

CARIBBEAN EXAMINATIONS COUNCIL

**CARIBBEAN SECONDARY EDUCATION CERTIFICATE®
EXAMINATION**

11 JANUARY 2022 (a.m.)



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SUBJECT CHEMISTRY – Paper 02

PROFICIENCY GENERAL

REGISTRATION NUMBER

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SCHOOL/CENTRE NUMBER

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NAME OF SCHOOL/CENTRE

CANDIDATE'S FULL NAME (FIRST, MIDDLE, LAST)

DATE OF BIRTH

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CARIBBEAN EXAMINATIONS COUNCIL

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.

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SECTION A

Answer ALL questions.

Do NOT spend more than 30 minutes on Question 1.

1. A student conducted an experiment to investigate the reaction between calcium carbonate and dilute nitric acid. He weighed 1.8 g of powdered calcium carbonate and allowed it to react with excess dilute nitric acid. The volume of gas produced at ten-second intervals was measured for a total of 80 seconds.

Table 1 is a record of the volume of gas produced from the reaction (with the powdered calcium carbonate). Figure 1 is an incomplete diagram of the arrangement of the apparatus used in the experiment.

TABLE 1: VOLUME OF GAS PRODUCED

Time (s)	0	10	20	30	40	50	60	70	80
Volume of Gas Produced (cm ³)	0	100	190	250	280	320	340	360	360

- (a) Complete Figure 1 by drawing and labelling the remaining apparatus to show how the gas was collected and measured during the experiment.



Figure 1. Arrangement of apparatus

(3 marks)

- (b) Using the axes in Figure 2, plot a graph on page 5, showing the volume of gas produced versus time for the reaction of dilute nitric acid with the powdered calcium carbonate. Label this Graph A.

(5 marks)

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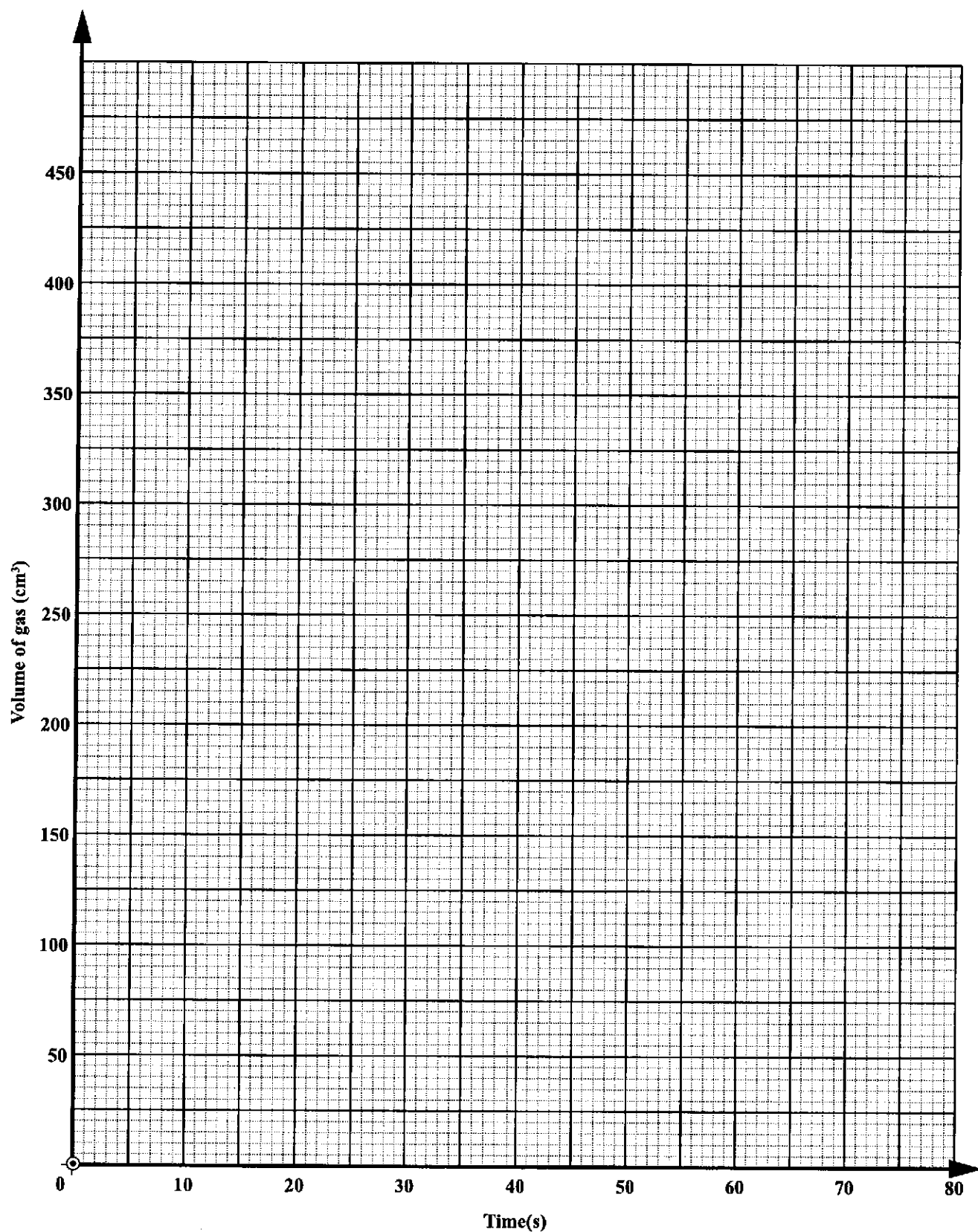


Figure 2. Graph of volume of gas produced versus time for the reaction

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- (c) Write a balanced equation, including state symbols, for the reaction between calcium carbonate and dilute nitric acid.

.....
.....
(3 marks)

- (d) Calculate the volume of gas that can be obtained from reacting 1.8 g of calcium carbonate with dilute nitric acid at RTP.

**[1 mole of gas occupies 24 000 cm³ at RTP.
RAM: C = 12; O = 16; Ca = 40]**

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(3 marks)

- (e) From the graph, the total volume of gas produced is 360 cm³. Calculate the difference in volume between the answer obtained in (d) and the total volume produced. Suggest a possible reason for the difference.

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(2 marks)

- (f) State THREE factors that can affect the rate of reaction between dilute nitric acid and calcium carbonate.

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.....
.....
(3 marks)

GO ON TO THE NEXT PAGE



- (g) If marble chips (large granules of calcium carbonate) were used instead of powdered calcium carbonate, sketch a graph of what this reaction would be, on Figure 2 on page 5. Label this sketch Graph B. (2 marks)
- (h) Complete the table below by identifying ONE similarity and ONE difference between Graph A and B and suggesting ONE reason for each.

	Graph A and B	Reason
Similarity		
Difference		

(4 marks)

Total 25 marks



2. (a) Kwasi went to the kitchen to collect his morning snack during his study break and saw some strips of green pawpaw in a container of water. He did not think anything of it but when he returned to the kitchen later, he observed that all the strips were swollen. "Ah! This must be osmosis!" he thought.

(i) Define the term 'osmosis'.

.....

.....

.....

.....

(2 marks)

(ii) Explain how osmosis in the pawpaw supports the particulate theory of matter.

.....

.....

.....

.....

(2 marks)

(iii) The green pawpaw was a solid that was placed into a liquid. State how the arrangement of particles in a liquid differs from that in a solid and a gas.

.....

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.....

.....

(3 marks)

(iv) Diffusion is another process that supports the particulate theory of matter. State ONE example of such a process.

.....

.....

(1 mark)



- (b) The element chlorine has an atomic number of 17, and it has TWO main isotopes, with mass numbers 35 and 37 respectively.

- (i) Define the terms 'atomic number' and 'mass number'.

.....

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(2 marks)

- (ii) Show by calculation that chlorine-35 and chlorine-37 are isotopes.

.....

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(2 marks)

- (iii) A student, while investigating the reactions of chlorine, bubbles chlorine gas into an aqueous solution of potassium iodide and deduces that the potassium iodide was oxidized because a colour change occurred.

Write a balanced chemical IONIC equation, with state symbols, for the reaction that is responsible for the colour change.

.....

.....

.....

.....

(3 marks)

Total 15 marks

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3. (a) Compound A is a straight-chain hydrocarbon with the molecular formula C_5H_{12} .

(i) State ONE natural source and TWO uses of Compound A.

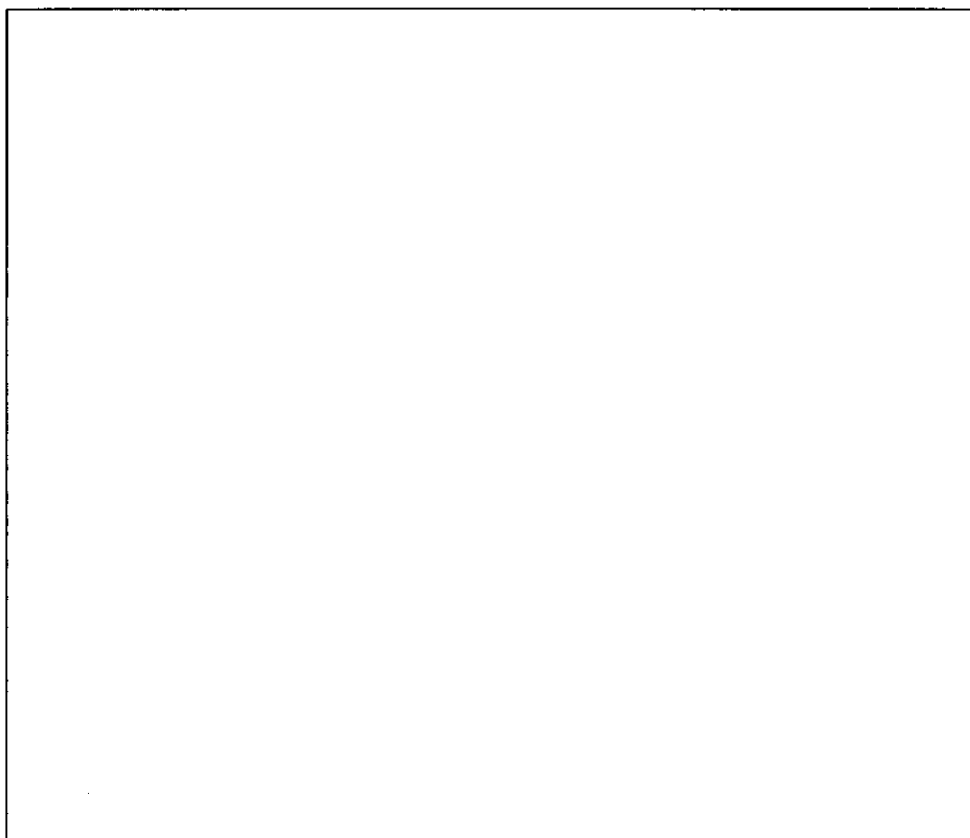
Source

Uses

.....

(3 marks)

(ii) Draw the FULLY DISPLAYED structure of Compound A.



(2 marks)

GO ON TO THE NEXT PAGE

(b) Thermal and catalytic cracking are very useful processes in the petrochemical industry.

(i) Define the term 'catalytic cracking'.

.....

.....

.....

.....

(2 marks)

(ii) State the importance of catalytic cracking in petroleum refineries.

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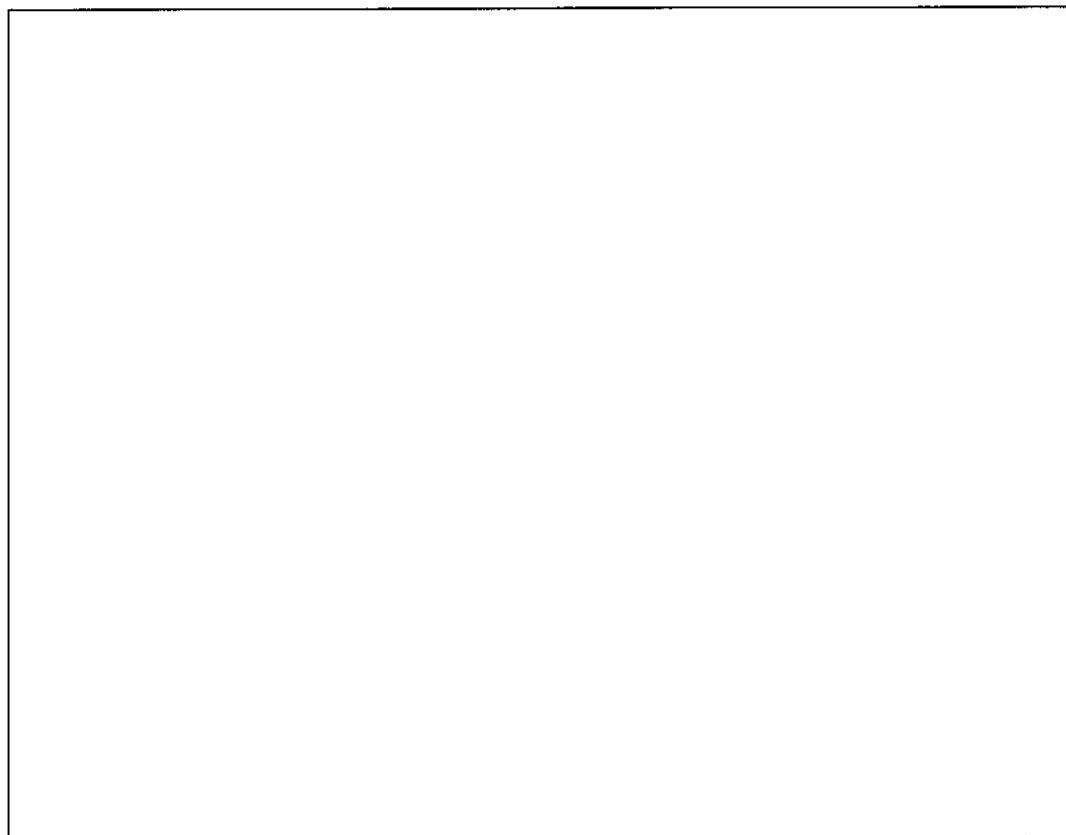
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(1 mark)



- (c) Ethene undergoes a halogenation reaction to form 1,2-dichloroethane.

Draw the FULLY DISPLAYED structure of 1,2-dichloroethane.



(2 marks)



(d) Dichloromethane can be obtained from methane. This reaction takes place in two steps.

- (i) Write balanced chemical equations to show EACH step in the formation of dichloromethane.

.....

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.....

.....

(4 marks)

- (ii) State whether the halogenation of methane is an addition or a substitution reaction.

.....

.....

(1 mark)

Total 15 marks



SECTION B

Answer ALL questions.

4. (a) The position of an unknown element, Q, is shown in the periodic table in Figure 3.

I	II		III	IV	V	VI	VII	VIII
Na	Mg							
	Q							

Figure 3. A part of the periodic table

- (i) State TWO factors that are used to arrange the elements in the periodic table.
-
-
- (2 marks)
- (ii) Based on the position of Element Q in the periodic table, state whether it would react more vigorously or less vigorously with water than Mg.
-
-
- (1 mark)
- (iii) State whether the solution formed from the reaction of Q with water would be acidic or basic. Give a range on the pH scale in which the solution would occur.
-
-
- (2 marks)
- (iv) Based on the position of Element Q, write the formula for its carbonate.
- Formula
-
- (1 mark)

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- (b) Sodium reacts with chlorine to form sodium chloride, a solid compound with a melting point of 801°C , which conducts electricity in solution or when molten.

(i) Deduce the type of bonding present in sodium chloride.

.....
(1 mark)

(ii) State the appearance that sodium chloride is expected to have.

.....
(1 mark)

- (c) Carbon is a non-metal element that is in Group IV and exists in two forms, diamond and graphite.

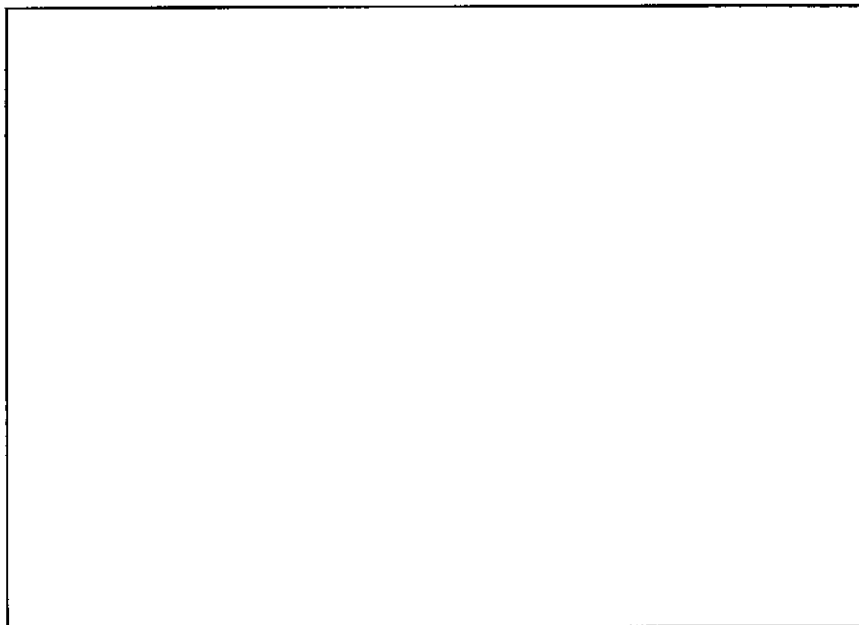
(i) Which of these forms of carbon conducts electricity?

.....
(1 mark)



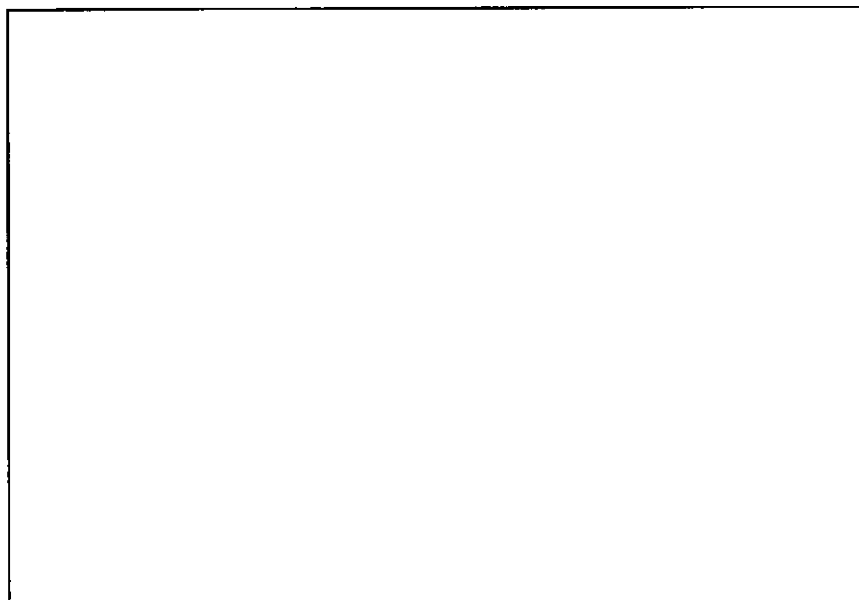
- (ii) Show, by using diagrams, the difference in structure between diamond and graphite which accounts for their difference in conductivity. Use solid lines (_____) to show strong bonds and dotted lines (.....) to show weak bonds.

Diamond



(3 marks)

Graphite



(3 marks)

Total 15 marks

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5. (a) The fully displayed structure of Compound B, C_4H_8 , is shown in Figure 4.

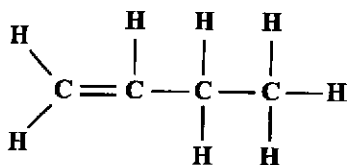


Figure 4. Compound B

- (i) Deduce the homologous series to which Compound B belongs.

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(1 mark)

- (ii) Write the name of Compound B.

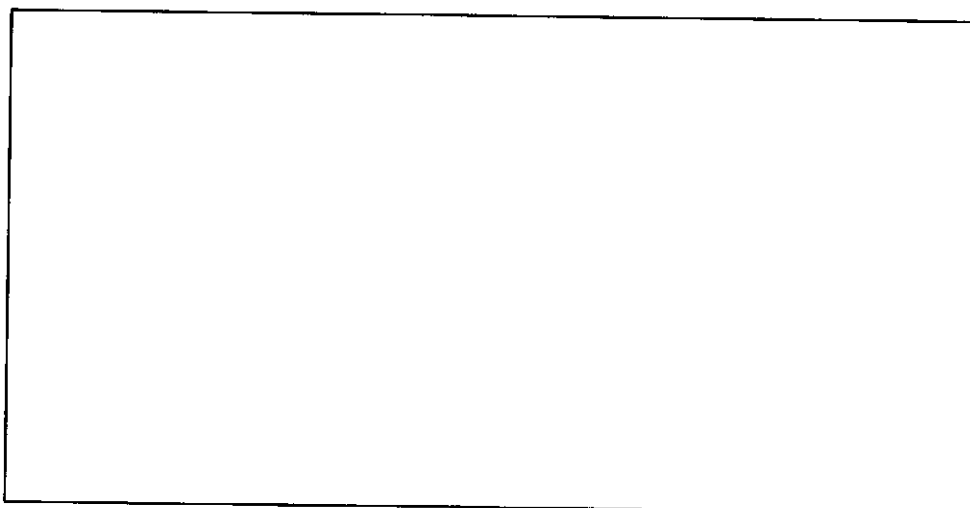
.....
(1 mark)

Compound B exhibits structural isomerism.

- (iii) Define the term 'structural isomerism'.

.....
.....
(2 marks)

- (iv) Draw the FULLY DISPLAYED structure of any structural isomer of Compound B and name it.



(3 marks)

- (b) Ethene and propene are typical monomers which are used as starting materials for making polymers. In forming polymers, ethene and propene undergo addition polymerization.

(i) Define the term 'polymer'.

.....
.....
.....

(1 mark)

(ii) Define what is meant by 'addition polymerization'.

.....
.....

(1 mark)

(iii) State ONE use of EACH of the following polymers:

Polyvinyl chloride

.....

(1 mark)

Teflon

.....

(1 mark)



- (c) There are several different types of polymers.

Figure 5 and Figure 6 below show the partial structure of a polymer. Deduce the type of polymer shown **and** the type of polymerization reaction that took place in EACH case.

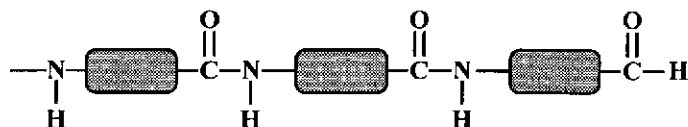


Figure 5. Partial structure of Polymer C

Type of polymer

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Type of polymerization

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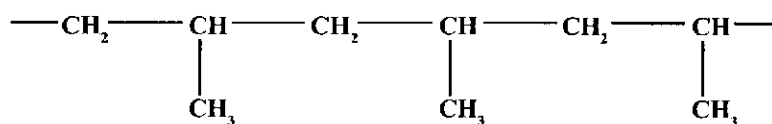


Figure 6. Partial structure of Polymer D

Type of polymer

.....

Type of polymerization

.....

(4 marks)

Total 15 marks



6. Chlorine bleach can be used to prepare emergency drinking water supplies in times of natural disasters when pipe-borne water is unavailable. It is made by mixing chlorine and sodium hydroxide (caustic soda) in a kind of reversal of the chlor-alkali process.

(a) (i) State ONE physical property and ONE chemical property of chlorine.

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.....
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(2 marks)

(ii) Describe a simple laboratory test that can be used to determine the presence of chlorine gas.

.....
.....
.....
.....

(2 marks)

(iii) State TWO uses of chlorine gas **other** than for purifying drinking water.

.....
.....

(2 marks)

(b) CFCs are organic compounds used as refrigerants and propellants in spray cans for deodorants, paints and insect repellants, and are known to be harmful to the environment.

(i) State the meaning of the term 'CFCs'.

.....
.....

(1 mark)

(ii) Give a named example of a CFC and state its formula.

.....
.....

(2 marks)

GO ON TO THE NEXT PAGE



- (iii) Give the name and formula of a molecule with which CFCs react in the environment.

.....
.....

(2 marks)

- (iv) Describe the process by which the use of CFCs result in a harmful effect on the environment.

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(4 marks)

Total 15 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.



11

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