FORM TP 2017051

TEST CODE 01212020

MAY/JUNE 2017

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.**

**NOTHING HAS BEEN OMITTED**



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## SECTION A

**Answer ALL questions in this section.**

**Write your responses in the spaces provided in this booklet.**

**DO NOT spend more than 30 minutes on Question 1.**

**1.** Hydrogen peroxide ($H_2O_2$) decomposes to produce oxygen and water. The rate of reaction can be increased by the use of catalysts. The effect of the mass of a catalyst on the rate of decomposition of hydrogen peroxide was investigated.

For EACH experiment, a different mass of the catalyst, manganese(IV) oxide ($MnO_2$) was combined with 50 $cm^3$ of 0.8 mol $dm^{-3}$ hydrogen peroxide solution and the volume of oxygen produced was measured. The masses used are shown on the balances displayed in Figure 1.

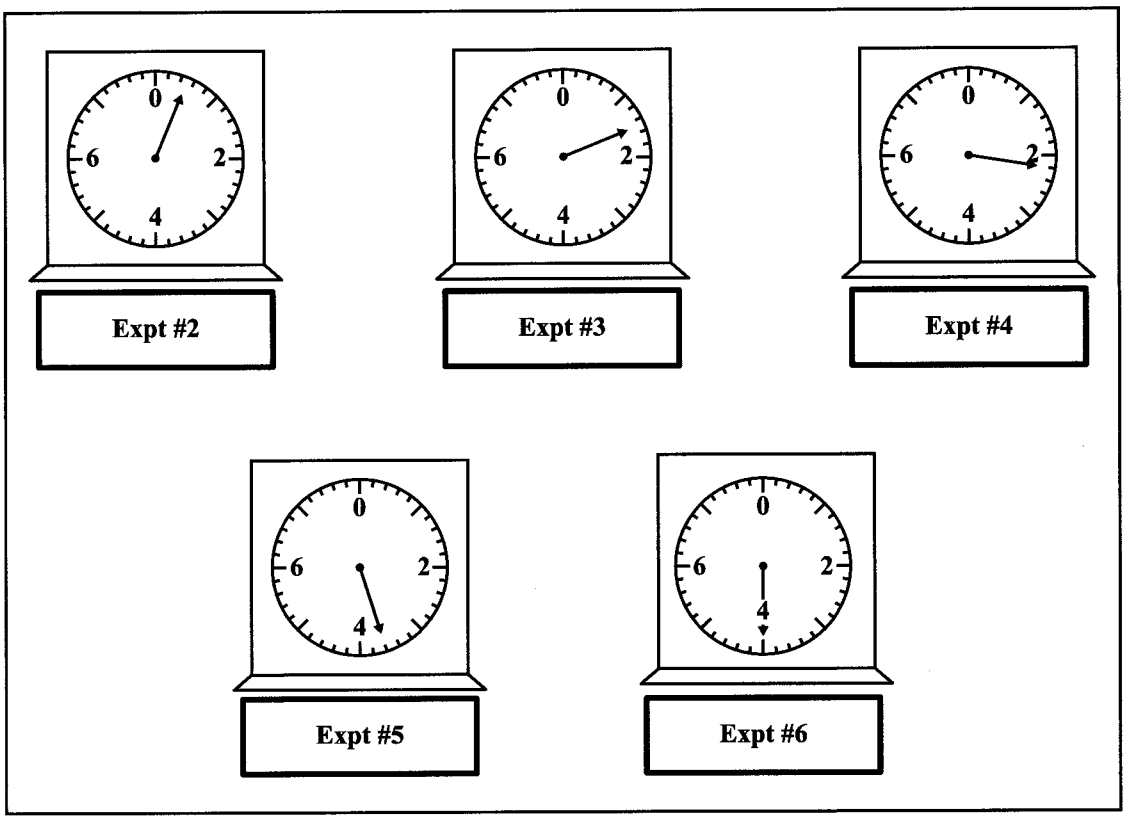


**Figure 1. Masses of manganese(IV) oxide**

(a) The rate of the reaction for EACH quantity of catalyst used was calculated and recorded in Table 1. Use the balances shown in Figure 1 **on page 5** to complete Table 1.

**TABLE 1 : RATE OF REACTION BY MASS OF MANGANESE(IV) OXIDE**

| Experiment | Mass of Manganese(IV) Oxide (g) | Rate of Reaction ($mLs^{-1}$) |
|---|---|---|
| 1 | 0.0 | 0.0 |
| 2 | | 0.6 |
| 3 | | 1.8 |
| 4 | | 2.7 |
| 5 | | 4.5 |
| 6 | | 5.0 |

**(5 marks)**

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

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**(1 mark)**

(c) Write a balanced chemical equation to show the decomposition of hydrogen peroxide.

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**(2 marks)**

(d) Using the axes in Figure 2 **on page 7**, plot a graph of rate of reaction versus mass of manganese(IV) oxide from the information in Table 1. One point has already been plotted. Circle the plotted points on the graph ⊗, and draw the line of best fit. **(5 marks)**

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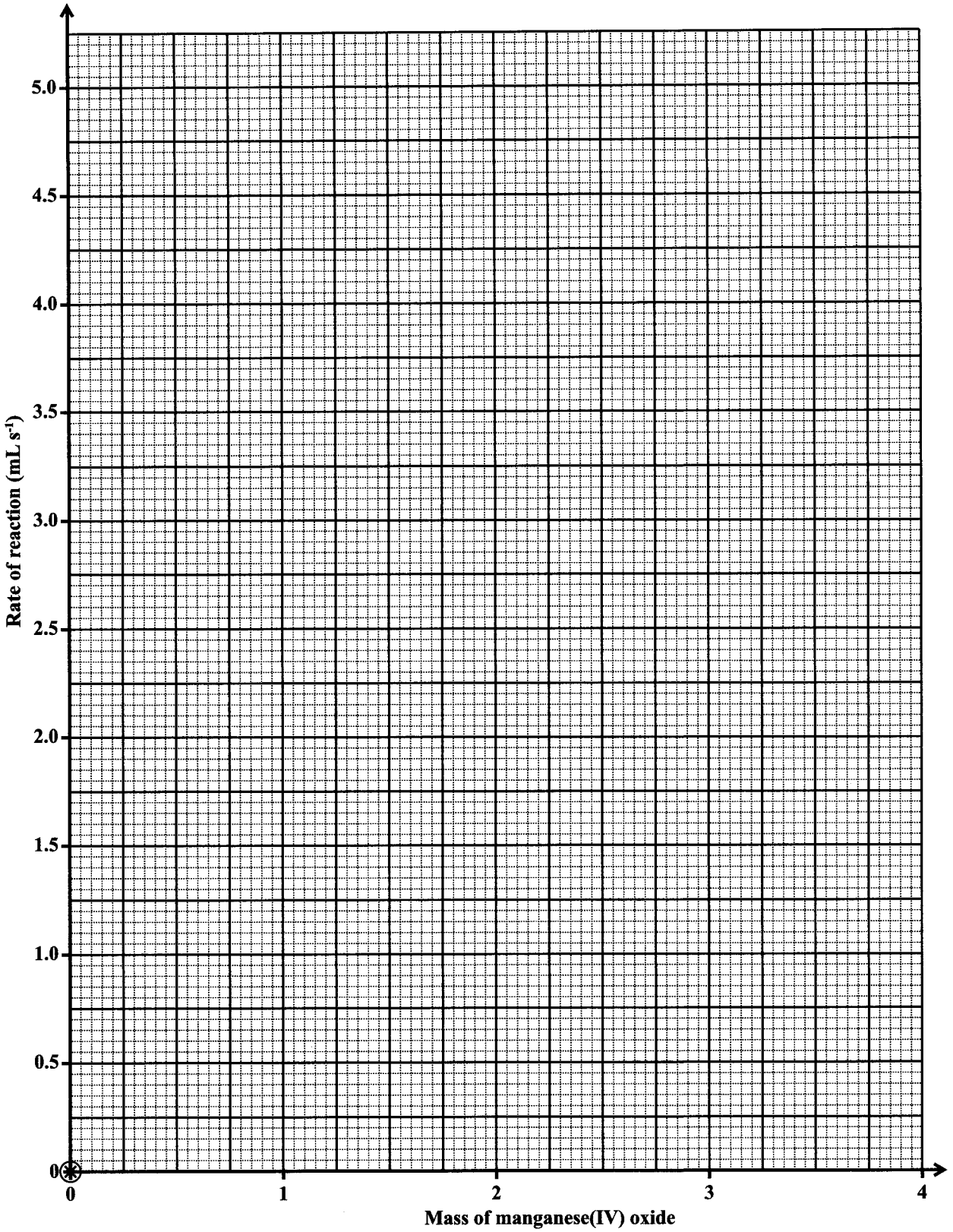


**Figure 2. Rate of reaction versus mass of manganese(IV) oxide**

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(e) Using your graph,

(i) describe the relationship between the rate of reaction and the mass of the catalyst

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**(2 marks)**

(ii) determine the rate of reaction using 3.0 g of the catalyst

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**(1 mark)**

(iii) determine the volume of oxygen produced after 10 s using the value obtained from (e) (ii).

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**(1 mark)**

(f) Complete and label the energy profile diagram in Figure 3 to show how a catalyst affects the rate of reaction.

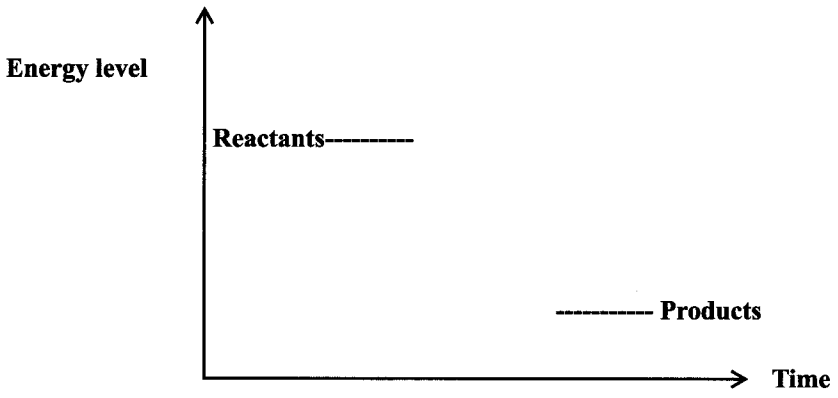


**Figure 3. Energy profile diagram**

**(2 marks)**

(g) Draw a labelled diagram of the apparatus (including reagents) that was used to conduct the experiment and collect the gas.

**(4 marks)**

(h) List TWO **other** factors which can affect the rate of reaction.

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**(2 marks)**

**Total 25 marks**

**2.** (a) Lesley was asked to weigh 0.20 moles of aspirin to be used in a supervised experiment during her chemistry laboratory class. Before doing so, she read the label, at the back of the bottle, shown in Figure 4.

**Aspirin**

**Drug**

Aspirin is used as an analgesic to relieve minor aches and pains, reduce fever, and as an anti-inflammatory medication.

**Formula**: $C_9H_8O_4$

**Molar mass**: 180 g $mol^{-1}$

**Melting point**: 136 °C

**Boiling point**: 140 °C

**Density**: 1.40 g $cm^{-3}$

**Figure 4. Aspirin label**

The information in Figure 4 may be used to answer the following questions:

(i) Define EACH of the following terms:

Mole: .....

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Molar mass: .....

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**(2 marks)**

GO ON TO THE NEXT PAGE

(ii) Calculate the mass Lesley would have to weigh to obtain 0.20 moles of aspirin.

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**(1 mark)**

(iii) Jared, another student in Lesley's class, weighed 18.0 g of aspirin. Calculate the number of moles of aspirin he weighed.

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**(1 mark)**

(b) Ethanoic acid is one of the products of the hydrolysis of aspirin as shown in Figure 5.

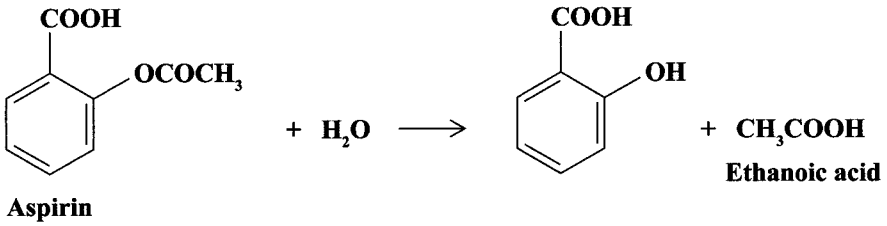


**Figure 5. The hydrolysis of aspirin**

Calculate the mass of ethanoic acid formed when Jared's 18.0 g of aspirin is hydrolysed.

[Molar mass of ethanoic acid = 60.0 g $mol^{-1}$]

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**(3 marks)**

(c) Ethanoic acid is known to be an electrolyte.

(i) Define the term 'electrolyte'.

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**(1 mark)**

(ii) Identify the ions that are produced from ethanoic acid during electrolysis.

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**(2 marks)**

(iii) Define the term 'cathode'.

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**(1 mark)**

(iv) Predict which ion from (c) (ii) will migrate to the cathode.

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**(1 mark)**

(v) Is ethanoic acid a strong or weak electrolyte? Explain your answer.

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**(3 marks)**

**Total 15 marks**

**3.** (a) Compound **P** has the condensed molecular formula $CH_3CH_2CH_2CH_2CH_3$.

(i) State the name and the general formula of the homologous series to which Compound **P** belongs.

Name of homologous series: .....

**(1 mark)**

General formula: .....

**(1 mark)**

(ii) State ONE use of Compound **P**.

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**(1 mark)**

(iii) Define the term 'structural isomerism'.

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**(2 marks)**

(iv) Draw the FULLY DISPLAYED structure of ONE isomer of Compound **P**.

**Isomer of Compound P**

**(2 marks)**

GO ON TO THE NEXT PAGE

(b) Compound **Q** has the condensed molecular formula $CH_3CH_2COOH$.

(i) Explain why Compound **Q** is soluble in water.

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**(2 marks)**

(ii) Is the solution of Compound **Q** acidic or basic? State a reason for your answer.

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**(2 marks)**

(c) Compound **R**, $CH_3CH=CHCH_3$, reacts with bromine to form Compound **S**.

(i) State the expected colour change for the reaction.

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**(2 marks)**

(ii) Draw the FULLY DISPLAYED structural formula of Compound **S**.

**Compound S**

**(2 marks)**

**Total 15 marks**

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## SECTION B

**Answer ALL questions in this section.**

**Write your responses in the spaces provided in this booklet.**

**4.** Calcium carbonate, $CaCO_3$, and sodium nitrate, $NaNO_3$, are two salts that are used in the manufacturing industry.

(a) Define the term 'salt'. Identify ONE product that EACH of the salts mentioned above is used to manufacture.

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**(4 marks)**

(b) Outline the laboratory preparation of a pure, dry sample of $CaCO_3$. Include in your response a balanced chemical equation.

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**(6 marks)**

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(c) Write a balanced chemical equation with state symbols to illustrate how $NaNO_3$ can be prepared in the laboratory. Explain why $NaNO_3$ cannot be prepared utilizing the same method used for the preparation of $CaCO_3$.

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**(5 marks)**

**Total 15 marks**

5. El Dorado, White Oak, Appleton and Cockspur are a few of the famous rum brands of the Caribbean. The main processes of rum making are fermentation and distillation.

(a) Describe the process of fermentation. Include in your description

- the starting material
- the role of yeast
- the reaction conditions
- a balanced chemical equation for the reaction.

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**(7 marks)**

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(b) After fermentation, the product is usually filtered and distilled. Suggest why distillation is necessary and draw a simple labelled diagram of the apparatus which can be used for distilling the fermented product in a school's laboratory.

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**(6 marks)**

(c) In some countries, the Breathalyzer test is used to determine the level of alcohol on the breath of suspected drunk drivers. Identify the main reagent used in the Breathalyzer test and hence state the type of reaction that occurs during the test.

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**(2 marks)**

**Total 15 marks**

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**6.** (a) 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.

(i) Arrange the metals A, B and Fe in order of reactivity from LEAST reactive to MOST reactive. Write a balanced chemical equation to show the reaction between metal A and $Fe^{2+}$ ions.

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**(4 marks)**

(ii) Metal A is placed in a solution of copper(II) sulfate, $CuSO_4$ (aq). Write an equation for the reaction. State ONE observable change that will occur and explain why this reaction takes place.

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**(5 marks)**

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(iii) For EACH metal, A and B, state ONE method that can be used to extract it from its respective oxide. Give a reason for EACH answer.

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**(4 marks)**

(b) Metal alloys are often used for making objects found in our daily lives. Name an alloy of iron and state ONE of its uses.

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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.**