FORM TP 2024060

TEST CODE 01212020

MAY/JUNE 2024

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.

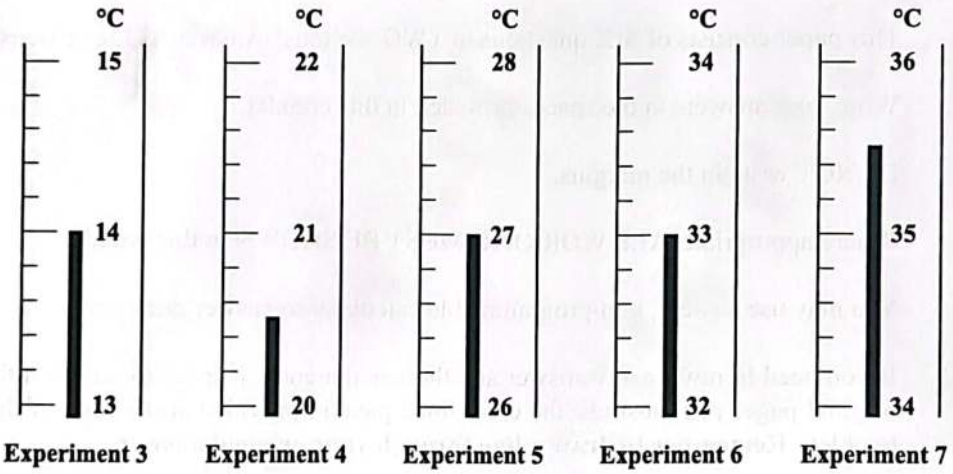
DO NOT spend more than 30 minutes on Question 1.

1. Sodium thiosulfate solution ($Na_2S_2O_3$) reacts with dilute hydrochloric acid to produce sodium chloride solution, sulfur dioxide gas, solid sulfur, and water.

To investigate the effect of temperature on the rate of reaction, Paul performed different experiments using sodium thiosulfate and dilute hydrochloric acid. For each experiment, the same volume and concentration of sodium thiosulfate and dilute hydrochloric acid were reacted but at different temperatures.

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The temperature was measured at the start of each experiment and the thermometer readings for Experiments 3–7 are shown in Figure 1.



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Figure 1. Temperature readings

(a) Define the term 'rate of reaction'.

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(1 mark)

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(b) (i) Write a balanced chemical equation for the reaction between sodium thiosulfate and dilute hydrochloric acid.

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(2 marks)

(ii) Describe a test and state the observation that can be used to confirm the presence of the sulfur dioxide gas produced from the reaction.

Test

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Observation

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(2 marks)

(iii) Determine the mass of sulfur dioxide produced when 50 cm^3 of the gas was collected at STP.

[RAM. S = 32, O = 16; 1 mole of a gas occupies 22 400 cm^3 at STP.]

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(3 marks)

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(c) (i) In Table 1, record the temperature readings for each of the experiments shown in Figure 1 **on page 4.**

TABLE 1: THE EFFECT OF TEMPERATURE ON THE RATE OF REACTION

Experiment Number	Temperature (°C)	Time (s)	Rate of Reaction (s^{-1})
1	5	59	0.017
2	10	50	0.020
3		40	
4		24	
5		15	
6		11	
7		10	

(5 marks)

(ii) Calculate, to three decimal places, the rate of reaction for EACH experiment, given that the rate is 1/Time. Record your results in Column 4 of Table 1. **(5 marks)**

(d) (i) Using the axes provided in Figure 2 **on page 7**, plot a graph of rate of reaction versus temperature for Experiments 1–7. Draw a smooth curve through the points. **(5 marks)**

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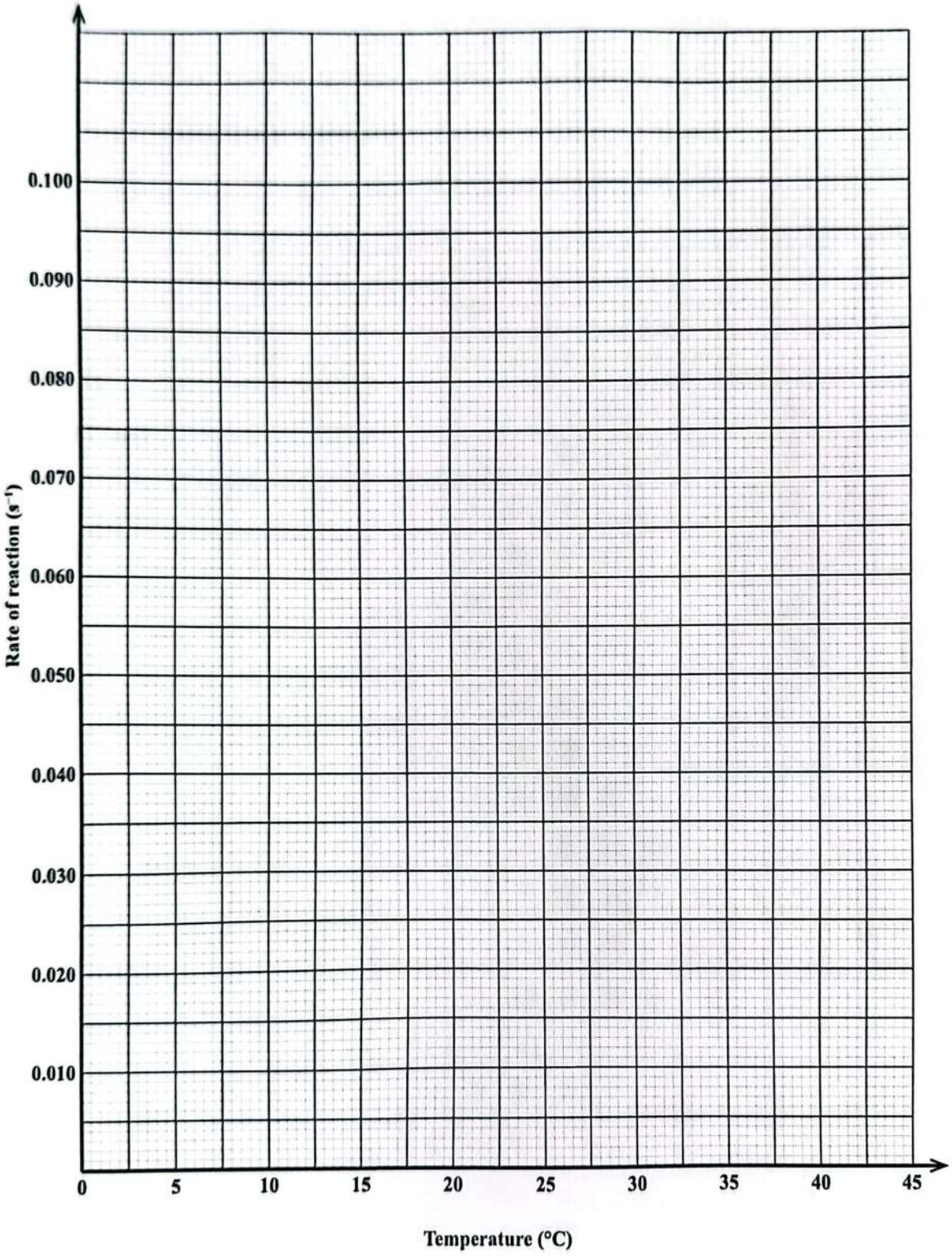


Figure 2. Graph of rate of reaction versus temperature

(ii) Using the graph you plotted **on page 7**, explain how the change in temperature affects the rate of the reaction between sodium thiosulfate and hydrochloric acid.

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(2 marks)

Total 25 marks

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2. The most stable form of the element oxygen has a mass number of 16 and an atomic number of 8. It can also exist as a radioactive isotope.

(a) Define the following terms.

(i) Atomic number

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(1 mark)

(ii) Mass number

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(1 mark)

(iii) Isotopes

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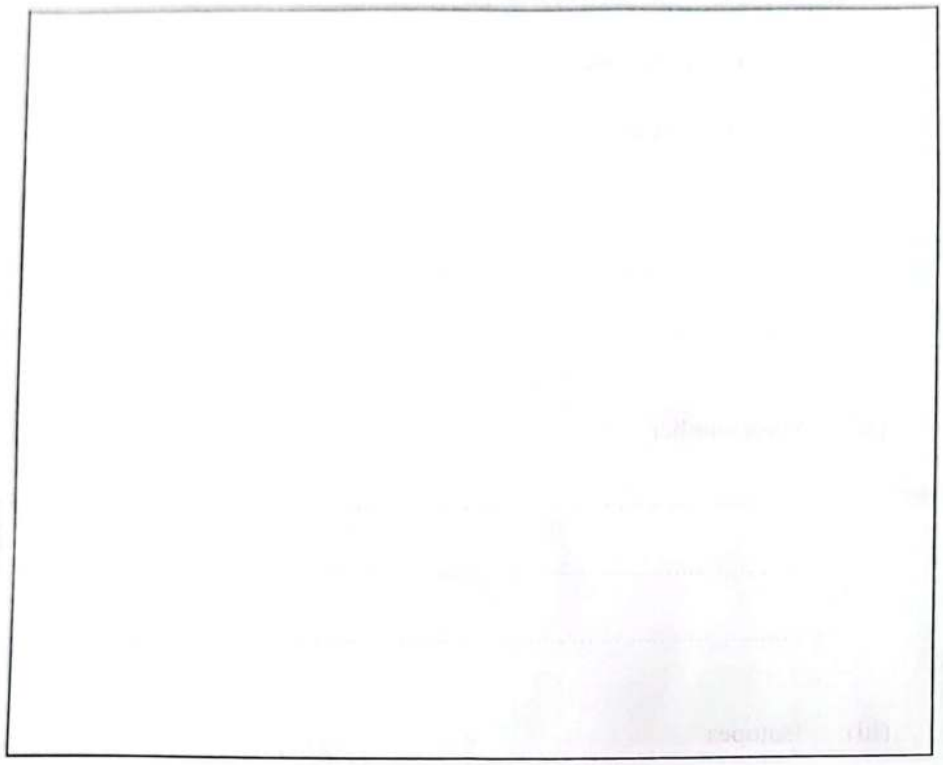
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(2 marks)

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(b) Use a dot and cross diagram to show the bonding present in oxygen gas.



(3 marks)

(c) There are many uses of radioactive isotopes in everyday life. List ANY THREE uses of radioactive isotopes.

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(3 marks)

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(d) Carbon burns completely in excess oxygen to produce carbon dioxide. Write a balanced chemical equation, including state symbols, to show this reaction.

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(2 marks)

(e) Carbon burns in limited oxygen supply to produce carbon monoxide. Write a balanced chemical equation, including state symbols, to show this reaction.

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(3 marks)

Total 15 marks

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3. (a) Compounds A and B are straight-chain hydrocarbons whose molecular formulas are C_5H_{12} and C_6H_{14} respectively.

(i) State ONE natural source of hydrocarbons.

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(1 mark)

(ii) State TWO uses of Compound B.

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(2 marks)

(b) (i) Draw the FULLY displayed structure of Compound A.

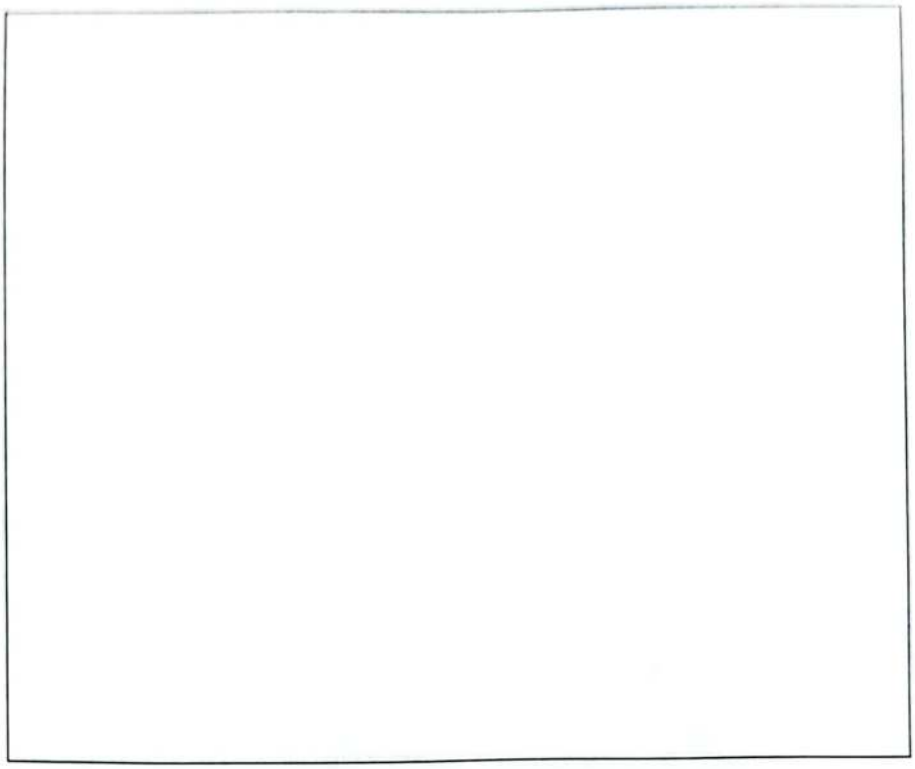
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(ii) Draw the FULLY displayed structure of Compound B.



(2 marks)

(c) (i) List ANY FOUR general characteristics of a homologous series.

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(4 marks)

(ii) Deduce the homologous series to which Compounds A and B belong.

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(1 mark)

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(d) Compound B (C_6H_{14}) burns completely in oxygen to produce carbon dioxide (CO_2) and water (H_2O). Write a balanced chemical equation, including state symbols, for this reaction.

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(3 marks)

Total 15 marks

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SECTION B

Answer ALL questions.

4. Magnesium and lead are metals often found in living things and in the environment.

(a) (i) Explain metallic bonding in metals.

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(2 marks)

(ii) Give the reason why metals conduct electricity in solid form.

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(1 mark)

(iii) State ANY TWO harmful effects of lead and its compounds on living things and their environment.

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(2 marks)

(b) A chemistry student conducted a series of experiments using an electrolytic cell to test the conductivity of magnesium chloride. The materials used to set up the apparatus and the student's observations were recorded in Table 2 below.

TABLE 2: MATERIALS USED TO SET UP EXPERIMENTS AND OBSERVATIONS

Experiment Number	Electrodes Used	Electrolyte	Bulb	Observations at Electrodes
1	PVC Plastic	Dilute aqueous magnesium chloride	Bulb did not light	No visible reaction
2	Graphite	Dilute aqueous magnesium chloride	Bulb lit	Gases produced at the cathode and the anode
3	Platinum	Solid magnesium chloride	Bulb did not light	No visible reaction

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(i) Explain why the bulb did **not** light in Experiments 1 and 3.

Experiment 1

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Experiment 3

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(4 marks)

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(ii) Explain why the bulb lit in Experiment 2.

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(3 marks)

(iii) State the process that took place in Experiment 2.

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(1 mark)

(c) Magnesium readily reacts with oxygen in the air. Write a balanced chemical equation for this reaction.

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(2 marks)

Total 15 marks

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5. (a) Proteins and starch are examples of natural polymers which are formed through the process of condensation polymerization.

(i) Define the term 'polymer'.

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(2 marks)

(ii) Define the term 'condensation polymerization'.

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(1 mark)

(b) The manufacture of ethanol makes use of the fermentation process.

(i) Define the term 'fermentation'.

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(3 marks)

(ii) Write a balanced chemical equation, including state symbols, to show the process of fermentation.

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(3 marks)

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(iii) Draw the FULLY displayed structure of ethanol.



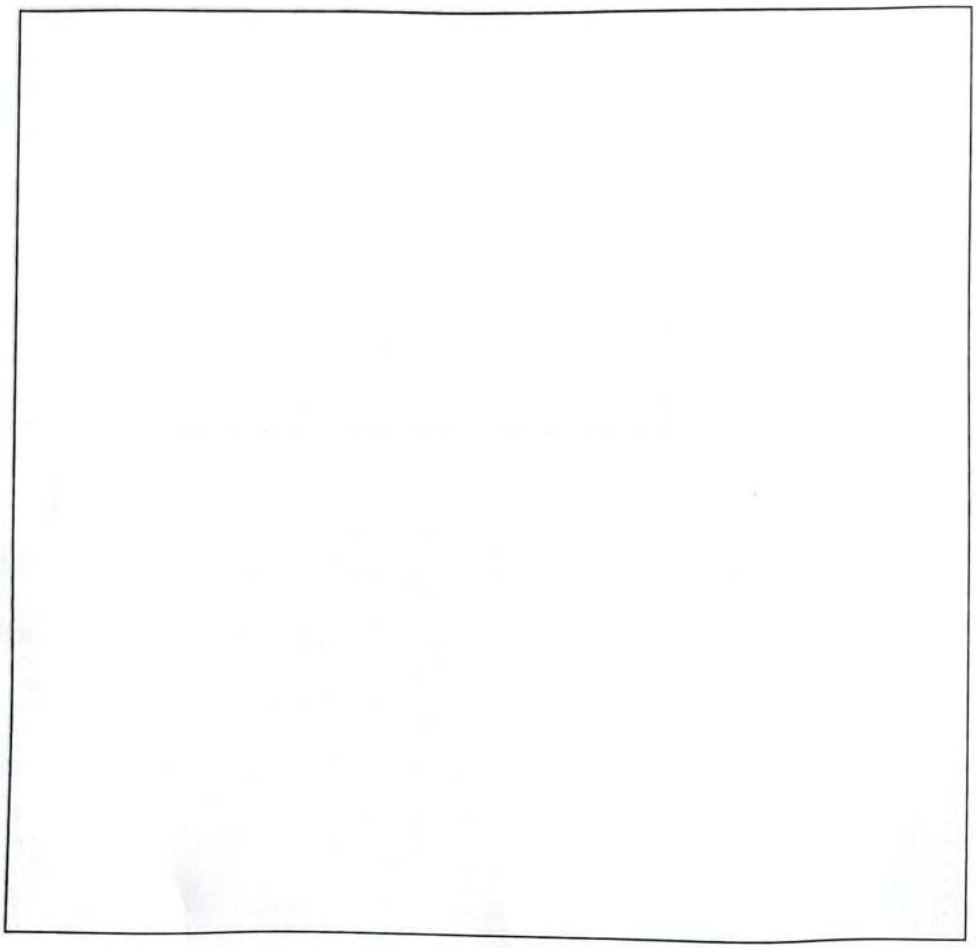
(2 marks)

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(iv) During a demonstration of the wine-making process in the school's food laboratory, a technician separated a pure sample of ethanol. However, the flask was not labelled and water was accidentally poured into the sample.

Using a line diagram, draw and label the apparatus that could be set up in the chemisty laboratory to obtain the pure ethanol from the contaminated sample.



(4 marks)

Total 15 marks

6. Alka Seltzer® and Epsom® salt are common remedies used in the Caribbean. Alka Seltzer® is an antacid used to treat upset stomach and Epsom® salt is used to treat sprains and muscle pain. The active ingredient in Alka Seltzer® is sodium bicarbonate ($NaHCO_3$) and in Epsom® salt, magnesium sulfate.

(a) Water is called the universal solvent because it dissolves many substances. Epsom® salt and Alka Seltzer® work by dissolving in water.

(i) Explain why water is a good solvent.

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(2 marks)

(ii) State TWO properties of water **other than** it is a good solvent.

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(2 marks)

(iii) State ANY TWO other compounds that dissolve in water.

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(2 marks)

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(b) Continuous use of Epsom® salt in water may cause hardness of water. This does not happen with Alka Seltzer®.

(i) State the type of water hardness caused by dissolving Epsom® salt in water.

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(1 mark)

(ii) Explain why Epsom® salt causes hardness of water.

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(2 marks)

(iii) Explain why boiling the water will **not** remove the hardness caused by Epsom® salt.

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(2 marks)

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(iv) Identify TWO salts that cause hardness of water and can be removed by boiling.

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(2 marks)

(v) When used as an antacid, Alka Seltzer® neutralizes the hydrochloric acid (HCl) in the stomach. Write a balanced chemical equation, including state symbols, to illustrate this process.

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(2 marks)

Total 15 marks

END OF TEST

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

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