

FORM TP 2018173



TEST CODE 02212020

MAY/JUNE 2018

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

CHEMISTRY

UNIT 2 – Paper 02

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. A data booklet is provided.
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.

MODULE 1: THE CHEMISTRY OF CARBON COMPOUNDS

1. Figure 1 shows the reaction sequence of an organic compound, A, producing compounds B and C.

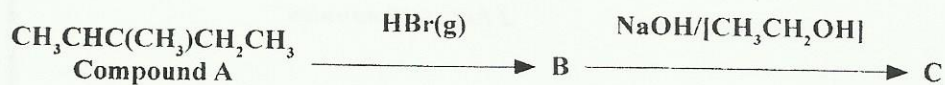


Figure 1. Reaction sequence

- (a) Identify the reaction mechanisms leading to Compound

B

C

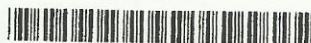
[2 marks]

- (b) Draw the displayed formula for EACH of the following compounds:

(i) B

(ii) C

[2 marks]



- (c) Using curved arrows to show the movement of electrons, write the mechanism for the conversion of Compound A to Compound B.



[4 marks]

- (d) State the name and reagents for a laboratory test that can be used to distinguish between Compound C and propan-1-ol.

Name

Reagents

[2 marks]

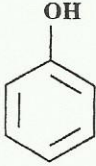
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- (e) Table 1 shows some reactions of phenol. Complete Table 1 by indicating the expected observations and the structures of expected products, if any.

TABLE 1: REACTIONS OF PHENOL WITH SELECTED REAGENTS

Reaction with Phenol		
		
Reagent	Observation	Structure of Expected Product(s) (if any)
Br ₂ (aq)	<ul style="list-style-type: none">•••	
NaOH(aq)		

[5 marks]

Total 15 marks



MODULE 2: ANALYTICAL METHODS AND SEPARATION TECHNIQUES

2. Gravimetric analyses rely on the final determination of weight as a means of quantifying an analyte.

(a) Describe the function of EACH of the following pieces of apparatus used in gravimetric analysis:

- Suction flask

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- Suction funnel

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- Silica crucible

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- Sintered glass crucible

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- Oven/furnaces

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[5 marks]

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(b) A sample of impure potassium chloride (KCl) of mass 0.450 g was dissolved in water and treated with an excess of silver nitrate (AgNO_3). A precipitate of silver chloride of mass 0.8402 g was obtained.

(i) Calculate the number of moles of silver chloride produced.

[1 mark]

(ii) Deduce the number of moles of KCl present in the sample.

[1 mark]

(iii) Calculate the percentage of KCl present in the sample.

[2 marks]

(c) State ONE example of the use of gravimetric analysis in quality control.

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[1 mark]



(d) Figure 2 shows the layout of the components of a UV spectrophotometer.

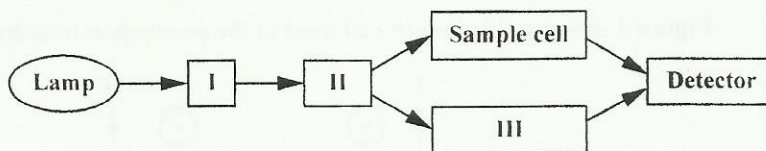


Figure 2. Layout of a spectrophotometer

Identify the components, I, II and III.

I

II

III

[3 marks]

(e) A 1 cm³ sample of a solution of guanosine showed an absorbance of 0.70 at 275 nm. Given that the molar absorptivity constant is 8400 dm³ mol⁻¹ cm⁻¹ and the cell path is 1 cm, calculate the concentration of the guanosine solution.

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[2 marks]

Total 15 marks

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MODULE 3: INDUSTRY AND THE ENVIRONMENT

3. (a) Figure 3 shows a diaphragm cell used in the production of chlorine.

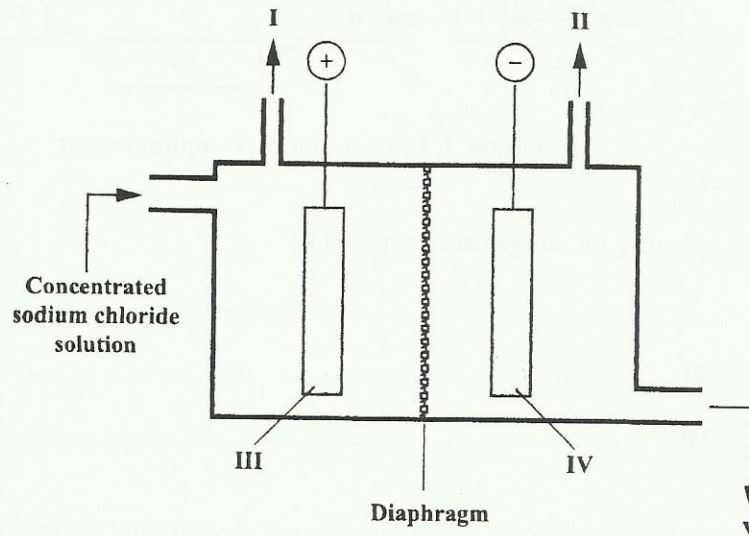


Figure 3. Diaphragm cell used in the production of chlorine

(i) Identify the products and components, I to V.

- I
- II
- III
- IV
- V

[5 marks]

(ii) Write the half-equations to represent the chemical processes occurring at III and IV.

- III
- IV

[2 marks]



- (iii) Using equations where appropriate, briefly describe what would happen if cracks developed in the diaphragm.

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[4 marks]

- (b) Chlorine is used in the manufacture of a large number of compounds.

State THREE categories of such compounds.

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[3 marks]

- (c) Suggest a reason why a community may protest the construction of a chlorine production plant in close proximity to the neighbourhood.

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[1 mark]

Total 15 marks

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SECTION B

Answer ALL questions.

MODULE 1: THE CHEMISTRY OF CARBON COMPOUNDS

4. (a) Butene, C_4H_8 , is an organic compound used in the manufacture of commercial solvents such as the alcohol 2-butanol.
- (i) Draw AND state the name of the displayed formulae of THREE isomers of butene. Include a pair of geometric isomers.

[6 marks]



(ii) Draw the displayed formula of 2-butanol.

[2 marks]

(iii) State, with ONE reason, the type of isomerism that 2-butanol is expected to exhibit.

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[2 marks]

(b) Nylon 6.6 is an example of a synthetic polymer made from the monomers 1,6-diaminohexane and hexane-1,6-dioic acid. Using nylon 6.6, describe, using a structural equation, the process of condensation polymerization.

[5 marks]

Total 15 marks

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MODULE 2: ANALYTICAL METHODS AND SEPARATION TECHNIQUES

5. (a) Mass spectrometry is one of the most widely used instrumental techniques for determining the structures of organic compounds. Figure 4 shows the mass spectrum of a haloalkane, C.

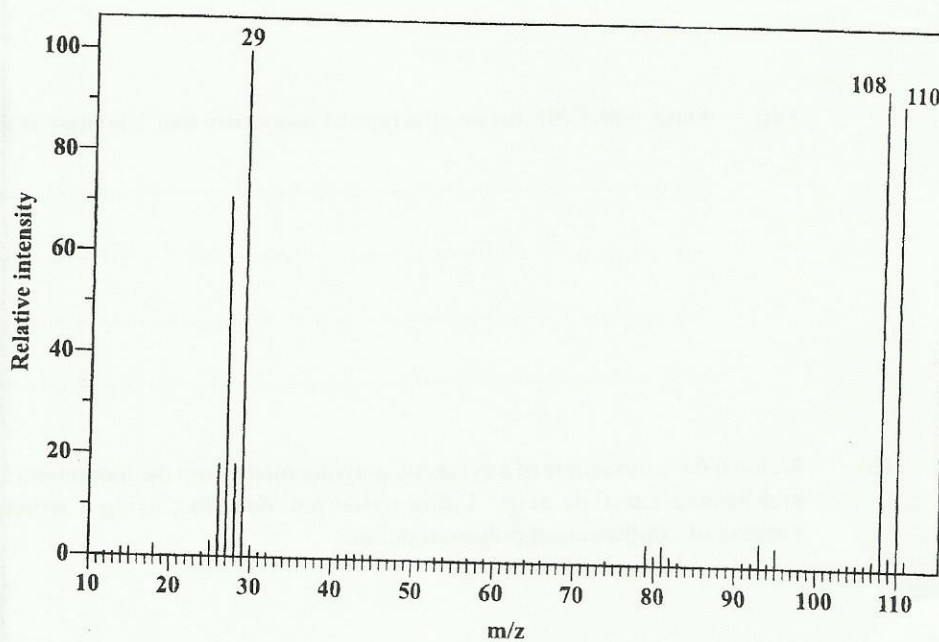


Figure 4. Mass spectrum of Haloalkane C

- (i) Identify the fragment that is responsible for the base peak at $m/z = 29$.

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[1 mark]



- (ii) Deduce, giving an explanation, the halogen present in the compound and hence draw the displayed formula of the compound.

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[3 marks]

- (iii) State a reason for the two peaks at $m/z = 108$ and 110 having almost the same intensity.

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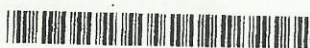
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(b) (i) State Raoult's law as applied to mixtures of miscible liquids.

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[2 marks]

(ii) A mixture of ethanol and cyclohexane is said to show a positive deviation from Raoult's law. Explain this phenomenon.

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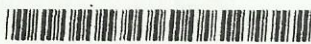
[3 marks]



- (iii) Draw a fully labelled boiling point-composition curve for a mixture of ethanol and cyclohexane which forms an azeotrope at boiling point $64.8\text{ }^{\circ}\text{C}$ and a mole fraction of ethanol of 0.430. The boiling points of ethanol and cyclohexane are $78\text{ }^{\circ}\text{C}$ and $81\text{ }^{\circ}\text{C}$ respectively.

[5 marks]

Total 15 marks



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MODULE 3: INDUSTRY AND THE ENVIRONMENT

6. (a) Outline, using relevant equations, the process by which sucrose is converted to ethanol.

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[4 marks]

(b) State the name of the process by which alcoholic beverages of high alcohol content (>95%) are produced.

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[1 mark]



- (c) Wine bottles are usually stoppered with corks which become porous when dry. Using TWO relevant equations, describe what could happen to wine stored in bottles whose cork stoppers have dried out.

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[4 marks]

- (d) Most alcoholic beverages are packaged in glass bottles. Outline TWO advantages and TWO disadvantages of this practice in terms of waste management and economic benefit.

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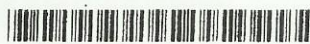
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[4 marks]

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(c) State TWO permanent physiological changes in the body that can result from sustained abuse of alcoholic beverages.

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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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