FORM TP 2023060

TEST CODE 01212020

MAY/JUNE 2023

CARIBBEAN EXAMINATIONS COUNCIL

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. 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.

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SECTION A

Answer ALL questions.

DO NOT spend more than 30 minutes on Question 1.

1. Hydrogen peroxide (H_2O_2) decomposes to produce oxygen and water in the presence of potassium iodide (KI), a catalyst. The effect of the concentration of the hydrogen peroxide (H_2O_2) on the rate of reaction was investigated.

For each experiment, the concentration of the hydrogen peroxide (H_2O_2) was changed and the time taken for the hydrogen peroxide (H_2O_2) to decompose was measured using a stop clock as shown in Figure 1.

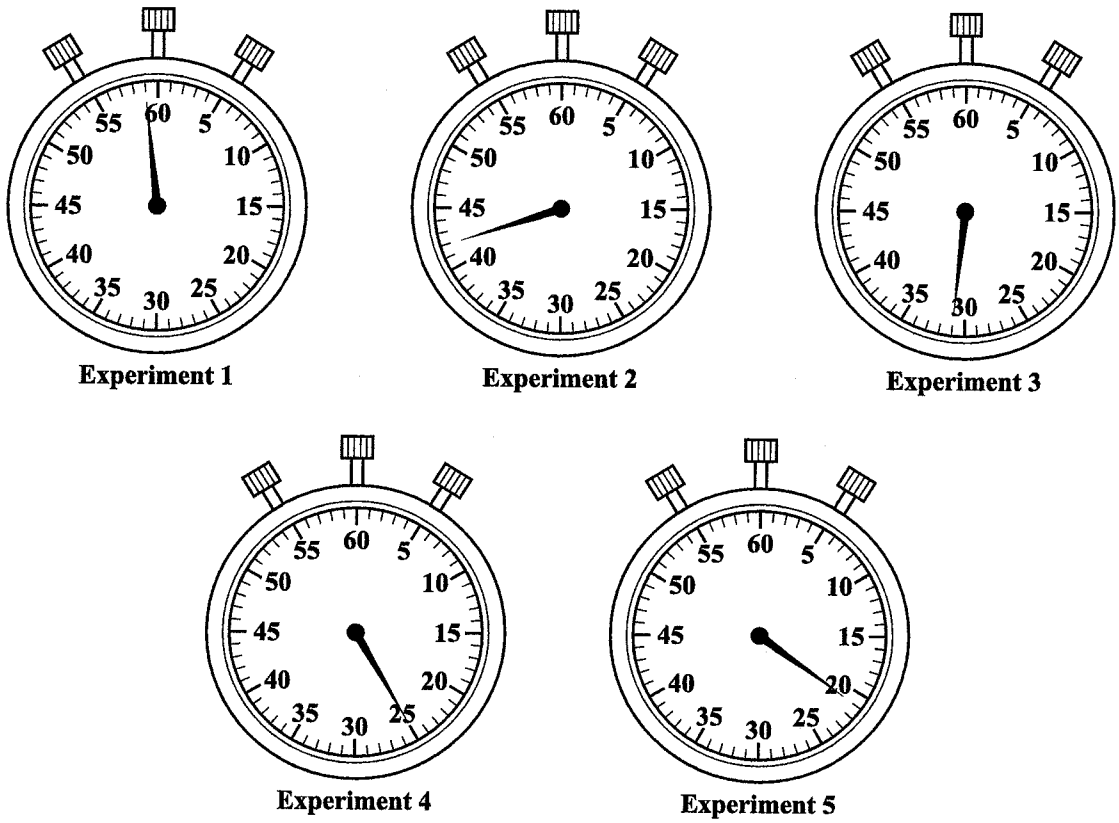


Figure 1. Time taken for hydrogen peroxide (H_2O_2) to decompose

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

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(1 mark)

(ii) Define the term 'catalyst'.

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(2 marks)

(b) For EACH experiment shown on the stop clocks in Figure 1 **on page 4**, record, in Table 1, the time taken for the hydrogen peroxide (H_2O_2) to decompose.

TABLE 1: THE EFFECT OF THE CONCENTRATION OF HYDROGEN PEROXIDE ON THE RATE OF REACTION

Experiment	**Concentration of Hydrogen Peroxide H_2O_2 (mol/dm^3)**	**Time (s)**	**Rate of Reaction (1/Time) (s^{-1})**
1	0.10	.....	.....
2	0.15	.....	.....
3	0.20	.....	.....
4	0.25	.....	.....
5	0.30	.....	.....

(5 marks)

(c) Complete Table 1 by calculating the rate of reaction ($\frac{1}{\text{Time}}$), **to three decimal places**, for EACH of the experiments. **(5 marks)**

(d) Using the axes provided in Figure 2 **on page 7**, plot a graph of rate of reaction versus concentration of hydrogen peroxide (H_2O_2), from the information in Table 1. Draw the line of best fit through the points. **(5 marks)**

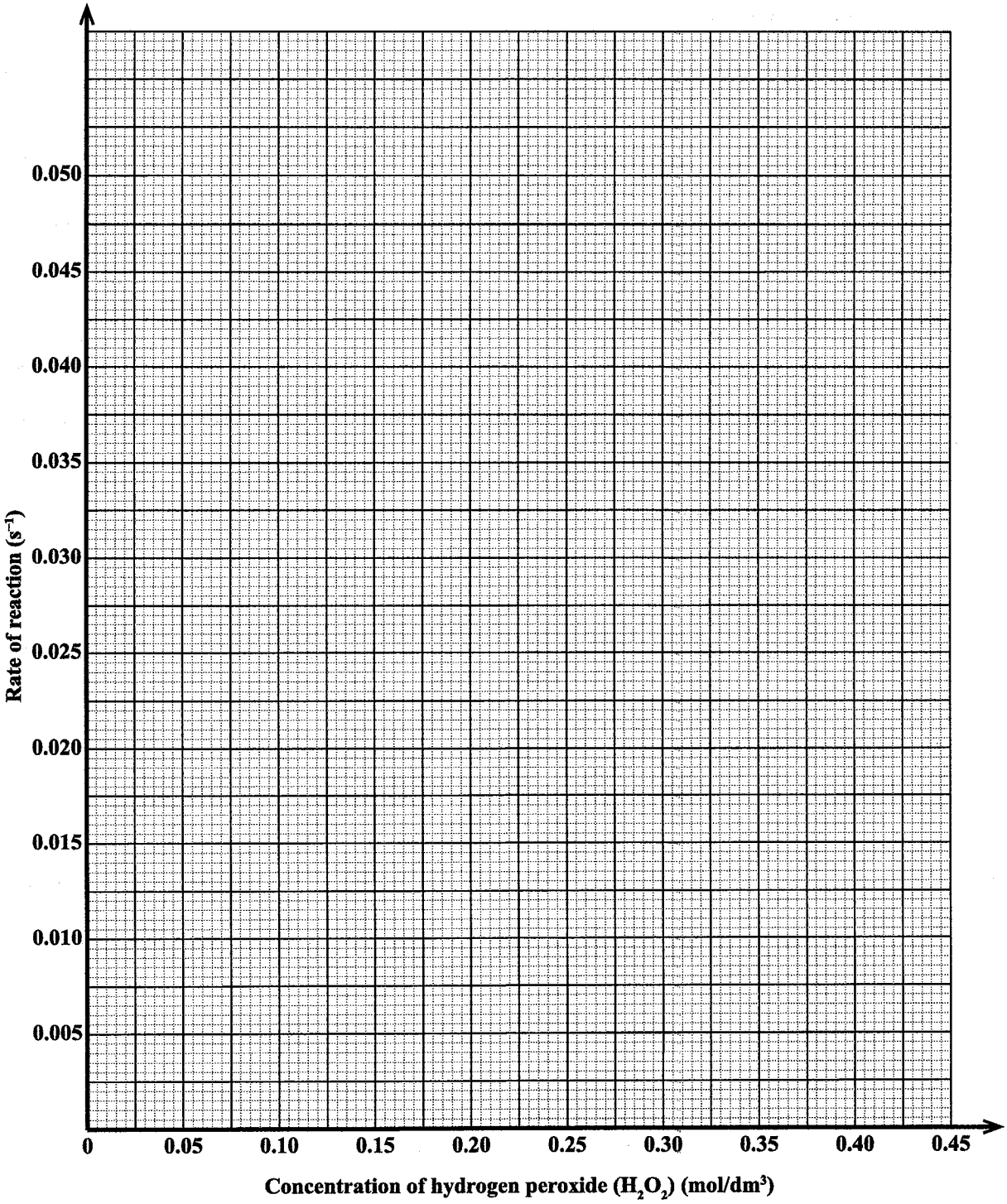


Figure 2. Graph of rate of reaction versus concentration of hydrogen peroxide (H_2O_2)

(e) Using your graph,

(i) describe the relationship between the rate of reaction and the concentration of the hydrogen peroxide (H_2O_2)

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(2 marks)

(ii) determine the concentration of the hydrogen peroxide (H_2O_2) given that the rate of reaction is 0.045 s^{-1}.

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(1 mark)

(f) Calculate the mass of the hydrogen peroxide (H_2O_2) present in the concentration identified in (e) (ii). [Molar mass, H_2O_2 = 34.01 g/mol]

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(1 mark)

(g) Write a balanced chemical equation, including state symbols, to show the decomposition of hydrogen peroxide (H_2O_2).

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(3 marks)

Total 25 marks

2. (a) At atmospheric pressure, water exists in three states of matter while carbon dioxide exists in only two states.

(i) List the THREE states of matter in which water can exist.

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(1 mark)

(ii) Describe the energy of the particles in EACH of the three states listed in (a) (i).

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(3 marks)

(iii) Name the process which occurs when carbon dioxide changes from one state to another.

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(1 mark)

(iv) Describe how the arrangement of the carbon dioxide particles changes as carbon dioxide undergoes the process named in (a) (iii).

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(2 marks)

(b) Using appropriate diagrams, illustrate the lattice structure of sodium chloride crystal and the giant molecular structure of diamond.

Sodium chloride	**Diamond**

(3 marks) **(3 marks)**

(c) In solution, two metals, A and B, form A^+ and B^{2+} ions respectively. Metal A displaces Fe from a solution containing Fe^{2+} ions but Metal B does not.

Write a balanced ionic equation to show the reaction between Metal A and Fe^{2+} ions.

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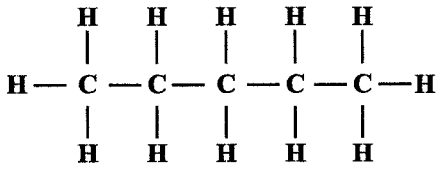
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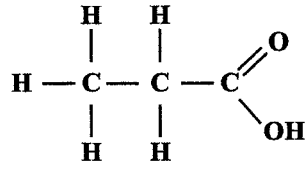
(2 marks)

Total 15 marks

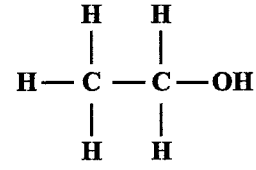
3. Figure 3 shows the fully displayed structures of three compounds, A, B and C, which are from different homologous series.



Compound A



Compound B



Compound C

Figure 3. Fully displayed structures of Compound A, Compound B and Compound C

(a) State the homologous series to which Compounds A and B belong.

Compound A .....

Compound B .....

(2 marks)

(b) Compound C burns with a blue flame in oxygen. Write a balanced equation for this reaction.

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(2 marks)

(c) State which of the two compounds, A or C, is more soluble in water. Give a reason for your answer.

More soluble compound .....

Reason .....

.....

(2 marks)

(d) State whether Compound B or Compound C would react more vigorously with sodium metal and give a reason for your choice.

More reactive compound: .....

Reason: .....

.....

(2 marks)

GO ON TO THE NEXT PAGE





(e) Write a balanced equation for the reaction of Compound C with sodium metal.

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(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 metal.

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(2 marks)

(g) Compound B and Compound C react together in the presence of a catalyst to form Compound D.

(i) State the name of the catalyst.

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(1 mark)

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

(2 marks)

Total 15 marks

SECTION B

Answer ALL questions.

4. (a) Sulfur and magnesium are two elements in the same period of the periodic table. The different properties of the oxides of these elements are presented in Table 2.

TABLE 2: PROPERTIES OF OXIDES

	Oxide of Sulfur	**Oxide of Magnesium**
State	Gas	Solid
Melting Point (°C)	-72	2852

(i) With reference to bonding, explain the difference in melting point between the oxides of sulfur and magnesium.

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(6 marks)

(ii) Explain whether the oxides of sulfur and magnesium will conduct electricity and, if so, under what conditions.

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(4 marks)

(b) Figure 4 is a partial diagram of the apparatus a group of students intend/propose to use to investigate whether ethanol, aqueous ammonia and aqueous lead(II) nitrate would conduct electricity.

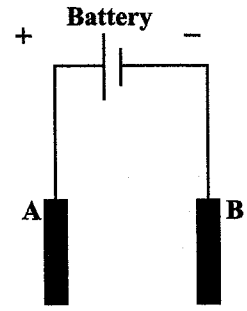


Figure 4. Partial diagram of apparatus

(i) Complete the diagram in Figure 4 in order to make it a circuit that is suitable for achieving the aim of the experiment. **(2 marks)**

(ii) Classify the three substances to be investigated (ethanol, aqueous ammonia and aqueous lead(II) nitrate) EITHER as conductors OR non-conductors.

Conductors .....

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Non-conductors .....

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(3 marks)

Total 15 marks

5. (a) Anaerobic fermentation occurs when yeast is used in the production of wine.

(i) Define the term 'anaerobic fermentation'.

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(2 marks)

(ii) State ONE reason why high temperatures are NOT suitable for anaerobic fermentation.

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(1 mark)

(iii) Write a balanced equation for the anaerobic fermentation of glucose.

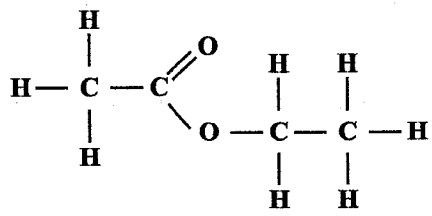
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(2 marks)

(b) Soaps are formed from the alkaline hydrolysis (saponification) of natural oils and fats (esters). Compound E, shown below, is an ester which is hydrolysed by aqueous sodium hydroxide. Draw the FULLY displayed structures of the hydrolysis products.



Compound E

(2 marks)

(2 marks)

(c) (i) Name the by-product of the saponification of fats and oils.

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(1 mark)

(ii) State ONE difference between the effect of using soaps and soapless detergents on hard water.

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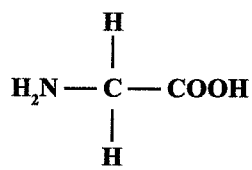
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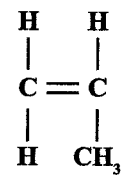
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(1 mark)

(d) Figure 5 shows the structures of an amino acid and propene.



Amino acid



Propene

Figure 5. Structures of an amino acid and propene

(i) State the type of polymerization that the amino acid in Figure 5, would undergo.

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(1 mark)

(ii) State the general name for the type of polymer formed from the amino acid in Figure 5.

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(1 mark)

(iii) State TWO chemical tests that can be used to distinguish between propene and its polymer.

Test 1: .....

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Test 2: .....

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(2 marks)

Total 15 marks

6. (a) Farmer Browne reaped a crop of vegetables and reported that the yield was far below what was expected. An analysis of the soil revealed that there was a deficiency of magnesium.

(i) Outline the importance of magnesium on plant health.

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(2 marks)

(ii) Explain how a magnesium deficiency can result in the low yield of vegetables.

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(3 marks)

(iii) State TWO other metal ions which are important to plant growth and the results of EACH deficiency.

Metal: .....

Deficiency: .....

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Metal: .....

Deficiency: .....

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(4 marks)

(b) The Caribbean Sea and many oceans around the world have been found to be polluted by solid waste, mainly in the form of plastics.

(i) State TWO examples of plastic waste that are commonly found in the seas and oceans.

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(2 marks)

(ii) Discuss TWO harmful effects of plastics on marine life.

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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.