BINDURA UNIVERSITY OF SCIENCE EDUCATION
SCIENCE AND MATHEMATICS EDUCATION DEPARTMENT
DIPLOMA IN SCIENCE EDUCATION

NOV 2021

COURSE: DC003/DCH006 ORGANIC CHEMISTRY
TIME 2 HOURS

ANSWER QUESTION 1 AND TWO QUESTIONS FROM SECTION A AND TWO OTHER QUESTIONS FROM SECTION B. EACH QUESTION CARRIES 20 MARKS

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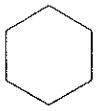
1. (a) Define the following terms:
   (i) Functional group. [2 marks]
   (ii) Homologous series. [2 marks]
   (iii) Isomers. [2 marks]

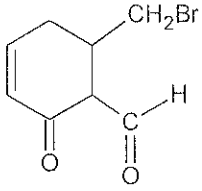
   (b) Draw skeletal structures for the following compounds:
   (i) $C(CH_3)_3CHClCOOH$ [2 marks]
   (ii) $CH_3CHICO_2CH_2CHBr_2$ [2 marks]
   (iii) $CH_2=CH-CH=CH-CH_3$ [2 marks]

   (c) Name the following compounds:
   (i) CH_2ClCH_2Cl
   (ii) $HCOOH$
   (iii) CH_3CHO
   (iv)



[4 marks]

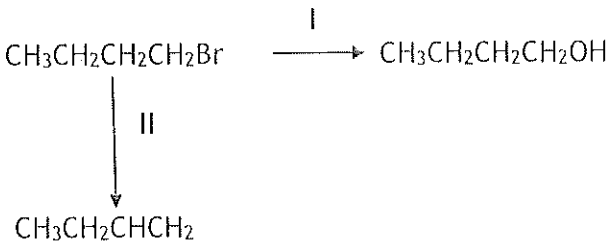
(d) Identify the functional groups in the following compound



[4 marks]

SECTION A: ANSWER ANY TWO QUESTIONS

2. 1-Bromobutane will undergo the following reactions:



(a) For reaction I

(i) Name the type of organic reaction. [1 mark]

(ii) Give the reagents and conditions employed. [1 mark]

(iii) Explain any difference in the reaction rate if 1-Iodobutane was used in place of 1-bromobutane. [2 marks]

(iv) Show the mechanism for reaction I. [5 marks]

(b) Reaction I was repeated with 2-bromo-2 methylpropane.

(i) Draw a displayed structure of the organic product formed. [2 marks]

(ii) Name the product. [1 mark]

(ii) Show the reaction mechanism for 2-bromo-2-methylpropane. [5 marks]

(c) For reaction II;

(i) Name the type of organic reaction. [1 mark]

(ii) State reaction conditions for the reaction. [2 marks]

3 (a) Alcohols D and E are isomers,

$CH_3CH(OH)CH_2CH_3$ (D) $(CH_3)_3COH$ (E)

(i) Classify the alcohols into 1°, 2° or 3° alcohol. [2 marks]

(ii) Draw the structural formula of 2 other alcohols which are

(iii) isomers of D and E. [2 marks]

(iv) What reagent will be used to dehydrate D and E to alkenes. [1 mark]

(v) Draw the structural formulae of the three isomers that are obtained by dehydrating D. [6 marks]

(vi) Describe a reaction that can be used to distinguish between D and E. [2 marks]

(vii) What observations would be made in each case? [3 marks]

(b) Draw the displayed structure of the compound formed when D

reacts with ethanoyl chloride, CH_3COCl. [2 marks]

(c) Draw diagrams to show how D gives rise to optical isomerism. [2 marks]

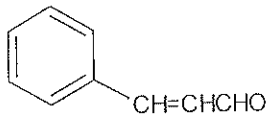
4. Cis-pent-2-ene and trans-pent-2-ene are alkenes.

(a) For each, give:
- (i) its molecular formula. [2 marks]
- (ii) its structural formula. [2 marks]
- (iii) its displayed formula. [4 marks]
- (iv) its skeletal formula. [4 marks]

(b) Ethene reacts with bromine to give 1,2 dibromoethane.
- (i) Name the reaction type. [1 mark]
- (ii) Write a balanced equation for the reaction. [2 marks]
- (iii) Show the reaction mechanism as fully as you can using curly arrows. [5 marks]

SECTION B: ANSWER ANY TWO QUESTIONS.

5. Cinnamaldehyde, F, is used in fragrances for its jasmine-like odour. F contains two functional groups other than the benzene ring. These functional groups behave independently of each other. The structure of cinnamaldehyde is shown below:



Cinnamaldehyde, F

(a) Name the functional groups present in the molecule. [2 marks]

(b) The presence of unsaturation in this molecule can be shown by reaction with bromine dissolved in hexane.
- (i) What is the observable result of this test? [2 marks]
- (ii) Give the equation of the reaction taking place. [3 marks]
- (iii) Give the structure of the organic product formed if bromine water is used. [3 marks]

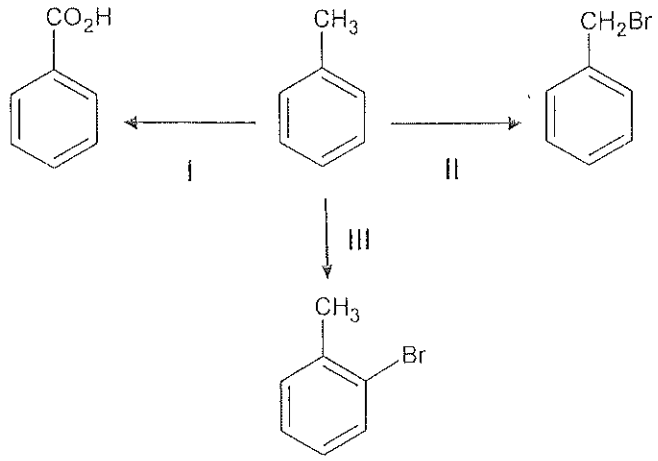
(c) How would you test for the presence of the $\rangle C=O$ group in this molecule. [2 marks]

(d) Give the structure of the molecule produced when the -CHO Group in cinnamaldehyde:
- (i) reacts with HCN [2 marks]
- (ii) is oxidized [2 marks]

(iii) is reduced [2 marks]

(e) Give the structure of the compound formed if the product in (d)(i) is reacted with H_2SO_4. [2 marks]

6. Some chemical transformations of methylbenzene are given below



Compound A

(a) (i) Name the reaction mechanisms labelled I and III. [2 marks]

(ii) State the reaction conditions for reactions I and III. [5 marks]

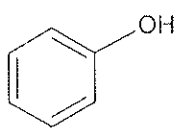
(iii) Give an outline of the mechanism for reaction II. [8 marks]

(b) There are two positional isomers for compound A.

(i) Draw their structural formulae. [4 marks]

(ii) Suggest which of the two is more likely to be formed alongside compound A. [1 mark]

7.(a) Name the following compounds. [3 marks]



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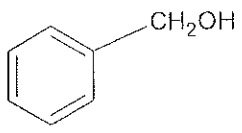
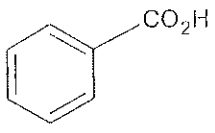


F



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(b) Show how each of the three compounds would react with the following reagents and in each case give the equation of the reaction:

(i) Na [6 marks]

(ii) NaOH [5 marks]

(c) Esters of carboxylic acids are often used as synthetic fruit flavours. Ethylbutanoate, H, is a major component of strawberry and

pineapple flavourings.

$$CH_3CH_2CH_2CO_2CH_2CH_3$$

H

(i) What reagents and conditions do you need to synthesize **H** from butanoic acid? [3 marks]

(ii) Give the name and displayed formula of a compound that can be used in place of butanoic acid? [3 marks]

END OF EXAM