Effect of heat on sodium nitrate: ______________________________

____

Effect of heat on the nitrate of Q: ______________________________

____

(4 marks)

(e) Briefly outline how a dry sample of the sulphate of Q can be prepared from a sample of the metal nitrate of Q.

Include an ionic equation to illustrate your method of preparation.

____

____

____

____

____

____

(4 marks)

Total 15 marks

END OF TEST

TEST CODE **01212030**

FORM TP 2005060

MAY/JUNE 2005

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 03 – General Proficiency

1 hour

27 MAY 2005 (a.m.)

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. **In addition to the 1 hour, candidates are allowed a reading time of 10 minutes. Writing may begin during the 10-minute period.**
2. **Answer THREE questions on this paper, ONE from Section A, ONE from Section B and ONE from Section C.**
3. **All working MUST be shown for calculations.**
4. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A

Answer ONE question from this section.

1. (a) (i) Describe ONE piece of experimental evidence for the existence of the particulate nature of matter. **(2 marks)**

(ii) Water can exist as solid ice, liquid water or gaseous steam in spite of the fact that the individual particles in these three states are the same.

Explain the differences between these three states in terms of the arrangement of their particles, forces of attraction between them, and their kinetic energy. **(6 marks)**

(b) Discuss how it is possible for gaseous pollutants emitted from a factory to affect areas far removed from its source. You should include in your answer the role of the air molecules in this process. **(4 marks)**

(c) The experimental arrangement in Figure 1 is set up by a group of students.

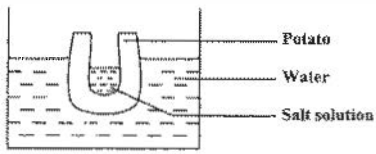


Figure 1: Diagram showing arrangement at start of experiment.

(i) What phenomenon are the students investigating? **(1 mark)**

(ii) Make a drawing of Figure 1 in your answer booklet. Next to it make another drawing to show any changes which may have occurred after two hours. **(2 marks)**

(iii) Suggest reasons for the changes you described in (ii) above. **(2 marks)**

(d) Figure 2 on page 3 shows the solubility curves for two substances, X and Y. Use this information to answer the following questions:

(i) Which of the two substances, X or Y, has a greater solubility at 10°C? **(1 mark)**

(ii) Calculate the mass of Y which would be deposited when its saturated solution is cooled from 80°C to 20°C.

Show your method of calculation. **(2 marks)**

Total 20 marks

GO ON TO THE NEXT PAGE

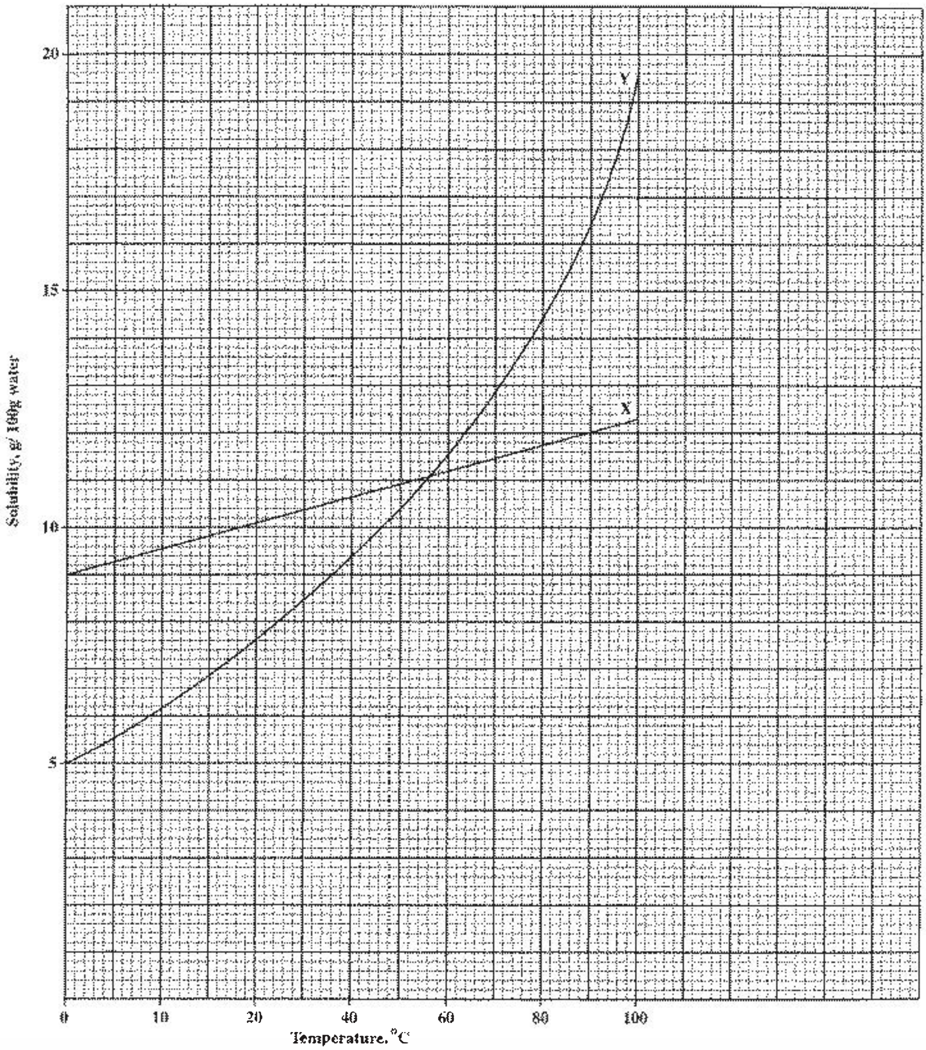


Figure 2: Solubility curves of X and Y

GO ON TO THE NEXT PAGE

2. The element chromium (Cr) forms a number of compounds in which chromium exhibits different oxidation numbers. Chromium, unlike iron, is also highly resistant to corrosion and, as such, it is widely used to chrome-plate metal objects.

(a) (i) Potassium dichromate ($K_2 Cr_2 O_7$) is a common reagent in a school's laboratory.

Describe ONE use of potassium dichromate as a laboratory reagent.

Your answer should include the test it is used for, the method of carrying out the test and any colour changes expected. **(4 marks)**

(ii) Calculate the oxidation number of chromium in potassium dichromate ($K_2 Cr_2 O_7$) and in chromium sulphate ($Cr_2 (SO_4)_3$). **(2 marks)**

(iii) Based on your answer in (ii) above, deduce the type of reaction which occurs when $K_2 Cr_2 O_7$ is converted to $Cr_2 (SO_4)_3$. **(1 mark)**

(b) In many Caribbean countries steel pans, in particular the tenor pans, are electroplated with chromium. Chrome-plating is believed to improve the pitch of the pan.

(i) Describe how a tenor pan could be chrome-plated.

You should include in your answer:

- the electrolyte to be used
- the nature of the electrodes
- equations for the reactions occurring at EACH electrode
- precautions to be taken to ensure that the chrome layer does not peel off

(8 marks)

(ii) Given that the mass of the chromium needed to plate a tenor pan is 0.52kg, calculate the length of time (in seconds) that a current of 20.0A would have to flow through the electrolytic cell to plate the pan.

Use the following data in your calculation:

Relative Atomic Mass: Cr = 52
1 Faraday = 96,000 coulombs. **(5 marks)**

Total 20 marks

SECTION B

Answer ONE question from this section.

3. (a) Explain how the electronic configuration of the carbon atom, ${}^{12}_{6}C$, can account for the fact that the bonding in carbon compounds is covalent rather than ionic. You should use the bonding in methane to illustrate your answer. **(5 marks)**

(b) Alkanes are relatively unreactive compounds. However, under certain conditions, they may undergo reactions with chlorine.

Write a balanced equation for the reaction between methane and chlorine. Include in your answer the reaction conditions and the type of reaction taking place. **(3 marks)**

(c) By including certain functional groups such as the $\rangle C = C\langle$, –OH or –COOH to the alkane structure, the reactivity greatly increases.

(i) a) Identify an alkene and an acid from among the following compounds:

C_3H_8, $C_3H_6O_2$, C_3H_6, C_3H_8O

b) Draw and name the structures you identified in (c) (i) a) above. **(6 marks)**

(ii) Describe ONE chemical reaction in EACH case which can be used to illustrate the differences in REACTIVITY between

a) an alkane and an alkene
b) an alkane and a carboxylic acid.

In EACH case you should include a chemical equation in your answer. **(4 marks)**

(d) (i) Name the industrial process which is used to bring about conversion of the following types:

$$\underset{\text{(long chain alkanes)}}{CH_3CH_2CH_2CH_2CH_2CH_3} \longrightarrow \underset{\text{(short chain alkanes) + alkenes}}{CH_3CH_2CH_3 + HC_2 = CHCH_3}$$

(ii) State ONE advantage of the process you named in (d) (i) above. **(2 marks)**

Total 20 marks

GO ON TO THE NEXT PAGE

4. (a) The electrochemical series is a convenient way for arranging metals. A metal's position in the electrochemical series can give information about its properties and uses.

Use the principles for placing metals in the electrochemical series to explain the following observations.

(i) Copper, silver and gold are used to make coins but magnesium, sodium and calcium are not. Support your answer with a suitable ionic equation. **(6 marks)**

(ii) When a zinc rod is placed in a copper sulphate solution, after a while a brown deposit (precipitate) is produced, the zinc rod gets smaller and the blue colour of the solution fades. However, there is no visible change when a copper rod is placed in a zinc sulphate solution. Support your answer with a suitable equation. **(6 marks)**

(iii) Iron and aluminium are both extracted from ores mined from the earth. However, different methods are used to extract each metal from its ore. You should state in your answer the names of the methods of extraction used. **(5 marks)**

(b) Sometimes a metal is most useful when it is pure. However, many metals are more useful when they contain a small percentage of one or more additional metals.

Suggest why copper wire might be more useful when it is pure but iron is almost never used in its pure form. **(3 marks)**

Total 20 marks

SECTION C

Answer ONE question from this section.

5. Dough is a mixture consisting of flour, water and a leavening agent as the major ingredients. During the making and baking of the dough, a number of important physical and chemical changes take place.

(a) Discuss the role of EACH of the following in the making and baking of a dough:

- water
- gluten
- leavening agent (both yeast and baking powder)
- heat

Include in your answer THREE relevant chemical equations, with at least ONE equation EACH, from the action of yeast and baking powder. **(14 marks)**

(b) Flour usually consists of between 65 – 80% carbohydrates (starches). Iodine can be used to test for the presence of starches.

(i) There is no blue-black colouration when flour, which is stored in a hot, humid room for a long time, is tested with iodine.

Suggest a possible explanation for this. Include an appropriate chemical equation in your answer. **(4 marks)**

(ii) Carbohydrates are polymers of simple sugars. Using the symbol $OH - \boxed{} - OH$ to represent a simple sugar, show how THREE of these units can be linked together to form part of the polymer chain found in carbohydrates present in flour. **(2 marks)**

Total 20 marks

6. Canning is one of the most widely used methods of food preservation in use today. Table 1 below lists the steps involved in the canning of fruits.

TABLE 1: CANNING OF FRUITS

Steps involved in canning of fruits	Purpose
1. Sorting/peeling/ washing/slicing	
2. Blanching	
3. Addition of brine/syrup to can filled with fruits	
4. Creation of vacuum	Removal of air (oxygen) thus providing an unfavourable environment for the growth of many microorganisms; prevents oxidation reactions which can affect food flavour.
5. Sealing	
6. Sterilization	
7. Rapid cooling	

(a) (i) Copy Table 1 in your answer booklet. In the blank spaces, fill in the purpose of steps 2, 3, 5, 6 and 7 in the canning process. **(5 marks)**

(ii) Nicin, an antibiotic, is often added after step 3 of the canning process. Suggest a possible reason for this. **(2 marks)**

(b) You are required to select one of two metals, A or B, to coat steel cans for canning fruit juices. Metal A is just above hydrogen and metal B is just below hydrogen in the electrochemical series.

Which of these two metals would be more suitable? You should include in your answer:

(i) A discussion on

- the need for coating the steel cans
- the rationale for selecting one metal over the other
- any possible limitations of your recommendations. **(9 marks)**

(ii) Any relevant chemical equations **(4 marks)**

Total 20 marks

END OF TEST

TEST CODE **01212020**

FORM TP 2006006

JANUARY 2006

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

1 hour and 45 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. **There are FIVE questions in this booklet. Answer ALL questions.**
2. **You MUST use this answer booklet when responding to the questions. For each question, write your answer in the space provided and return the answer booklet at the end of the examination.**
3. **Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.**
4. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Answer ALL questions.

Do NOT spend more than 30 minutes on Question 1.

1. (a) A student is provided with two solutions, **X** and **Y**. **X** is aqueous sulphuric acid containing 4.9 g dm^{-3}.

Y is an aqueous sodium hydroxide solution which was prepared by dissolving 5.0 g of impure sodium hydroxide in 1 dm^3 of solution.

The student titrates **X** against 25.0 cm^3 of **Y** in order to determine the purity of the sodium hydroxide.

Figure 1 below shows the readings on the burette before and after each titration against 25 cm^3 of solution **Y**.

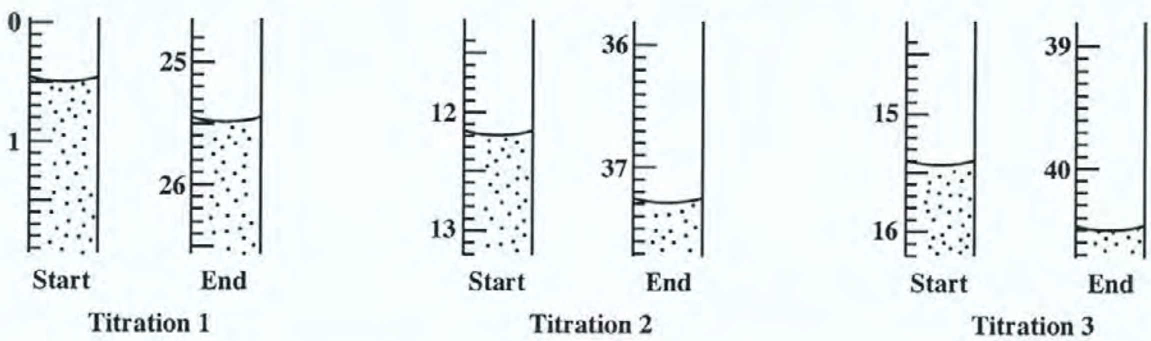


Figure 1. Readings on the burette

(i) In the space below construct Table 1 to record the titration results. You should include the initial and final burette volumes and the volume of solution **X** used.

TABLE 1

(7 marks)

GO ON TO THE NEXT PAGE

(ii) What is the volume of **X** to be used for calculation?

____

(1 mark)

(iii) Calculate the concentration of sulphuric acid in solution **X** in mol dm^{-3}.

(Relative atomic mass: H = 1; S = 32; O = 16)

____

____

____

(1 mark)

(iv) Calculate the number of moles of sulphuric acid used in the titration.

____

____

(1 mark)

(v) Write a balanced equation for the reaction between the sulphuric acid and sodium hydroxide solutions.

____

(2 marks)

(vi) Determine the number of moles of sodium hydroxide in the 25 cm^3 of solution used.

____

(1 mark)

(vii) Calculate the concentration of NaOH in g dm^{-3}.

(Relative atomic mass: Na = 23; O = 16; H = 1)

____

____

____

____

(2 marks)

(viii) Calculate the percentage purity of the sodium hydroxide solution.

____

____

(1 mark)

(b) Stearic acid is solid organic acid with a melting point less than 100 °C. A student conducts an experiment to determine the melting point of stearic acid. Table 2 shows the data collected by the student.

TABLE 2

Time / min	0	0.5	1.5	2.0	2.5	3.0	5.0	7.0	8.5	9.5	10.0
Temperature / °C	19	29	40	48	53	55	55	55	64	73	74

(i) Draw a fully labelled diagram of the arrangement of the apparatus that the student may have used for conducting the experiment.

(3 marks)

(ii) Using the graph paper on page 5, plot a graph of temperature against time.

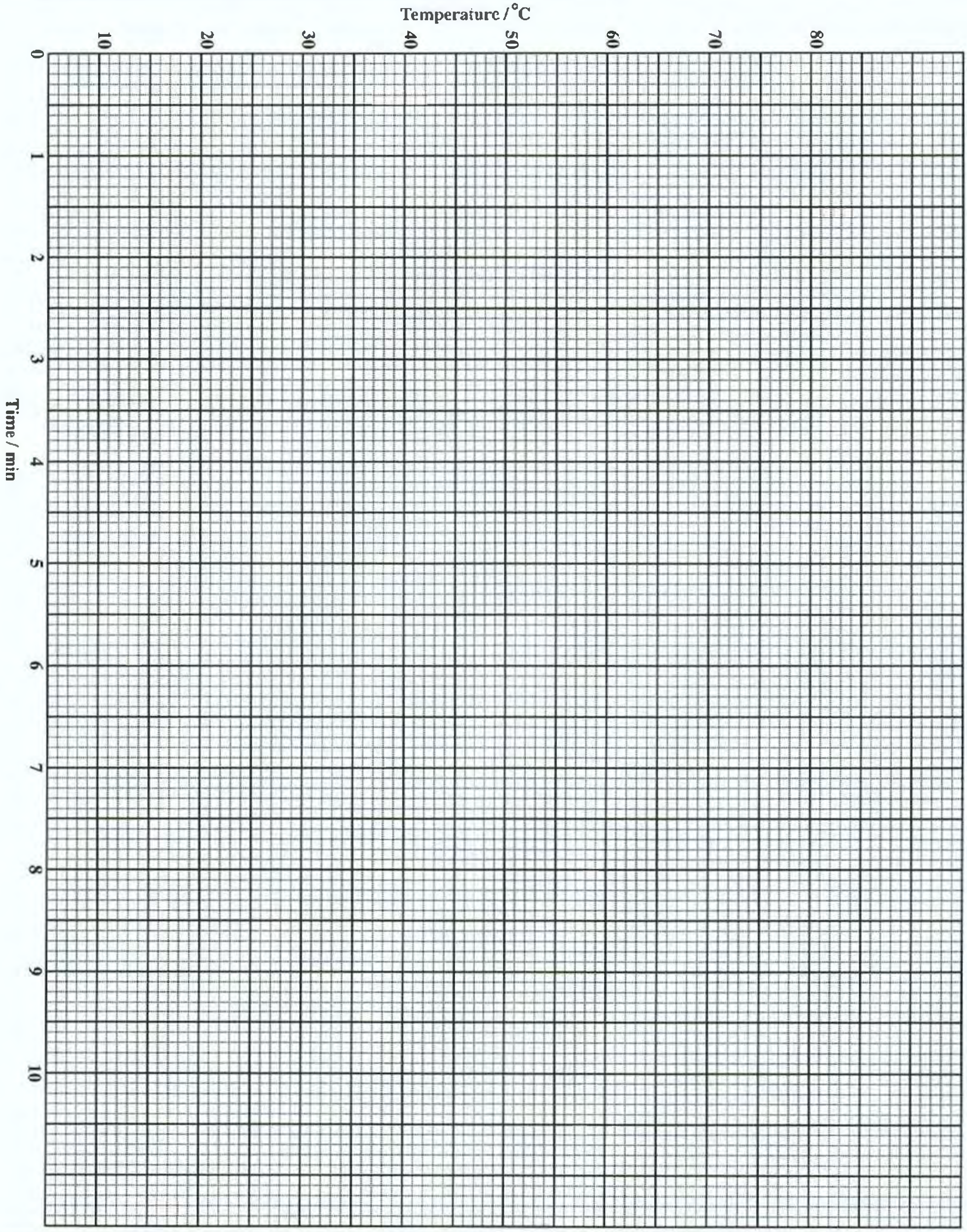
(4 marks)

(iii) From the graph determine the melting point of stearic acid.

____

(1 mark)

GO ON TO THE NEXT PAGE


Temperature / °C
10
20
30
40
50
60
70
80
Time / min
0
1
2
3
4
5
6
7
8
9
10

(c) A student conducts a number of tests on an aqueous solution of compound **P**. Some of the observations and inferences made are recorded in Table 3. You are required to complete the missing observations and inferences.

TABLE 3

Test	Observation	Inference
(i) To a sample of solution **P**, dilute nitric acid is added, followed by a few drops of silver nitrate solution.	**(1 mark)**	No Cl^-, Br^- or I^- ions present
(ii) To a sample of solution **P**, a few copper turnings are added, followed by concentrated sulphuric acid.	Brown fumes evolve which turn moist blue litmus red.	**(1 mark)**
(iii) To a sample of solution **P**, a few drops of acidified aqueous potassium manganate (VII) solution are added.	The potassium manganate (VII) solution changes from purple to colourless.	**(1 mark)**
(iv) To a sample of solution **P**, aqueous sodium hydroxide is added, until in excess.	• A green precipitate forms. • The precipitate is insoluble in excess sodium hydroxide.	**(1 mark)** (Ionic equation required) **(2 marks)**

Total 30 marks

GO ON TO THE NEXT PAGE

2. Steve places a zinc nail in a beaker containing aqueous copper (II) sulphate. Figures 2a and 2b indicate what happens to the contents of the beaker over a three-day period.

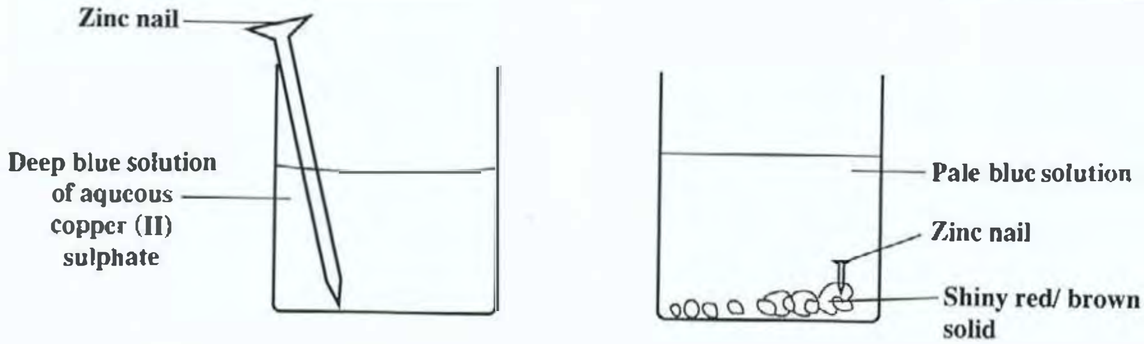


Figure 2a.
Start of experiment

Figure 2b.
Experiment after 3 days

(a) Based on the observed differences between Figures 2a and 2b, name TWO ions that would most likely be present in the beaker after three days.

____

(2 marks)

(b) Write ionic equation(s) to show the reactions that take place in the beaker in Figure 2b. Explain why these reactions occur.

Ionic equation(s): ______________________________

____

Explanation: ______________________________

____

(4 marks)

(c) Name the type of chemical reaction occurring in the experiment.

____

(1 mark)

(d) Comment on how the RATE OF REACTION might be affected if the zinc nail is replaced by EACH of the following:

(i) Magnesium metal

(ii) Lead

Explain your answer.

(i) Magnesium replaces zinc.

Observation: ______________________________

____

Explanation: ______________________________

____

(ii) Lead replaces zinc.

Observation: ______________________________

____

Explanation: ______________________________

____

(6 marks)

(e) Steve modifies the apparatus in the experiment as shown in Figure 3 below.

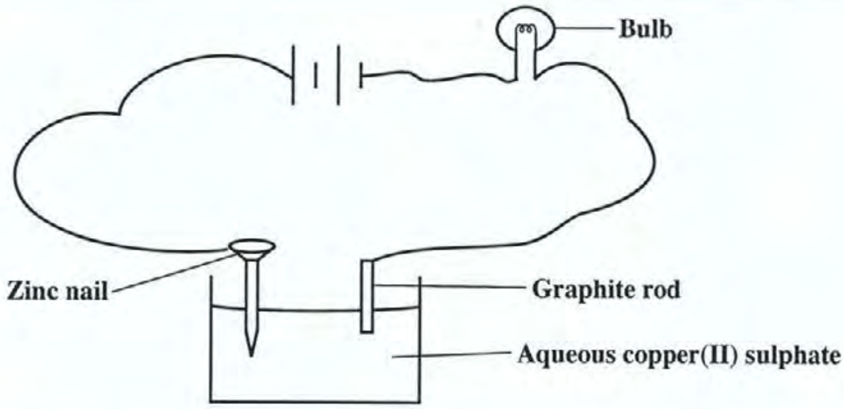


Figure 3. The modified experiment

(i) State what effect this experimental arrangement will have on the bulb.

____

(1 mark)

(ii) Explain your answer in (e) (i).

____

____

____

(2 marks)

Total 16 marks

3. Lauri conducts an experiment to investigate how the mass of a catalyst, manganese (IV) oxide, affects the rate of production of oxygen during the decomposition of hydrogen peroxide (H_2O_2). Water and heat are also produced during the decomposition.

(a) (i) Name THREE factors OTHER THAN a catalyst, which can affect the rate of a chemical reaction.

____

(3 marks)

(ii) Write a balanced equation to show the decomposition of hydrogen peroxide by manganese (IV) oxide, MnO_2.

____

(2 marks)

(b) Figure 4 on page 11 shows the rate of decomposition of hydrogen peroxide, as a plot of grams of oxygen liberated per second against mass of catalyst for both 0.40 and 0.80 mol dm^{-3} hydrogen peroxide.

(i) Explain why the plots in Figure 4 are different.

____

____

____

(2 marks)

(ii) For 0.80 mol dm^{-3} H_2O_2 and 4.0 g of catalyst, determine EACH of the following:

a) The quantity of O_2 produced in 16 seconds

____

b) The number of moles of O_2 produced in 16 seconds

[Atomic mass: O = 16]

____

____

c) Volume of O_2 produced at S.T.P. in 16 seconds

[1 mole of gas occupies 22.4 dm^3 at S.T.P.]

____

____

(5 marks)

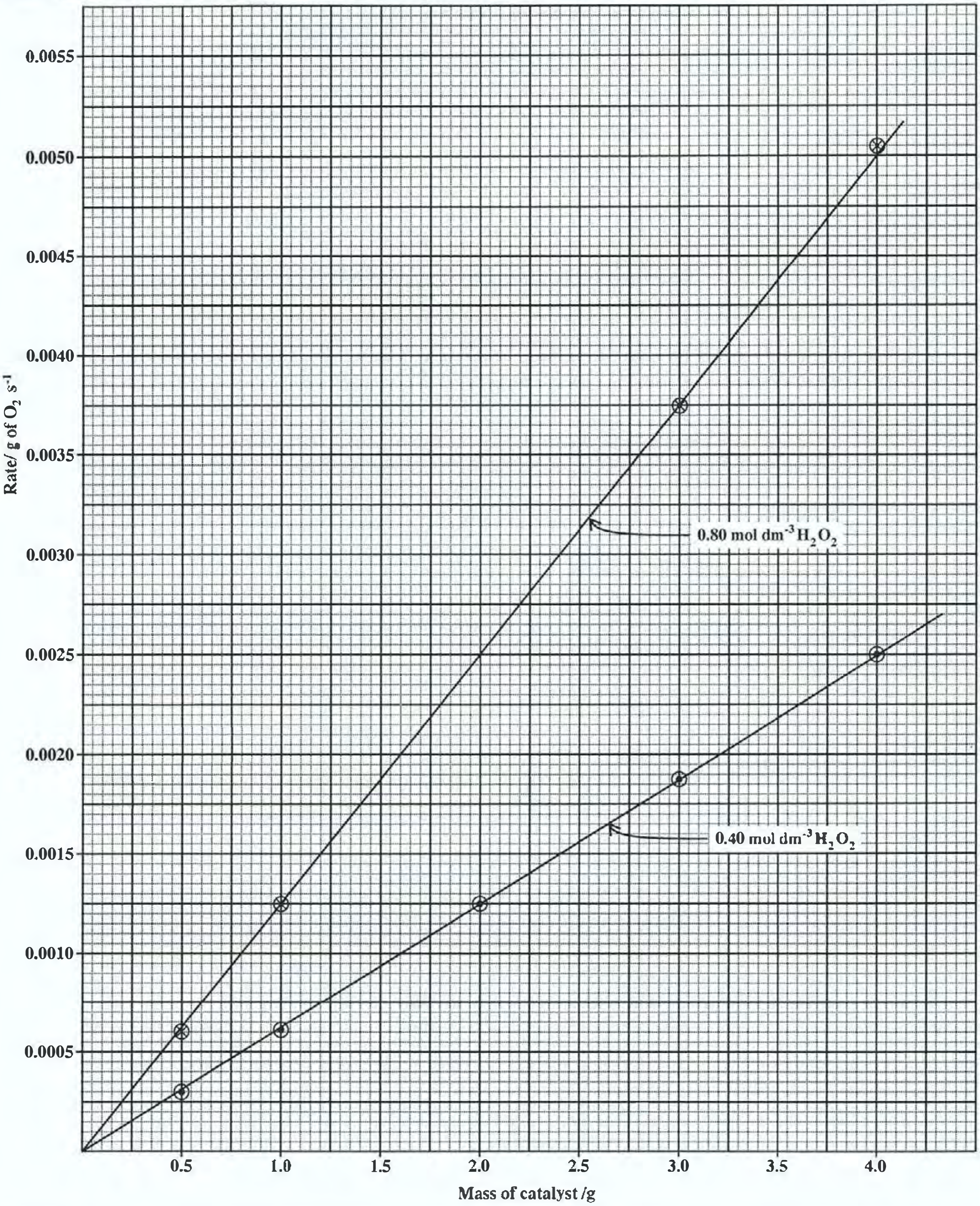


Figure 4. Rate of decomposition of H_2O_2

GO ON TO THE NEXT PAGE

(c) Draw a fully labelled energy profile diagram to illustrate how the catalyst affects the rate of decomposition of hydrogen peroxide.

(3 marks)

Total 15 marks

4. Ethene is processed from crude oil in two stages. First the crude oil is separated into fractions; then ethene is produced from some of these fractions by a process known as cracking.

(a) (i) What is meant by the term 'cracking'?

____

____

____

(1 mark)

(ii) Write a balanced equation to illustrate how ethene is formed by the cracking of C_8H_{18}.

____

(2 marks)

(b) Ethene reacts with chlorine to form 1, 2 – dichloroethane.

(i) Write a balanced equation to show this reaction.

____

(2 marks)

GO ON TO THE NEXT PAGE

(ii) 1, 2 – dichloroethane can be decomposed to form chloroethene ($CH_2 = CHCl$) and hydrogen chloride.

Describe a test that can be used to distinguish between 1, 2 – dichloroethane and chloroethene in the laboratory.

Reagent: ____________________

Observation: ____________________

____

(3 marks)

(iii) The boiling points of the components in (b) (ii) above are shown in Table 4 below.

TABLE 4

Compound	**Boiling point / °C**
1, 2 – dichloroethane	87.3
Chloroethene	– 13.9
Hydrogen Chloride	– 85

Based on the data in Table 4, suggest a suitable technique that can be used to separate chloroethene from the reaction mixture.

____

(1 mark)

(c) Poly (chloroethene), (PVC), is a polymer, which is made from chloroethene.

(i) Write an equation to illustrate how a partial structure of PVC is formed from its monomer, chloroethene.

(2 marks)

(ii) Name the polymerization process which occurs in the formation of PVC.

____

(1 mark)

(iii) Name a polymer that is formed by a process which is different from that of PVC, and the type of linkage which occurs in that polymer.

Name of polymer: ______________________________

Type of polymerization process: ______________________________

Type of linkage: ______________________________

(3 marks)

Total 15 marks

5. Table 5 gives information about two metals, **A** and **B**, and their oxides.

TABLE 5

	Metal			**Oxide of metal**	
	Valency	**Action of air**	**Action of water**	**Action of hydrogen**	**Action of heat**
A	2		Unaffected by steam at red heat		Decomposes to metal
B	1	Readily burns in air to form oxide		Not decomposed by hydrogen	

(a) Complete Table 5 by writing in the missing information. **(4 marks)**

(b) Using the hypothetical symbols **A** and **B**, as shown in Table 5, write balanced equations for the reactions between

(i) **A** and air

____

(2 marks)

(ii) **B** and water.

____

(2 marks)

(c) Use a suitable dot cross diagram to show the formation of the bond between **B** and oxygen.

(3 marks)

(d) Account for the differences between the reactivities of the oxides of the metals **A** and **B**.

____

____

(3 marks)

Total 14 marks

END OF TEST

TEST CODE **01212030**

FORM TP 2006007

JANUARY 2006

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 03 – General Proficiency

1 hour

17 JANUARY 2006 (p.m.)

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. **In addition to the 1 hour, candidates are allowed a reading time of 10 minutes. Writing may begin in the 10-minute period.**
2. **Answer THREE questions on this paper, ONE from Section A, ONE from Section B and ONE from Section C.**
3. **All working MUST be shown for calculations.**
4. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

NOTHING HAS BEEN OMITTED

SECTION A

Answer ONE question from this section.

1. One mole of an element **X** (atomic number = 11) reacts with chlorine to form one mole of its chloride of mass 58.5 g mol^{-1}.

(a) (i) Based on the information given above, calculate the relative atomic mass of the element **X**.

[Relative atomic mass: C*l* = 35.5] **(2 marks)**

(ii) Write a balanced equation to show the formation of the chloride of **X**. **(2 marks)**

(iii) Describe the type of bonding present in

a) element **X**

b) the chloride of element **X**. **(6 marks)**

(b) (i) How is the bonding present in element **X** different from that in diamond? **(2 marks)**

(ii) How is the bonding present in diamond related to its hardness? **(2 marks)**

(c) Table 1 is an incomplete table of the physical properties of the chloride of **X** and iodine. Copy Table 1 in your answer booklet and fill in the relative corresponding physical properties of the chloride of **X** and of iodine. In filling in the table you should use terms such as high or low melting/boiling points; soluble, very soluble or insoluble; conducting or non-conducting.

TABLE 1

THE PHYSICAL PROPERTIES OF THE CHLORIDE OF X AND IODINE

Property	**Chloride of X**	**Iodine**
Melting point		
Boiling point		
Solubility in water		
Solubility in organic solvents		
Conductivity in water		
Conductivity in organic solvents		

(6 marks)

Total 20 marks

GO ON TO THE NEXT PAGE

2. It is possible to determine the end point in an acid-base reaction by a thermometric titration, such as when H_2SO_4 is titrated against NaOH. Figure 1 on page 5 shows the respective temperature changes on titration of H_2SO_4 against 25 cm^3 of 2.0 mol dm^{-3} NaOH.

(a) Define the terms 'acid' and 'acid salt'. **(2 marks)**

(b) Explain the shape of the graph in Figure 1, in terms of the changes which take place as H_2SO_4 is titrated against 2.0 mol dm^{-3} NaOH. **(2 marks)**

(c) (i) Determine from the graph, the volume of H_2SO_4 required to completely neutralise 25 cm^3 of 2.0 mol dm^{-3} NaOH. **(1 mark)**

(ii) Based on your answer in (c) (i) above, calculate the molar concentration of the H_2SO_4. Include the balanced equation for the reaction in your answer. **(7 marks)**

(iii) Based on your answer in (c) (i) above, determine the heat change at the point of neutralisation.

Heat change $= m \text{ x } c \text{ x } \Delta T$
m = mass of solution, $c = 4.2 \text{ J g}^{-1} \text{ °C}^{-1}$, and ΔT = temperature change

Assume 1 cm^3 of solution to have a mass of 1 g. **(3 marks)**

(d) Maria prepared two salts in the laboratory by combining, as follows:

I: 12.5 cm^3 of 4.0 mol dm^{-3} H_2SO_4 and 25 cm^3 of 4.0 mol dm^{-3} NaOH
II: 25.0 cm^3 of 4.0 mol dm^{-3} H_2SO_4 and 25 cm^3 of 4.0 mol dm^{-3} NaOH

(i) Which of the two salts is an acid salt and which is a normal salt? **(2 marks)**

(ii) Describe how an acid salt can be distinguished from a normal salt. **(3 marks)**

Total 20 marks

GO ON TO THE NEXT PAGE

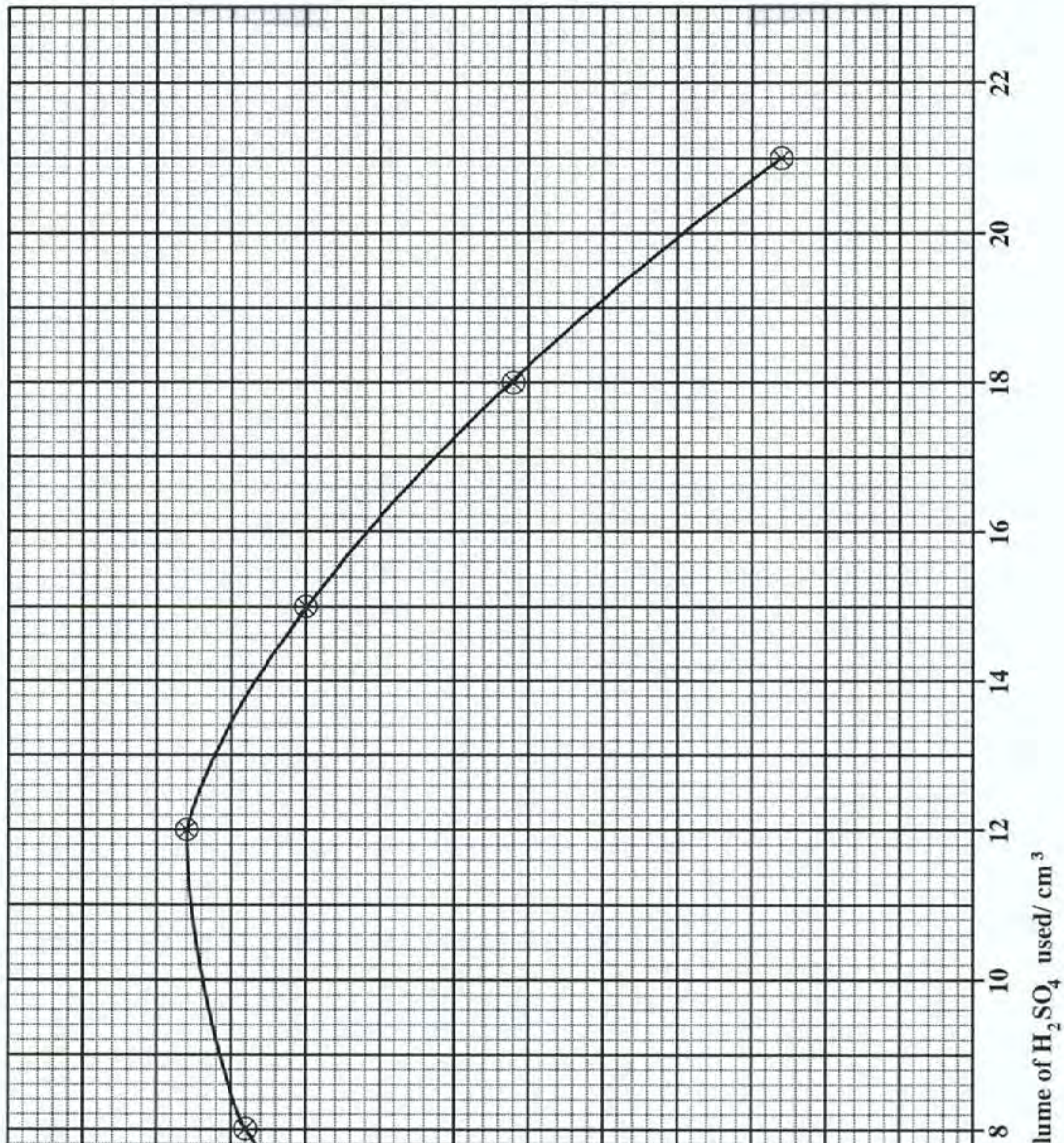

Temperature/ °C
45
40
35
30
25
20
15
0
2
4
6
8
10
12
14
16
18
20
22
Volume of H_2SO_4 used/ cm^3

Figure 1

SECTION B

Answer ONE question from this section.

3. PGE$_1$ is used medicinally to significantly lower blood pressure. PGE$_1$ can react with some known reagents as shown in Figure 2 below.

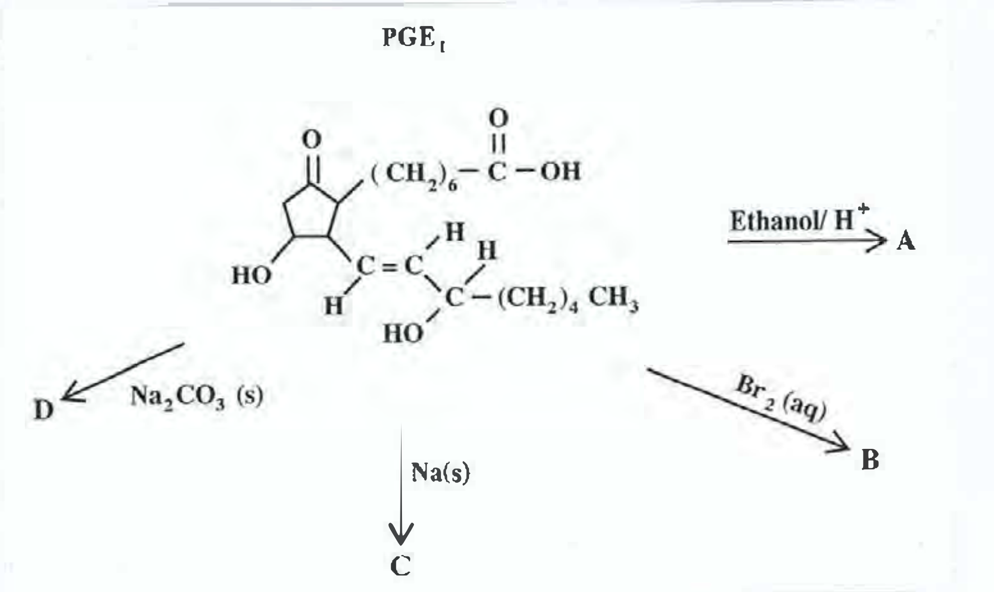


Figure 2. Some reactions of PGE$_1$

(a) (i) Draw the structure of PGE$_1$ in your answer booklet. Circle and name THREE functional groups in the PGE$_1$ structure. **(3 marks)**

(ii) Describe the changes that would be observed when sodium, bromine and sodium carbonate are separately added to PGE$_1$ to form **C**, **B** and **D** respectively. Support your answer with appropriate chemical equations. USE ONLY THE RELEVANT FUNCTIONAL GROUPS AND THE REAGENTS IN WRITING THESE EQUATIONS. **(9 marks)**

(b) Ethanol will also react with PGE$_1$ to produce an organic compound, **A**.

(i) Using only the relevant functional group in the PGE$_1$ molecule, write the equation to show the reaction with ethanol. **(2 marks)**

(ii) Examine the structure of glycerol in Figure 3 below.

Compare the relative solubilities of glycerol and the organic product A, from (b) (i) in water. Give reasons for your answer.

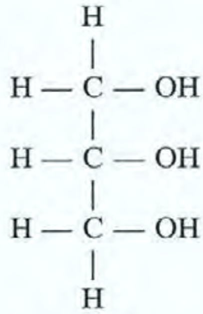


Figure 3. Structure of glycerol

(4 marks)

(c) Assuming that PGE_1 can be represented as shown by Figure 4 below, explain whether it will be possible to form polymers from PGE_1.

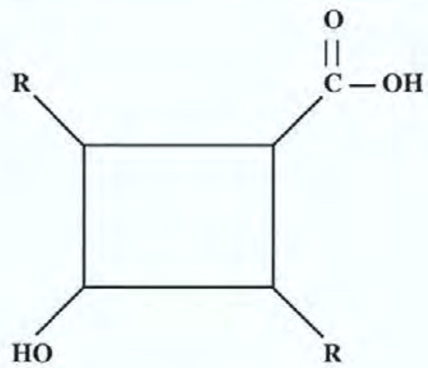


Figure 4. Representation of PGE_1

(2 marks)

Total 20 marks

GO ON TO THE NEXT PAGE

4. Chlorine is manufactured industrially by electrolysis.

(a) (i) With the aid of a labelled diagram, describe this process. Include the following in your answer:

a) The name of the electrolyte
b) The name of the electrodes
c) The reactions occurring at the electrodes **(8 marks)**

(ii) An important by-product in the manufacture of chlorine is NaOH. Using an equation, show how NaOH is produced from this process. **(2 marks)**

(b) (i) List TWO uses of chlorine. **(2 marks)**

(ii) Chlorine is bubbled into two test tubes which contain iodide and fluoride ions as shown in Figure 5 below.

What is expected to be seen in test tube **Y** and test tube **Z**? Give a reason for your answer.

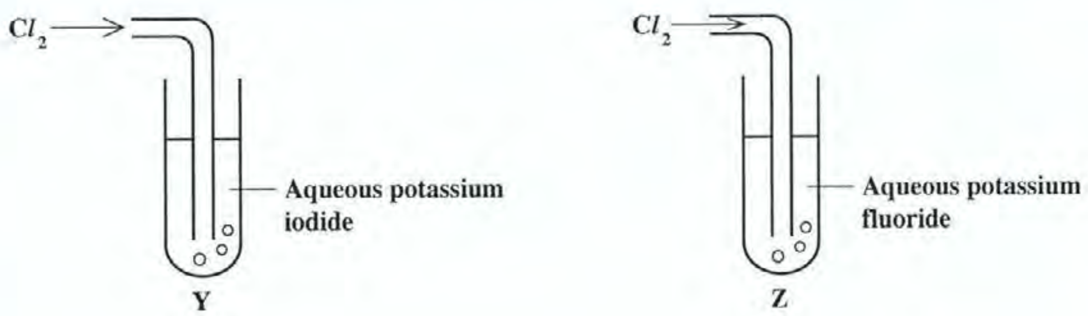


Figure 5. Chlorine bubbled in Y and Z

(4 marks)

(c) Describe how solutions containing Cl^-, Br^-, and I^- ions respectively can be distinguished from one another. **(4 marks)**

Total 20 marks

SECTION C

Answer ONE question from this section.

5. (a) Table 2 shows the names of some common environmental pollutants, with headings of their sources and effects. Copy Table 2 in your answer booklet. Complete Table 2 by writing ONE source and ONE effect of the pollutants. For EACH source, write a relevant balanced equation.

TABLE 2

COMMON POLLUTANTS, THEIR SOURCES AND EFFECTS

Pollutants	Source	Effect
Carbon monoxide		
	Equation:	
Carbon dioxide		
	Equation:	
Oxides of nitrogen		
	Equation:	

(12 marks)

(b) In 1984, scientists discovered a large hole in the ozone layer above Antarctica.

(i) State a possible cause of this hole. **(1 mark)**

(ii) Suggest TWO consequences of the hole in the ozone layer. **(2 marks)**

(iii) Give TWO steps that can be taken to reduce the size of the hole. **(2 marks)**

(c) (i) Define the term 'environment'. **(1 mark)**

(ii) State TWO benefits which can be derived from managing and preserving the environment. **(2 marks)**

Total 20 marks

6. (a) Identify TWO types of active ingredients in laundry detergent and state the mode of action of EACH type identified. **(4 marks)**

(b) The pH of a detergent can affect the integrity of a fabric. Suzie suggested that her friend, Mary, wash her silk dress with a detergent of pH 13 rather than of pH 7.

What advise would you give to Mary? Give a reason for your answer. **(3 marks)**

(c) (i) Identify the active ingredient in toilet bowl cleaners. **(1 mark)**

(ii) Describe the chemical principles on which the action of toilet bowl cleaners is based. Write balanced ionic equations to support your answer. **(3 marks)**

(d) State ONE advantage and TWO disadvantages of the use of EACH of the following waste disposal methods:

(i) Incineration of plastics **(3 marks)**

(ii) Recycling **(3 marks)**

(iii) Landfills **(3 marks)**

Total 20 marks

END OF TEST

TEST CODE **01212042**

FORM TP 2006008

JANUARY 2006

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 04/2 – Alternative to SBA

General Proficiency

2 hours

READ THE FOLLOWING DIRECTIONS CAREFULLY

In addition to the 2 hours allowed for the examination, candidates are allowed 10 minutes in order to read through the entire paper.

Writing may begin during the 10-minute period.

1. **Answer ALL questions on this paper.**
2. **Use this answer booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the answer booklet at the end of the examination.**
3. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Answer ALL questions.

1. (a) In this exercise, you will be required to determine the heat change for the reaction between metals **A** and **B** and aqueous copper (II) sulphate.

You are provided with the following reagents:

- Container, labelled **A**, containing 1.05 g of powdered metal **A**.
- Container, labelled **B**, containing 0.42 g of powdered metal **B**.
- Container, labelled **X**, containing 100 cm^3 of aqueous copper (II) sulphate (2.0 mol dm^{-3}).

Procedure:

(i) Using the measuring cylinder provided, pour 25 cm^3 of solution **X** into the polystyrene cup.

(ii) Using the thermometer provided, measure the initial temperature (T_1) of solution **X**.

(iii) Empty the contents of the container, labelled **A**, into the polystyrene cup. Stir the contents of the cup with the thermometer. Measure the highest temperature (T_2) attained.

(iv) Discard the contents of the polystyrene cup and rinse with distilled water.

(v) Repeat steps (i) to (iii) using instead the contents of the container labelled **B**.

(vi) Record your results in Table 1.

TABLE 1

RESULTS OF EXPERIMENT

Metal	**Initial Temperature (T_1), °C**	**Final Temperature (T_2), °C**	**Change in Temperature ($T_2 - T_1$), °C**
A			
B			

(13 marks)

(b) Calculate EACH of the following:

(i) The number of moles of metal **A** used in the experiment. Assume that the relative atomic mass of **A** is 65.

____

____

(1 mark)

(ii) The number of moles of metal **B** used in the experiment. Assume that the relative atomic mass of **B** is 27.

____

____

(1 mark)

(iii) a) The heat change for the reaction involving metal **A**. Assume that 25 cm^3 of solution **X** is equivalent to 25 g of solution **X**.

[Heat change = mass of solution **X** x 4.2 J g^{-1} $°C^{-1}$ x temperature change]

___

___

(1 mark)

b) The heat change per mole of metal **A**.

___

___

(1 mark)

c) The heat change for the reaction involving metal **B**. Assume that 25 cm^3 of solution **X** is equivalent to 25 g of solution **X**.

[Heat change = mass of solution **X** x 4.2 J g^{-1} $°C^{-1}$ x temperature change]

___

___

(1 mark)

d) The heat change per mole of metal **B**.

___

___

(1 mark)

(iv) Based on your answer in (b) (iii), which of the two metals is more reactive?

___

(1 mark)

Total 20 marks

2. You will be provided with a sample labelled **Y**. **Y** is a mixture of two solids. Carry out the following tests and complete Table 2 below.

TABLE 2

RESULTS OF TEST

Test	Observation	Inference
(i) Divide **Y** into two equal portions. To one portion, add 10 cm^3 distilled water, stir, and then filter. Divide the filtrate into three equal portions. Keep the other portion of the solid for test (v).		
(ii) To the first portion of the filtrate from (i) above, add aqueous ammonia, a little at a time until in excess.	**(1 mark)**	**(2 marks)**
(iii) To the second portion of the filtrate from (i) above, add 5 drops of dilute nitric acid, followed by 5 drops of aqueous potassium manganate (VII).	**(1 mark)**	**(1 mark)**
(iv) To the third portion of the filtrate from (i) above, add aqueous barium chloride, followed by an excess of dilute hydrochloric acid.	**(2 marks)**	**(2 marks)**

GO ON TO THE NEXT PAGE

Test	Observation	Inference
(v) To the second portion of the solid from (i) above, add 8 cm^3 of dilute nitric acid, stir, filter and divide the filtrate into two equal portions.		
(vi) To the first portion of the filtrate from (v) above, add aqueous sodium hydroxide, a little at a time, until in excess.	**(2 marks)**	(Ionic equation required) **(2 marks)**
(vii) To the second portion of the filtrate from (v) above, add aqueous ammonia, a little at a time until in excess.	**(2 marks)**	**(1 mark)**

Total 16 marks

GO ON TO THE NEXT PAGE

3. Plan and design an experiment to determine whether the addition of the following nitrates of Na^{+}, K^{+}, Ca^{2+}, Mg^{2+} and Fe^{2+} to water has the effect of making the water hard or soft.

Your answer should include the following.

(i) Aim

____

____

(1 mark)

(ii) Apparatus and materials

____

____

____

(2 marks)

(iii) Procedure

____

____

____

____

____

____

(3 marks)

(iv) Variables to control

____

____

____

(2 marks)

(v) Data to be collected

(2 marks)

(vi) Discussion of results as it is related to your hypothesis.

(2 marks)

(vii) Possible sources of errors

(2 marks)

Total 14 marks

END OF TEST

TEST CODE **01212020**

FORM TP 2006060

MAY/JUNE 2006

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

1 hour 45 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. There are five questions in this booklet. Answer ALL questions.
2. You MUST use this answer booklet when responding to the questions. For each question, write your answer in the space provided and return the answer booklet at the end of the examination.
3. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
4. The use of non-programmable calculators is permitted.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Answer ALL questions.

Do not spend more than 30 minutes on Question 1.

1. (a) The following procedure is used to determine the solubility of X in water at various temperatures. In Experiment 1 (Table 1), 2g of X is added to 4 cm^3 water in a boiling tube. The tube is heated while stirring in a water bath until all of solid X has dissolved. The solution is then allowed to cool and the temperature at which crystals of X first reappear is noted. Experiments 2 to 5 are carried out using 2g of X in each case but different volumes of water as shown in Table 1. The temperatures at which crystals of X reappear are shown in Figure 1.

TABLE 1: DETERMINATION OF THE SOLUBILITY OF X AT VARIOUS TEMPERATURES

Experiment number	Mass of X/g	Volume of water/cm^3	Temperature at which crystals reappear/°C	Solubility of X(g/100 g water)
1	2	4		
2	2	8		
3	2	12		
4	2	16		
5	2	20		

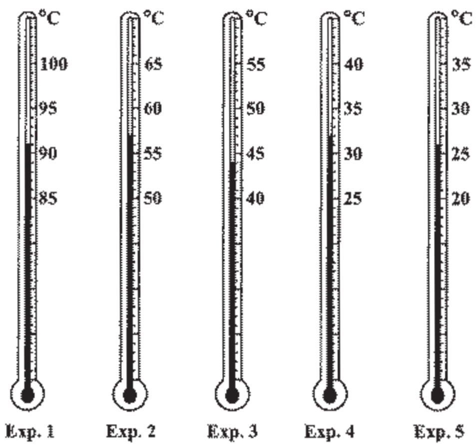


Figure 1. Temperatures at which crystals of X first reappear

GO ON TO THE NEXT PAGE

(i) Complete **Table 1** by filling in:

a) The temperatures at which crystals of X reappear in EACH experiment using the information in **Figure 1**.

b) The corresponding solubilities of X (g/100 g water).

Use the following equation to calculate the solubility of X at each temperature:

$$\text{Solubility of X (g/100 g water)} = \frac{\text{mass of X}}{\text{mass of water}} \times 100 \text{ (Equation 1))}$$

Assume 1 cm^3 water = 1 g. **(5 marks)**

(ii) Using the graph paper provided on page 4, plot a graph of solubility of X (g/100 g water) against temperature in °C. **(4 marks)**

(iii) What deduction about the solubility of X can be made from the graph drawn in **Figure 2**?

....

....

(2 marks)

(iv) Using Equation 1 and the graph drawn in **Figure 2,** calculate the volume of water which is required to just dissolve 2 g of X at 60 °C.

(3 marks)

(v) Based on the graph in **Figure 2**, calculate the mass of X which would be deposited when 100 g of a solution of X at 60 °C is cooled to 40 °C.

....

....

(1 mark)

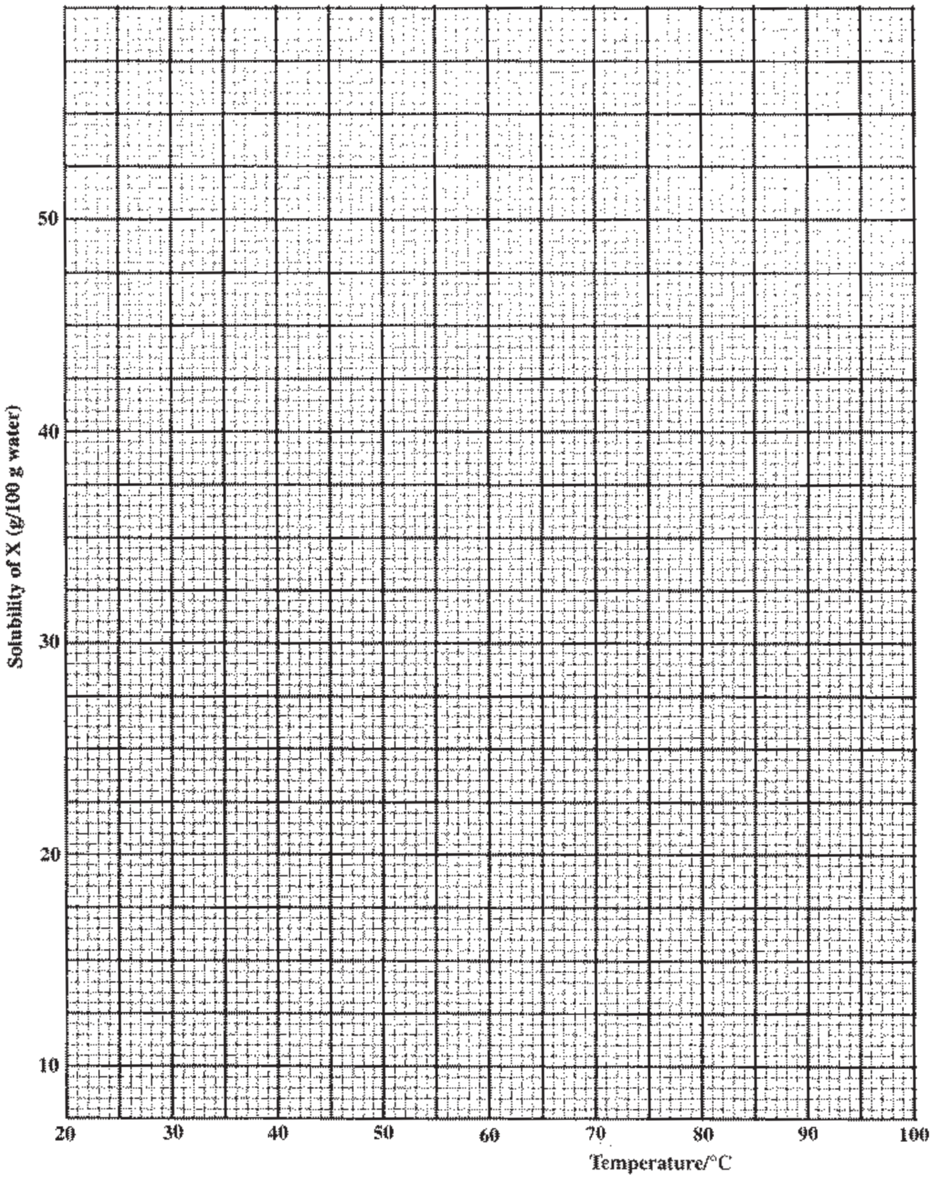


Figure 2

GO ON TO THE NEXT PAGE

(b) Complete Table 2 below for tests carried out on Solid Q.

TABLE 2: TESTS CARRIED OUT ON SOLID Q

Tests	Observations	Inferences
(i) To solid Q, add water, stir, filter and then divide the filtrate into four portions. Retain and dry the residue for test (vi) below.		
(ii) To the first portion of the filtrate from (i) above, add aqueous NaOH until in excess.	• • **(2 marks)**	• Al^{3+}, Pb^{2+}, Zn^{2+}, Ca^{2+} present • Al^{3+}, Pb^{2+}, Zn^{2+} present
(iii) To the second portion of the filtrate from (i) above, add aqueous NH_3 until in excess.	• White precipitate formed. • Precipitate soluble in excess aqueous NH_3.	• • **(2 marks)**
(iv) To the third portion of the filtrate from (i) above, add aqueous KI.	• Yellow precipitate formed.	• (ionic equation required) **(2 marks)**
(v) To the fourth portion of the filtrate from (i) above, add aqueous $AgNO_3$, followed by aqueous NH_3.	• No observable change.	• **(1 mark)**
(vi) To the dried residue from (i) above, add dilute HNO_3, warm, filter and then divide the filtrate into two portions.	• Vigorous effervescence observed upon addition of dilute HNO_3. • Gas evolved turns lime water cloudy.	• • (ionic equation required) **(2 marks)**
(vii) To the first portion of the filtrate from (vi) above, add aqueous NaOH until in excess.	• • **(2 marks)**	• Cu^{2+} ions present • (ionic equation required) **(2 marks)**
(viii) To the second portion of the filtrate from (vi) above, add aqueous NH_3 until in excess.	• • **(2 marks)**	• Cu^{2+} ions present

(15 marks)

Total 30 marks

GO ON TO THE NEXT PAGE

2. Chlorine has two isotopic forms with mass numbers 35 and 37 respectively. Chlorine has an atomic number of 17.

(a) (i) What differences, if any, are expected between the chemical reactions of chlorine 35 and chlorine 37? Explain your answer.

....

....

(2 marks)

(ii) Determine the number of electrons, protons and neutrons in the **anion** formed from the chlorine 37 atom.

Number of:

Electrons ....

Protons ....

Neutrons ....

(3 marks)

(b) (i) Explain the term 'ionic crystal'.

....

....

....

(2 marks)

(ii) Using the symbols, ●, for sodium ions and ◍, for chloride ions, fill in on the diagram in **Figure 3**, the positions occupied by these ions in the sodium chloride crystal.

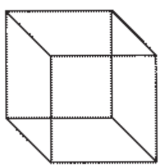


Figure 3. Diagram representing sodium chloride crystal

(3 marks)

(c) The melting points of chlorine, sodium chloride and magnesium oxide are –101°C, 800°C and 2 800°C respectively.

(i) Explain why the melting point of sodium chloride is much higher than that of chlorine.

....

....

(3 marks)

(ii) The crystal structures of magnesium oxide and sodium chloride are similar. Suggest why the melting point of magnesium oxide is much higher than that of sodium chloride.

....

....

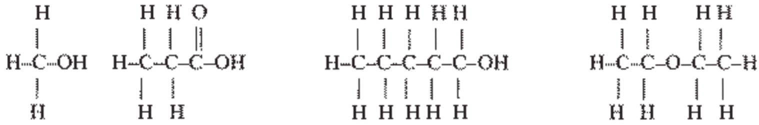
....

(3 marks)

Total 16 marks

GO ON TO THE NEXT PAGE

3. Below are four organic compounds, A, B, C and D.



Compound A   Compound B   Compound C   Compound D

(a) (i) Which compounds belong to the same homologous series?

....

(1 mark)

(ii) State the homologous series to which the compounds you named in (a) (i) belong, and give a reason for placing them in the same homologous series.

....

....

....

(2 marks)

(iii) Draw fully displayed structures of ANY TWO structural isomers of Compound C. Give the name of EACH isomer you have drawn.

(4 marks)

GO ON TO THE NEXT PAGE

(b) **Figure 4** shows some reactions of Compound E. Use the information in **Figure 4** to answer the questions which follow.

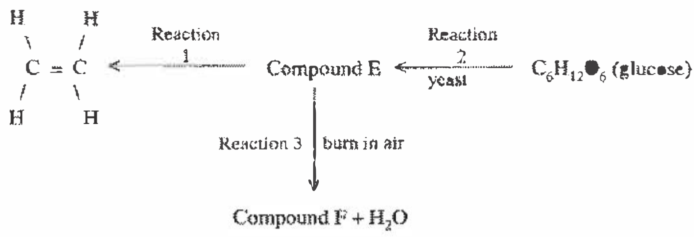


Figure 4. Some reactions of Compound E

(i) State the reagent(s) and condition(s) for Reaction 1.

Reagent(s): ....

Reaction condition(s): ....

(2 marks)

(ii) State the name of the process occurring during Reaction 2.

....

(1 mark)

(iii) Draw the correct formulae for Compounds E and F and hence write a balanced equation for Reaction 3.

(3 marks)

(iv) Draw the full structural formula of the organic product that is formed when Compound E reacts with Compound B, the structure of which is shown on page 8.

Structure:

(2 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

4. **Table 3** shows part of the periodic table.

TABLE 3: PART OF THE PERIODIC TABLE

	Be		C				Ne
		Al	Si	P		Cl	
	Ca					Br	

Use only the elements indicated in **Table 3** to answer the questions which follow. Each element may be used once, more than once or not at all.

(a) (i) Which element reacts most readily with dilute hydrochloric acid?

....

(1 mark)

(ii) Write a balanced equation to illustrate the reaction occurring in (a) (i) above.

....

(2 marks)

(iii) Describe any difference(s) that may be observed in the reaction indicated in (a) (i) above, if dilute sulphuric acid were to be used instead of dilute hydrochloric acid. Give a reason for your answer.

....

....

....

....

....

(4 marks)

(b) (i) Identify TWO different elements in Table 3 which will combine by covalent bonding.

....

(1 mark)

(ii) Draw dot-cross diagrams to illustrate the bonding in b (i) above.

(3 marks)

(c) (i) An element X (not the actual symbol) has an atomic number of 19. Place element X in the correct position in **Table 3**. (1 mark)

(ii) Give a reason for your answer in (c) (i).

....

....

(2 marks)

Total 14 marks

5. A student produces ammonia in the laboratory by adding Liquid Y to Solid W and warming as shown in **Figure 5**. He uses damp blue litmus in seeking to identify the ammonia produced.

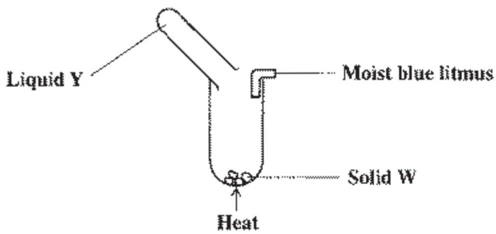


Figure 5. Apparatus used to prepare ammonia

(a) (i) Suggest ONE suitable reagent that can be used as Y and ONE as W for the experiment.

Y ....

W ....

(2 marks)

(ii) Identify the process by which the ammonia gas that is produced at the bottom of the test tube comes in contact with the litmus paper at the mouth of the test tube.

....

(1 mark)

(iii) Comment on the suitability of using the moist blue litmus paper to identify ammonia gas.

....

....

....

(2 marks)

(iv) Instead of the litmus test used above, describe ONE OTHER chemical test that can be used to identify ammonia gas. Write a balanced equation to represent the chemical test you have described.

....

....

....

....

....

(4 marks)

GO ON TO THE NEXT PAGE

(b) Ammonia is prepared industrially by the Haber process. In this process nitrogen and hydrogen are allowed to react in the presence of a catalyst at approximately 200 atm and 400°C. The reaction is exothermic.

(i) Name the catalyst used in the Haber process.

....

(1 mark)

(ii) Explain the importance of using relatively high pressure in this process.

....

....

....

(2 marks)

(iii) Draw a fully labelled energy profile diagram of the reaction for the production of ammonia during the Haber process. You should name the reactants and products on your diagram.

(3 marks)

Total 15 marks

END OF TEST

TEST CODE **01212030**

FORM TP 2006061

MAY/JUNE 2006

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 03 – General Proficiency

1 hour

26 MAY 2006 (a.m.)

In addition to the 1 hour, candidates are allowed a reading time of 10 minutes. Writing may begin during the 10-minute period.

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. **Answer THREE questions on this paper, ONE from Section A, ONE from Section B and ONE from Section C.**
2. **All working MUST be shown for calculations.**
3. **The use of non-programmable calculators is permitted.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A

Answer ONE question from this section.

1. (a) (i) Outline the steps in preparing a dry sample of calcium nitrate crystals starting from calcium carbonate and dilute nitric acid. **(6 marks)**

(ii) Describe a test to determine whether the sample of calcium nitrate crystals prepared in (a)(i) above is free of calcium carbonate. **(2 marks)**

(iii) Write chemical equations to show the differences in products obtained when sodium nitrate and calcium nitrate are heated. **(4 marks)**

(b) (i) With the aid of a fully labelled diagram, show how an iron rod can be electroplated with chromium, using aqueous chromium (III) nitrate as the electrolyte. Write ionic equations to represent the reactions taking place at the electrodes. **(4 marks)**

(ii) Assume that the iron rod to be electroplated in (b)(i) above originally weighed 25.00 g. Calculate the mass of the iron rod AFTER electroplating, if a current of 10 A was passed through the electrolyte for 30 minutes.

[Relative Atomic Mass: Cr = 52; Faraday's constant = 96 500 C mol^{-1}]
(4 marks)

Total 20 marks

2. A student sets up three experiments to investigate the particulate nature of matter. **Figure 1** shows the apparatus used in these three experiments.

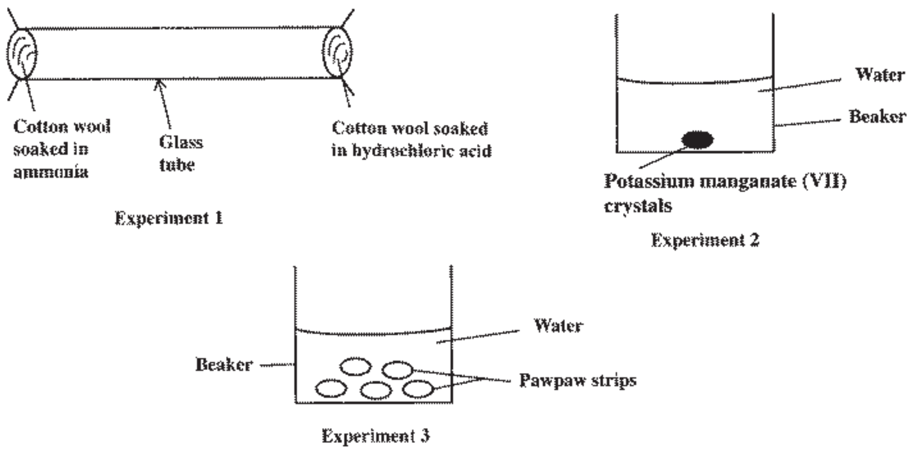


Figure 1. Experiments to investigate the particulate nature of matter

(a) (i) Describe what would be observed in Experiments 1, 2 and 3 as the experiments proceed. **(6 marks)**

(ii) Account for the observations you described in (a)(i). You should include in your answer

- the names of the processes involved
- the nature of matter
- how matter is transported in the different media. **(7 marks)**

(iii) Suggest how the rate of change of the observations made in Experiment 2 could be increased. Explain your answer. **(2 marks)**

(b) Chromatography is widely used in the pharmaceutical industry to check the purity of substances.

(i) Suggest ONE advantage of using chromatography as a means of separating the components of a mixture. **(1 mark)**

(ii) Using two fully labelled chromatograms, illustrate how chromatography can be used to indicate whether or not a compound is a pure substance. **(4 marks)**

Total 20 marks

SECTION B

Answer ONE question from this section.

3. (a) Hexanoic acid, $C_5H_{11}COOH$, belongs to the same homologous series as ethanoic acid. Based on this fact, write equations to represent the reaction between hexanoic acid and EACH of the following:

(i) Sodium **(2 marks)**

(ii) Ethanol in the presence of a trace of acid as a catalyst **(2 marks)**

(b) Hexane is an alkane of formula C_6H_{14}. A mixture of hexane and bromine is placed in a reaction flask in bright sunlight. After a while, bubbles of gas are seen to escape from the reaction mixture. The escaping gas forms dense fumes in contact with ammonia gas.

(i) Explain the above observations. **(4 marks)**

(ii) Write an equation to represent the reaction taking place between hexane and bromine. **(2 marks)**

(iii) What difference, if any, would be observed if hexene (C_6H_{12}) is used in place of hexane in the flask? Explain your answer. **(2 marks)**

(c) The gas, C_3H_6, is unsaturated and is used in the manufacture of polymers. It can also be readily converted into the alcohol, C_3H_7OH.

(i) Write an equation to show the partial structure of the polymer that is formed when three molecules of C_3H_6 are linked together. State the type of polymerization which occurs. **(3 marks)**

(ii) Write an equation for the conversion of C_3H_6 into the alcohol, C_3H_7OH. Include the reaction conditions. **(2 marks)**

(iii) Show by means of a fully labelled diagram ONLY, how a pure sample of the alcohol from the reaction mixture in (c) (ii) above can be obtained. **(3 marks)**

Total 20 marks

4. (a) Most metals exist as their ores in nature in combination with other elements. The extraction of metals from their ores is a reduction process. The choice of the reduction method depends upon the position of the metal in the reactivity series.

Explain the above statements using TWO appropriate examples of metal oxides to illustrate your answer. **(5 marks)**

(b) A newly discovered ore is found to consist of a mixture of the oxides of two metals, A and B. Some properties of the metal oxides of A and B are given in Table 1.

TABLE 1: SOME PROPERTIES OF THE METAL OXIDES OF A AND B

	Oxide of Metal A	Oxide of Metal B
1.	It consists of a metal just above aluminium in the reactivity series.	It consists of a metal just below iron in the reactivity series.
2.	Soluble in sodium hydroxide	Insoluble in sodium hydroxide

Based on the data in **Table 1** outline a possible extraction procedure for metals **A and B** from their ore. **(8 marks)**

(c) Metal X is a Group 1 metal. It is extracted by the electrolysis of its molten halide. Explain why the molten salt and not the aqueous halide is used. **(3 marks)**

(d) Calcium oxide, CaO, is used to remove sulphur dioxide gas from the exhaust gases from factories, by precipitating the sulphur dioxide in the form of calcium sulphate.

Suggest why this is possible. Illustrate your answer by means of appropriate equations. **(4 marks)**

Total 20 marks

SECTION C

Answer ONE question from this section.

5. Water possesses a number of unique physical properties which makes it an ideal transport medium as well as a medium for the various chemical processes occurring in organisms. Some of these unique properties of water are as follows:

- Solvent properties
- Specific heat capacity
- Volatility

(a) Discuss any TWO of the above properties of water as they relate to processes occurring in living systems. **(4 marks)**

(b) The presence of certain ions in water can cause temporary and permanent hardness. Hard water is of serious concern in the laundry industry.

(i) What is meant by the term 'hard water'? **(1 mark)**

(ii) Write the formula for EACH of the following:

a) A compound which causes temporary hardness

b) An ion which causes permanent hardness **(2 marks)**

(iii) Sodium carbonate is widely used to remove both temporary and permanent hardness, while temporary hardness may also be removed by boiling.

Write an equation to illustrate the removal of EACH of the following:

a) Permanent hardness using sodium carbonate

b) Temporary hardness by boiling **(4 marks)**

(iv) Compare the effect of soaps and soapless detergents on hard water. **(3 marks)**

(c) We use water, together with detergents, to do most of our washing. However, sometimes we send our clothes to be dry-cleaned instead of being washed at home.

(i) What is meant by the term 'dry-cleaning'? **(1 mark)**

(ii) Discuss TWO advantages and ONE disadvantage of using dry-cleaning when compared to using water. **(3 marks)**

(iii) Vinita is returning home in her car with the clothes she has just collected from the dry-cleaners. The car windows are closed and she soon begins to feel nauseous. Suggest a possible reason for Vinita's ill feeling. **(2 marks)**

Total 20 marks

6. Regular brushing of teeth and periodic visits to the dentist are highly recommended since they lead to healthy teeth.

(a) (i) List THREE important components of toothpaste. **(3 marks)**

(ii) The enamel of teeth is composed of a calcium phosphate compound, $Ca_{10}(PO_4)_6(OH)_2$. Describe, with the aid of a balanced equation, how ONE of the components of toothpaste listed in (a)(i), can strengthen the enamel of teeth. **(4 marks)**

(iii) A sticky film of bacteria and food can remain on teeth long after eating. These bacteria act on carbohydrates and convert them to substances which promote tooth decay.

Explain how teeth can decay in the presence of these bacteria. Support your answer with a balanced equation. **(5 marks)**

(b) Since the earliest days of recorded human history, people have been plagued by insect pests. Now, chemical and biological control may be the only forms of pest control that stand between us and some of the insect-borne plagues.

Discuss TWO advantages and TWO disadvantages of

(i) chemical control of pests

(ii) biological control of pests. **(8 marks)**

Total 20 marks

END OF TEST

TEST CODE **01212020**

FORM TP 2007006

JANUARY 2007

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

1 hour and 45 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. There are FIVE questions in this booklet. Answer ALL questions.
2. You MUST use this answer booklet when responding to the questions. For each question, write your answer in the space provided and return the answer booklet at the end of the examination.
3. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
4. The use of non-programmable calculators is allowed.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

1. (a) A student conducts an experiment to compare the effect of temperature on the solubility of two salts, R and T. The data collected are represented in Table 1.

TABLE 1: SOLUBILITIES OF R AND T AT VARIOUS TEMPERATURES

Temperature (°C)	Solubility (g per 100 g water)	
	R	**T**
10	25.0	40.0
30	50.0	43.0
50	90.0	45.0
70	140.0	48.0
90	200.0	55.0
100	250.0	58.0

(i) Using the graph paper provided on page 3, plot the data for the solubility of R and T given in Table 1. **(4 marks)**

Use the information from the graph to answer the following questions.

(ii) Describe the effect of increasing temperature on the solubilities of R and T.

____

(1 mark)

(iii) Determine the temperature at which the solubilities of R and T are equal.

____

(1 mark)

(iv) Determine the solubility of T at 75°C.

____

(1 mark)

(v) Which of the two salts is more soluble at 5°C?

____

(1 mark)

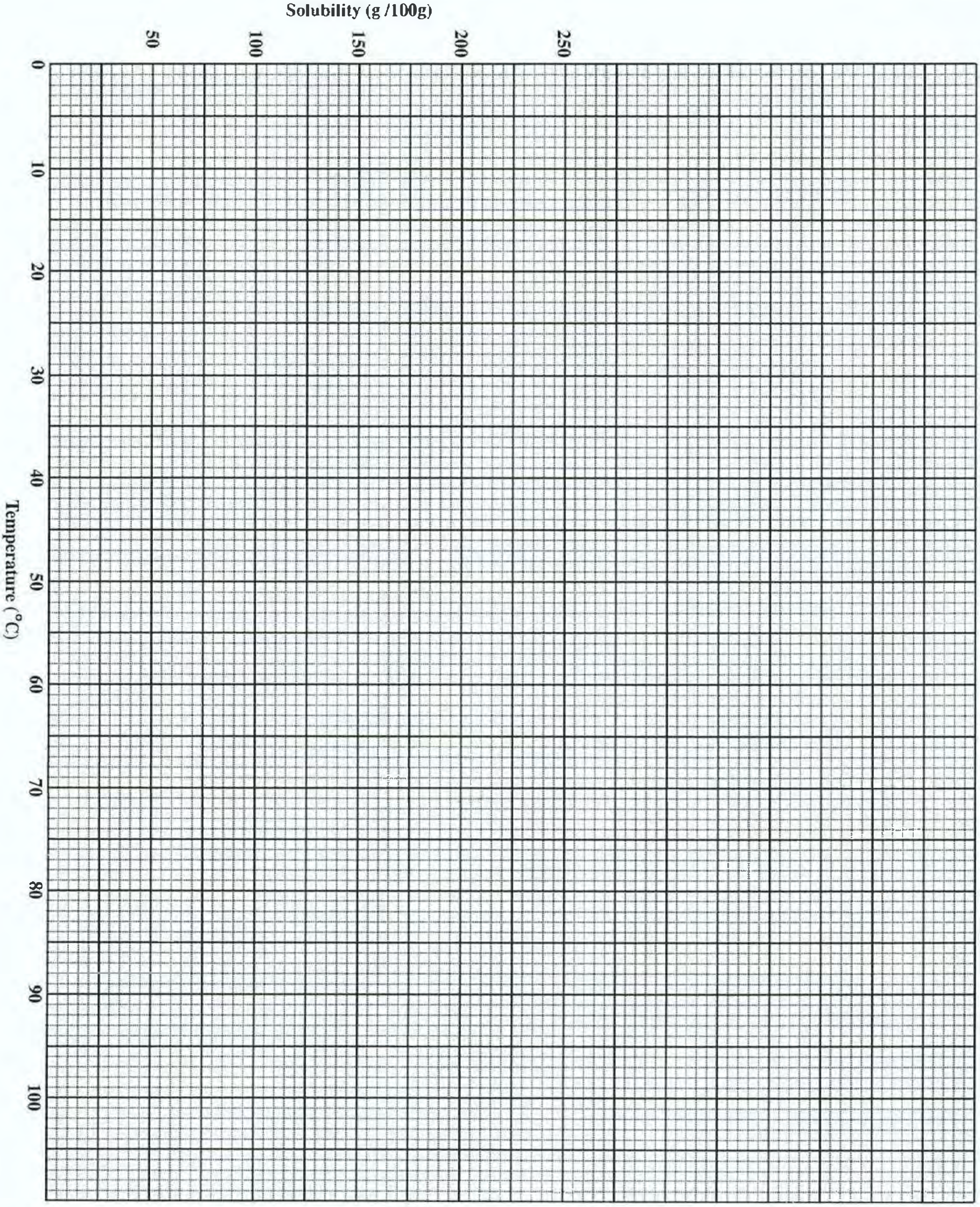
(vi) Suggest a way for obtaining an essentially pure sample of R from a sample which has been contaminated with a small amount of T.

____

____

____

(3 marks)


Solubility (g /100g)
50
100
150
200
250
Temperature (°C)
0
10
20
30
40
50
60
70
80
90
100

(b) Complete Table 2 below by writing the inferences for tests carried out on Solid W.

TABLE 2

Test	Observation	Inference
(i) A sample of Solid W is moistened with sodium hydroxide solution and the mixture heated. Moist red and moist blue litmus are held at the top of the test tube.	• Pungent gas evolves. • Red litmus turns blue.	**(1 mark)**
(ii) To an aqueous solution of W, a few drops of acidified silver nitrate are added, followed by aqueous ammonia.	• White precipitate is formed. • The precipitate dissolves in aqueous ammonia.	(Ionic equation required) **(2 marks)**
(iii) To an aqueous solution of W, a solution containing barium ions is added.	• A white precipitate is formed.	**(3 marks)**
(iv) Dilute hydrochloric acid is added to the mixture from (iii) above.	• The precipitate is insoluble in the acid.	(Ionic equation required) **(2 marks)**

GO ON TO THE NEXT PAGE

(c) Kerosene and methylated spirit are used as fuels in lamps (burners) in the laboratory. When lit, these fuels burn (undergo combustion) to produce heat energy. The heat of combustion of these fuels can be readily determined from experimental data obtained from the heating of water by the fuels.

Using the information given above, plan and design an experiment to determine whether kerosene and methylated spirit produce the same amount of energy on combustion. The hypothesis of the experiment is given below.

Hypothesis: Methylated spirit and kerosene produce the same amount of energy on combustion.

(i) Procedure:

____

____

____

____

____

(2 marks)

(ii) Draw a fully labelled diagram of the apparatus required to conduct your experiment.

(3 marks)

(iii) Data to be collected:

____

____

____

(2 marks)

(iv) SAMPLE calculation to be performed to determine the heat of combustion per mole of the fuel:

____

____

____

____

____

____

____

____

(2 marks)

(v) TWO possible sources of error in your experiment:

____

____

(2 marks)

Total 30 marks

NOTHING HAS BEEN OMITTED

2. Electrolysis has many applications. The apparatus shown below in Figure 1 can be used to purify copper by electrolysis.

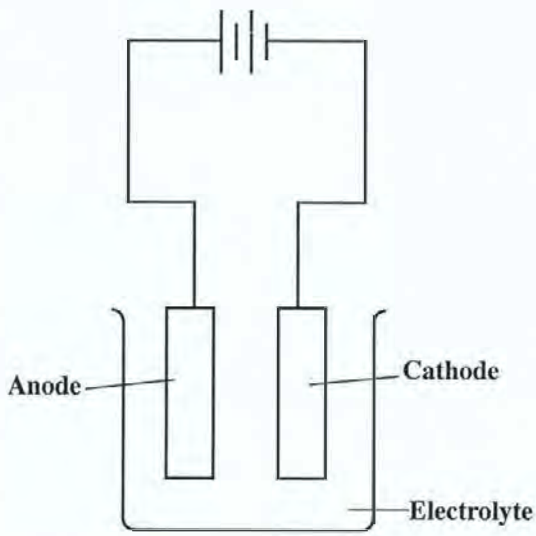


Figure 1. A generalised electrolytic cell

(a) In order to adapt the electrolytic cell in Figure 1 for the purification of copper, what material may be used as the

(i) cathode?

___

(ii) anode?

___

(iii) electrolyte?

___

(3 marks)

(b) As electrolysis proceeds, describe the changes expected to be observed

(i) at the cathode

___

(ii) at the anode

___

(iii) in the electrolyte.

___

(3 marks)

GO ON TO THE NEXT PAGE

(c) Write half-equations for the reactions occuring at the

(i) cathode

____

(ii) anode.

____

(2 marks)

(d) A current of 5 amperes is passed for 2 hours during the period of the electrolysis.

Calculate EACH of the following:

(i) The quantity of electricity passed in coulombs

____

____

____

(2 marks)

(ii) The mass of copper deposited

$$\left[\begin{array}{l}\text{Relative Atomic Mass of Cu} = 64 \\ \text{Faraday's constant} = 96500 \text{ coulombs}\end{array}\right]$$

____

____

____

____

____

____

(3 marks)

(e) In addition to extraction of metal from their compounds, electrolytic processes are also widely used to protect metals from corrosion, as well as to make them attractive. Name TWO such electrolytic processes.

____

____

(2 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

3. (a) Ammonia is manufactured industrially by the Haber process. The information in Figure 2 relates to the manufacture of ammonia. It shows the percentage yield of ammonia under different conditions of temperature and pressure.

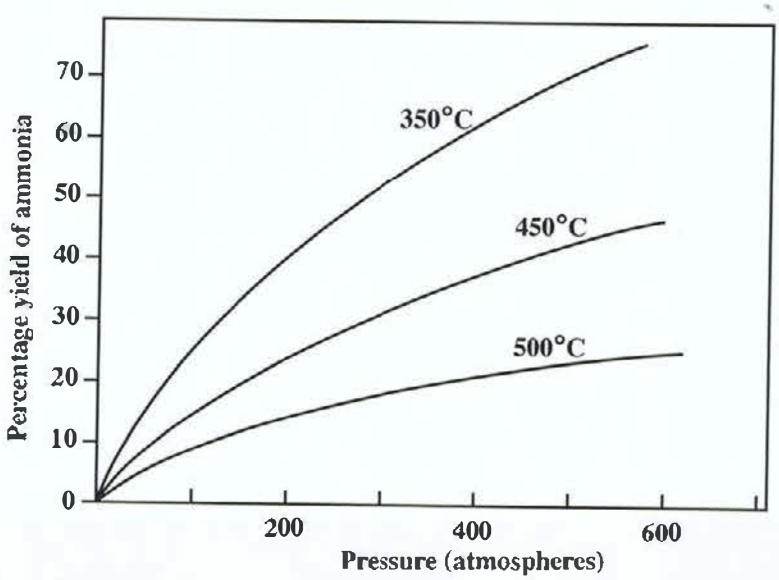


Figure 2. Percentage yield of ammonia under different conditions of temperature and pressure

(i) Over what range of temperatures and pressures is ammonia NORMALLY produced by the Haber process?

____

(1 mark)

(ii) Based on the information given in Figure 2, deduce whether increased yields of ammonia would result from conditions of

a) high or low temperature

____

b) high or low pressure.

____

(2 marks)

(iii) Suggest TWO reasons why ammonia is not usually produced at 100°C and 1200 atm.

____

____

(2 marks)

GO ON TO THE NEXT PAGE

(iv) Under normal conditions, approximately 18% of the hydrogen and nitrogen used in the Haber process is converted to ammonia. The unreacted nitrogen and hydrogen are separated from the ammonia and recycled.

With reference to the properties of ammonia, nitrogen and hydrogen, suggest ONE way that ammonia can be separated from the other gases. Give a reason for your answer.

____

____

____

(2 marks)

(b) Chlorine and ammonia react together to form NH_4Cl and NH_2Cl only.

(i) Write a balanced equation for the reaction between chlorine and ammonia.

____

(2 marks)

(ii) Both NH_4Cl and NH_2Cl dissolve in water, but whereas aqueous NH_4Cl conducts electricity, the aqueous NH_2Cl does not. What does this information suggest about the type of bonding in NH_4Cl and in NH_2Cl?

____

____

(2 marks)

(iii) Draw a dot-cross diagram to show the bonding in NH_2Cl.

(2 marks)

(iv) Suggest ONE reason why NH_2Cl dissolves in water.

____

____

(2 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

4. Study the information given in Figure 3 and answer the questions that follow.

$$C_2H_5OH \xrightarrow[\text{KMnO}_4\text{, heat}]{\text{acidified}} \mathbf{X} \xrightarrow{q} \underset{\mathbf{D}}{CH_3COONa} + H_2O$$

$$\mathbf{X} \xrightarrow[\text{warm}]{C_2H_5OH\text{, concentrated } H_2SO_4\text{,}} \mathbf{E} + H_2O$$

Figure 3. Reaction scheme

(a) (i) Complete Table 3 below by drawing the displayed structure, and writing the name of EACH of the compounds, X, E and D.

TABLE 3: NAME AND STRUCTURE OF X, E AND D

Compound	Fully displayed structure	Name
X		
E		
D		

(7 marks)

GO ON TO THE NEXT PAGE

(ii) Name the reagent, **q**, required to convert X to D in Figure 3.

____

(1 mark)

(b) (i) Identify the homologous series to which Compounds X and E belong.

Compound X:

____

Compound E:

____

(2 marks)

(ii) State ONE physical property of EACH of the following:

a) Compound X:

____

b) Compound E:

____

(2 marks)

(c) Based on your knowledge of the solubilities of Compounds X and E, suggest a suitable method of separating E from a mixture of X and E.

____

____

____

____

(3 marks)

Total 15 marks

5. A student conducts a number of experiments to investigate the rate of reaction between hydrochloric acid and limestone (calcium carbonate).

(a) Write a balanced equation for the reaction between hydrochloric acid and limestone.

____

(2 marks)

(b) 5.0 g of $CaCO_3$ is allowed to react completely with hydrochloric acid. Using the balanced equation in (a), calculate the mass of gas that would be produced.
[Relative Atomic Mass: Ca = 40, O = 16, C = 12]

____

____

____

____

____

(3 marks)

(c) Suggest ONE way to verify the identity of the gas given off in (a).

____

____

(1 mark)

(d) (i) What data must be collected if one wants to measure the rate of the reaction in (a) on page 14?

____

____

____

(2 marks)

(ii) Sketch a labelled diagram to illustrate how the data collected in (d) (i) above may be represented.

(3 marks)

(e) (i) State TWO ways in which the rate of a reaction could be increased.

____

____

(2 marks)

(ii) Explain how ONE of the ways stated in (e) (i) above causes an increase in reaction rate.

____

____

____

(2 marks)

Total 15 marks

END OF TEST

TEST CODE **01212030**

FORM TP 2007007

JANUARY 2007

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 03 – General Proficiency

1 hour

16 JANUARY 2007 (p.m.)

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. **In addition to the 1 hour, candidates are allowed a reading time of 10 minutes. Writing may begin during the 10-minute period.**

2. **Answer THREE questions on this paper, ONE from Section A, ONE from Section B and ONE from Section C.**

3. **All working MUST be shown for calculations.**

4. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A

Answer ONE question from this section.

1. Salts can be prepared by

- reacting acids with metals
- reacting acids with bases
- direct combination of the elements.

(a) From the methods mentioned above, select ONE suitable method for preparing a dry sample of potassium sulphate. In your answer, give full experimental details, including

- a description of the method
- ONE relevant equation. **(7 marks)**

(b) Discuss why the two other methods not selected in (a) above would be **unsuitable** choices for the preparation of potassium sulphate. **(5 marks)**

(c) The hydrochloric acid used in the laboratory has a lower pH than that of vinegar. Yet, vinegar is recommended for removing limescale deposits in a kettle while hydrochloric acid is not.

(i) Explain why vinegar, and NOT hydrochloric acid, is recommended for removing limescale deposits in kettles. Include TWO relevant ionic equations to support your argument. **(7 marks)**

(ii) Suggest what could possibly be done to a solution of hydrochloric acid to make it suitable for removing the limescale deposits in a kettle. **(1 mark)**

Total 20 marks

2. (a) Ethanol and water, as well as black ink are examples of two mixtures.

For EACH of these two mixtures, outline a suitable technique which can be used to separate them into their various components.

Include in your answer the

(i) apparatus required

(ii) principles involved in the separation process. **(9 marks)**

(b) You are provided with a piece of plastic tubing and an iron rod.

(i) Describe an experiment that could be used to determine the ability of each of these two materials mentioned above to conduct electricity.

You should include in your answer a labelled diagram of the apparatus to be used. **(3 marks)**

(ii) Distinguish between an electrolytic conductor and a metallic conductor. **(2 marks)**

(iii) With reference to structure and bonding, explain which of these two pieces of materials, plastic tubing or an iron rod, will conduct electricity. **(4 marks)**

(iv) Explain how the experiment and the apparatus you have described in (b) (i) above may be modified to test the ability of aqueous sodium chloride to conduct electricity. **(2 marks)**

Total 20 marks

SECTION B

Answer ONE question from this section.

3. Crude oil is a complex mixture and serves as the primary source of a wide range of hydrocarbons. These hydrocarbons can be used directly or further modified for use as feedstock chemicals for a wide range of industrial processes.

(a) Draw a fully labelled diagram of the industrial apparatus used to separate crude oil into its various hydrocarbon fractions. You should indicate on your diagram the points at which the various fractions come off. **(5 marks)**

(b) Name the process by which heavier hydrocarbon fractions are converted into lighter fractions. Illustrate your answer by means of a suitable chemical equation. **(3 marks)**

(c) Write ONE chemical equation EACH to show the difference between an addition reaction and a substitution reaction. Use the reaction of ethane and ethene with bromine to illustrate your answers. **(4 marks)**

(d) (i) Draw and name the structural isomers of molecular formula C_4H_8. **(4 marks)**

(ii) Draw the structure of a compound which belongs to the same homologous series as C_4H_8 but which has a lower boiling point. **(2 marks)**

(e) Scientists are searching for an economic, less polluting alternate to hydrocarbons as a fuel. Hydrogen is regarded by many as the fuel of the future.

Suggest ONE advantage and ONE disadvantage associated with the use of hydrogen as a fuel, when compared to hydrocarbons. **(2 marks)**

Total 20 marks

4. (a) Account for EACH of the following observations:

(i) The non-metal, carbon, forms an oxide, CO_2, which is a gas at room temperature and is also acidic.

In contrast, the metal, sodium, forms an oxide, Na_2O, which is a solid at room temperature and is also alkaline.

Include appropriate chemical equations in your answer. **(7 marks)**

(ii) Aluminium metal is much more reactive than iron yet it is more resistant to corrosion. **(3 marks)**

(b) Consider the following information and answer the questions which follow.

A strip of a metal A, which forms A^+ ions, when placed in a solution containing Fe^{2+} ions causes Fe metal to be deposited. In contrast a strip of metal B, which forms B^{2+} ions, does NOT displace Fe^{2+} from solution.

(i) Arrange the metals A, B and Fe in order of increasing reactivity.

Write a chemical equation to represent the displacement reaction between A and Fe^{2+} ions. **(4 marks)**

(ii) Write chemical equations to illustrate the effect, if any, of heat on the nitrates of metals A and B. **(3 marks)**

(iii) What method of extraction may be used to extract metals A and B from their respective oxides? Give a reason for your answer. **(3 marks)**

Total 20 marks

SECTION C

Answer ONE question from this section.

5. In many countries, the management of solid waste disposal is being given greater attention, especially with the increased generation of toxic and non-biodegradable waste.

(a) Explain what is meant by

(i) non-biodegradable waste

(ii) toxic waste.

Give ONE example of EACH. **(4 marks)**

(b) (i) Many countries have developed sanitary landfills as one means of managing solid waste disposal. Explain what are sanitary landfills and discuss TWO likely problems to be encountered in setting them up. **(4 marks)**

(ii) Illegal dumping is a method frequently used by citizens for the disposal of solid waste. With reference to this practice, discuss THREE likely effects of the improper management of solid waste disposal on a community. **(6 marks)**

(iii) Suggest TWO ways by which citizens can help reduce the negative effects of solid waste on the environment. **(2 marks)**

(c) Sewage is generated wherever humans live.

Describe the steps used in the treatment of sewage. **(4 marks)**

Total 20 marks

6. Two major household problems are the build-up of rust and calcium carbonate in toilet bowls, and the presence of grease deposits from cooking in ovens.

(a) (i) Name TWO active ingredients in toilet bowl cleaners and ONE active ingredient in oven cleaners. **(3 marks)**

(ii) Discuss the chemical principles involved in the action of EACH type of cleaner when it is used. Include ONE relevant equation for EACH type of cleaner in your answer. **(10 marks)**

(b) Concerns have been raised about the excessive use of disinfectants and pesticide sprays. Some persons believe that they do more harm than good.

Evaluate the use of EITHER disinfectants OR pesticide sprays.

In your discussion, you should include:

- ONE reason for their use
- TWO major disadvantages of their use
- TWO major advantages of their use
- ONE alternative to their use and ONE limitation to this alternative

(7 marks)

Total 20 marks

END OF TEST

TEST CODE **01212042**

FORM TP 2007008

JANUARY 2007

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 04/2 – Alternative to SBA

General Proficiency

2 hours

READ THE FOLLOWING DIRECTIONS CAREFULLY

In addition to the 2 hours allowed for the examination, candidates are allowed 10 minutes in order to read through the entire paper.

Writing may begin during the 10-minute period.

1. **Answer ALL questions on this paper.**
2. **Use this answer booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the answer booklet at the end of the examination.**
3. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Answer ALL questions.

1. At one time sodium carbonate was widely used as the active ingredient in water softeners. You are required to determine the percentage of hydrated sodium carbonate present in the water softener "Super Softener", using the following procedure.

(a) **Reagents**

You are provided with the following:

Solution A: This was prepared by dissolving 20.0g of "Super Softener" in distilled water to make 1 dm^3 of solution.

Solution B: This is a 0.10 mol dm^{-3} solution of hydrochloric acid.

(b) **Procedure**

(i) Rinse and fill your burette with Solution B.

(ii) Pipette 25 cm^3 of solution A into a conical flask and add 3 drops of methyl orange indicator.

(iii) Titrate the contents of the conical flask from (ii) with Solution B from the burette.

(iv) Record your results in Table 1 below.

(v) Repeat steps (i) to (iv) as many times as may be necessary to obtain accurate results.

(c) **Results**

TABLE 1. TITRATION OF SOLUTION A WITH SOLUTION B

	1	**2**	**3**	**4**
Final burette reading / cm^3				
Initial burette reading / cm^3				
Volume of Solution B used / cm^3				

(11 marks)

25 cm^3 of Solution A requires ______________________________ cm^3 of Solution B.

Indicate which titration values you used to obtain your average titration value.

____

(1 mark)

GO ON TO THE NEXT PAGE

(d) **Treatment of results**

(i) Write a balanced chemical equation for the reaction between the sodium carbonate in Solution A and aqueous hydrochloric acid in Solution B.

____

(2 marks)

(ii) Calculate EACH of the following:

a) The number of moles of hydrochloric acid used in the titration

____

____

(1 mark)

b) The number of moles of the active ingredient, sodium carbonate, in 25 cm^3 of Solution A

____

(1 mark)

c) The number of moles of the active ingredient, sodium carbonate, in 1 dm^3 of Solution A

____

(1 mark)

d) The mass of the active ingredient, hydrated sodium carbonate, in 1 dm^3 of Solution A

[The relative atomic mass of hydrated sodium carbonate is 286.]

____

(1 mark)

e) The percentage by mass of hydrated sodium carbonate in the "Super Softener".

____

(1 mark)

Total 19 marks

2. You are provided with a sample labelled **M**. **M** is a mixture of two solids. Carry out the following tests and complete Table 2 below.

TABLE 2: RESULTS OF TESTS CARRIED OUT ON SAMPLE M

Test	Observation	Inference
(i) Divide **M** into two equal portions. To one portion add 10 cm^3 of distilled water, stir and then filter. Divide the filtrate into two equal portions. Keep the other portion of the solid for Test (iv).		
(ii) To the first portion of the filtrate from (i) above, add 5 drops of dilute sulphuric acid, followed by 5 drops of aqueous potassium manganate (VII).	**(1 mark)**	**(1 mark)**
(iii) To the second portion of the filtrate from (i) above, add aqueous barium chloride, followed by an excess of dilute hydrochloric acid.	**(2 marks)**	(Ionic equation required here.) **(3 marks)**
(iv) To the second portion of the solid from (i) above, add 10 cm^3 of dilute nitric acid, stir, filter and divide the filtrate into three equal portions.		

TABLE 2 CONTINUED

Test	Observation	Inference
(v) To the first portion of the filtrate from (iv) on page 4, add aqueous sodium hydroxide, a little at a time until in excess.	**(1 mark)**	**(1 mark)**
(vi) To the second portion of the filtrate from (iv) on page 4, add aqueous ammonia, a little at a time, until in excess.	**(2 marks)**	**(2 marks)**
(vii) To the third portion of the filtrate from (iv) on page 4, add aqueous potassium iodide.	**(1 mark)**	**(1 mark)**

Total 15 marks

3. The following is an extract of a conversation among a group of students about the percentage of alcohol in various brands of rums in the Caribbean.

"El Dorado is the smoothest. It has the lowest amount of alcohol."

"Mount Gay is the strongest . . ."

"Appleton is what the tourist likes, not too much or too little alcohol . . ."

You are required to plan and design an experiment, the aim of which is to determine the percentage of ethanol by MASS in these three brands of Caribbean rums.

Your answer should include:

(i) Procedure

(4 marks)

(ii) A fully labelled diagram of the apparatus to be used

(4 marks)

GO ON TO THE NEXT PAGE

(iii) Data to be collected

(3 marks)

(iv) Sample calculation to be performed

(3 marks)

(v) Any TWO possible sources of errors

(2 marks)

Total 16 marks

END OF TEST

FORM TP 2007060

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

1 hour 45 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. There are FIVE questions in this booklet. Answer ALL questions.
2. You MUST use this answer booklet when responding to the questions. For each question, write your answer in the space provided and return the answer booklet at the end of the examination.
3. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
4. The use of non-programmable calculators is allowed.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

Answer ALL questions.

Do NOT spend more than 30 minutes on Question 1.

1. (a) A student is asked to make a solution of sodium hydroxide by dissolving an unknown mass of the pellets in 250 cm^3 of water. 25.0 cm^3 of the solution is then titrated against a standard solution of hydrochloric acid (0.050 mol dm^{-3}).
Figure 1 below shows the initial and final volumes of the burette reading for the volume of acid added.

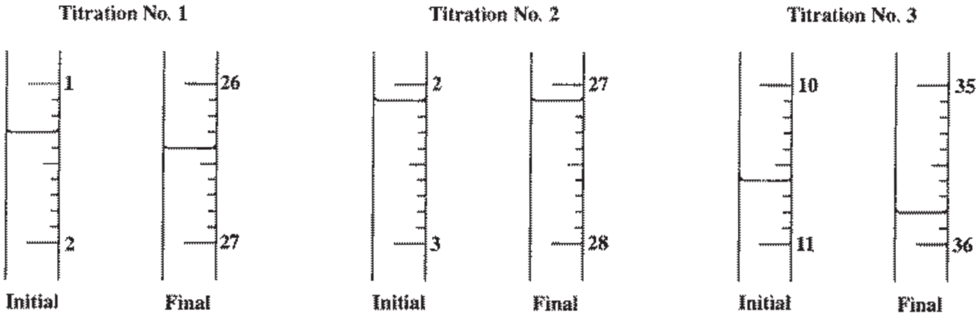


Figure 1. Burette readings showing volumes of acid used

(i) Use the information given in Figure 1 above to complete Table 1 below.

TABLE 1: RESULTS OF EXPERIMENT

	Titration number		
	1	2	3
Final volume / cm^3			
Initial volume / cm^3			
Volume used / cm^3			

Average volume of acid used / cm^3

____

(4 marks)

(ii) Write a chemical equation for the reaction that occurs during the titration.

____

(1 mark)

GO ON TO THE NEXT PAGE

From the data in Table 1 calculate EACH of the following:

(iii) The number of moles of hydrochloric acid used in the titration

____

____

____

(1 mark)

(iv) The number of moles of sodium hydroxide in 25.0 cm^3 of the solution

____

____

(1 mark)

(v) The number of moles of sodium hydroxide in 250 cm^3 of solution

____

____

____

(1 mark)

(vi) Mass of sodium hydroxide dissolved in 250 cm^3 of water

(Relative atomic mass: Na = 23, O = 16, H = 1)

____

____

____

____

(2 marks)

GO ON TO THE NEXT PAGE

(b) A student carries out the following tests on a solid, Q, and makes the observations recorded in Table 2 below. Complete Table 2 to show all possible inferences and write ionic equations where required.

TABLE 2: RESULTS OF TESTS ON SOLID Q

Tests	Observations	Inferences
(i) A small amount of Q is heated in a dry test tube.	• A brown gas evolves which turns moist blue litmus red. • Another gas evolves which rekindles a glowing splint.	• •
A portion of Q is dissolved in approximately 10 cm^3 of deionized water. The resulting solution is divided into 3 portions for Tests (ii) - (iv).		
(ii) To one portion of Solution Q from above, aqueous sodium hydroxide is added dropwise until in excess.	• A white precipitate is formed • Precipitate is soluble in excess sodium hydroxide.	• •
(iii) To another portion of Q from above, aqueous ammonia is added dropwise until in excess.	• A white precipitate is formed • Precipitate is insoluble in excess aqueous ammonia.	• •
(iv) To another portion of Q from above, aqueous potassium iodide is added.	• A yellow precipitate is formed.	• (Ionic equation required)

(7 marks)

(v) Suggest the possible identity of Q.

____

(1 mark)

GO ON TO THE NEXT PAGE

(c) You are provided with a bottle of sea water which also contains some sand.

Plan and design an experiment to recover the solid 'sea salt' from the mixture. Your answer should include the following:

(i) A suggested list of apparatus which you would use in recovering the solid sea salt from the sandy sea water

____

____

____

(4 marks)

(ii) An outline of the steps for the procedure you could use

____

____

____

____

____

____

____

(4 marks)

(iii) List the main observations that would be expected at each stage of the experiment.

____

____

____

(2 marks)

(iv) A student suggests that solid sea salt contains chloride ions. How would you go about testing for chloride ions in the solid sea salt?

____

____

____

(2 marks)

Total 30 marks

GO ON TO THE NEXT PAGE

2. Table 3 presents some information on the reactions of Compound A and copper metal with various reagents. Use the information in Table 3 to answer the questions that follow.

TABLE 3: SOME REACTIONS OF COMPOUND A AND COPPER

	Reactions with		
	Acidified potassium chromate (VI) solution	Aqueous iron (II) nitrate	Aqueous silver nitrate solution
Aqueous solution of A	Experiment 1 Potassium chromate (VI) changes from orange to green.	Experiment 2 The iron (II) nitrate changes from pale green to pale yellow.	
Copper metal		Experiment 3	Experiment 4 Silver solid is deposited. Pale blue solution is formed.

(a) (i) Classify Solution A as an oxidizing or a reducing agent in Experiments 1 and 2.

Experiment 1 : A is acting as ....

Experiment 2 : A is acting as ....

(2 marks)

(ii) Using the information given in Table 3 only, explain your answer to (a) (i) above.

Experiment 1:

____

____

Experiment 2:

____

____

(4 marks)

(b) (i) Write a balanced ionic equation to represent the reaction that occurs in Experiment 4.

____

(2 marks)

(ii) Account for the pale blue solution that is observed in Experiment 4.

____

(1 mark)

(c) With reference to the electrochemical series, predict what you may be expected to observe in Experiment 3. Give a reason for your answer.

____

____

____

____

(3 marks)

(d) When exposed to air for some time, copper ornaments become tarnished by green copper carbonate.

(i) Suggest the name of a common household chemical that can be used to clean such tarnished copper ornaments.

____

(1 mark)

(ii) Write a suitable ionic equation to show the reaction in (d) (i) above.

____

(2 marks)

Total 15 marks

3. The information provided in Table 4 below refers to atoms of two elements, A and B.

(a) Complete Table 4 by writing the required information in the relevant spaces.

TABLE 4: ATOMIC PROPERTIES OF ELEMENTS A AND B

	A	B
Mass number		19
Atomic number	12	
Number of protons		9
Number of electrons	12	9
Number of neutrons	12	
Electronic configuration		
Group number	2	
Period number		2

(4 marks)

(b) (i) What type of bonding would take place between A and B?

____

(1 mark)

(ii) Give a reason for your answer in (b) (i) above.

____

____

____

(2 marks)

(iii) Use dot cross diagrams to illustrate the bonding between A and B.

(2 marks)

GO ON TO THE NEXT PAGE

(c) Describe the bonding expected in A.

____

____

____

(2 marks)

(d) (i) Describe the bonding in graphite.

____

____

____

(2 marks)

(ii) Graphite is used as a lubricant. How does this use relate to its structure and bonding?

____

____

(2 marks)

Total 15 marks

4. X and Y are two hydrocarbons. When X is completely burnt in air, 0.50 moles of X produce 60 dm^3 of CO_2 and 3 moles of water at r.t.p.

(a) Deduce the molecular formula of X. (1 mole of gas at r.t.p. has a volume of 24 dm^3.)

____

____

____

____

____

____

____

____

____

____

(4 marks)

GO ON TO THE NEXT PAGE

(b) (i) Based on your answer in 4 (a) on page 9, deduce the homologous series to which X belongs.

____

(1 mark)

(ii) Write the name of Compound X.

____

(1 mark)

(iii) Draw the fully displayed structure of X.

(1 mark)

(c) Y has the molecular formula, C_5H_{10}.

(i) To what homologous series does Y belong?

____

(1 mark)

(ii) Write the name of Compound Y.

____

(1 mark)

(iii) Draw the fully displayed structure of Y.

(2 marks)

(d) What chemical test may be used to distinguish between Compounds X and Y?

Reagent: ____

Observation: ____

____

(2 marks)

GO ON TO THE NEXT PAGE

(e) What reagent and reaction conditions are necessary to convert Y to X?

Reagent: ______________________________

Conditions: ______________________________

(2 marks)

Total 15 marks

5. (a) Define EACH of the following terms:

(i) Amphoteric oxide

____

____

(2 marks)

(ii) Acid anhydride

____

____

(2 marks)

(b) Describe appropriate chemical tests, the results of which could be used to determine whether zinc oxide is amphoteric or whether it is an acid anhydride.

Chemical tests:

(i) To determine if zinc oxide is amphoteric

____

____

____

(ii) To determine if zinc oxide is an acid anhydride

____

____

____

(5 marks)

(c) Sulphur (IV) oxide, a gaseous pollutant, dissolves in water droplets in the atmosphere and thus causes acid rain.

(i) Write the formula for sulphur (IV) oxide.

____

(1 mark)

(ii) Write an equation for the reaction between sulphur (IV) oxide and water.

____

(1 mark)

(d) It has been suggested that the amount of polluting gases emitted into the atmosphere, such as the oxides of sulphur and nitrogen which are acidic, could be reduced by first passing exhaust air from factories through beds of powdered reagents.

Based on this information:

(i) Give the name of ONE reagent that could be used for this purpose.

Support your answer by writing a chemical equation, using ONE of the named pollutants mentioned above.

____

____

(2 marks)

(ii) Suggest why the reagent you have named in (d) (i) above should be used in the powdered form.

____

____

(2 marks)

Total 15 marks

END OF TEST

TEST CODE **01212030**

FORM TP 2007061

MAY/JUNE 2007

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 03 – General Proficiency

1 hour

23 MAY 2007 (a.m.)

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. In addition to the 1 hour, candidates are allowed a reading time of 10 minutes. Writing may begin during the 10-minute period.
2. Answer THREE questions on this paper, ONE from Section A, ONE from Section B and ONE from Section C.
3. All working MUST be shown for calculations.
4. The use of non-programmable calculators is allowed.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A

Answer ONE question from this section.

1. (a) Phosphoric acid (H_3PO_4), which is used as an additive in soft drinks, can react with sodium hydroxide to form both normal and acidic salts.

   (i) Define the terms 'acid salts' and 'normal salts'. **(2 marks)**

   (ii) Write ONE balanced equation EACH for the formation of a normal salt and an acid salt when phosphoric acid reacts with aqueous sodium hydroxide. **(4 marks)**

   (iii) Excess consumption of soft drinks may lead to excess stomach acid.

   a) How is this problem usually treated?

   b) Explain the chemical principles upon which the treatment you stated in (iii) a) above is based.

   c) Write an ionic equation for the reaction.

   (4 marks)

   (b) 25.0 cm^3 of 2.0 mol dm^{-3} sodium hydroxide and 50.0 cm^3 of 1.0 mol dm^{-3} hydrochloric acid, both at 30.0°C, are mixed together in a styrofoam cup. On mixing, the temperature rises to 38.9°C.

   (i) Calculate the heat of neutralisation for the reaction in kJ mol^{-1}.

   Use the following information in your calculation:

   - Heat evolved = mass (g) x specific heat capacity, C, (Jg^{-1} $°C^{-1}$) x change in temperature
   - C = 4.2 Jg^{-1} $°C^{-1}$
   - Density of solution = 1 g/cm^3 **(5 marks)**

   (ii) Draw a labelled energy profile diagram to illustrate the reaction in (b) (i) above. **(3 marks)**

   (c) A solution of phosphoric acid has a pH of 4 and a solution of hydrochloric acid has a pH of 1. Which of the two is the stronger acid? Explain your answer. **(2 marks)**

Total 20 marks

GO ON TO THE NEXT PAGE

2. In Experiments I and II, 6.5 g of zinc granules are allowed to react with excess 1 **mol dm^{-3}** sulphuric acid at 25°C and 80°C respectively. Figure 1 shows the rate of production of hydrogen gas for both experiments.

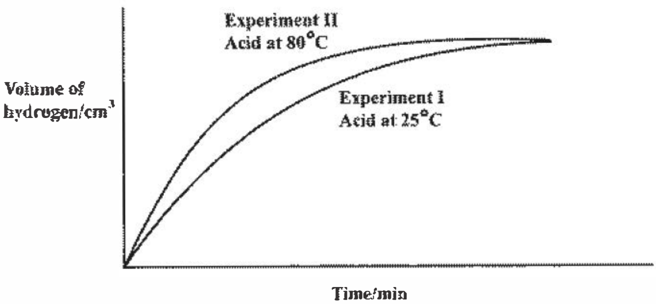


Figure 1. Production of hydrogen from zinc and sulphuric acid

(a) (i) Write a balanced equation for the reaction between zinc and aqueous sulphuric acid. **(2 marks)**

(ii) Based on the balanced equation you wrote in (a) (i) above, calculate the maximum volume of hydrogen gas at r.t.p. which can be generated from Experiment I using 6.5 g of zinc granules. **(2 marks)**

(R.A.M: H = 1, Zn = 65, S = 32, O = 16; 1 mole of gas occupies 24 dm^3 at r.t.p.)

(b) In a third experiment, Experiment III, 6.5 g of zinc reacts with excess **2 mol dm^{-3}** sulphuric acid at 80°C.

(i) Make a sketch of the graph in Figure 1 in your answer booklet. On your sketch, draw the expected results for Experiment III. **(2 marks)**

(ii) With reference to the slopes of the graphs for Experiments I, II and III, discuss the effects of EACH of the following on the rate of production of hydrogen:

a) Temperature

b) Concentration of the acid **(8 marks)**

(c) State TWO precautions that should be taken when conducting these experiments. **(2 marks)**

(d) Catalysts are used to alter the rates of chemical reactions.

(i) Explain how a catalyst works to increase the rates of chemical reactions. **(2 marks)**

(ii) Draw a labelled energy profile diagram to show how a catalyst would alter the rate of reaction between zinc and sulphuric acid. **(2 marks)**

Total 20 marks

GO ON TO THE NEXT PAGE

SECTION B

Answer ONE question from this section.

3. Carefully study the reaction scheme in Figure 2 and answer the questions which follow.

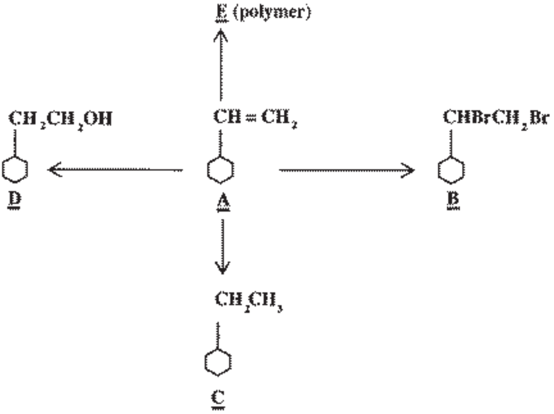


Figure 2. Reaction scheme

(a) Identify suitable reagents and reaction conditions which can be used to convert

(i) Compound A into Compound B

(ii) Compound A into Compound C.

(4 marks)

(b) Describe what may be OBSERVED when Compound D reacts with EACH of the following:

(i) Acidified potassium chromate (VI)

Give a reason for your answer. **(3 marks)**

(ii) Sodium metal

Include a balanced chemical equation in your answer. **(3 marks)**

(c) Table 1 below gives TWO statements about Compound A. These statements may be true or false.

Copy this table in your answer booklet and fill in the information required in the blank spaces. In answering this question you should refer to the information about Compouud A given in Figure 2 on page 4.

TABLE 1

Statements about Compound A	**Indicate whether true or false**	**Reason**	**Where statement is false, give correct statement**
(i) Compouud A is a saturated hydrocarbon.			
(ii) Compound A undergoes condensation polymerization.			

(6 marks)

(d) (i) Draw the partial structure of the polymer, E, that is formed when Compound A is polymerized. **(2 marks)**

(ii) State how the structure of the polymer you have drawn in (d) (i) above differs from that formed from the polymerization of Compound F shown below. Illustrate your answer by means of an appropriate partial structure.

Compound F

(2 marks)

Total 20 marks

GO ON TO THE NEXT PAGE

4. (a) (i) Show by means of chemical equations, the main steps involved in the manufacture of sulphuric acid by the Contact process, starting with sulphur. You should state the reaction conditions required. **(6 marks)**

(ii) The manufacture of sulphuric acid is a highly exothermic process. Suggest how this helps to make the whole process more economical. **(1 mark)**

(iii) Suggest why in the manufacture of sulphuric acid, the sulphur trioxide is dissolved in sulphuric acid (98%) rather than directly in water. **(1 mark)**

(iv) Name TWO factors that should be taken into consideration in the siting of a sulphuric acid plant. **(2 marks)**

(b) Account for the following observation:

Sulphur burns in air to form an oxide which is gaseous, whereas sodium forms an oxide which is a solid, although both elements belong to the same period of the periodic table. **(4 marks)**

(c) Natural rubber is very soft and pliable. It can be strengthened by the process of vulcanization. Illustrate by means of a labelled diagram the role of sulphur in the vulcanization process. **(2 marks)**

(d) Consider the following equations and determine whether sulphuric acid and sulphur dioxide are acting as reducing or oxidizing agents. You should indicate how you arrived at your answer.

(i) $Cu(s) + 2H_2SO_4(aq) \rightarrow CuSO_4(aq) + SO_2(g) + 2H_2O(l)$

(ii) $SO_2(g) + 2H_2O(l) + Cl_2(g) \rightarrow H_2SO_4(aq) + 2HCl(aq)$

(4 marks)

Total 20 marks

SECTION C

Answer ONE question from this section.

5. The increase in the intensity and frequency of hurricanes and flooding in the Caribbean has been attributed in some quarters to an increase in the average global temperature. The rise in global temperature has been partially attributed to the increase in greenhouse gases in the atmosphere.

(a) Briefly outline how greenhouse gases can contribute to an increase of the earth's atmospheric temperature.

Include in your answer:

(i) The name of the main greenhouse gas **(1 mark)**

(ii) TWO main causes of the increase in concentration of the named greenhouse gas **(2 marks)**

(iii) An explanation of how EACH of the causes named in (ii) above can lead to the increase of this gas in the atmosphere **(3 marks)**

You should include ONE chemical equation in your answer.

(iv) A brief explanation of how the greenhouse effect works. Use a labelled diagram to illustrate your answer. **(5 marks)**

(b) There is a claim that the use of electrical cars can completely eliminate the greenhouse gas effect. Do you support this statement? Suggest TWO reasons for your answer. **(2 marks)**

(c) Over the years, studies have shown that there has been a significant decrease in the levels of the ozone layer. This has been linked to the extensive use of chlorofluorocarbons (CFCs) for many years.

Discuss the significance of the above statement, making reference to:

- The function of the ozone layer
- The action of CFCs on the ozone layer
- TWO health or environmental effects of the reduction of the ozone layer
- The possible long-term implications for the Caribbean's tourism industry
- ONE measure that has been put in place to reduce the amount of CFCs in the atmosphere **(7 marks)**

Total 20 marks

GO ON TO THE NEXT PAGE

6. Figure 3 below shows a generalized structure of a detergent.

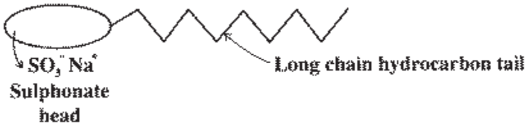


Figure 3. A generalised structure of a detergent

(a) Using the information given in Figure 3 above, suggest how detergents remove dirt from a piece of clothing during washing. **(4 marks)**

(b) In those areas that use hard water, when soaps are used for bathing, bathrooms must be cleaned very often. However, when detergents such as bath gels are used this frequent cleaning is not found to be necessary.

Suggest a reason for this. **(4 marks)**

(c) One major function of laundering clothes is stain removal.

Stacy-Ann has two similar pieces of cloth. On one piece there is a tea stain and on the other a rust stain.

(i) Suggest an appropriate reagent to effectively remove EACH stain. **(2 marks)**

(ii) Give ONE reason for the selection of EACH stain remover and explain how EACH of them works. **(4 marks)**

(d) Fabric softeners are usually added to the final rinse when laundering.

(i) What type of compounds are fabric softeners? **(1 mark)**

(ii) State THREE reasons why fabric softeners are used. **(3 marks)**

(iii) For ONE of the reasons identified in (d) (ii) above, explain how fabric softeners help to carry out this function. **(2 marks)**

Total 20 marks

END OF TEST

TEST CODE **01212020**

FORM TP 2008006

JANUARY 2008

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

1 hour and 45 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. **There are FIVE questions in this booklet. Answer ALL questions.**
2. **You MUST use this answer booklet when responding to the questions. For each question, write your answer in the space provided and return the answer booklet at the end of the examination.**
3. **Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.**
4. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

NOTHING HAS BEEN OMITTED

Answer ALL questions.

Do NOT spend more than 30 minutes on this question.

1. (a) A student is provided with the following:

- Five aqueous solutions (50 cm^3 each) of KIO_3 of different concentrations, EACH labelled 1, 2, 3, 4 and 5.

- An aqueous solution containing $NaHSO_3$, dilute H_2SO_4, and starch indicator, labelled, P.

To each solution of KIO_3 is added a fixed volume of Solution P in a clean dry 250 cm^3 beaker. The solution is stirred and the time taken for the appearance of a blue colour is recorded. These times are shown in seconds on the stopwatches in Figure 1 below. Under each stopwatch is given the concentration of KIO_3 solution used.

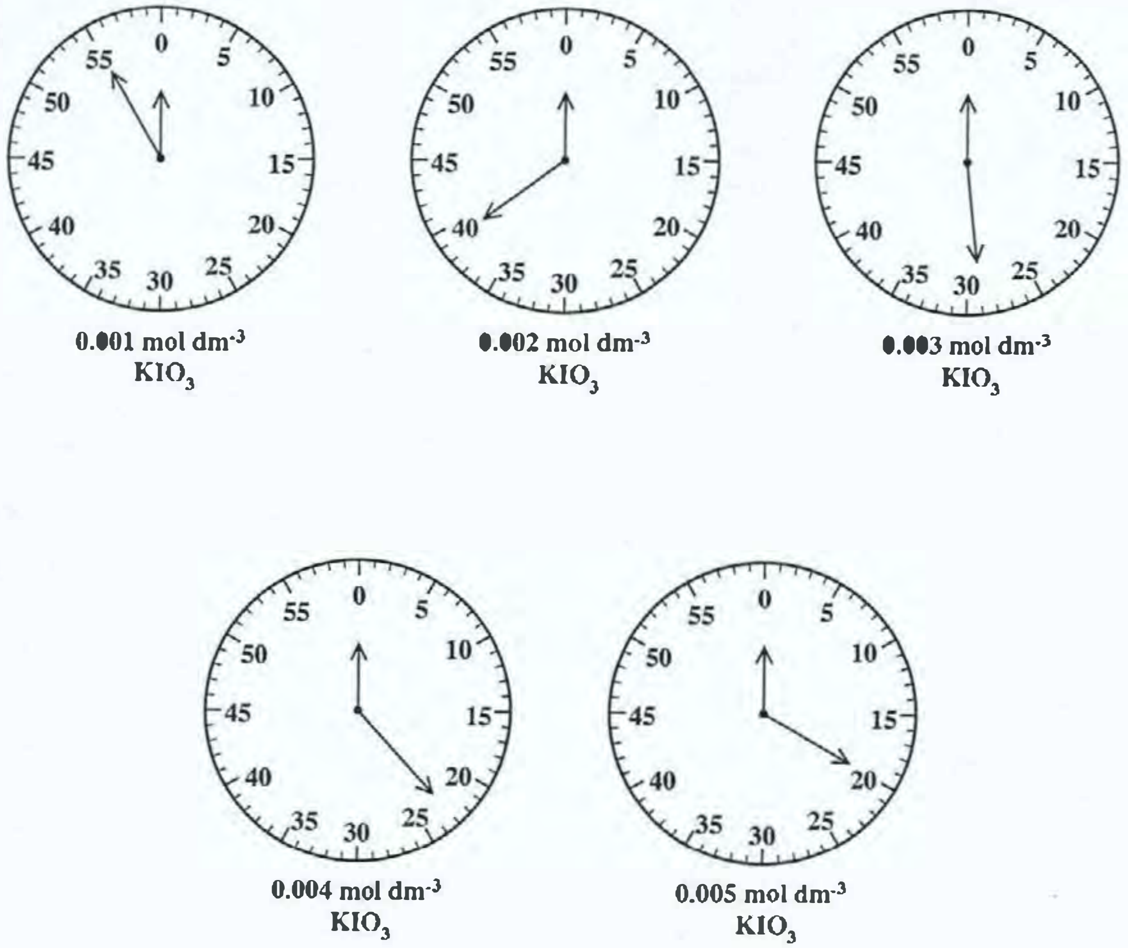


Figure 1. Stopwatches showing time in seconds

GO ON TO THE NEXT PAGE

(i) Complete Table 1 below to show, for the concentration of KIO_3 solution used, the corresponding times in seconds (s) and the reciprocal times ($\frac{1}{t}$) at which the blue colour appears.

TABLE 1: RESULTS

Concentration of KIO_3 (mol dm^{-3})	**Time (s)**	**$\frac{1}{t}$ (s^{-1})**
0.001		
0.002		
0.003		
0.004		
0.005		

(7 marks)

(ii) Using the graph paper on page 5, plot the reciprocal of time against the concentration of KIO_3. **(5 marks)**

(iii) Explain the shape of the graph.

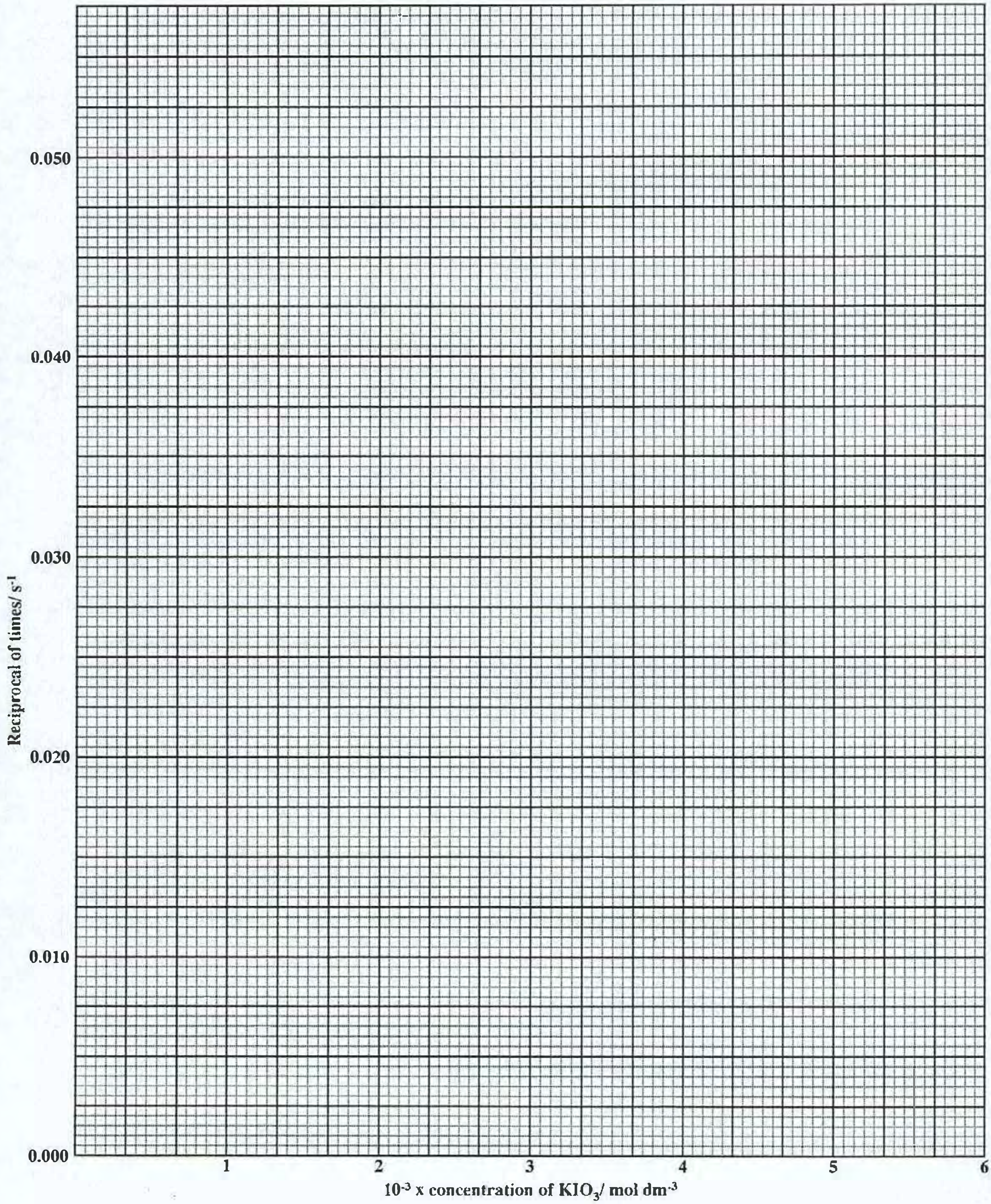
____

____

____

____

(2 marks)



GO ON TO THE NEXT PAGE

(b) Complete Table 2 below for tests carried out on the mixture labelled as Q.

TABLE 2: DATA ON TESTS CARRIED OUT ON Q

Test	Observation	Inference
(i) • A sample of Q is heated in a dry test tube. • A glowing splint is placed into the heated test tube containing a sample of Q. • The gases evolved upon heating are bubbled through lime water.	• The solid turns yellow when hot and white when cold. • A gas which relights a glowing splint evolves. • A gas which forms a white precipitate with lime water evolves.	• • • (3 marks)
(ii) To the solid remaining in (i) after heating, excess dilute HNO_3 is added. This mixture is boiled, then filtered and the filtrate divided into two equal portions.		
(iii) To one portion of the filtrate from (ii) above, aqueous NaOH is added until in excess.	• A white precipitate is formed. • Precipitate is soluble in excess aqueous NaOH.	• (1 mark)
(iv) To the other portion of the filtrate from (ii) above, aqueous ammonia is added until in excess.	• A white precipitate is formed. • Precipitate is soluble in excess aqueous ammonia.	• • (2 marks)
(v) Copper turnings are added to a sample of solid Q, followed by a few drops of concentrated H_2SO_4.	Brown fumes evolve and a blue solution is formed.	(2 marks)

GO ON TO THE NEXT PAGE

(c) You are provided with three brands of beer, namely, Carib, Banks and Red Stripe. Plan and design an investigation to find out which beer has the highest percentage alcohol content.

Your answer should include the following:

(i) Apparatus and materials needed

____

____

____

(2 marks)

(ii) Description of the method to be used

____

____

____

____

____

____

(2 marks)

(iii) ONE variable needed to be controlled

____

(1 mark)

(iv) ONE precaution to be taken

____

(1 mark)

(v) Expected results

____

____

____

(2 marks)

Total 30 marks

GO ON TO THE NEXT PAGE

2. Elements X and Y have the following electron configurations. (X and Y are not the correct symbols of the elements.)

X	Y
2, 8, 2	2, 8, 8, 2

(a) (i) What is the atomic number of Element Y?

____

(1 mark)

(ii) Place Elements X and Y in their correct positions on the periodic table in Figure 2. **(2 marks)**

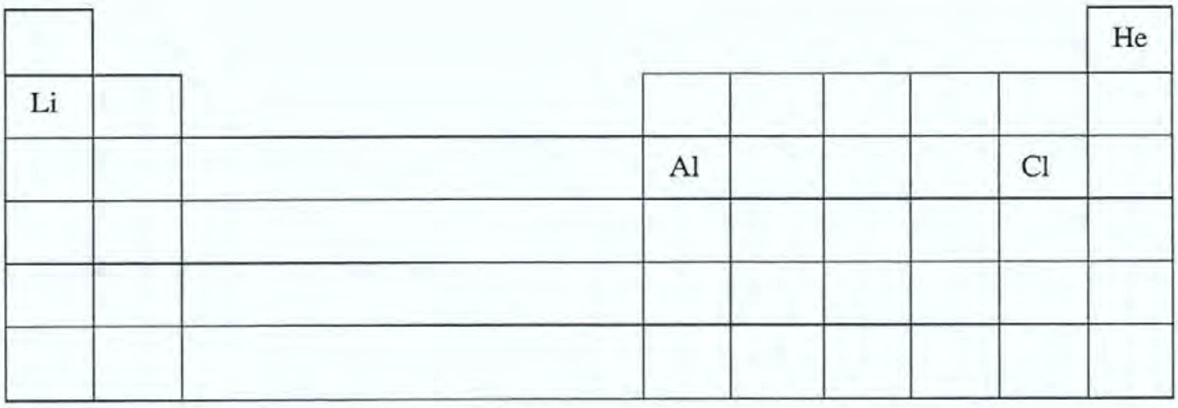


Figure 2. Part of the periodic table

(iii) Explain why you placed the Elements X and Y in the particular group and period in Figure 2 above.

____

____

____

(3 marks)

(iv) Classify X and Y as metals or nonmetals. Give ONE reason for your answer.

____

____

____

(2 marks)

GO ON TO THE NEXT PAGE

(b) Based on the position of X and Y in the periodic table, how will X and Y react with cold water? Give ONE reason for your answer. You should comment on the products formed and the relative rates of the reaction.

____

____

____

____

____

____

(3 marks)

(c) (i) Write a balanced chemical equation for the reaction between X and oxygen.

____

(2 marks)

(ii) What type of bond will be formed when X combines with oxygen? Give a reason for your answer.

____

____

____

(2 marks)

Total 15 marks

3. Figure 3 shows the set up of two experiments. In Experiments I and II the bulb will light when the switch W is closed.

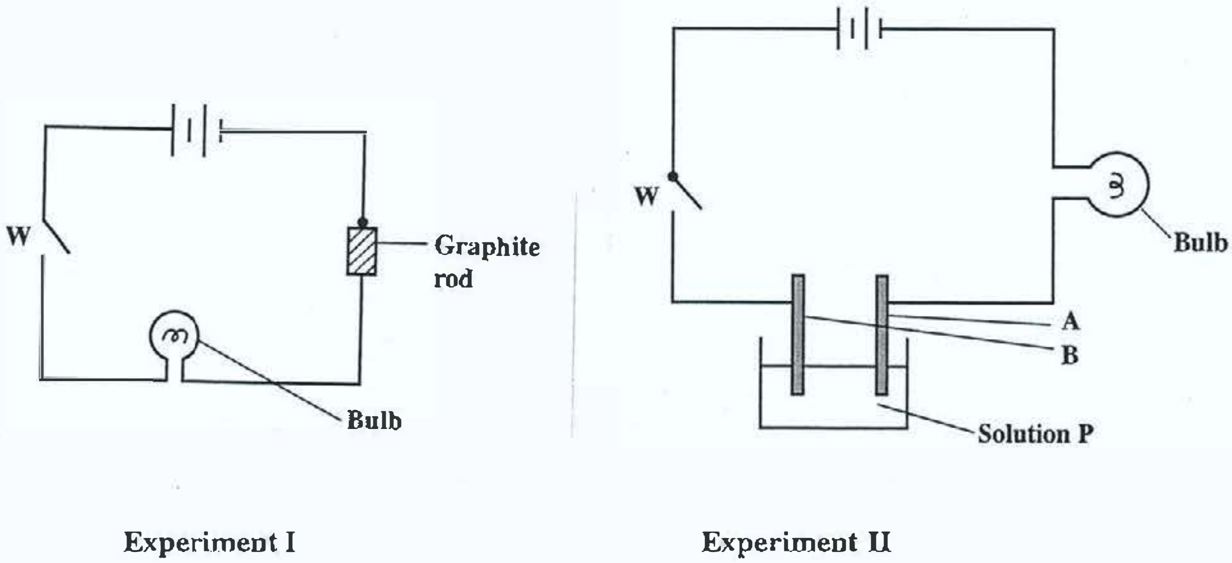


Figure 3. Diagram of the set up of Experiments I and II

(a) Identify the processes which cause the bulbs to light in Experiments I and II. Explain how the processes differ.

Experiment I ______________________________

Experiment II ______________________________

Difference ______________________________

____

____

(4 marks)

(b) Give the name of one substance which, if it replaces graphite in Experiment I, would cause the bulb NOT to light when the switch W is closed.

____

(1 mark)

(c) In Experiment II, Solution P is replaced with Solution Q. It is found that the bulb does not light as brightly with Q as it does with P.

(i) Provide a suitable explanation for the difference observed with Solutions P and Q.

____

____

____

____

(4 marks)

(ii) Suggest a suitable substance for Solution Q.

____

(1 mark)

(d) (i) What are the names of the parts of the apparatus labelled A and B in Experiment II?

Name of A: ____

Name of B: ____

(ii) What are the processes occurring at A and B?

Process occurring at A: ____

Process occurring at B: ____

(4 marks)

Total 14 marks

4. (a) Compound A has the molecular formula C_3H_6. It decolourizes aqueous bromine solution.

(i) Draw the fully displayed structural formula for Compound A.

(1 mark)

(ii) Write a chemical equation to represent the reaction occurring between Compound A and the bromine solution.

____

(1 mark)

(iii) Name the type of reaction which occurs when Compound A reacts with bromine.

____

(1 mark)

(b) Compound B has the molecular formula C_3H_8. It reacts with bromine gas in the presence of light or heat to give a number of products. One of these products has the formula C_3H_7Br.

(i) Draw the fully displayed structural formula for Compound B.

(1 mark)

(ii) Write a chemical equation to represent the reaction occurring between Compound B and bromine.

____

(1 mark)

(iii) Name the type of reaction which occurs when Compound B reacts with bromine.

____

(1 mark)

(c) Compound C has the formula, $CH_3CH_2CH_2CH_2OH$ and Compound D has the formula, $CH_3CH_2CH_2CO_2H$.

(i) Describe ONE simple chemical test which can be used in the laboratory to distinguish between Compounds C and D. State the reagent to be used and describe the observations.

Reagent ______________________________

Observations ______________________________

____

____

(3 marks)

(ii) Write a chemical equation to represent the condensation reaction between Compounds C and D.

(2 marks)

(iii) a) Write a chemical equation to represent the dehydration of Compound C.

(2 marks)

b) Indicate the reagent and reaction conditions for (iii) a) above.

Reagent: ______________________________

Reaction conditions: ______________________________

____

(2 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

5. (a) Stainless steel and duralumin are common alloys used in industry.

(i) Name the MAIN components of EACH of the following:

a) Stainless steel ______________________________

b) Duralumin ______________________________

(2 marks)

(ii) State how the properties of alloys are altered when compared to those of the starting materials from which they are made. Explain your answer.

____

____

____

____

____

(3 marks)

(b) Lead is used in solder and as protection against X-rays.

(i) Suggest ONE property in EACH case that allows lead to be used as

a) a component in solder

____

b) protection against X-rays.

____

(2 marks)

(ii) a) List TWO sources of lead as a pollutant.

____

b) Name ONE effect that lead as a pollutant has on the environment.

____

(3 marks)

(c) The oxides of silicon, carbon and sulphur are used in various industrial processes. Complete Table 3 below by writing the chemical formula for ONE oxide of EACH of the elements and give an example of the use of the oxide in industry.

TABLE 3: ELEMENTS AND USES

Element	**Formula of oxide**	**Use of oxide in industry**
Silicon		
Carbon		
Sulphur		

(6 marks)

Total 16 marks

END OF TEST

TEST CODE **01212030**

FORM TP 2008007

JANUARY 2008

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 03 – General Proficiency

1 hour

17 JANUARY 2008 (p.m.)

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. **In addition to the 1 hour, candidates are allowed a reading time of 10 minutes. Writing may begin during the 10-minute period.**
2. **Answer THREE questions on this paper, ONE from Section A, ONE from Section B and ONE from Section C.**
3. **All working MUST be shown for calculations.**
4. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A

Answer ONE question from this section.

1. The properties of solid substances depend upon

- the properties of the particles they contain
- the arrangement of the particles
- the bonding between these particles.

Depending upon their structure and properties, solids may be classified as having giant ionic, giant metallic, giant covalent or molecular lattice structures.

(a) (i) Draw the lattice structure for EACH of the following:

a) Diamond

b) Sodium chloride **(5 marks)**

(ii) Discuss how EACH of the following properties is related to the lattice structure of diamond:

a) Melting point

b) Conduction of electricity **(4 marks)**

(b) Suggest possible explanations for EACH of the following sets of observations:

(i) Sodium chloride and magnesium oxide both have similar giant ionic lattice structures, yet the melting point of sodium chloride is 801°C but that of magnesium oxide is 2852°C . **(3 marks)**

(ii) Graphite is a nonmetal, yet it conducts electricity. Include a structure of the graphite lattice in your answer. **(5 marks)**

(c) Based on your knowledge of solid air fresheners, would you classify them as having giant ionic, giant covalent or molecular lattices? Explain your answer. **(3 marks)**

Total 20 marks

2. Bases are important chemicals used in many areas in the home, the laboratory and in industry. They can be classified in various ways.

(a) (i) Distinguish among the following terms used in classifying bases:

a) Alkali

b) Strong alkali

c) Weak alkali **(3 marks)**

(ii) Give the name of a strong alkali and state ONE household use of this alkali. **(2 marks)**

(b) Lime is one of the most widely used and cheapest industrial chemicals. It is made by heating limestone ($CaCO_3$).

Write a chemical equation for the formation of lime from limestone. **(2 marks)**

(c) One use of bases in the laboratory is in the preparation of salts. This can be done by observing the changes in temperature during neutralization by an acid. When neutralization is complete, the resulting mixture is crystallized to produce the salt.

(i) Explain whether it is possible to prepare samples of sodium sulphate AND calcium sulphate using this method of salt preparation. Include a chemical equation in your answer. **(7 marks)**

(ii) Briefly explain the basis on which temperature changes, which occur during acid/base reactions, can be used to determine when complete neutralization occurs. **(3 marks)**

(iii) Identify ONE limitation in using this method to prepare salts. **(1 mark)**

(iv) Briefly describe how you would calculate the percentage yield of the salt obtained using the method of salt preparation in (c) (i) above. **(2 marks)**

Total 20 marks

SECTION B

Answer ONE question from this section.

3. Ethanol is only one member of a large group of compounds belonging to the homologous series called the alcohols. They find widespread use in industry and can be synthesized from different starting materials.

(a) Show by means of suitable chemical equations how ethanol can be prepared from EACH of the following starting materials:

(i) Ethene

(ii) Glucose

In EACH case you should indicate the names of the reagents and the reaction conditions. **(7 marks)**

(b) Ethanol produced from sugars is impure. Draw a fully labelled diagram of the apparatus used to obtain pure ethanol from such reaction mixtures. **(4 marks)**

(c) Suggest why there is a change in colour of acidified potassium chromate (VI) when it is warmed with white wine. Use an ionic equation to illustrate your answer. **(3 marks)**

(d) The ethene used in the commercial synthesis of ethanol can be obtained indirectly from the heavier fractions of crude oil.

Using $C_{14}H_{30}$ as an example of a heavy crude oil fraction, show by means of a balanced chemical equation how ethene can be obtained from it. You should state the name of the commercial process. **(3 marks)**

(e) State with a reason whether sodium can be used as a reagent to distinguish between ethanol and ethanoic acid in the laboratory. Include a chemical equation in your answer. **(3 marks)**

Total 20 marks

4. The method used to extract a metal from its ore is related to the position of the metal in the electrochemical series. Figure 1 shows the relative position of two unnamed metals, W and Y, in the electrochemical series.

W
Al
Zn
Fe
Y
Cu

Figure 1. Relative positions of W and Y in the electrochemical series

(a) (i) Based on the information provided in Figure 1, name the extraction process by which W and Y can be obtained from their respective ores. Explain your answer. **(6 marks)**

(ii) Given that the chemical formula for the ore of W is WO, write ONE ionic equation for the reaction producing W from its ore. Your equation should be based on the extraction method you named at (a) (i) above. **(2 marks)**

(b) (i) Compare the properties of metals and nonmetals in terms of their

a) reactions with oxygen to form acidic or basic oxides

b) oxidizing or reducing properties.

Use appropriate equations to explain your answer. **(8 marks)**

(ii) Suggest why the oxides of nonmetals are MORE likely to pollute the atmosphere than the oxides of metals. **(4 marks)**

Total 20 marks

SECTION C

Answer ONE question from this section.

5. Linen and polyester are examples of fabrics. Fabrics are made from fibres which are woven or knitted together. These fibres are obtained from different sources (natural and synthetic), and have different properties.

(a) Mrs. James noticed that the linen curtains that she bought a year ago faded after exposure to sunlight and the first wash. In contrast, the polyester curtains she purchased were still brightly coloured.

(i) Classify the linen and polyester fibres according to their source (natural or synthetic). **(2 marks)**

(ii) Suggest ONE difference, other than fading, that Mrs. James might have also noticed about her linen and polyester curtains after washing. **(1 mark)**

(iii) Draw structures to represent the monomer units present in the linen AND polyester fibres. **(3 marks)**

(iv) Illustrate by means of suitable equations how THREE of these monomer units in linen AND in polyester can be linked together to form part of the macro-molecules present in these fabrics. **(4 marks)**

(b) Mrs. James decides to dye the linen curtains to restore their colour. She purchases some fabric dye containing methylene blue to do the job. What advice would you give to Mrs. James about the procedure for dyeing the curtains?

You should include in your answer:

(i) ONE general property of all dyes used in colouring fabrics. **(1 mark)**

(ii) An explanation of the chemical principles on which dyes work. **(4 marks)**

(iii) Any step that Mrs. James should take before applying the methylene blue dye to the curtains. Give a suitable reason for this step and include a chemical equation in your answer. **(5 marks)**

Total 20 marks

6. The humus content of soils, the availability of mineral nutrients, and soil acidity all play an important role in plant growth.

(a) Discuss the nature AND importance of humus in soil. **(5 marks)**

(b) (i) Briefly describe the procedure you would use in the laboratory to measure the pH of a soil sample. **(2 marks)**

(ii) A soil sample from a farmer's estate is found to have a pH of 4.0. Describe a method that the farmer can use to reduce the acidity of the soil.

Include in your answer:

a) The normal pH range of soils

b) The name AND chemical formula of the substance recommended for use

c) A chemical explanation as to how this recommended substance can bring about a reduction in soil acidity

d) Relevant chemical equations **(7 marks)**

(c) (i) Name an element which is essential for plant growth and describe the effects of a deficiency of this element on plant growth. **(3 marks)**

(ii) Design an appropriate experiment to investigate the effects of the deficiency of this element on plant growth. **(3 marks)**

Total 20 marks

END OF TEST

TEST CODE **01212042**

FORM TP 2008008

JANUARY 2008

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 04/2 – Alternative to SBA

General Proficiency

2 hours

READ THE FOLLOWING DIRECTIONS CAREFULLY

In addition to the 2 hours allowed for the examination, candidates are allowed 10 minutes in order to read through the entire paper.

Writing may begin during the 10-minute period.

1. **Answer ALL questions on this paper.**
2. **Use this answer booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the answer booklet at the end of the examination.**
3. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

NOTHING HAS BEEN OMITTED.

Answer ALL questions.

1. Chemical reactions are accompanied by heat changes. Heat may be absorbed or given out to the surrounding. Such heat changes can be readily measured experimentally. In this exercise you are required to determine the heat change which occurs when solid potassium nitrate is dissolved in water.

(a) You are provided with 5.0 g of solid potassium nitrate.

PROCEDURE

1. Using a measuring cylinder, pour 50 cm^3 of distilled water into the polystyrene cup provided.

2. Measure the temperature of the water in the cup at one-minute intervals for four minutes. Record your data as indicated in Table 1.

3. Pour the 5.0 g of solid potassium nitrate into the cup. Stir with the thermometer and record the temperature of the solution at one-minute intervals over a further period of 6 minutes. Record the data as indicated in Table 1.

CALCULATION

Calculate ΔT for EACH of the 6 minutes and record your answers as indicated in Table 1.

TABLE 1: TEMPERATURE CHANGES UPON DISSOLVING POTASSIUM NITRATE IN WATER

	Before addition of potassium nitrate				**After the addition of potassium nitrate**					
Time/min	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Temp/°C										
ΔT/°C*	X	X	X	X						

*ΔT = temperature reading at a particular time − temperature reading at 4 minutes

(12 marks)

(b) (i) On the graph paper provided on page 5, plot a graph of temperature against time using your experimental data in Table 1. **(5 marks)**

(ii) From your graph calculate the maximum change in temperature which occurs when 5.0 g of potassium nitrate is dissolved in 50 cm^3 of water. You should indicate on your graph how you arrived at your answer.

Maximum temperature change: ______________________

(2 marks)

(iii) Is the reaction exothermic or endothermic? Give a reason for your answer.

____

____

(2 marks)

(iv) Calculate EACH of the following:

a) The number of moles of potassium nitrate used in the experiment

____

____

(Relative atomic masses: K = 39; N = 14; O = 16)

(1 mark)

b) The heat change which occurs when 5.0 g of potassium nitrate is dissolved in 50 cm^3 of water

____

____

____

Heat change = mass of solution x specific heat capacity of solution x temperature change
Assume that the specific heat capacity of the solution is 4.2 J g^{-1} $°C^{-1}$ and 1 cm^3 of solution = 1 g. **(1 mark)**

c) The heat change in kJ $mole^{-1}$

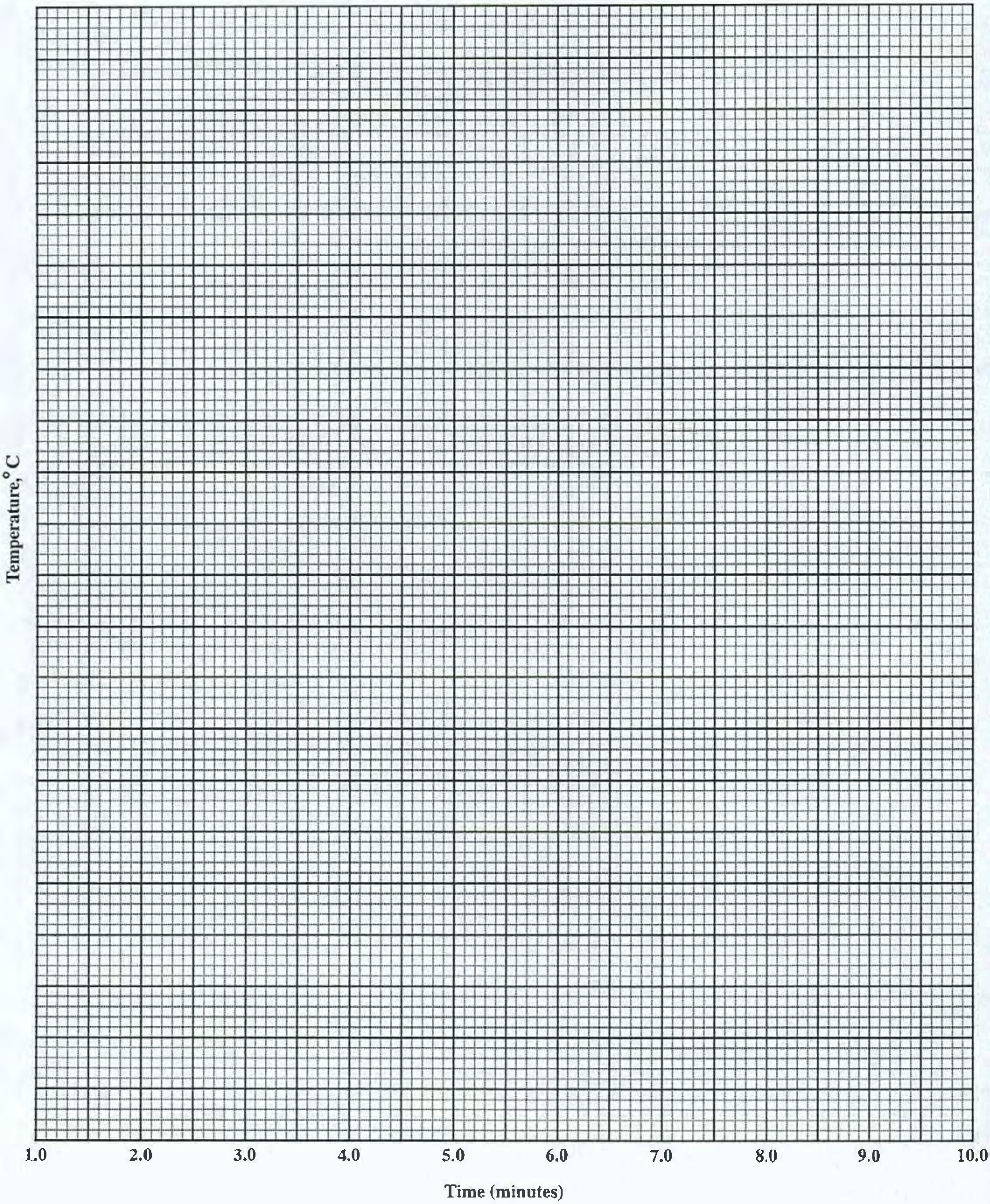
____

____

(2 marks)

Total 25 marks

GO ON TO THE NEXT PAGE


Temperature, °C
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Time (minutes)

2. You are provided with a solid sample M. Sample M consists of a mixture of two salts. One of these salts is water soluble whereas the other is insoluble. You are required to carry out the following tests on sample M and record the results in Table 2.

TABLE 2: TESTS ON SAMPLE M

Test	Observation	Inference
(i) Place a small amount of Sample M in a test tube and heat strongly in a bunsen flame.		
(ii) Dissolve the remainder of Sample M in about 10 cm^3 of distilled water. Stir and then filter. Collect the filtrate for Test (iii) below. Retain the residue on the filter paper for Test (iv) below.		
(iii) Divide the filtrate from (ii) above into three equal parts.		
a) • To one portion of the filtrate add aqueous sodium hydroxide slowly while shaking. • Continue adding until in excess.	• •	• •

TABLE 2 CONTINUED

Test	Observation	Inference
b) • To the second portion of the filtrate add aqueous ammonia slowly while shaking. • Continue adding until in excess.	• •	• •
c) To the third portion of the filtrate add aqueous potassium iodide.	•	•
(iv) Dissolve the residue from (ii) in a minimum amount of dilute nitric acid. Filter and collect the filtrate. Add aqueous potassium iodide to the filtrate.	•	• (Include an ionic equation)

Total 13 marks

3. The following is an extract taken from a student's laboratory notebook.

1. Rinse and fill the burette with the aqueous solution of sodium hydroxide provided.
2. Pipette 25 cm^3 of the rust remover, Solution X, into the conical flask.
3. Add 3 drops of phenolphthalein indicator to the conical flask.
4. Titrate the contents of the conical flask with the sodium hydroxide solution from the burette to a faint pink endpoint.
5. Repeat steps 1 to 4 above using the two other brands of rust remover, Solutions Y and Z provided.

Study the above extract carefully and answer the questions which follow.

(a) Suggest the hypothesis the student wanted to test.

____

____

(1 mark)

(b) List the apparatus and materials required to conduct the experiment.

____

____

____

(2 marks)

GO ON TO THE NEXT PAGE

(c) Construct a suitable fully labelled table to show the relevant experimental results the student would be expected to gather in order to test his/her hypothesis.

You should use hypothetical burette readings in the construction of your table.

(5 marks)

(d) State ONE precaution you should take in carrying out the experiment.

____

____

(1 mark)

(e) State ONE variable that needs to be controlled in conducting the experiment.

____

(1 mark)

(f) Discuss whether the results in the table you constructed in (c) above support or contradict your stated hypothesis in (a) on page 8.

____

____

(2 marks)

Total 12 marks

END OF TEST

TEST CODE **01212020**

FORM TP 2008055

MAY/JUNE 2008

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. This paper consists of SEVEN questions in THREE sections.
2. Answer the THREE compulsory questions in Section A. Write your answers in this answer booklet.
3. Answer the TWO compulsory questions in Section B. Write your answers in the answer booklet provided.
4. Answer ONE question from Section C. Write your answers in the answer booklet provided.
5. Attach your question paper to your answer booklet and return them to the supervisor.
6. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet and the answer booklet provided.
7. The use of non-programmable calculators is allowed.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A

Answer ALL questions in this section.

Write your answers in the spaces provided in this booklet.

Do NOT spend more than 30 minutes on Question 1.

1. (a) When a strong acid is titrated with a strong base, the change in pH which occurs can be used to determine the end point of the titration. The pH will change sharply at 7.0 at the end point of the titration.

A pH meter can be used to measure the changes in pH during the reaction.

Figure 1 on page 3 shows ten pH readings obtained when a student uses pH changes to determine the end point of an acid-base reaction. The acid used is 20.0 cm^3 of a 0.005 mol dm^{-3} sulphuric acid solution. The base is sodium hydroxide of unknown concentration.

Reading I represents the pH of 20.0 cm^3 of sulphuric acid at the start of the experiment. Readings II to X represent the pH readings when various volumes of sodium hydroxide are added to the sulphuric acid solution. The volumes of sodium hydroxide solution added are indicated in Figure 1 on page 3.

(i) What is meant by EACH of the following?

a) pH scale

____

____

b) The end point of an acid-base titration

____

____

____

____

(4 marks)

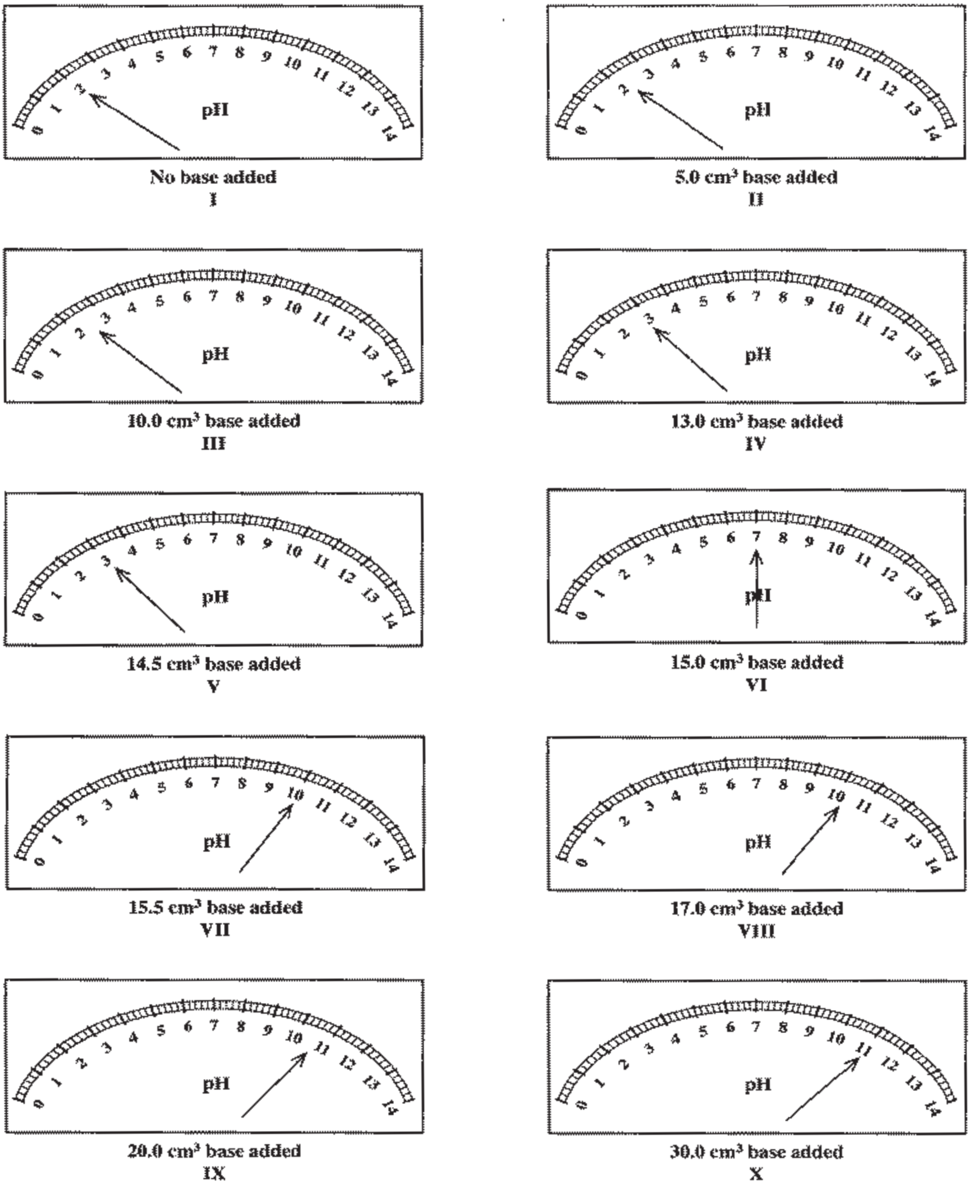


Figure 1. pH meter readings when various volumes of sodium hydroxide are added to $20.0\ cm^3$ of sulphuric acid ($0.005\ mol\ dm^{-3}$)

GO ON TO THE NEXT PAGE

(ii) Complete Table 1 below by recording the missing pH meter readings from Figure 1.

TABLE 1: pH METER READINGS

Volume of base added (cm^3)	pH meter reading
0	2.0
5.0	
10.0	
13.0	2.8
14.5	
15.0	
15.5	10.2
17.0	
20.0	
30.0	11.2

(2 marks)

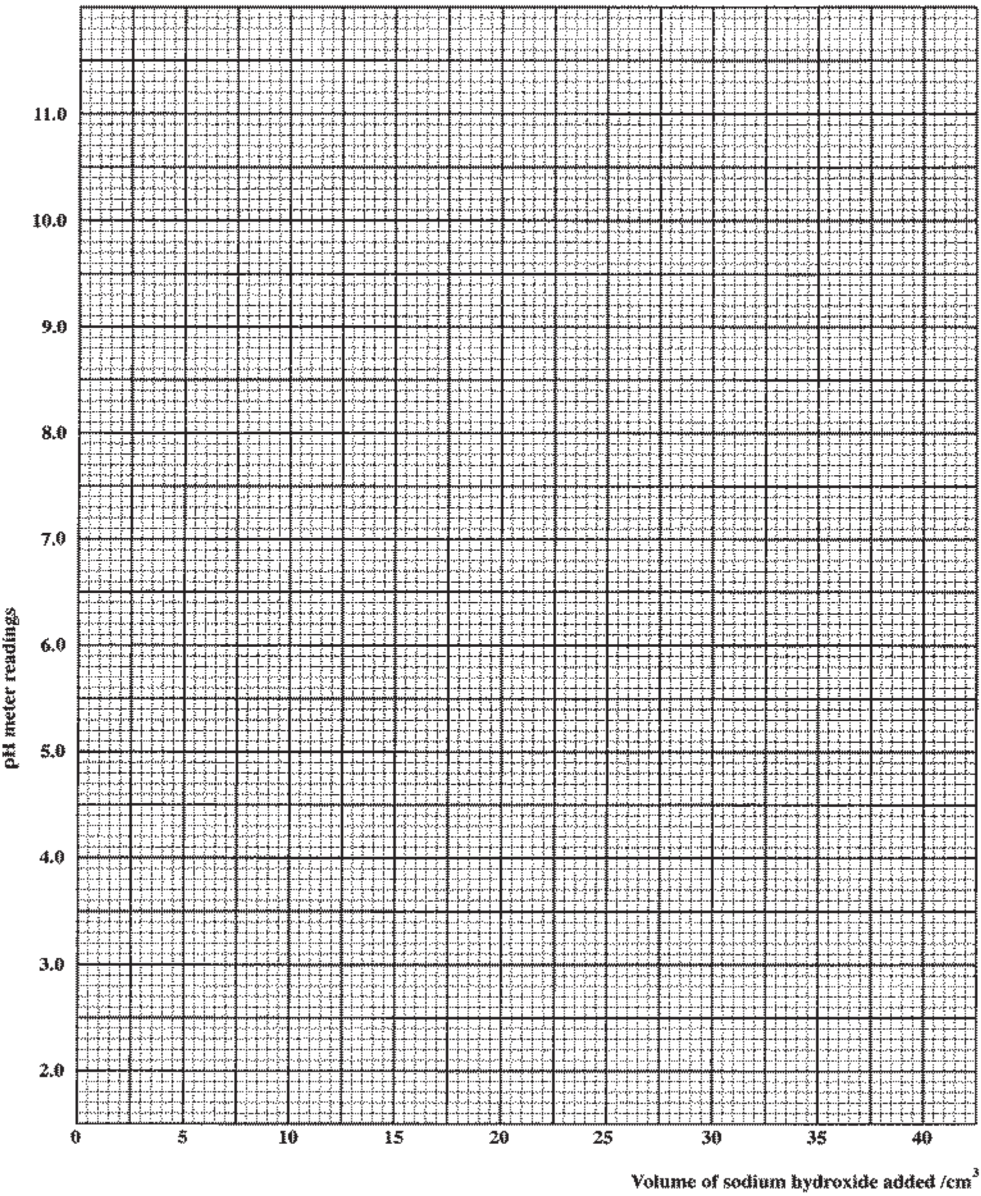
(iii) Using the graph paper provided on page 5 and the data in Table 1, plot a graph of pH against volume of sodium hydroxide added. **(3 marks)**

(iv) Use the graph to determine the volume of sodium hydroxide which reacts completely with the 20 cm^3 of 0.005 mol dm^{-3} sulphuric acid.

Volume of NaOH = ________________________ cm^3
(1 mark)

GO ON TO THE NEXT PAGE

Graph showing pH against volume of sodium hydroxide added



GO ON TO THE NEXT PAGE

(v) Calculate EACH of the following:

a) The number of moles of sulphuric acid in 20 cm^3 of the sulphuric acid used

____

____

(2 marks)

b) The number of moles of sodium hydroxide in the volume of sodium hydroxide used in (a) (iv)

____

____

(2 marks)

c) The number of moles of sodium hydroxide in 1 dm^3 of this solution

____

____

(1 mark)

(b) A student conducts a number of tests on an aqueous solution of Compound **X**. The observations made are recorded in Table 2 below. Complete Table 2 by filling in the inferences that could be made based on the observations recorded.

TABLE 2: RESULTS OF TESTS ON A SOLUTION OF COMPOUND X

Test	Observation	Inference
To a sample of a solution of **X**, dilute nitric acid is added followed by a few drops of silver nitrate solution.	A white precipitate which turns grey black in light is formed.	**(1 mark)** (Ionic equation required) **(1 mark)**
To a sample of a solution of **X**, aqueous sodium hydroxide is added until in excess.	A pale blue gelatinous precipitate is formed which is insoluble in excess.	**(1 mark)**
To a sample of a solution of **X**, a few drops of acidified aqueous potassium manganate (VII) solution are added and the solution heated.	The potassium manganate (VII) solution is decolourised.	**(1 mark)**
To a sample of a solution of **X**, a few drops of barium chloride solution followed by dilute hydrochloric acid are added.	• A white precipitate is formed. • The precipitate dissolves in acid.	• **(1 mark)** • **(1 mark)**

(c) Hydrogen peroxide will decompose slowly at room temperature to produce water and oxygen. The rate of decomposition can be increased by using a catalyst.

Manganese (IV) oxide, copper oxide, liver extracts and potato extracts have been used to catalyse various reactions.

Plan and design an experiment to determine which of the four catalysts above will be most effective in increasing the rate of decomposition of hydrogen peroxide. Write your answer in the spaces provided.

Outline of method (include the variables controlled):

____

____

____

____

____

____

(2 marks)

Labelled diagram of apparatus to be used:

(2 marks)

Total 25 marks

2. Figure 2 represents a part of the periodic table showing the location of fluorine (F), chlorine (Cl), bromine (Br), iodine (I) and astatine (At).

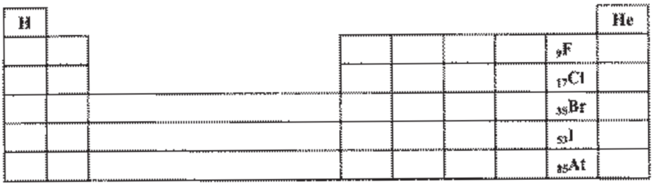


Figure 2. Part of the periodic table

(a) Identify the group in the periodic table in which fluorine (F), chlorine (Cl), bromine (Br), iodine (I) and astatine (At) are placed. Give ONE reason for your answer.

Group: ______________________________

Reason: ______________________________

(2 marks)

(b) Figure 3 represents the experimental set up used by a group of students who are investigating the reactivity of halogens.

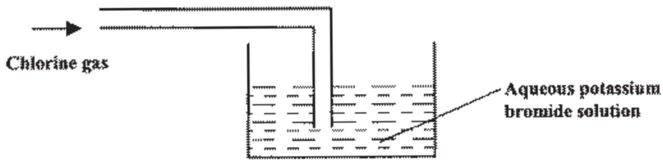


Figure 3. Experiment to investigate the reactivity of halogens

What would the students observe when they conduct the experiment represented in Figure 3? Illustrate your answer by means of an equation.

____

____

____

(3 marks)

GO ON TO THE NEXT PAGE

(c) Two compounds of Elements **X** and **Y** undergo the reactions recorded in Table 3. Study the information carefully and answer the questions that follow.

TABLE 3: REACTIONS OF COMPOUNDS OF ELEMENTS X AND Y

Action of	Compound of Element X	Compound of Element Y
Dilute acid on solid	Vigorous reaction to produce a gas which forms a white precipitate with aqueous calcium hydroxide	Dissolves to form a blue solution.
Heat on solid	No visible change	Forms a black solid and a brown gas is evolved.
Strip of magnesium added to an aqueous solution of compound	No visible change	Magnesium dissolves. A reddish brown solid is precipitated.

(i) Deduce whether **X** and **Y** are metals or nonmetals.

X is ______________________________

Y is ______________________________

(2 marks)

(ii) Based on your answer to (c) (i) above, describe the bonding in Element **Y**.

____

____

____

(2 marks)

(iii) Predict the type of bond that would be formed between **X** and oxygen. Give a reason for your answer.

Type of bonding: ______________________________

Reason: ______________________________

____

____

(2 marks)

(iv) Based on the information given in Table 3, arrange the elements **Mg**, **X** and **Y** in order of decreasing activity. Explain your answer.

Order of activity (**most** reactive first): ____________________

Explanation: ____________________

____

____

(4 marks)

Total 15 marks

3. But-1-ene (1–butene) and but-2-ene (2–butene) are structural isomers of molecular formula C_4H_8.

(a) (i) Define 'structural isomerism'.

____

____

(1 mark)

(ii) Draw fully displayed structures of but-1-ene and but-2-ene.

But-1-ene But-2-ene

(2 marks)

GO ON TO THE NEXT PAGE

(iii) Draw and name ONE OTHER structural isomer of C_4H_8.

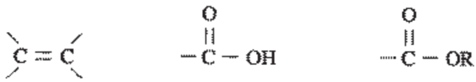
(2 marks)

(iv) State ONE physical property of C_4H_8.

____

(1 mark)

(b) Ethanol will react under different conditions to produce compounds with the following functional groups:



(i) What is meant by a 'functional group'?

____

____

(1 mark)

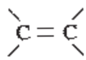
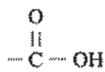
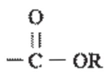
(ii) Ethanol reacts with different reagents to form products with the functional groups shown in Table 4.

Complete Table 4 by

a) identifying the reagents

b) drawing the fully displayed structures of the products.

TABLE 4: REACTIONS OF ETHANOL

	Reagents	**Functional group in product formed**	**Structure of organic product formed**
Ethanol			
			
			

(8 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

SECTION B

Answer ALL questions in this section.

Write your answers in the answer booklet provided.

4. Barium (Ba) is below calcium in the same group in the periodic table.

(a) (i) Draw a fully labelled diagram of the apparatus which could be used in the electrolysis of molten $BaBr_2$. You should indicate the material from which the electrodes are made. **(3 marks)**

(ii) Write equations to indicate the chemical reactions which occur at the electrodes. **(4 marks)**

(iii) A current of 5A is passed for 2 minutes through the molten $BaBr_2$. Calculate the mass of the product that will be formed at the cathode.

(Relative atomic mass: Ba = 137, Br = 80)
(1 Faraday = 96 500 C mol^{-1}) **(5 marks)**

(iv) List TWO factors which can in general affect the products formed during electrolysis of compounds. **(2 marks)**

(b) State ONE reason why the reaction of barium with water is faster than the reaction of calcium with water. **(1 mark)**

Total 15 marks

5. Organic compounds may be classified as either saturated or unsaturated. Their characteristic reactions are quite different and are related to the type of bonding present in these molecules.

Consider the following compounds, A to D below, and answer the questions which follow.

C_4H_8	$C_3H_7CO_2H$	C_4H_{10}	$C_3H_7CH_2OH$
A	**B**	**C**	**D**

(a) (i) From the compounds A to D above, select ONE compound which is saturated and ONE compound which is unsaturated. **(2 marks)**

(ii) Name AND give the general formula for the homologous series to which EACH of the two compounds selected in (a) (i) above belongs. **(4 marks)**

(b) Nitrogen constitutes about 78% of the gases in the atmosphere. It exists as very stable diatomic molecules. It undergoes very few but important reactions (called fixation reactions) to produce nitrogenous compounds required by plants.

Nitrogen is "fixed" by the Haber process according to the following equation:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3 \qquad \Delta H = -92 \text{ kJ mol}^{-1}$$

The pressure used in ammonia plants today is about 200 – 300 atmospheres and the temperature about 400 – 500°C.

Suggest reasons for using these reaction conditions. Explain your answer in terms of the equation above. **(3 marks)**

(c) With reference to the nitrogen cycle:

(i) Name ONE process by which nitrogen in the atmosphere can be converted into nitrates. **(1 mark)**

(ii) Name ONE process by which nitrogen in the nitrates in soil is released back into the atmosphere. **(1 mark)**

(d) Two metal nitrates, **P** and **Q**, are separately heated. **P** gives off a colourless gas which rekindles a glowing splint. **Q** gives off a brown gas.

(i) Which of these two metal nitrates, **P** or **Q**, possibly contains

– Group 1 metal?

– Group 2 metal? **(2 marks)**

(ii) Write a chemical equation to show the reaction taking place when **Q** is heated. **(2 marks)**

Total 15 marks

SECTION C

Answer ONE question from this section.

Write your answers in the answer booklet provided.

6. When silica is mixed with sodium carbonate and calcium carbonate and heated strongly, the mixture forms a transparent liquid which, when cooled, becomes glass. Different types of glass can be produced by varying the proportions of these reactants and by adding other substances.

(a) (i) State TWO benefits of adding sodium carbonate or calcium carbonate to silica in the manufacture of glass. **(2 marks)**

(ii) State how the basic components of glass are modified to produce

- lead-potassium glass
- borosilicate glass. **(4 marks)**

(b) Glass is a non-crystalline solid which melts over a wide range of temperatures. It consists mainly of silicates (SiO_4). The chemical bonds in the SiO_4 tetrahedron are not all of the same strength.

(i) Why is it important that glass does NOT crystallize as it cools? **(2 marks)**

(ii) Suggest how the bonding in SiO_4 affects what happens when glass melts. Explain why this is important for blowing and moulding glass. **(3 marks)**

(iii) Although no scarce and vital raw material is used in the manufacture of glass, recycling of glass is strongly recommended. Suggest TWO reasons for this. **(2 marks)**

(iv) Glass is now widely used as a construction material in buildings. State ONE advantage and ONE disadvantage of using glass in this way. **(2 marks)**

Total 15 marks

7. Soil is the most important medium required for plant growth. It consists mainly of mineral and organic matter. Some of the organic matter does not decompose. It remains in the soil for a long time as humus. The optimum pH range of soil is 6.0 to 6.8.

(a) State the importance of EACH of the following factors in plant growth:

(i) Mineral balance **(1 mark)**

(ii) pH **(1 mark)**

(iii) Humus content of the soil **(2 marks)**

(b) A farmer observes that the leaves of his bean crop are few in number and yellow in colour. The Agricultural Extension Officer decides to test the farmer's soil for ammonium and iron (III) ions, as well as for its pH.

(i) Briefly describe the test for the presence of ammonium ions in a soil sample. **(2 marks)**

(ii) The Officer finds the soil to be acidic and recommends the addition of lime.

- Suggest ONE possible reason for the acidic nature of the soil.

- Explain the effect of adding lime to the soil. Use a suitable equation to support your answer. **(4 marks)**

(c) The farmer, in addition to adding the recommended lime to the soil, also decides to add an ammonium fertilizer, thinking that it would increase his crop yield.

Do you think that the farmer's decision to add both lime and ammonium fertilizer to the soil at the same time is a wise one? Give ONE reason for your answer. Include any relevant chemical equation. **(5 marks)**

Total 15 marks

END OF TEST

TEST CODE **01212020**

FORM TP 2009005

JANUARY 2009

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. **This paper consists of SEVEN questions in THREE sections.**
2. **Answer the THREE compulsory questions in Section A. Write your answers in this answer booklet.**
3. **Answer the TWO compulsory questions in Section B. Write your answers in the space provided in this answer booklet.**
4. **Answer ONE question from Section C. Write your answers in the space provided in this answer booklet.**
5. **Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.**
6. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A

Answer ALL questions in this section.

Write your answers in the spaces provided in this booklet.

Do NOT spend more than 30 minutes on Question 1.

1. (a) A group of students are asked to conduct an experiment to determine the effect of **concentration of hydrochloric acid** on **the rate of reaction** with magnesium. They are provided with

- magnesium ribbon
- a 1.5 mol dm^{-3} solution of aqueous hydrochloric acid
- a supply of deionized water and
- access to laboratory equipment.

They are asked to conduct a set of FOUR experiments using 50 cm^3 of acid in each case.

(i) Explain the effect of increasing the concentration of the reactants on the rate of a chemical reaction.

____

____

(2 marks)

(ii) Write a balanced equation for the reaction between magnesium and hydrochloric acid.

____

(2 marks)

(iii) Calculate the mass of magnesium that will COMPLETELY react with 50 cm^3 of 1.5 mol dm^{-3} HCl. (Relative atomic mass of Mg = 24; H = 1; Cl = 35.5)

(3 marks)

(iv) Describe how you would prepare 50 cm^3 of different concentrations of hydrochloric acid from the solution of 1.5 mol dm^{-3} hydrochloric acid provided.

____

____

____

____

(3 marks)

GO ON TO THE NEXT PAGE

NOTHING HAS BEEN OMITTED

(v) Figure 1 shows a series of diagrams that represents how the students set up the experiment to determine the effect of the **concentration of acid** on the rate of the reaction. Identify THREE **major** flaws in the design of the experiment conducted by the students. Write your answer on page 5.

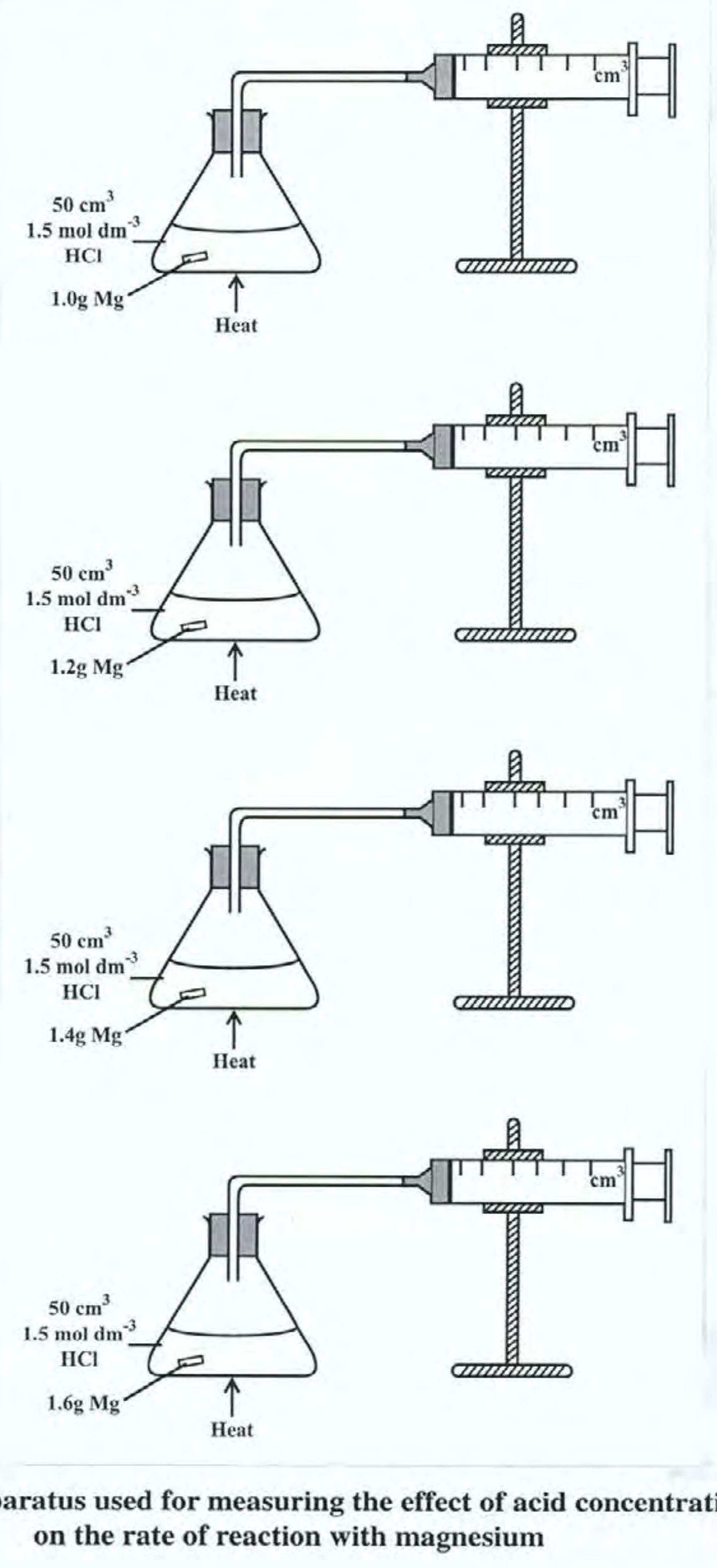


Figure 1. Apparatus used for measuring the effect of acid concentration on the rate of reaction with magnesium

(v) Figure 1 shows a series of diagrams that represents how the students set up the experiment to determine the effect of the **concentration of acid** on the rate of the reaction. Identify THREE **major** flaws in the design of the experiment conducted by the students. Write your answer on page 5.

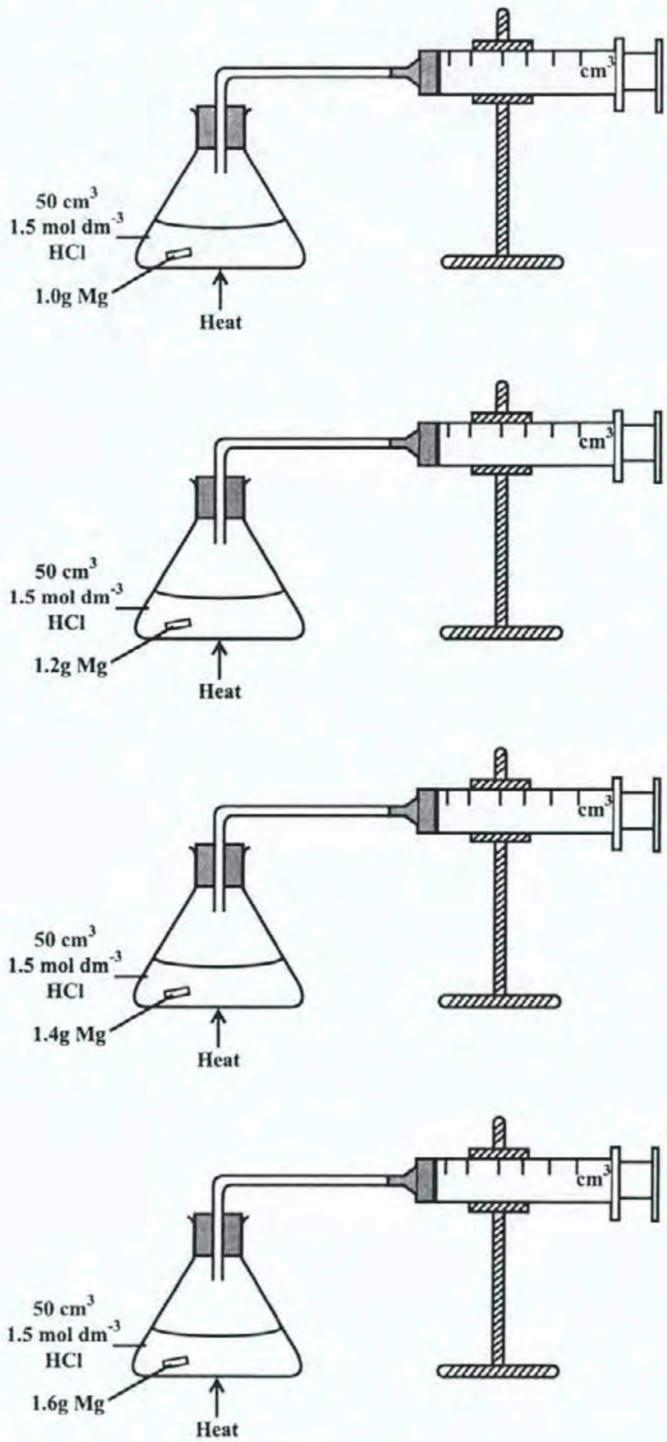


Figure 1. Apparatus used for measuring the effect of acid concentration on the rate of reaction with magnesium

(3 marks)

(b) In another set of experiments, students were asked to measure the volume of oxygen given off at different time intervals when the enzyme, catalase, decomposes hydrogen peroxide according to the equation:

$$2H_2O_2 \xrightarrow{\text{catalase}} O_2 + 2H_2O$$

Table 1 gives the data obtained by the students.

TABLE 1: DECOMPOSITION OF HYDROGEN PEROXIDE BY CATALASE

Time / s	**Total volume of O_2 given off / cm^3**
0	0
15	4
30	8
45	12
60	16
75	19
90	21
105	22
120	23

(i) Plot the TOTAL volume of oxygen given off against time, on the graph paper on page 7. **(3 marks)**

(ii) Account for the shape of the graph obtained.

____

____

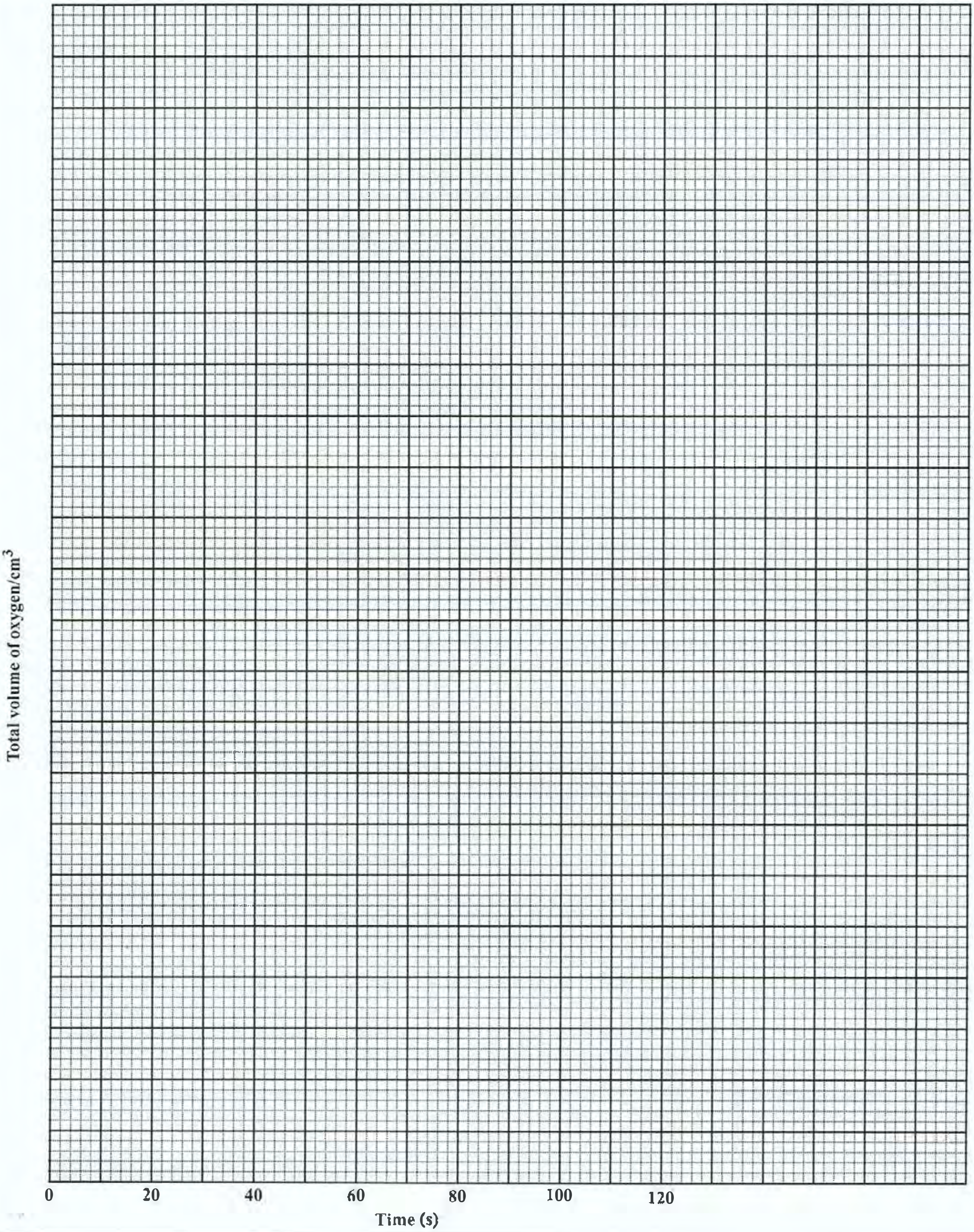
____

(2 marks)

(iii) From your graph determine the volume of oxygen gas produced after 50 seconds.

____

(1 mark)


Total volume of oxygen/cm^3
0
20
40
60
80
100
120
Time (s)

(c) A number of tests were carried out on an aqueous solution of Compound R. The observations obtained are recorded in Table 2. Write suitable inferences and ionic equations for EACH reaction in the spaces provided.

TABLE 2: TESTS ON COMPOUND R

Test	Observation	Inference
(i) A strip of Mg is placed in a small amount of a solution of R.	• Magnesium ribbon dissolves. • A brown solid is formed.	• • • (ionic equation required)
(ii) Aqueous sodium hydroxide is added to a solution of R until in excess.	• Blue gelatinous precipitate is formed. • The precipitate does not dissolve in excess sodium hydroxide.	• • (ionic equation required)
(iii) Aqueous barium nitrate followed by aqueous nitric acid is added to a solution of R.	• A white precipitate is formed. • The precipitate is insoluble in acid.	• • • (ionic equation required)

(6 marks)

Total 25 marks

2. Isotopes are quite common, with a number of naturally occurring elements having more than one stable isotope. Chlorine – 35 ($^{35}_{17}Cl$) and carbon – 12 ($^{12}_{6}C$) are the more abundant isotopes of chlorine and carbon respectively. The other isotopes are $^{37}_{17}Cl$ and $^{14}_{6}C$. Carbon – 14 is radioactive.

(a) (i) Define the term 'isotopes'.

____

____

(1 mark)

(ii) State ONE use of carbon – 14.

____

(1 mark)

(b) Write the electron configurations of $^{37}_{17}Cl$ and $^{14}_{6}C$.

Electron configuration of $^{37}_{17}Cl$ ______________________________

Electron configuration of $^{14}_{6}C$ ______________________________

(2 marks)

(c) Calculate the percentage of carbon – 14 in 1 mole of tetrachloromethane, $^{14}_{6}C\,^{37}_{17}Cl_4$.

(3 marks)

(d) Based on your knowledge of the properties of compounds and isotopes, complete Table 3 below by writing the differences between the sets of compounds, and a suitable explanation in EACH case.

TABLE 3: SETS OF COMPOUNDS, THEIR DIFFERENCES AND EXPLANATION OF THE DIFFERENCES

Properties and compounds	Difference (if any)	Explanation
(i) The boiling points of ${}^{12}_{6}C\,{}^{35}_{17}Cl_4$ and ${}^{12}_{6}C\,{}^{37}_{17}Cl_4$		(2 marks)
(ii) The melting points of $Mg\,{}^{37}_{17}Cl_2$ and ${}^{14}_{6}C\,{}^{37}_{17}Cl_4$		(3 marks)
(iii) The products of the reactions between ${}^{35}_{17}Cl_2$ and ${}^{37}_{17}Cl_2$ with aqueous potassium bromide		(3 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

3. Table 4 shows the properties of four metals, A, B, D and E. Use the information in Table 4 to answer the questions which follow, about the metals and their compounds. You are NOT required to identify the metals.

TABLE 4: SOME PROPERTIES OF METALS

	A	**B**	**D**	**E**
Formula of chloride	ACl_2	BCl_2	DCl_2	ECl
Reaction with steam	No reaction	Violent reaction to produce hydrogen	Burns to produce hydrogen	Violent reaction to produce hydrogen
Reaction with dilute acid	Slowly displaces hydrogen from acids	Readily displaces hydrogen from acids		Explosive reaction to produce hydrogen

(a) Arrange Metals A, B, D and E in order of reactivity with the MOST reactive FIRST.

(2 marks)

(b) Write an **ionic** equation to represent the reaction between Metal B and dilute nitric acid.

(2 marks)

(c) (i) Write an equation to represent the action of heat on the hydroxide of Metal A.

(2 marks)

(ii) How would the effect of heat on the hydroxides of Metals A, B and D differ from the effect of heat on the hydroxide of Metal E?

(2 marks)

(d) With reference to their positions in the reactivity series, suggest a suitable method of extraction of Metals A and E. Give a reason for your answer in EACH case.

Extraction of Metal A:

Method ______________________________

Explanation

____

____

Extraction of Metal E:

Method ______________________________

Explanation

____

____

(4 marks)

(e) Metals such as copper are often combined with other metals to form alloys.

(i) State ONE reason why metals are often combined with others to form alloys.

____

(1 mark)

(ii) Name ONE alloy of copper and state the metals used to make it.

Alloy ______________________________

Metals ______________________________

(2 marks)

Total 15 marks

SECTION B

Answer ALL questions in this section.

Write your answers in the space provided after EACH question in this answer booklet.

4. Students in a chemistry class are required to devise an experiment to classify substances as conductors and non-conductors. They are provided with a bulb, a source of power, two graphite rods and connecting wires. They are also provided with the following substances for testing.

- Zinc metal
- Aqueous potassium bromide
- A solution of bromine in carbon tetrachloride
- Solid potassium bromide

(a) The students are required to conduct the experiment and record their results in a table such as Table 5. Study the information in Table 5 and answer the questions that follow.

TABLE 5: RESULTS OF EXPERIMENT

Substance tested	Observation	Explanation
Zinc metal		
Aqueous potassium bromide		
Solution of bromine in carbon tetrachloride		
Solid potassium bromide		

(i) On page 14, draw a fully labelled generalized diagram to show how the materials provided could be arranged to conduct the experiment in order to determine whether the substances tested are conductors or non-conductors. **(2 marks)**

(ii) Complete Table 5 to indicate the observations that the students would have made when conducting the experiment. **(4 marks)**

(iii) By referring to the nature of the substances tested, provide a suitable explanation for EACH observation you recorded in (a) (ii) above.
Write your answer in Table 5. **(4 marks)**

(b) During the electrolysis of aqueous copper(II) sulphate using copper electrodes, a current of 3.0 A is passed through the solution for 10 minutes. Copper is deposited at the cathode.

(i) Define the terms 'electrolysis' AND 'cathode'. **(2 marks)**

(ii) Calculate the mass of copper that is deposited during the reaction.
(Relative Atomic Mass: Cu = 64; 1F = 96 500 C) **(3 marks)**

Total 15 marks

Write the answer to Question 4 here.

Write the answer to Question 4 here.

Write the answer to Question 4 here.

5. Ethanol is becoming an increasingly more important commodity on the world market today. It can be obtained commercially from ethene and from carbohydrates.

(a) (i) Write a chemical equation to illustrate the reaction taking place in the commercial preparation of ethanol from EACH of the following:

a) Ethene

b) Glucose

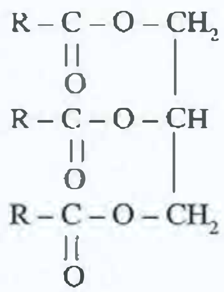
In EACH case you should state the reaction conditions. **(6 marks)**

(ii) Draw a fully labelled diagram of the apparatus that is used to separate the ethanol from the reaction mixture during the fermentation of glucose.

(3 marks)

(b) Soaps are prepared from the saponification of oils and fats.

(i) Using Compound C to represent the structure of a fat, draw the structure of the product(s) expected from the saponification of this fat.



Compound C

(3 marks)

(ii) A number of vegetable oils are unsaturated and are liquids at room temperature. These can be solidified by the process of hydrogenation (for example, in margarine production).

Write an equation to illustrate the process of hydrogenation of an oil represented by Compound D. You should name the catalyst used in the process.

$$R-(CH_2)_x-CH=CH-(CH_2)_y-CO_2R$$

Compound D

(3 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

Write your answer to Question 5 here.

Write your answer to Question 5 here.

SECTION C

Answer ONE question from this section.

Write your answer in the space provided at the end of this section in this answer booklet.

6. (a) Glass is widely used in and around the home in a variety of ways.

(i) Name TWO types of glass used in and around the home. **(2 marks)**

(ii) Identify the MAIN components for ONE of the types of glass named in (a)(i) above. **(2 marks)**

(iii) a) State ONE property of EACH of the two types of glass named in (a) (i) above.

b) Relate the property to the use of the type of glass. **(4 marks)**

(b) Most dyes can be classified as direct dyes or as mordant dyes.

(i) Compare the mode of action of direct dyes to that of mordant dyes. **(3 marks)**

(ii) Suggest why mordant dyes are used when dyeing cotton fabrics. **(3 marks)**

(iii) Suggest a fabric for which direct dyeing can be used. **(1 mark)**

Total 15 marks

7. A common fertiliser used by many farmers is NPK which contains the elements nitrogen, phosphorous and potassium. NPK is produced in a variety of strengths.

Below are the labels on three different bags of NPK fertilisers.

20 : 8 :14 Bag A	14 : 14 : 14 Bag B	10 : 25 : 15 Bag C

For example, Bag A contains 20% N: 8% P: 14% K.

Consider the following scenarios.

Scenario 1: Farmer Brown planted some tomatoes and recognized that the tomatoes took much longer than usual to ripen. Out of frustration, he pulled up the plants and realized that the roots were thin and fragile.

Scenario 2: The herbs planted by Farmer George, such as parsley, chives and thyme, began to appear yellow and limp.

(a) Based on your knowledge of the importance of various elements to plant growth and development:

(i) Suggest which bag of fertiliser (A, B or C) the farmers should use to solve the problems encountered in Scenario 1 and Scenario 2 above.

(ii) Provide a suitable explanation for your selection in EACH case.

(7 marks)

(b) Cotton thrives in soil with high pH. In some places, in order to facilitate the growth of cotton, lime has to be added to the soil.

(i) Write the chemical formula for lime. **(1 mark)**

(ii) What is the effect of lime on the acidity of a soil? **(1 mark)**

(iii) Write a balanced ionic equation to illustrate the action of lime on soil.

(2 marks)

(iv) A cotton farmer recognizes that his soil needs more nitrogen, and lime, so he adds an ammonium fertiliser and lime to the soil at the same time. Explain how this action could cause nitrogen to be lost. Use a balanced equation to support your answer. **(4 marks)**

Total 15 marks

Write your answer to EITHER Question 6 OR Question 7 here.

Question Number _______

Write your answer to EITHER Question 6 OR Question 7 here.

Question Number _______

Write your answer to EITHER Question 6 OR Question 7 here.

Question Number _______

Write your answer to EITHER Question 6 OR Question 7 here.

Question Number _______

END OF TEST

TEST CODE **01212032**

FORM TP 2009006

JANUARY 2009

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 03/2 – Alternative to SBA

General Proficiency

2 hours

READ THE FOLLOWING DIRECTIONS CAREFULLY

In addition to the 2 hours allowed for the examination, candidates are allowed 10 minutes in order to read through the entire paper.

Writing may begin during the 10-minute period.

1. **Answer ALL questions on this paper.**
2. **Use this answer booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the answer booklet at the end of the examination.**
3. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

1. You are required to determine the concentration of ethanoic acid (acetic acid) in a commercial brand of vinegar.

You are provided with the following solutions:

SOLUTION A: This is a DILUTED solution of commercial vinegar. It was prepared by pipetting out 25 cm^3 of the commercial vinegar into a 250 cm^3 volumetric flask and making it up to the calibration mark with distilled water.

SOLUTION B: This is an aqueous solution of a 0.10 mole dm^{-3} of sodium hydroxide.

(a) PROCEDURE:

(i) First rinse and then fill the burette provided with Solution B.

(ii) Using the pipette filler provided, pipette 25 cm^3 (20 cm^3) of Solution A into a clean conical flask. Add 2 to 3 drops of phenolphthalein indicator to the flask and swirl.

(iii) Titrate the contents of the conical flask with Solution B from the burette.

(iv) Record your burette readings in Table 1.

(v) Repeat Steps (i) – (iv) above until consistent results are obtained.

(b) RESULTS:

TABLE 1: TITRATION RESULTS

Burette readings/cm^3	**Titration number**			
	1	2	3	4
Final burette reading				
Initial burette reading				
Volume of Solution B used				

Pipette volume used: ______________ cm^3

Average volume of Solution B used in titration = ______________ cm^3

(13 marks)

(c) You are required to use your results recorded in Table 1 to determine the percentage by mass of ethanoic acid, CH_3COOH, in the commercial brand of vinegar used.

(i) Write a balanced chemical equation for the reaction occurring between the ethanoic acid in the vinegar and aqueous sodium hydroxide.

____

(1 mark)

(ii) Calculate:

a) The number of moles of sodium hydroxide used in the titration.

(1 mark)

b) The number of moles of ethanoic acid present in 25 cm^3 (20 cm^3) of Solution A (the DILUTED commercial vinegar).

(1 mark)

c) The number of moles of ethanoic acid present in 25 cm^3 of the commercial vinegar (the UNDILUTED commercial vinegar).

(1 mark)

d) The mass of ethanoic acid, CH_3COOH, present in 25 cm^3 of the commercial vinegar.

(Relative Atomic Mass: C = 12; H = 1; O = 16)

(2 marks)

e) The percentage (by mass) of ethanoic acid in the commercial vinegar used. Assume that the density of the vinegar is 1 g cm^{-3}.

(1 mark)

Total 20 marks

2. You are provided with a solid sample of a substance labelled X. This sample contains two cations and one anion. You are required to carry out the following tests on a solution of X. Record your observations and inferences in Table 2.

TABLE 2: TESTS FOR CATIONS AND ANIONS PRESENT IN X

Test	Observation	Inference
(i) Dissolve the solid, X, in about 10 cm^3 distilled water in a test tube. Use this solution to carry out Tests (ii) – (vi) below.	•	•
(ii) To 1 cm^3 of Solution X from (i) above, add 1 cm^3 of aqueous sodium hydroxide and heat. Test for any gases that may evolve.	• • •	• • •
(iii) To 1 cm^3 of Solution X from (i) above, add aqueous ammonia drop by drop with shaking. Add until in excess.	• •	• •
(iv) To 1 cm^3 of Solution X from (i) above, add aqueous barium chloride. Then add dilute hydrochloric acid.	• •	• •
(v) To 1 cm^3 of Solution X from (i) above, add a few drops of dilute nitric acid followed by aqueous silver nitrate.	•	•
(vi) To 1 cm^3 of Solution X from (i) above, add acidified aqueous potassium manganate(VII) drop by drop with shaking, and warm.	•	•

(17 marks)

GO ON TO THE NEXT PAGE

3. The following information is given for a planning and design exercise. Study the information carefully, and answer the questions which follow.

When an aqueous solution, containing Pb^{2+} ions, is added to an aqueous solution containing I^{-} ions, a bright yellow precipitate is formed.

By reacting different amounts of Pb^{2+} and I^{-} ions, it is possible to determine the chemical formula of the lead iodide formed.

You are provided with the following:

- An aqueous solution containing 0.5 mol dm^{-3} of Pb^{2+} ions
- An aqueous solution containing 1.0 mol dm^{-3} of I^{-} ions
- Two measuring cylinders
- Test tubes
- A rule graduated in millimeters

Using the information given above, plan and design an experiment, the results of which can be used to

– determine the volume of the iodide ion solution required to completely react with different volumes of the solution containing Pb^{2+} ions

– determine the chemical formula of the precipitate formed.

(i) Describe the experimental procedure you would employ.

____

____

____

____

____

____

____

____

(4 marks)

(ii) Name TWO variables that you would need to control.

____

____

(2 marks)

GO ON TO THE NEXT PAGE

(iii) State ONE precaution that should be taken in conducting the experiment.

____

(1 mark)

(iv) State the expected data you need to collect from the experiment. This should be presented in the form of a fully labelled table.

(3 marks)

(v) Explain how you would analyse your data to determine

- the ratio of the number of moles of Pb^{2+} and I^- ions required for complete precipitation and hence
- the formula of the precipitate.

____

____

____

____

____

____

____

(3 marks)

Total 13 marks

END OF TEST

FORM TP 2009051

MAY/JUNE 2009

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY

1. **This paper consists of SEVEN questions in THREE sections.**
2. **Answer the THREE compulsory questions in Section A. Write your answers in this answer booklet.**
3. **Answer the TWO compulsory questions in Section B. Write your answers in the spaces provided in this answer booklet.**
4. **Answer ONE question from Section C. Write your answers in the space provided in this answer booklet.**
5. **Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.**
6. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

NOTHING HAS BEEN OMITTED.

SECTION A

Answer ALL questions in this section.

Write your answers in the spaces provided in this booklet.

Do NOT spend more than 30 minutes on Question 1.

1. (a) (i) A student conducts an experiment to investigate the temperature changes that occur when various quantities of powdered zinc are added to 100 cm^3 of 0.20 mol dm^{-3} copper(II) sulphate. The apparatus used is shown in Figure 1.

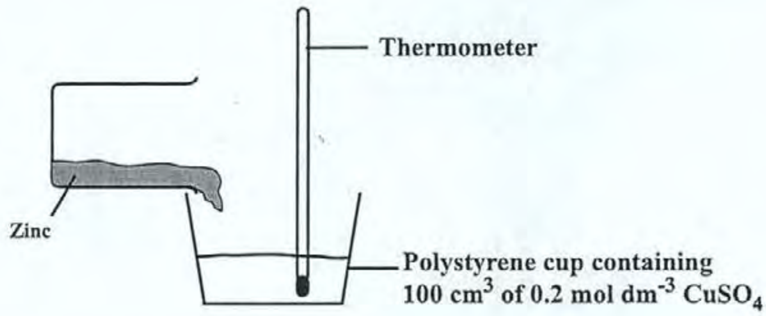


Figure 1. Apparatus used in experiment

The equation for the reaction which occurs is shown below:

$$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$$

a) Describe what would be observed in the polystyrene cup in Figure 1.

___

___

___

(2 marks)

b) What does the observation you described in a) above indicate about the relative positions of zinc and copper in the reactivity series?

___

(1 mark)

c) Distinguish between an exothermic and an endothermic reaction.

____

____

____

(2 marks)

(ii) Figure 2 shows the thermometer readings for the highest temperature recorded for each addition of zinc to the $CuSO_4$. The initial temperature in each case is 28°C.

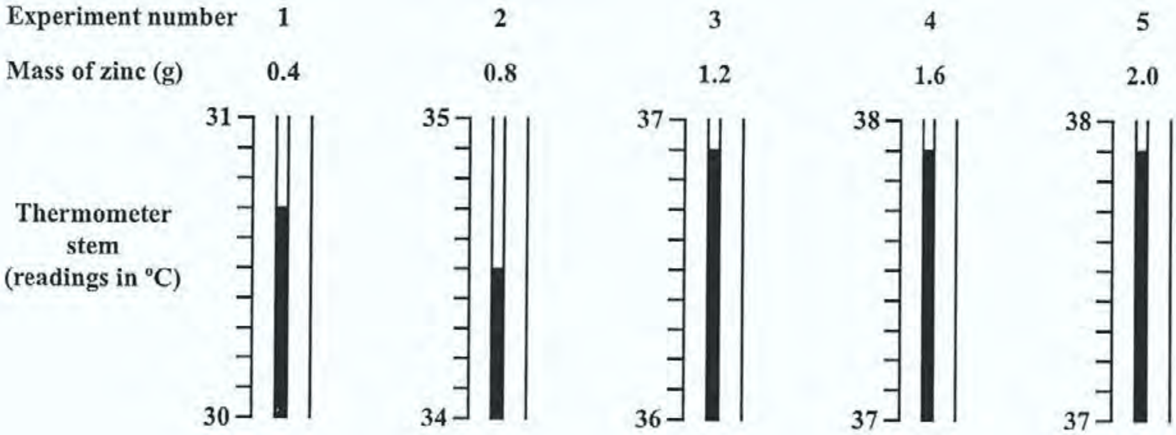


Figure 2. Final thermometer readings

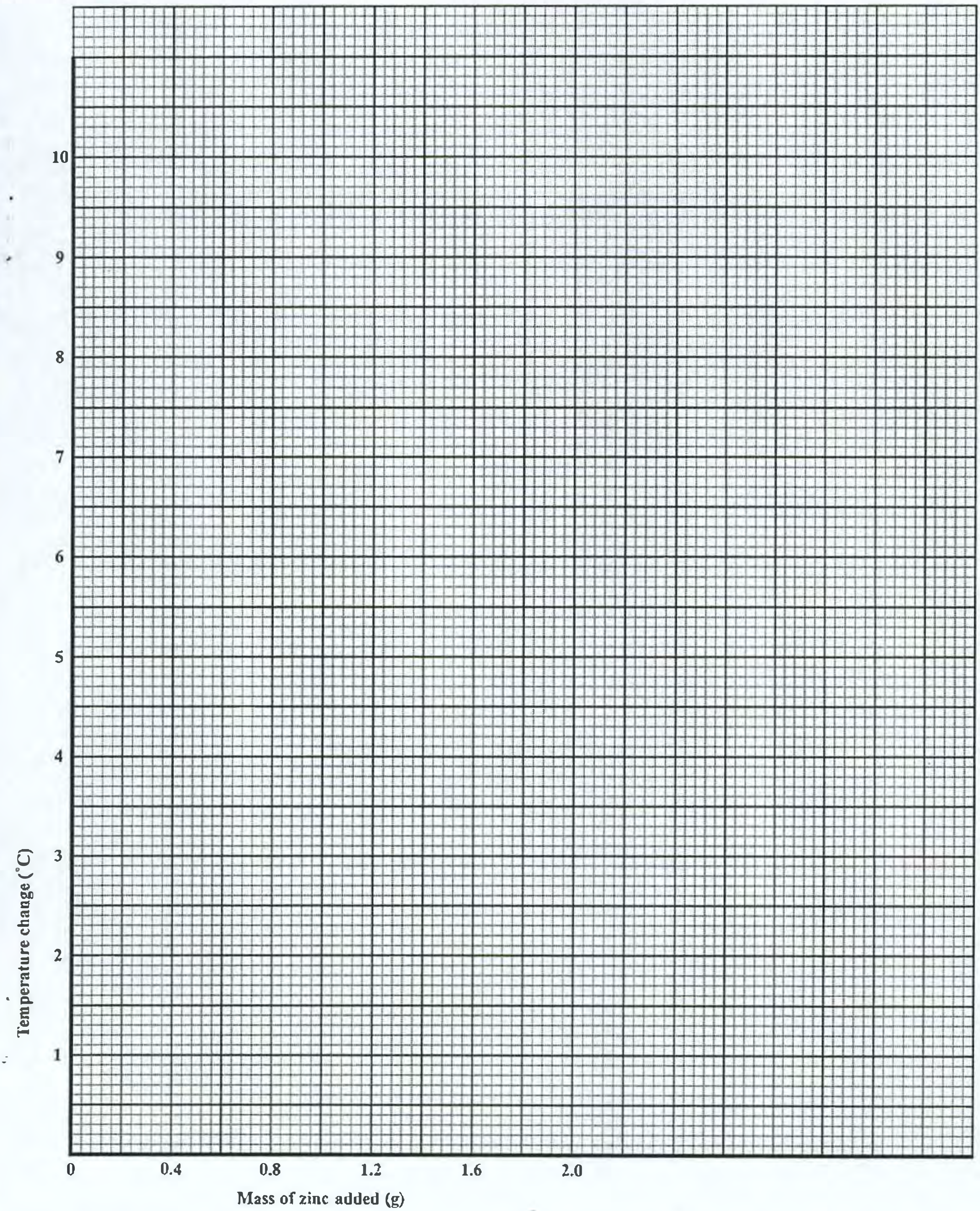
a) Using the readings in Figure 2, complete Table 1 to show the final thermometer readings, and the changes in temperature.

TABLE 1: RESULTS OF EXPERIMENT

Experiment	Mass of zinc (g)	Initial thermometer reading (°C)	Final thermometer reading (°C)	Temperature change (ΔT)
1	0.4	28		
2	0.8	28		
3	1.2	28		
4	1.6	28		
5	2.0	28	37.9	9.9

(2 marks)

b) On the graph paper provided on page 5, plot the temperature change (ΔT) against mass of zinc added. (3 marks)


Temperature change (°C)
1
2
3
4
5
6
7
8
9
10
0
0.4
0.8
1.2
1.6
2.0
Mass of zinc added (g)

c) From your graph, deduce the temperature change (ΔT) that will occur when 1.0 g of zinc is added to the copper(II) sulphate solution.

____

(1 mark)

(iii) Calculate the minimum mass of zinc required to completely react with 100 cm^3 of 0.20 mol dm^{-3} copper(II) sulphate. Relative atomic mass of Zn = 65.

(2 marks)

(iv) Use the information in (iii) above to explain why the different masses of zinc used in Experiments 4 and 5 give approximately the same change in temperature.

____

____

(1 mark)

(v) Another group of students performs a similar experiment but uses silver instead of zinc. No temperature change is observed. Account for this observation.

____

____

(2 marks)

(b) A student conducts the following tests on a solid, R, and makes the observations recorded in Table 2.

(i) Complete Table 2 to show all of the possible inferences and write ionic equations where indicated.

TABLE 2: TESTS PERFORMED ON SOLID R

Test	Observation	Inference
A portion of R is dissolved in approximately 6 cm^3 of water. The resulting solution is divided into equal portions for Tests (1) and (2).	A colourless solution is formed.	
(1) To one portion of Solution R from above, aqueous sodium hydroxide is added dropwise until in excess, then heated.	• No precipitate is formed. • Upon heating, a pungent gas evolves which turns moist red litmus blue.	• • **(2 marks)**
(2) To another portion of R from above, dilute nitric acid, followed by silver nitrate, is added dropwise. This is followed by the addition of aqueous ammonia.	• A white precipitate is formed. • Precipitate dissolves in aqueous ammonia.	• (Ionic equation required) **(2 marks)**

(ii) Suggest a possible identity of the solid, R: ______________________

(1 mark)

(c) Sally, a cleaner, was preparing to clean Ms George's home. She usually cleans the kettle with vinegar and the tiles and toilet with muriatic acid (hydrochloric acid). However, the labels from the bottles containing the two cleaning agents were removed. Sally attempted to distinguish these two cleaning agents by smelling them. However, she was still unsure.

Plan and design an experiment that one can undertake in the laboratory to determine which bottle contains the vinegar and which contains the muriatic acid.

(i) Outline the procedure for the experiment.

____

____

____

____

____

(**2 marks**)

(ii) List the materials necessary.

____

____

(**1 mark**)

(iii) What evidence will result from your procedure to distinguish between the two acids?

____

____

____

(**1 mark**)

Total 25 marks

2. (a) Transitions between the three states of matter can be efficiently illustrated by using water.

Consider the information given in Figure 3 and answer the questions that follow.

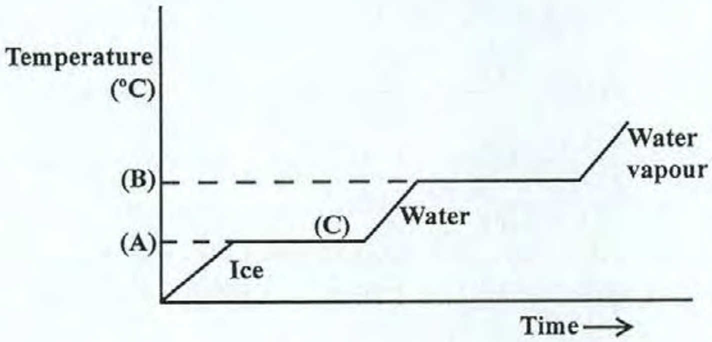


Figure 3. States of matter

(i) Name the THREE states of matter.

____

(1 mark)

(ii) Which of the two temperatures, (A) and (B) in Figure 3 represents

melting point? ____________________________

boiling point? ____________________________

(2 marks)

(iii) What would be observed at (C) in Figure 3?

____

(1 mark)

(iv) Name the process which occurs when the following conversions take place.

Water vapour $\rightarrow$ water ____________________________

Iodine (s) $\rightarrow$ iodine (g) ____________________________

(2 marks)

(b) Diamond and graphite are both allotropes of carbon.

(i) Explain what is meant by the term 'allotrope'.

____

____

(1 mark)

(ii) Which of the two allotropes of carbon, diamond or graphite, conducts electricity? Explain your answer in terms of the structure and bonding of the two allotropes.

Conducts electricity: ______________________________

Explanation: ______________________________

____

____

(2 marks)

(c) Carbon forms numerous compounds and a large number of these are hydrocarbons. These include the alkanes and alkenes. Many of these also exist as isomers.

(i) Name ONE natural source of hydrocarbons.

____

(1 mark)

(ii) Define the term 'structural isomerism'.

____

____

(1 mark)

(iii) In the space provided below draw fully displayed structures of TWO isomers of a hydrocarbon with four carbon atoms. Name the TWO isomers.

Isomer #1	Isomer #2
Name:	Name:

(4 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

3. The first stage in the process of refining crude oil to produce more value-added products is fractional distillation.

(a) (i) Name the property of compounds upon which fractional distillation is based.

____

(1 mark)

(ii) Name the lightest and heaviest fractions that are usually obtained from the fractional distillation of crude oil.

Lightest fraction: ____

Heaviest fraction: ____

(2 marks)

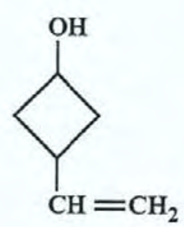
(iii) State ONE use of EACH of the fractions named in (a) (ii) above.

Lightest fraction: ____

Heaviest fraction: ____

(2 marks)

(b) Consider the structure of Compound A below and answer the questions which follow.



Compound A

(i) Draw the structure of the product formed when Compound A reacts with EACH of the following:

Bromine

(2 marks)

Sodium

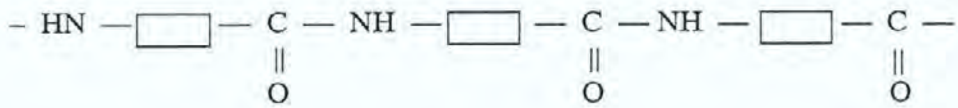
(2 marks)

(ii) Draw the partial structure of the polymer formed when Compound A undergoes ADDITION polymerisation with other molecules of A.

Use three molecules of A in the representation of the partial polymer structure.

(**2 marks)**

(c) B represents the partial structure of a polyamide.



Structure B

(i) Name the type of polymerisation process involved in the formation of B.

____

(1 mark)

(ii) Polyamides of the type B can undergo both acid hydrolysis in the laboratory as well as enzyme hydrolysis in the body.

a) Draw the monomer formed when B undergoes acid hydrolysis.

(2 marks)

b) State ONE difference in the reaction conditions required for acid hydrolysis when compared to enzyme hydrolysis of polyamides.

____

____

(1 mark)

Total 15 marks

SECTION B

Answer ALL questions in this section.

Write your answers in the spaces provided after EACH question in this answer booklet.

4. Table 3 illustrates part of the periodic table.

TABLE 3: PART OF THE PERIODIC TABLE

GROUP / PERIOD	I	II	III	IV	V	VI	VII	VIII
1								He
2		Be			N	O		
3	Na	Mg	Al	Si	P	S	Cl	
4				Sn				
5	Rb			Pb			I	

(a) State the basis upon which elements are arranged into groups and periods in the periodic table. Select an element from Table 3 and use its electronic configuration to illustrate your answer. **(4 marks)**

(b) Identify from Table 3:

(i) ONE element which can be extracted from its oxide by electrolytic reduction but NOT chemical reduction with coke. Give a reason for your answer. **(3 marks)**

(ii) TWO elements, one of which will displace the other from a solution containing its ions. Write an ionic equation to illustrate your answer. **(3 marks)**

(c) Iodine and chlorine will combine to form iodine monochloride (ICl). Suggest the type of bonding which would occur in this compound. Give a reason for your answer and use dot-cross diagrams to illustrate your answer. **(5 marks)**

Total 15 marks

GO ON TO THE NEXT PAGE

Write your answer to Question 4 here.

GO ON TO THE NEXT PAGE

Write your answer to Question 4 here.

5. (a) Ammonia is produced industrially by the Haber Process according to the following equation.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)\,;\ \Delta H = -92\ \text{kJmol}^{-1}$$

Figure 4 shows the steps in the Haber Process used for the industrial preparation of ammonia.

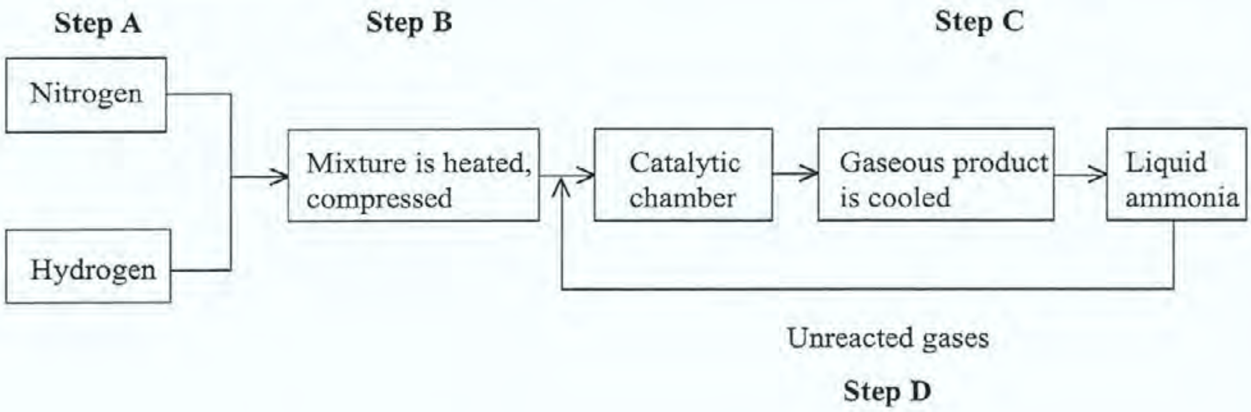


Figure 4. The industrial preparation of ammonia

(i) Name the catalyst and state the temperature used in the manufacture of ammonia. **(2 marks)**

(ii) The temperatures currently used in the manufacture of ammonia make the process cost-effective. Suggest ONE reason for this. **(2 marks)**

(iii) Suggest ONE reason for the importance of Step D in Figure 4. **(1 mark)**

(b) Ammonia can also be produced in the laboratory.

(i) Write a balanced equation to show the laboratory preparation of ammonia. **(2 marks)**

(ii) Describe a suitable test for identifying ammonia. **(2 marks)**

(c) Ammonia is used in the industrial preparation of nitric acid.
In Step 1, ammonia is heated with oxygen in the presence of a catalyst at 850 °C to produce nitrogen(II) oxide as shown in the following equation.

$$4NH_3(g) + 5O_2(g) \xrightarrow[850\ ^\circ C]{Pt - Rh\ catalyst} 4NO(g) + 6H_2O(g)$$

In Step 2, the nitrogen(II) oxide is further oxidized to form nitrogen(IV) oxide.
In Step 3, nitrogen(IV) oxide reacts with oxygen and water to produce nitric acid.

(i) Write balanced equations for Steps 2 and 3 to show the production of nitric acid from ammonia. **(4 marks)**

(ii) State TWO OTHER uses of ammonia. **(2 marks)**

Total 15 marks

Write your answer to Question 5 here.

Write your answer to Question 5 here.

GO ON TO THE NEXT PAGE

SECTION C

Answer ONE question in this section.

Write your answer in the space provided at the end of this section in this answer booklet.

6. (a) The properties of clay which make it suitable for pottery production are its plasticity, porosity and its ability to be vitrified.

(i) Briefly explain what is meant by EACH of the following terms as they relate to pottery production.

- Plasticity
- Porosity
- Vitrification **(3 marks)**

(ii) Suggest ONE reason why EACH of the following makes clay a suitable substance for the making of pottery.

– Plasticity
– Porosity **(2 marks)**

(b) (i) Name ONE component of cement. **(1 mark)**

(ii) Cement is the binding agent in concrete. Identify TWO OTHER ingredients used to make concrete. **(2 marks)**

(iii) Maynard, a mason, cast a concrete floor for Mr. Smith. Before leaving, Maynard suggested to Mr. Smith that he should dampen the floor while it was hardening. From your knowledge of the components of cement and its use in making concrete, explain to Mr. Smith why it is necessary to dampen the concrete floor.

Suggest to Mr. Smith what may occur if he decides NOT to dampen the floor. **(4 marks)**

(c) Some of the ingredients in clays and cements are quite similar. Suggest if it would be appropriate to dampen clay while hardening. Give ONE reason for your answer. **(3 marks)**

Total 15 marks

7. (a) (i) What is meant by the term 'humus' as it relates to soil?

(ii) State THREE reasons why humus is an important component of soil. **(4 marks)**

(b) A student puts a sample of soil in a test tube, adds sodium hydroxide and heats the mixture. For which ions is the student MOST likely testing? **(1 mark)**

(c) For years farmers in the Caribbean have been using chemicals to control many pests which attack agricultural produce.

Biological control, for example, the use of parasitic wasps to control the pink mealy bug, is another means of controlling pests.

Suggest ONE advantage and ONE disadvantage EACH of biological and chemical control of pests. **(4 marks)**

(d) (i) What is meant by the term 'hydroponics'? **(2 marks)**

(ii) Mrs. Wills is considering setting up a hydroponics farm. Advise Mrs. Wills on TWO advantages and TWO limitations of setting up such a farm. **(4 marks)**

Total 15 marks

Write your answer to EITHER Question 6 OR Question 7 here.

Question Number ___________

Write your answer to EITHER Question 6 OR Question 7 here.

Question Number __________

GO ON TO THE NEXT PAGE

Write your answer to EITHER Question 6 OR Question 7 here.

Question Number __________

END OF TEST

FORM TP 2010005

TEST CODE **01212020**

JANUARY 2010

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY.

1. **This paper consists of SEVEN questions in THREE sections.**
2. **Answer the THREE compulsory questions in Section A. Write your answers in this answer booklet.**
3. **Answer the TWO compulsory questions in Section B. Write your answers in the spaces provided in this answer booklet.**
4. **Answer ONE question from Section C. Write your answers in the space provided in this answer booklet.**
5. **Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.**
6. **The use of silent, non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions in this section.

Write your answers in the spaces provided in this booklet.

Do NOT spend more than 30 minutes on Question 1.

1. (a) Copper(II) oxide can react with dilute sulphuric acid to produce either the anhydrous or the hydrated form of a salt as one of the products. The type of salt produced (anhydrous or hydrated) depends on the procedure used.

Table 1 shows 5 experiments with the different masses of an anhydrous copper(II) salt that can be formed by reacting different masses of copper(II) oxide with 50 cm^3 of 1 mol dm^{-3} sulphuric acid. One reading for Experiment 3 is missing from Table 1.

TABLE 1: MASSES OF ANHYDROUS COPPER(II) SALT FORMED FROM COPPER(II) OXIDE USING 1 MOL DM^{-3} H_2SO_4

Experiment Number	**1**	**2**	**3**	**4**	**5**
Mass of copper(II) oxide used (g)	1.58	2.36	3.58	4.00	4.50
Mass of anhydrous salt produced (g)	3.16	4.72		8.00	8.00

(i) Explain how a salt is formed.

____

____

(2 marks)

(ii) What is the difference between ‘anhydrous salts’ and ‘hydrated salts’?

____

____

(2 marks)

(iii) Write a **balanced** chemical equation to show the production of the **anhydrous** salt from the reaction between copper(II) oxide and dilute sulphuric acid.

____

____

(2 marks)

(iv) Given that the relative formula mass of copper(II) oxide is 80, complete the data in Table 1 by calculating the mass of the salt formed in Experiment 3. (Relative Atomic Mass: Cu = 64; S = 32; O = 16; H = 1)

Show your working.

(4 marks)

(v) Using the data from Table 1 and the axes provided on page 4, plot a graph of the mass of anhydrous salt produced against the mass of copper(II) oxide used.

(3 marks)

(vi) Using the graph plotted in (v) above, determine the mass of salt that would be formed from 2.95 g of copper(II) oxide.

____

____

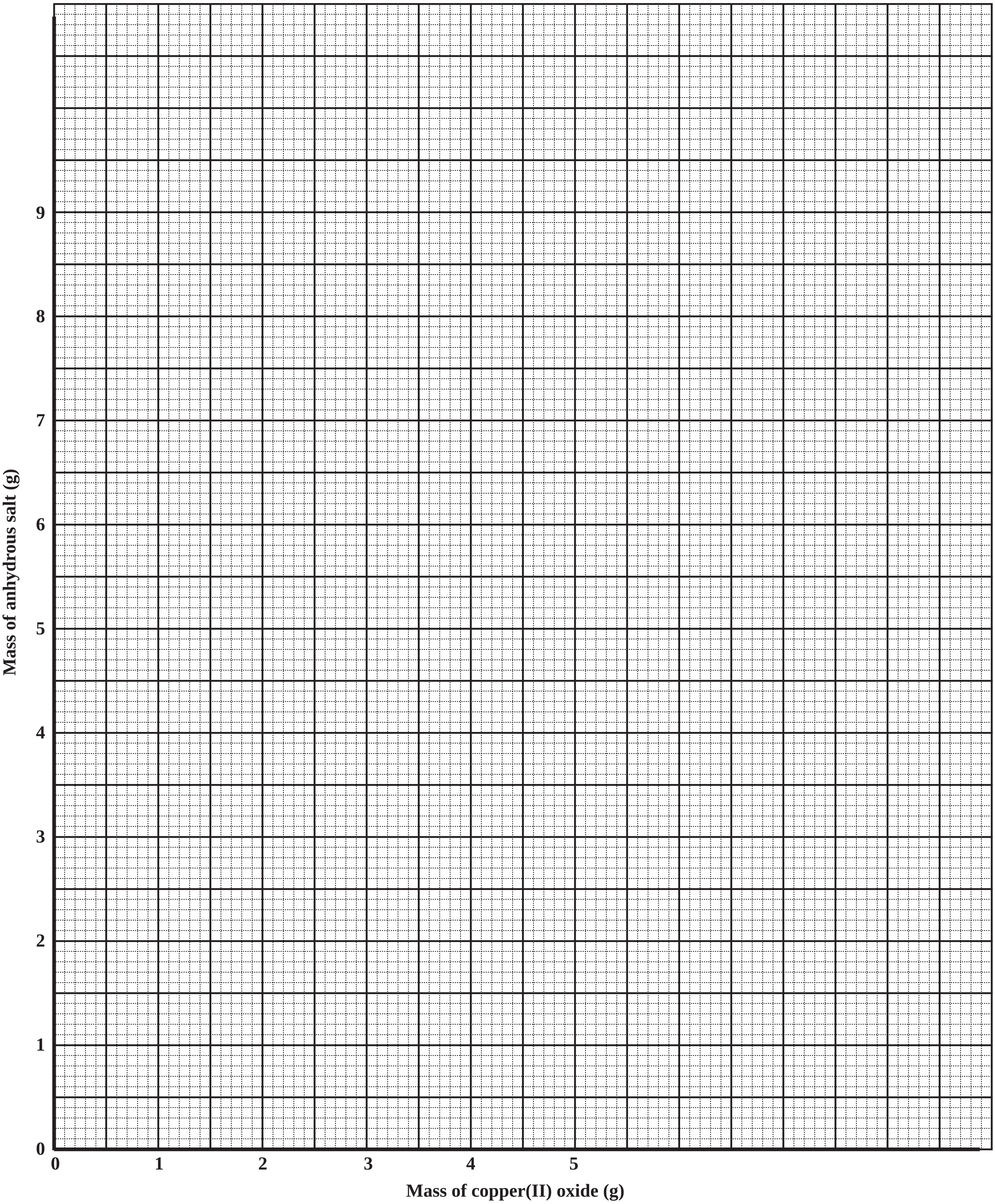
(1 mark)

(vii) Explain why there is no change in the mass of salt produced for Experiments 4 and 5.

____

____

(1 mark)


Mass of anhydrous salt (g)
0
1
2
3
4
5
6
7
8
9
0
1
2
3
4
5
Mass of copper(II) oxide (g)

(b) A student conducts a number of tests on Substance X. Some of the observations and inferences are recorded in Table 2. Complete Table 2 to show the remaining observations and inferences made by the student.

TABLE 2: TESTS ON SUBSTANCE X

Test	Observation	Inference
A small sample of Solid X is gently heated in a dry test tube. Damp red litmus is used to test for any gas.	**(1 mark)**	Alkaline gas is produced.
Approximately 2 cm^3 of aqueous sodium hydroxide is added to a sample of Solid X and warmed.	A gas evolves which forms dense white fumes with hydrogen chloride.	**(Equation required)** **(2 marks)**
A small amount of Solid X is dissolved in about 5 cm^3 of water. To this solution, sodium hydroxide is added gradually until in excess.	**(2 marks)**	X contains iron(II) ions. **(Ionic equation required)** **(2 marks)**

(c) Describe an appropriate method to produce a pure solid sample of silver chloride starting with silver nitrate solution. (Hint! All silver salts are decomposed by light.)

____

____

____

____

____

____

(3 marks)

Total 25 marks

GO ON TO THE NEXT PAGE

2. V and Q are two different forms of the element carbon. R is an ionic solid. Table 3 presents some properties of V, Q and R. Use this information to answer the questions that follow.

TABLE 3: INCOMPLETE TABLE SHOWING PROPERTIES OF V, Q AND R

Property	**V**	**Q**	**R**
Appearance	Transparent, colourless, solid	Black, opaque, solid, shiny	White, solid
Melting Point (°C)	3823 °C	3925 °C	801 °C
Electrical Conductivity	Electrical non-conductor		Electrical conductor when molten but non-conductor in solid state
Structure		Giant molecular or giant covalent	Giant ionic

(a) (i) Complete Table 3 by writing in the table, the

– structure of V

– electrical conductivity of Q. **(2 marks)**

(ii) State the term used to describe different forms of an element such as the two forms of carbon, V and Q.

____

(1 mark)

(b) (i) Identify the forms of carbon, V and Q.

V ____

Q ____

(2 marks)

(ii) Figure 1 represents a partially drawn structure of Q. Complete the figure to show the bonding within and between the layers.

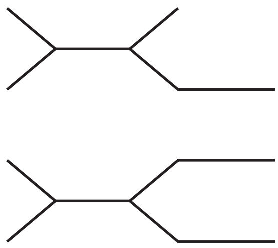


Figure 1. Partially drawn structure of Q

(2 marks)

(iii) State ONE use of Element V and ONE use of Element Q and indicate the property upon which EACH use is based.

Use of V

____

Property of V

____

Use of Q

____

Property of Q

____

(4 marks)

(iv) Explain why R will conduct electricity when molten but NOT in the solid state.

____

____

____

(2 marks)

(c) Iodine and chlorine are halogens. They combine to form a gaseous compound, iodine monochloride (ICl).

Using dot cross diagrams, show the bonding in iodine monochloride.

(2 marks)

Total 15 marks

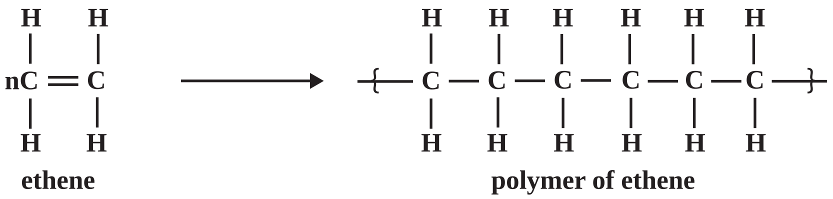
3. (a) Define the term ‘polymer’.

____

____

(2 marks)

(b) The polymerisation of ethene is represented in **Equation 1** below.



(Equation 1)

The polymerisation reaction between a di-acid, $HOOC–CH_2–COOH$ and a di-alcohol, $HO – (CH_2)_2– OH$ is represented in the unbalanced **Equation 2** below.

$$n\ HOOC – CH_2– COOH + n\ HO – (CH_2)_2– OH \quad \rightarrow$$

$$-\!\!(OOC–CH_2–COO–(CH_2)_2–OOC–CH_2–COO–(CH_2)_2–O—\!\!) + H_2O$$ **(Equation 2)**

(i) Which of the Equations in (b) above shows addition polymerisation?

____

(1 mark)

(ii) Give the name of EACH of the polymers shown in Equation 1 and Equation 2.

Polymer in Equation 1

____

Polymer in Equation 2

____

(2 marks)

(iii) State ONE use of EACH of the polymers named in (ii) above.

Polymer in Equation 1

____

Polymer in Equation 2

____

(2 marks)

(c) (i) Ethanoic acid, CH_3COOH, is a weak, monobasic, organic acid. Write a balanced equation for the reaction of ethanoic acid with magnesium metal, Mg (s).

____

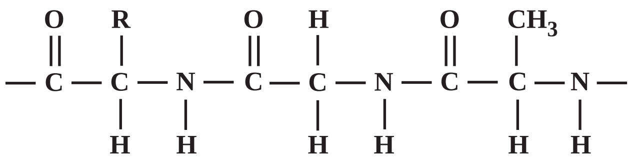
(2 marks)

(ii) Would this reaction take place at room temperature?

____

(1 mark)

(d) During digestion, proteins undergo hydrolysis to form amino acids, which are absorbed by the body. A partial structure of a protein molecule, where R is an alkyl group is shown below.



(i) On the diagram, circle the peptide bond (link) that is found in proteins.

(1 mark)

(ii) Based on the partial protein structure given above, draw the fully displayed structure of an amino acid that would be produced upon hydrolysis.

(2 marks)

(iii) State TWO conditions under which proteins can be hydrolysed.

____

____

(2 marks)

Total 15 marks

SECTION B

Answer ALL questions in this section.

Write your answers in the space provided after EACH question in this answer booklet.

4. (a) Figure 2 shows the apparatus used to investigate the conducting properties of some substances, when placed in contact with electrodes.

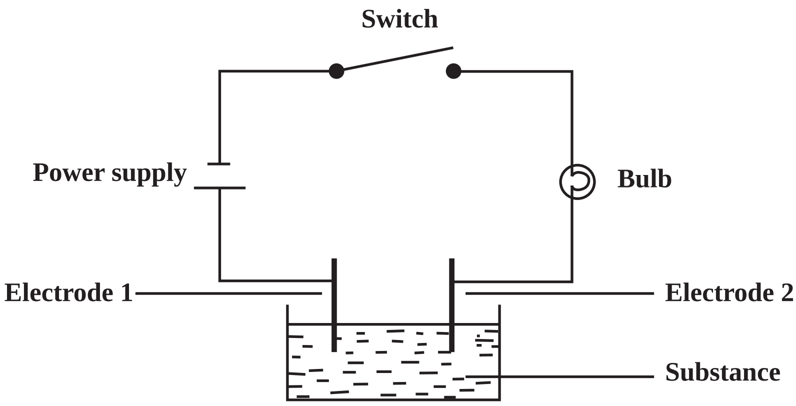


Figure 2. Apparatus for investigating the conducting properties of substances

The investigation is carried out on two pairs of substances as indicated below.

(i) Pair 1: solid lead bromide
molten lead bromide

State whether or not the bulb will glow for EACH substance. Explain your answer for EACH substance. **(4 marks)**

(ii) Pair 2: 1 mol dm^{-3} hydrochloric acid
1 mol dm^{-3} ethanoic acid

The bulb glows for both substances, but glows more brightly for one of the substances.

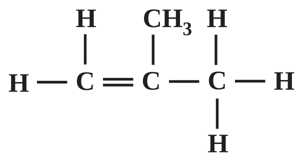
a) State which substance causes the bulb to glow more brightly.

b) Explain why the substance you have stated at a) causes the bulb to glow brighter than the other substance. **(3 marks)**

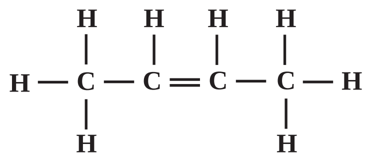
(iii) Write a balanced ionic equation for the reaction occurring at the cathode for any of the substances in Pair 2. **(2 marks)**

GO ON TO THE NEXT PAGE

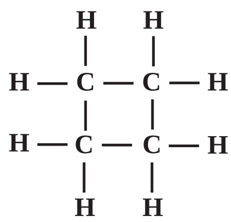
(b) The structures of four hydrocarbons, **a**, **b**, **c** and **d** are shown below.



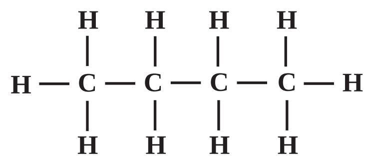
a



b



c



d

(i) Give the name for structure **a**. **(1 mark)**

(ii) State which of these hydrocarbons are isomers. **(2 marks)**

(iii) Which TWO hydrocarbons belong to the same homologous series? Give ONE reason for your answer. **(2 marks)**

(iv) Write the general formula of the isomers identified in (iii) above. **(1 mark)**

Total 15 marks

Write your answer to Question 4 here.

Write your answer to Question 4 here.

GO ON TO THE NEXT PAGE

5. (a) Hydrogen, chlorine and nitrogen are all diatomic gases. The following chemical test(s) can be used to distinguish among them.

Test 1	A lighted splint
Test 2	A piece of moist litmus

Explain how the tests above can be used to distinguish among the gases, hydrogen, chlorine and nitrogen. Include observations in your answer. **(5 marks)**

(b) Chlorine is industrially manufactured by the electrolysis of brine.

(i) Explain what occurs at the anode and the cathode in the electrolysis of brine. **(4 marks)**

(ii) Write an ionic equation for the reaction which occurs at the anode. **(2 marks)**

(iii) Suggest why brine is used instead of dilute sodium chloride. Give an equation to justify your answer. **(4 marks)**

Total 15 marks

Write your answer to Question 5 here.

GO ON TO THE NEXT PAGE

Write your answer to Question 5 here.

SECTION C

Answer EITHER Question 6 OR Question 7.

Write your answer in the space provided at the end of this booklet.

6. (a) (i) Describe the chemical composition of clay. **(1 mark)**

(ii) When clay is fired, a rigid glass-like framework is formed. Suggest a possible source of 'glass' in fired clay. **(1 mark)**

(iii) Clay is used extensively in pottery to make items of different shapes. Relate this use of clay to ONE of its properties. **(2 marks)**

(b) A mason advised one of his clients to keep the freshly completed concrete floor moist while hardening, to prevent cracks from forming. The client was concerned that this practice would stop the concrete from setting. From your knowledge of the composition of cement and its use in making concrete, explain the reason for the mason's advice. **(3 marks)**

(c) Fibres are abundant in nature and are produced by both plants and animals.

(i) Name ONE plant fibre and ONE animal fibre used in making fabric, **and** state the chemical composition of plant fibres and animal fibres. **(4 marks)**

(ii) Suggest TWO chemical tests which may be used to distinguish an animal fibre from a plant fibre. Include the expected observations. **(4 marks)**

Total 15 marks

7. There are many substances that are essential for healthy plant growth.

(a) Name TWO elements that are essential for plant growth. For EACH of the elements named, identify ONE effect of its deficiency. **(4 marks)**

(b) Figure 3 represents part of the nitrogen cycle. Some of the names of the reactions and compounds formed have been replaced by the letters A, B, C and D.

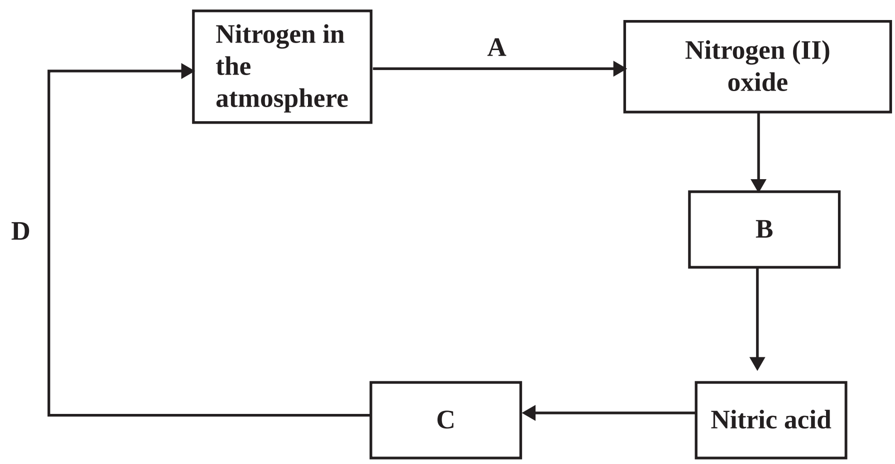


Figure 3. Incomplete Nitrogen Cycle

(i) Write the names of the type of chemical reactions taking place at A and D. **(2 marks)**

(ii) Write the name of the formula of compound B. **(2 marks)**

(iii) Name the type of compound labelled C. **(1 mark)**

(c) Lime is added to soil to increase the pH and reduce problems caused by acid soils, but it can also cause nitrogen to be lost from the soil. Suggest ONE way in which lime can cause nitrogen to be lost from the soil. Include a balanced ionic equation in your answer. **(3 marks)**

(d) Hydroponics is an alternative method of growing crops.

(i) State TWO advantages of using hydroponics. **(2 marks)**

(ii) Suggest ONE possible limitation of using hydroponics. **(1 mark)**

Total 15 marks

Write your answer to EITHER Question 6 OR Question 7 here.

Question Number _______

GO ON TO THE NEXT PAGE

Write your answer to EITHER Question 6 OR Question 7 here.

Question Number _______

END OF TEST

TEST CODE **01212032**

FORM TP 2010006

JANUARY 2010

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 03/2 – Alternative to SBA

General Proficiency

2 hours

READ THE FOLLOWING DIRECTIONS CAREFULLY.

In addition to the 2 hours allowed for the examination, candidates are allowed 10 minutes in order to read through the entire paper.

Writing may begin during the 10-minute period.

1. **Answer ALL questions on this paper.**
2. **Use this answer booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the answer booklet at the end of the examination.**
3. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Answer ALL Questions.

Write your answers in the spaces provided in this booklet.

1. Students in a class conduct an experiment to determine the optimum mole ratio in which hypochlorite ions (ClO^-) react with thiosulphate ions ($S_2O_3^{2-}$) in the presence of base (OH^-).

The mole ratio of reactants that produces the maximum amount of heat will be related to the optimum mole ratio of the reactants.

The experiment involves reacting a solution of household bleach, (which contains ClO^- ions as the active ingredient) with aqueous sodium thiosulphate ($Na_2S_2O_3$) in the presence of aqueous sodium hydroxide (NaOH), as follows.

Solution 1 is 300 cm^3 of bleach solution containing 0.50 mol dm^{-3} NaClO.

Solution 2 is 300 cm^3 of an aqueous solution containing 0.50 mol dm^{-3} of $Na_2S_2O_3 \bullet 5H_2O$ (and sodium hydroxide to make it basic).

PROCEDURE

(a) Two measuring cylinders labelled 1 and 2 are rinsed with a small quantity of Solutions 1 and 2, respectively, and used to measure out the various volumes of Solutions 1 and 2 for each of the experiments (1 – 7) specified in Table 1.

(b) For Experiment 1 (see Table 1 on page 4), the students followed the instructions below:

(i) Measure 45 cm^3 of Solution 2 using Measuring Cylinder 2.

(ii) Pour Solution 2 from the measuring cylinder into the plastic cup provided.

(iii) Measure the temperature (T_1) of the solution in the plastic cup and record this in Table 1.

(iv) Measure 5 cm^3 of Solution 1 using the Measuring Cylinder 1.

(v) Pour Solution 1 from the Measuring Cylinder 1 into the plastic cup containing Solution 2.

(vi) Stir the solution in the plastic cup with the thermometer and record the HIGHEST temperature (T_2) reached.

(vii) Discard the solution in the plastic cup, rinse with distilled water and proceed with Experiments 2 – 7, using different volumes of Solutions 1 and 2 as shown in Table 1.

RESULTS

Figure 1 below gives the thermometer readings for Experiments 4 – 7. The values of T_1 and T_2 for Experiment 1 have been entered in Table 1 on page 4.

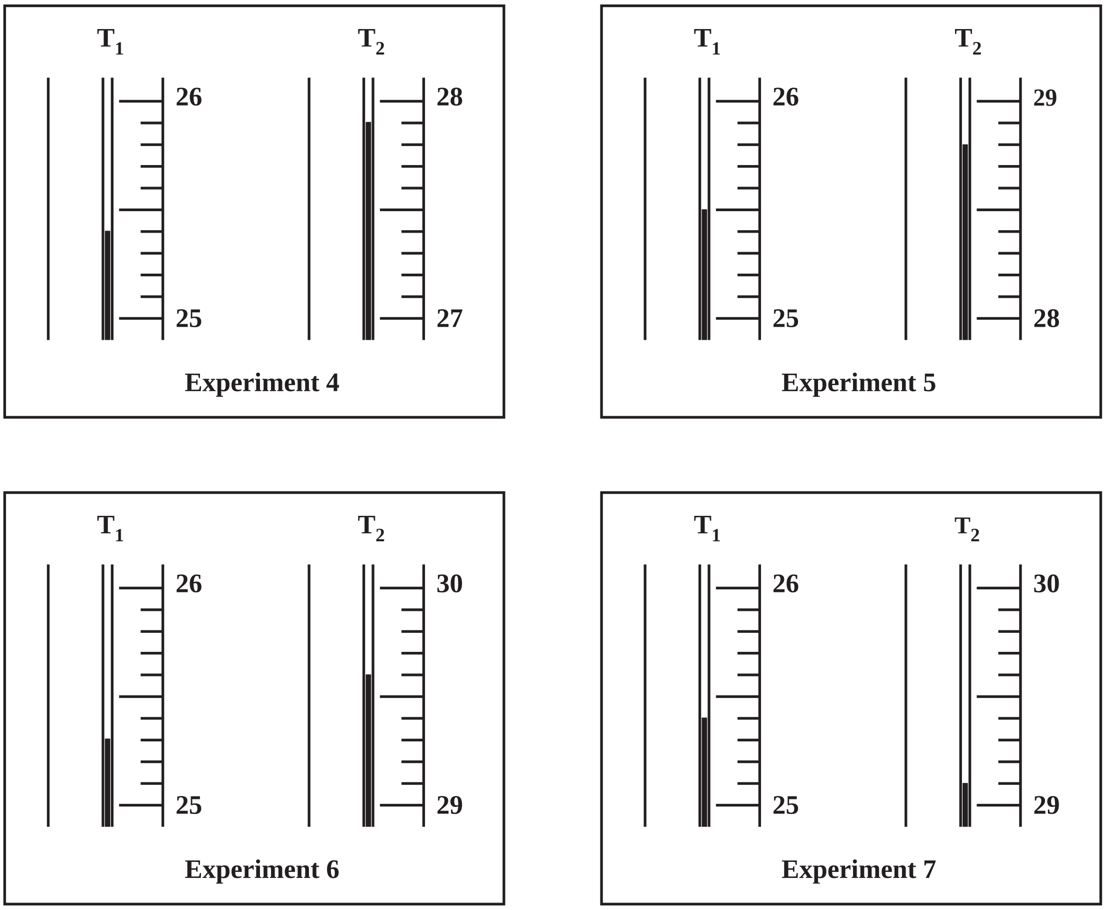


Figure 1: Thermometer readings before mixing (T_1) and after mixing (T_2) for Experiments 4 – 7

(a) (i) For Experiments 5 to 7, take the readings of T_1 and T_2 from Figure 1, and record the values in Table 1. **(6 marks)**

TABLE 1: RESULTS OF EXPERIMENTS 1 – 7

Experiment	**Solution 1 (cm^3)**	**Solution 2 (cm^3)**	**T_1(°C)**	**T_2(°C)**	**$\Delta T = (T_2 - T_1)$ (°C)**	**Volume Ratio of Solution 1: Solution 2**
1	5	45	25.4	26.4	1.0	1 : 9
2	10	40	25.3	26.8		1 : 4
3	20	30	25.5	27.4		1 : 1.5
4	30	20	25.4	27.9		1.5 : 1
5	35	15				2.33 : 1
6	40	10				4 : 1
7	45	5				9 : 1

(ii) Calculate the missing values of Δ**T** in Table 1. **(3 marks)**

(iii) Using the axes provided on page 6, plot ΔT (°C) against experiment number. The first two points have been plotted for you. **(5 marks)**

(iv) Determine the maximum value for ΔT from your graph.

____

(1 mark)

(v) State the volume ratio of Solution 1 : Solution 2 when ΔT is at its maximum.

____

(1 mark)

(vi) Using your answer in (v) on page 4, calculate EACH of the following when ΔT is at its maximum:

a) Number of moles of ClO^- in Solution 1

(2 marks)

b) Number of moles of $S_2O_3^{2-}$ in Solution 2

(2 marks)

(vii) Determine the mole ratio of ClO^- to $S_2O_3^{2-}$.

____

(1 mark)

(viii) Based on your answer in (vii) and the following unbalanced equation for the reaction, write a balanced equation for the reaction.

Unbalanced equation: $ClO^-(aq) + S_2O_3^{2-}(aq) + OH^-(aq) \rightarrow SO_4^{2-}(aq) + Cl^-(aq) + H_2O(l)$

Balanced equation:

____

(2 marks)

(b) State TWO precautions which should be taken during the experiment.

____

____

(2 marks)

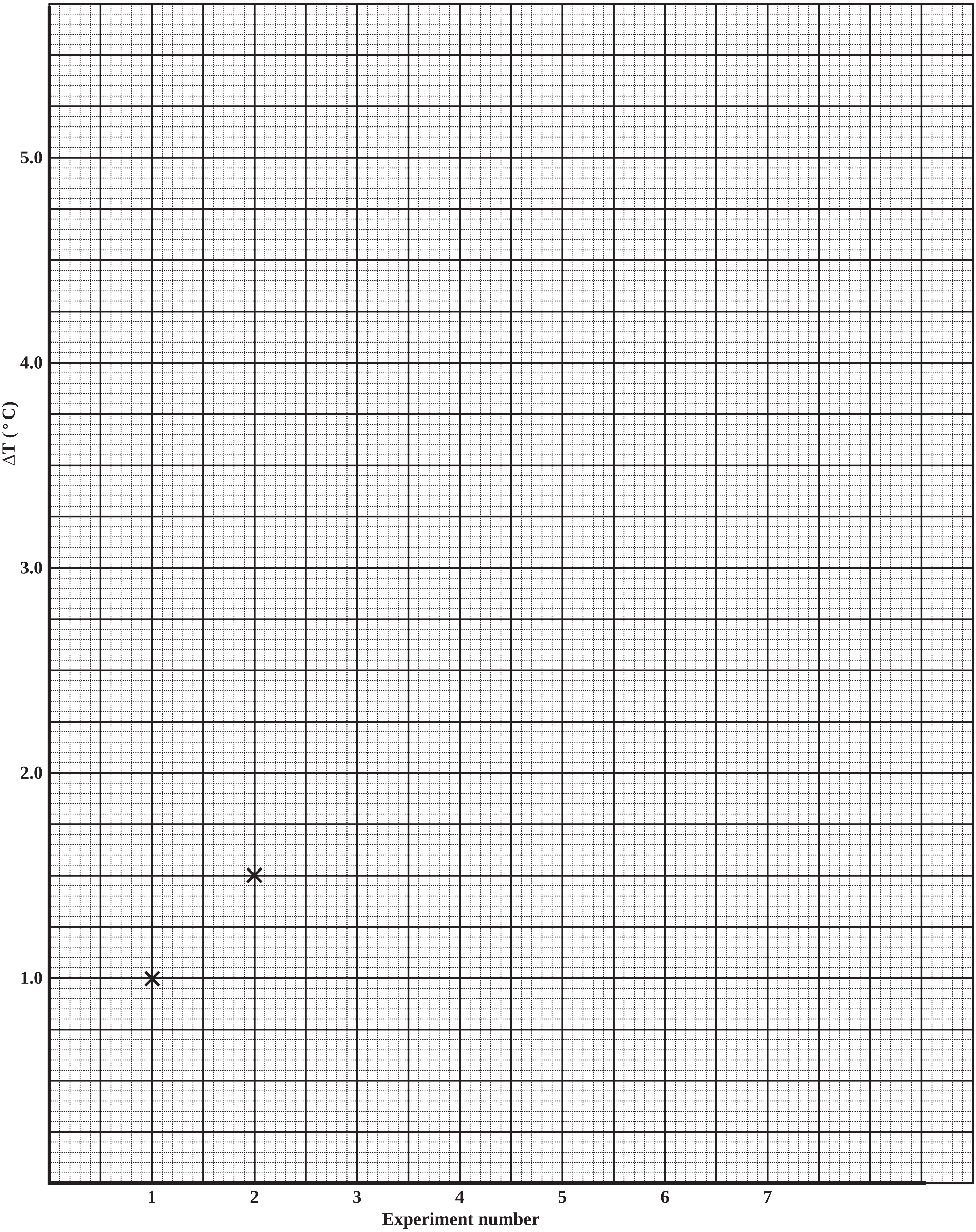
(c) State ONE possible source of error.

____

(1 mark)

Total 26 marks

Graph for Question 1 (iii)



2. Table 2 shows the tests carried out on a Solid Y, which is a mixture of two compounds. Complete Table 2 by writing the observations that are missing.

TABLE 2: RESULTS OF VARIOUS TESTS ON SOLID Y

Test	Observation	Inference
(a) The sample of Solid Y is divided into TWO equal parts. One portion is used for Part (b) below. Dilute nitric acid is added to one portion of Solid Y. It is boiled and filtered. The filtrate is divided into THREE equal portions, for Tests (i) to (iii) below.		
(i) To the first portion of the filtrate from (a) above, aqueous sodium hydroxide is added slowly until in excess.	**(2 marks)**	The solution contains Al^{3+}, Pb^{2+} or Zn^{2+} ions.
(ii) To the second portion of the filtrate from (a) above, aqueous potassium iodide is added.	**(1 mark)**	Pb^{2+} ions are absent.
(iii) To the third portion of the filtrate from (a) above, aqueous ammonia is added until in excess.	**(2 marks)**	Zn^{2+} ions are present.
(b) To the second portion of the solid Y from (a) above, about 8 cm^3 of water is added. It is stirred and then filtered. The filtrate is tested below.	**(3 marks)**	One of the compounds in the mixture is soluble in water. Sodium, potassium, or ammonium salt, or nitrate may be present.
To the portion of the filtrate from (b) above, aqueous silver nitrate is added, followed by aqueous ammonia.	**(2 marks)**	Chloride(Cl^-) ions are present. **Total 10 marks**

GO ON TO THE NEXT PAGE

3. Plan and design an experiment to determine whether the addition of the following nitrates of Na^+, K^+, Ca^{2+}, Mg^{2+} and Fe^{2+} to water has the effect of making the water hard or soft.

Hypothesis: The nitrates of Na^+, K^+, Ca^{2+}, Mg^{2+} and Fe^{2+} will make tap water harder.

Your answer should include the following:

(i) Apparatus and materials

(2 marks)

(ii) Procedure

(3 marks)

(iii) Variables to control

(2 marks)

(iv) Data to be collected

(2 marks)

(v) Discussion of results as they relate to the hypothesis

(2 marks)

(vi) ONE possible source of error

(1 mark)

Total 12 marks

END OF TEST

TEST CODE **01212020**

FORM TP 2010052

MAY/JUNE 2010

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY.

1. **This paper consists of SIX questions in TWO sections.**
2. **Answer ALL questions.**
3. **Write your answers in the spaces provided in this booklet.**
4. **Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.**
5. **The use of silent, non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions in this section.

Write your answers in the spaces provided in this booklet.

Do NOT spend more than 30 minutes on Question 1.

1. (a) The catalyst manganese(IV) oxide can be used to alter the rate of decomposition of hydrogen peroxide.

Jonathan carried out an experiment at RTP (room temperature and pressure) to determine the rate of decomposition of hydrogen peroxide using manganese(IV) oxide as the catalyst. He did this by measuring the volume of oxygen given off at different time intervals. Water is also produced during the decomposition and the reaction is exothermic.

Table 1 records Jonathan's results using manganese(IV) oxide and 100 cm^3 of **0.80 mol dm^{-3}** hydrogen peroxide.

Karen carried out a similar experiment to Jonathan using 100 cm^3 of **0.40 mol dm^{-3}** hydrogen peroxide solution. Figure 1 on page 3 shows a graph of the data obtained by Karen.

TABLE 1: RESULTS OF JONATHAN'S EXPERIMENT

Time (s)	**Volume of O_2 at RTP (cm^3)**
1	0
15	4
30	8
45	12
60	16
75	19
90	21
105	23
120	23

GO ON TO THE NEXT PAGE

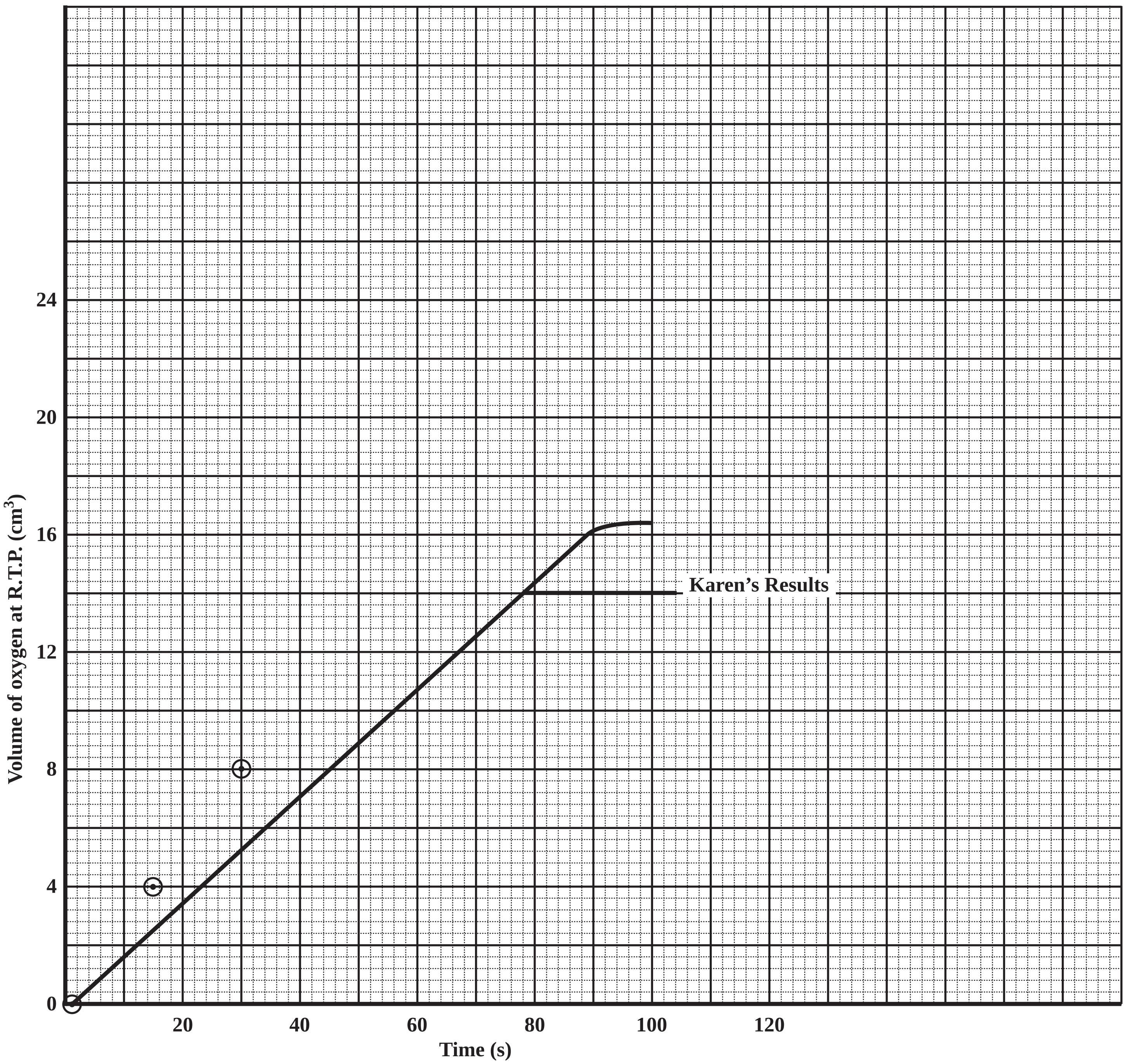


Figure 1. Graph of results

Figure 2 is a diagram of the enthalpy change for an exothermic reaction showing the effect of a catalyst on the reaction pathway.

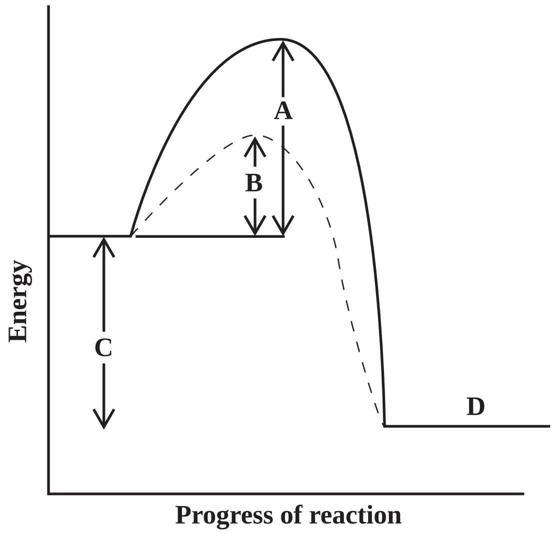


Figure 2. Enthalpy change for an exothermic reaction

(i) Identify the parts labelled A, B, C, D on the diagram.

A ____

B ____

C ____

D ____

(4 marks)

(ii) Write a balanced equation to show the decomposition of hydrogen peroxide by manganese(IV) oxide (MnO_2).

____

(2 marks)

(iii) Using the same axes as the graph (Figure 1) on page 3, plot a graph of the volume of oxygen against time using the data in Table 1.

The first three points have been plotted for you on the graph. **(3 marks)**

(iv) Compare the plots obtained from Jonathan's and Karen's results in terms of the slope of the graph and the volume of oxygen produced. Account for the differences between Jonathan's and Karen's results.

____

____

____

____

____

____

(4 marks)

(v) Using Karen's graph, determine

a) the volume of oxygen produced in 45 seconds

____

(1 mark)

b) the number of moles of oxygen produced in 45 seconds at RTP (room temperature and pressure).
(1 mole of gas occupies 24 dm^3 at RTP: Relative Atomic Mass O = 16)

____

____

____

(2 marks)

GO ON TO THE NEXT PAGE

(b) A student conducts a number of tests on an aqueous solution of Compound X. Some of the inferences and observations made are recorded in Table 2. Complete Table 2 by filling in the missing observations and inferences.

TABLE 2: TESTS ON COMPOUND X

Test	**Observation**	**Inference**
To 1 ml of a solution of X is added a few copper turnings, followed by concentrated sulphuric acid.	Brown gas evolves which turns moist blue litmus red.	**(1 mark)**
To 1 ml of a solution of X is added dilute nitric acid followed by aqueous silver nitrate. Aqueous ammonia is then added until in excess.	**(2 marks)**	I^- ions present I^- ions confirmed
To 1 ml of a solution of X is added aqueous lead nitrate solution.	A bright yellow precipitate forms.	Ionic equation required **(2 marks)**

GO ON TO THE NEXT PAGE

(c) You are required to plan and design an experiment to compare the effects of the catalysts manganese(IV) oxide and catalase on the rate of decomposition of hydrogen peroxide.

(i) Draw a CLEARLY labelled diagram of a suitable experimental arrangement for carrying out the investigation in the laboratory. **(2 marks)**

(ii) State TWO variables that should be controlled during the experiment.

___

___

(2 marks)

Total 25 marks

2. (a) The following statements were taken from a student's notebook. These statements are INCORRECT. In each case, you should state why the statement is incorrect and give the correct statement.

(i) Sodium, magnesium, aluminium, silicon and chlorine are found in the same group in the periodic table.
(Give your answer in terms of electron configuration.)

Reason: ______________________________

____

Correct statement:

____

____

(2 marks)

(ii) Of the elements magnesium and copper, magnesium will more readily oxidize an aqueous solution of zinc ions than copper will.

Reason: ______________________________

____

Correct statement:

____

____

(4 marks)

(b) **P** and **Q** both have an electron configuration of 2, 8, 1. The mass numbers of **P** and **Q** are 23 and 24 respectively.

(i) **P** reacts with water to produce a solution of its hydroxide and hydrogen gas. Write a balanced equation for the reaction between **P** and water.

____

(2 marks)

(ii) Both **P** and **Q** give similar products when reacted with water. Account for this observation.

____

____

____

(2 marks)

GO ON TO THE NEXT PAGE

(iii) **Q** is radioactive. Radioactive substances are widely used in medicine, agriculture and industry. What is meant by the term ‘radioactive’?

____

____

(1 mark)

(iv) Give TWO uses of radioactive elements in medicine, agriculture or industry.

Use 1 ____

Use 2 ____

(2 marks)

(c) Using dot-and-cross diagrams, show the bonding between **Q** and oxygen. [$^{16}_{8}O$]

(2 marks)

Total 15 marks

3. But-1-ene (1–butene) and but-2-ene (2–butene) are structural isomers of molecular formula C_4H_8.

(a) (i) Define 'structural isomerism'.

____

____

(1 mark)

(ii) Draw fully displayed structures of but-1-ene and but-2-ene.

But-1-ene **But-2-ene**

(2 marks)

(iii) Draw and name ONE OTHER structural isomer of C_4H_8.

(3 marks)

(iv) State ONE physical property of C_4H_8.

____

(1 mark)

(b) Ethanol reacts with different reagents to form products with the functional groups shown in Table 3.

(i) What is meant by a 'functional group'?

____

____

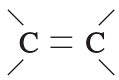
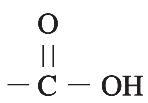
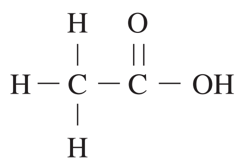
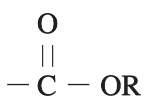
(1 mark)

(ii) Complete Table 3 by

a) identifying the reagents or reaction conditions

b) drawing the fully displayed structures of the products.

TABLE 3: REACTIONS OF ETHANOL

	Functional Group in Product Formed	**Reagents or Reaction Conditions**	**Structure of Organic Product Formed**
	 Alkene	**(1 mark)**	**(1 mark)**
Ethanol	 Acid	**(1 mark)**	
	 Ester	**(2 marks)**	**(2 marks)**

Total 15 marks

GO ON TO THE NEXT PAGE

SECTION B

Answer ALL questions in this section.

Write your answers in the spaces provided at the end of EACH question in this booklet.

4. (a) (i) A pink solution of aqueous acidified potassium manganate(VII) is decolourised by the addition of ferrous(Fe^{2+}) ions. The chemical equation for the reaction is

$$MnO_4^-(aq) + 5\,Fe^{2+}(aq) + 8\,H^+(aq) \rightarrow Mn^{2+}(aq) + 5\,Fe^{3+}(aq) + 4\,H_2O.$$

Identify the oxidizing and reducing agents in the equation, and explain your answer. **(4 marks)**

(ii) Iron(II) oxide reacts with dilute sulphuric acid to give a pale green solution. Write the equation for the reaction between iron(II) oxide and dilute sulphuric acid. **(2 marks)**

(iii) State whether the reaction in (ii) above is acid-base or redox, and explain your answer. **(3 marks)**

(b) (i) What is meant by 'fermentation,' as it relates to the manufacture of rum? **(2 marks)**

(ii) Write the equation for the fermentation process defined in (i). **(2 marks)**

(iii) Suggest ONE material that could be used to produce wine by fermentation, and give a reason for your suggestion. **(2 marks)**

Total 15 marks

Write the answer to Question 4 here.

Write the answer to Question 4 here.

5. The raw materials necessary for the extraction of iron from its ore are an iron ore, coke and limestone.

(a) Write the chemical formula for ONE ore of iron. **(1 mark)**

(b) Outline the steps involved in the extraction of iron from its ore. Write a balanced chemical equation for EACH step. **(8 marks)**

(c) Stainless steel, an alloy of iron, is used to make cooking utensils. Suggest TWO reasons why stainless steel is used instead of iron for making cooking utensils. **(2 marks)**

(d) Besides cooking utensils, state ONE other use of iron or its alloys. **(1 mark)**

(e) Name the compound of iron that is found in the blood and explain how a lack of iron would affect the human body. **(3 marks)**

Total 15 marks

Write your answer to Question 5 here.

Write your answer to Question 5 here.

6. (a) Almost all animals eat their food raw, whereas humans tend to cook their food. Give TWO reasons why humans may need to cook their food. **(2 marks)**

(b) Egg white is a transparent liquid in its natural state.

(i) What does egg white look like when it is cooked? **(1 mark)**

(ii) What is the effect of heat on the protein of the egg? **(1 mark)**

(c) Table 4 shows three different methods which can be used to cook a leg of lamb.

TABLE 4: METHODS FOR COOKING LAMB

Method 1	Place in a covered dish and bake.
Method 2	Chop into small pieces, add raw pineapple and boil.
Method 3	Chop into small pieces and boil in the pressure cooker.

(i) Select the method by which the lamb will take the LONGEST to cook. **(1 mark)**

(ii) Outline the principles involved in the functioning of the pressure cooker. **(2 marks)**

(iii) Suggest TWO benefits of using the pressure cooker in Method 3. **(2 marks)**

(iv) Explain how the pineapple functions in cooking the lamb in Method 2.

How does this differ from the use of the pressure cooker in Method 3? **(4 marks)**

(v) Explain how heat affects the Vitamin C in the pineapple. **(2 marks)**

Total 15 marks

Write your answer to Question 6 here.

Write your answer to Question 6 here.

END OF TEST

TEST CODE **01212032**

FORM TP 2010053

MAY/JUNE 2010

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 03/2 – Alternative to SBA

General Proficiency

2 hours

READ THE FOLLOWING DIRECTIONS CAREFULLY.

In addition to the 2 hours allowed for the examination, candidates are allowed 10 minutes in order to read through the entire paper.

Writing may begin during the 10-minute period.

1. **Answer ALL questions on this paper.**
2. **Use this answer booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the answer booklet at the end of the examination.**
3. **The use of silent, non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

1. Students in a class are required to determine the number of moles of water molecules in one mole of a sample of an iron-containing salt, $(NH_4)_2SO_4.FeSO_4.nH_2O$. They must titrate a solution of the iron-containing salt (Solution Y) with aqueous potassium manganate(VII) solution (Solution X) provided.

(a) Starting with a sample of the solid iron-containing salt, $[(NH_4)_2SO_4.FeSO_4.nH_2O]$, describe the preparation of a solution of concentration 39.29 g per 1 dm^3. This is Solution Y.

(Relative atomic mass: H = 1; Fe = 56; N = 14; O = 16; S = 32)

(4 marks)

(b) Solution X which contains 0.02 mol dm^{-3} $KMnO_4$ is used to titrate 25 cm^3 portions of Solution Y in the presence of dilute sulphuric acid. Figure 1 gives the representations of the initial and final burette readings obtained.

(i) Complete Table 1 using the readings from Figure 1.

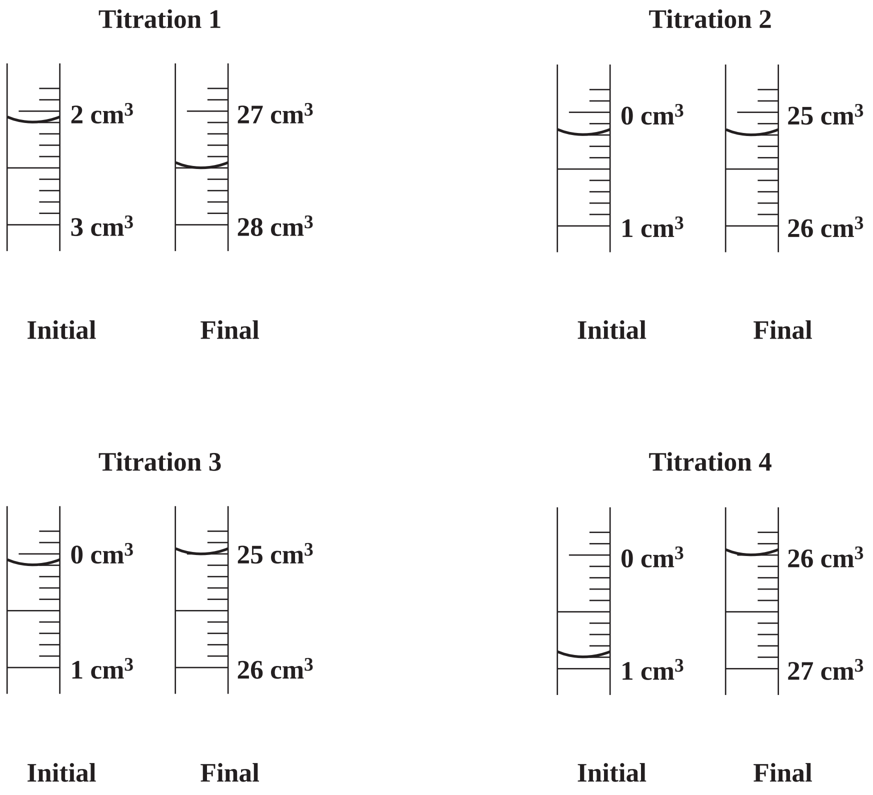


Figure 1. Burette readings

TABLE 1: TITRATION RESULTS

Burette Readings (cm^3)	**Titration Number**			
	1	2	3	4
Final Reading				
Initial Reading				
Volume of Solution X used				

(8 marks)

GO ON TO THE NEXT PAGE

(ii) Volume of Solution X to be used in the calculation: ___________ cm^3

(1 mark)

(iii) The ionic equation for the reaction between X and Y is as follows:

$5Fe^{2+}(aq) + MnO_4^-(aq)\ 8H^+(aq) \rightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(l)$

Use the titration results from Table 1 and the ionic equation given to answer the following questions.

a) State the name of the type of reaction that occurs during the titration.

____

(1 mark)

b) What is the reacting ratio of Fe^{2+} to MnO_4^- ?

____

(1 mark)

c) Calculate the number of moles of $KMnO_4$ in the volume of Solution X used in the titration.

____

____

____

(2 marks)

d) Using the results from b) and c) above, calculate the number of moles of $(NH_4)_2SO_4.FeSO_4.nH_2O$ in the volume of Solution Y in the titration.

____

____

____

(2 marks)

e) Use the results from d) above to calculate the number of moles of $(NH_4)_2SO_4.FeSO_4.nH_2O$ in 1000 cm^3 of Solution Y.

____

____

(1 mark)

f) Using the results from e) above, calculate the number of water molecules, n, in one mole of $(NH_4)_2SO_4.FeSO_4.nH_2O$,

(Relative atomic mass: H = 1; Fe = 56; N = 14; O = 16; S = 32)

(3 marks)

Total 23 marks

2. The following tests were done on Compound X, which is a mixture of two substances. Complete Table 2 by writing the observations and inferences that are missing.

TABLE 2: TESTS ON COMPOUND X

Test	Observation	Inference
(a) To the sample of X provided, add 8 cm^3 of water, stir, then filter. Save the residue for Part (b). Divide the filtrate into THREE equal portions.		
(i) To the first portion of the filtrate from (a) above, add sodium hydroxide solution slowly, until in excess.	**(2 marks)**	Pb^{2+}, Zn^{2+}, Al^{3+} present.
(ii) To the second portion of the filtrate from (a) above, add aqueous ammonia slowly, until in excess.	**(2 marks)**	Confirms the presence of Zn^{2+}
(iii) To the third portion of the filtrate from (a) above, add aqueous barium nitrate, followed by dilute nitric acid.	White precipitate forms. Precipitate is insoluble in acid.	**(2 marks)**
(b) To the residue from (a) above, add about 10 cm^3 of dilute nitric acid. Heat, then filter. Divide the filtrate into TWO portions.	**(2 marks)**	Carbonate or hydrogen carbonate ions present.
(i) To the first portion of the filtrate from (b) above, add sodium hydroxide solution slowly, until in excess.	**(2 marks)**	Al^{3+}, Zn^{2+} or Pb^{2+} ions present.
(ii) To the second portion of the filtrate from (b) above, add potassium iodide solution.	A bright yellow precipitate forms.	**(1 mark)** Ionic equation **(2 marks)**

Total 13 marks

GO ON TO THE NEXT PAGE

3. Plan and design an experiment to determine whether the following fuels produce the same amount of energy upon combustion.

Hypothesis: Biodiesel produces the same amount of energy upon combustion, as ethanol and kerosene.

Your answer should include the following:

(a) Apparatus and materials

____

____

____

____

(2 marks)

(b) Procedure

____

____

____

____

____

____

____

____

____

(3 marks)

(c) Variables to control

____

____

(2 marks)

(d) Data to be collected

(2 marks)

(e) Discussion of results as they relate to the hypothesis

(2 marks)

(f) ONE possible source of error

(1 mark)

Total 12 marks

END OF TEST

TEST CODE **01212020**

FORM TP 2011005

JANUARY 2011

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

**SECONDARY EDUCATION CERTIFICATE
EXAMINATION**

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY.

1. **This paper consists of SIX compulsory questions in THREE sections.**
2. **Write your answer to EACH question in the space provided in this answer booklet.**
3. **Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.**
4. **Return this booklet at the end of the examination.**
5. **The use of silent, non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions in this section.

Write your answers in the spaces provided in this booklet.

Do NOT spend more than 30 minutes on Question 1.

1. It is possible to determine the end point of an acid-base reaction by measuring the temperature changes when different volumes of a strong acid react with a strong base. Table 1 shows the volumes of sulphuric acid used to react with 25 cm^3 of 2.0 mol dm^{-3} sodium hydroxide and the temperature changes that occurred. Figure 1 shows the thermometer readings for the addition of 10 cm^3 and 20 cm^3 of the H_2SO_4.

TABLE 1: EXPERIMENTAL RESULTS

Volume of H_2SO_4 Added (cm^3)	**Temperature (°C)**
0	22.5
3	29.5
6	36.0
10	
15	38.0
20	
25	13.5

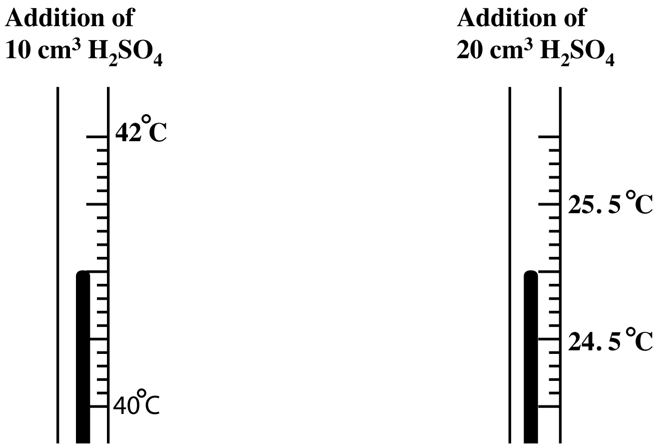
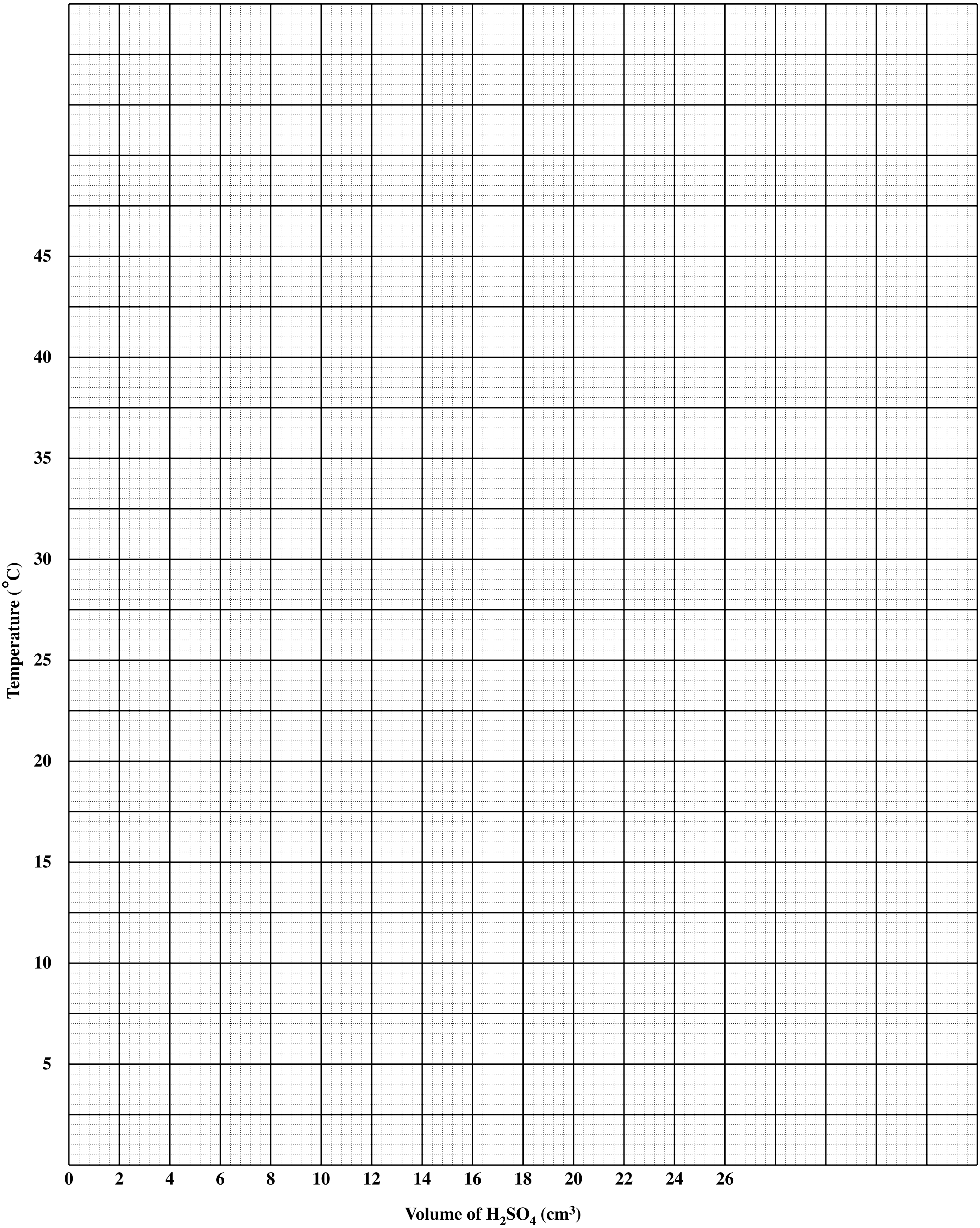


Figure 1. Thermometer readings for acid-base reactions



GO ON TO THE NEXT PAGE

(a) (i) Differentiate between a 'strong acid' and a 'weak acid'.

____

____

(2 marks)

(ii) Suggest ONE other base that could be used instead of NaOH.

____

(1 mark)

(iii) Using the thermometer readings in Figure 1, complete Table 1 by recording the temperature for the addition of 10 cm^3 and 20 cm^3 of the H_2SO_4.

(2 marks)

(iv) Plot the points for temperature against volume of acid added using the axes on page 3. **(3 marks)**

(v) Draw the TWO lines of **best fit** through the points in (iv) above where the temperature is increasing **and** where the temperature is decreasing and hence determine the end point of the reaction.

Volume of H_2SO_4 at end point ____________________________________

(3 marks)

(vi) Write a **balanced** equation for this reaction.

____

(2 marks)

(vii) Calculate the number of moles of NaOH used in the reaction.

____

____

(1 mark)

(viii) Calculate the concentration of H_2SO_4 in mol dm^{-3}.

____

____

____

____

(2 marks)

GO ON TO THE NEXT PAGE

(b) Paul conducted two experiments in the laboratory to identify carbon dioxide and ammonia. Figure 2 shows the experimental arrangement of the procedures that he used to test for the gases.

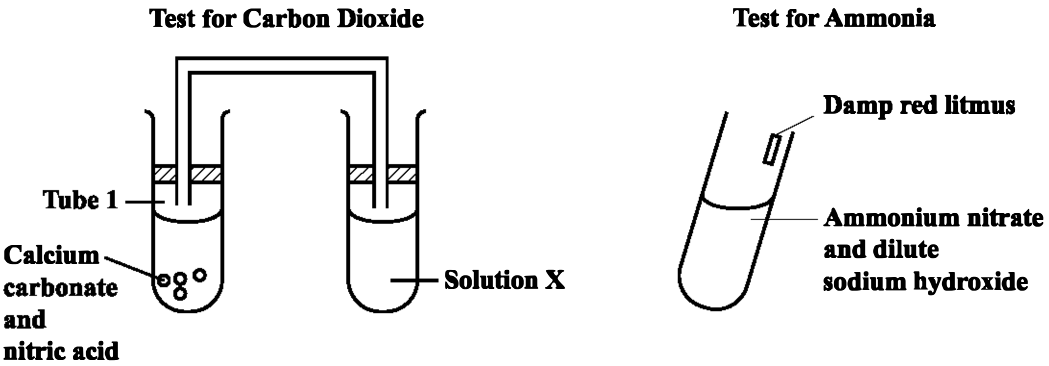


Figure 2. Experimental arrangement for testing of gases

(i) Identify Solution X.

____

(1 mark)

(ii) Identify ONE flaw in the procedure that Paul used for carrying out EACH test.

____

____

____

(2 marks)

(iii) Write a **balanced** equation for the reaction occurring in Tube 1.

Balanced equation:

____

(2 marks)

(iv) Explain why nitric acid **instead of** sulphuric acid is used in the experiment in Tube 1 in order to obtain a positive test result.

____

____

____

____

(4 marks)

Total 25 marks

GO ON TO THE NEXT PAGE

2. A group of students set up Experiments I and II as shown in Figure 3.

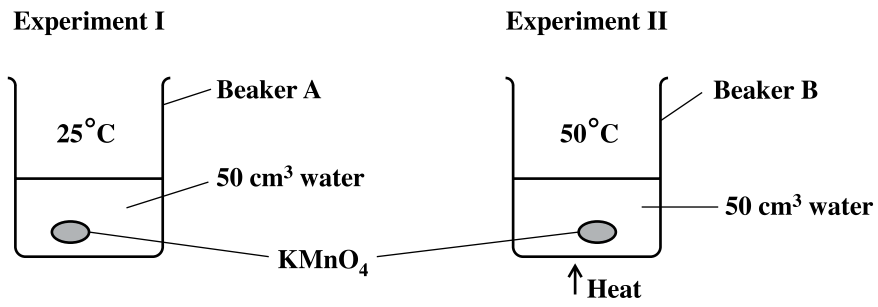


Figure 3. Diagrams of Experiments I and II

(a) (i) What changes would be observed in Beakers A and B over a 24-hour period?

____

____

(2 marks)

(ii) How do the changes in Beaker A differ from that in Beaker B?

____

____

(1 mark)

(iii) Account for any differences in the observations in (a) (ii) above.

____

____

____

____

(3 marks)

(b) The students conducted a third experiment, Experiment III, to determine the heat of solution of ammonium nitrate by mixing 8 g of ammonium nitrate with 50 cm^3 water at room temperature. The temperature before and after the ammonium nitrate was added to the water is given as:

Initial temperature = 27°C
Final Temperature = 19°C

(i) State whether the process in Experiment III is exothermic or endothermic.

The process is ______________________________________ .

(1 mark)

(ii) Draw a labelled energy profile diagram to show the heat changes involved in Experiment III.

(3 marks)

(iii) Calculate the heat change when 8 g of ammonium nitrate is dissolved in 50 cm^3 of water.

[Relative Atomic Mass: N = 14; H = 1; O = 16; the specific heat capacity of the solution is 4.2 kJ kg^{-1} K^{-1}; density of water is 1.0 g cm^{-3}]

____

____

____

(2 marks)

(iv) State ONE assumption necessary in your calculation in (b) (iii) above.

____

(1 mark)

(v) From your answer to (b) (iii), calculate the heat change when 1 mole of ammonium nitrate dissolves in water.

____

____

____

____

(2 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

3. (a) Compound A (C_3H_6) and Compound B (C_3H_8) are hydrocarbons. Draw the FULLY displayed structures and state the names of BOTH compounds.

Compound A **Compound B**

Name: ______________________ Name: _______________________

(4 marks)

(b) One of these compounds reacts with bromine dissolved in trichloroethane.

(i) State the observation for this reaction.

Observation: ____

(1 mark)

(ii) Write a chemical equation for this reaction.

Equation: ____

(2 marks)

(iii) Draw the FULLY displayed structure of the product in the equation in (b) (ii) above and state the name of this product.

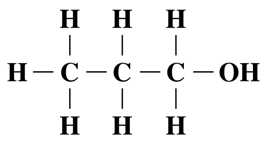
Structure

Name: ____

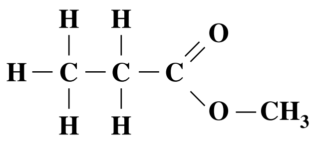
(2 marks)

GO ON TO THE NEXT PAGE

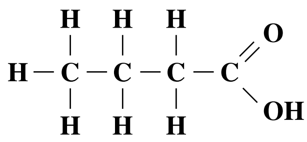
(c) The fully displayed structures of Compounds X, Y and Z are shown below:



X



Y



Z

(i) Write the names of the **homologous series** to which EACH of these three compounds belongs.

Compound X: ______________________________

Compound Y: ______________________________

Compound Z: ______________________________

(3 marks)

(ii) State which TWO of these compounds are soluble in water, and give a reason for your choice.

TWO compounds: ____________ and ____________.

(2 marks)

Reason: ______________________________

____

____

(1 mark)

Total 15 marks

SECTION B

Answer ALL questions in this section.

Write your answers in the space provided after EACH question in this answer booklet.

4. (a) The production of sugar from sugar cane is important to the Caribbean economy. The process of extracting sucrose from the juice of sugar cane involves several steps. Two of these steps are:

(i) Clarifying

(ii) Crystallizing

Outline what happens in EACH step. **(4 marks)**

(b) Table 2 shows selected properties of four Group II elements.

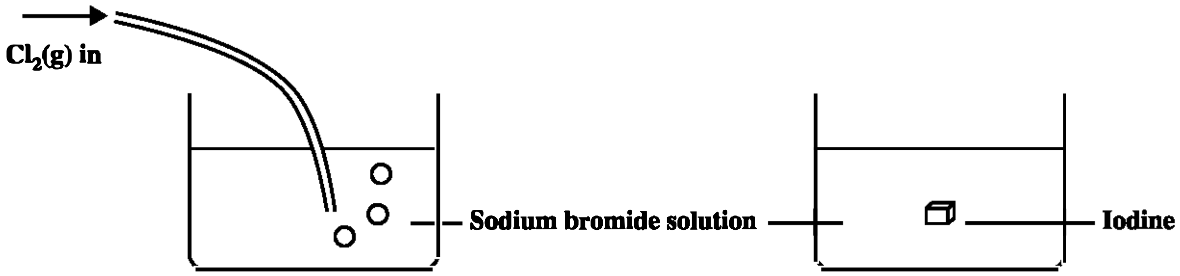
TABLE 2: ATOMIC RADII AND IONISATION ENERGIES OF SOME GROUP II ELEMENTS

Group II Element	**Atomic Radius (pm)**	**Ionisation Energy (kJ mol^{-1})**
Magnesium	160	747
Calcium	197	596
Strontium	215	558
Barium	217	512

(i) Outline the reason for the change in atomic radius from magnesium to barium. **(2 marks)**

(ii) Barium reacts more readily with water than magnesium does. With reference to the data in Table 2, explain this observation. **(2 marks)**

(c) Two samples of aqueous sodium bromide are treated with chlorine gas and solid iodine as shown in Experiments 1 and 2 in Figure 4.



Experiment 1: Bubbling chlorine gas into an aqueous solution of sodium bromide

Experiment 2: Stirring solid iodine in an aqueous solution of sodium bromide

Figure 4. Experiments 1 and 2

(i) State whether a reaction would take place in EACH case. **(2 marks)**

(ii) Write a **balanced** equation, where appropriate, for the reaction occurring in (c) (i) above. **(2 marks)**

(d) Sodium oxide and sulphur dioxide were each dissolved in water to form colourless solutions.

(i) Describe a test that can be used to identify the solution formed with sulphur dioxide. **(2 marks)**

(ii) Write a **balanced** equation to support the use of this test. **(1 mark)**

Total 15 marks

GO ON TO THE NEXT PAGE

Write your answer to Question 4 here.

GO ON TO THE NEXT PAGE

Write your answer to Question 4 here.

5. (a) Sulphuric acid is prepared industrially via the Contact Process represented in Figure 5.

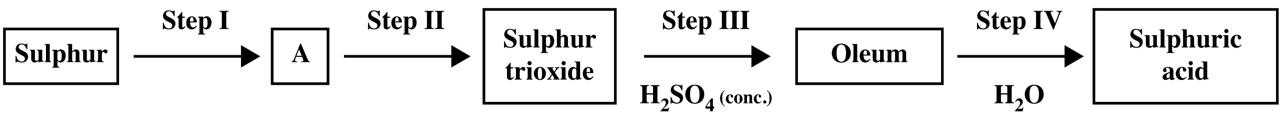


Figure 5. Schematic diagram of the Contact Process

(i) Describe the processes involved in converting sulphur to sulphur trioxide. In your response,

a) identify A from Figure 5

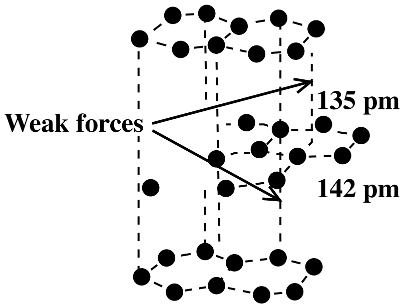
b) include TWO balanced chemical equations for the reactions taking place at Steps I and II

c) include the necessary reaction conditions for Step II. **(8 marks)**

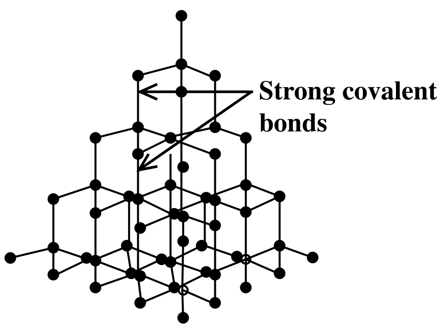
(ii) Explain why concentrated H_2SO_4 is used instead of pure water in Step III of Figure 5. **(2 marks)**

(iii) When sulphur trioxide gets into the atmosphere, it can form acid rain which can destroy buildings made from limestone. Write an ionic equation which BEST represents the chemical reaction taking place when acid rain reacts with limestone. **(2 marks)**

(b) Study Figure 6 which shows the structures of graphite and diamond.



Graphite



Diamond

Figure 6. Structures of graphite and diamond

With reference to this figure, explain why diamond is used for cutting and graphite is not. **(3 marks)**

Total 15 marks

GO ON TO THE NEXT PAGE

Write your answer to Question 5 here.

GO ON TO THE NEXT PAGE

Write your answer to Question 5 here.

SECTION C

Answer this question.

Write your answer in the space provided after the question in this booklet.

6. (a) Starch is a major constituent of wheat flour. Identify ONE OTHER major constituent of wheat flour. **(1 mark)**

(b) Baking powder and yeast can both be used as raising agents in bread making.

(i) State ONE similarity and ONE difference in the way they act as raising agents. **(3 marks)**

(ii) Explain how the action of yeast during bread-making causes the dough to rise. Include TWO chemical equations and the reaction conditions. **(6 marks)**

(c) Tamarinds grown in the Caribbean are a good source of Vitamin C which is acidic. They can be used as tamarind drinks or as stewed tamarinds. When preparing tamarind drink, sodium hydrogen carbonate, $NaHCO_3$, is often added. However, this is not necessary when stewing tamarinds. Suggest a possible explanation for this practice. Write ONE chemical equation to support this practice. **(5 marks)**

Total 15 marks

Write your answer to Question 6 here.

GO ON TO THE NEXT PAGE

Write your answer to Question 6 here.

END OF TEST

TEST CODE **01212032**

FORM TP 2011006

JANUARY 2011

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 03/2 – Alternative to SBA

General Proficiency

2 hours

READ THE FOLLOWING DIRECTIONS CAREFULLY.

In addition to the 2 hours allowed for the examination, candidates are allowed 10 minutes in order to read through the entire paper.

Writing may begin during the 10-minute period.

1. **Answer ALL questions in this booklet.**
2. **Use this booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the booklet at the end of the examination.**
3. **The use of non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Answer ALL questions.

1. (a) A technician prepared samples of two salts, sodium sulphate (Na_2SO_4) and lead sulphate ($PbSO_4$) but forgot to label the containers.

(i) Describe a simple test that can be used to distinguish the two salts.

____

____

____

____

____

____

(2 marks)

(ii) Starting with 1 mol dm^{-3} H_2SO_4 and 3.31 g of solid $Pb(NO_3)_2$, provide full experimental details of how the technician could prepare dry samples of $PbSO_4$. List the apparatus that will be required and include the relevant equation in your answer.

Preparation of $PbSO_4$

Apparatus:

____

____

____

Procedure:

____

____

____

____

____

____

Equation:

____

____

(7 marks)

(iii) Calculate the theoretical yield of $PbSO_4$ that will be obtained from 3.31 g of lead nitrate.
[Relative atomic masses: Pb = 207; N = 14; O = 16; S = 32]

(4 marks)

(iv) Calculate the percentage yield of the $PbSO_4$ if 2.25 g of the salt was produced from the experiment.

____

____

(1 mark)

(b) Stearic acid is a solid organic acid with a melting point that is less than 100 °C. A student conducts an experiment to determine the melting point of stearic acid. Table 1 shows the data collected by the student.

TABLE 1: EXPERIMENTAL RESULTS

Time (min)	0	0.5	1.5	2.0	2.5	3.0	5.0	7.0	8.0	9.5	10.0
Temperature (℃)	19	29	40	48	53	55	55	55	64	73	74

(i) Draw a FULLY labelled diagram of the arrangement of the apparatus that the student might have used for conducting the experiment.

(3 marks)

(ii) Using the axes in Figure 1 on page 5, plot a graph of temperature against time.
(4 marks)

(iii) From your graph, determine the melting point of stearic acid.

____

(1 mark)

(iv) Discuss the change in state of the stearic acid with increasing temperature and so account for the shape of the graph.

____

____

____

____

(4 marks)

Total 26 marks

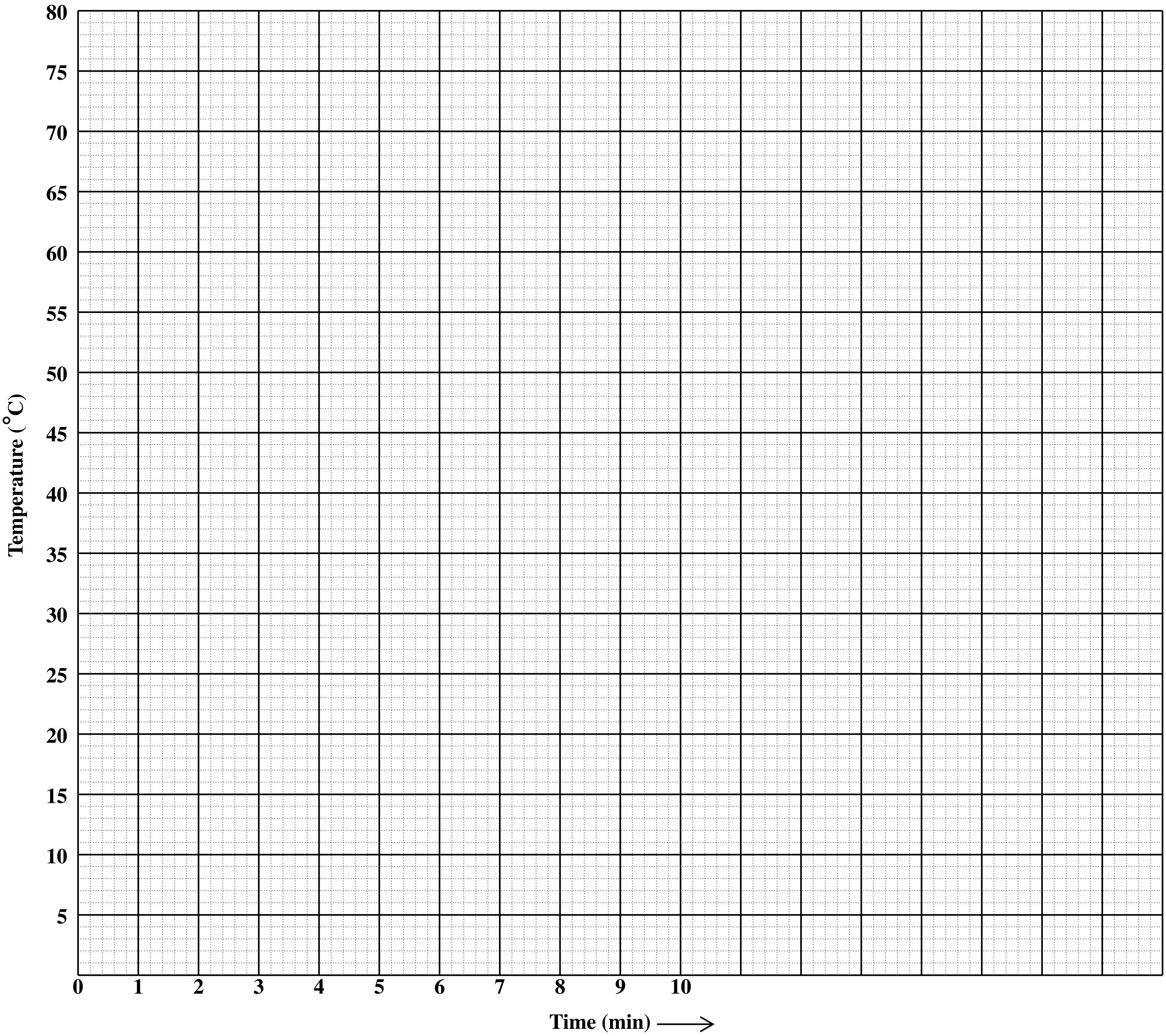


Figure 1. Graph of temperature against time

GO ON TO THE NEXT PAGE

2. A student carries out the following tests on Solid Q and makes the inferences recorded in Table 2. Complete Table 2 to show ALL possible observations.

TABLE 2: RESULTS OF TESTS ON SOLID Q

Test	Observations	Inferences
(i) To solid Q, add water, stir, filter and then divide the filtrate into three portions. Retain and dry the residue for test (v) below.		
(ii) To the first portion of the filtrate from (i) above, add aqueous NaOH until in excess.	• •	• Al^{3+}, Pb^{2+}, Zn^{2+}, Ca^{2+} present • Al^{3+}, Pb^{2+}, Zn^{2+} present
(iii) To the second portion of the filtrate from (i) above add aqueous KI.	•	Pb^{2+} ions present
(iv) To the third portion of the filtrate from (i) above, add aqueous $AgNO_3$, followed by aqueous NH_3.	•	Cl^-, I^- or Br_- ions absent
(v) To the dried residue from (i) above, add dilute HNO_3, pass the gas into a test tube with lime water, warm, filter and then divide the filtrate into two portions.	• •	• CO_2 gas is produced • CO_3^{2-} ions present
(vi) To the first portion of the filtrate from (v) above, add aqueous NaOH until in excess.	• •	Cu^{2+} ions present
(vii) To the second portion of the filtrate from (v) above, add aqueous NH_3 until in excess.	• •	Cu^{2+} ions present

Total 10 marks

3. Kerosene and methylated spirit are used as fuels in lamps (burners) in the laboratory. When lit, these fuels undergo combustion to produce heat energy. The heat of combustion of these fuels can be readily determined from experimental data obtained from the heating of water by the fuels.

Using the information given above, plan and design an experiment (specifying measurements where relevant) to determine whether kerosene and methylated spirit produce the same amount of energy on combustion. The hypothesis of the experiment is given below.

Hypothesis: Methylated spirit and kerosene produce the same amount of energy on combustion.

(a) Procedure:

____

____

____

____

____

____

(3 marks)

(b) Draw a FULLY labelled diagram of the apparatus required to conduct your experiment.

(3 marks)

(c) Data to be collected:

(2 marks)

(d) Write the mathematical equation to be used for calculating the heat of combustion per mole of the fuel.

(2 marks)

(e) Identify TWO possible sources of error in your experiment.

(2 marks)

Total 12 marks

END OF TEST

TEST CODE **01212020**

FORM TP 2011057

MAY/JUNE 2011

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING DIRECTIONS CAREFULLY.

1. **This paper consists of SIX compulsory questions in THREE sections.**
2. **Write your answer to EACH question in the space provided in this answer booklet.**
3. **Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.**
4. **Return this booklet at the end of the examination.**
5. **The use of silent, non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions in this section.

Write your answers in the spaces provided in this booklet.

Do NOT spend more than 30 minutes on Question 1.

1. A group of students conducted an investigation to determine the products of electrolysis when copper(II) sulphate was electrolysed using copper electrodes. The following steps indicate the procedure they used.

- The copper cathode was first washed in distilled water, dried and weighed and then connected to a suitable circuit.
- A current of 0.2 Amps was passed through the solution and the starting time recorded.
- After 5 minutes, the switch was turned off and the cathode was removed, rinsed with distilled water, dried in air and then weighed.
- The cathode was returned to the circuit and the process was repeated, recording the mass of cathode at five-minute intervals. After each interval, the cathode was rinsed in distilled water, dried in air and weighed until a total of five readings was taken.
- Table 1 shows the initial mass of the cathode and its mass for three of the five readings.

TABLE 1: EXPERIMENTAL RESULTS

Time (min)	Mass of Cathode (g)	Actual Mass of Copper Deposited (g)
0	11.80	
5	11.83	0.03
10		0.05
15	11.87	
20		0.09
25	11.91	

GO ON TO THE NEXT PAGE

(a) (i) Define the term ‘electrolysis’.

____

____

____

(2 marks)

(ii) State TWO differences between the ‘anode’ and the ‘cathode’.

____

____

(2 marks)

(iii) Draw a diagram to show a circuit for carrying out this investigation. Label the cathode and the electrolyte.

Diagram of Circuit used in the Electrolysis of Copper Sulphate

(3 marks)

(iv) Complete Table 1 by recording the mass of the cathode after 10 minutes and 20 minutes and the mass of copper deposited after 15 and 25 minutes.

(2 marks)

(v) Plot a graph of actual mass of copper deposited versus time using the axes in Figure 1 on page 5. **(3 marks)**

(vi) Use the graph to predict the mass of copper that would be deposited after 28 minutes.

____

(1 mark)

(vii) Write an ionic equation to represent the reaction at the cathode.

____

(2 marks)

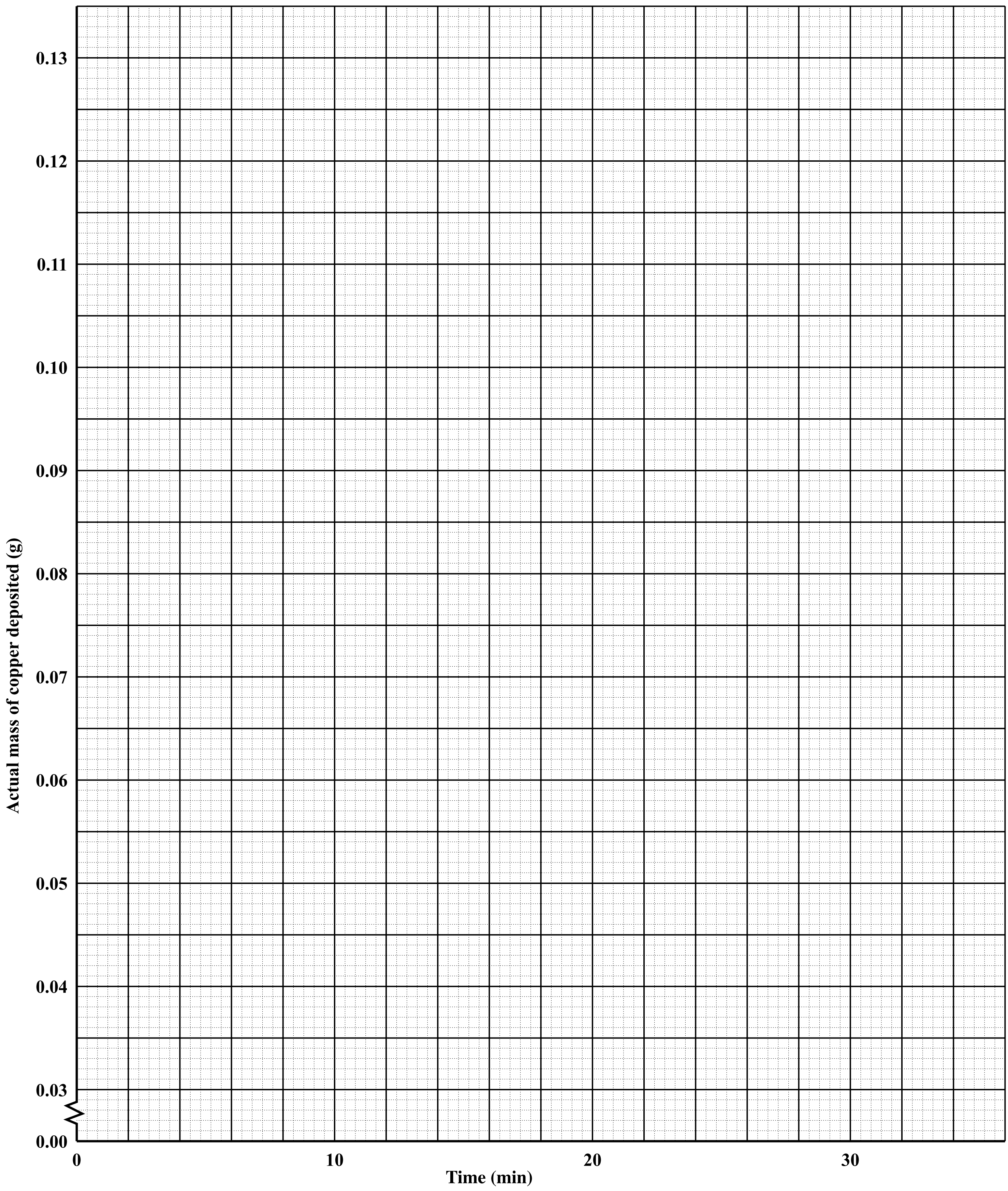


Figure 1. Actual mass of copper versus time

GO ON TO THE NEXT PAGE

(viii) Calculate the quantity of electricity that passed through the copper sulphate solution when 0.2 A of current flowed for 20 minutes.

(Quantity of electricity = current × time; 1 F = 96 500 C)

(2 marks)

(ix) Calculate the number of moles of copper that would be formed.

(2 marks)

(x) Calculate the mass of copper that would be formed.

(Relative atomic mass: Cu = 64; 1 F = 96 500 C)

(1 mark)

(xi) Suggest a reason for the difference between the mass of copper obtained in (x) above and that recorded in Table 1.

____

____

(1 mark)

(xii) The circuit used in this experiment was modified by replacing the copper electrodes with graphite electrodes. State ONE difference in the reaction at the anode when graphite electrodes are used.

Difference at the anode

____

____

(1 mark)

(b) Complete Table 2 by writing the observations for the tests carried out on Salt S.

TABLE 2. OBSERVATIONS FOR TESTS ON SALT S

Test	Observation	Inference
A sample of Salt S is heated strongly in a dry test tube. Moist red and blue litmus is held at the mouth of the test tube.	• •	An acidic gas is produced. Nitrate ions are present.
To an aqueous solution of Salt S, aqueous sodium hydroxide is added gradually until in excess.		Zn^{2+} are present.

(3 marks)

Total 25 marks

2. Depending on their structures and properties, solids may be classified as having metallic, giant covalent, simple molecular, or ionic lattice structures. The structure and conductivity of selected solids are to be summarized in Table 3.

(a) Complete Table 3 to show the structure and conductivity of EACH solid substance listed. The first one is done as an example.

TABLE 3. STRUCTURE AND CONDUCTIVITY OF SELECTED SOLIDS

Solid	Structure	Conducts Electricity in Solid State
Magnesium chloride	Ionic	No
Iodine		
Zinc		
Diamond		

(6 marks)

(b) Magnesium chloride and potassium nitrate have ionic lattice structures. Figure 2 on page 9 shows the solubility curves for magnesium chloride and potassium nitrate. Use the information in Figure 2 to answer the questions below.

(i) Which of the two compounds, magnesium chloride or potassium nitrate, has the GREATER solubility at 15 °C?

____

(1 mark)

(ii) Calculate the mass of potassium nitrate that would be deposited when its saturated solution is cooled from 80 °C to 20 °C.

____

____

____

____

(2 marks)

(iii) Determine the temperature at which the solubilities of magnesium chloride and potassium nitrate are equal. **(1 mark)**

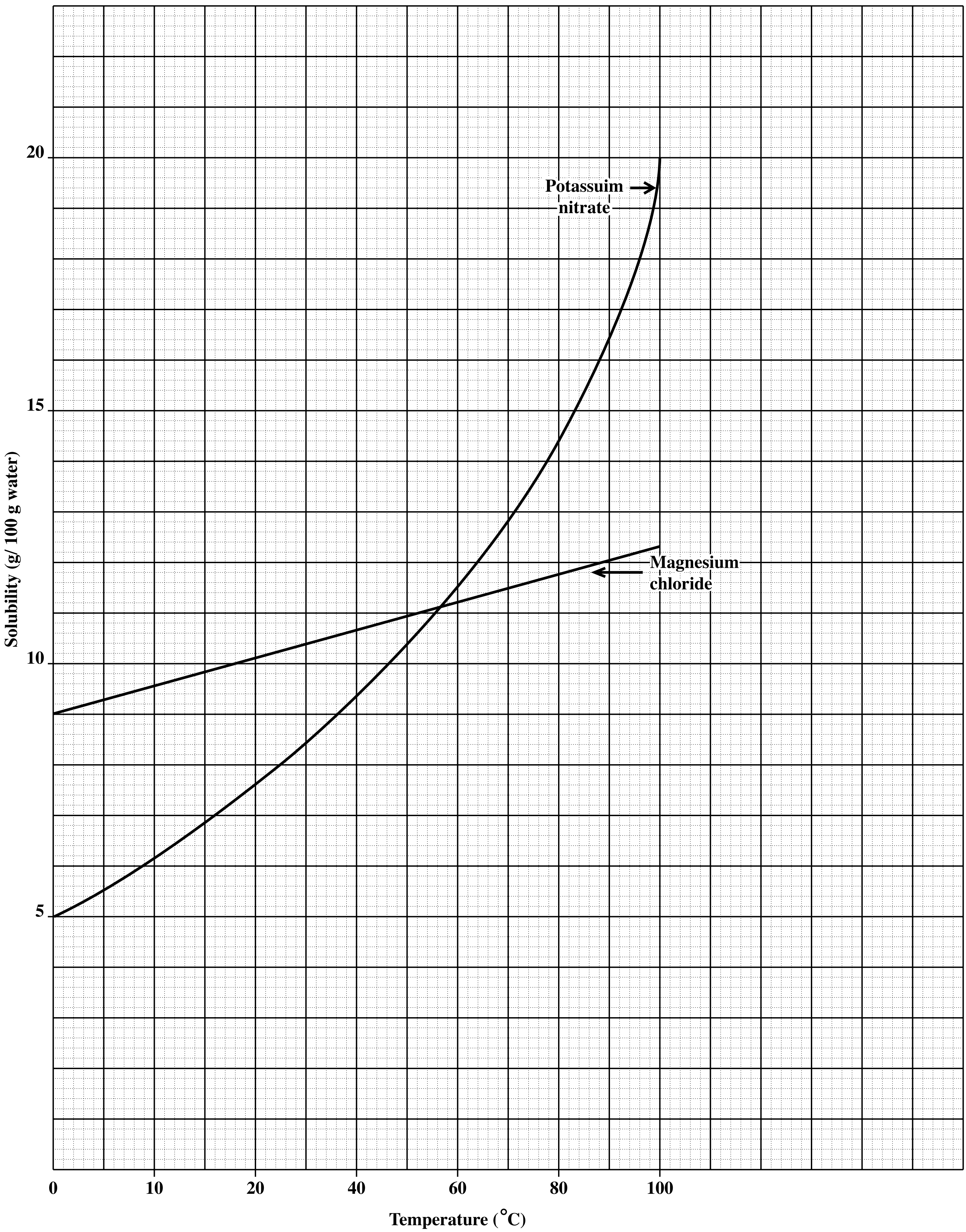


Figure 2. Solubility curves of magnesium chloride and potassium nitrate

GO ON TO THE NEXT PAGE

(c) Draw the bonding diagram to show how magnesium combines with chlorine to form magnesium chloride.

(2 marks)

(d) Based on the use and purpose of solid air fresheners, would you classify them as having simple molecular, giant covalent, or ionic lattices? Explain your answer.

____

____

____

____

(3 marks)

Total 15 marks

3. (a) Anaerobic fermentation occurs in the production of wines using yeast.

(i) Define 'anaerobic fermentation'.

Definition: ____

____

____

(2 marks)

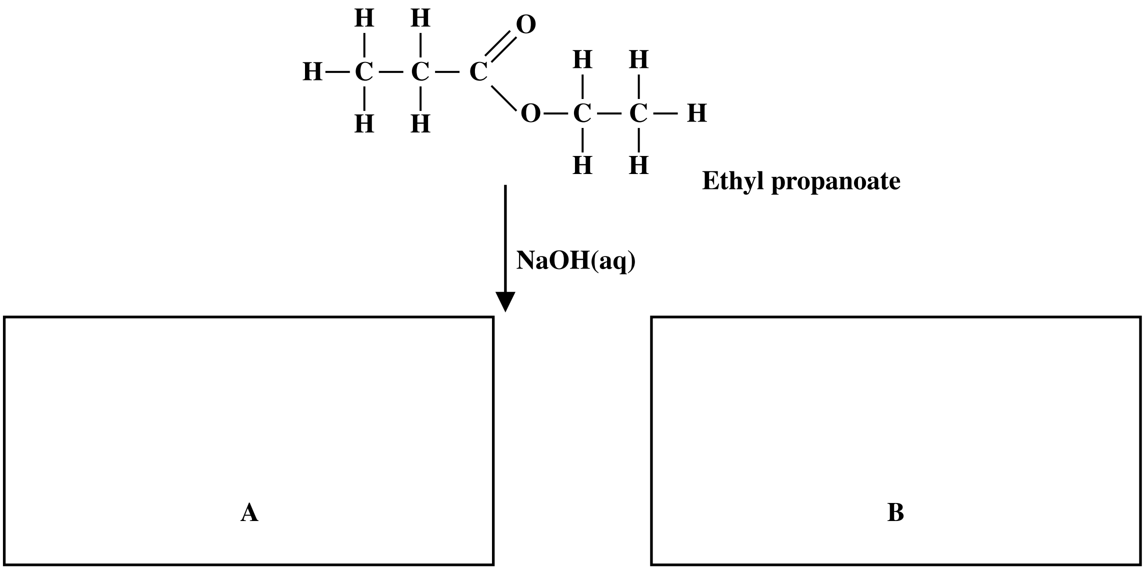
(ii) Give ONE reason why high temperatures are NOT suitable for anaerobic fermentation.

Reason: ____

____

(1 mark)

(b) Soaps are formed from the alkaline hydrolysis (saponification) of natural fats and oils, which are esters. Ethyl propanoate, an ester of relatively low molecular weight, is hydrolysed by aqueous sodium hydroxide. Draw FULLY displayed structures of the hydrolysis products, **A** and **B**.



(4 marks)

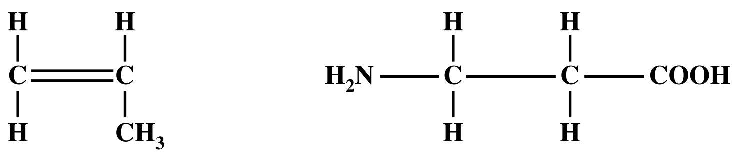
(c) Name ONE by-product of the saponification of fats and oils, and state ONE disadvantage of synthetic cleaning agents over soaps.

By-product: ____

Disadvantage: ____

(2 marks)

(d) The structures of propene and 3-amino propanoic acid, an amino acid, are shown below:



Propene **3-amino propanoic acid (amino acid)**

(i) Draw the structure of the polymer formed from propene. Use THREE units of the monomer to demonstrate your answer.

(2 marks)

(ii) What type of polymerisation would the 3-amino propanoic acid undergo? State the general name for the type of polymer formed from 3-amino propanoic acid.

Type of polymerisation: ____

(1 mark)

General name: ____

(1 mark)

(iii) Outline a chemical test that can be used to distinguish between propene and its polymer.

____

____

(2 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

SECTION B

Answer ALL questions in this section.

Write your answers in the space provided after EACH question in this answer booklet.

4. (a) (i) Potassium carbonate (K_2CO_3) and zinc metal (Zn) are both treated with an excess of dilute nitric acid in separate experiments. State the expected observations and write balanced chemical equations to explain any reactions that take place. Give the chemical test(s) which may be used to identify any gases produced. Record your answer in a table using the headings: Test, Observations, Equations.

(10 marks)

(ii) Outline a method that can be used to obtain a solid sample of a salt where **EITHER** the K_2CO_3 **OR** Zn completely reacts with the dilute nitric acid as described in (a) (i) above. **(2 marks)**

(b) An experiment was performed in three parts (A, B and C) to investigate the factors that are responsible for corrosion (rusting) in iron. Each of three shiny new iron rods was placed in a container and treated as described below, and left for two days.
Part A: The water is boiled and the container is sealed from the atmosphere.
Part B: No water is present and the container is sealed off from the atmosphere.
Part C: Water is present and the container is open to the atmosphere.

Explain the observations expected for EACH part.

(3 marks)

Total 15 marks

Write the answer to Question 4 here.

GO ON TO THE NEXT PAGE

Write the answer to Question 4 here.

GO ON TO THE NEXT PAGE

5. (a) Some students carried out Experiments I and II below in order to determine the relative reactivity of iron, copper and an unknown Metal X, which has a valency of 2.

Experiment I : A piece of Metal X was placed into a solution of copper(II) sulphate. Metal X was copper plated and the solution gradually became colourless.

Experiment II : A piece of Metal X was placed into a solution of iron(II) sulphate. There was no change to the Metal X or the solution.

(i) Use the information given to place Metal X, copper and iron in the order in which they will appear in the reactivity series, starting with the MOST reactive.
(2 marks)

(ii) Write an ionic equation for the reaction between Metal X and copper(II) sulphate. Include the relevant state symbols. **(2 marks)**

(b) An alloy of copper and aluminium is used in the manufacture of aircraft.

(i) What is an alloy? **(1 mark)**

(ii) Name the alloy of copper and aluminium. **(1 mark)**

(iii) State TWO properties of aluminium that make the alloy in (b) (ii) a good choice to be used in the manufacture of aircraft. **(3 marks)**

(iv) List TWO other uses of this alloy. **(2 marks)**

(c) Copper is a product of the reaction that occurs when dry ammonia is passed over a sample of heated copper (II) oxide. The equation for the reaction is given below:

$$2NH_3 + 3CuO \rightarrow 3Cu + 3H_2O + N_2 .$$

Calculate the mass of copper produced if 0.12 dm^3 of nitrogen is produced at room temperature and pressure (rtp). **(4 marks)**

(Relative atomic mass of Cu = 64; One mole of gas occupies 24 dm^3 at rtp.)

Total 15 marks

Write the answer to Question 5 here.

Write the answer to Question 5 here.

SECTION C

Write your answer to this question in the space provided at the end of this booklet.

6. (a) Athletes who use high-protein powders to supplement their diets are advised to mix them with cold or lukewarm water rather than boiling water. Suggest a reason for this.
(2 marks)

(b) Meat is an excellent source of protein but it is usually necessary to tenderize meat for human consumption. Both natural and commercial tenderizers can be used to tenderize meat.

(i) Explain how natural OR commercial tenderizers work when used to tenderize meat. **(3 marks)**

(ii) List ONE advantage and ONE disadvantage of using commercial tenderizers over natural tenderizers. **(2 marks)**

(iii) Baking soda, $NaHCO_3$, can also be used to tenderize meat. Suggest why this is possible. **(2 marks)**

(c) The vitamin C content in orange juice can be determined by titrating it with iodine solution using starch as the indicator. Vitamin C reacts with the iodine to form iodide ions. When all the vitamin C is used up the excess iodine reacts with the starch indicator.

A sample of orange juice was divided into two equal portions, A and B. Sample B was boiled then left to cool. Both samples were then titrated against iodine solution.

(i) What colour change would you expect at the end point in BOTH cases?
(1 mark)

(ii) Which sample, A or B, would require the LARGER volume of iodine? Explain your answer. **(3 marks)**

(iii) With reference to the oxidation number of iodine, explain whether vitamin C is acting as an oxidizing or a reducing agent when it reacts with iodine.
(2 marks)

Total 15 marks

Write your answer to Question 6 here.

GO ON TO THE NEXT PAGE

Write your answer to Question 6 here.

Write your answer to Question 6 here.

END OF TEST

TEST CODE **01212032**

FORM TP 2011058

MAY/JUNE 2011

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 03/2 – Alternative to SBA

General Proficiency

2 hours

READ THE FOLLOWING DIRECTIONS CAREFULLY.

In addition to the 2 hours allowed for the examination, candidates are allowed 10 minutes in order to read through the entire paper.

Writing may begin during the 10-minute period.

1. **Answer ALL questions on this paper.**
2. **Use this answer booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the answer booklet at the end of the examination.**
3. **The use of silent, non-programmable calculators is allowed.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

1. Chemical reactions are accompanied by heat changes. Heat may be absorbed from (or given out to) the surroundings. Such heat changes can be measured experimentally. In this experiment, you are required to determine the heat change which occurs when solid potassium nitrate is dissolved in water.

(a) The procedure for the experiment is outlined below.

PROCEDURE

1. 50 cm^3 of distilled water were measured into a polystyrene cup.

2. The temperature of the water in the cup was measured at one-minute intervals for four minutes, and the data were recorded in Table 1.

3. Potassium nitrate (5.0 g) was poured into the cup. The contents were stirred with the thermometer and the temperature was recorded at one-minute intervals over a further period of 6 minutes. The temperature for minute 5 is also recorded in Table 1.

TABLE 1. TEMPERATURE CHANGES UPON DISSOLVING POTASSIUM NITRATE IN WATER

	Before The Addition of Potassium Nitrate				**After The Addition of Potassium Nitrate**					
Time (min)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Temp (°C)	27.2	27.1	27.1	27.1	23.5					
ΔT (°C)*	X	X	X	X	–3.6					

***ΔT = (temperature reading at a particular time) – (temperature reading at 4 minutes)**

(i) State the name of an apparatus that is suitable for measuring the 50 cm^3 of water.

Apparatus: ______________________________

(1 mark)

GO ON TO THE NEXT PAGE

(ii) Read and record in Table 1 the temperature readings for 6 minutes to 10 minutes from the diagrams in Figure 1.

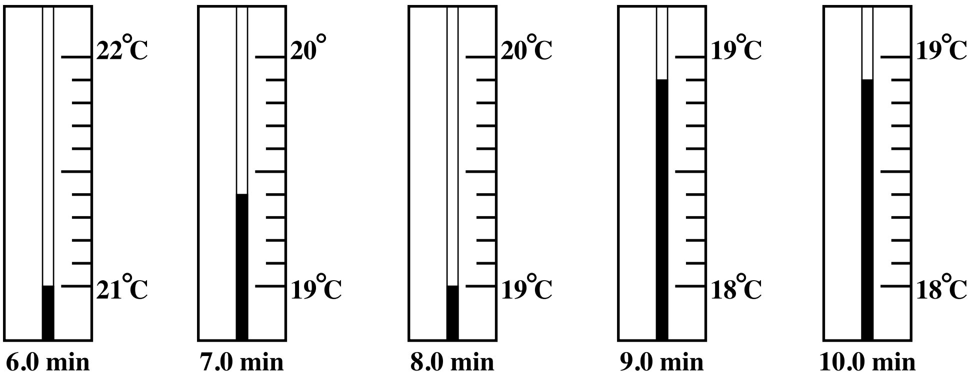


Figure 1. Thermometer readings at different times upon dissolving potassium nitrate in water

(5 marks)

CALCULATION

(iii) Calculate the change in temperature (ΔT) EACH minute from 6 minutes to 10 minutes and record your answers in Table 1. **(2 marks)**

[See note below Table 1.]

(b) (i) Using the axes provided in Figure 2 on page 5, plot a graph of temperature against time using the data in Table 1. **(4 marks)**

(ii) From your graph, calculate the MAXIMUM change in temperature which occurs when 5.0 g of potassium nitrate is dissolved in 50 cm^3 of water. You should indicate on your graph how you arrived at your answer.

Maximum temperature change: ____________________________

(2 marks)

(iii) Is the reaction exothermic or endothermic? State a reason for your answer.

____

____

(2 marks)

GO ON TO THE NEXT PAGE

NOTHING HAS BEEN OMITTED.

Graph for Question 1 (b) (i)

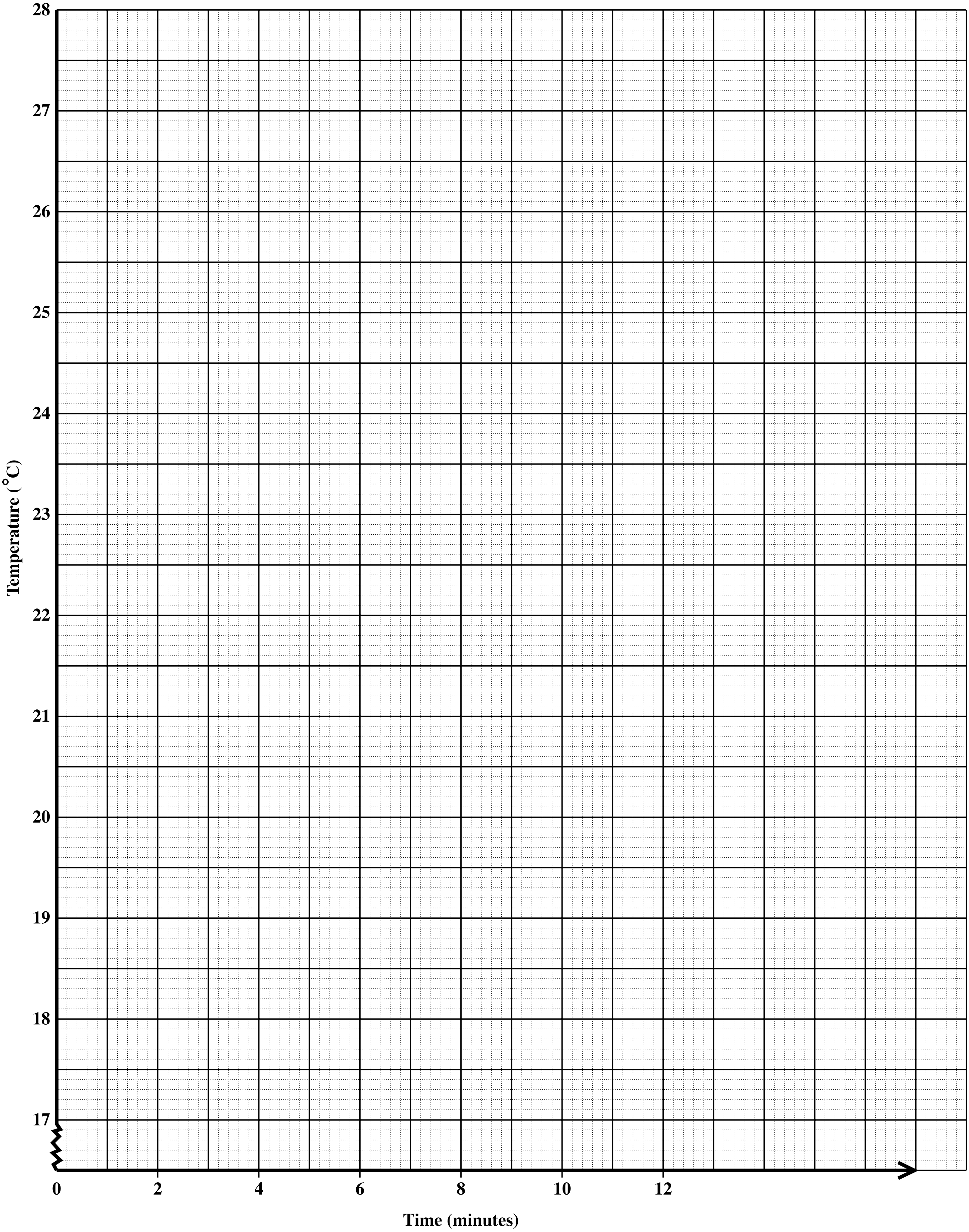


Figure 2. Temperature against time

(iv) Calculate EACH of the following:

a) The number of moles of potassium nitrate used in the experiment.

(2 marks)

(Relative atomic mass: K = 39, N = 14, O = 16)

b) The heat change which occurs when 5.0 g of potassium nitrate is dissolved in 50 cm^3 of water.

(Heat change = mass of solution × specific heat capacity of solution × temperature change that is, $Q = m \times c \times \Delta T$;

Assume that the specific heat capacity of the solution is 4.2 J g^{-1} $°C^{-1}$ and the mass of 1 cm^3 of solution is 1 gram.) **(2 marks)**

c) The heat change when 1 mole of potassium nitrate is dissolved in water.

(2 marks)

(c) Describe how you would prepare a saturated solution of potassium nitrate (KNO_3) at 25 °C.

(4 marks)

Total 26 marks

GO ON TO THE NEXT PAGE

2. A student carries out the following tests on Solid R and makes the inferences recorded in Table 2. Complete Table 2 to show ALL possible observations.

TABLE 2: RESULTS OF TESTS ON SOLID R

Test	Observations	Inferences
(i) Heat a small sample of Solid R gently in a dry test tube. Test the gas evolved with damp red litmus.	• •	NH_3 gas evolved
(ii) Add approximately 2 cm^3 of aqueous sodium hydroxide to a sample of Solid R and warm. Test gas with concentrated HCl.		NH_3 gas evolved
(iii) Dissolve a spatula full of Solid R in approximately 10 cm^3 of de-ionized water. Divide the resulting mixture into 3 portions for the tests, iv – vi, below.		Fe^{2+} ions present
(iv) To one portion of **Solution R** from (iii) above, add aqueous sodium hydroxide dropwise until excess.	• •	Fe^{2+} ions confirmed
(v) To another portion of **Solution R** from (iii) above, add dilute nitric acid followed by aqueous silver nitrate solution.		Cl^- , Br^- or I^- ions are **not** present
(vi) To another portion of **Solution R** from (iii) above, add barium nitrate followed by dilute nitric acid.	• •	SO_4^{2-} ions are **not** present
(vii) To another portion of Solid R add dilute HCl and test the gas evolved with damp potassium dichromate paper.		SO_3^{2-} ions present.

Total 10 marks

GO ON TO THE NEXT PAGE

3. Metals A and B are two unknown metals. Design an experiment to determine which of the metals, A or B, is more reactive. The hypothesis is given below.

Hypothesis: Metal A is more reactive towards acids than Metal B.

Your answer should include the following:

(a) Apparatus and materials

____

____

____

(2 marks)

(b) Procedure

____

____

____

____

____

____

(3 marks)

(c) Variables to control

____

____

____

(2 marks)

(d) Data to be collected

____

____

____

(2 marks)

(e) Discussion of results as they relate to the hypothesis

____

____

____

____

____

____

(2 marks)

(f) ONE possible source of error

____

(1 mark)

Total 12 marks

END OF TEST

TEST CODE **01212020**

FORM TP 2012005

JANUARY 2012

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX compulsory questions in TWO sections.
2. Write your answer to EACH question in the space provided in this answer booklet.
3. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
4. Return this booklet at the end of the examination.
5. The use of silent, non-programmable calculators is allowed.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

NOTHING HAS BEEN OMITTED.

SECTION A

Answer ALL questions in this section.

Write your answers in the spaces provided in this booklet.

Do NOT spend more than 30 minutes on Question 1.

1. A group of students conducted three experiments: Experiment 1, Experiment 2 and Experiment 3.

(a) **Experiment 1** was carried out to determine the heat of neutralization for the reaction between sodium hydroxide and sulphuric acid.

The procedure is given below and the data collected are given in Table 1.

Procedure for Experiment 1

- 25 cm^3 of dilute sodium hydroxide was measured and poured into a styrofoam cup.
- 25 cm^3 of sulphuric acid was poured into a burette.
- The solutions were left for a while until they reached room temperature and their temperatures recorded.
- The sulphuric acid was added to the sodium hydroxide solution 3 cm^3 at a time.
- The mixture was stirred on each addition of acid and the maximum temperature, in °C, was recorded in Table 1.

TABLE 1: RESULTS FOR EXPERIMENT 1

Volume of Sulphuric Acid Added (cm^3)	0	3	6	9	12	15	18	21
Temperature of Mixture (°C)	25	30	36	41	43	38	31	22

(i) Define the term 'heat of neutralization'.

____

____

____

(2 marks)

(ii) Use the data in Table 1 to plot a graph of temperature against volume of acid for Experiment 1 using the axes provided on page 5. The first two points have been plotted for you. **(3 marks)**

(iii) From the graph, determine the volume of sulphuric acid required to completely neutralize 25 cm^3 of sodium hydroxide. **(1 mark)**

(iv) Given that the difference in temperature from the start of the reaction to the point of neutralization is 18 °C, calculate the heat change at the point of neutralization for the reaction between sodium hydroxide and sulphuric acid.

[The specific heat capacity of the solution is 4.2 kJ kg^{-1} K^{-1}. Assume that the density of the solution is 1g cm^{-3}, $\Delta H = m \times c \times \Delta T$.]

____

____

____

____

____

____

(3 marks)

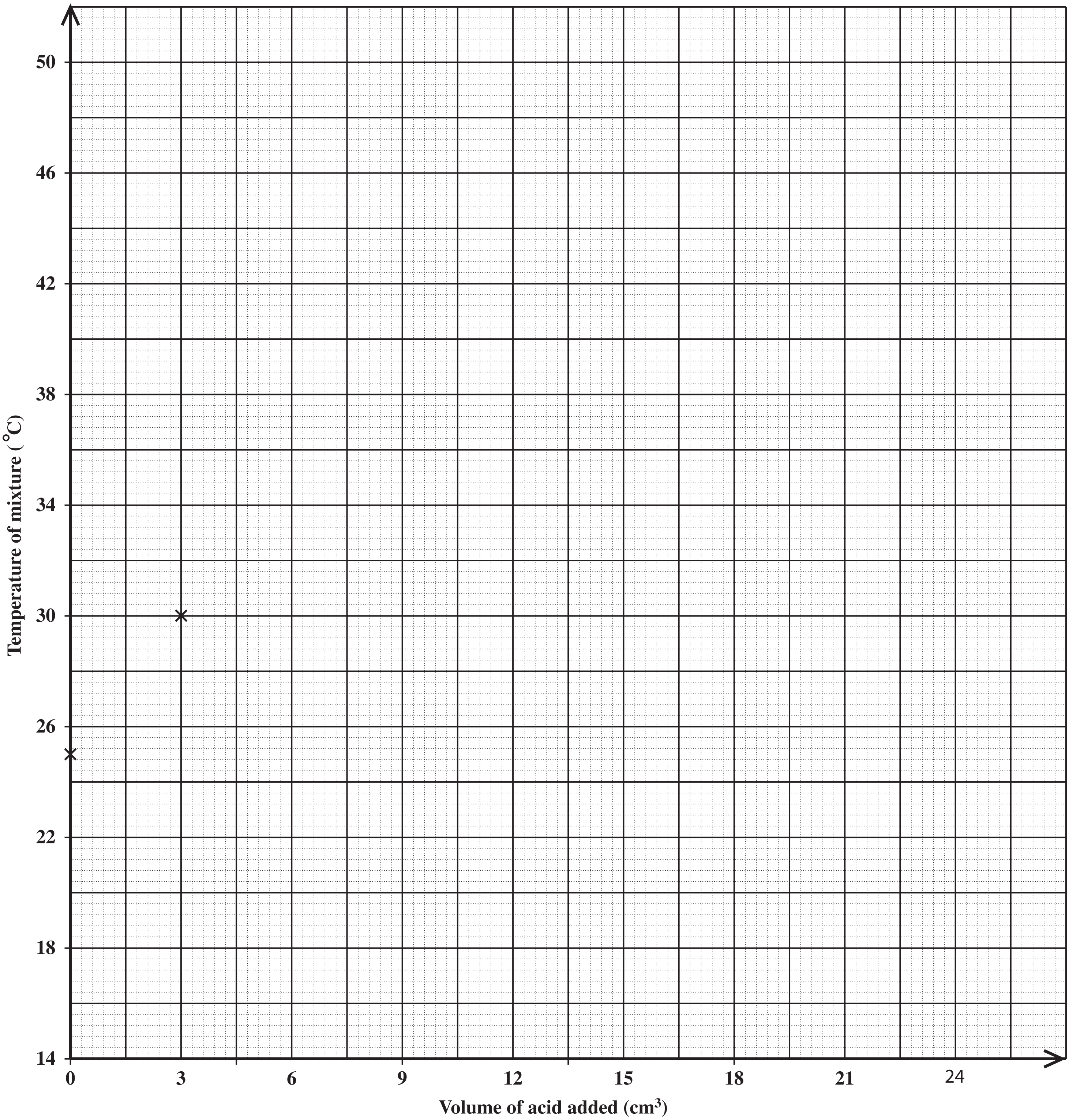


Figure 1. Temperature of mixture versus volume of acid

GO ON TO THE NEXT PAGE

(b) **Experiment 2** was carried out to determine the heat of solution made by mixing 8 g of potassium nitrate in 50 cm^3 of water.

(i) Define the term ‘heat of solution’.

____

____

____

(2 marks)

(ii) Figure 2 shows the thermometer readings for the initial and final temperatures obtained for Experiment 2. Record the reading, in °C, on each thermometer in the space provided.

Initial Temperature ____________________ Final Temperature ________________

Figure 2. Thermometer readings for Experiment 2

(1 mark)

(iii) Write a suitable procedure that could be carried out for Experiment 2.

____

____

____

____

____

____

(3 marks)

(iv) Draw a labelled energy profile diagram for the reaction taking place in Experiment 2.

(3 marks)

(c) **Experiment 3** involved reactions between a colourless unknown Solution X and three aqueous solutions, iron(II) nitrate, acidified potassium manganate(VII) and potassium iodide. Two of the three observations made are recorded in Table 2.

TABLE 2: REACTIONS OF SOLUTION X

Reactions of Solution X		
Aqueous Iron(II) Nitrate	**Acidified Potassium Manganate(VII)**	**Aqueous Potassium Iodide**
The solution changes from pale green to pale yellow.	The solution changes from purple to colourless.	Observation 3

Use the data in Table 2 to answer the following questions.

(i) Write a **balanced** half-equation to represent the change which takes place when Solution X reacts with aqueous iron(II) nitrate.

____

____

(2 marks)

(ii) Explain whether Solution X is behaving as a reducing agent, an oxidizing agent or both.

____

____

____

(3 marks)

(iii) Describe Observation 3 as indicated in Table 2.

(2 marks)

Total 25 marks

2. An experiment was carried out at 25 °C by dissolving an unknown mass of limestone granules into excess 1 mol dm^{-3} hydrochloric acid. The volume of gas produced over a period of 6 minutes was measured using a gas syringe. The result was plotted as shown in Figure 3.

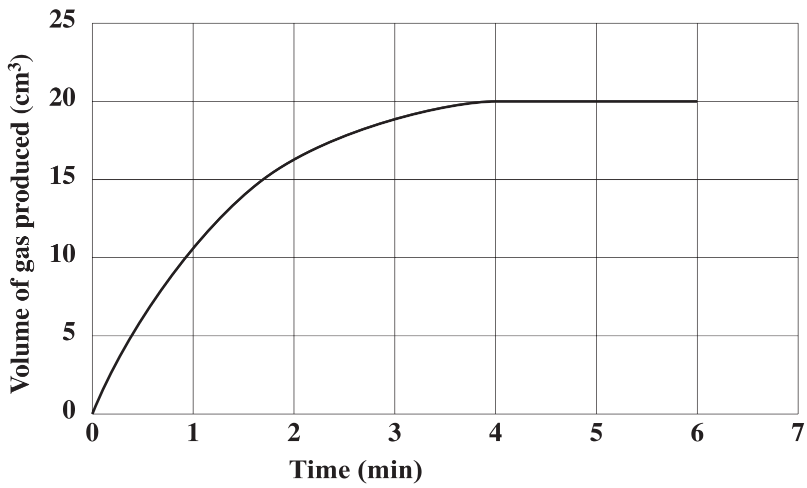


Figure 3. Volume of gas produced against time

(a) Assuming that the limestone granules are pure calcium carbonate, write a **balanced** equation for its reaction with hydrochloric acid.

(2 marks)

(b) Use the data from Figure 3

(i) to determine the **total** volume of gas produced

(1 mark)

GO ON TO THE NEXT PAGE

(ii) to calculate the moles of gas produced at STP
[1 mole of any gas at STP has a volume of 22 400 cm^3.]

(1 mark)

(iii) to calculate the mass of limestone granules used.
[Relative molecular mass of $CaCO_3$ is 100.]

(2 marks)

(c) (i) What is meant by the term ‘rate of reaction’?

____

____

(1 mark)

(ii) Besides temperature, identify TWO **other** factors that can affect the rate of the reaction.

____

____

(2 marks)

(iii) a) If the temperature at which the reaction was carried out was changed from 25 °C to 40 °C, would the rate of reaction increase or decrease?

____

(1 mark)

b) Explain your answer.

____

____

(2 marks)

(d) Like sodium chloride, calcium carbonate has a giant ionic crystalline structure.

(i) Is it LIKELY that calcium carbonate will conduct electricity in its solid state?

____

(1 mark)

(ii) Give a reason for your answer.

____

____

____

(2 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

3. (a) Hydrocarbons are compounds that contain the elements, hydrogen and carbon. Name TWO natural sources of hydrocarbons.

____

____

(2 marks)

(b) Fractional distillation of crude oil produces several fractions, containing a range of compounds with varying numbers of carbon atoms. Three of these fractions are shown in Table 3.

TABLE 3: THREE FRACTIONS FROM CRUDE OIL

Fraction	1	2	3
Number of Carbon Atoms	C1 – C4	C12 – C18	C20 – C40

(i) State the name of Fraction 1 **OR** Fraction 3.

Fraction number: ____________________

Fraction name: ____

(1 mark)

(ii) State ONE use of Fraction 2.

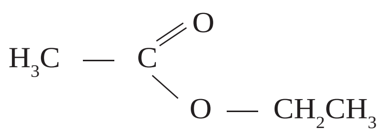
____

____

(1 mark)

GO ON TO THE NEXT PAGE

(c) Compound X is sweet smelling, and is hydrolysed by dilute hydrochloric acid.



Compound X

(i) State the name of Compound X and the homologous series to which it belongs.

Name of Compound X: ______________________________

(1 mark)

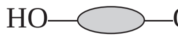
Homologous series: ______________________________

(1 mark)

(ii) Write the FULLY DISPLAYED structural formulae of the two molecules that are produced when Compound X is hydrolysed.

Structure 1 **Structure 2**

(2 marks)

(d) (i) Glucose, a monosaccharide, can be represented by the  unit.

a) Name a polymer of glucose.

Name of polymer: ______________________________

(1 mark)

b) Using three glucose units, draw the partial structure of the polymer in the space provided.

Partial structure of polymer of glucose

(2 marks)

(ii) A student is asked to distinguish between a sample of glucose and a sample of its polymer. The student adds a portion of glucose and a portion of the polymer to two separate beakers of water, and stirs the contents of the beakers.

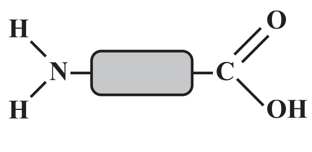
State the expected observations in EACH case.

Glucose: ______________________________

Polymer: ______________________________

(2 marks)

(e) The monomer shown below undergoes condensation polymerisation. Name the type of polymer formed and give ONE use for this type of polymer.



Monomer

Type of polymer: ______________________________

(1 mark)

Use: ______________________________

(1 mark)

Total 15 marks

GO ON TO THE NEXT PAGE

SECTION B

Answer ALL questions in this section.

Write your answers in the space provided after EACH question in this answer booklet.

4. Selected elements in the Periodic Table are presented in Figure 4.

I	II		III	IV	V	VI	VII	VIII
Li	Be			C	N	O	F	
Na	**Y**				P	S	Cl	
K							Br	
X							I	

Figure 4. Selected elements of the Periodic Table

(a) (i) Write the electronic configuration of sodium and state a reason for its placement in Period 3. **(2 marks)**

(ii) Sodium and potassium react vigorously with water at room temperature.

a) Write a **balanced** equation for the reaction of sodium with water. **(2 marks)**

b) Outline ONE test that can be used to identify any gas that is produced during the reaction. **(2 marks)**

c) An unknown element X is shown in Figure 4. Predict the reactivity of X with water as compared with sodium and potassium. **(1 mark)**

(iii) Element Y and sulphur react with oxygen gas to form oxides. Both of these oxides are soluble in water to form colourless solutions. Give ONE test that can be used to distinguish the solution of the oxide of Element Y from the solution of the oxide of sulphur. **(2 marks)**

(b) (i) During an experiment, chlorine gas, $Cl_2(g)$, is bubbled into a green solution of acidified iron(II) sulphate. The solution changes gradually from green to yellow. Write a **balanced** IONIC equation for the overall reaction, and identify the species being oxidised and reduced. **(4 marks)**

(ii) In a second experiment, iodine is stirred with another solution of iron(Π) sulphate. No observable change takes place. Account for the difference in reactivity of chlorine and iodine towards iron(Π). **(2 marks)**

Total 15 marks

GO ON TO THE NEXT PAGE

Write your answer to Question 4 here.

Write your answer to Question 4 here.

GO ON TO THE NEXT PAGE

5. (a) Iron is extracted from its ore (Fe_2O_3) by thermal reduction using carbon monoxide.

(i) Describe the process for obtaining iron from its ore. In your description, identify the materials used and include a chemical equation to show how iron is produced. **(6 marks)**

(ii) Carbon and carbon monoxide are both able to reduce the oxide ore to produce iron. Suggest a suitable explanation why carbon monoxide is used to reduce the iron ore instead of carbon. **(1 mark)**

(b) A chemist analysed a newly discovered oxide of a Metal M and found that it had the following properties:

- The oxide of Metal M was soluble in sodium hydroxide.
- The formula for the oxide of Metal M was MO.
- When the oxide (MO) was heated with carbon at high temperatures, no reaction occurred.
- Metal M displaced aluminium from a solution of Al^{3+} ions.

(i) Write suitable equations for the action of heat on the

a) hydroxide of M

b) nitrate of M. **(4 marks)**

(ii) Suggest a suitable method for extracting Metal M from its ore and explain your answer. **(3 marks)**

(iii) Suggest ONE chemical property of Metal M. **(1 mark)**

Total 15 marks

Write your answer to Question 5 here.

GO ON TO THE NEXT PAGE

Write your answer to Question 5 here.

6. Dough has a mixture of flour, water and a leavening agent as the major ingredients. During the making of dough, a number of important physical and chemical changes take place.

(a) Discuss the role of EACH of the following agents in the making of dough:

(i) Water **(2 marks)**

(ii) Leavening agent (baking powder and yeast) **(2 marks)**

(iii) Heat **(2 marks)**

(b) Write THREE relevant chemical equations to support your answer in (a). Include AT LEAST ONE equation from the action of yeast and ONE from the action of baking powder. **(6 marks)**

(c) Flour usually consists of 55–80% carbohydrates (starches). Iodine can be used to test for the presence of starches.

There is no blue-black colouration when flour, which is stored in a hot, humid room for a long time, is tested with iodine. Suggest a possible explanation for this. **(3 marks)**

Total 15 marks

Write your answer to Question 6 here.

Write your answer to Question 6 here.

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

TEST CODE **01212032**

FORM TP 2012006

JANUARY 2012

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 032 – General Proficiency

Alternative to SBA

2 hours 10 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. Answer ALL questions on this paper.

2. Use this answer booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the answer booklet at the end of the examination.

3. You may use a silent, non-programmable calculator.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Answer ALL questions.

1. (a) A student was provided with a standard solution of aqueous sodium hydroxide containing X grams of NaOH in 250 cm^3 of solution. In order to determine the mass of sodium hydroxide used, he titrated 25 cm^3 portions of the solution using 0.025 mol dm^{-3} sulphuric acid in the burette and a suitable indicator.

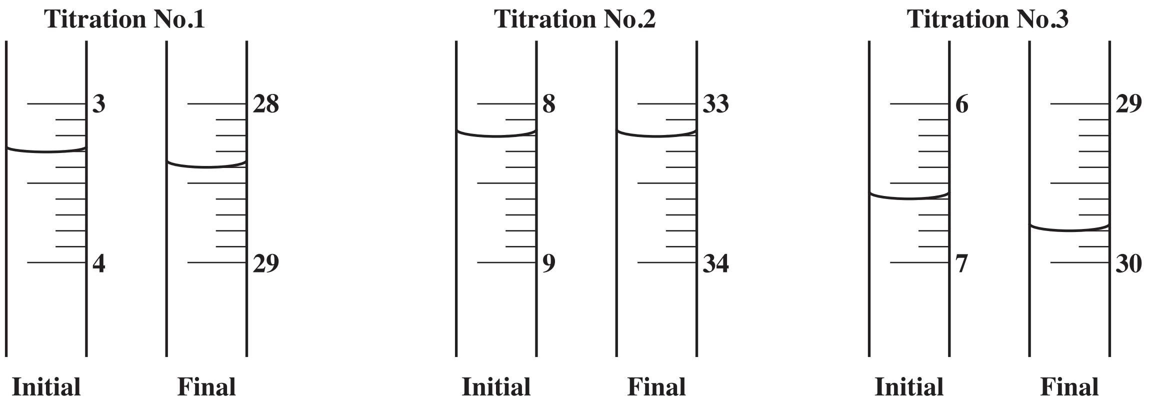


Figure 1. Burette readings showing volumes of acid used in cm^3

(i) Describe the process involved in preparing a standard solution of aqueous sodium hydroxide containing X grams in a 250 cm^3 solution.

____

____

____

____

____

____

(3 marks)

(ii) a) Figure 1 shows the initial and final volumes of the burette readings for the acid used. Use the information given in Figure 1 on page 2 to complete Table 1 below.

TABLE 1: RESULTS OF EXPERIMENT

Burette Readings (cm^3)	Titration Number		
	1	2	3
Final volume			
Initial volume			
Volume used			

(3 marks)

b) Using the best TWO values from Table 1, state the average volume of acid used in cm^3.

____

(1 mark)

(iii) a) Identify a suitable indicator for titrating sodium hydroxide and sulphuric acid.

____

____

(1 mark)

b) Explain how you will be able to determine the end-point of the reaction.

____

____

(1 mark)

(iv) Write a **balanced** chemical equation for the reaction that occurs when sodium hydroxide reacts with dilute sulphuric acid.

____

(2 marks)

(v) Using the data that you provided in Table 1, calculate EACH of the following:

a) The number of moles of sulphuric acid used in the titration

____

____

____

(1 mark)

b) The number of moles of sodium hydroxide in 25.0 cm^3 of the solution

____

____

(1 mark)

c) The number of moles of sodium hydroxide in 250 cm^3 of solution

____

____

____

(1 mark)

d) The mass of sodium hydroxide dissolved in 250 cm^3 of water
[Relative atomic masses: Na = 23; O = 16; H = 1]

____

____

____

____

(2 marks)

(b) Another group of students conducted an experiment to copper plate an iron spoon.

(i) Identify suitable materials needed for the anode, cathode and electrolyte.

Anode: ____

Cathode: ____

Electrolyte: ____

(2 marks)

(ii) Draw a diagram to show the arrangement of the apparatus needed to conduct this experiment.

(3 marks)

(iii) State the name of the type of reaction which occurs at the anode.

____

(1 mark)

(iv) Write a **balanced** equation to show the reaction taking place at the anode and the cathode.

Reaction at the anode:

____

Reaction at the cathode:

____

(4 marks)

Total 26 marks

2. A student conducted a number of tests on an aqueous solution of Compound Z. The inferences made are recorded in Table 2. Complete this table by filling in the observations based on the inferences recorded.

TABLE 2: TESTS ON COMPOUND Z

Test	Observations	Inferences
(a) To a sample of Solution Z, dilute nitric acid was added followed by a few drops of silver nitrate solution.	• **(1 mark)**	No Cl^-, Br^- or I^- ions are formed.
(b) To a sample of Solution Z, a few copper turnings were added, followed by concentrated sulphuric acid.	• • **(2 marks)**	Nitrate ions are present.
(c) To a sample of Solution Z, aqueous sodium hydroxide was added, until in excess.	• • **(2 marks)**	Zn^{2+}, Pb^{2+} or I^- ions are present.
(d) To a sample of Solution Z, aqueous ammonia was added, until in excess.	• • **(2 marks)**	Zn^{2+} ions are confirmed.
(e) To a sample of Solution Z, a few drops of acidified aqueous potassium manganate (VII) solution were added, and the solution heated.	• **(1 mark)**	Z is not a reducing agent.
(f) To a sample of Solution Z, a few drops of barium chloride solution was added followed by dilute hydrochloric acid.	• • **(2 marks)**	SO_4^{2-} ions are present.

Total 10 marks

3. You are provided with samples of lead nitrate crystals and sodium chloride crystals. Plan and design an experiment to make lead chloride crystals. Write your responses in the spaces provided below.

(a) Procedure:

____

____

____

____

____

(4 marks)

(b) Apparatus and materials:

____

____

____

(2 marks)

(c) Precautions to be taken (this should include ONE experimental precaution and ONE safety precaution):

____

____

____

(2 marks)

(d) Discussion: In preparing lead chloride crystals, it is unlikely that the yield will be 100 per cent. Discuss TWO reasons why this may be so.

____

____

____

____

____

____

(4 marks)

Total 12 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

CARIBBEAN EXAMINATIONS COUNCIL

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX compulsory questions in TWO sections.
2. Write your answer to EACH question in the space provided in this answer booklet.
3. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
4. Return this booklet at the end of the examination.
5. You may use a silent, non-programmable calculator to answer questions.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions in this section.

Write your answers in the spaces provided in this booklet.

Do NOT spend more than 30 minutes on Question 1.

1. (a) A student conducts an experiment to investigate the effect of particle size on the rate of reaction between calcium carbonate and nitric acid. He weighed 1.8 g of powdered calcium carbonate and 1.8 g of large granules of calcium carbonate (marble chips), and allowed EACH to react with excess dilute nitric acid. The volume of gas produced at 10-second intervals was measured for a total of 100 seconds.

Table 1 is a record of the volume of gas produced from each set of reactions (with the powdered calcium carbonate and with the marble chips). Figure 1 is an **incomplete** diagram of the arrangement of the apparatus used in the experiment. Figure 2 shows the graph obtained for the rate of production of gas from powdered calcium carbonate.

TABLE 1: VOLUME OF GAS PRODUCED

Time (s)	0	10	20	30	40	50	60	70	80	90	100
Volume of Gas Produced from 1.8 g of Powdered Calcium Carbonate (cm^3)	0	170	190	250	280	320	340	357	365	369	370
Volume of Gas Produced from 1.8 g of Marble Chips (cm^3)	0	70	125	195	235	275	300	330	350	365	370

(i) Complete Figure 1 to show how the gas was collected and measured during the experiment.

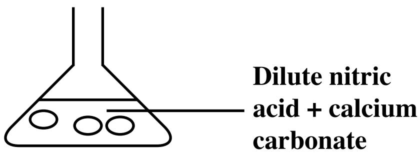


Figure 1. Arrangement of apparatus

(2 marks)

(ii) Using the same axes in Figure 2, plot a graph of the volume of gas produced versus time for the reaction with marble chips. Four of the points have already been plotted on the graph. **(3 marks)**

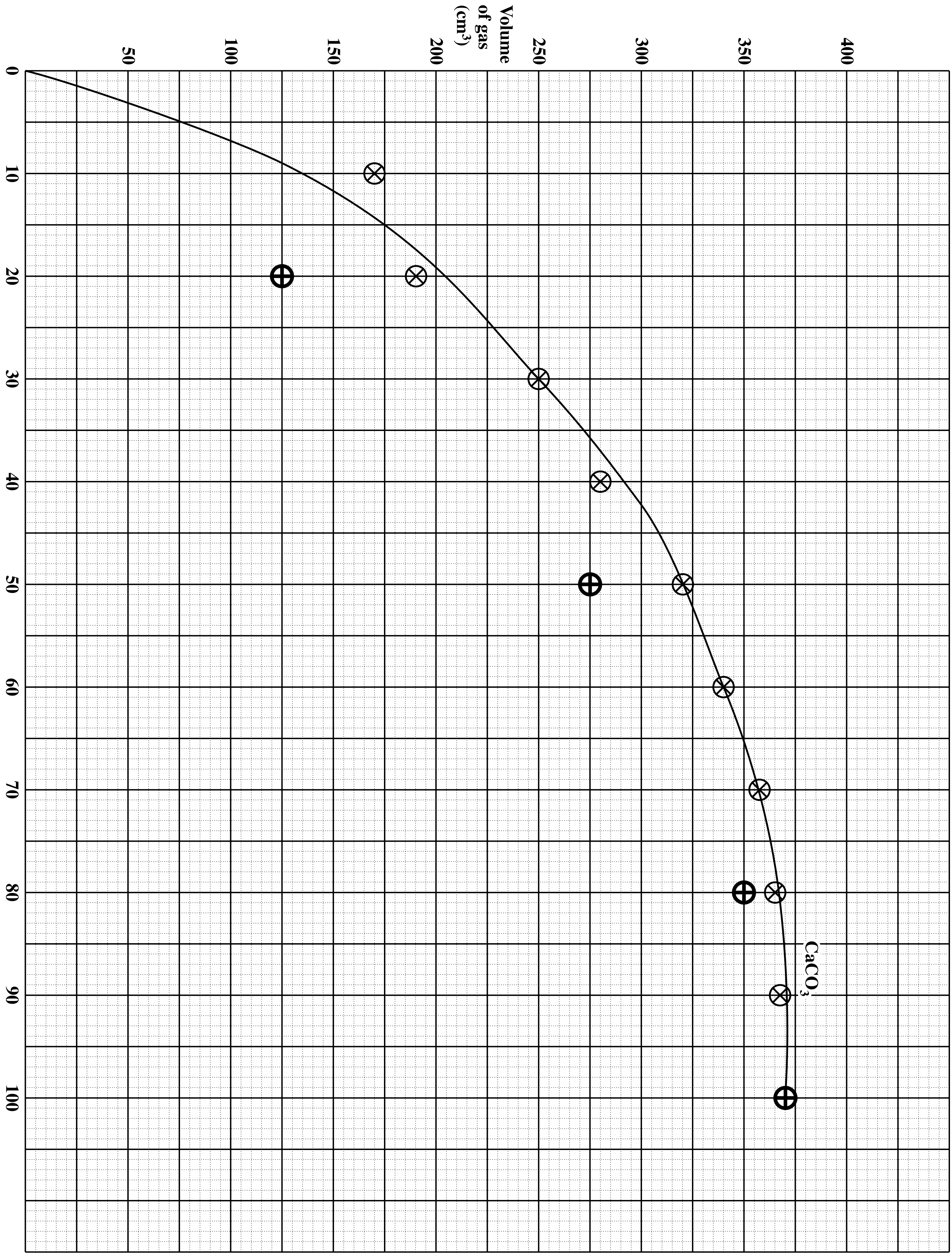


Figure 2. Volume of gas with time

(iii) With reference to the volume of gas produced and the slopes along the two curves on the graph, outline ONE similarity and ONE difference in the volume of carbon dioxide produced from powdered calcium carbonate and from marble chips. Include a reason in EACH case.

____

____

____

____

____

(4 marks)

(iv) Write a **balanced** equation for the reaction between calcium carbonate and nitric acid.

____

(2 marks)

(v) Calculate the volume of gas that can be obtained from reacting 1.8 g of calcium carbonate with dilute nitric acid at R.T.P.

[1 mole of gas occupies 24 000 cm^3 at R.T.P. R.A.M: C = 12; O = 16; Ca = 40]

____

____

____

____

____

(3 marks)

(vi) From the graph, the total volume of gas produced is 370 cm^3. Suggest a possible reason for the difference in your answer obtained in (v) on page 4 and the volume of gas obtained from the graph.

____

____

____

(1 mark)

(vii) State TWO **other** factors (than the one given in (vi) above) that can affect the rate of reaction between nitric acid and calcium carbonate.

____

____

____

(2 marks)

(b) A student conducts a number of tests on a solution of Compound Y. Some of the observations and the inferences made from these tests are recorded in Table 2. Complete Table 2 by writing in the observations and inferences numbered (i) – (v).

TABLE 2: RESULTS OF TESTS CARRIED OUT ON SOLUTION OF COMPOUND Y

	Test	**Observation**	**Inference**
1.	Aqueous sodium hydroxide is added gradually until in excess.	A red-brown precipitate insoluble in excess sodium hydroxide is formed.	(i) •
2.	A strip of magnesium ribbon is added.	(ii) • •	The magnesium reduces Solution Y. Iron(II) ions are produced.
	Aqueous sodium hydroxide is added to the mixture until in excess.	A green gelatinous precipitate insoluble in excess sodium hydroxide is formed.	(iii) The balanced ionic equation is •
3.	Dilute nitric acid is added followed by barium nitrate solution.	No precipitate is formed.	(iv) •
4.	Silver nitrate is added followed by aqueous ammonia.	(v) •	Chloride ions are confirmed.

(8 marks)

Total 25 marks

GO ON TO THE NEXT PAGE

2. Figure 3 shows a simplified diagram of the apparatus used for the electrolysis of aqueous copper(II) sulphate, $CuSO_4$, using platinum electrodes.

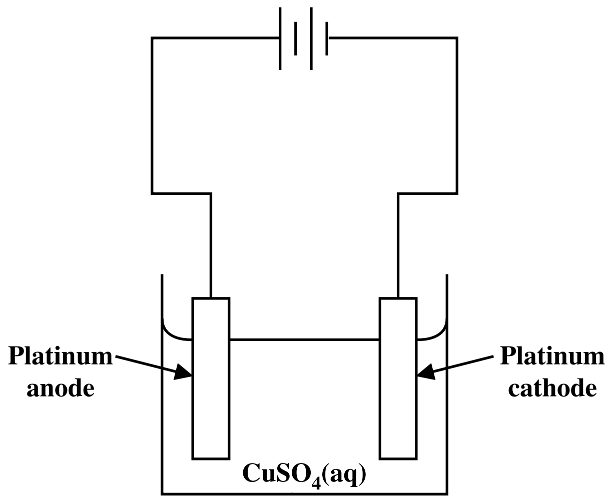


Figure 3. Electrolysis of $CuSO_4$(aq)

(a) Deduce the oxidation state of sulphur in $CuSO_4$.

____

(1 mark)

(b) At the anode, the hydroxide ions are discharged in preference to the sulphate ions. State a reason for this.

____

____

(1 mark)

(c) Write a **balanced** equation for the reaction at the anode.

____

(2 marks)

(d) From the equation written in (c) above, state whether the reaction at the anode is oxidation or reduction. Give an explanation for your answer.

Reaction at the anode: ____

(1 mark)

Explanation: ____

____

(1 mark)

(e) State TWO changes that occur in the electrolyte.

____

____

(2 marks)

(f) Determine the mass of copper (in grams) which will be deposited at the cathode when 5A of current passes through the electrolytic cell for half an hour.

[R.A.M. Cu = 64; 1 Faraday = 96 500 C]

(4 marks)

(g) Indicate below how the apparatus in Figure 3 can be modified to obtain pure copper from impure copper. If no modification is required write ***"no modification required"*** in the relevant space.

Anode:

____

____

Cathode:

____

____

Electrolyte:

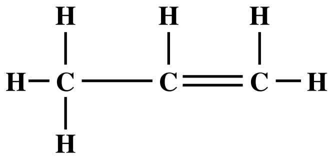
____

____

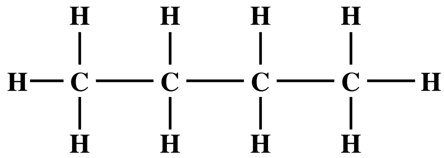
(3 marks)

Total 15 marks

3. (a) The fully displayed structures of two hydrocarbons, **A** and **B**, are shown below.



A



B

(i) Write the names of the homologous series to which **A** and **B** belong.

Homologous series for **A**: ____

Homologous series for **B**: ____

(2 marks)

(ii) Write the general formulae for EACH homologous series named in (i) above.

General formula for homologous series of **A**:

____

General formula for homologous series of **B**:

____

(2 marks)

(iii) Both **A** and **B** react with chlorine, but under different conditions.

a) State ONE necessary condition for **B** to react with chlorine.

____

(1 mark)

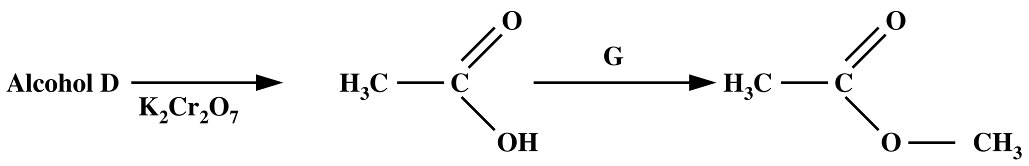
b) Draw the FULLY displayed structures of the organic products for the reactions of **A** and **B** with chlorine.

Organic product of A with chlorine	**Organic product of B with chlorine**

(4 marks)

GO ON TO THE NEXT PAGE

(b) The questions below are based on the following reaction scheme.



E J

(i) State the role of $K_2Cr_2O_7$ in the conversion of **D** to **E**.

____

(1 mark)

(ii) Write a **balanced** equation for the reaction of **E** with solid magnesium oxide (MgO).

Equation: ____

(2 marks)

(iii) Describe ONE chemical test that could be used to identify the gas given off from the reaction of Compound **E** with solid calcium carbonate. Include the expected observation.

____

____

____

(2 marks)

(iv) State the name of the homologous series to which Compound **J** belongs.

____

(1 mark)

Total 15 marks

SECTION B

Answer ALL questions in this section.

Write your answers in the space provided after EACH question in this booklet.

4. (a) Radioisotopes are very useful in everyday life. For example, Uranium - 235 is used in energy generation because it produces large amounts of energy when the atoms split.

State TWO other uses of radioisotopes and explain the importance of EACH.

(4 marks)

(b) The properties of elements can be explained based on their electronic configuration and hence their position in the Periodic Table.

The electronic configurations of four elements P, Q, R and S are:

P: 2, 7 Q: 2, 8, 2 R: 2, 8, 6 S: 2, 8, 8, 2

(i) Outline the criteria for placing elements in the Periodic Table. Hence, state the appropriate group and period for EACH of the elements P, Q, R and S.

(4 marks)

(ii) Elements P and Q react together to form a compound. Deduce whether this compound is ionic or covalent. Use 'dot cross' diagrams to show the bonding in the compound formed and write its formula. **(4 marks)**

(iii) Compare the reactivity of EACH of elements Q and S with dilute hydrochloric acid. Write a **balanced** equation for EITHER of these reactions with dilute hydrochloric acid. **(3 marks)**

Total 15 marks

Write the answer to Question 4 here.

Write the answer to Question 4 here.

Write the answer to Question 4 here.

5. Most metals undergo corrosion. In the case of aluminium, this can be beneficial to the metal while in the case of iron, it may be harmful and quite costly.

(a) State the property of metals that is responsible for corrosion and describe the process of corrosion. **(3 marks)**

(b) Write THREE relevant chemical equations for the corrosion of iron. **(3 marks)**

(c) Explain why the corrosion of aluminium is beneficial while that of iron is not. In your answer, you should refer to the products of corrosion and their properties. **(7 marks)**

(d) Aluminium is widely used to make cookware. Explain why it is NOT advisable to use aluminium pots to prepare acidic foods. **(2 marks)**

Total 15 marks

Write the answer to Question 5 here.

Write the answer to Question 5 here.

GO ON TO THE NEXT PAGE

Write the answer to Question 5 here.

6. (a) "Scientists believe that without water all life would cease to exist."

Outline THREE properties of water and relate them to its function in maintaining life on earth. **(6 marks)**

(b) (i) State the meaning of the term 'hard water'. **(1 mark)**

(ii) Describe ONE way in which water can be softened. Include a chemical equation with state symbols in your description. **(4 marks)**

(c) It is important that communities and individual households play a part in the management and preservation of the environment. Suggest FOUR practical ways in which households or communities can manage or preserve the environment. At least ONE way must be related to water. **(4 marks)**

Total 15 marks

Write the answer to Question 6 here.

GO ON TO THE NEXT PAGE

Write the answer to Question 6 here.

GO ON TO THE NEXT PAGE

Write the answer to Question 6 here.

Write the answer to Question 6 here.

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

FORM TP 2012058

TEST CODE **01212032**

MAY/JUNE 2012

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

SECONDARY EDUCATION CERTIFICATE EXAMINATION

CHEMISTRY

Paper 032 – Alternative to SBA

General Proficiency

2 hours 10 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. Answer ALL questions on this paper.
2. Use this answer booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the answer booklet at the end of the examination.
3. You may use a silent, non-programmable calculator to answer questions.
4. You are advised to take some time to read through the paper and plan your answers.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

1. (a) An experiment was carried out to investigate the effect of temperature on the physical state of a substance, X. Some of the Solid X was heated until it melted. The temperature changes that occurred as the hot liquid cooled were recorded. Some of the results are shown in Table 1. The other temperature readings are displayed in Figure 1.

TABLE 1: TEMPERATURE VERSUS TIME DATA FOR SUBSTANCE X

Time (min)	0	2	4	6	8	10	12	14	16
Temperature (°C)	67.0	61.0			56.0	56.0			

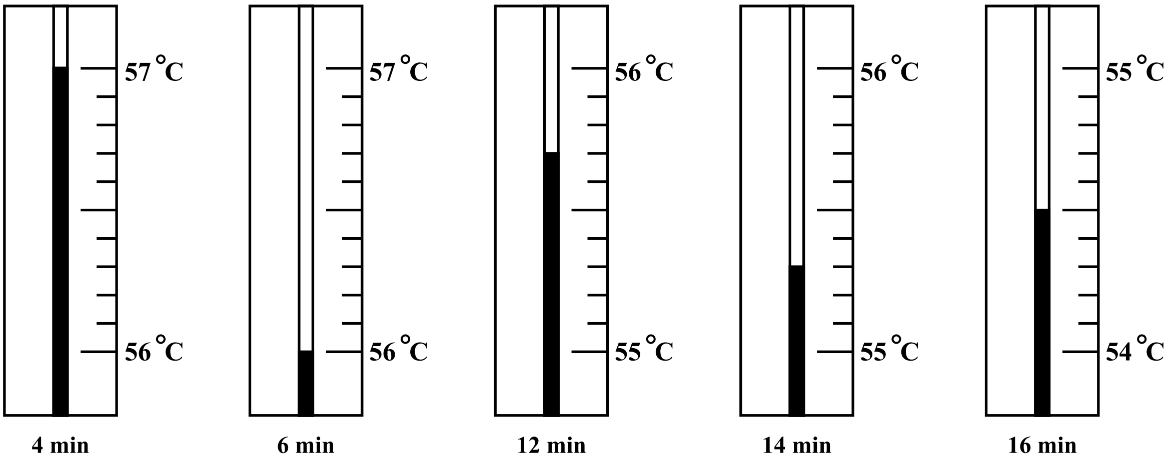


Figure 1. Thermometer readings at different times for Substance X

(i) Read EACH of the temperatures displayed in Figure 1, and record them in the appropriate spaces in Table 1. **(5 marks)**

(ii) Use the data in Table 1 to plot a graph of temperature of Substance X against time on the axes provided in Figure 2. Four of the points have already been plotted on the graph. **(4 marks)**

GO ON TO THE NEXT PAGE

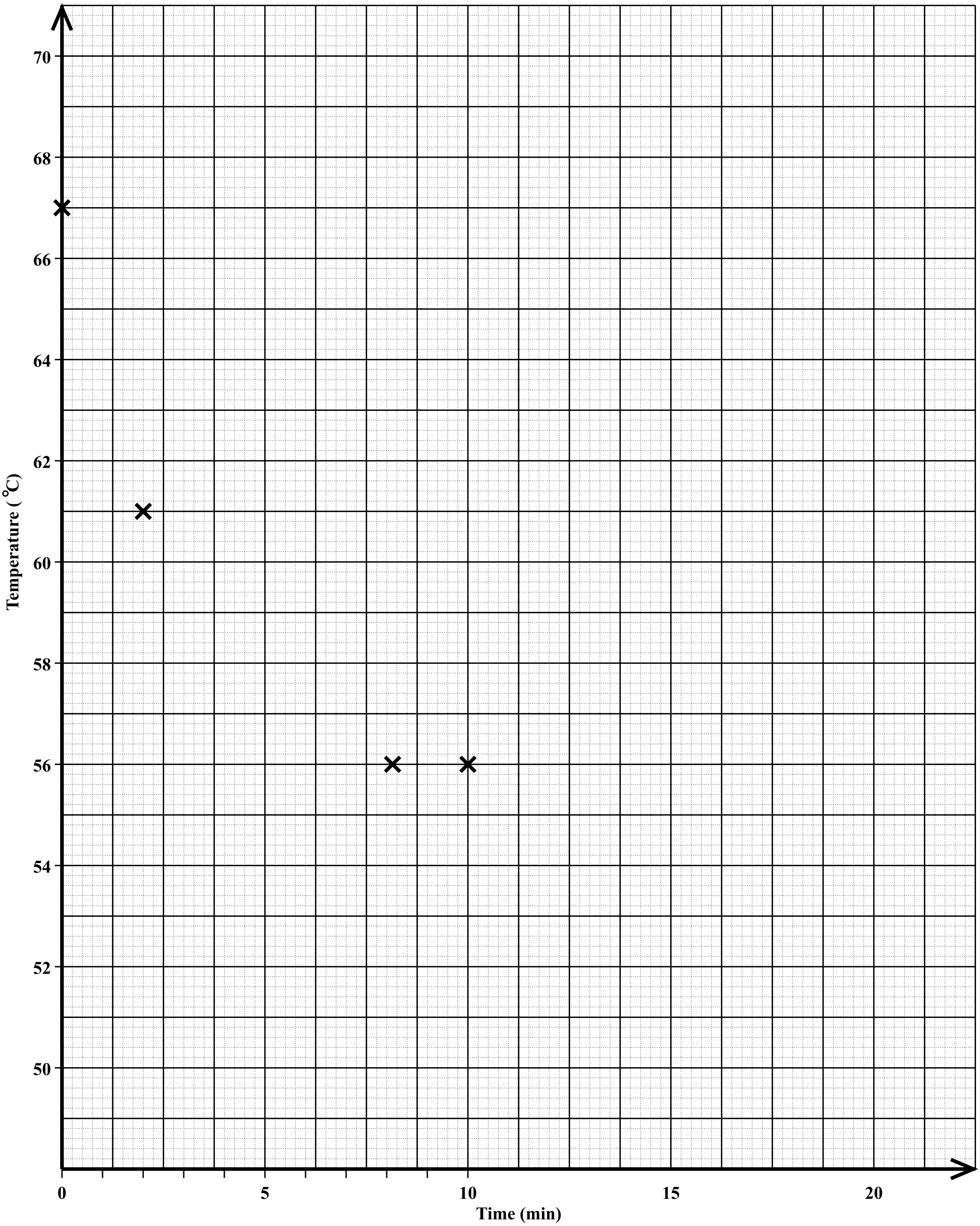


Figure 2. Temperature of Substance X against time

GO ON TO THE NEXT PAGE

(iii) Draw a smooth curve through the points on the graph. **(1 mark)**

(iv) From the graph, determine a value for the melting point of Substance X.

Melting point of Substance X: ________________________________

(1 mark)

(v) From the graph, determine the temperature of the hot liquid after 3 minutes of cooling.

Temperature: ________________________________

(1 mark)

(vi) What is the physical state of Substance X at 6 minutes after cooling?

____

____

(2 marks)

(vii) Compare the arrangement of the particles in Substance X at 2 minutes and at 16 minutes after cooling.

____

____

____

____

(3 marks)

(b) An experiment is carried out to determine the percentage composition by mass of sand and copper(II) sulphate in a mixture. A 10.0 g portion of the mixture is stirred in 200 cm^3 of distilled water, until no further change takes place. The resulting mixture is filtered into a clean beaker using a funnel fitted with filter paper.

(i) State clearly what is observed in the beaker and on the filter paper at the end of the experiment.

Beaker: ________________________________

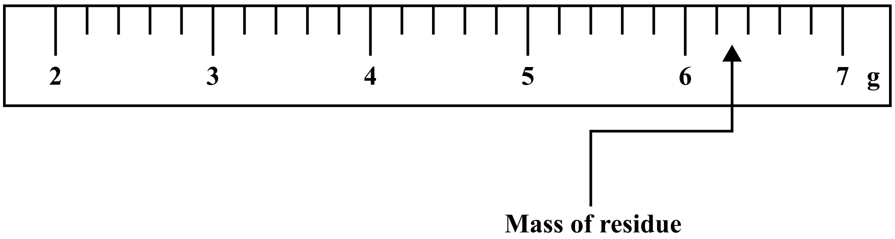
____

Filter paper: ________________________________

____

(2 marks)

(ii) The residue from (b) (i) on page 4 was washed, dried and weighed on a watch glass of mass 2.0 g. The mass (in grams) was recorded on a balance. A part of the scale is shown.

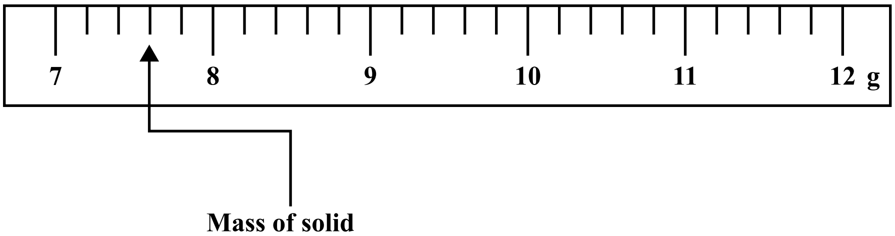


Determine the mass of the residue and record it in the space provided.

Mass of residue: ____

(2 marks)

(iii) The filtrate in the beaker from (b) (i) on page 4 was evaporated to dryness and the remaining solid was transferred to a watch glass of mass 2.0 g, and weighed on the same balance as in (b) (ii). A part of the scale is shown below.



Determine the mass of the solid and record it in the space provided.

Mass of solid: ____

(2 marks)

(iv) Calculate the percentage mass of sand in the mixture.

(1 mark)

(v) Calculate the percentage mass of copper(II) sulphate in the mixture.

(1 mark)

GO ON TO THE NEXT PAGE

(vi) Add the percentage masses of sand and copper(II) sulphate. Give ONE reason why the value is different from 100%.

____

____

____

(1 mark)

Total 26 marks

2. A student carried out the following tests on a solid, **R**, which is a mixture of two compounds, and made the inferences recorded in Table 2. Complete Table 2 to show ALL possible observations.

TABLE 2: RESULTS OF TESTS ON SOLID R

Tests	Observations	Inferences
A small amount of solid **R** is stirred with water. The mixture is filtered and the filtrate is separated into three portions.		
(i) To one portion of the filtrate, aqueous sodium hydroxide is added drop-wise and then in excess.	• •	Zn^{2+}, Al^{3+} or Pb^{2+} ions are present. **(2 marks)**
(ii) To another portion of the filtrate, aqueous ammonium hydroxide is added drop-wise and then in excess.	• •	Al^{3+} or Pb^{2+} ions are present. **(2 marks)**
(iii) To the third portion of the filtrate, aqueous potassium iodide is added drop-wise.	•	Pb^{2+} ions are absent. **(1 mark)**
(iv) To the residue, dilute nitric acid is added. Any gas given off is tested with filter paper dipped in acidified potassium dichromate(VI), and the resulting solution is tested further.	• •	Sulphur dioxide gas given off. Sulphite salt is present. **(2 marks)**
(v) One portion of the solution from (iv) is treated with aqueous sodium hydroxide drop-wise and then in excess.	• •	Ca^{2+} ions are present. **(2 marks)**
(vi) Another portion of the solution from (iv) is treated with ammonium hydroxide drop-wise, and then in excess.	•	Ca^{2+} ions are present. **(1 mark)**

Total 10 marks

GO ON TO THE NEXT PAGE

3. Plan and design an experiment which could be used to determine whether water-soluble black ink made by two different manufacturers consists of the same components.

Your answer should include the following:

(a) Hypothesis:

____

____

(1 mark)

(b) Procedure:

____

____

____

____

____

(3 marks)

(c) Apparatus and materials:

____

____

(2 marks)

(d) Data to be collected:

____

____

____

(2 marks)

(e) Variable to control:

____

(1 mark)

(f) Discussion of the results as they relate to the hypothesis. You may include a diagram to illustrate your discussion.

____

____

____

____

____

____

(3 marks)

Total 12 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX compulsory questions in TWO sections.
2. Write your answer to EACH question in the space provided in this answer booklet.
3. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
4. Return this booklet at the end of the examination.
5. You may use a silent, non-programmable calculator to answer items.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions.

Write your responses in the spaces provided in this answer booklet.

Do NOT spend more than 30 minutes on Question 1.

1. Derrick performed four experiments to investigate how certain factors affect the rate of production of hydrogen gas when zinc metal reacts with dilute hydrochloric acid. In Experiment 1, which was done at 30 °C, he added 1.0 gram of granulated zinc in excess to 0.1 mol dm^{-3} hydrochloric acid and measured the volume of hydrogen gas liberated after 2 minutes. He then performed three other experiments with the following variations: In Experiment 2, he varied the concentration of the acid; in Experiment 3, he varied the form of zinc, and in Experiment 4, the temperature. In EACH experiment (illustrated in Figure 1), the gas produced was collected for the **same** period, 2 minutes. The data for Experiments 1, 2, 3 and 4 are summarized in Table 1.

TABLE 1: DATA FOR EXPERIMENTS

Experiment	[HCl] (mol dm^{-3})	Form of Zinc	Temperature (°C)	Volume (cm^3)
1	0.1	granules	30	89
2	0.2	granules	30	
3	0.1	powder	30	
4	0.1	granules	20	

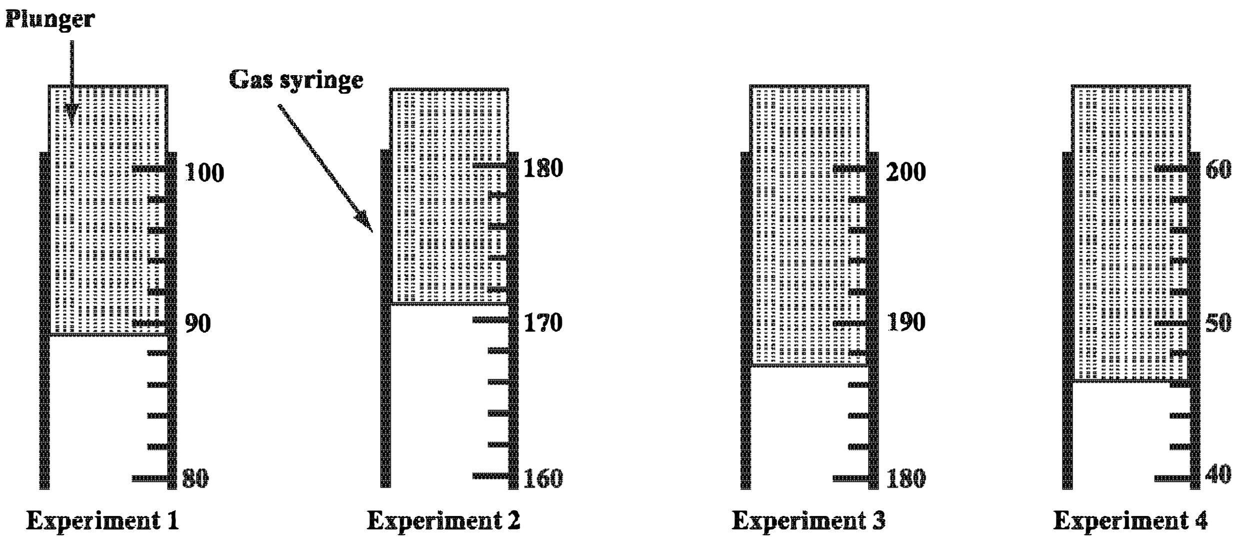


Figure 1. Diagrams showing the volumes, in cm^3, of gas produced as seen on a gas syringe

(a) Define the term ‘rate of reaction’.

____

____

(1 mark)

(b) Read, from the diagrams in Figure 1 and record in Table 1, the volume of the gas produced for EACH experiment. Experiment 1 has been done for you. **(3 marks)**

(c) (i) Write a **balanced** chemical equation, including state symbols, for the reaction between zinc metal and dilute hydrochloric acid.

Equation: ____

(2 marks)

(ii) Identify the oxidizing agent in the equation in (c) (i), and give a reason, in terms of oxidation numbers, why the agent is oxidizing.

____

____

____

____

(2 marks)

(iii) Calculate the maximum volume of hydrogen gas, at room temperature and pressure (RTP), that would be produced when 1.0 gram of zinc metal reacts with excess dilute hydrochloric acid.

(1 mole of a gas occupies 24 dm^3 at RTP, RAM Zn = 65).

____

____

____

____

____

(3 marks)

(d) Compare the volume of gas produced in Experiments 2, 3 and 4, to the volume produced in Experiment 1, and give an explanation in EACH case.

Experiment 2: ____

____

Experiment 3: ____

____

Experiment 4: ____

____

(6 marks)

(e) The sketch in Figure 2 shows how the volume of hydrogen varies with time for Experiment 1. In this experiment, an equal number of moles of magnesium granules is used instead of zinc granules.

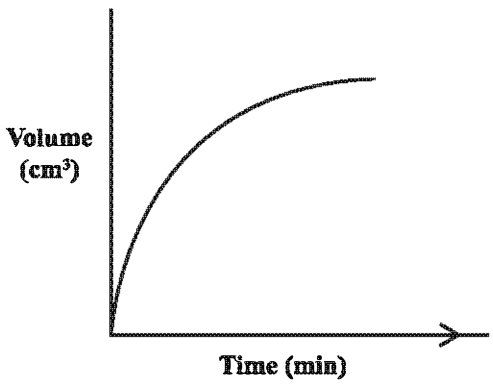


Figure 2. Variation in volume of hydrogen gas produced in Experiment 1 with time

(i) With which granules, zinc or magnesium, will Experiment 1 be more reactive?

____

(1 mark)

(ii) Using the same axes in Figure 2, sketch the curve when magnesium granules are used in Experiment 1.

(1 mark)

GO ON TO THE NEXT PAGE

(f) Plan and design an experiment that can distinguish between a 'strong electrolyte' and a 'weak electrolyte'. You may select from the range of apparatus and chemicals that is provided below.

Beakers, measuring cylinders, pipettes, burettes, volumetric flasks, stop clocks, bunsen burner, conductivity meter, ammeter, power supply (battery), balance, sodium chloride, barium sulphate, hydrochloric acid, ethanoic (acetic) acid.

Your answer should include the following:

(i) An outline of the steps for a procedure you can use

____

____

____

____

____

____

(4 marks)

(ii) A list of the main observations that would be expected at EACH stage of the experiment

____

____

____

____

____

____

(2 marks)

Total 25 marks

GO ON TO THE NEXT PAGE

2. Both sodium chloride (NaCl) and iodine (I_2) have crystalline structures. A sample of solid NaCl was contaminated with a small amount of iodine crystals. A student suggested that the iodine could be separated from the sodium chloride by gently heating the mixture as shown in Figure 3.

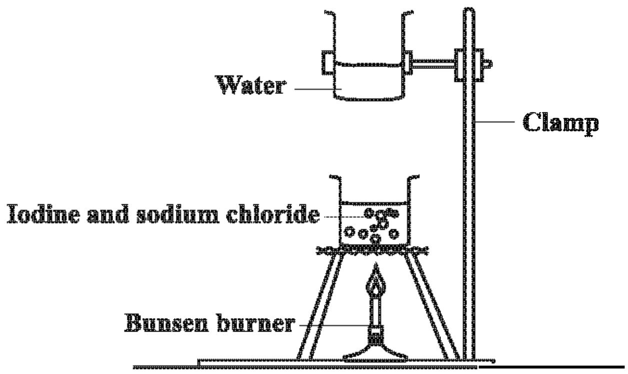


Figure 3. Action of heat on mixture of iodine and sodium chloride

(a) (i) State the name of the process being used in Figure 3 to separate the iodine from sodium chloride.

____

(1 mark)

(ii) Describe what should be observed when the sample of NaCl and I_2 is heated.

____

____

____

(3 marks)

(iii) Using dot cross diagrams, show the bonding in NaCl.

(3 marks)

(iv) By comparing the forces of attraction between the NaCl particles and the I_2 molecules, explain why gentle heating is suitable for separating I_2 from a mixture of NaCl and I_2.

(4 marks)

(b) (i) A second sample of NaCl is known to be contaminated with iron filings (powdered iron). State whether the method outlined in Figure 3 is suitable for separating the Fe from NaCl.

(1 mark)

(ii) With reference to the bonding in Fe, explain your answer to (b) (i).

(3 marks)

Total 15 marks

3. (a) Two compounds, (C_2H_4) and (C_3H_8) labelled **A** and **B** respectively, are gases which burn in oxygen.

(i) Draw the FULLY DISPLAYED structures and state the names of BOTH compounds.

Compound A

Name: ____________________

(2 marks)

Compound B

Name: ____________________

(2 marks)

(ii) State whether Compound **A** burns in air with a sooty flame or a clean, blue flame.

____

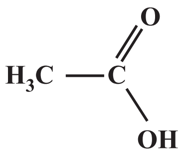
(1 mark)

(iii) Write a **balanced** chemical equation for this reaction.

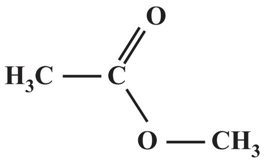
Equation: _______________________________________

(2 marks)

(b) The structures of Compounds **C** and **D** are shown below.



Compound C



Compound D

(i) Explain why Compound **C** is soluble in water and Compound **D** is not.

____

____

____

____

(2 marks)

(ii) Write a **balanced** equation for the chemical reaction of Compound **C** with calcium metal.

Equation: ____

(2 marks)

(c) (i) What is a polymer?

____

____

(1 mark)

(ii) Compound **E**, C_3H_6, undergoes polymerization when heated under pressure.

a) What type of polymerization has taken place?

____

b) What is the name of the product that is formed in (ii) a)?

____

c) State ONE use of the product formed in (ii) a).

____

(3 marks)

Total 15 marks

SECTION B

Answer ALL questions.

4. (a) Explain why magnesium conducts electricity when solid but magnesium iodide (MgI_2) only conducts electricity when molten or in solution. **(4 marks)**

(b) (i) Draw a labelled diagram of apparatus which could be used in the electrolysis of molten MgI_2. **(2 marks)**

(ii) Write equations to indicate the chemical reactions which will occur at EACH electrode. **(4 marks)**

(c) A current of 5 A is passed for 10 minutes through the molten MgI_2. Calculate the mass of product that will be formed at the cathode.

(Relative atomic masses: Mg = 24; I = 127)
(1 Faraday = 96 500 C mol^{-1}) **(5 marks)**

Total 15 marks

Write your answer to Question 4 here.

Write your answer to Question 4 here.

Write your answer to Question 4 here.

5. (a) Major stores of carbon exist in the atmosphere and the oceans. Carbon is moved through living systems via the carbon cycle. Figure 4 is a diagram of the carbon cycle, with three processes labelled **X**, **Y** and **Z** respectively.

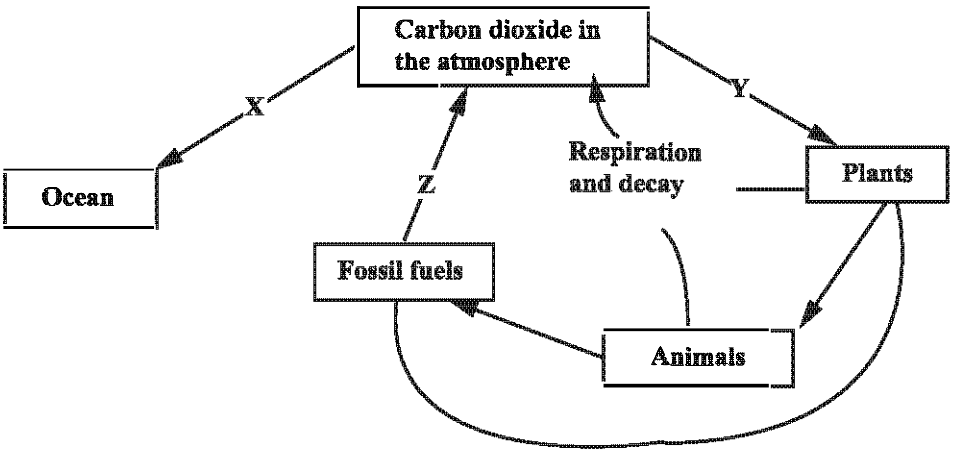


Figure 4. Carbon cycle

(i) Outline how processes **X** and **Y** move carbon through the cycle. **(2 marks)**

(ii) Describe the process occurring at **Z** and explain ONE harmful effect that could occur as a result of this process. Write ONE **balanced** equation to support your answer. **(5 marks)**

(b) A chemist conducted experiments on two unknown metals, **R** and **M**, and found the properties recorded in Table 2.

TABLE 2: PROPERTIES OF R AND M

Properties	**Metal R**	**Metal M**
Formula of oxide	**RO**	**MO**
Reaction with aqueous aluminium ions	No visible reaction	Aluminium is displaced from solution
Reaction with dilute acid	Very slow production of hydrogen gas	Rapid liberation of hydrogen gas

(i) Write a suitable equation for

a) the action of heat on the carbonate of **R**

b) the reaction between **M** and aqueous aluminium ions. **(4 marks)**

GO ON TO THE NEXT PAGE

(ii) Explain why **M** is more reactive with dilute acid than **R**. **(2 marks)**

(iii) State ONE physical and ONE chemical property that both **M** and **R** are likely to share. **(2 marks)**

Total 15 marks

Write your answer to Question 5 here.

Write your answer to Question 5 here.

6. (a) Chlorofluorocarbons and phosphates are two known pollutants.

(i) Identify a possible source for EACH of them. **(2 marks)**

(ii) Explain how the environment is affected by EACH pollutant. **(4 marks)**

(b) The use of landfills, incinerators and recycling are three major methods used for solid waste disposal. Discuss the advantages and disadvantages of using these THREE methods in the Caribbean. For EACH method, identify ONE advantage and TWO disadvantages. **(9 marks)**

Total 15 marks

Write your answer to Question 6 here.

Write your answer to Question 6 here.

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

FORM TP 2013006

TEST CODE **01212032**

JANUARY 2013

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

CHEMISTRY

Paper 032 – General Proficiency

Alternative to SBA

2 hours and 10 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. Answer ALL questions in this booklet.
2. Use this booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the booklet at the end of the examination.
3. You may use a silent, non-programmable calculator to answer items.
4. You are advised to take some time to read through the paper and plan your answers.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Answer ALL questions.

1. The students in a class conducted an experiment to determine the heat of neutralization for the reaction of hydrochloric acid with sodium hydroxide.

The materials, reagents and the procedure of the experiment are given below.

MATERIALS: Styrofoam cup with cover; thermometer; balance; 2 beakers; 2 measuring cylinders; stirrer.

REAGENTS: 2 mol dm^{-3} HCl; 2 mol dm^{-3} NaOH.

PROCEDURE:

1. Place 150 ml each of the HCl and NaOH into separate labelled beakers and let stand for approximately 5 minutes.
2. Weigh, together, the Styrofoam cup with cover, thermometer and stirrer, and record the mass.
3. Measure out **exactly** 50 ml of 2 mol dm^{-3} HCl and transfer it as completely as possible to the Styrofoam cup.
4. Cover the cup and record the temperature.
5. Measure out exactly 50 ml of 2 mol dm^{-3} NaOH and transfer it as completely as possible to the Styrofoam cup.
6. Replace the lid and stir the solution gently. Record the **highest** temperature reached.
7. Weigh the Styrofoam cup with cover, thermometer, stirrer and solution; record the mass.

RESULTS:

Figure 1 shows the results of the experiment.

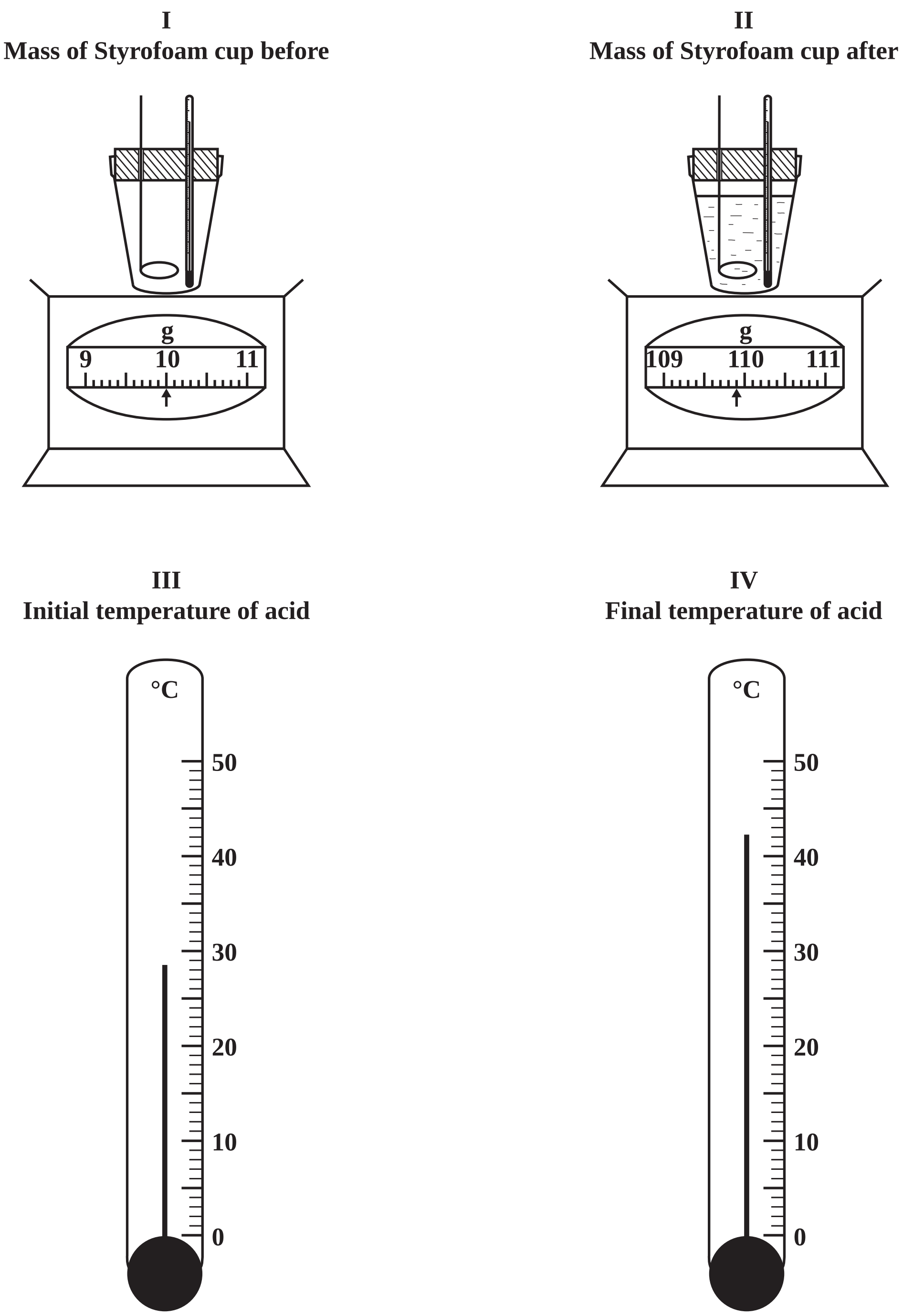


Figure 1. Results of experiment

GO ON TO THE NEXT PAGE

(a) Use the information given in Figure 1 to complete Table 1.

TABLE 1: RESULTS FROM EXPERIMENT

Measure	Reading
(i) Mass of empty Styrofoam cup, lid, thermometer and stirrer	
(ii) Temperature of acid before reaction	
(iii) Highest temperature reached	
(iv) Mass of Styrofoam cup, lid, thermometer, stirrer and solution	

(6 marks)

(b) Write a chemical equation for the reaction.

____

(1 mark)

(c) Calculate EACH of the following:

(i) The mass of solution

____

(1 mark)

(ii) The temperature change that occurred during the reaction

____

(1 mark)

(iii) The heat change for the reaction.

[Heat change = mass of solution × 4.2 J g^{-1} $°C^{-1}$ × temperature change]

(1 mark)

(iv) Moles of water produced

(2 marks)

(v) Heat of neutralization

(1 mark)

(d) State whether neutralization reactions are endothermic or exothermic.

(1 mark)

(e) State THREE precautions that should be taken during the experiment.

(3 marks)

(f) State THREE possible sources of error.

(3 marks)

(g) If the students had used a beaker instead of a Styrofoam container, would you expect the experimental heat of neutralization to increase, decrease, or remain the same? Briefly explain.

(2 marks)

(h) Calculate the mass of NaOH pellets required to make 100 ml of a 2 mol dm^{-3} solution of NaOH.

(2 marks)

(i) A stirrer made from metal ONLY should not be used in this experiment. Suggest how such a stirrer could be adapted for use in the experiment.

(2 marks)

Total 26 marks

2. A student conducted a number of tests on a solid mixture, X. The inferences made are recorded in Table 2. Complete Table 2 by filling in the observations based on the inferences made.

TABLE 2: TESTS ON MIXTURE X

Test	Observation	Inferences
(a) Distilled water was added to a portion of X and the resulting mixture stirred and filtered. (The residue was set aside for use later.) The filtrate was divided into 3 equal portions and tests (b) to (d) **done on separate portions.**		
(b) Dilute nitric acid followed by a few drops of silver nitrate solution was added. Ammonium hydroxide solution was added to the resulting mixture.	• • • **(3 marks)**	Cl^- ions are present.
(c) A few drops of potassium iodide solution were added.	• **(2 marks)**	An oxidizing agent is present.
(d) Aqueous sodium hydroxide was added until in excess.	• • **(2 marks)**	Iron(III) ions are present.
(e) Dilute nitric acid was added to the residue from test (a) and the gas produced passed through lime water.	• • • **(3 marks)**	Carbonate ions are present.

Total 10 marks

3. You are provided with three colourless compounds – *anhydrous calcium nitrate, anhydrous calcium carbonate* and *calcium hydroxide* – which are placed in unlabelled containers. You are required to plan and design an experiment using the 'action of heat' to distinguish these three compounds.

Hypothesis: The compounds, *anhydrous calcium nitrate*, *anhydrous calcium carbonate* and *calcium hydroxide*, can be distinguished by the application of heat.

Your answer should include the following:

(a) Apparatus and materials

____

____

____

(2 marks)

(b) Procedure

____

____

____

____

____

____

(3 marks)

(c) State ONE precaution that should be taken in conducting the experiment.

____

(1 mark)

(d) State the expected observations for this experiment in a fully labelled table.

(3 marks)

(e) Discuss the observations in the table, stating clearly how they can be used to distinguish the three compounds.

____

____

____

____

____

(3 marks)

Total 12 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

FORM TP 2013057

TEST CODE **01212020**

MAY/JUNE 2013

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in TWO sections.
2. Answer ALL questions.
3. Write your answers in the spaces provided in this booklet.
4. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
5. You may use a silent, non-programmable calculator to answer questions.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions in this section.

Write your responses in the spaces provided in this booklet.

DO NOT spend more than 30 minutes on Question 1.

1. (a) Peter was asked by his teacher to design an experiment to investigate how the solubility of a salt, potassium iodide (KI), varied with temperature. The procedure that Peter used is outlined below.

Procedure

1. Exactly 100 cm^3 of distilled water is measured and poured into a clean, dry 250 cm^3 beaker.

2. The beaker with the water is weighed and the mass is recorded in Table 1.

3. While **maintaining the temperature at 20 °C**, solid potassium iodide is added slowly, with stirring, until no more salt dissolves.

4. The beaker with the salt solution is weighed and the mass is recorded in Table 1.

5. The experiment is repeated with three different 250-cm^3 beakers while maintaining temperatures of 40, 60 and 80 °C.

TABLE 1: MASS OF POTASSIUM IODIDE SOLUTION AT VARYING TEMPERATURES

Temperature (°C)	Mass of Beaker and 100 cm^3 of Water (g)	Mass of Beaker and Salt Solution (g)	Mass of Salt Dissolved (g)
20	243	405	
40	249	445	
60	245	475	
80	247	511	

(i) For EACH temperature in Table 1, calculate the mass of potassium iodide that was dissolved in the beaker of water, and record the value in the space provided. **(2 marks)**

(ii) On Figure 1, plot mass of salt dissolved (solubility) against temperature, and draw a straight line through the points.

(3 marks)

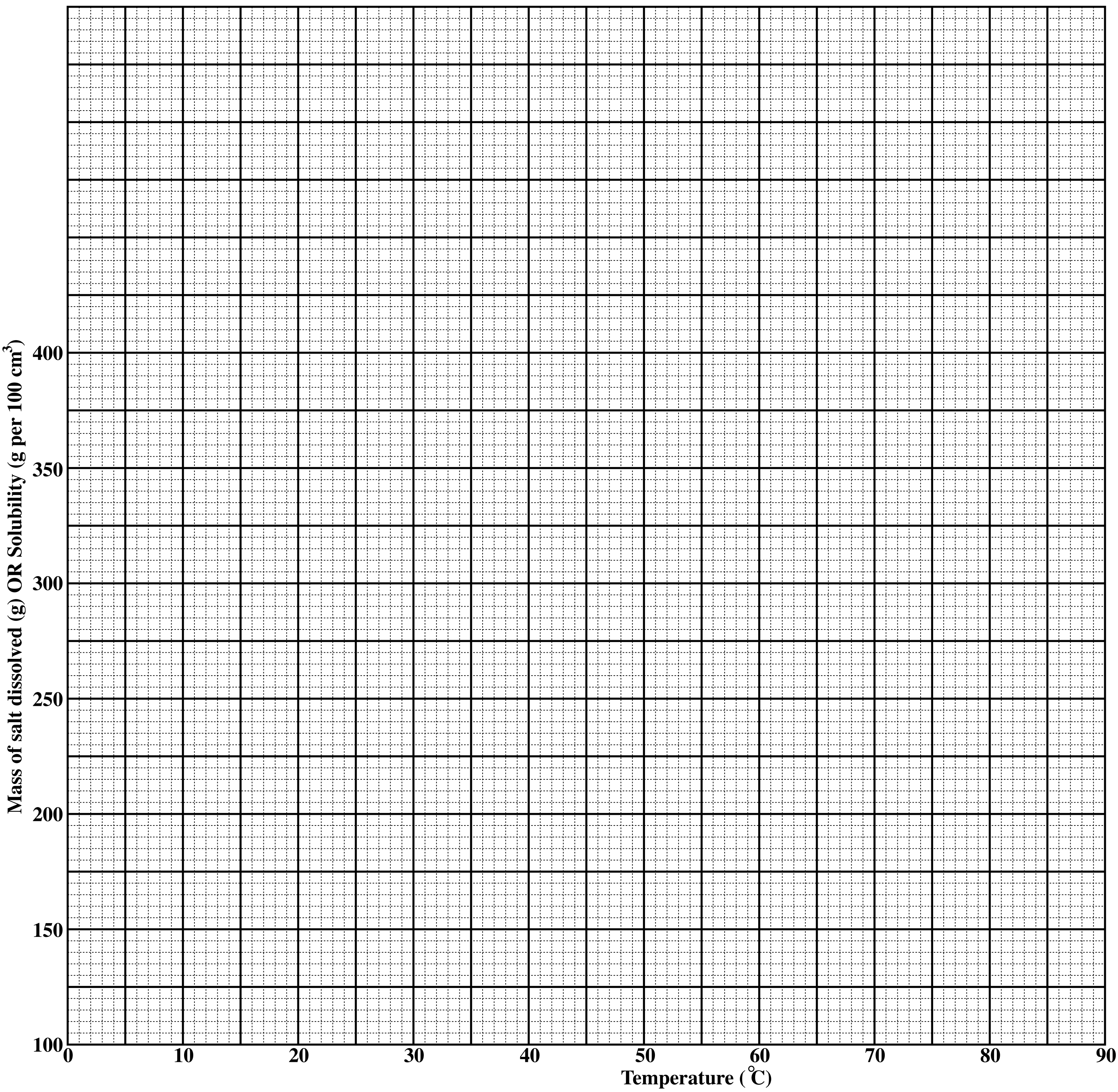


Figure 1. Solubility of potassium iodide

(iii) From the graph, determine the solubility (in grams per 100 cm^3) of potassium iodide at 70 °C.

____

____

(1 mark)

(iv) 100 cm^3 of distilled water is saturated with potassium iodide at 70 °C. Calculate the mass of potassium iodide that will be precipitated out from solution, if this solution is then cooled down to 30 °C.

(2 marks)

(v) Calculate the concentration (mol dm^{-3}) of a saturated solution of potassium iodide at 30 °C. (RAM: K = 39, I = 127).

(3 marks)

(b) "Potassium iodide is soluble in water but not very soluble in ethanol."

Explain why the statement above is true.

____

____

____

____

____

____

(4 marks)

(c) You are provided with a mixture of solid sodium sulfate and sodium chloride.

Plan and design an experiment to obtain **either** solid sodium sulfate **or** solid sodium chloride from the mixture. Your answer should include the following:

(i) A suggested list of apparatus and chemicals which you will use in obtaining the pure solid sample of EITHER of the two salts.

____

____

____

____

(1 mark)

(ii) An outline of the steps for the procedure to be used.

____

____

____

____

____

____

(3 marks)

(iii) List the MAIN observations that will be expected at EACH stage of the experiment.

____

____

____

____

____

____

(2 marks)

(d) Table 2 shows the tests performed on a substance labelled Q and the observations of the tests.

Complete the table by inserting the appropriate inferences.

TABLE 2: TEST FOR IONS PRESENT IN Q

Test	Observation	Inference
(i) A small amount of solid Q was placed in a test tube and heated over a Bunsen burner.	• A brown gas was produced. • Damp blue litmus changed to red.	• •
(ii) A solution of potassium iodide was added to a solution of Q.	• A bright yellow precipitate was formed.	• • (Balanced IONIC equation required)

(4 marks)

Total 25 marks

2. Figure 2 shows a section of a periodic table with two unknown elements represented as X and Y. Use the figure to answer the questions that follow.

N.B. You are not required to identify X and Y.

Na	**Mg**		**Al**	**Si**	**P**	**S**	**Cl**	**Ar**
	X						**Y**	

Figure 2. Section of the periodic table

(a) Compare Mg and X in terms of the ease of ionization, and Cl and Y in terms of the strength of oxidizing power. Provide a suitable explanation for your answer in EACH case.

(i) Comparison of Mg and X according to ease of ionization

____

____

Explanation

____

____

____

(3 marks)

(ii) Comparison of Cl and Y according to strength of oxidizing power

____

____

Explanation

____

____

____

(3 marks)

GO ON TO THE NEXT PAGE

(b) State ONE physical property that is similar for both X and Y, and ONE physical property which is different.

(i) Similar physical property

____

(1 mark)

(ii) Different physical property

____

(1 mark)

(c) Element Y will bond with phosphorous to form a compound.

(i) State the type of bonding that occurs between phosphorous and Element Y.

____

(1 mark)

(ii) Referring to only the electrons in the outer shells of the elements, sketch a diagram to show the bonding between phosphorous and Y.

(3 marks)

(iii) Write the chemical formula for the compound formed from phosphorous and Y. Suggest TWO properties of this compound.

____

____

____

(3 marks)

Total 15 marks

3. (a) Cracking is a very important process in the petroleum industry. Explain what is meant by the term ‘cracking’.

____

____

____

(2 marks)

(b) Glucose is a small molecule that contains several OH groups, and can be polymerized to form starch.

(i) Draw a structural representation of glucose.

(1 mark)

(ii) Use THREE units of glucose (monomer from Part (b) (i)) to show how the monomers are linked together in a partial structure of starch.

(2 marks)

GO ON TO THE NEXT PAGE

(iii) State the type of polymerization reaction that glucose undergoes to form starch, and the name of the family of polymers to which starch belongs.

Type of polymerization: ______________________________

(1 mark)

Family of polymers: ______________________________

(1 mark)

(c) Proteins are naturally occurring polymers. The partial structure of a protein molecule is shown in Figure 3.

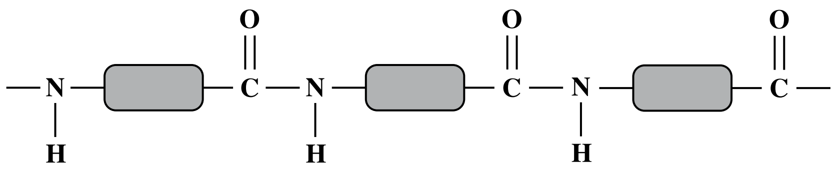


Figure 3. Partial structure of protein

(i) Describe how the structure of the protein is affected by acid hydrolysis.

____

____

(2 marks)

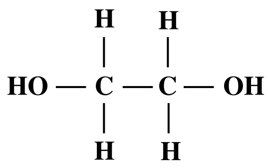
(ii) Draw the structure of the monomer unit that results from the acid hydrolysis of the structure shown in Figure 3.

Structure of monomer

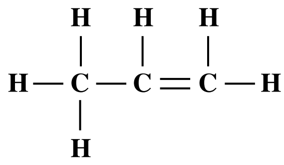
(2 marks)

GO ON TO THE NEXT PAGE

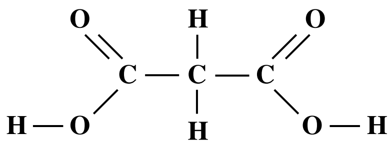
(d) The structures of four monomers, P, Q, R and S, are shown below:



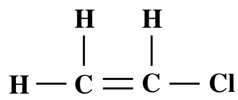
P



Q



R



S

(i) Identify

a) TWO monomers that will undergo condensation polymerization

____

(2 marks)

b) ONE monomer that will undergo addition polymerization.

____

(1 mark)

(ii) State the name of the family of polymers that will be formed when monomers P and R react together.

____

(1 mark)

Total 15 marks

SECTION B

Answer ALL questions in this section.

Write your responses in the spaces provided in this booklet.

4. (a) State FOUR factors that can influence the rate of reaction. **(4 marks)**

(b) An experiment was carried out by a group of students in which an unknown mass of calcium carbonate chips was added to an excess of 2 mol dm^{-3} hydrochloric acid. At specific times the volume of CO_2 evolved was measured using a gas syringe. The results were plotted and produced the graph shown in Figure 4.

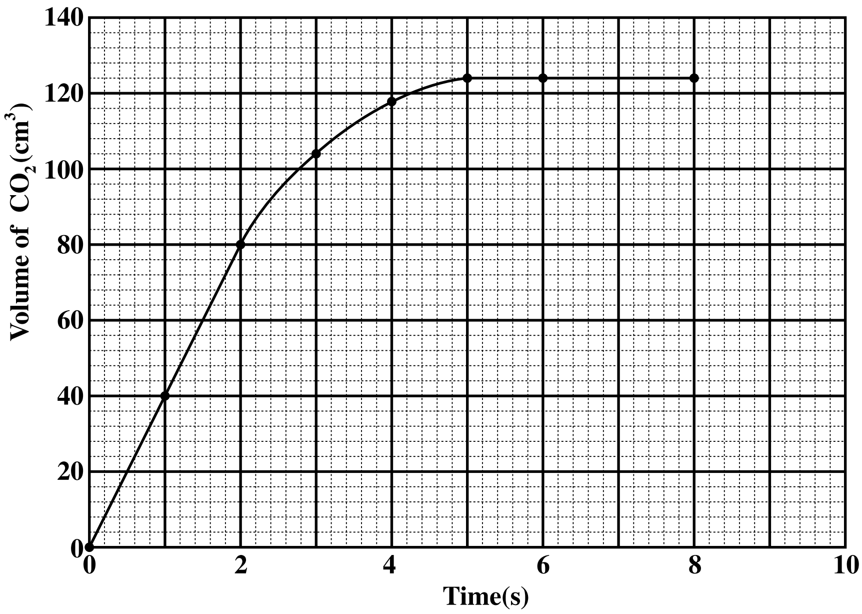


Figure 4. Volume of CO_2 versus time

Equation for the reaction: $CaCO_3$ (s) + 2HCl (aq) → $CaCl_2$ (aq) + CO_2 (g) + H_2O (*l*)

(i) Use the graph in Figure 4 to determine the total volume of CO_2 produced. **(1 mark)**

(ii) Calculate the mass of $CaCO_3$ used in the experiment.

[RAM: Ca = 40, C = 12, O = 16] **(2 marks)**

(iii) One of the students suggested that powdered calcium carbonate should have been used instead of chips. State, with reason, how the time for completion of the experiment would have been affected. **(2 marks)**

(c) Manganese is above hydrogen in the electrochemical series. One important alloy of manganese is duralumin. Duralumin contains 95% aluminium, 4% copper and traces of magnesium and manganese.

(i) Explain why metals are often combined to make alloys. **(2 marks)**

(ii) Other than electrolysis, describe a suitable laboratory procedure that could be used to obtain a sample of dry copper from a sample of the alloy. **(4 marks)**

Total 15 marks

Write your answer to Question 4 here.

Write your answer to Question 4 here.

5. Figure 5 is a diagram of a cell used in the industrial preparation of chlorine by electrolysis.

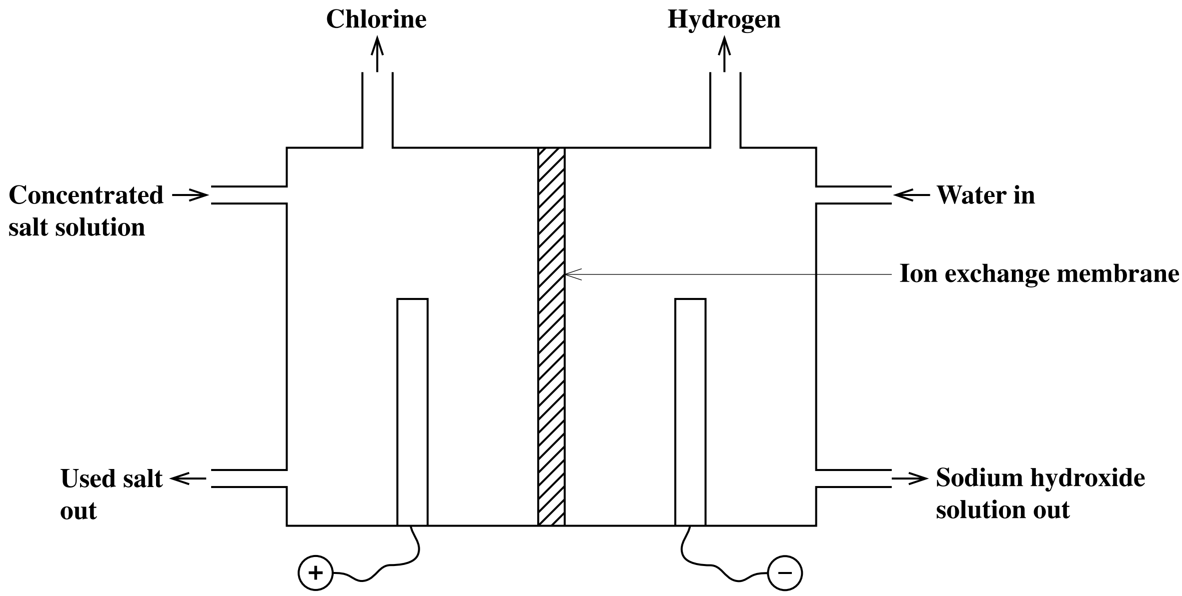


Figure 5. Diagram of cell used in industrial preparation of chlorine by electrolysis

(a) Outline the industrial preparation of chlorine using a cell such as the one shown in Figure 5. Include in your answer

(i) the name of the electrolyte and ions present **(2 marks)**

(ii) an explanation for which ions are preferentially discharged at the electrodes **(2 marks)**

(iii) ionic equations showing the reactions at EACH electrode **(4 marks)**

(iv) the role of the ion exchange membrane in the diagram. **(1 mark)**

(b) An experiment was carried out to purify copper by electrolyzing copper(II) sulfate solution using the impure copper as the anode and a pure copper cathode.

(i) State what is expected to happen to the anode during the experiment. **(1 mark)**

(ii) Calculate the mass of pure copper that would be produced during the experiment if a current of 5 A flowed for 30 minutes.

(Molar mass of Cu: 64 g mol^{-1}) **(5 marks)**

Total 15 marks

GO ON TO THE NEXT PAGE

Write your answer to Question 5 here.

Write your answer to Question 5 here.

6. (a) There is an international effort to reduce the effect of pollution in the environment. Two main effects of pollution are ozone depletion and global warming.

For EACH of the main effects of pollution (ozone depletion, global warming)

(i) name the MAIN pollutant responsible **(2 marks)**

(ii) state TWO harmful effects. **(4 marks)**

(b) Caribbean hoteliers are required to play their part in preserving the environment by 'going green'.

Suggest TWO ways in which hoteliers may 'go green' in addressing EACH of the following issues within their hotels.

(i) Water use **(2 marks)**

(ii) Garbage disposal **(2 marks)**

(iii) Energy use **(2 marks)**

(c) International agencies are strongly recommending the setting up of common international standards for pollution control which countries must follow.

State your opinion (position) on this statement and provide TWO points to justify your position. **(3 marks)**

Total 15 marks

Write your answer to Question 6 here.

Write your answer to Question 6 here.

Write your answer to Question 6 here.

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

FORM TP 2013058

TEST CODE **01212032**

MAY/JUNE 2013

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE®
EXAMINATION

CHEMISTRY

Paper 032 – General Proficiency

Alternative to SBA

2 hours and 10 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. Answer ALL questions on this paper.

2. Use this answer booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the answer booklet at the end of the examination.

3. You may use a silent, non-programmable calculator to answer questions.

4. You are advised to take some time to read through the paper and plan your answers.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Answer ALL questions.

1. (a) Some students conducted two experiments, Experiments 1 and 2, to investigate the rate of reaction of magnesium with dilute hydrochloric acid. The procedure for Experiment 1 is given below and Table 1 presents the data collected.

Procedure for Experiment 1

1. Using a ruler, measure 5-cm, 6-cm, 7-cm, 8-cm, 9-cm and 10-cm lengths of magnesium ribbon.
2. Place each piece of measured magnesium ribbon into a separate beaker.
3. Measure 40 cm^3 of 1 mol dm^{-3} hydrochloric acid using a measuring cylinder.
4. Pour the acid onto the 5-cm length of magnesium ribbon.
5. Record the time taken for this length of magnesium ribbon to react completely.
6. Repeat Steps 3–5 for EACH of the other lengths of magnesium ribbon.

TABLE 1: EXPERIMENTAL DATA

Length of Magnesium (cm)	5	6	7	8	9	10
Time (s)	14	19	22	23	25	26

(i) Using the axes in Figure 1 on page 3, plot a graph to show how the time taken for the reaction varies with the different lengths of magnesium ribbon.

(4 marks)

(ii) Write a **balanced** chemical equation for the reaction in Experiment 1.

____

(2 marks)

(iii) Describe the general shape of the graph.

____

____

(1 mark)

(iv) Provide a reason for the general shape of the graph.

____

____

____

(2 marks)

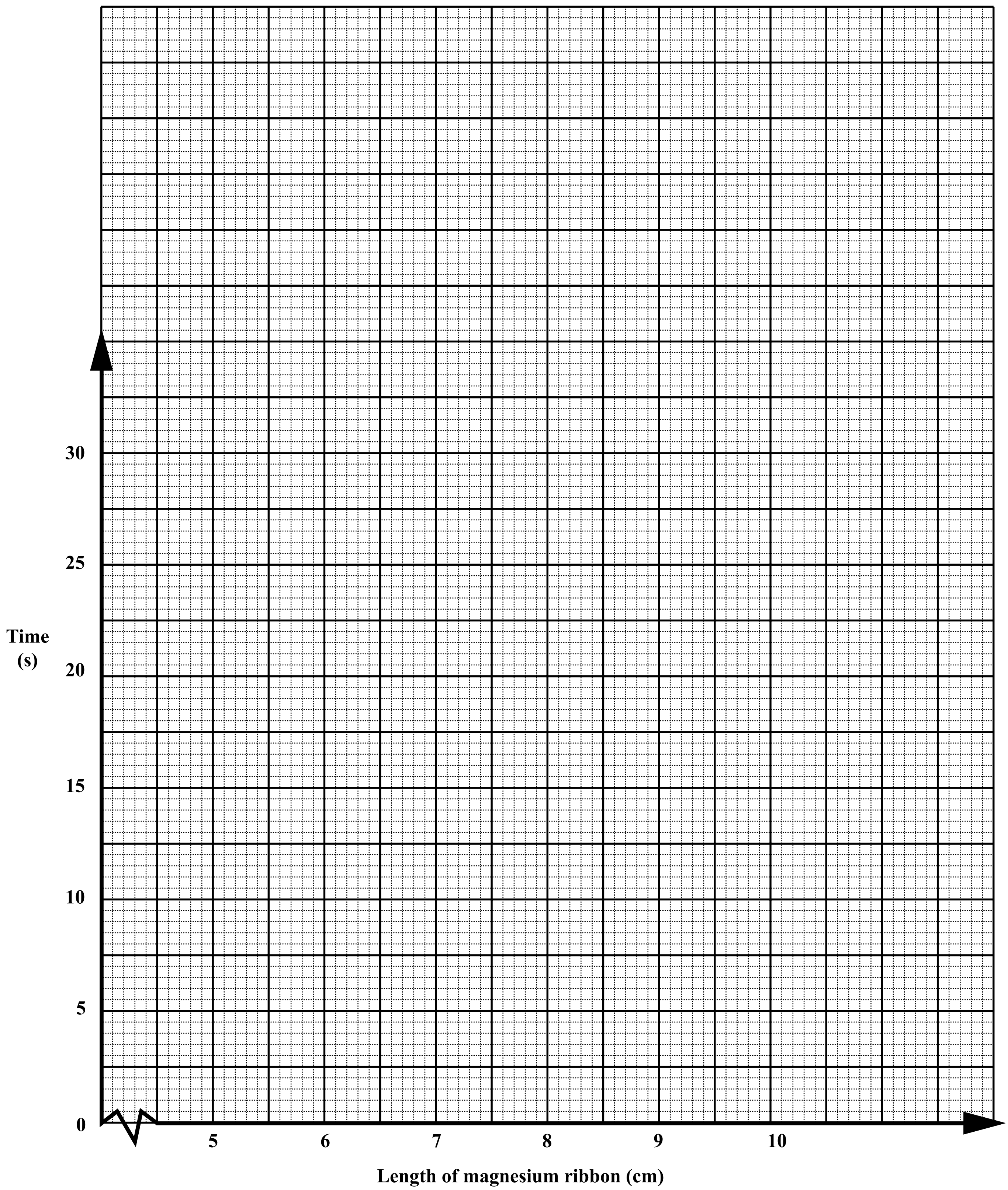


Figure 1. Plot of time versus length of magnesium ribbon

(v) Given that a 3-cm length of magnesium weighs approximately 0.04 g, calculate the number of moles of acid that reacted with the 9-cm piece of magnesium ribbon.

(RAM Mg = 24)

____

____

____

____

(3 marks)

(vi) Determine the volume of gas that would be produced when 9 cm of magnesium ribbon reacts with the acid at RTP. (1 mole of gas occupies 24 dm^3 at RTP.)

____

____

____

(2 marks)

(b) In Experiment 2, 4 g of magnesium reacted with 100 cm^3 of 1 mol dm^{-3} hydrochloric acid and the time taken for the reaction to be completed was recorded. Figure 2 is a diagram of the arrangement of the apparatus used in Experiment 2.

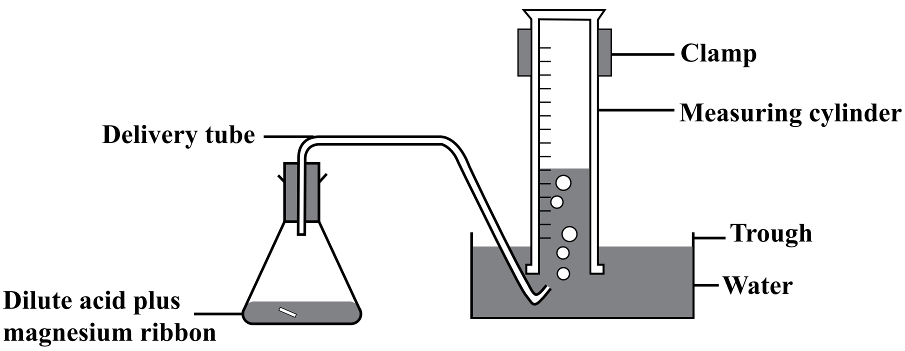


Figure 2. Diagram for Experiment 2

(i) State a possible aim of Experiment 2.

____

____

(2 marks)

(ii) Identify ONE variable that should be controlled in Experiment 2.

____

(1 mark)

(iii) Identify the variable being measured in Experiment 2.

____

(1 mark)

(iv) Describe how the students would identify the gas produced in Experiment 2.

____

____

(2 marks)

(v) State ONE physical property of the gas produced that can be deduced from this experiment.

____

(1 mark)

(vi) State ONE change that the students would observe if 2 mol dm^{-3} hydrochloric acid was used instead of 1 mol dm^{-3} in Experiment 2.

____

____

(1 mark)

(vii) When the reaction in Experiment 2 had ceased, a small piece of magnesium ribbon remained in the liquid in the conical flask.

a) Provide a suitable explanation for this observation.

____

____

____

(1 mark)

b) Describe what the students would observe if the liquid remaining in the conical flask was tested with red and blue litmus paper.

____

____

____

(2 marks)

Total 25 marks

GO ON TO THE NEXT PAGE

2. A student conducted a number of tests on Compound P. The inferences made are recorded in the table below. You are required to fill in the observations based on the inferences recorded.

	Test	**Observation**	**Inferences**
(a)	Heat a small portion of P in a dry test tube. Test the gas with a glowing splint.	• • **(2 marks)**	Oxygen evolved.
(b) (i)	Divide the remainder of P into two equal portions.		
(ii)	To one portion of P, add 15 cm^3 of dilute nitric acid, warm for two minutes, filter and divide the filtrate into three equal portions.		
(iii)	To the first portion of the filtrate from (b) (ii) above, add aqueous sodium hydroxide a little at a time – continue adding until in excess.	• • **(2 marks)**	Al^{3+}, Pb^{2+} or Zn^{2+} present.
(iv)	To the second portion of the filtrate from (b) (ii) above, add aqueous ammonia a little at a time – until in excess.	• • **(2 marks)**	Zn^{2+} present.
(v)	To the third portion of the filtrate from (b) (ii) above, add aqueous silver nitrate followed by an excess of aqueous ammonia.	• • **(2 marks)**	I^- ions present.
(vi)	To the second portion of solid P from (b) (i) above, add ten drops of concentrated sulfuric acid, followed by three pieces of copper turnings. Gently warm the resulting mixture.	• • **(2 marks)**	NO_2 evolved, NO_3^- present.

Total 10 marks

3. When an aqueous solution of copper(II) sulfate is electrolyzed using copper electrodes, the mass of each electrode changes. You are provided with a 2.0 mol dm^{-3} solution of aqueous copper(II) sulfate.

Hypothesis: The change in the mass of the copper cathode, for a fixed time period, is dependent on the concentration of the copper(II) sulfate solution.

Plan and design an experiment to investigate this hypothesis.

Your answer should include the following:

(a) Aim

____

____

(1 mark)

(b) Apparatus and materials

____

____

____

(2 marks)

(c) Procedure

____

____

____

____

____

____

(3 marks)

(d) TWO variables to be controlled

____

____

____

(2 marks)

(e) Data to be collected

____

____

____

____

____

(2 marks)

(f) Discussion of the results (whether the hypothesis will be accepted or rejected)

____

____

____

____

____

____

____

(2 marks)

(g) ONE possible source of error

____

____

(1 mark)

Total 13 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

TEST CODE **01212020**

FORM TP 2014005

JANUARY 2014

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX compulsory questions in TWO sections.
2. Write your answer to EACH question in the space provided in this answer booklet.
3. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
4. Return this booklet at the end of the examination.
5. You may use a silent, non-programmable calculator to answer items.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

NOTHING HAS BEEN OMITTED.

SECTION A

Answer ALL questions.

Write your responses in the spaces provided in this answer booklet.

Do NOT spend more than 30 minutes on Question 1.

1. (a) Students were required to prepare a sample of the normal salt produced when aqueous sodium hydroxide reacts with dilute sulfuric acid.

(i) Define the term 'normal salt'.

____

____

____

____

(2 marks)

(ii) Identify ONE other type of salt that can be formed from the reaction between dilute sulfuric acid and sodium hydroxide. Write the chemical formula for that salt.

Type of salt ____

Chemical formula ____

(2 marks)

(iii) State the name of ONE other acid that can also produce the type of salt identified in (ii) above.

____

(1 mark)

(b) The normal salt was produced by conducting a titration. The students were provided with

– a dilute solution of sulfuric acid containing 4.9 g dm^{-3}
– 5 g of sodium hydroxide
– methyl orange indicator.

They carried out the procedure outlined in Parts A and B on page 4. The titration results for Part A are presented in Figure 1.

GO ON TO THE NEXT PAGE

Review the procedure for the preparation of the normal salt and answer the questions that follow.

Part A – Procedure

1. Place the 5 g of sodium hydroxide solution in the volumetric flask and add distilled water to make 250 cm^3 of solution.

2. Pipette 25 cm^3 of the sodium hydroxide solution and transfer to a conical flask.

3. Add 2 drops of methyl orange indicator to the sodium hydroxide solution in the flask.

4. Place the sulfuric acid in the burette and titrate the sodium hydroxide solution until the end point is reached.

5. Repeat Steps 2 – 4 until consistent results are obtained.

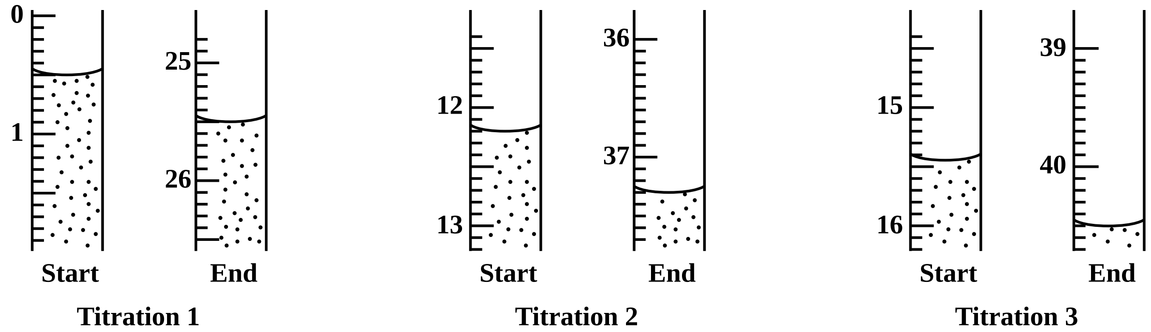


Figure 1. Readings on the burette

Part B – Procedure

1. Pipette 25 cm^3 of the sodium hydroxide solution and transfer to a conical flask.

2. Using the burette, add the volume of sulfuric acid used to neutralize the base from Part A to the sodium hydroxide solution in the conical flask.

3. ____

____

(Step 3 is to be completed in Part (iv) on page 5.)

(i) Complete Table 1 by using the readings shown in Figure 1.

TABLE 1: TITRATION RESULTS

	Titration Number		
	1	**2**	**3**
Final Volume (cm^3)	25.5		
Initial Volume (cm^3)			15.5
Volume Used (cm^3)			

(2 marks)

(ii) Determine the volume of acid used to neutralize 25 cm^3 of NaOH.

Volume of acid ______________________________________ **(1 mark)**

(iii) Explain why NO indicator was used in the procedure in Part B.

____

____

____

(1 mark)

(iv) Complete the procedure for Part B by stating Step 3. **Step 3 is required for obtaining a dry sample of the normal salt.**

____

____

____

____

____

____

(2 marks)

(v) Write a balanced equation for the formation of the normal salt from sulfuric acid and sodium hydroxide.

(2 marks)

GO ON TO THE NEXT PAGE

(vi) Calculate the number of moles of sulfuric acid used to neutralize the sodium hydroxide.

(3 marks)

(vii) Calculate the mass of the normal salt expected from the reaction.

(2 marks)

(viii) The actual mass of salt obtained by the students was 0.09 g. Suggest ONE possible reason for the difference between the mass of salt expected and the mass obtained.

____

____

(1 mark)

GO ON TO THE NEXT PAGE

(ix) The students noticed that when the sodium hydroxide solution was made in Part A, the volumetric flask got warm. Draw an energy profile diagram to show the heat change when sodium hydroxide dissolves in water.

(3 marks)

(c) A student carried out the following tests on a solid, Compound X, and recorded the observations in Table 2. Complete Table 2 by inserting the inference and writing an ionic equation as indicated.

TABLE 2: TESTS PERFORMED ON COMPOUND X

Test	Observation	Inference
A sample of X was heated in a dry test tube.	A brown gas is evolved which turns damp blue litmus red but does not bleach it.	**(1 mark)**
To one portion of a solution of X, aqueous sodium hydroxide is added dropwise until in excess and then heated.	• No precipitate is formed. • Upon heating, a pungent gas evolves which turns moist red litmus blue.	Ionic equation is required. **(2 marks)**

Total 25 marks

2. (a) The process of electrolysis has a number of useful applications. During the purification of copper by electrolysis, special electrodes are used to give the desired products.

(i) Define the term 'electrolysis'.

____

____

(2 marks)

(ii) State the type of anode that is used in the purification of copper.

____

(1 mark)

(b) Figure 2 depicts the apparatus that is used to electrolyse a sample of molten lead(II) bromide.

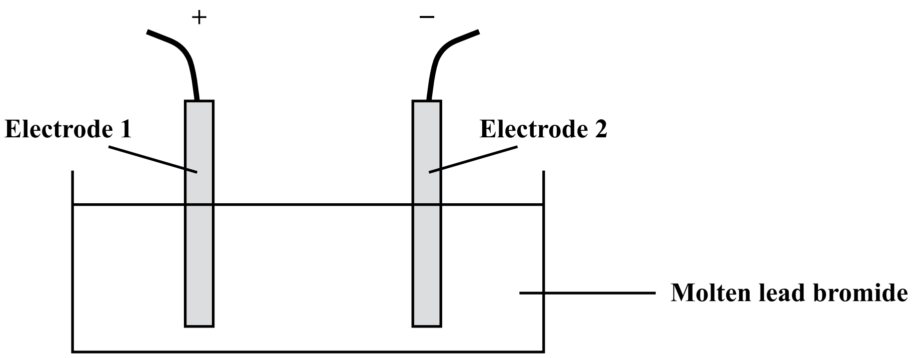


Figure 2: Electrolysis of lead bromide

(i) Which of the electrodes (Electrode 1 or Electrode 2) in the diagram is the cathode?

____

(1 mark)

(ii) Write the formula of the ion that migrates towards the anode.

____

(1 mark)

(iii) Write a balanced ionic equation for the reaction occurring at the cathode.

Equation:

(2 marks)

GO ON TO THE NEXT PAGE

(iv) A current of 5 amperes is passed through the molten lead bromide for 5 minutes. Calculate the mass of lead that would be deposited. (RAM: Pb = 207; Faraday's constant, F = 96 500 C mol^{-1})

(4 marks)

(c) Two experiments were set up as shown in Figure 3.

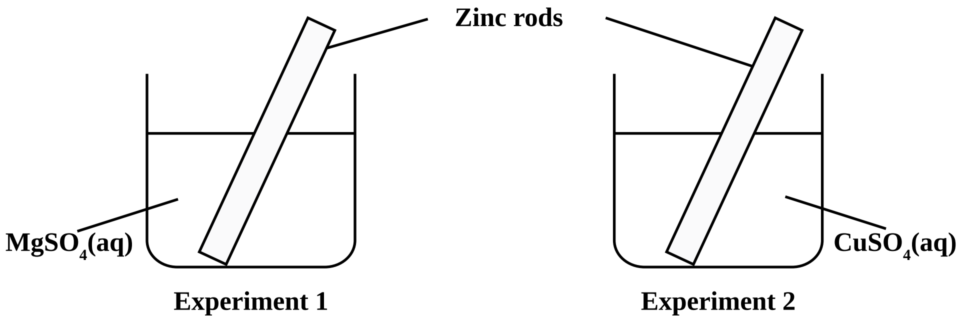


Figure 3. Experiments 1 and 2

Experiment 1: A zinc rod is immersed in a solution of magnesium(II) sulfate.
Experiment 2: A zinc rod is immersed in a solution of copper(II) sulfate.

In Experiment 1, no visible change was observed, while in Experiment 2, a brown solid settled to the bottom of the container.

Explain the observations from BOTH experiments.

Experiment 1: ____

____

____

____

Experiment 2: ____

____

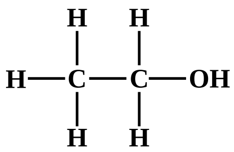
____

____

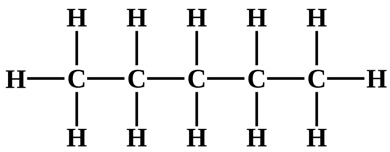
(4 marks)

Total 15 marks

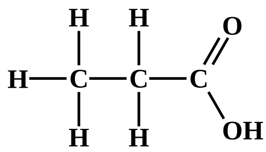
3. The structures of three organic compounds are shown below.



Compound A



Compound B



Compound C

(a) State the name of the **homologous** series to which EACH of Compounds B and C belongs.

Compound B: ______________________________________

Compound C: ______________________________________

(2 marks)

(b) Compound A burns with a blue flame in oxygen. Write a balanced equation for this reaction.

Equation:

(2 marks)

(c) State which of the two compounds, A or B, is more soluble in water. Give a reason for your answer.

More soluble compound: ______________________________________

(1 mark)

Reason: ______________________________________

____

(1 mark)

(d) State whether Compound A or Compound C would react more vigorously with sodium metal and give a reason for your choice.

More reactive compound: ____

(1 mark)

Reason: ____

____

(1 mark)

(e) Write a balanced equation for the reaction of Compound C with sodium metal.

Equation:

(2 marks)

(f) Describe ONE test that could be used to identify the gas that is produced in the reaction of Compound C with sodium.

Test: ____

____

____

(2 marks)

(g) Compounds A and C react together in the presence of a catalyst to form Compound D. State the name of the catalyst and draw the FULLY DISPLAYED structure of Compound D.

Name of catalyst: ____

(1 mark)

(2 marks)

Total 15 marks

SECTION B

Answer ALL questions.

4. (a) Element M is found in Group 2 of the Periodic Table and reacts with chlorine to form a chloride of relative formula mass 159. [RAM Cl = 35.5]

(i) Calculate the relative atomic mass of Element M. **(2 marks)**

(ii) Write a balanced equation, including state symbols, to show the formation of the chloride of M. **(2 marks)**

(iii) Describe the formation of the type of bond found in

a) Element M

b) the **chloride** of Element M. **(4 marks)**

(b) The bonding of various substances can account for the properties they display. Graphite is used as an electrode whereas element M is NOT likely to be used as an electrode.

(i) With reference to the bonding in graphite and M, and their relative positions in the Periodic Table, explain why graphite is used as an electrode and M is not. **(5 marks)**

(ii) Draw a diagram to show the bonding in the element chlorine. **(2 marks)**

Total 15 marks

Write your answer to Question 4 here.

Write your answer to Question 4 here.

Write your answer to Question 4 here.

5. (a) Chlorine can be manufactured industrially by the electrolysis of brine (concentrated NaCl). This process produces two beneficial by-products.

(i) Name the TWO by-products. **(2 marks)**

(ii) Write balanced ionic equations for the production of

a) chlorine

b) ONE of the named by-products in (i) above. **(4 marks)**

(b) Figure 4 represents part of the water cycle in nature.

(i) In the water cycle, water enters and leaves the atmosphere readily. Identify TWO physical processes by which water leaves the atmosphere and ONE physical process by which water enters the atmosphere. **(3 marks)**

(ii) In the Caribbean, the need for housing can lead to the removal of various trees and plants. Explain ONE way in which this may affect the water cycle. **(2 marks)**

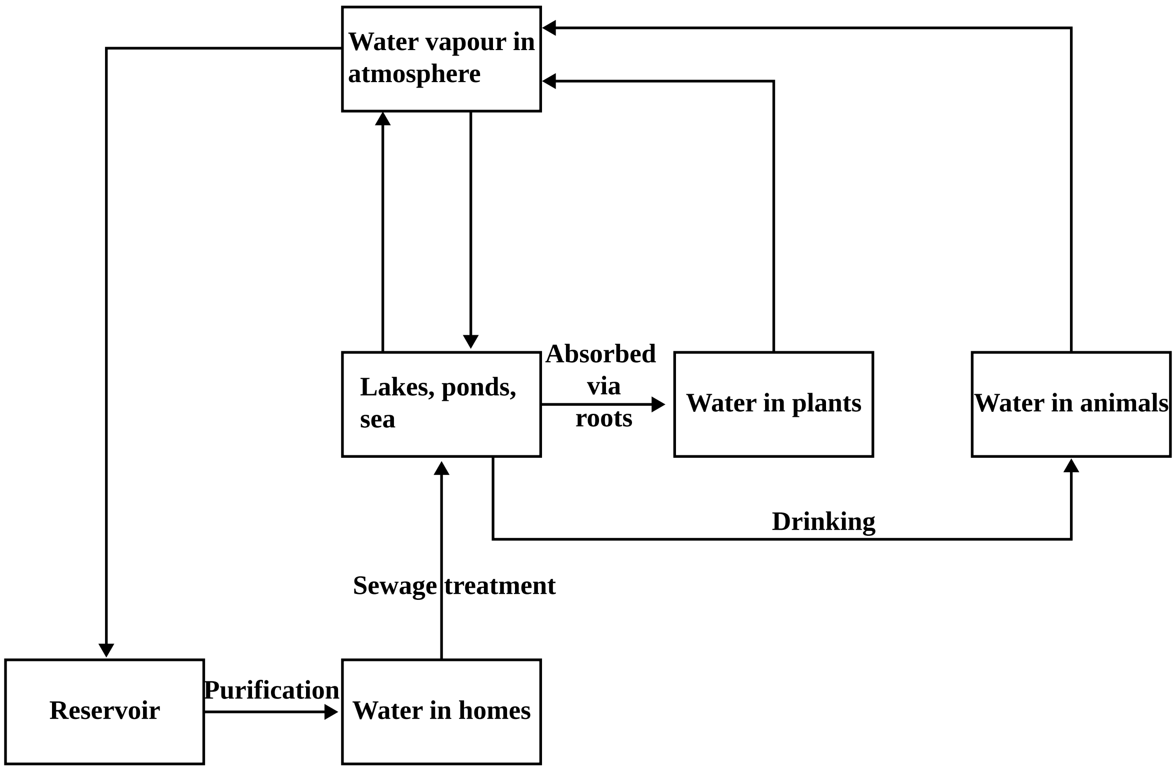


Figure 4. A simplified water cycle

(c) R and T are metals and the oxidation state of each is +2. The hydroxide of T is stable to heat but the hydroxide of R decomposes to produce the oxide and water.

(i) Write a balanced chemical equation to show the action of heat on the hydroxide of R. **(1 mark)**

(ii) Predict what will happen to the carbonates of R and T when heated strongly. **(2 marks)**

(iii) State a reason why it is more likely to find R rather than T combined with other substances in nature. **(1 mark)**

Total 15 marks

Write your answer to Question 5 here.

Write your answer to Question 5 here.

6. Many scientists believe that global warming and acid rain result from pollution in the environment.

(a) Define the following terms:

(i) Pollution

(ii) Environment **(4 marks)**

(b) Discuss the possible impact that **global warming** and **acid rain** can have on the agriculture and tourism industries in the Caribbean. In your discussion include:

– ONE pollutant responsible for global warming and ONE pollutant for acid rain **(2 marks)**

– A possible source for EACH pollutant identified above **(2 marks)**

– A balanced chemical equation for ONE of the pollutants to show how it is formed **(2 marks)**

– ONE effect that global warming can have on EACH of the two named industries **(2 marks)**

– ONE effect that acid rain can have on EACH of the two named industries **(2 marks)**

– At least ONE suggestion for reducing ONE of the pollutants **(1 mark)**

Total 15 marks

Write your answer to Question 6 here.

Write your answer to Question 6 here.

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

FORM TP 2014006

TEST CODE **01212032**

JANUARY 2014

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

CHEMISTRY

Paper 032 – General Proficiency

Alternative to SBA

2 hours 10 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. Answer ALL questions in this booklet.
2. Use this booklet when responding to the questions. For EACH question, write your answer in the space indicated and return the booklet at the end of the examination.
3. You may use a silent, non-programmable calculator to answer items.
4. You are advised to take some time to read through the paper and plan your answers.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Answer ALL questions.

1. A student was required to investigate the effect of temperature on the rate of reaction. The materials and procedure are indicated below.

MATERIALS: A piece of paper, black marker, conical flask, measuring cylinder, a stopwatch, 250 cm^3 sodium thiosulfate (0.80 M), 25 cm^3 hydrochloric acid (1.00 M), Bunsen burner, tripod and gauze.

PROCEDURE:

Step 1: Draw a cross on a piece of paper and place the paper on the bench top.

Step 2: Place 50 cm^3 of sodium thiosulfate in the conical flask and warm.

Step 3: Place the warm conical flask on the cross, measure the temperature of the sodium thiosulfate, immediately add 5 cm^3 of the hydrochloric acid to the flask, mix, and start timing.

Step 4: Record the time it takes for the cross to disappear, that is, for the reaction to finish (reaction time).

Step 5: Repeat Steps 1– 4 FOUR times at different temperatures.

RESULTS:

Figure 1 shows the thermometer and stopwatch readings for Readings 2 and 4. Readings 1, 3 and 5 are recorded in Table 1 on page 5.

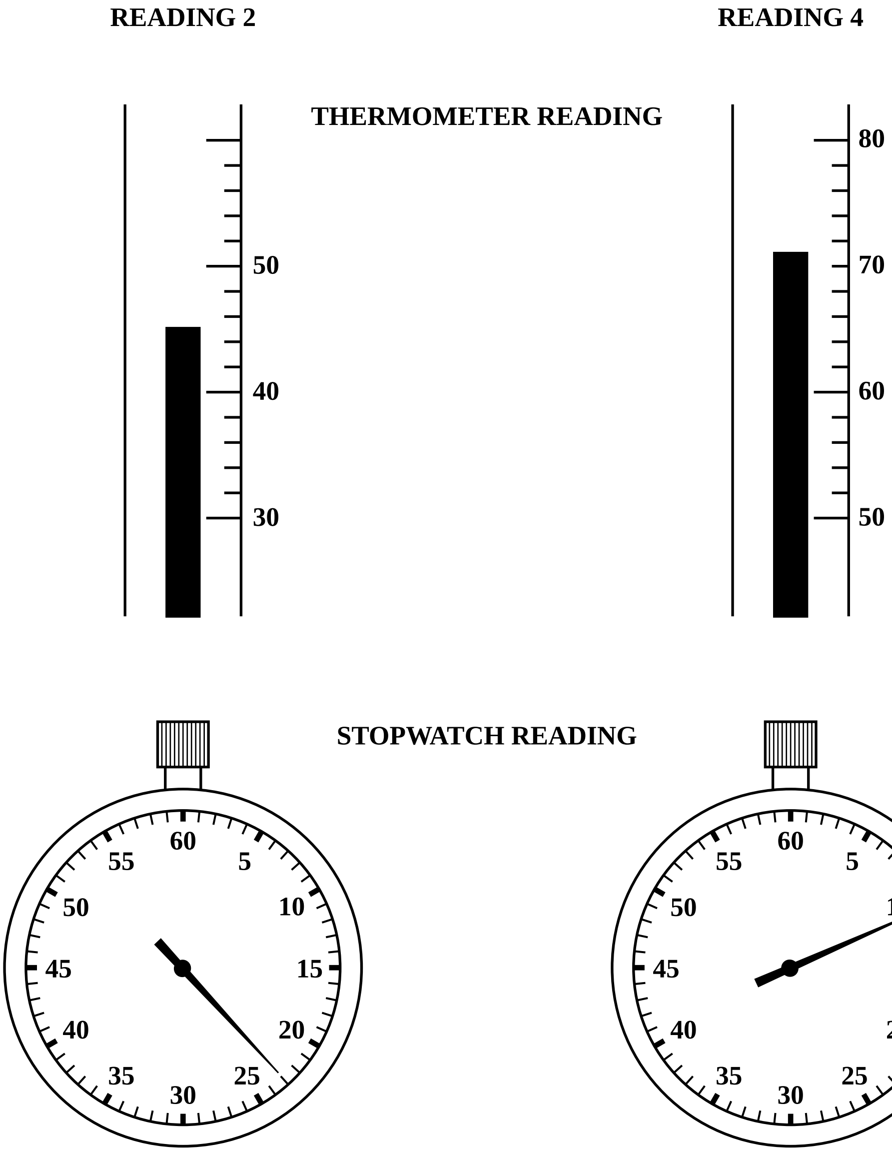
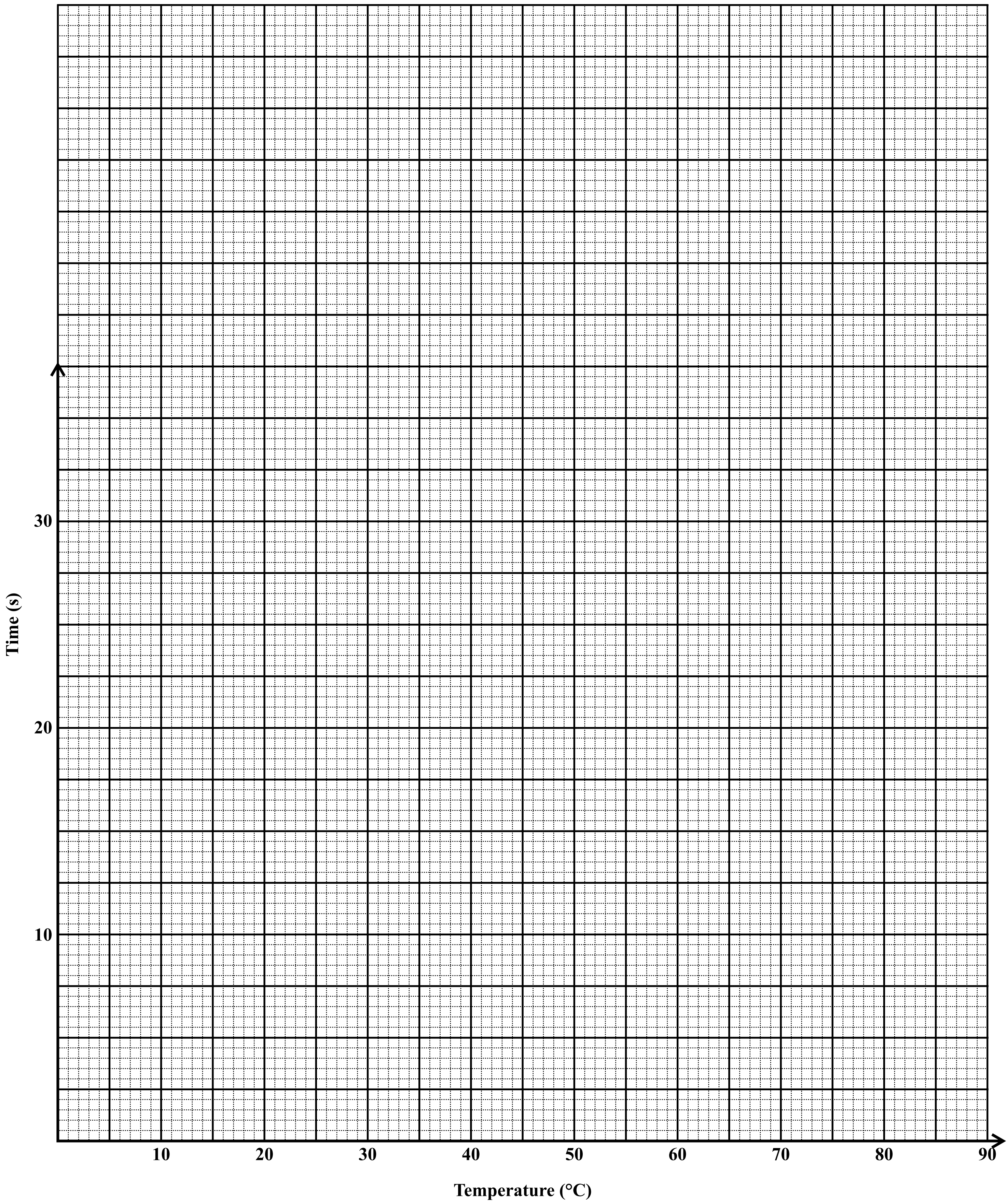


Figure 1. Temperature and reaction times for Readings 2 and 4


Time (s)
30
20
10
10 20 30 40 50 60 70 80 90
Temperature (°C)

(a) Use the information given in Figure 1 to complete Table 1.

TABLE 1: RESULTS FROM EXPERIMENT

Reading	Temperature of Sodium Thiosulfate (°C)	Reaction Time (s)
1	38	26
2		
3	58	17
4		
5	82	6

(4 marks)

(b) Using the grid provided on Page 4, plot a graph to show how the time taken for the reaction to finish (reaction time) varies with temperature and draw the best-fit line through the points. **(4 marks)**

(c) What conclusions can be made about the rate of the reaction based on the graph in (b) above?

____

____

____

____

(2 marks)

(d) One precaution that should be taken in this experiment is to control the temperature.

(i) Suggest ONE way of controlling the temperature.

____

____

____

____

(1 mark)

(ii) State TWO precautions, one of which must be related to safety, which should be taken while carrying out this experiment.

____

____

____

____

(2 marks)

(e) At 38 °C, instead of using 50 cm^3 of the sodium thiosulfate solution, 40 cm^3 of thiosulfate and 10 cm^3 of water were used.

(i) Would you expect more than 26 seconds or less than 26 seconds for the cross to disappear?

____

____

(1 mark)

(ii) Give a reason for your answer in (i) above.

____

____

____

____

____

(2 marks)

(f) The sodium thiosulfate must be of a minimum concentration for this experiment to work.

(i) When sodium thiosulfate ($Na_2S_2O_3$) reacts with hydrochloric acid, sodium chloride, water, sulfur and sulfur dioxide are formed. Write a balanced chemical equation (including state symbols) for the reaction.

(2 marks)

GO ON TO THE NEXT PAGE

(ii) Determine the mass of $Na_2S_2O_3$ required for making 250 cm^3 of a 0.080 M $Na_2S_2O_3$ solution. (Molar Mass of $Na_2S_2O_3$ is 158 g mol^{-1}.)

(2 marks)

(iii) Hence, describe how you would make a 250 cm^3 solution of 0.080 M $Na_2S_2O_3$.

(3 marks)

(iv) Considering that 5 cm^3 of the 1.00 M hydrochloric acid was used, calculate the maximum mass of sulfur that can be formed during the reaction. (RAM of S is 32.)

(3 marks)

Total 26 marks

2. A student conducted a number of tests on three solutions, A, B and C. The inferences made are recorded in Table 2. Complete Table 2 by filling in the observations based on the inferences made.

TABLE 2: TESTS ON SOLUTIONS A, B AND C

Test	**Observation**	**Inference**
(a) To a sample of A, dilute sodium hydroxide solution was added dropwise, then in excess.	• • **(2 marks)**	Fe^{3+} ions are present.
(b) To another sample of A, nitric acid was added followed by a few drops of silver nitrate solution, then aqueous ammonia.	• • **(2 marks)**	$C1^{-}$ ions are present.
(c) To a sample of B, dilute sodium hydroxide was added dropwise.	• **(1 mark)**	No metal cation is present.
(d) The resulting solution from (c) above was heated gently and any gas evolved was tested.	• • **(2 marks)**	NH_4^+ ions are present.
(e) To another sample of B, a few drops of barium nitrate solution were added followed by dilute nitric acid.	• • **(2 marks)**	SO_4^{2-} ions are present.
(f) To a sample of C, potassium iodide solution was added.	• **(1 mark)**	Pb^{2+} ions are present.

Total 10 marks

3. Some information for a planning and design exercise is given below. Study the information carefully and answer the questions which follow.

When an aqueous solution containing Pb^{2+} ions is added to an aqueous solution containing I^- ions, a bright yellow precipitate is formed.

By reacting different quantities of Pb^{2+} and I^- ions, it is possible to determine the chemical formula of the lead iodide formed.

The following materials are provided:

- An aqueous solution containing 0.5 mol dm^{-3} of Pb^{2+} ions
- An aqueous solution containing 1.0 mol dm^{-3} of I^- ions
- Two measuring cylinders
- Test tubes
- A rule graduated in millimetres

Using the information given above, plan and design an experiment so that the results can be used to determine

– the volume of the iodide ion solution required to completely react with different volumes of the solution containing Pb^{2+} ions
– the chemical formula of the precipate formed.

(a) Describe the experimental procedure to be used.

____

____

____

____

____

____

____

____

(4 marks)

(b) Identify TWO variables that should be controlled.

____

____

(2 marks)

(c) State ONE precaution that should be taken in conducting the experiment.

____

(1 mark)

(d) Present, in the form of a fully labelled table, the data that should be collected from the experiment.

(3 marks)

(e) Outline how to use the data obtained in (d) above to determine

(i) the ratio of the number of moles of Pb^{2+} and I^{-} required for complete precipitation

____

____

____

(1 mark)

(ii) the chemical formula of the precipitate.

____

____

____

(1 mark)

Total 12 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

TEST CODE **01212020**

FORM TP 2015005

JANUARY 2015

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE®
EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX compulsory questions in TWO sections.
2. Write your answer to EACH question in the space provided in this answer booklet.
3. Do NOT write in the margins.
4. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
5. Return this booklet at the end of the examination.
6. You may use a silent, non-programmable calculator to answer questions.
7. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer**.
8. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

Do NOT spend more than 30 minutes on Question 1.

1. The solubility of a solid, X, in water at various temperatures is determined by the procedure described below. This procedure comprises a series of experiments numbered 1 to 5. Some of the data are recorded in Table 1.

Procedure:

- In Experiment 1, 2 g of X is added to 4 cm^3 of water in a boiling tube.
- The tube is heated while stirring in a water bath until **all** of X has dissolved.
- The solution is then allowed to cool and the temperature at which the crystals of X **first** appear is noted and recorded in Table 1.
- In each of Experiments 2 to 5, the **same** mass of X (2 g) is added to a **different** volume of water as indicated in Table 1.
- In each case, the temperature at which the crystals of X **first reappear** is displayed on the relevant thermometer in Figure 1.

TABLE 1: DETERMINATION OF THE SOLUBILITY OF X AT VARIOUS TEMPERATURES

Experiment Number	Mass of X (g)	Volume of Water (cm^3)	Temperature at which Crystals Reappear (^oC)	Solubility of X (g/100 g water)
1	2	4	91	50
2	2	8	57	
3	2	12		
4	2	16		
5	2	20		

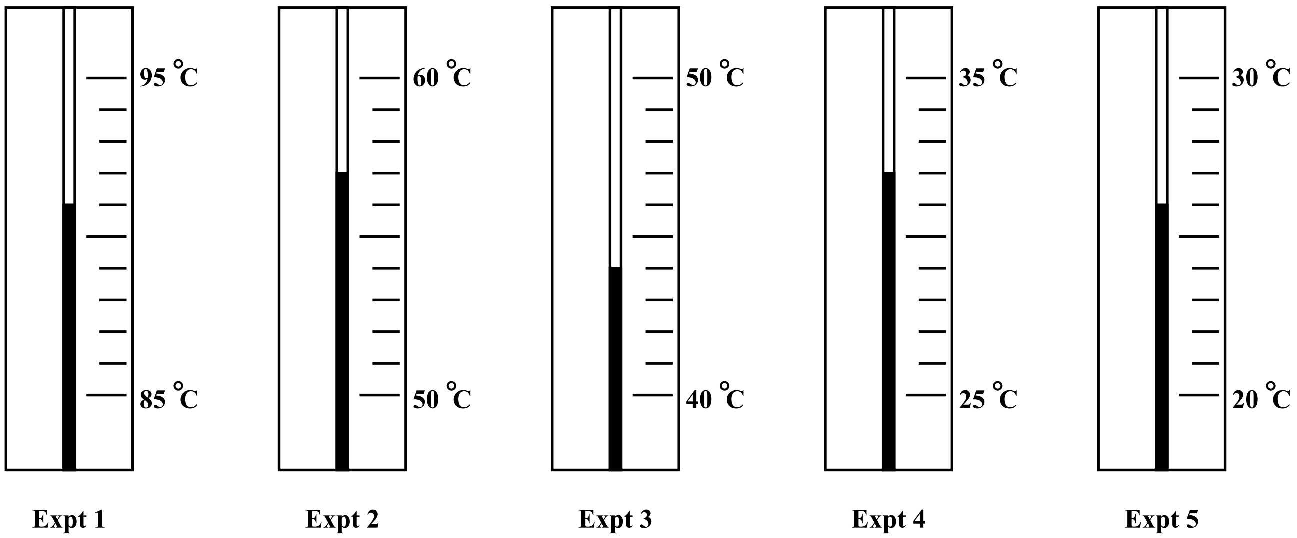


Figure 1. Temperature at which crystals of X first reappear

(a) Complete Table 1 by

(i) recording the temperatures at which the crystals of X reappear in EACH experiment using the information in Figure 1 **(3 marks)**

(ii) determining and recording the corresponding values for the solubility of X.

[At each temperature, Solubility of X = $\frac{\text{mass of X}}{\text{mass of water}}$ × 100; assume 1 cm^3 water = 1 g.] **(3 marks)**

(b) Using the axes on the grid provided on page 5, plot a graph of solubility of X (g/100 g water) against temperature in °C.

Draw a best-fit curve through the points plotted. **(4 marks)**

(c) What deduction about the solubility of X can be made from the graph drawn in 1 (b) above?

....

.... **(1 mark)**

GO ON TO THE NEXT PAGE

(d) Using the equation given in 1 (a) (ii) and the graph drawn in 1 (b), calculate the minimum volume of water which is required to dissolve 2 g of X at 60 ^{o}C.

....

....

....

....

(3 marks)

(e) Distinguish between ‘a solution’ and ‘a suspension’.

....

....

....

(2 marks)

(f) Besides temperature, state TWO **other** factors that affect the rate at which a solute dissolves.

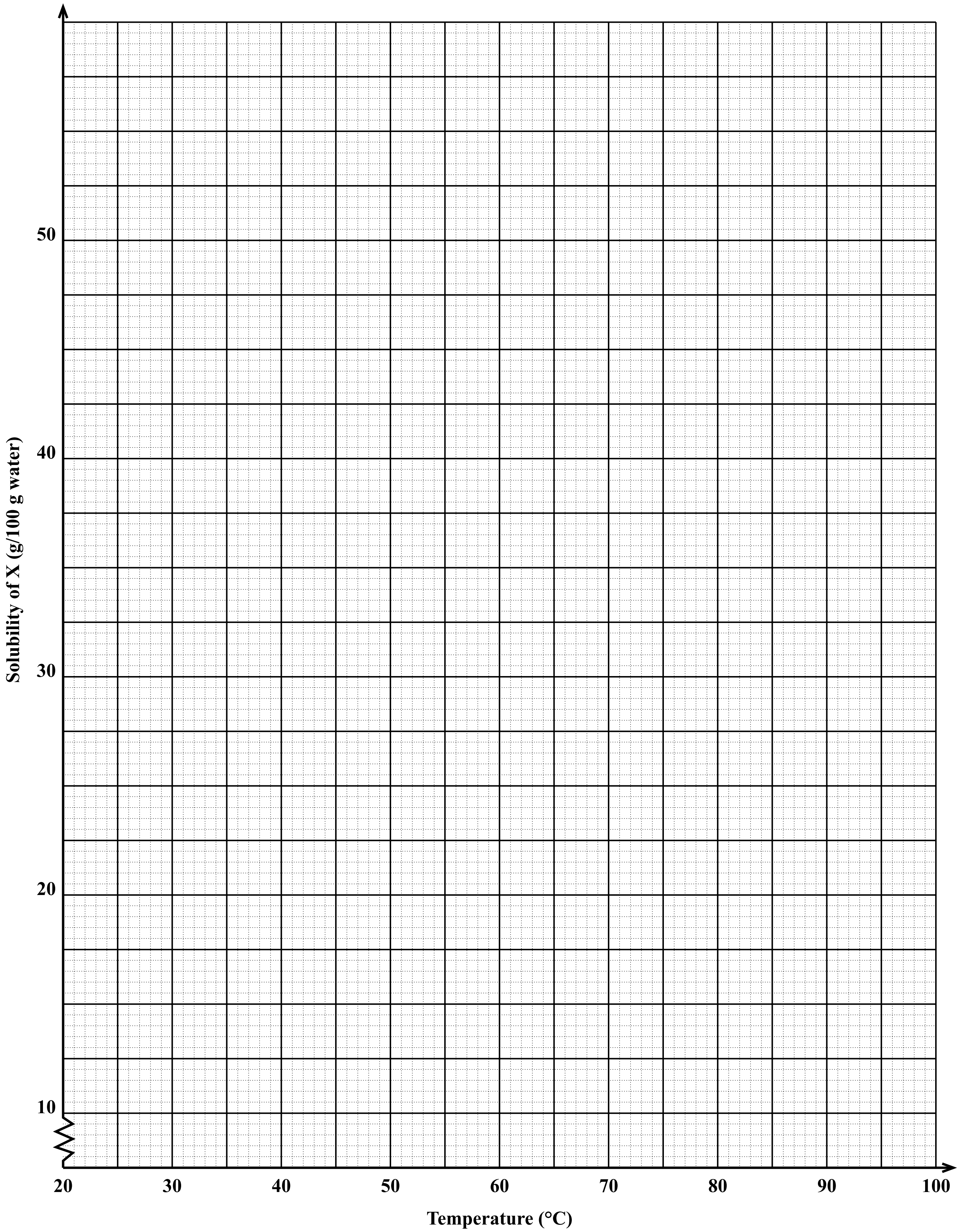
....

....

....

(2 marks)

GO ON TO THE NEXT PAGE


Solubility of X (g/100 g water)
50
40
30
20
10
20
30
40
50
60
70
80
90
100
Temperature (°C)

(g) Complete Table 2 to show the observations and inferences from tests carried out on a solution, M.

TABLE 2: TESTS CARRIED OUT ON SOLUTION M

Test	Observation	Inference
(i) To a portion of M, add aqueous sodium hydroxide until in excess.	• • **(2 marks)**	• Al^{3+} or Pb^{2+} or Zn^{2+} or Ca^{2+} possibly present. • Al^{3+} or Pb^{2+} or Zn^{2+} possibly present.
(ii) To a second portion of M, add aqueous ammonia until in excess.	• White precipitate formed. • Precipitate soluble in excess aqueous ammonia.	• • **(2 marks)**
(iii) To a third portion of M, add aqueous sodium iodide.	• Yellow precipitate formed.	• (ionic equation required) **(2 marks)**
(iv) To a fourth portion of M, add aqueous silver nitrate followed by aqueous ammonia.	• No observable change.	• **(1 mark)**

Total 25 marks

GO ON TO THE NEXT PAGE

2. Different halogens can combine to form compounds. One such compound is ICl.

(a) (i) In the space below draw a diagram to show the arrangement of electrons in the chlorine atom. [Atomic number = 17]

Chlorine

(2 marks)

(ii) Using valence shells only, draw a diagram below to show the bonding which occurs in ICl.

ICl

(2 marks)

GO ON TO THE NEXT PAGE

(b) State TWO reasons why ICl is expected to have a low melting point.

....

....

....

....

(2 marks)

(c) Analysis of a sample of ICl shows that it consists of molecules of the same molecular formula, but with different molar masses. What is a possible explanation for this?

....

....

....

....

(3 marks)

(d) Write a balanced equation for the reaction which occurs when chlorine is reacted with aqueous potassium iodide.

....

....

(2 marks)

(e) Based on the balanced equation you have written in (d) above, determine

(i) the change in oxidation number that the iodide ions undergo

....

....

(2 marks)

(ii) whether chlorine is acting as an oxidizing or a reducing agent. State a reason for your answer.

....

....

(2 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

3. (a) State TWO natural sources of hydrocarbons.

....

....

(2 marks)

(b) Fractional distillation of crude oil produces several fractions, containing a range of compounds with varying numbers of carbon atoms. Three of these fractions, labelled 1, 2 and 3, are shown in Table 3.

TABLE 3: THREE FRACTIONS FROM CRUDE OIL

Fraction	1	2	3
Number of Carbon Atoms	C1 – C4	C12 – C18	C20 – C40

(i) Identify ONE of these numbered fractions.

Fraction number: ....

Fraction name : ....

(1 mark)

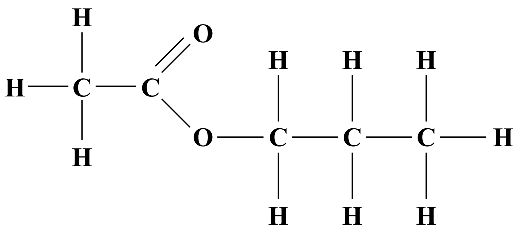
(ii) State ONE use of Fraction 3.

....

....

(1 mark)

(c) Compound **W** has the characteristic odour of pears, and is used in fragrances and as a food additive.



Compound W

(i) Identify the homologous series to which Compound **W** belongs.

....

(1 mark)

GO ON TO THE NEXT PAGE

(ii) Write the FULLY DISPLAYED structural formulae of the two molecules that are produced when Compound **W** is hydrolysed by dilute hydrochloric acid, and state the name of any ONE of the structures.

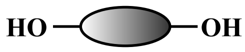
Structure A

Structure B

(2 marks)

Structure ....; Name: ....

(1 mark)

(d) (i) Glucose, a monosaccharide, can be represented by the 

unit. State the name of a polymer of glucose, and using THREE glucose units, draw the partial structure of this named polymer in the space provided.

Polymer of glucose: ....

(1 mark)

Partial structure of polymer of glucose

(2 marks)

(ii) A student is asked to distinguish between a sample of glucose and a sample of its polymer. He adds water to separate portions of glucose and its polymer, and stirs. State the expected observations in EACH case.

Glucose: ....

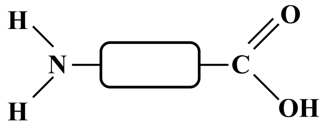
Polymer: ....

(2 marks)

GO ON TO THE NEXT PAGE

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(e) The monomer shown below undergoes condensation polymerization. Name the type of polymer formed and give ONE use of this polymer.



Type of polymer formed: ....

(1 mark)

Use: ....

(1 mark)

Total 15 marks

SECTION B

Answer ALL questions.

4. The applications of electrolysis can be varied. It can be used to extract some metals from their compounds and to protect metals from corrosion.

(a) (i) Define the term 'electrolysis'. **(2 marks)**

(ii) Describe what happens during the electrolysis of molten sodium chloride. Support your answer with relevant balanced ionic equations. **(4 marks)**

(i) ....

....

....

....

....

....

(ii) ....

....

....

....

....

....

....

....

....

....

....

....

....

GO ON TO THE NEXT PAGE

(b) Aqueous sodium chloride can be electrolysed using inert electrodes. Discuss the effect that the position of ions in the electrochemical series has on the products of this electrolysis.

....

....

....

....

....

....

....

....

(3 marks)

(c) Aluminium is made corrosion resistant by anodizing it. Using a labelled diagram and equations, explain what happens during the anodizing of aluminium.

....

....

....

....

....

....

....

....

....

....

....

....

....

(6 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

5. (a) The acid anhydride of sulfuric acid is produced as an intermediate product in the manufacture of sulfuric acid from sulfur.

(i) State the name of the anhydride and describe how it is produced. **(5 marks)**

(The conditions for the reactions are necessary but there is no need to write the equations.)

(ii) Using balanced chemical equations, with state symbols, explain how the anhydride is converted to sulfuric acid in the manufacturing process. **(4 marks)**

(iii) Suggest why the anhydride is NOT directly added to water to produce sulfuric acid. **(2 marks)**

(i) ....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

GO ON TO THE NEXT PAGE

(ii) ....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

(iii) ....

....

....

....

....

....

....

(b) Iron and its compounds are important in the manufacturing industry and in biological systems.

(i) Suggest TWO reasons why the alloy, stainless steel, is preferred to pure iron when making cooking utensils. **(2 marks)**

(ii) In humans, iron is found in haemoglobin which is responsible for the transfer of oxygen throughout the body. Suggest how a lack of iron in the human diet could affect the body. **(2 marks)**

(i) ....

....

....

....

....

....

....

(ii) ....

....

....

....

....

....

....

....

....

....

....

....

Total 15 marks

6. Both the availability of mineral nutrients and soil acidity play an important role in healthy plant growth.

(a) (i) Identify ONE element that is essential for plant growth and state ONE effect of its deficiency. **(2 marks)**

(ii) Design an experiment to investigate the effect of the deficiency stated in (a) (i) above on plant growth. **(4 marks)**

(i) ....

....

....

....

....

....

(ii) ....

....

....

....

....

....

....

....

....

....

....

....

....

....

GO ON TO THE NEXT PAGE

(b) To reduce the problems caused by acidic soils, lime is usually added.

(i) State ONE problem associated with acidic soils. **(1 mark)**

(ii) Use a balanced ionic equation to explain how the addition of lime can increase the pH of acidic soils. **(2 marks)**

(iii) Lime can also cause nitrogen to be lost from soils. State a reason for this. Include a balanced ionic equation with state symbols in your answer. **(3 marks)**

(i) ....

....

....

....

(ii) ....

....

....

....

....

....

(iii) ....

....

....

....

....

....

....

....

....

....

GO ON TO THE NEXT PAGE

(c) Hydroponics is an alternative method of growing crops, but there are some disadvantages with its use.

Identify TWO such disadvantages and suggest ONE way to address ONE of these disadvantages.

....

....

....

....

....

....

....

....

....

(3 marks)

Total 15 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

FORM TP 2015006

TEST CODE **01212032**

JANUARY 2015

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

CHEMISTRY

Paper 032 – General Proficiency

Alternative to SBA

2 hours 10 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. Answer ALL questions in this booklet.
2. Write your answer to EACH question in the space provided in this answer booklet.
3. Do NOT write in the margins.
4. You may use a silent, non-programmable calculator to answer items.
5. Return this booklet at the end of the examination.
6. You are advised to take some time to read through the paper and plan your answers.
7. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer**.
8. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

NOTHING HAS BEEN OMITTED.

Answer ALL questions.

1. In each of seven experiments, a different volume of dilute sulfuric acid is added from a burette to 50 cm^3 of a 0.50 mol dm^{-3} silver nitrate solution in a beaker.

In each experiment, the precipitate formed is filtered, washed, dried and weighed.

The volume of sulfuric acid and the corresponding mass of the precipitate obtained are shown in Figure 1 and are to be recorded in Table 1.

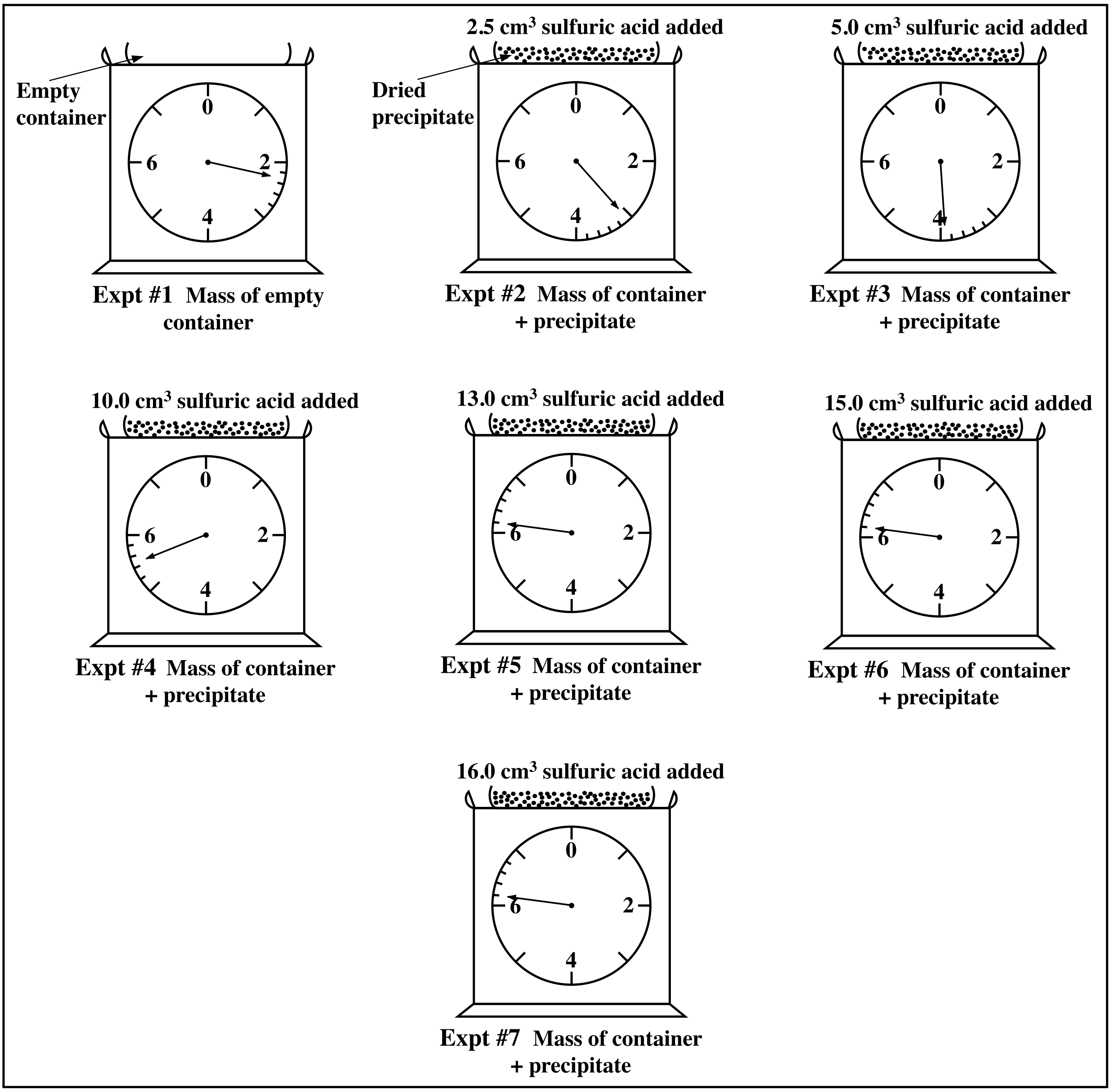


Figure 1. Mass of precipitate obtained when different volumes of sulfuric acid are added

(a) Write a balanced equation, including state symbols, for the reaction between sulfuric acid and silver nitrate.

....

(2 marks)

(b) Using the results shown in Figure 1, complete Table 1 to show the mass of the container and the precipitate, and the mass of the precipitate obtained in each experiment.

Table 1: VOLUME OF SULFURIC ACID ADDED AND MASS OF PRECIPITATE FORMED

Experiment Number	Volume of Sulfuric Acid Used (cm^3)	Mass of Container and Precipitate (g)	Mass of Empty Container (g)	Mass of Precipitate Obtained (g)
1	0	....	2.3	....
2	2.5		2.3	
3	5.0		2.3	
4	10.0		2.3	
5	13.0		2.3	
6	15.0		2.3	3.9
7	16.0		2.3	3.9

(10 marks)

(c) Using the axes provided on page 5, plot a graph of the mass of precipitate obtained against volume of sulfuric acid added. Your graph should include two intersecting lines.

(4 marks)

(d) Use the data from your graph to determine the MINIMUM volume of sulfuric acid required to precipitate ALL the silver ions from the silver nitrate solution.

Volume of sulfuric acid = ... cm^3 **(1 mark)**

(e) (i) Calculate the number of moles of silver ions in 50 cm^3 of the 0.50 mol dm^{-3} silver nitrate solution.

....

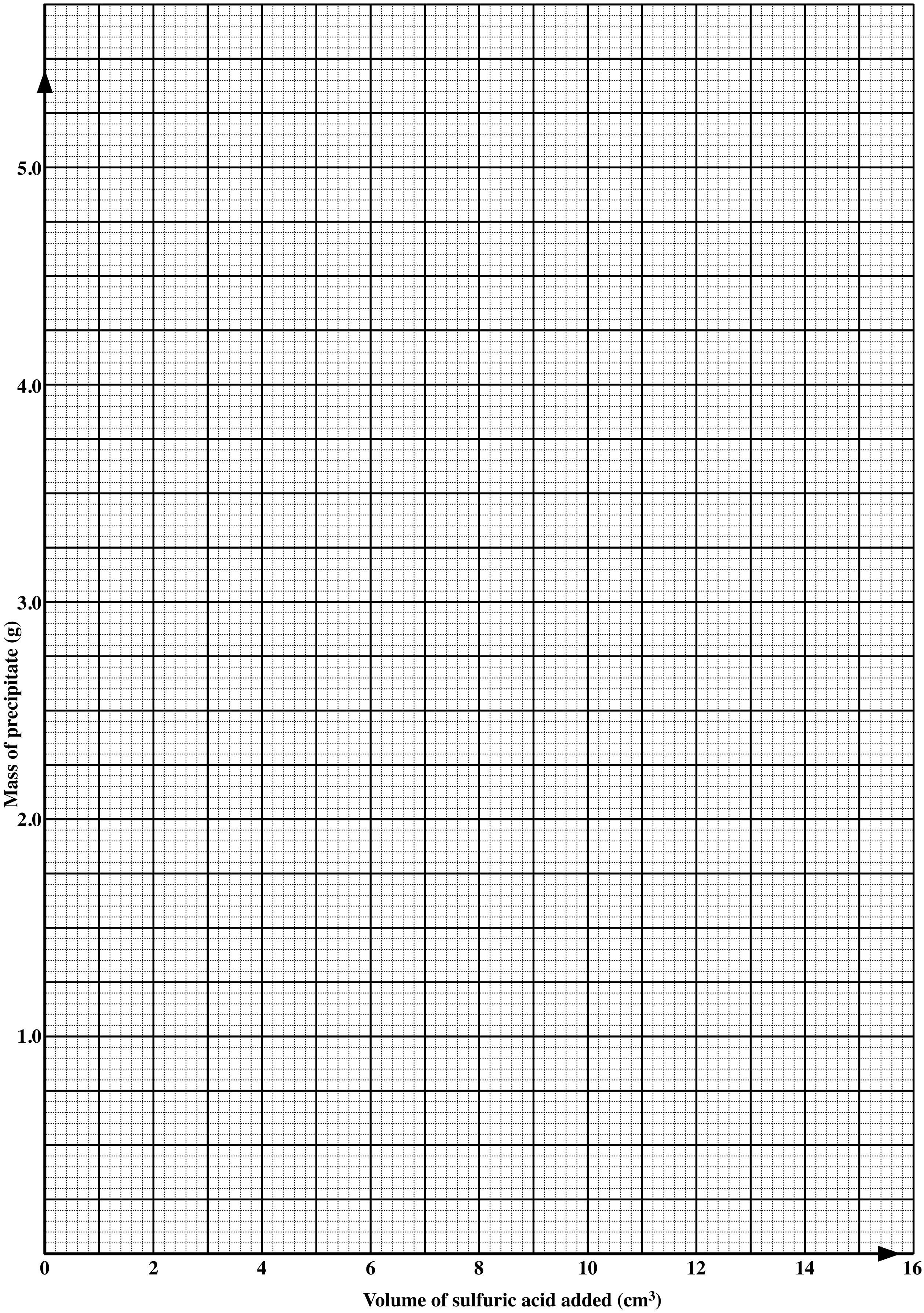
....

....

(1 mark)

GO ON TO THE NEXT PAGE

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA


5.0
4.0
3.0
2.0
1.0
Mass of precipitate (g)
0
2
4
6
8
10
12
14
16
Volume of sulfuric acid added (cm^3)

(ii) Calculate the number of moles of sulfuric acid in the minimum volume you obtained in (d) on page 4. (Make use of the equation written in (a).)

....

....

....

(2 marks)

(iii) Calculate the number of moles of sulfuric acid in 1 dm^3 of solution.

....

....

(1 mark)

(iv) Calculate the number of moles of silver precipitate (RMM = 312) in Experiment 4.

....

....

(1 mark)

(f) Identify TWO possible sources of error in this experiment.

....

....

....

(2 marks)

(g) List TWO safety precautions that should have been taken during this experiment.

....

....

....

(2 marks)

Total 26 marks

2. A student carries out a number of tests on a sample of Compound A and Compound B. The tests and inferences are recorded in Table 2. Complete the table by inserting the observations that would have been made based on the information recorded.

TABLE 2: RESULTS OF TESTS ON COMPOUNDS A AND B

Test	Observation	Inference
(i) To a solution of Compound A, add aqueous sodium hydroxide dropwise until in excess.	• • **(2 marks)**	Al^{3+}, Ca^{2+}, Pb^{2+}, Zn^{2+} possibly present. Al^{3+}, Pb^{2+}, Zn^{2+} possibly present.
(ii) Heat the mixture from (i) above. Hold moist red and blue litmus paper at the top of the test tube during heating.	• • **(2 marks)**	NH_3 (g) was given off. NH_4^+ present in Compound A.
(iii) To a solution of Compound A, add aqueous ammonia solution drop-wise until in excess.	• • **(2 marks)**	Al^{3+}, Pb^{2+}, Zn^{2+} possibly present. Zn^{2+} present.
(iv) To a solution of Compound A, add aqueous barium nitrate. Followed by aqueous nitric acid.	• • **(2 marks)**	SO_4^{2-} or SO_3^{2-} possibly present. SO_4^{2-} possibly present.
(v) To Compound B, add aqueous sodium hydroxide, a few pieces of aluminium and heat the mixture carefully. Hold moist red and blue litmus paper at the top of the test tube.	• • **(2 marks)**	NO_2 given off. Acidic gas given off. NO_3^- present.

Total 10 marks

GO ON TO THE NEXT PAGE

3. You are provided with a bottle of sea water which also contains some sand.

(a) Plan and design an experiment to recover the solid 'sea salt' from the mixture. Your answer should include the following:

(i) A suggested list of apparatus to be used for recovering the solid sea salt from the sandy sea water

....

....

....

....

(4 marks)

(ii) An outline of the steps for the procedure to be used

....

....

....

....

....

....

....

....

....

....

(4 marks)

GO ON TO THE NEXT PAGE

(iii) A list of the **main** observations that would be expected at EACH stage of the experiment

....

....

....

....

(2 marks)

(b) A student suggests that solid sea salt contains chloride ions. Outline a method to test for chloride ions in the solid sea salt.

....

....

....

....

(2 marks)

Total 12 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

FORM TP 2015055

MAY/JUNE 2015

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in TWO sections.
2. Answer ALL questions.
3. Write your answers in the spaces provided in this booklet.
4. DO NOT write in the margins.
5. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
6. You may use a silent, non-programmable calculator to answer questions.
7. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer.**
8. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions in this section.

Write your responses in the spaces provided in this booklet.

DO NOT spend more than 30 minutes on Question 1.

1. (a) Hydrocarbons are widely used as fuels. They burn in oxygen to form carbon dioxide and water, and energy is released in the process.

(i) List TWO natural sources of hydrocarbons.

....

....

(2 marks)

(ii) Name ONE hydrocarbon, other than wax, that can be used as fuel.

....

(1 mark)

(b) A student carried out an experiment in order to determine the heat of combustion of candle wax (a mixture of solid hydrocarbons) by using the apparatus shown in Figure 1.

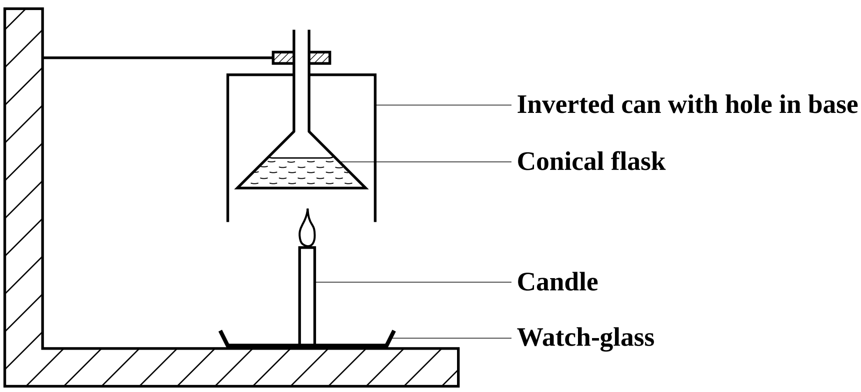


Figure 1. Apparatus for combustion of candle wax

Procedure:

1. The conical flask was first weighed empty, then a known volume of water was added and it was reweighed.
2. The conical flask was then clamped and encased by a can as shown in Figure 1.
3. The initial temperature of the water in the flask was recorded.
4. The candle and the watch-glass were weighed and placed directly under the calorimeter (the conical flask enclosed by the can).
5. The candle was lit and the heat generated was used to heat the contents of the calorimeter.
6. After 15 minutes, the candle was extinguished and the HIGHEST temperature of the water was recorded.
7. The candle and watch-glass were allowed to cool and then reweighed.

The results for the masses of the candle and water used, and the observed temperatures of the water are shown in Diagrams I–VI of Figure 2 **on page 4**.

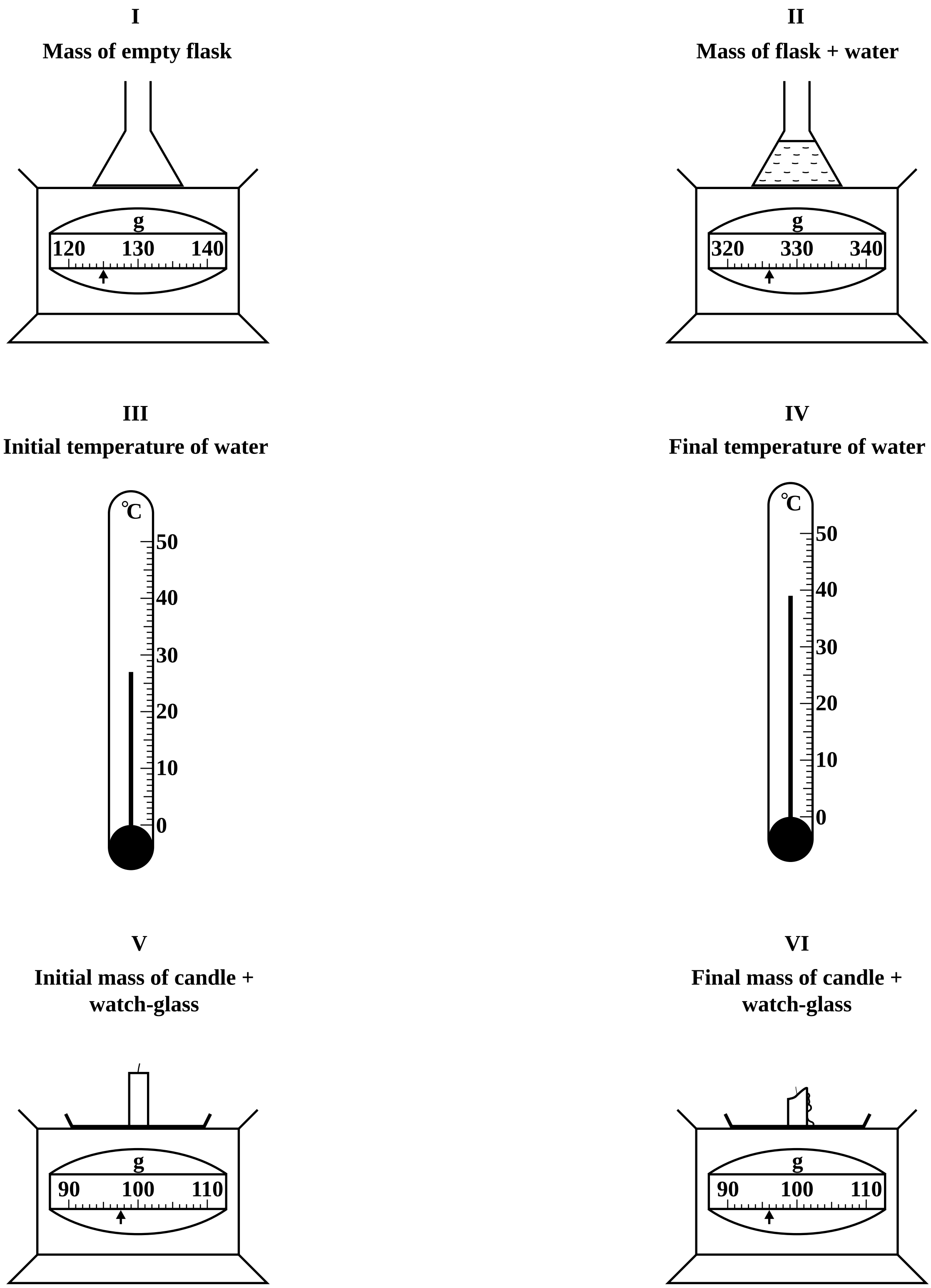


Figure 2. Results of experiment

GO ON TO THE NEXT PAGE

(i) Use the readings shown in Figure 2 to complete Table 1.

TABLE 1: READINGS FROM FIGURE 2

Mass of conical flask and water (g)	
Mass of conical flask (g)	
Mass of water used (g)	
Final temperature of water (°C)	
Initial temperature of water (°C)	
Temperature change (°C)	
Initial mass of candle and watch-glass (g)	
Final mass of candle and watch-glass (g)	
Mass of candle burnt (g)	

(9 marks)

(ii) Assuming that the heat absorbed by the conical flask

= (mass of the conical flask) × (0.861 J g^{-1} °C^{-1}) × (temperature change),

calculate the heat absorbed by the conical flask used in the experiment.

Heat absorbed by conical flask: .... J

(1 mark)

(iii) Assuming that the heat absorbed by the water

= (mass of water in the conical flask) × (4.2 J g^{-1} $°C^{-1}$) × (temperature change),

calculate the heat absorbed by the water in the conical flask.

Heat absorbed by water in conical flask: .... J

(1 mark)

(iv) Calculate the TOTAL heat absorbed by the calorimeter.

Total heat absorbed by the calorimeter

= (heat absorbed by the conical flask) + (heat absorbed by water in the conical flask)

= .... J **(1 mark)**

(v) Calculate the heat of combustion of the candle wax.

Heat of combustion = $\frac{\text{(total heat absorbed by the calorimeter)}}{\text{(mass of candle burnt)}}$ = ... J g^{-1}

(1 mark)

(vi) What was the role of the can in this experiment?

....

....

(1 mark)

GO ON TO THE NEXT PAGE

(c) A student carried out a number of tests on a solid mixture labelled Q. Some of the observations and inferences are recorded in Table 2. Complete the table by inserting the inferences or observations as necessary.

TABLE 2: OBSERVATIONS AND INFERENCES

Test	Observation	Inference
(i) Q is heated strongly in a boiling tube. A glowing splint is placed at the mouth of the boiling tube. The gases evolved are bubbled into aqueous calcium hydroxide.	Brown fumes are seen around the mouth of the boiling tube. The glowing splint is rekindled. A white precipitate is formed.	• • • **(3 marks)**
(ii) Dilute HCl is added in excess to Q and the mixture warmed. To the resulting solution, aqueous NaOH is added until in excess.	A green precipitate is formed which is insoluble in excess NaOH.	• (Ionic equation required) **(2 marks)**
(iii) Dilute nitric acid followed by a few drops of silver nitrate solution was added to Q. The test tube was left standing in light for 5 minutes. Ammonium hydroxide was then added to the resulting mixture.	• • • **(3 marks)**	Cl^- ions present

Total 25 marks

GO ON TO THE NEXT PAGE

2. (a) Water exists in three states of matter while iodine exists in two.

(i) List the THREE states of matter in which water exists.

....

....

(1 mark)

(ii) Describe the strength of the forces of attraction present between the particles in EACH of the three states you have mentioned in (a) (i) above.

....

....

....

....

....

....

(3 marks)

(iii) When heated, iodine changes from one state into another. What is this process called?

....

(1 mark)

(iv) Describe how the energy of the iodine particles changes as iodine undergoes the process mentioned in (a) (iii) above.

....

....

....

(2 marks)

(b) Using appropriate diagrams, illustrate how the bonding in solid sodium chloride differs from that of diamond.

Sodium Chloride	**Diamond**
(2 marks)	**(2 marks)**

(c) Describe TWO tests that are performed in the laboratory to distinguish between an 'ionic solid' and a 'molecular solid'. Suggest how the results of the tests described can be used to distinguish between the two solids.

....

....

....

....

....

....

....

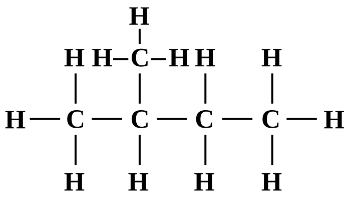
....

(4 marks)

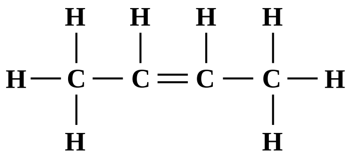
Total 15 marks

GO ON TO THE NEXT PAGE

3. (a) The fully displayed structures for two hydrocarbons, Compound A and Compound B, are shown below.



Compound A



Compound B

(i) Name the homologous series to which Compounds A and B belong.

Compound A: ....

Compound B: ....

(2 marks)

(ii) State the name of EACH compound.

Compound A: ....

Compound B: ....

(2 marks)

(b) (i) Define ‘structural isomerism’.

....

....

(2 marks)

(ii) Draw the FULLY DISPLAYED structure of ONE structural isomer for EACH of Compounds A and B.

(2 marks)	**(2 marks)**
Structural Isomer of Compound A	**Structural Isomer of Compound B**

GO ON TO THE NEXT PAGE

(c) Polyethene is manufactured in Trinidad and is used extensively throughout the Caribbean.

(i) Define the term ‘polymer’.

....

....

(1 mark)

(ii) Identify the type of polymerization that is used in the manufacture of polyethene.

....

(1 mark)

(iii) State TWO uses of polyethene.

....

....

....

....

(2 marks)

(iv) State the name of ONE other polymer.

....

(1 mark)

Total 15 marks

SECTION B

Answer ALL questions in this section.

Write your responses in the spaces provided in this booklet.

4. (a) Tums® and Epsom salts are items commonly found in most household medicine cabinets. Calcium carbonate is the main active ingredient in Tums®, an antacid used to relieve heartburn, acid indigestion and upset stomach.

(i) Describe ONE method for the preparation of dry calcium carbonate in the laboratory. In your answer, include an equation for the reaction as well as the steps that are involved in its preparation. **(5 marks)**

....

....

....

....

....

....

....

....

....

....

....

....

....

....

(ii) The main ingredient in Epsom salts is magnesium sulfate. List ONE use of Epsom salts. **(1 mark)**

....

....

....

(iii) In order to effectively use Epsom salts, it is usually made into a solution. Explain why water molecules are able to dissolve Epsom salts. **(3 marks)**

....

....

....

....

....

....

(b) When magnesium ions are present in natural water, it is referred to as 'permanent hard water'.

Describe how permanent hard water is formed. Include balanced chemical equations with state symbols to illustrate this process. **(6 marks)**

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

Total 15 marks

5. (a) Figure 3 is a flow diagram of the industrial processing of sugar cane to produce crystalline sucrose. Study the figure carefully and answer the questions which follow.

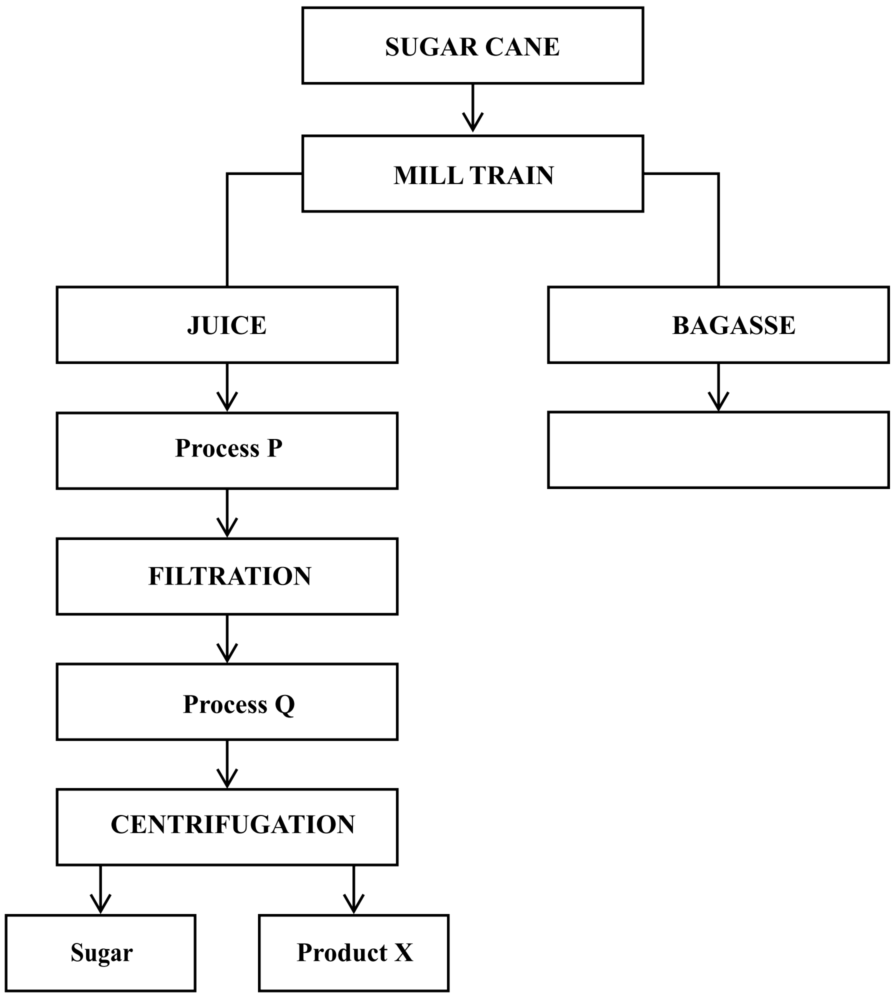


Figure 3. Industrial processing of sugar

(i) Identify Process **P** and Process **Q**. **(2 marks)**

Process **P**: ....

....

Process **Q**: ....

....

GO ON TO THE NEXT PAGE

(ii) State the importance of the centrifugation process. **(1 mark)**

....

....

....

(iii) Identify Product **X**. **(1 mark)**

....

....

....

(iv) The bagasse produced is used in the factory during the processing of sugar cane. In which part of the factory is this bagasse used and what is it used for? **(2 marks)**

....

....

....

....

(b) Many Caribbean islands are renowned for the quality of rum they produce. The alcohol content of a typical rum averages between 40% and 55%.

(i) During the fermentation process in the making of rum, yeast feeds on the sucrose in molasses converting it into simpler sugars which are then converted to ethanol. Outline, using balanced equations, the formation of ethanol from sucrose. **(3 marks)**

....

....

....

....

....

....

(ii) Jemina was presented with a flask that contains a mixture of diluted rum. Draw a labelled diagram of the apparatus she should use in the laboratory to obtain a concentrated sample of ethanol. **(3 marks)**

Space for diagram

(c) After accidentally leaving a bottle of wine open for several days, Jemina found that the wine tasted slightly sour. She was given magnesium oxide to react with a sample of the sour wine.

Suggest the type of reaction that takes place when the magnesium oxide is mixed with the sour wine. Write a balanced chemical equation for this reaction. **(3 marks)**

....

....

....

....

....

....

....

....

....

....

Total 15 marks

6. (a) Sally and Ann live on opposite sides of an island. When Sally visits Ann she observes that the soap takes longer to lather and produces more scum.

(i) Explain to Sally why the soap may be producing more scum at Ann's house than at her house. **(4 marks)**

....

....

....

....

....

....

....

....

....

....

....

(ii) Do you expect that Sally would get the same result if she uses soapless detergent? State a reason for your answer. **(2 marks)**

....

....

....

(b) Second generation detergents contained phosphates but their use was banned because of the effect they had on the environment, particularly rivers and streams. Outline the harmful effect that second generation detergents had on the environment. **(3 marks)**

....

....

....

....

....

....

....

....

....

(c) In recent years, emphasis has been placed on preserving the environment and as such a new area of chemistry, Green Chemistry, has evolved.

(i) What is meant by the term 'Green Chemistry'? **(2 marks)**

....

....

....

....

....

....

(ii) Discuss TWO benefits of utilizing the principles involved in Green Chemistry. **(4 marks)**

....

....

....

....

....

....

....

....

....

....

....

Total 15 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No. $\boxed{}$

EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No.

EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

TEST CODE **01212032**

FORM TP 2015056

MAY/JUNE 2015

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE®
EXAMINATION

CHEMISTRY

Paper 032 – General Proficiency

Alternative to SBA

2 hours and 10 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.
3. DO NOT write in the margins.
4. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
5. You may use a silent, non-programmable calculator to answer questions.
6. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer.**
7. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

0121203203

Answer ALL questions.

Write your responses in the spaces provided in this booklet.

1. (a) You are required to investigate whether a particular sample of liquid bleach meets certain manufacturing standards.

To meet these manufacturing standards, 1000 cm^3 of bleach should oxidize at least 0.01 moles of Fe^{2+}.

You are provided with three solutions, A, B and C.

Solution A is potassium manganate(VII), $KMnO_4$ of concentration 3.2 g dm^{-3}.

Solution B is a 0.1 mol dm^{-3} solution of Fe^{2+}.

Solution C is a sample of the liquid bleach.

Procedure:

1. Place solution A in the burette.

2. Pipette 25 cm^3 of Solution B into a conical flask.

3. Using a clean pipette, transfer 25 cm^3 of Solution C into the same conical flask containing Solution B and mix gently.

4. Titrate Solution A against the mixture in the conical flask until a faint pink colour remains after shaking.

5. Repeat the experiment until you receive consistent results but do NO MORE than 3 titrations.

Results:

(i) Record your volume readings to 2 decimal places in Table 1.

TABLE 1: RESULTS FROM THE EXPERIMENT

Burette Readings (cm^3)	**Titration 1**	**Titration 2**	**Titration 3**
Final volume			
Initial volume			
Volume of A used			

(9 marks)

(ii) Calculate the average volume of Solution A used in the titration. Indicate in Table 1 with asterisks (*) the titrations you used for this calculation.

....

....

....

....

(2 marks)

(iii) Calculate the number of moles of $KMnO_4$ in 1000 cm^3 of Solution A. (The relative molecular mass of $KMnO_4$ is 158.)

....

....

(1 mark)

(iv) Calculate the number of moles of $KMnO_4$ in the volume of Solution A determined in (a) (ii) above.

....

....

(1 mark)

GO ON TO THE NEXT PAGE

(v) Calculate the number of moles of Fe^{2+} originally present in 25 cm^3 of Solution B.

....

....

(1 mark)

(vi) Calculate the number of moles of Fe^{2+} that reacted with the $KMnO_4$ during the titration. (1 mol of $KMnO_4$ reacts with 5 mol of Fe^{2+}.)

....

....

(1 mark)

(vii) Calculate the number of moles of Fe^{2+} which reacts with 25 cm^3 of Solution C.

....

....

(1 mark)

(viii) Calculate the number of moles of Fe^{2+} which reacts with 1000 cm^3 of Solution C.

....

....

(1 mark)

(ix) Does Solution C meet the required standard? Explain your answer.

....

....

(1 mark)

GO ON TO THE NEXT PAGE

(b) You will be provided with a solid sample labelled D. Carry out the following tests and complete Table 2.

TABLE 2: RESULTS OF TESTS ON SAMPLE D

Test	Observation	Inference
(i) Dissolve D into 6 cm^3 of distilled water. Divide the resulting solution into two equal portions.		
(ii) To the first portion of solution from (i) above, add aqueous barium chloride followed by an excess of dilute hydrochloric acid.	• • **(2 marks)**	• • **(2 marks)**
(iii) To the second portion of solution from (i) above, add aqueous sodium hydroxide, a little at a time until in excess.	• • **(2 marks)**	• • (Ionic equation required) **(2 marks)**

Total 26 marks

GO ON TO THE NEXT PAGE

2. Figure 1 shows 7 test tubes with the results obtained when different volumes of Solution X, 0.5 mol dm^{-3} of lead(II) nitrate, are reacted with 5.0 cm^3 of Solution Y, 0.5 mol dm^{-3} of potassium iodide solution.

A key is provided to help you interpret the results.

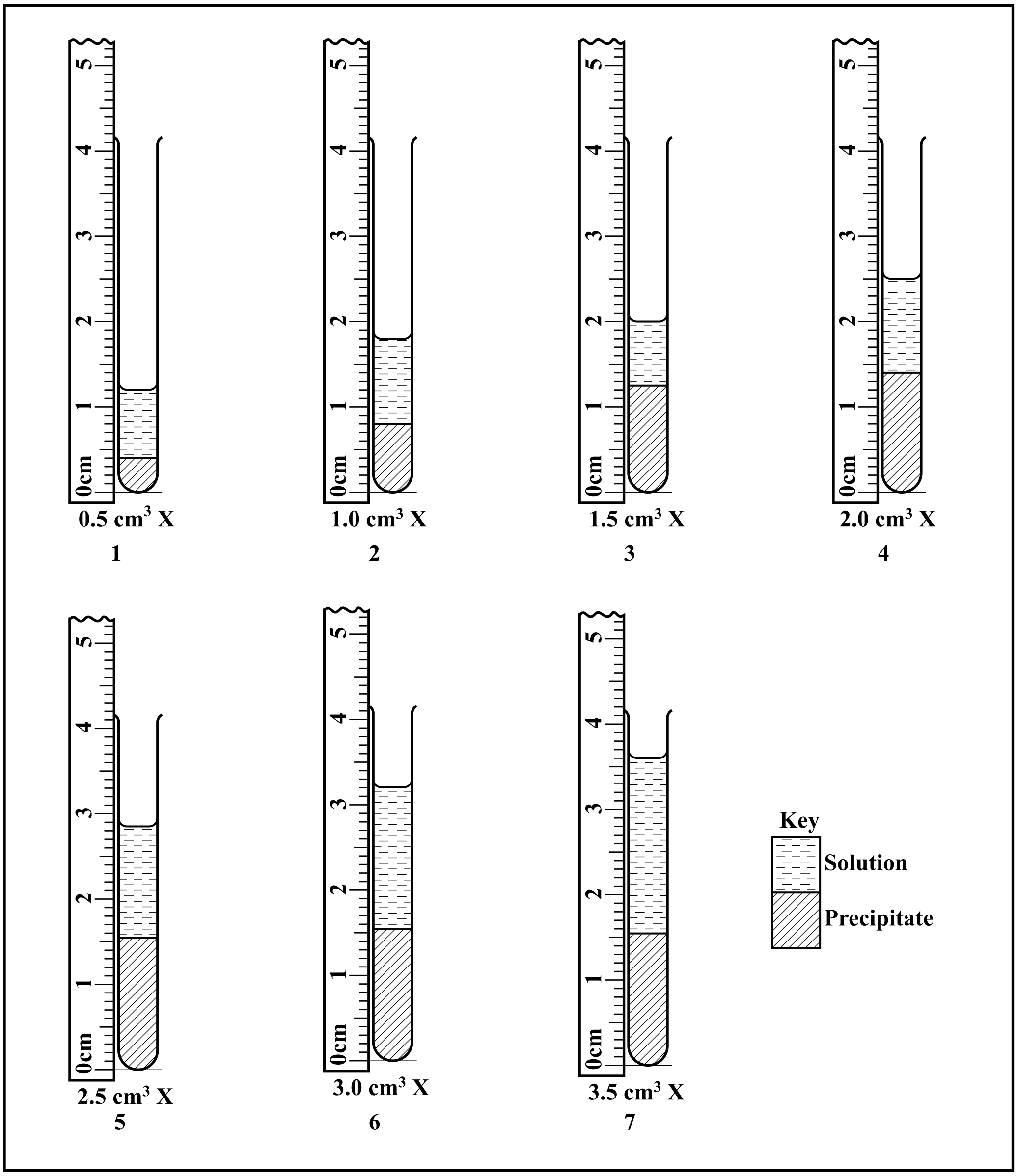


Figure 1.

GO ON TO THE NEXT PAGE

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

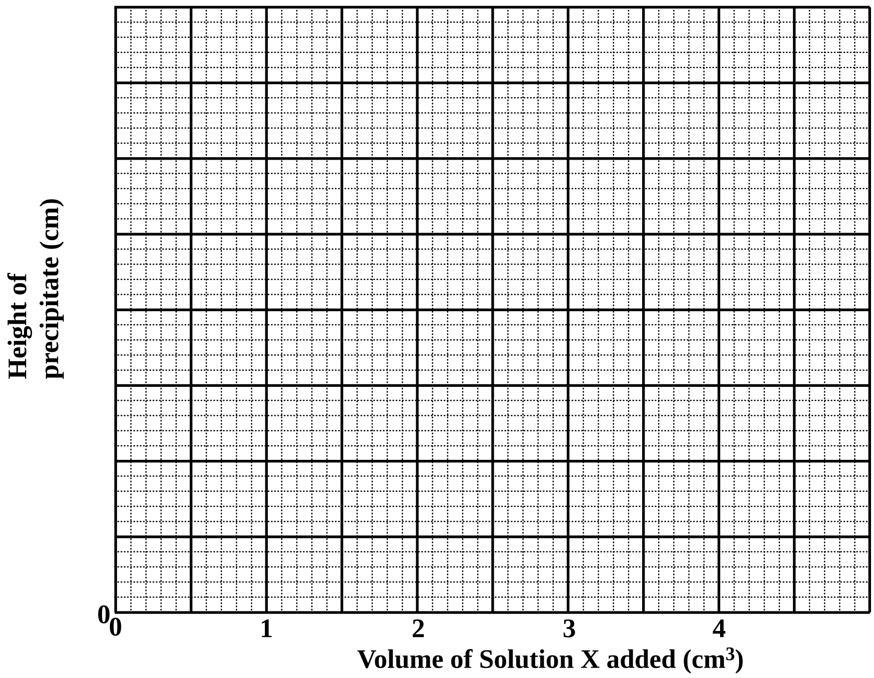
(a) Use the results from Figure 1 to complete Table 3.

TABLE 3: RESULTS OF PRECIPITATION REACTIONS

Volume of Solution X added (cm^3)	Height of Precipitate (cm)

(4 marks)

(b) Using the data recorded in Table 3, plot a graph, on the axes provided in Figure 2, of the height of the precipitate versus the volume of Solution X added. You are required to determine an appropriate scale for the *y*-axis.



Scale: 1 cm = ____ cm of precipitate

Figure 2.

(6 marks)

Total 10 marks

GO ON TO THE NEXT PAGE

3. It is recommended that vitamin C (ascorbic acid) tablets be dissolved in cold water rather than warm water. It is suspected that the reason for this is that the effect of vitamin C is reduced on heating.

Plan and design a suitable experiment to investigate the effect of heat on vitamin C.

Hypothesis: The concentration of vitamin C (ascorbic acid) decreases with increasing temperature.

In your response you should include the following:

(a) Apparatus/Materials

....

....

....

....

....

....

(2 marks)

(b) Procedure

....

....

....

....

....

....

....

....

(3 marks)

(c) Data to be collected (in tabular form)

(2 marks)

(d) Variable to be controlled

....

....

....

(1 mark)

(e) Manipulated variable

....

....

(1 mark)

(f) Possible source of error

....

....

....

....

(1 mark)

Total 10 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

12 JANUARY 2016 (a.m.)

J1601212020

FILL IN ALL THE INFORMATION REQUESTED CLEARLY IN CAPITAL LETTERS.

TEST CODE | 0 | 1 | 2 | 1 | 2 | 0 | 2 | 0 |

SUBJECT CHEMISTRY – Paper 02

PROFICIENCY GENERAL

REGISTRATION NUMBER

SCHOOL/CENTRE NUMBER					

NAME OF SCHOOL/CENTRE

CANDIDATE'S FULL NAME (FIRST, MIDDLE, LAST)

DATE OF BIRTH

D	D	M	M	Y	Y	Y	Y

SIGNATURE ____________________

0121202001

TEST CODE **01212020**

FORM TP 2016005

JANUARY 2016

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in TWO sections.
2. Answer ALL questions.
3. Write your answers in the spaces provided in this booklet.
4. Do NOT write in the margins.
5. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
6. You may use a silent, non-programmable calculator to answer questions.
7. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer.**
8. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions in this section.

Write your responses in the spaces provided in this booklet.

DO NOT spend more than 30 minutes on Question 1.

1. (a) (i) Define the term 'rate of reaction'.

....

....

(1 mark)

(ii) State TWO factors, other than concentration, which affect the rate of a chemical reaction.

....

....

(2 marks)

(b) Carol carried out a number of experiments to investigate the effect of concentration on the rate of reaction. Different concentrations of aqueous potassium iodate (KIO_3) were allowed to react with a fixed concentration of aqueous sodium hydrogen sulfite ($NaHSO_3$) in the presence of sulfuric acid and starch as indicated in Table 1 **(page 6)**. The time taken for a blue-black colour to appear was noted.

The equations for the reactions that occurred during the experiments are shown below.

$$NaHSO_3 + H_2SO_4 \rightarrow H_2SO_3 + NaHSO_4$$

$$KIO_3 + 3H_2SO_3 \rightarrow KI + 3H_2SO_4$$

$$KIO_3 + 3H_2SO_4 + 5KI \rightarrow 3K_2SO_4 + 3H_2O + 3I_2$$

$$I_2 + \text{starch} \rightarrow \text{starch–}I_2 \text{ complex (blue-black)}$$

Materials:

The six experiments were done using measured volumes of the following solutions as shown in Table 1 **on page 6**:

Solution 1: 100 cm^3 of aqueous solution containing 0.214 g of potassium iodate (KIO_3).

Solution 2: 100 cm^3 of a mixture of aqueous sodium hydrogen sulfite ($NaHSO_3$), sulfuric acid, and starch solution.

Solution X: 50 cm^3 of aqueous potassium iodate (KIO_3) of an unknown concentration.

In Experiment 6, Solution 1 was replaced with Solution X.

The solutions were mixed in a container and the time taken for a blue-black colour to appear was recorded. The results of these experiments are summarized in Table 1 **(page 6)**.

(i) Calculate the concentration, in mol dm^{-3}, of KIO_3 in **Solution 1**.

[RAM: K = 39.1, I = 126.9, O = 16.0]

....

....

....

....

(3 marks)

(ii) The final concentration of $NaHSO_3$ in all experiments was 0.0008 mol dm^{-3}. Using the information provided in Table 1 **on page 6**, determine the concentration of $NaHSO_3$ in **Solution 2**.

....

....

....

(2 marks)

TABLE 1: RESULTS AND RECIPROCAL TIMES OF EXPERIMENTS 1–6

Experiment	**Solution 1 (cm^3)**	**Solution 2 (cm^3)**	**Distilled Water (cm^3)**	**Time Taken for Blue-Black Colour to Appear (s)**	**Reciprocal Time (s^{-1})**	**Concentration of KIO_3 after Mixing (mol dm^{-3})**
1	5	10	35	83.5	0.012	0.0010
2	10	10	30			0.0020
3	15	10	25			0.0030
4	20	10	20			0.0040
5	25	10	15			0.0050
6	20 Solution X	10	20			

(c) (i) From the stopwatches displayed in Figure 1 **on page 7**, record the times taken for the blue-black colour to appear in the appropriate spaces in Table 1. The time taken for Experiment 1 has already been recorded for you. **(3 marks)**

(ii) Calculate the reciprocal times (1/time) and record them to 3 decimal places in the appropriate spaces in Table 1. One of the times has already been recorded for you. **(3 marks)**

(iii) Using the axes provided **on page 8**, plot a graph of concentration of KIO_3 versus reciprocal time for Experiments 1–5, and draw the best straight line through the points. **(5 marks)**

Figure 1 shows the stopwatch readings of the times taken for the blue-black colour to appear in Experiments 2–6.

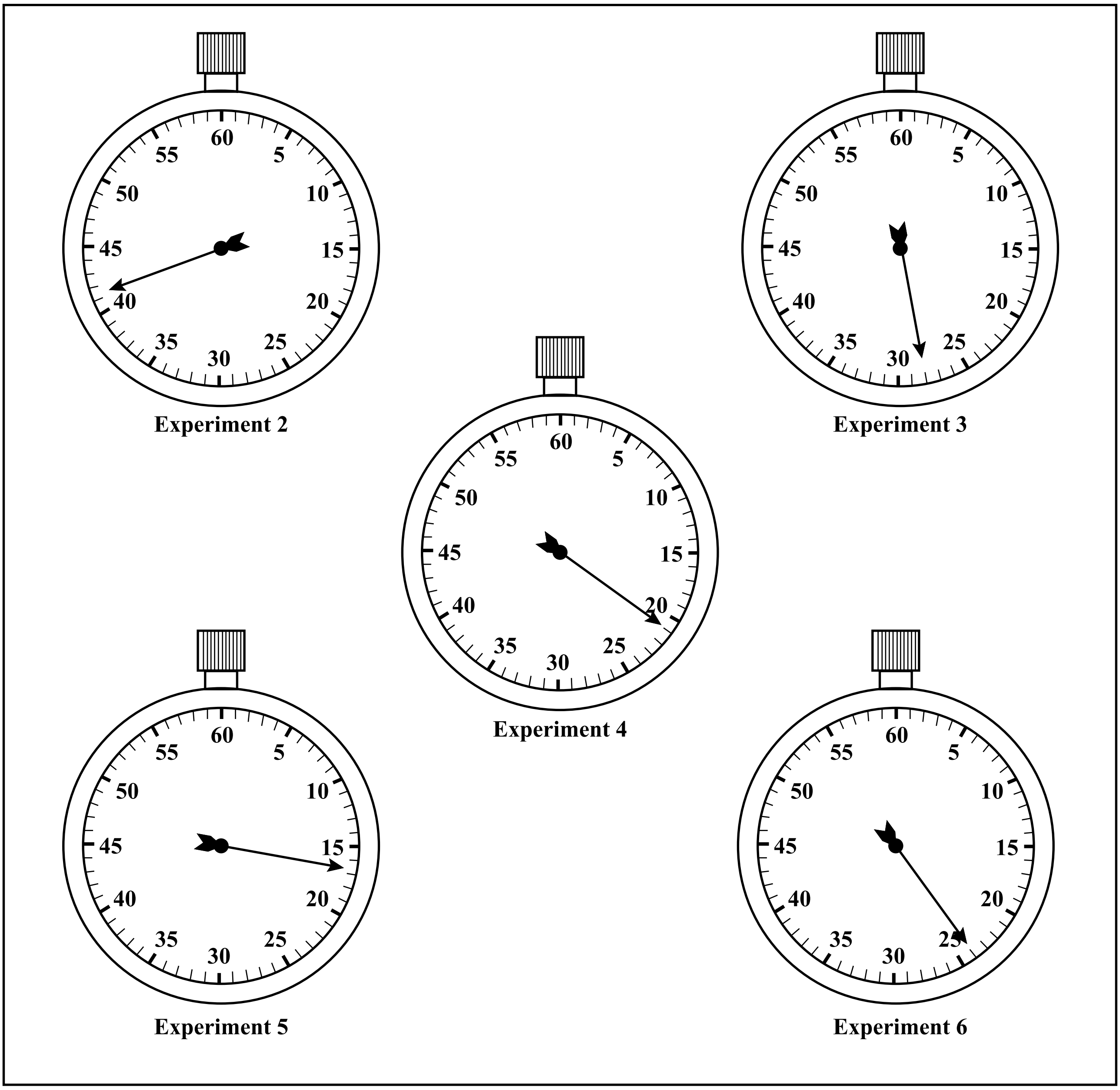
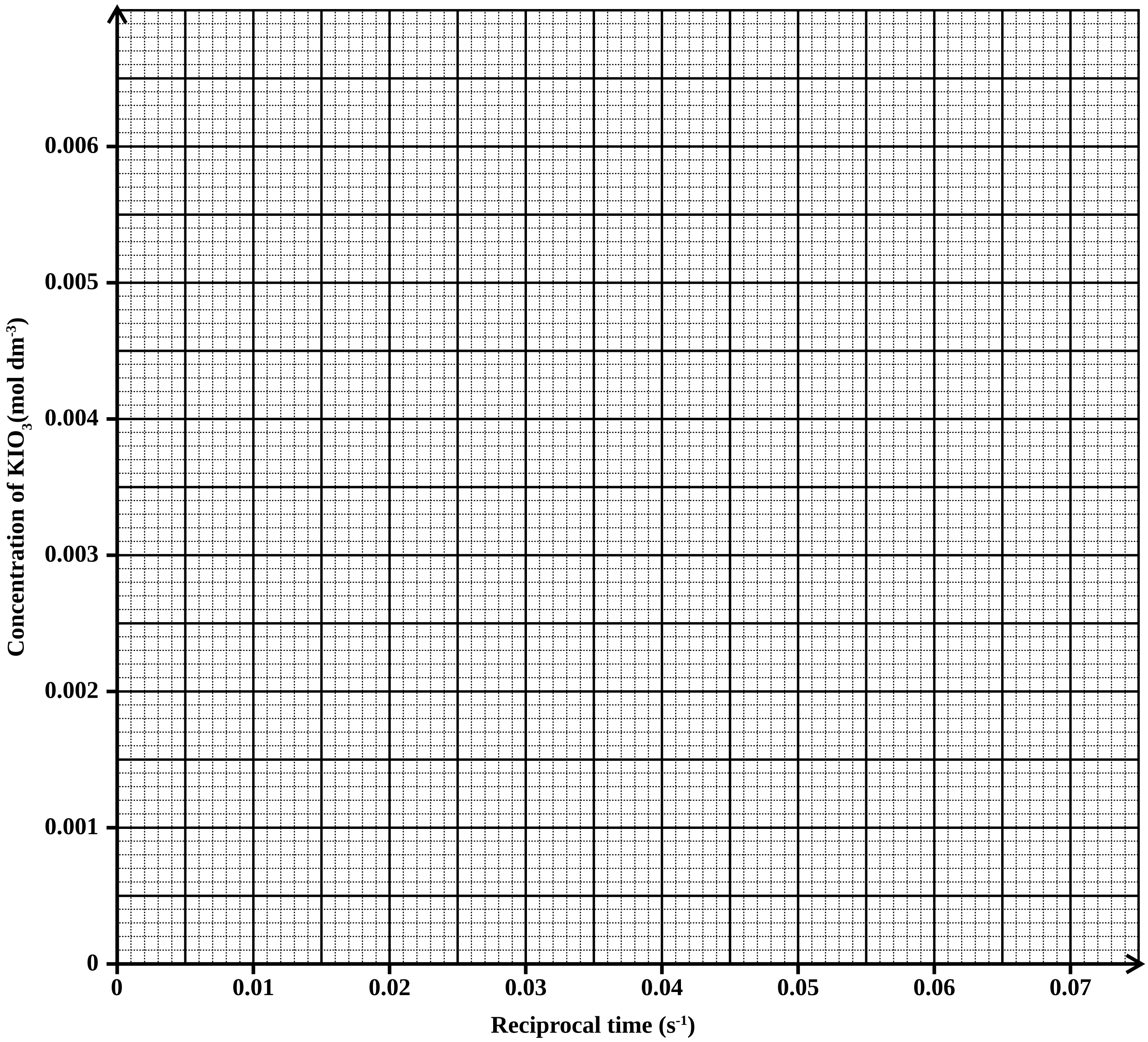


Figure 1. Time taken for blue-black colour to appear

Axes for Question 1 (c) (iii)



GO ON TO THE NEXT PAGE

(d) Based on the graph drawn in (c) (iii) **on page 8**, what deduction can be made about the effect of concentration of aqueous KIO_3 on the rate of reaction?

....

....

....

....

....

(2 marks)

(e) Experiment 6 was carried out using Solution X, which contained an unknown concentration of KIO_3. Using the reciprocal time calculated in Experiment 6, determine from your graph, the concentration of KIO_3 in this reaction mixture.

....

....

....

(2 marks)

(f) (i) State the responding variable.

....

(1 mark)

(ii) State the controlled variable.

....

(1 mark)

Total 25 marks

2. One of the main active ingredients in chlorine bleach is the oxidizing agent, sodium hypochlorite (NaClO). By adding it to water, the hypochlorous acid (HOCl) is formed according to the equation below.

$$NaClO + H_2O \rightarrow HOCl + NaOH \qquad \text{Equation 1}$$

Hypochlorite and chlorine are in equilibrium in water; the position of the equilibrium is pH dependent and low pH (acidic) favours chlorine.

$$Cl_2 + H_2O \rightleftharpoons H^+ + Cl^- + HClO \qquad \text{Equation 2}$$

(a) State ONE use of bleach in the laundering of clothing.

....

(1 mark)

(b) Define, in terms of oxidation state, the terms ‘oxidizing agent’ and ‘oxidation’.

(i) Oxidizing agent

....

....

(1 mark)

(ii) Oxidation

....

....

(1 mark)

(c) Deduce the oxidation number of Cl in the formula, NaClO.

....

....

(3 marks)

GO ON TO THE NEXT PAGE

(d) In Equation 2 **on page 10**, chlorine gas, Cl_2 has become a chloride ion, Cl^-.

(i) What is the change in oxidation number of Cl for the process?

....

(2 marks)

(ii) Is this an oxidation or reduction process?

....

(1 mark)

(iii) Describe a simple laboratory test for chlorine gas.

....

....

....

(2 marks)

(e) A more natural alternative to chlorine bleach is the use of detergents which release hydrogen peroxide in water. The bleaching action of hydrogen peroxide is also a redox reaction and is represented by the following equation:

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

During one stage of the reaction, $H_2O_2(aq)$ is converted to $H_2O(l)$. Use the changes in oxidation number to determine whether this is an oxidation or reduction process.

....

....

....

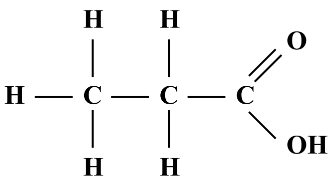
....

(4 marks)

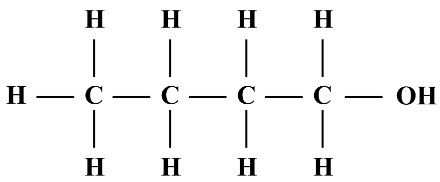
Total 15 marks

GO ON TO THE NEXT PAGE

3. Two organic molecules, Compound D and Compound E, are shown below.



Compound D



Compound E

(a) Compound D inhibits the growth of mould and bacteria and is used as a preservative in the food industry.

(i) State the name of Compound D.

....

(1 mark)

(ii) Identify the homologous series to which Compound D belongs.

....

(1 mark)

(iii) State ONE chemical property of Compound D.

....

(1 mark)

(b) Compound E is present in alarm pheromones that are produced by honey bees.

(i) State the name of Compound E.

....

(1 mark)

(ii) Identify the homologous series to which Compound E belongs.

....

(1 mark)

(iii) Write the general formula for this homologous series.

....

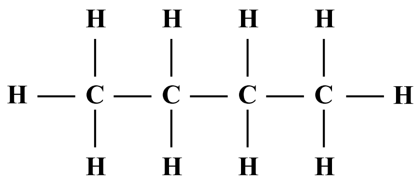
(1 mark)

GO ON TO THE NEXT PAGE

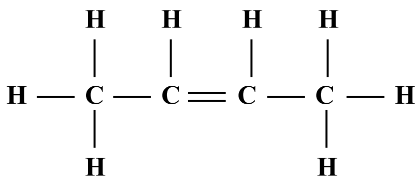
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(c) Compound F and Compound G shown below are hydrocarbons.



Compound F



Compound G

(i) State ONE physical property that is common to both Compounds F and G.

....

(1 mark)

(ii) State which compound, F or G, will react with bromine in the dark.

....

(1 mark)

(iii) Draw the FULLY displayed structure of the product that is formed from the reaction in (c) (ii).

Fully displayed structure

(2 marks)

GO ON TO THE NEXT PAGE

(iv) Will Compound F burn in air with a clear blue flame?

....

(1 mark)

(v) Write a balanced chemical equation for the reaction that occurs when Compound F burns in air.

....

....

(2 marks)

(vi) State TWO properties of hydrocarbons that make them good fuels.

....

....

(2 marks)

Total 15 marks

DO NOT WRITE IN THIS AREA ***DO NOT WRITE IN THIS AREA*** ***DO NOT WRITE IN THIS AREA***

NOTHING HAS BEEN OMITTED.

SECTION B

Answer ALL questions in this section.

Write your responses in the spaces provided in this booklet.

4. (a) Dilute sulfuric acid is the electrolyte used in car batteries. Remi obtained a sample of this electrolyte from a car battery and carried out an investigation on it using electrolysis in the laboratory.

(i) Define the term 'anion'.

....

....

(1 mark)

(ii) What anions will be present in a sample of this electrolyte?

....

....

(1 mark)

(iii) Draw a clearly labelled line diagram to represent an electrolytic cell.

(4 marks)

(b) During the electrolysis of the acidified water, hydrogen is produced at the cathode. The equation for formation of hydrogen is:

$$2H^{+}(aq) + 2e^{-} \rightarrow H_2(g)$$

Calculate the volume of hydrogen gas liberated at STP, if a current of 965 A is passed through the circuit for 1 hour. ($Q = I \times t$, $F = 96\ 500\ C\ mol^{-1}$. At STP, 1 mol of gas occupies 22.4 L)

....

....

....

....

....

....

....

(5 marks)

(c) Remi also wants to purify an impure nickel sample by electrolysis. Suggest how he could modify the line diagram drawn in (a) (iii) **on page 16** in order to achieve this, and state ONE observation that would be expected.

....

....

....

....

....

....

....

....

....

(4 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

5. (a) State ONE natural source of hydrocarbons.

....

....

(1 mark)

(b) Plastics are common materials in today's world and are made from the naptha fraction obtained from the fractional distillation of petroleum.

List TWO other fractions that can be obtained and state ONE use of EACH fraction.

Fraction: ....

Use: ....

....

Fraction: ....

Use: ....

....

(4 marks)

(c) Heavy oil fractions with a high carbon content can be subjected to breakdown through either catalytic or thermal cracking.

(i) Define the term 'cracking'.

....

....

(1 mark)

(ii) How does catalytic cracking differ from thermal cracking?

....

....

....

....

(2 marks)

GO ON TO THE NEXT PAGE

(d) There are two unlabelled flasks on a laboratory shelf each containing a different, colourless organic liquid. It is believed that one flask contains pentane, and the other butanoic acid. To determine their identities, dilute sodium hydroxide is added to each flask.

(i) Write an equation, using FULLY displayed structures, which summarizes the expected reactions in EACH case. Identify any products formed.

(5 marks)

(ii) Write a balanced chemical equation for the complete combustion of pentane.

....

....

....

(2 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

6. Dry ammonia gas can be produced in a school laboratory.

(a) Identify TWO reagents that are necessary for the laboratory production of ammonia.

....

....

(1 mark)

(b) Two common drying agents used in the laboratory are calcium oxide and concentrated sulfuric acid. However, calcium oxide is the preferred choice for drying ammonia gas.

Explain why concentrated sulfuric acid is not used. Include in your answer a balanced chemical equation.

....

....

....

....

....

....

....

....

(3 marks)

(c) When gases are prepared in the laboratory, there are three main ways in which they can be collected:

- Upward delivery
- Downward delivery
- Displacement of water

(i) What TWO factors should be considered when choosing an appropriate method for the collection of gases in the laboratory?

....

....

....

(2 marks)

(ii) Identify ONE of the three methods that is best suited for the collection of ammonia gas in the laboratory. Explain why EACH of the other two methods would NOT have been appropriate.

....

....

....

....

....

....

....

....

(5 marks)

(d) Hence, draw a labelled diagram of the apparatus which could be used for the preparation of dry ammonia in the laboratory.

Be sure to identify in your diagram

- where the reagents are placed,
- where the ammonia is dried, and
- where the ammonia is collected.

(4 marks)

Total 15 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No. ☐

EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No.

EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No.

EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No.

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE®
EXAMINATION

19 JANUARY 2016 (p.m.)

J1601212032

FILL IN ALL THE INFORMATION REQUESTED CLEARLY IN CAPITAL LETTERS.

TEST CODE

0	1	2	1	2	0	3	2

SUBJECT CHEMISTRY – Paper 032

PROFICIENCY GENERAL

REGISTRATION NUMBER

SCHOOL/CENTRE NUMBER					

NAME OF SCHOOL/CENTRE

CANDIDATE'S FULL NAME (FIRST, MIDDLE, LAST)

DATE OF BIRTH

D	D	M	M	Y	Y	Y	Y

SIGNATURE ____________________

0121203201

9009

DO NOT WRITE ON THIS PAGE

TEST CODE **01212032**

FORM TP 2016006

JANUARY 2016

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

CHEMISTRY

Paper 032 – General Proficiency

Alternative to SBA

2 hours and 10 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.
3. Do NOT write in the margins.
4. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
5. You may use a silent, non-programmable calculator to answer questions.
6. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer.**
7. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

NOTHING HAS BEEN OMITTED

Answer ALL questions.

Write your responses in the spaces provided in this booklet.

1. In this experiment, you will be required to determine the heat produced when magnesium metal reacts with dilute hydrochloric acid.

You are provided with the following reagents and apparatus:

- A solution of 1.0 mol dm^{-3} hydrochloric acid
- A 10 cm length of magnesium ribbon (cleaned)
- A thermometer (0 – 100 °C)
- Styrofoam cup and Styrofoam lid (with a small hole to insert the thermometer)
- A stop clock
- A measuring cylinder (100 cm^3)
- An analytical balance

The experimental set-up is as shown in Figure 1.

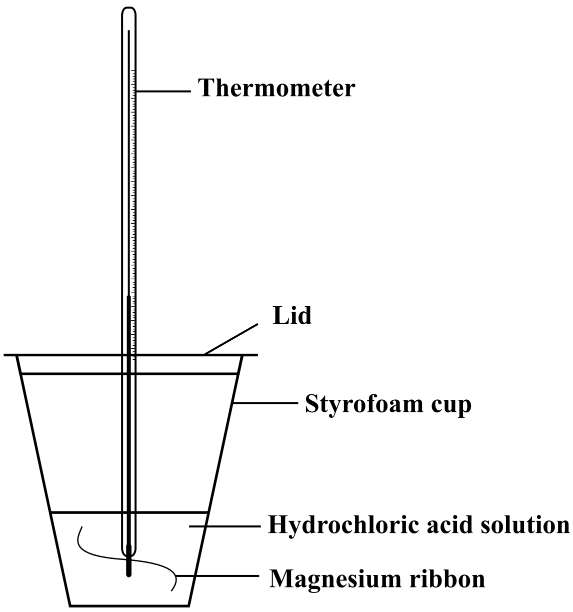


Figure 1. Arrangement of apparatus and reagents

Procedure:

1. Weigh, to the nearest milligram (i.e. ± 0.001 g), the empty Styrofoam cup on the balance provided and record the mass (W1) in Table 1 **on page 7**.

2. Add the 10 cm length of magnesium ribbon to the cup. Weigh and record the mass (W2) of the cup and ribbon in Table 1 **on page 7**.

3. Use the measuring cylinder to measure 50 cm^3 of the 1.0 mol dm^{-3} hydrochloric acid.

4. Place the thermometer in the measuring cylinder with the hydrochloric acid.

5. Start the stop clock and take the temperature readings every minute for FOUR minutes. After every temperature reading, record the value in Table 2 **on page 7**.

6. On the FIFTH minute, carefully but quickly, pour all of the hydrochloric acid from the measuring cylinder into the Styrofoam cup with the magnesium ribbon.

7. Cover the Styrofoam cup with the lid, and insert the thermometer through the hole in the lid.

8. Gently swirl the cup continuously and take thermometer readings EVERY minute for the next five minutes, and record these temperature readings in Table 2 **on page 7**.

TABLE 1: DETERMINATION OF THE MASS OF THE MAGNESIUM RIBBON

Mass of Styrofoam cup and magnesium ribbon, W2 (g)	
Mass of empty Styrofoam cup, W1 (g)	
Mass of magnesium ribbon (g)	

(3 marks)

TABLE 2: TEMPERATURE READINGS

Time (min)	**Temperature (°C)**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

(5 marks)

(a) (i) Calculate the mass of the magnesium ribbon and record the value in Table 1 **on page 7**. **(1 mark)**

(ii) Determine the number of moles of magnesium used in the reaction.

[RAM: Mg = 24.3]

....

....
(1 mark)

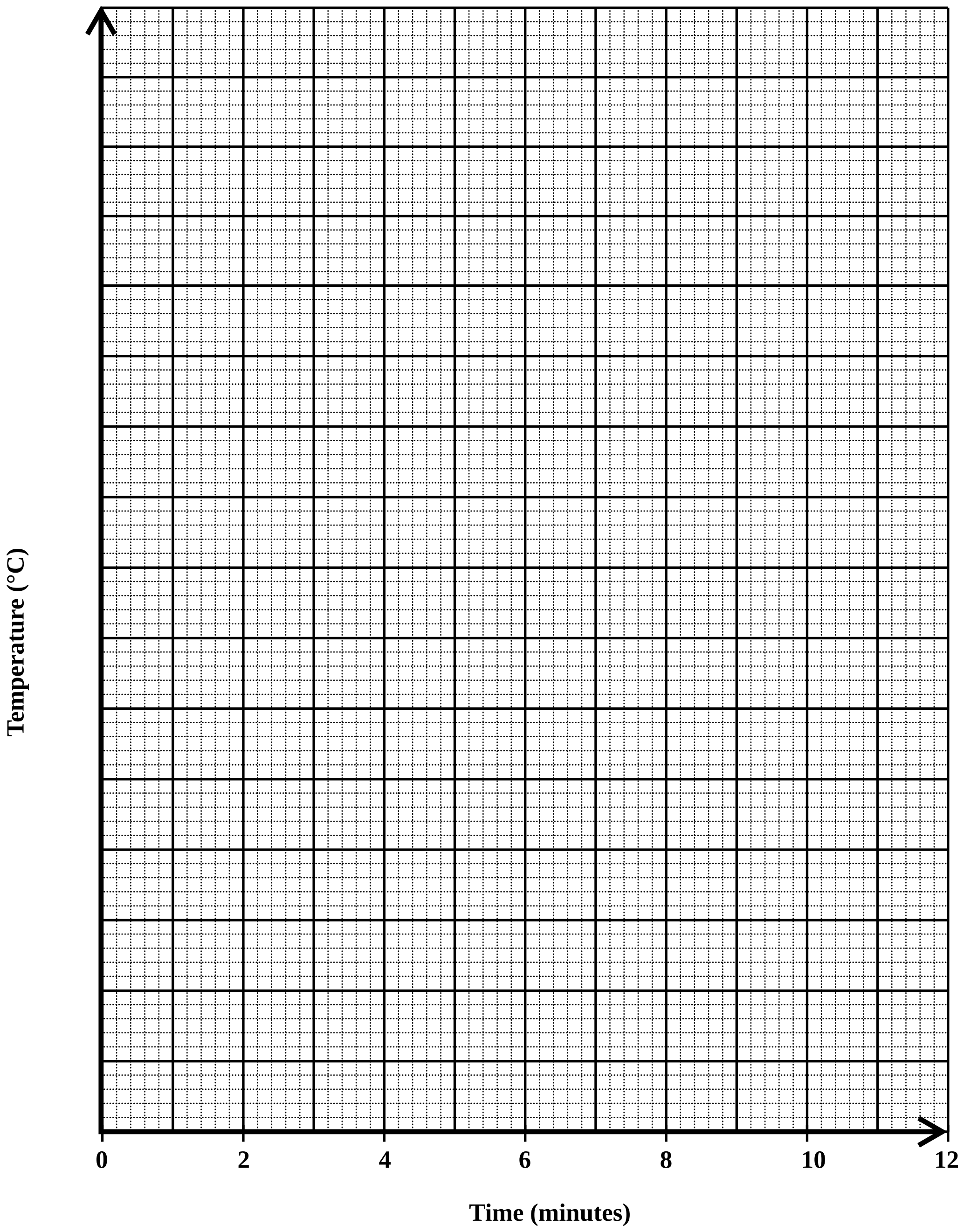
(b) (i) Using the grid provided **on page 9**, choose an appropriate temperature scale and plot the graph of temperature versus time. **(4 marks)**

(ii) From the graph plotted in (b) (i), determine the minimum temperature, the maximum temperature, and the temperature change, ΔT, for the experiment.

Maximum temperature: ....

Minimum temperature: ....

Temperature change, ΔT: ....
(3 marks)



(c) (i) Assuming that the solution in the Styrofoam cup has a density of 1.0 g cm^{-3}, determine the mass of the solution.

....

....

(1 mark)

GO ON TO THE NEXT PAGE

(ii) Calculate the heat change for the reaction taking place in the Styrofoam cup.

[$Q = m \times c \times \Delta T$; c, specific heat capacity of the solution = 4.00 J °C^{-1} g^{-1}]

....

....

(1 mark)

(iii) Making use of your answer in (a) (ii) **on page 8**, calculate the heat change that would be expected for ONE mole of magnesium ribbon.

....

....

(1 mark)

(iv) Is the reaction exothermic or endothermic?

....

(1 mark)

(d) (i) Write a balanced chemical equation for the reaction between the magnesium ribbon and dilute hydrochloric acid.

....

....

(2 marks)

(ii) Calculate the volume of hydrogen gas (at RTP) that was produced from the reaction occurring in the Styrofoam cup.

....

....

....

....

(3 marks)

Total 26 marks

2. You were given an unknown solid, M, which you identified, through a series of tests, to be ferrous ammonium sulfate. Complete Table 3 below by stating the expected observations that would have led to the inferences listed for EACH test performed.

TABLE 3: TESTS, OBSERVATIONS AND INFERENCES

Test	Observation	Inference
(a) A portion of M was dissolved in 5 cm^3 of distilled water and 1 cm^3 portions were used for the following tests.	• **(1 mark)**	• Fe^{2+} ions present.
(b) To the first portion, 2 drops of aqueous sodium hydroxide were added.	•	• Fe^{2+} ions present.
More drops of sodium hydroxide were added until in excess.	•	• Fe^{2+} ions present.
The resulting mixture was then warmed and any gas liberated was tested with damp red litmus paper.	• **(3 marks)**	• NH_3 gas liberated, therefore NH_4^+ ions present.
(c) To the second portion, 2 drops of aqueous ammonia were added.	•	• Fe^{2+} ions present.
More drops of aqueous ammonia were added until in excess.	• **(2 marks)**	• Fe^{2+} ions present.
(d) To the third portion, a drop of silver nitrate solution was added followed by aqueous ammonia.	• **(1 mark)**	• Cl^- , Br^-, I^- ions absent.
(e) To the fourth portion, dilute nitric acid was added. Any gas liberated was tested with lime water.	• **(1 mark)**	• HCO_3^- and CO_3^{2-} absent.
(f) To the fifth portion, aqueous barium nitrate was added.	•	• SO_3^{2-} or SO_4^{2-} present.
To the resulting mixture, dilute nitric acid was added.	• **(2 marks)**	• SO_4^{2-} present.

Total 10 marks

GO ON TO THE NEXT PAGE

3. MistiCleen and Freshalwaze are two liquid laundry detergents, manufactured by the same company, which may have been bottled incorrectly. MistiCleen is known to be a soap detergent and Freshalwaze is known to be a soapless detergent.

You have been provided with samples of the two laundry detergents and have available to you the following reagents:

- Distilled water
- Solid calcium carbonate
- Solid calcium chloride
- Solid iron(II) sulfate
- Solid magnesium sulfate
- Solid zinc chloride

Plan and design an experiment to determine whether these two detergents have been bottled incorrectly. The aim has been provided for you.

AIM: To distinguish between soap and soapless detergents using the method of ionic precipitation.

In your response, include the following:

(a) Hypothesis

....

....

(1 mark)

(b) The required reagents from the list provided

....

....

....

(1 mark)

GO ON TO THE NEXT PAGE

(c) Procedure

....

....

....

....

....

....

(3 marks)

(d) Apparatus

....

....

....

(2 marks)

(e) Variables to be controlled

....

....

(2 marks)

(f) Data to be collected

....

....

(1 mark)

(g) Discussion

....

....

....

....

....

(2 marks)

Total 12 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

FORM TP 2016055

TEST CODE **01212020**

MAY/JUNE 2016

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE®
EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in TWO sections.
2. Answer ALL questions.
3. Write your answers in the spaces provided in this booklet.
4. Do NOT write in the margins.
5. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
6. You may use a silent, non-programmable calculator to answer questions.
7. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer.**
8. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

“*”Barcode Area”*”
Sequential Bar Code

SECTION A

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

Do NOT spend more than 30 minutes on Question 1.

1. (a) A group of students was required to carry out an experiment in order to determine the melting point of an unknown solid, **A**. The apparatus was set up as shown in Figure 1.

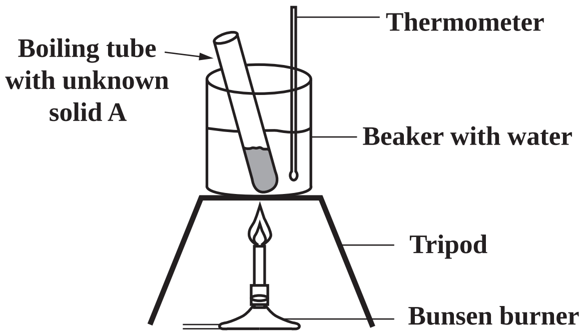


Figure 1. Diagram of apparatus set-up

Using the Bunsen burner, the water was heated to 80 °C. The Bunsen burner was turned off and temperature readings were recorded EVERY minute for 10 minutes.

GO ON TO THE NEXT PAGE

Figure 2 shows some of the thermometer readings recorded during the experiment.

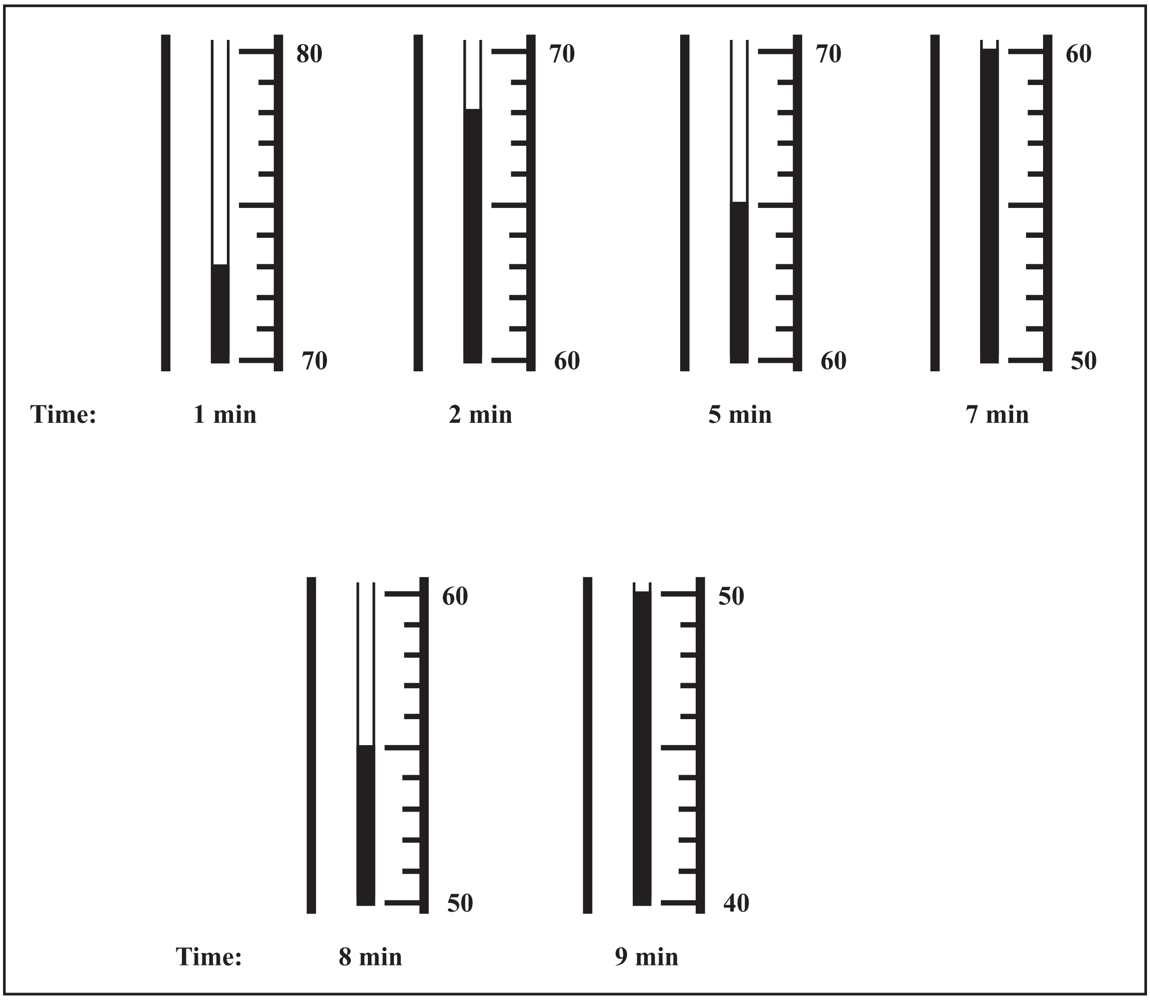


Figure 2. Thermometer readings

GO ON TO THE NEXT PAGE

(i) Complete Table 1 by inserting the thermometer readings from Figure 2 **(page 5)** at the appropriate times.

TABLE 1: RESULTS OF EXPERIMENT

Time (min)	**Temperature (°C)**
0	80
1	
2	
3	65
4	65
5	
6	64
7	
8	
9	
10	48

(4 marks)

(ii) Using the data from Table 1, plot the graph of temperature versus time on the grid provided in Figure 3 **on page 7**. Five points have already been plotted for you. Draw a smooth curve through the points to complete the cooling curve for **A**.

(5 marks)

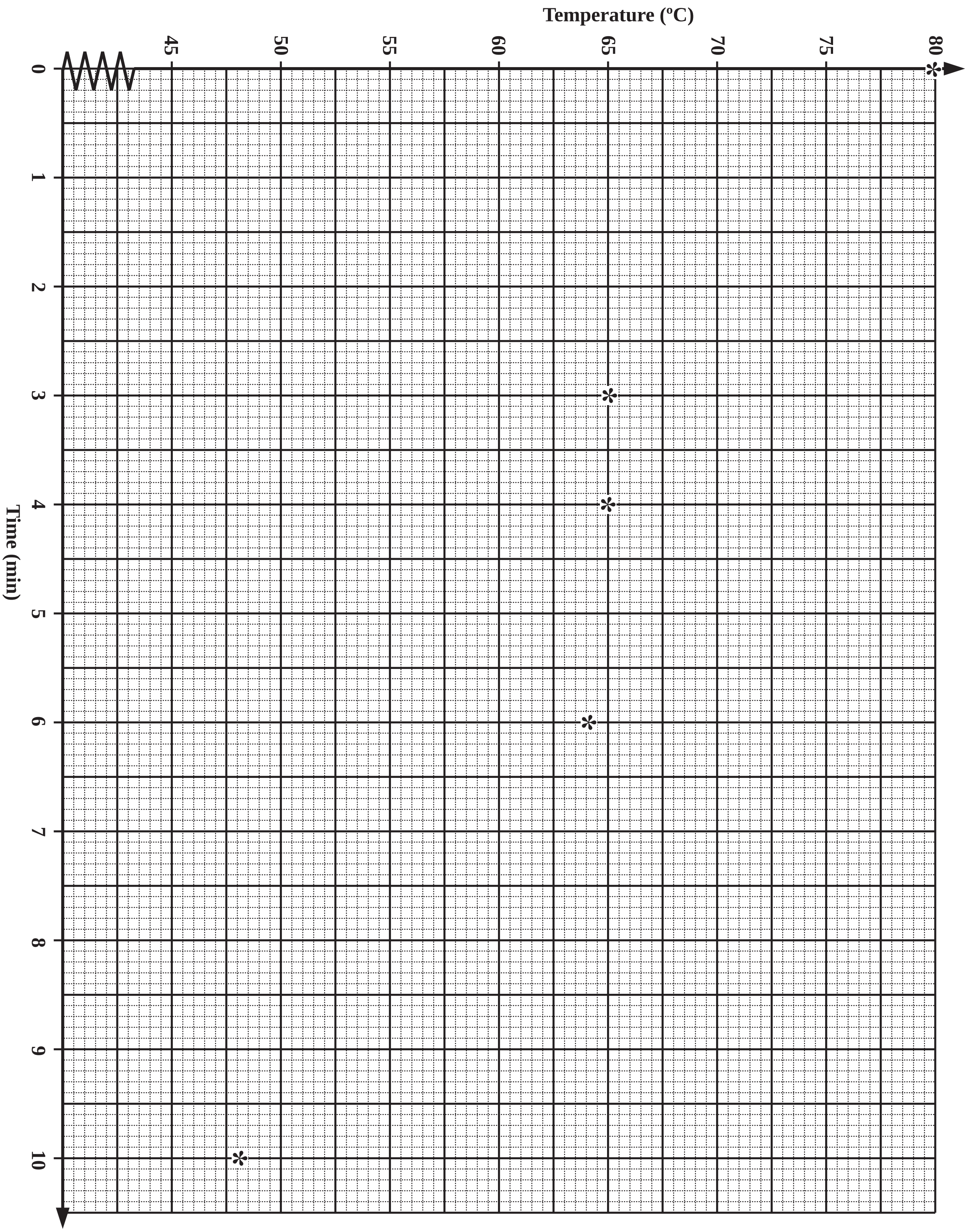


Figure 3. Cooling curve of A

GO ON TO THE NEXT PAGE

(iii) List the THREE states of matter.

....

....

(1 mark)

(iv) Define the term 'melting point'.

....

....

....

(2 marks)

(v) Based on information from the graph plotted in (a) (ii), state the melting point of **A**.

....

(1 mark)

(vi) From the graph plotted in (a) (ii), identify the time range during which there should be a mixture of liquid and solid in the boiling tube.

....

(1 mark)

(vii) State ONE precaution, other than wearing safety apparel, which should be taken during this experiment to avoid injury to the face or hands.

....

....

....

(1 mark)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(viii) Complete Figure 4 by drawing the arrangement of the particles of **A** at 0 min and 10 min. Use • (one dot) to represent a particle. **(2 marks)**

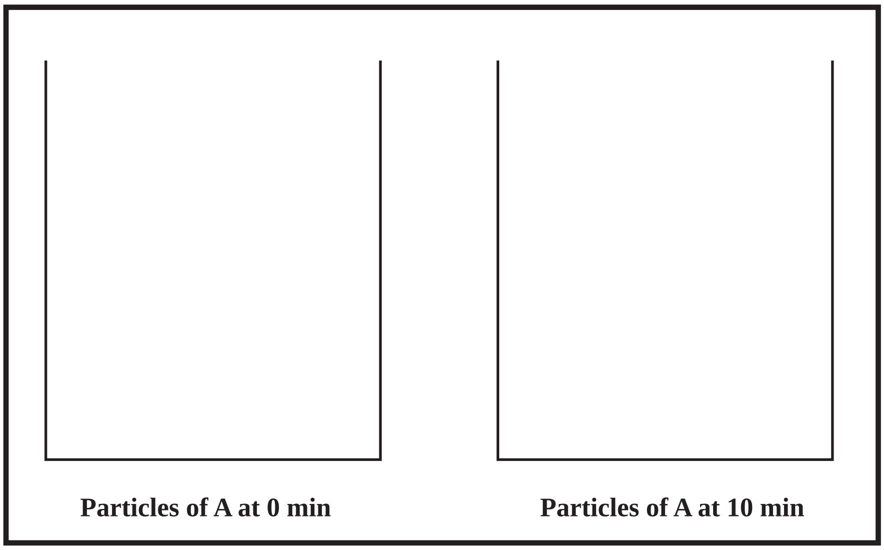


Figure 4. Particles of A

(b) In another experiment, the group of students was given another unknown solid, **B**, and asked to identify it. They performed a series of tests and made some observations which are recorded in Table 2. Complete Table 2 by inserting the appropriate inferences.

(8 marks)

TABLE 2: RESULTS OF TESTS ON UNKNOWN SOLID, B

	Test	**Observation**	**Inference**
(i)	Place a small portion of solid, **B** in a test tube and heat strongly using a Bunsen flame.	• A reddish brown gas evolved	• **(1 mark)**
(ii)	Dissolve the remainder of **B** in about 10 cm^3 of distilled water, stir, then filter. Collect the filtrate and divide it into three equal portions for use in the following tests.		
(iii)	To the first portion of the filtrate from (b) (ii), add NaOH solution slowly until in excess.	• White precipitate formed • Soluble in excess	• • **(2 marks)**
(iv)	To the second portion of the filtrate from (b) (ii), add aqueous NH_3 slowly until in excess.	• White precipitate formed • Insoluble in excess	• • **(2 marks)**
(v)	To the third portion of the filtrate from (b) (ii), add aqueous KI.	• Yellow precipitate formed	• (Ionic equation required) • **(3 marks)**

Total 25 marks

GO ON TO THE NEXT PAGE

NOTHING HAS BEEN OMITTED.

2. (a) Distinguish between an 'oxidizing agent' and a 'reducing agent' in terms of electron gain or loss.

....

....

....

....

(2 marks)

(b) Jaden carried out some tests and recorded the observations in Table 3 below. Use the information in the table to answer the questions that follow.

TABLE 3: OBSERVATIONS

Test		Observation
1	An aqueous solution of **C** was added to acidified potassium manganate(VII).	Potassium manganate(VII) solution changed from purple to pale pink.
2	An aqueous solution of **C** was added to a solution of potassium iodide.	Potassium iodide solution changed from colourless to brown.
3	A strip of iron was placed into an aqueous solution of copper(II) sulfate.	Blue solution faded and brown deposits settled.
4	A strip of silver was placed into an aqueous solution of copper(II) sulfate.	Solution remained blue.

(i) State an oxidizing agent that is NOT mentioned in Table 3.

....

(1 mark)

(ii) Identify whether Solution **C** is acting as an oxidizing or reducing agent in Test 1 and Test 2.

Test 1:

....

Test 2:

....

(2 marks)

GO ON TO THE NEXT PAGE

“*”Barcode Area”*”
Sequential Bar Code

(iii) With reference to oxidation states, explain EACH of your answers in (b) (ii).

Test 1:

....

....

....

Test 2:

....

....

....

(4 marks)

(iv) Write an ionic equation (with state symbols) for the reaction which took place in Test 3.

....

(2 marks)

(v) With reference to the electrochemical series, explain the difference in observations between Tests 3 and 4.

....

....

....

....

....

....

(4 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

3. (a) Define the term 'structural isomerism'.

....

....

....

(2 marks)

(b) Compound P, $H_2C{=}CHCH_2CH_2CH_3$, is a hydrocarbon.

(i) State the name of Compound P.

....

(1 mark)

(ii) State ONE physical property of Compound P.

....

....

(1 mark)

(iii) State ONE chemical property of Compound P.

....

....

(1 mark)

(iv) Draw the FULLY DISPLAYED structural formulae of Compound P and ONE of its isomers.

Compound P	**Isomer of Compound P**

(4 marks)

GO ON TO THE NEXT PAGE

(c) Compound P reacts with hydrogen gas in the presence of a catalyst to form Compound Q.

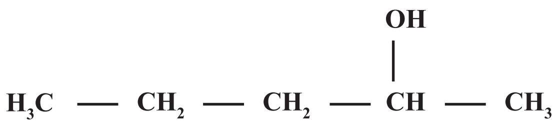
(i) Draw the FULLY DISPLAYED structure of ONE BRANCHED isomer of Compound Q.

(2 marks)

(ii) State ONE physical property of Compound Q.

....
(1 mark)

(d) The following diagram shows the structure of Compound R.



Compound R

State the name of Compound R.

....
(1 mark)

(e) State the conditions required for the dehydration of ethanol.

....

....
(2 marks)

Total 15 marks

SECTION B

Answer ALL questions.

4. (a) Graphite and diamond are two allotropes of carbon. Define the term 'allotrope'. Illustrate your answer by drawing the lattice structures for **both** diamond and graphite.

....

....

....

Diamond	**Graphite**

(6 marks)

GO ON TO THE NEXT PAGE

(b) Like metals, graphite can conduct electricity but diamond cannot conduct electricity.

(i) Describe the bonding present in metals.

....

....

....

(2 marks)

(ii) Explain, in terms of bonding, why graphite conducts electricity but diamond does NOT conduct electricity.

....

....

....

(2 marks)

(c) Sodium chloride and calcium oxide both have similar giant ionic crystalline structures with high melting points. However, the melting point of calcium oxide is higher than that of sodium chloride. Sketch the lattice structure for sodium chloride and suggest why its melting point would be lower than that of calcium oxide.

....

....

....

....

(5 marks)

Total 15 marks

5. (a) Methane, CH_4, is the simplest hydrocarbon known to man.

Identify the type of bonding present in methane. State a reason for your answer.

....

....

....

....

(3 marks)

(b) Methane, like other alkanes, is generally unreactive. However, under certain conditions, it can undergo reactions with chlorine, Cl_2, forming carbon tetrachloride, CCl_4.

(i) Write a balanced equation for this reaction.

....

....

....

(2 marks)

(ii) State the type of reaction taking place and identify the reaction conditions.

....

....

....

(2 marks)

GO ON TO THE NEXT PAGE

(c) Identify and draw the structural formulae of the alkene and the acid from the list of molecular formulae given below.

C_4H_8, C_4H_{10}, $C_4H_8O_2$, $C_4H_{10}O$

Alkene: _______________ **Acid:** _______________

(4 marks)

(d) For EACH of the following pairs of compounds, identify a test that can be used to distinguish between them. In your answer, include the expected observation(s).

(i) An alkane and an alkene

....

....

....

(2 marks)

(ii) An alkane and a carboxylic acid.

....

....

....

(2 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

6. (a) The Caribbean islands are known for their many resources. For example, the ore of aluminium is found in Jamaica and Guyana.

(i) Briefly describe the extraction of aluminium from its named ore. Include in your description ONE ionic equation.

....

....

....

....

....

....

....

....

....

(5 marks)

(ii) Although aluminium ore is mined in the Caribbean, the extraction of aluminium usually takes place in other countries. Suggest ONE reason why it may be difficult to extract aluminium in the Caribbean.

....

....

....

(2 marks)

(b) An alloy can be described as a ‘mixed metal solution’. Aluminium forms an alloy with magnesium that is used to make aircraft.

Identify this alloy and suggest why it is better to use it, rather than the pure metal, in the manufacture of aircraft.

....

....

....

....

....

....

....

(5 marks)

(c) “Some metals can be useful to man but yet harmful to the environment.” Comment on this statement with reference to mercury.

....

....

....

....

....

(3 marks)

Total 15 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

TEST CODE **01212032**

FORM TP 2016056

MAY/JUNE 2016

C A R I B B E A N   E X A M I N A T I O N S   C O U N C I L

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

CHEMISTRY

Paper 032 – General Proficiency

Alternative to SBA

2 hours 10 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of THREE questions. Answer ALL questions.
2. Write your answers in the spaces provided in this booklet.
3. Do NOT write in the margins.
4. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
5. You may use a silent, non-programmable calculator to answer questions.
6. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer.**
7. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

“*”Barcode Area”*”
Sequential Bar Code

NOTHING HAS BEEN OMITTED.

Answer ALL questions.

1. (a) At one time, sodium carbonate was widely used as the active ingredient in water softeners. It reacts with hydrochloric acid according to the following equation:

$$Na_2CO_3\ (aq) + 2HCl\ (aq) \rightarrow 2NaCl\ (aq) + H_2O\ (l) + CO_2\ (g)$$

You are required to determine the mass of hydrated sodium carbonate present in a water softener, ‘ Super Softee’, using the following procedure.

You are provided with the following reagents:

Solution A: This is a 1.0 dm^3 ‘Super Softee’ solution.
Solution B: This is a 0.10 mol dm^{-3} solution of hydrochloric acid.
Methyl orange indicator

Procedure:

1. Rinse and fill your burette with Solution B.

2. Pipette 25 cm^3 of Solution A into a conical flask and add 3 drops of methyl orange indicator.

3. Titrate the contents of the conical flask from (2) with Solution B from the burette.

4. Repeat the experiment until you receive consistent results but do NO MORE than 4 titrations.

Results:

(i) Record your volume readings to 2 decimal places in Table 1 below.

TABLE 1: TITRATION RESULTS FOR SOLUTION A WITH SOLUTION B

Burette Readings (cm^3)	**1**	**2**	**3**	**4**
Final volume				
Initial volume				
Volume of Solution B used				

(10 marks)

GO ON TO THE NEXT PAGE

(ii) Indicate the titration volumes you will use to obtain the average titration volume of Solution B used in the experiment.

....

(1 mark)

(iii) Hence, determine the average volume of Solution B that is required to react with 25 cm^3 of Solution A.

....

....

....

(1 mark)

(iv) Calculate the number of moles of hydrochloric acid (Solution B) used in the titration.

....

....

(1 mark)

(v) Calculate the number of moles of the active ingredient, sodium carbonate, in the 25 cm^3 of Solution A.

....

....

(1 mark)

(vi) Calculate the number of moles of the active ingredient, sodium carbonate, in the 1 dm^3 of Solution A.

....

....

(1 mark)

(vii) Calculate the mass of the active ingredient, hydrated sodium carbonate, in Solution A.
[The molar mass of hydrated sodium carbonate is 286 g mol^{-1}.]

....

....

(1 mark)

GO ON TO THE NEXT PAGE

(b) Sample **C** is a single compound. You are to identify the cation and anion present in **C** by carrying out the tests as described in Table 2 below. Record your observations and inferences in the spaces provided.

TABLE 2: RESULTS OF TESTS ON SAMPLE C

Test	Observation	Inference
(i) Dissolve the sample of solid, **C**, in 10 cm^3 of distilled water and note colour of solution.	• **(1 mark)**	• **(1 mark)**
(ii) If solid does not completely dissolve, filter and divide the filtrate into three portions.		
(iii) To the first portion, add aqueous sodium hydroxide dropwise until in excess.	• • **(2 marks)**	• **(1 mark)**
(iv) To the second portion of the solution, add aqueous ammonia solution dropwise until in excess.	• • **(2 marks)**	• **(1 mark)**
(v) To the third portion of the solution, add three drops of aqueous solution of barium nitrate, followed by dilute nitric acid.	• • **(2 marks)**	• **(1 mark)**

Total 27 marks

2. (a) The solubility of a solid in water is affected by different factors including temperature. A student performed an experiment to investigate the solubility of a solid, **D** in water at various temperatures. The results of this experiment are recorded in Table 3.

TABLE 3: DETERMINATION OF THE SOLUBILITY OF D AT VARIOUS TEMPERATURES

Experiment Number	Mass of D (g)	Volume of Water (cm^3)	Temperature at which Crystals Reappear (°C)	Solubility of D (g/100 g water)
1	15	10	71	150
2	15	12	66	
3	15	14	61	
4	15	16	56	
5	15	18	51	
6	15	20	45	75

(i) Complete Table 3 by calculating the solubilities of **D** (g/100 g water) using the following formula:

$$\text{Solubility of } \mathbf{D} \text{ (g/100 g water)} = \frac{\text{mass of } \mathbf{D}}{\text{Volume of water}} \times 100$$

Assume 1 cm^3 water = 1 g

Record your values to the nearest whole number. **(2 marks)**

(ii) Using the grid provided in Figure 1 **on page 9**, plot a graph of the solubility of **D** (g/100 g water) against temperature (in °C). Draw a smooth curve through the points. **(5 marks)**

(iii) What deduction about the solubility of **D** can be made from the graph you have drawn in (a) (ii)?

....

....

(1 mark)

(b) In order to safely carry out the experiment, suggest the **best** method for heating the solution of **D**.

....

....

(1 mark)

Total 9 marks

GO ON TO THE NEXT PAGE

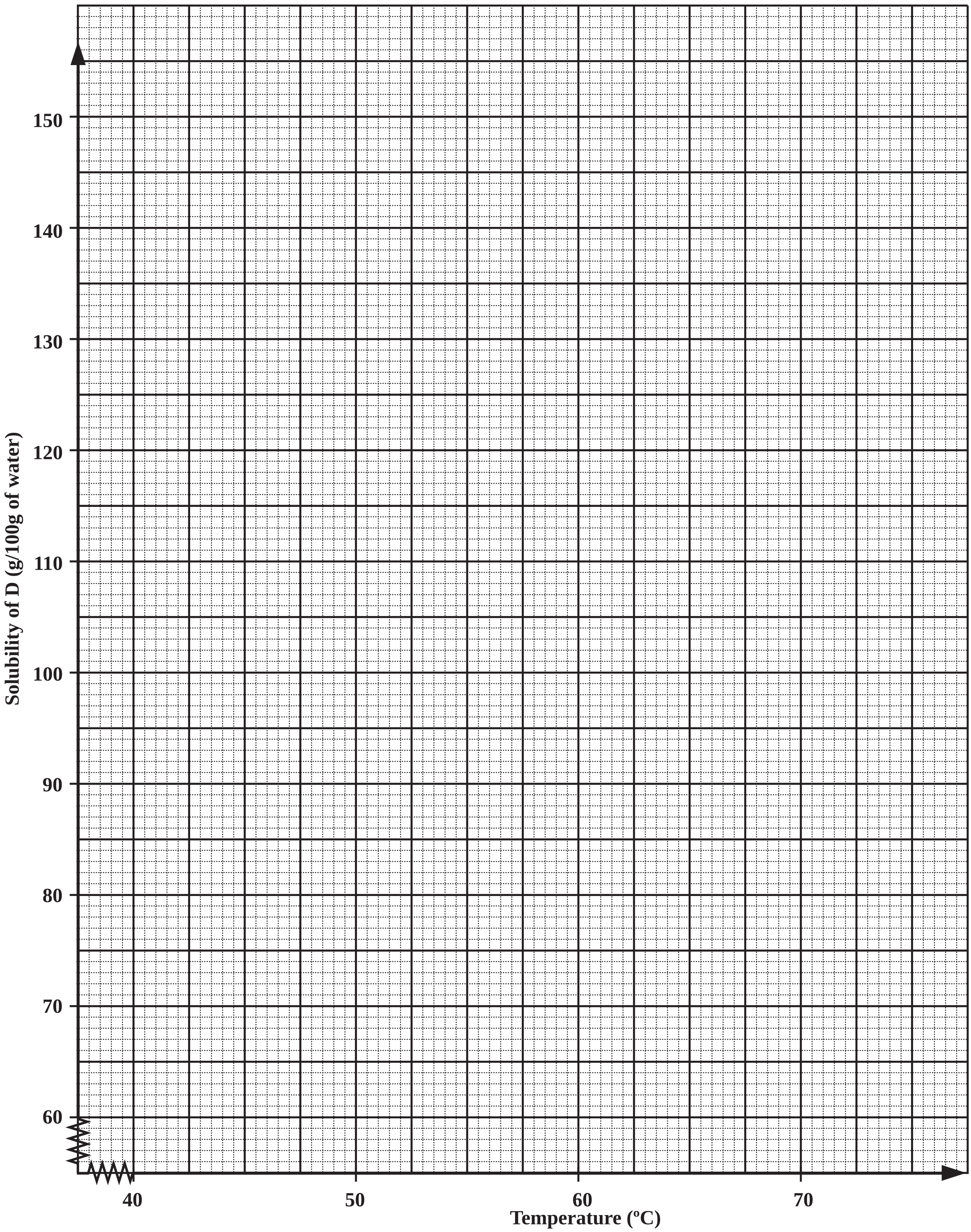


Figure 1. Solubility curve of Solid D

GO ON TO THE NEXT PAGE

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

3. You are provided with the following reagents:

- 0.1 mol dm^{-3} of magnesium sulfate solution
- 0.1 mol dm^{-3} copper(II) sulfate solution
- 0.1 mol dm^{-3} iron(II) sulfate solution
- Equal lengths of metal strips labelled X, Y and Z which are believed to be magnesium, copper and iron

You are required to design an experiment to identify the metals X, Y and Z. The aim and hypothesis are given below.

Aim: To identify metals X, Y and Z based on their displacement reactions.

Hypothesis: A metal higher in the reactivity series will displace a metal lower than itself in the reactivity series from a solution of its salt.

Your answer should include the following:

(a) Procedure

....

....

....

....

....

....

....

(3 marks)

(b) Apparatus/materials required

....

....

....

....

....

(2 marks)

(c) THREE controlled variables

....

....

....

(3 marks)

(d) Format for Table of Results

(2 marks)

(e) Discussion of results in relation to aim and hypothesis

....

....

....

....

....

....

(2 marks)

Total 12 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.