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

NOV 2024

COURSE: DC004/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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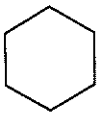
1. (a) Define the following terms:
   (i) Functional group. [2 marks]
   (ii) Homologous series. [2 marks]
   (iii) Isomers. [2 marks]

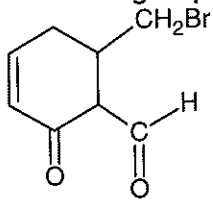
   (b) Draw skeletal structures for the following compounds:
   (i) $C(CH_3)_3CHClCOOH$ [2 marks]
   (ii) $CH_3CHICO_2CH_2CHBr_2$ [2 marks]
   (iii) $CH_2=CH-CH=CH-CH_3$ [2 marks]

   (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]

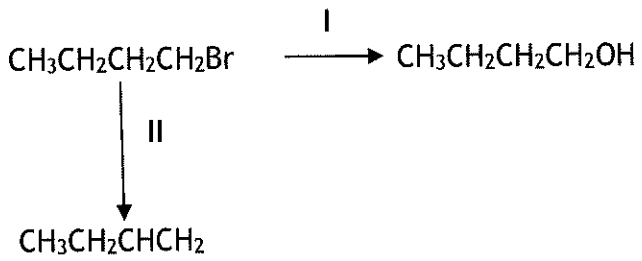
SECTION A: ANSWER ANY TWO QUESTIONS

2. 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]

3. 1-Bromobutane will undergo the following reactions:



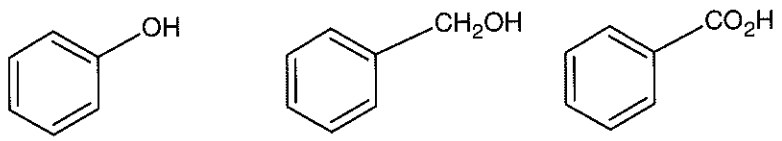
(a) For reaction I
(i) Name the type of organic reaction. [1 mark]
(ii) Give the reagents and conditions employed. [1 mark]
(iii) Explain any difference in the reaction rate if 1-Iodobutane was used in place of 1-bromobutane. [2 marks]
(iv) Show the mechanism for reaction I. [5 marks]

(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]

4. (a) Phenol, phenylmethanol and benzoic acid are three compounds containing benzene rings.



- None of these compounds is particularly soluble in water.
- Phenol and benzoic acid each dissolve in NaOH(aq).
- Only benzoic acid dissolves in Na_2CO_3(aq).

(i) Write equations for the reactions taking place in each case. [9 marks]

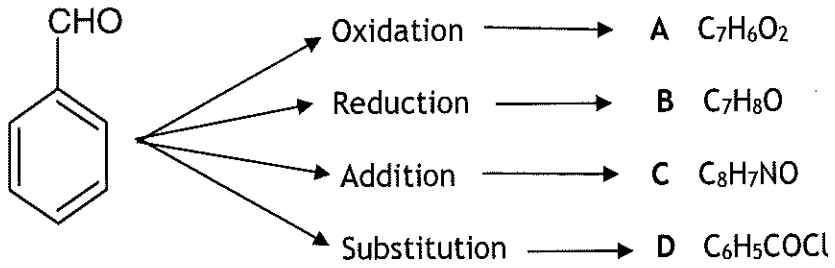
(ii) Explain what these observations indicate about the relative acidities of the three compounds.
Explain this trend in acidity [5 marks]

(b) Suggest structural formulae for the organic products of the reactions of phenylmethanol with:
(i) HBr [2 marks]
(ii) $Cr_2O_7^{2-}/H^+$ [2 marks]

(c) Suggest why phenol does not undergo a similar reaction to that in b(ii) above: [2 marks]

SECTION B: ANSWER ANY TWO QUESTIONS.

5. Some reactions of benzaldehyde, C_6H_5CHO are represented below:



(a) Give the structural formula of each of the compounds **A, B, C, D.** [8 marks]

(b) For each reaction give the reagents and conditions needed. [8 marks]

(c) Explain how the addition reactions of benzaldehyde differ from those of alkenes. [2 marks]

(d) Give a chemical test that could be used to distinguish between benzaldehyde and phenylethanone, $C_6H_5COCH_3$. [2 marks]

6 Mandelic acid, **H**, is produced from the hydrolysis of the oil of bitter almonds. It can be synthesized from benzaldehyde in a 2-step reaction as shown below

$$C_6H_5CHO \xrightarrow{I} \mathbf{G} \xrightarrow{II} \underset{\mathbf{H}}{C_6H_5CH(OH)CO_2H}$$

(a) (i) Draw a displayed structure for **H**. [2 marks]
(ii) Name the functional groups in **H**. [1 mark]
(iii) Suggest conditions and reagents for steps I and II. [5 marks]
(iv) Draw the structural formula of intermediate **G**. [2 marks]

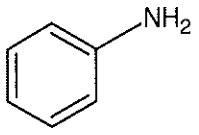
(b) Suggest structural formulae for the products of the reaction of Mandelic acid with the following reagents:
(i) HBr
(ii) PCl_5
(iii) CH_3COCl
(iv) C_2H_5OH/H^+
(v) NaOH [10 marks]

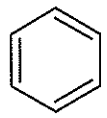
7. (a) Compare the reactions of ethylamine and phenylamine with reference to:

(i) their basicities, explaining why they differ. [4 marks]
(ii) their reactions with bromine. [4 marks]
(iii) their reactions with ethanoyl chloride. [6 marks]

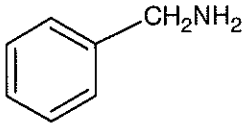
(b) Suggest a synthesis for each of the following compounds:

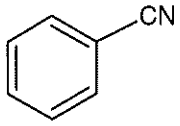
(i)



J from  benzene [4 marks]

(ii)



K from 

phenylnitrile [2 marks]

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