JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL, PHYSICAL, MATHEMATICS AND ACTUARIAL SCIENCES

UNIVERSITY EXAMINATION FOR DEGREE OF BACHELOR OF

BACHELOR OF EDUCATION (SCIENCE) WITH IT

FOURTH YEAR FIRST SEMESTER EXAMINATIONS

UNIVERSITY EXAMINATIONS: 2021/2022 ACADEMIC YEAR

SPB 9210 (SCH 206): ORGANIC CHEMISTRY II

EXAM VENUE: **STREAM: (BEd. Science)**

DATE: **EXAM SESSION:**

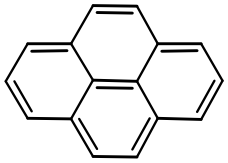
TIME: 2.00 HOURS

Instructions:

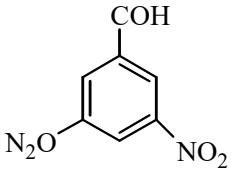
1. **Answer question 1 (Compulsory) in Section A and ANY other 2 questions in Section B.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

QUESTION 1

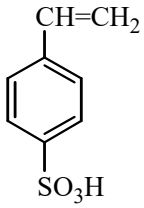
a) Which of the following compounds/ions are aromatic? Explain your answer. [5 marks]

(i)  (ii)  (iii)  (iv)  (v) 

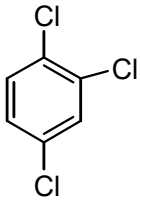
b) Give the IUPAC names of the following compounds: [5 marks]



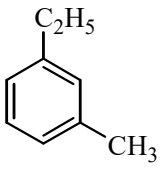
A



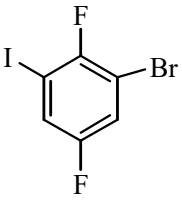
B



C



D



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c) Explain the following terms; [5 marks]

(i) Stereochemistry
(ii) Optical activity
(iii) Racemic mixture
(iv) Nucleophile
(v) Electrophile

d) Discuss the principles underlying the naming of enantiomers. [5 marks]

e) Account for the following observations; [10 marks]

(i) 1,3-dimethylcyclohexane exists only in three rather than four isomers though it has two stereogenic centres.
(ii) A pair of enantiomers has identical infra red spectra, indexes of reflection, solubilities and reaction kinetics in ordinary solvents.
(iii) Benzene is inert towards addition reactions
(iv) Bond dissociation energy can be used to calculate enthalpy (ΔH) of a reaction.
(v) The heat of hydrogenation of benzene is not three times that of cyclohexene

SECTION B (40 MARKS):

ANSWER ANY TWO QUESTIONS FROM THIS SECTION-EACH QUESTION CARRIES 20 MARKS

QUESTION 2

a) Give the mechanism for the nitration of benzene. [5 marks]

b) Using a sequence of reactions, outline how (±)-$CH_3CH(OH)CO_2H$ can be separated. What is the name of this process? [5 marks]

c) Calculate the heat of reaction (ΔH) for the following reactions, assuming that in both reactions, bond breakage is homolytic. Comment on the reaction. [5 marks]

(i) CH_3-H + Cl -Cl ⟶ CH_3-Cl + H -Cl

D = 436.8 kJ mol^{-1} *D = 243.6 kJ mol^{-1}* *D = 352.8 k J mol^{-1}* *D = 432.6 k J mol^{-1}*

(ii) CH_3-H + Br-Br ⟶ CH_3-Br + H -Br

D = 436.8 kJ mol^{-1} *D = 193.2 kJ mol^{-1}* *D = 249.0 k J mol^{-1}* *D = 369.9 k J mol^{-1}*

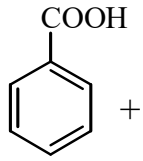
d) Illustrate keto-enol tautomerism using the reaction of propanone with water. [5 marks]

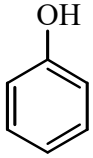
QUESTION 3

a) Define each of the following terms: [5 marks]

(i) Diastereomers
(ii) Stereogenic centre
(iii) Meso compound
(iv) Enantiometrically pure substances
(v) Solvolysis reaction

b) Complete the following reactions; [5 marks]

(i)  + $HONO_2$ $\xrightarrow{H_2SO_4}$

(ii)  + Cl_2 $\xrightarrow{AlBr_3}$

c) Methanol reacts with acetic acid to form methyl acetate and water in the presence of a catalyst as shown by the following equation:

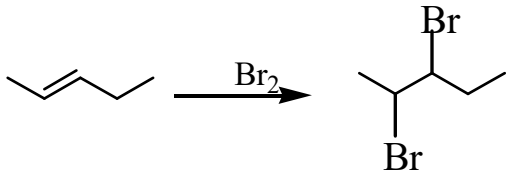
$$CH_3OH(l) + CH_3COOH(aq) \longrightarrow CH_3COOCH_3(aq) + H_2O(l)$$

The bond dissociation energies in kj mol^{-1} are given below;

C-C = 348; C-H = 413; C=O = 805; O-H = 464; C-O = 360

What is the heat of formation of methyl acetate in kJmol^{-1} [5 marks]

d) Consider the reaction below: [5 marks]



How many stereoisomers of the product are possible? Draw them. Are the products optically active?

QUESTION 4

a) State any FIVE features of aromaticity. [5 marks]

b) Illustrate the effect of the substituent group on the benzene ring on further substitution. [10 marks]

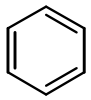
c) At 24°C, a sample of S-2-iodobutane whose specific rotation is: $[\alpha]^{24}_{D} = 22.4°$ was put in a1 dm vila of solution of 1 gml^{-1} showed an optical rotation of +3.975°.

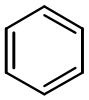
(i) What is the optical purity? [2½ marks]

(ii) What is the enantiomeric excess? [2½ marks]

QUESTION 5

a) Complete the following reactions giving the necessary reagents and reaction conditions. [4 marks]

(i)  + $CH_3CH_2CH_2Cl$ ⟶

(ii)  + HNO_3 $\xrightarrow{H_2SO_4}$

b) Give the mechanism for the reactions in (e) (i) and (ii) above. [12 marks]

c) What is aromaticity? [2 marks]

d) A racemic mixture shows no optical activity. Explain. [2 marks]

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