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MAY/JUNE 2025

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours 30 minutes

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READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in TWO sections. 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.**

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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 group of students conducted an investigation to determine the products of electrolysis when dilute aqueous copper(II) sulfate solution was electrolyzed using copper electrodes.

The following steps indicate the procedure used.

1. The copper cathode was first washed in distilled water, dried and weighed, and then connected to a suitable circuit.

2. A current of 0.2 A was passed through the solution and the starting time recorded.

3. After five minutes, the switch was turned off and the cathode was removed, rinsed with distilled water, dried in air and then weighed.

4. The cathode was returned to the circuit and the process was repeated, recording the mass of the 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 were taken.

(a) (i) Define the term 'electrolysis'.

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(2 marks)

(ii) State ONE difference between the 'anode' and the 'cathode'.

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(1 mark)

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(iii) 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.

(4 marks)

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	

(iv) Plot a graph of actual mass of copper deposited versus time, using the axes in Figure 1 **on page 7**. Draw a line of best fit through the points. **(4 marks)**

(v) Use the graph to predict the mass of copper that would be deposited after 28 minutes. [Use dotted lines on the graph to show how you obtained your answer.]

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(2 marks)

(vi) Write an ionic equation to represent the reaction at the cathode.

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(2 marks)

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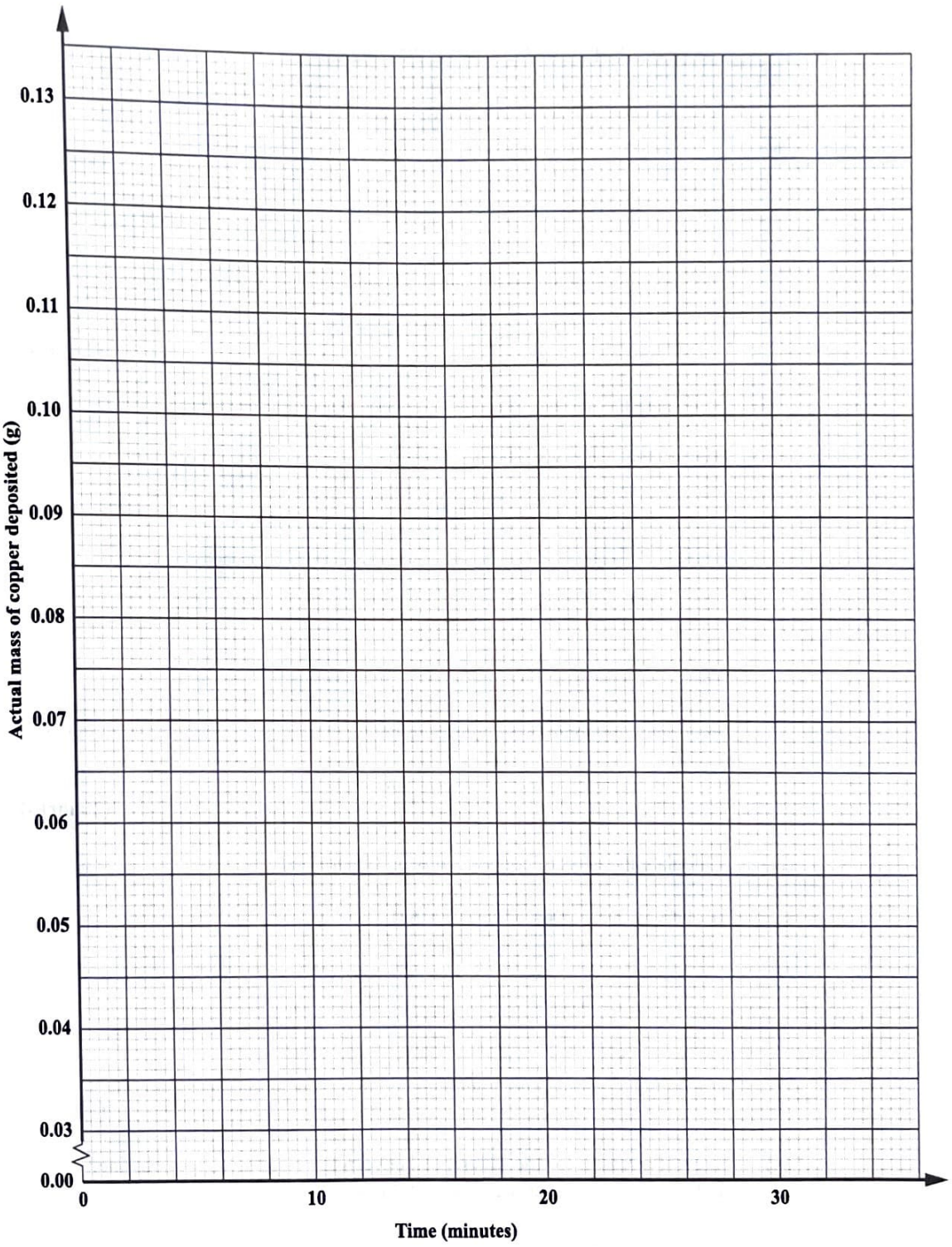


Figure 1. Actual mass of copper versus time

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(vii) Calculate the quantity of electricity that passed through the copper sulfate solution when 0.2 A of current flowed for 20 minutes.

(Given that quantity of electricity = current × time)

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(2 marks)

(viii) Calculate the number of moles of copper that would be formed.

(Given that 1 F = 96 500 C)

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(2 marks)

(ix) Calculate the mass of copper that would be formed.

(Relative atomic mass of copper = 64)

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(1 mark)

(x) Suggest a reason for the difference between the mass of copper obtained in (ix) and the mass of copper recorded in Table 1.

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(1 mark)

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(b) Complete Table 2 by writing the observations for each test 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.	• • **(2 marks)**	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.	• • **(2 marks)**	Zn^{2+} are present.

Total 25 marks

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2. Phosphoric acid, H_3PO_4, is a common additive in most soft drinks. It reacts with sodium hydroxide, an alkali, to form both normal and acid salts.

(a) Define EACH of the following terms.

(i) Acid

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(1 mark)

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(ii) Alkali

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(1 mark)

(iii) Normal salt

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(2 marks)

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(b) Write a balanced equation, including state symbols, to show the formation of the **normal salt** formed from the reaction between phosphoric acid and sodium hydroxide.

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(3 marks)

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(c) (i) State the molecular formula for an **acid salt** formed from the reaction between phosphoric acid and sodium hydroxide.

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(1 mark)

(ii) Write a balanced equation to show the formation of the **acid salt** stated in (c) (i).

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(2 marks)

(d) A solution of 0.05 M phosphoric acid has a pH of 4 while a solution of 0.05 M sulfuric acid has a pH of 1. State which of the two acids is stronger.

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(1 mark)

(e) Jeffrey complains of pains due to excess stomach acid after consuming too much orange juice.

(i) Name TWO acids present in orange juice.

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(2 marks)

(ii) State the type of chemical reaction that takes place in the treatment of excess stomach acid.

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(1 mark)

(iii) State the **chemical name or formula** of ONE compound that can be used to treat excess stomach acid.

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(1 mark)

Total 15 marks

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3. (a) State TWO natural sources of hydrocarbon.

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(2 marks)

(b) Identify the process used in the oil and gas industry to separate the components found in a natural source of hydrocarbon.

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(1 mark)

(c) Name TWO fractions that are obtained from the process for separating the components found in natural sources of hydrocarbon. State the use of EACH fraction.

Fraction 1 .....

Use .....

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(2 marks)

Fraction 2 .....

Use .....

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(2 marks)

(d) Methane and propene are obtained from the separation of hydrocarbons and both react with bromine.

(i) Write a balanced equation for the complete reaction of methane and bromine.

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(2 marks)

(ii) Write a balanced equation, including state symbols, for the reaction of propene and bromine.

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(2 marks)

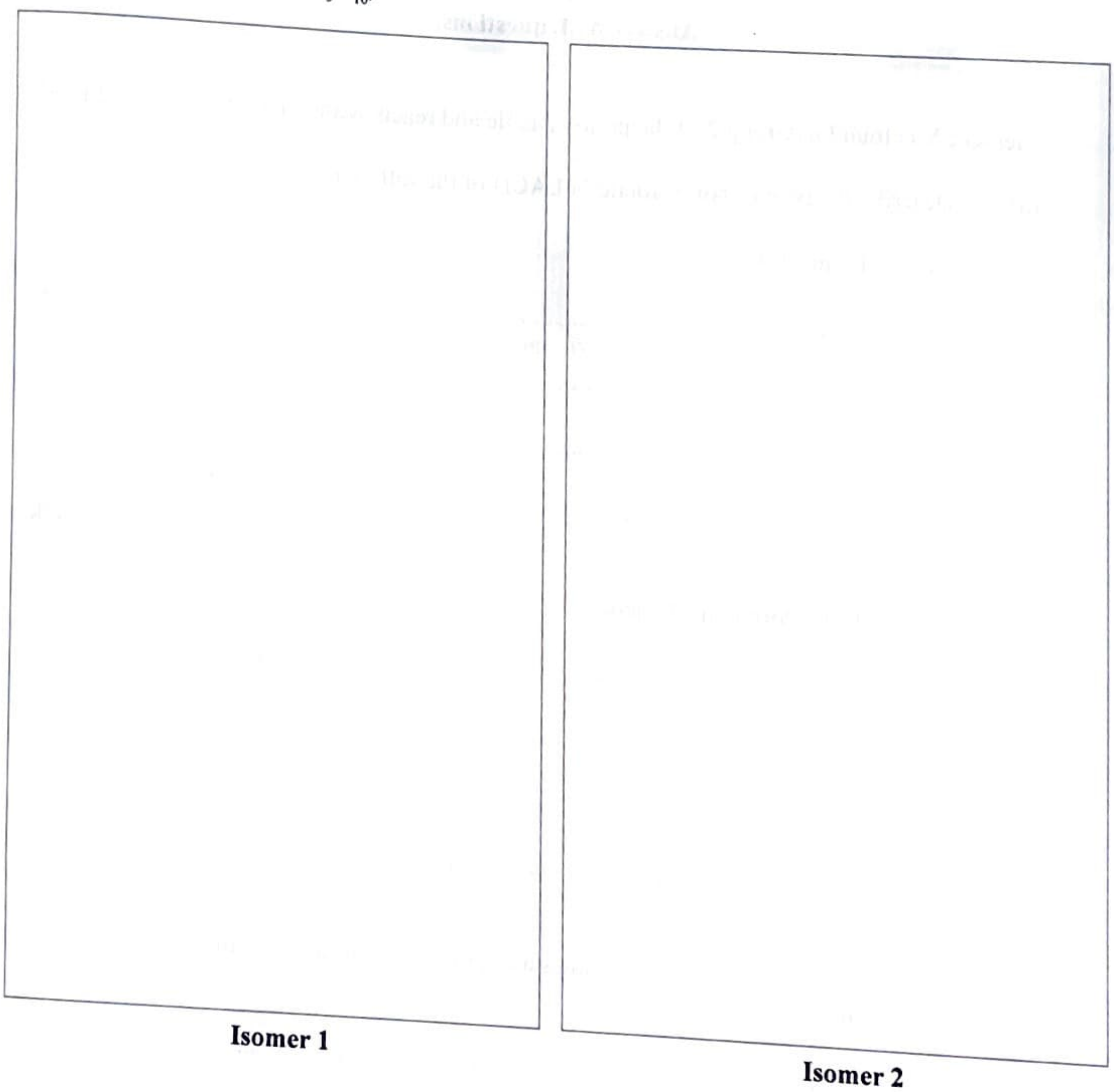
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(e) Pentene can exist as isomers. Draw the FULLY DISPLAYED structures of TWO isomers of pentene (C_5H_{10}).



Isomer 1 **Isomer 2**

(4 marks)

Total 15 marks

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natural sources of hydrocarbon.

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(2 marks)

rocess used in the oil and gas industry to separate the components found in ce of hydrocarbon.

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(1 mark)

actions that are obtained from the process for separating the components l sources of hydrocarbon. State the use of EACH fraction.

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(2 marks)

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(2 marks)

ene are obtained from the separation of hydrocarbons and both react

nced equation for the complete reaction of methane and bromine.

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(2 marks)

ced equation, including state symbols, for the reaction of propene

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(2 marks)

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(e) Pentene can exist as isomers. Draw the FULLY DISPLAYED structures of TWO isomers of pentene (C_5H_{10}).

Isomer 1

Isomer 2

(4 marks)

Total 15 marks

GO ON TO THE NEXT PAGE

SECTION B

Answer ALL questions.

4. Element X is found in Group 2 of the periodic table and reacts with chlorine to form a chloride.

(a) Describe the type of bonds found in EACH of the following.

(i) Element X

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(2 marks)

(ii) The chloride of Element X

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(2 marks)

(b) Write a balanced equation, including state symbols, to show the formation of the chloride of Element X.

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(2 marks)

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(c) Calculate the relative atomic mass of Element X. (Given that the molar mass of the chloride of Element X = 159; relative atomic mass of chlorine = 35.5)

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(2 marks)

(d) Element X also reacts with oxygen. Write the formula for the oxide formed.

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(1 mark)

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(e) The bonding of various substances can account for the properties they display. Graphite is used as an inert electrode whereas Element X is NOT likely to be used as an inert electrode.

With reference to the bonding in graphite **and** Element X, explain why graphite is used as an inert electrode while Element X is not.

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(6 marks)

Total 15 marks

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5. Organic compounds A, B, C and D belong to different homologous series. The molecular formulae of these compounds are shown below.

Compound A: C_4H_8 **Compound B:** C_4H_{10}

Compound C: $C_4H_8O_2$ **Compound D:** $C_4H_{10}O$

(a) State FOUR characteristics of a homologous series.

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(4 marks)

(b) Compound D is often used in industry to form polyesters.

State TWO uses of polyesters.

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(2 marks)

(c) Identify a test that can be used to distinguish between Compound A and Compound B. In your answer, include the expected observation(s) for EACH compound.

Test .....

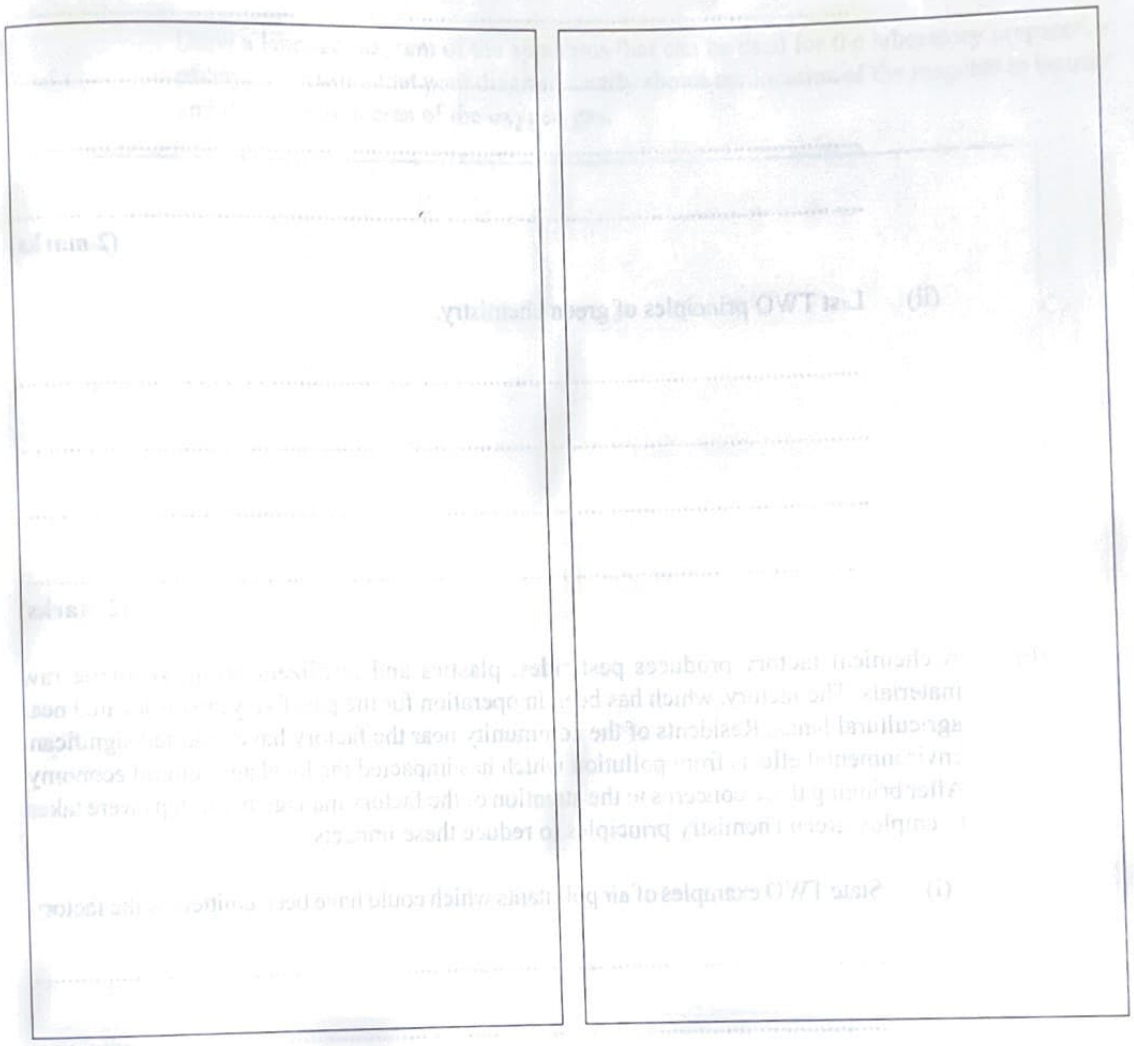
Observations .....

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(3 marks)

(d) From the list of compounds A, B, C and D **on page 18**, identify and draw the FULLY DISPLAYED structural formulae of the alkene and the acid.



Alkene ..... Acid .....

(6 marks)

Total 15 marks

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6. (a) (i) Define the term 'green chemistry'.

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(2 marks)

(ii) List TWO principles of green chemistry.

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(2 marks)

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(b) A chemical factory produces pesticides, plastics and fertilizers, using synthetic raw materials. The factory, which has been in operation for the past five years, is located near agricultural lands. Residents of the community near the factory have reported significant environmental effects from pollution which has impacted the local agricultural economy. After bringing these concerns to the attention of the factory management, steps were taken to employ green chemistry principles to reduce these impacts.

(i) State TWO examples of air pollutants which could have been emitted by the factory.

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(2 marks)

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(ii) Suggest THREE substances found in the products produced by the chemical factory that may have polluted the waterways.

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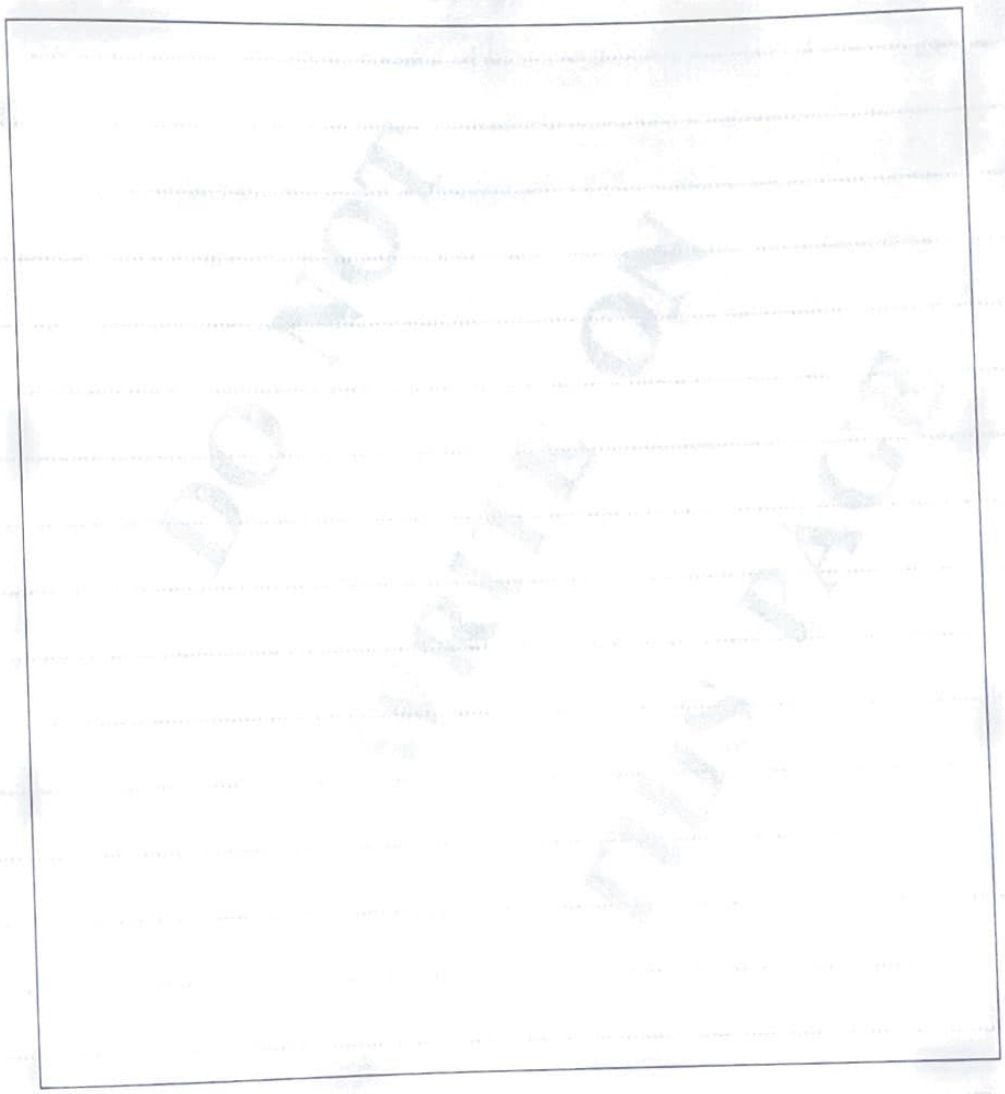
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(3 marks)

(c) Clean air in the Earth's atmosphere is made up of approximately 21 per cent oxygen. Oxygen gas can be prepared in the laboratory.

Draw a labelled diagram of the apparatus that can be used for the laboratory preparation of oxygen. Ensure that your diagram clearly shows the location of the reagents to be used and the collection area of the oxygen gas.



(6 marks)

Total 15 marks

END OF TEST

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

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