FORM TP 2013156

MAY/JUNE 2013

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. For Section A, write your answers in the spaces provided in this booklet.
- 3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
- 4. ALL working MUST be shown
- 5. You may use a silent, non-programmable calculator to answer questions.
- 6. A data booklet is provided.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

Copyright © 2011 Caribbean Examinations Council All rights reserved.

SECTION A

Answer ALL questions in this section.

Write your answers in the spaces provided in this booklet.

MODULE 1

THE CHEMISTRY OF CARBON COMPOUNDS

1. (a) Figure 1 shows two reactions of Compound X, a vegetable oil

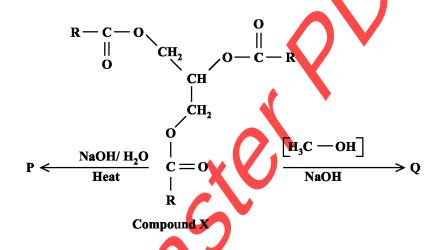


Figure 1. Reaction of Compound X

(i) Draw the products formed at P.

(ii) Draw the products formed at Q.

2	marks
4	mai K5

a) P _____

(iv) State a use of the non-alcoholic product formed at

a) P

b) Q _____

[2 marks]

(b) (i) A student was asked to identify the organic compound, Z. Table 1 shows the student's incomplete record of tests conducted on Z. Complete the student's record by writing the correct observation or inference in the appropriate space.

TABLE 1: RECORD OF TESTS ON COMPOUND Z

Test	Observation	Inference
To 1.0 cm ³ Z in a test tube add 2,4 – DNPH.	a)	Z is a carbonyl compound.
To 1.0 cm^3 of Z in a test tube add acidifie KMnO_4 and heat.	b)	Z reduces KMnO ₄ .
To 1.0 cm ³ of Z in a test tube add Tollen's reagent.	A silver mirror appears.	c)
To 1.0 cm ³ of Z in a test tube add Fehling's solution.	No reaction	d)

[4 marks]

(ii) Draw the LIKELY structure for Compound Z.

[1 mark]

(c) The reaction between carbonyl compounds and HCN occurs via nucleophilic addition.

$$\begin{array}{ccc}
\mathbf{O} & & \mathbf{OH} \\
\parallel & & \mid \\
\mathbf{C} + \mathbf{HCN} \longrightarrow \mathbf{C} \\
\hline
 & & & & \\
\hline
 & & & \\$$

Outline the mechanism for the reaction, using curved arrows to show the movement of electrons.

[2 marks]

ANALYTICAL METHODS AND SEPARATION TECHNIQUES

(a)	State TWO characteristics of a molecule which make it suitable for analysis by infrare spectroscopy (IR).
	[2 mark
(b)	Give TWO examples of the use of IR spectroscopy.
	[2 mark

(c) The IR spectra in Figures 2, 3 and 4 belong to the compounds 2-propanol (CH₃CH(OH)CH₃), butanoic acid (CH₃CH₂CH₂COOH) and acetone (CH₃COCH₃). Identify EACH of the compounds A, B and C in Figures 2, 3 and 4 respectively from the IR spectra provided. Justify your choice by indicating which band on the spectra was used to verify the identity of the compounds and indicate the functional group responsible for the band in EACH case.

(i)

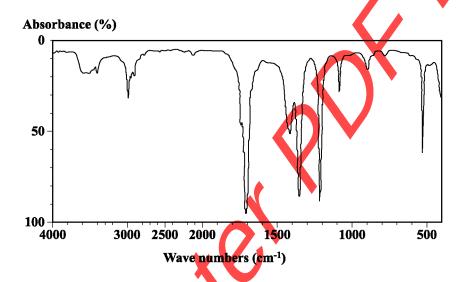


Figure 2. Compound A

- a) Identity of Compound A
- b) Band used for identification and functional group

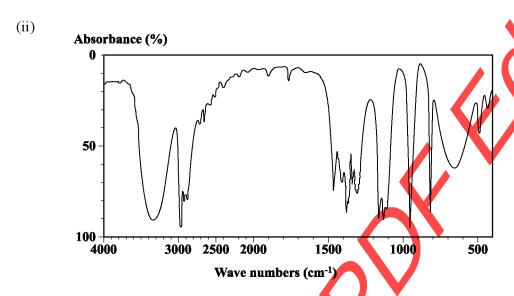


Figure 3. Compound B

- a) Identity of Compound B
- b) Band used for identification and functional group

(iii)

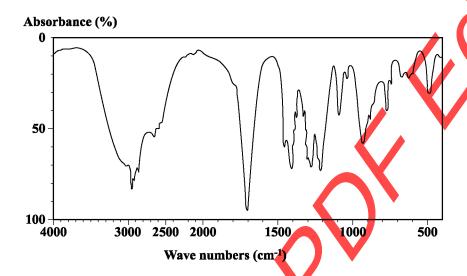


Figure 4. Compound C

- a) Identity of Compound C
- b) Band used for identification and functional group

	ident is asked to prepare a solid sample for analysis using IR spectroscopy.
(i)	Describe FOUR steps to be taken by the student in preparing the sample analysing it.
	[4 m
(ii)	Why are the plates used for IR spectroscopy made from NaCl?
	x
	[1 n
	[

INDUSTRY AND THE ENVIRONMENT

3.	(a)	Samp	am which fl ws through an agricultural community is also used for domestic washing. les taken from a site downstream after a heavy rainfall were found to contain a number llutants.
		(i)	State the process that may have resulted in pollutants being present in the stream.
			[1 mark]
		(ii)	Identify TWO sources of the pollutants (other than fertilizers) that are MOST likely to be present in the stream.
			[2 marks]
	(b)	Analy	vsis of the samples revealed excessive quantities of nitrates and phosphates.
		Descr	ribe how the presence of these pollutants can be identifie in a laboratory.
		(i)	Nitrates
			Reagents:
			Observations:
			[2 marks]
		(ii)	<u>Phosphates</u>
			Reagents:
	X	V	Observations:
			[2 marks]

(c)	(i)	State TWO ways by which oxygen enters waterways.
		[2 marks]
	(ii)	Dissolved oxygen is essential for maintaining good water quality and the preservation of aquatic life.
		Explain why the process of eutrophication leads to poor water quality.
		[2 marks]
	(iii)	Explain why dissolved oxygen must be removed from water before it is used in industrial processes.
		[2 marks]
(d)	State	TWO steps involved in the treatment of water in order to make it potable.
	A	[2 marks]
A A		

SECTION B

Answer ALL questions.

Write your answers in the spaces provided at the end of each question.

MODULE 1

THE CHEMISTRY OF CARBON COMPOUNDS

4. (a) Table 2 shows some reactions of phenol. Identify the reagents and structures needed to complete the table correctly. (Write your answers in the space provided on page 14.)

TABLE 2: REACTIONS OF PHENOI

Phenol	Reagents	Structure of Organic Product Formed
	(i)	ONa
ОН	Br ₂ (aq)	(ii)
•	(in)	О

[3 marks]

GO ON TO THE NEXT PAGE

02212020/CAPE 2013

(b) Figure 5 shows the formation of 3-bromoaniline from benzene in three steps labelled I, II and III.

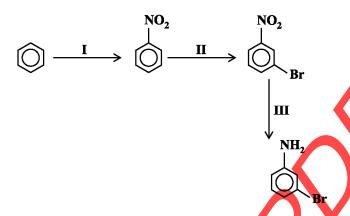


Figure 5. Formation of 3-bromoaniline from benzene

- (i) State the reagents and conditions to be used in EACH of the reactions at Steps I, II and III. [3 marks]
- (ii) Outline the reaction mechanism for the reaction in Step I, using curved arrows to show the movement of electrons. [3 marks]
- (iii) State the reaction mechanism outlined in (b) (ii) above. [1 mark]
- (iv) For Step II, explain why the bromo substituent occupies its position on the molecule. [1 mark]
- (c) Benzene, nitrobenzene and methylbenzene will react with chlorine, in the presence of a catalyst, to form aromatic substituted compounds. The three reactions take place at different rates.
 - (i) Arrange the reagents benzene, nitrobenzene and methylbenzene in order of INCREASING ease of reactivity with chlorine. [1 mark]
 - (ii) For EACH reaction, draw the MAJOR mono-substituted aromatic product that is formed. [3 marks]

Writ	te the a	nswer to Questi	on 4 here.
(a)	(i)	Reagent:	
	(ii)	Structure:	
	(iii)	Reagent	
		•	
		.01	
	X		

Write the answer to Question 4 here.	
	$-\Delta V$
	VV)
	/
N O	
VV)	
- 1	

ANALYTICAL METHODS AND SEPARATION TECHNIQUES

5. (a) Define the term 'partition coefficient'.

2 marks

(b) When butanedioic acid was shaken with a mixture of water and ether, 10 cm³ of water was found to contain 0.854 g of the acid while a similar volume of ether contained 0.159 g.

In a separate experiment, 10 cm³ of water and 20 cm³ of ether were shaken together with 1 g of the acid.

Calculate the mass of the acid found in the aqueous layer.

[4 marks]

- (c) Suggest an appropriate method for separating the components of EACH of the following:
 - (i) Eucalyptus oil from an aqueous suspension of its leaves
 - (ii) Penicillin (organic solid) from an aqueous solution
 - (iii) Components of a coal tar residue
 - (iv) Ethoxyethane from an impure source

[4 marks]

(d)

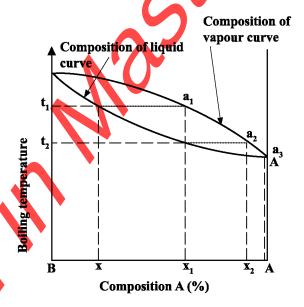


Figure 6. Boiling point – composition curve for ideal mixture of liquids

Use the boiling point – composition curve in Figure 6 to explain the principles of fractional distillation, starting with a liquid of composition x. [5 marks]

Write the answer to Question 5 here.	
	/)
<u> </u>	V
	V
<u> </u>	
XV	

Write the answer to Question 5 here.	
	<u> </u>
XU	

INDUSTRY AND ENVIRONMENT

6.	(a)			e process on your answ	_	luminium oxide	from its ore. In	clude T	WO relevant [7 marks]
	(b)	(i)	Nar	ne a polluta	ant formed as	a by-product of	the process in (a	a).	
		(ii)		scribe TWC b) (i).	environment)	tal consequence	s resulting from	the nam	ned pollutant [3 marks]
	(c)	Alum	inium	is extracted	d by electroly	sis of its oxide.		•	
		(i)	Wri	ite equation	s to show the	reactions occur	ring at the electr	odes.	[2 marks]
		(ii)	a)	Outline O	NE reason for	the high cost ass	ociated with this:	method (of extraction.
			b)	Suggest T	WO reasons	why the recyclin	ng of aluminium	is impo	ortant. [3 marks]
						x ()		Tot	al 15 marks
Writ	e the an	swer to (Questi	ion 6 here.					
					10				
					1				
			•						
		•							
				•					
			プ						
	×	V							
		V							
		•							

	\sim
	XV
	5
7. .	
	GO ON TO THE NEXT

	- XV
~ V 1	
	END OF TEST
IFYOU FINISH BEFORE TI	ME IS CALLED, CHECK YOUR WORK ON THIS TE
00	•
VI	
	02212020/C