

FORM TP 2012057



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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.

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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)

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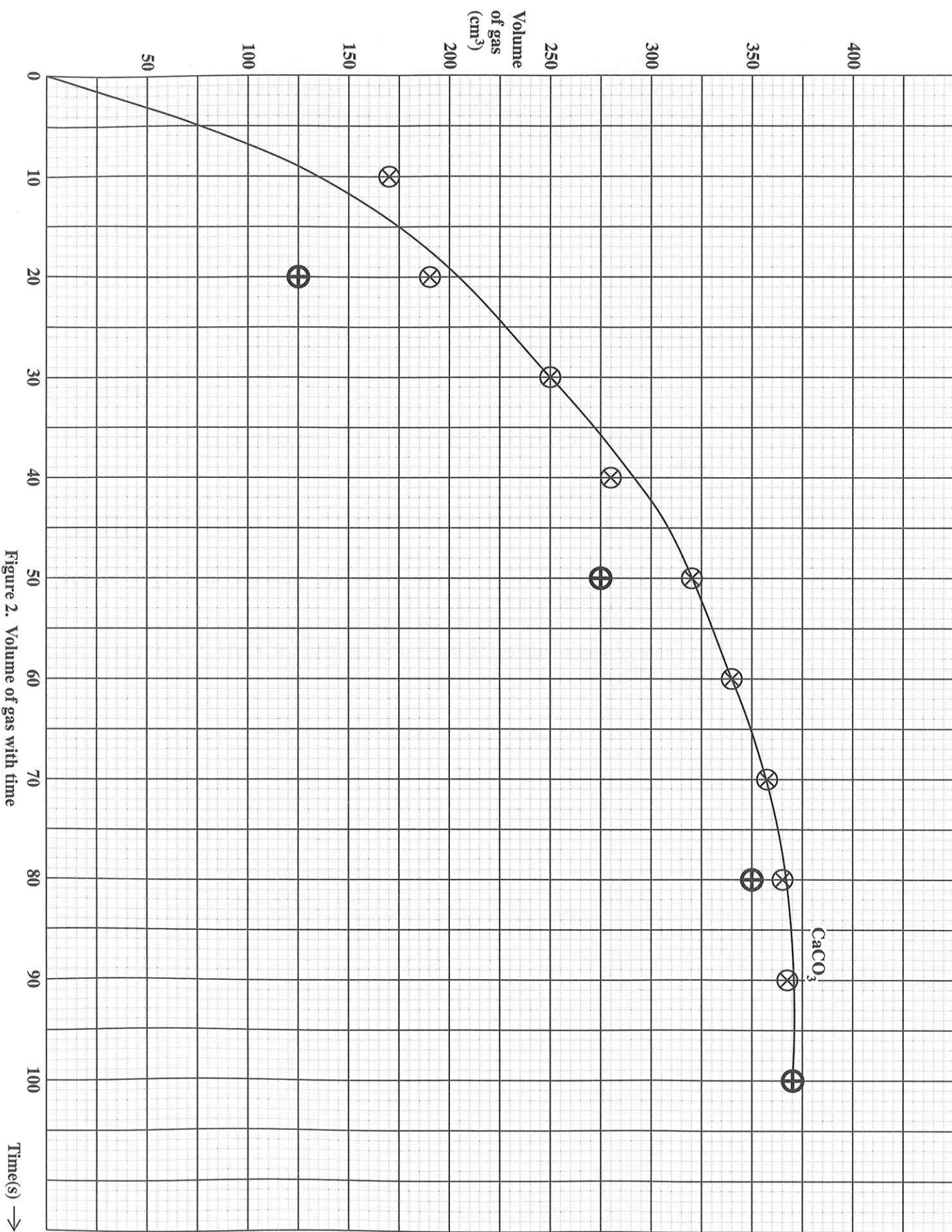


Figure 2. Volume of gas with time

- (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 cm³ 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. Aqueous sodium hydroxide is added to the mixture until in excess.	(ii) • • A green gelatinous precipitate insoluble in excess sodium hydroxide is formed.	The magnesium reduces Solution Y. Iron(II) ions are produced. (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

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2. Figure 3 shows a simplified diagram of the apparatus used for the electrolysis of aqueous copper(II) sulphate, CuSO_4 , using platinum electrodes.

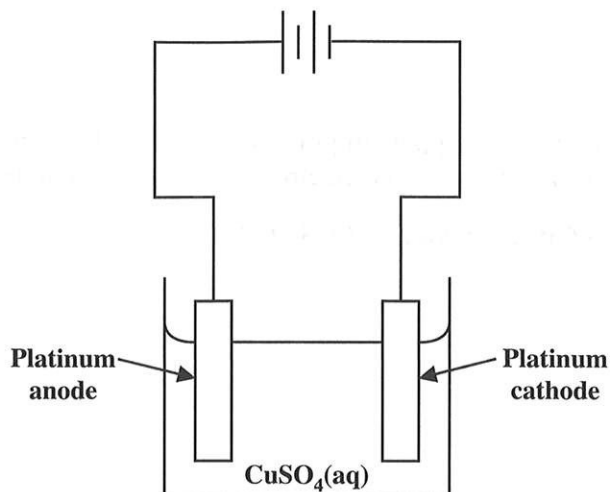


Figure 3. Electrolysis of $\text{CuSO}_4(\text{aq})$

- (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:

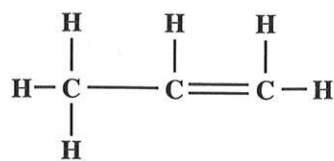
Electrolyte:

(3 marks)

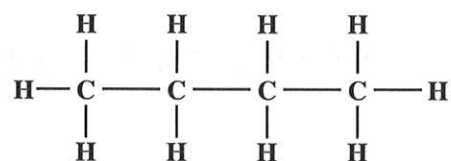
Total 15 marks

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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**:

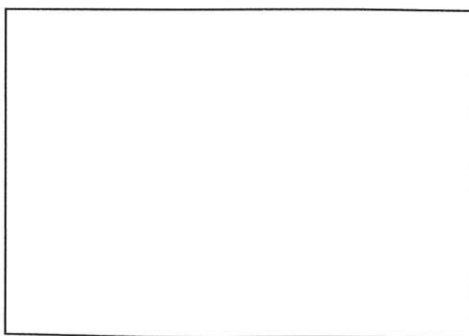
(2 marks)

- (iii) Both **A** and **B** react with chlorine, but under different conditions.

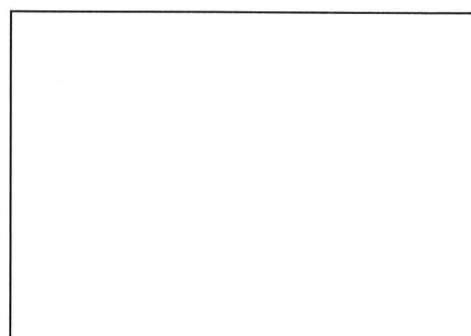
- a) State ONE necessary condition for **B** to react with chlorine.

(1 mark)

- b) Draw the FULLY displayed structures of the organic products for the reactions of **A** and **B** with chlorine.



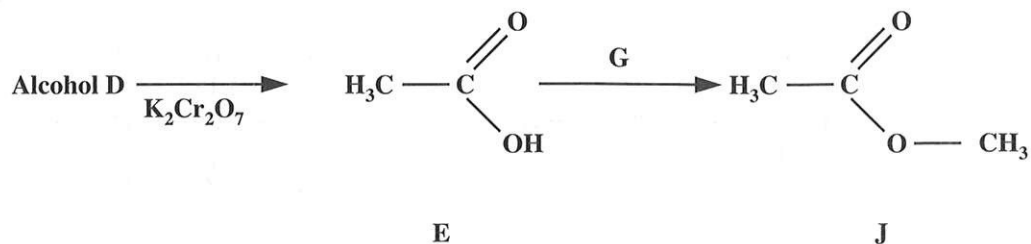
Organic product of A with chlorine



Organic product of B with chlorine

(4 marks)

- (b) The questions below are based on the following reaction scheme.



- (i) State the role of $\text{K}_2\text{Cr}_2\text{O}_7$ 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.
