

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**DEPARTMENT OF APPLIED CHEMISTRY**

**END OF SEMESTER EXAMINATIONS – APRIL 2002**

**ORGANIC CHEMISTRY (FOR CHEMICAL ENGINEERS AND TEXTILE TECHNOLOGY STUDENTS) – SCH 1221**

**TIME = THREE (3) HOURS**

**INSTRUCTIONS TO CANDIDATES:**

1. ANSWER ALL QUESTIONS FROM SECTION A AND ANY THREE FROM SECTION B. SECTION A CARRIES 40 MARKS AND EACH QUESTION IN SECTION B CARRIES 20 MARKS.

GRAPH PAPER WILL BE PROVIDED ON REQUEST

2. SHOW MECHANISM, CHEMICAL STEPS OR SYNTHESIS BY MEANS OF CURVED ARROWS.

**TOTAL MARKS = 100**

THIS QUESTION PAPER CONSISTS OF **FIVE PRINTED PAGES** (ON ONE SIDE ONLY) INCLUDING THE TOP PAGE WITH THE INSTRUCTIONS.

**SECTION A**

1. (a) Draw the structural formulae for the following compounds.

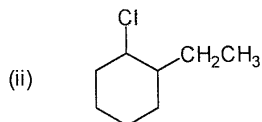
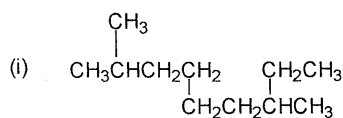
- (i) 3-propyl-4,7-dimethyl nonane  
 (ii) cis-1,2-dimethylcyclopentane

(2 Marks)

(b) What is plane-polarised light?

(4 Marks)

(c) Give IUPAC names of the following compounds.



(2 Marks)

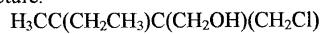
(d) From the list given below, select the substituents, which are

- (i) ortho/para - directing    (ii) meta - directing

-Br, -CHO, -OCH<sub>3</sub>, -F, -NO<sub>2</sub>, -COOH, -NH<sub>2</sub>, -N(CH<sub>3</sub>)<sub>3</sub>

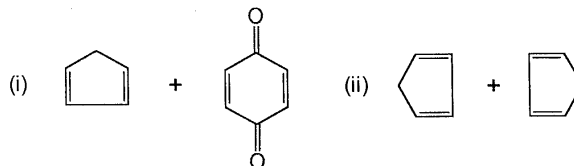
(4 Marks)

(e) Draw E and Z configuration for the following alkene and indicates priority on the structure.



(6 Marks)

(f) Draw the structures of the products arising from the following pericyclic reactions.

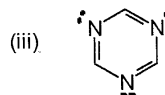
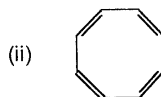
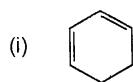


(2 Marks)

(g) Draw and label the reaction energy diagram for one step exothermic reaction. (4 Marks)

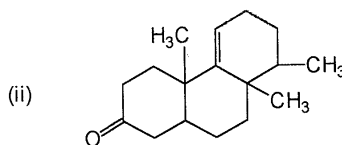
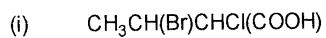
(h) Describe Huckel's theory in your own words. (4 Marks)

(i) State whether the following compounds are aromatic or non-aromatic and state the number of pi electrons present in each compound.



(6 Marks)

(j) Mark with an asterisk (\*) all chiral centers present in the following compounds. How many (i) stereoisomers and (ii) optical isomers do you expect from each compound.



(6 Marks)

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**SECTION B**

2. (a) Construct a potential energy diagram for rotation about the carbon – carbon bond of 1,2 dibromobutane..

Draw Newman projections for the various conformations on the diagram. Indicate which projection is (i) the most stable and (ii) the least stable conformation. Give your reason.

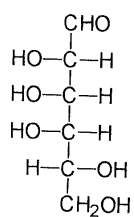
Ignore the energy cost for interactions in various conformers.

(12 Marks)

- (b) Explain in detail with an appropriate example of your choice the sp hybridisation.

(8 Marks)

3. (a) the structure of D-talose is as follows.



**D - TALOSE**

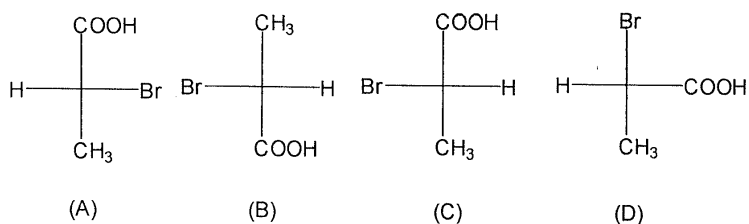
- (i) Draw Fischer projection and then Haworth projection for D-talose. (4 Marks)
- (ii) Draw  $\alpha$  and  $\beta$ -anomers of D-talopyranose.. (4 Marks)
- (iii) Explain with the aid of chair conformation, the stability of the isomers. (8 Marks)
- (b) Draw all possible isomers of a compound with molecular formula  $\text{C}_5\text{H}_{12}\text{O}$ . (4 Marks)

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4. (a) Write the reaction mechanism for the reaction between 2-butene and bromine ( $\text{Br}_2$ ). The product is optically active. Find out how many stereoisomers, enantiomers and meso compound the product has.

(12 Marks)

- (b) Assign R or S designation to the following Fischer projections (show your workings) and comment on the relationship between them.



(8 Marks)

5. (a) Predict the product(s) and give IUPAC names for the following reactions. (No mechanism required).

- (i) Reaction of benzene with chlorobutane in presence of aluminium chloride.
- (ii) Reaction of benzene with nitronium ion followed by reduction with tin and hydrochloric acid. The product is then treated with nitrous acid in hydrochloric acid below  $10^\circ\text{C}$ . the final product is then treated with phenol.
- (iii) reaction of chlorobenzene with con.  $\text{H}_2\text{SO}_4$  and con.  $\text{HNO}_3$ .
- (iv) reduction of  $\text{CH}_3\text{C}=\text{CCH}_2\text{CH}_3$  with Lindler catalyst.

(16 Marks)

- (b) List the following alkyl halides in *DESCREASING* order of  $\text{S}_{\text{N}}^2$  reactivity:

1-bromobutane, 1-bromo-2,2-dimethylpropane, 1-bromo-2-methylbutane and 1-bromo-3-methylbutane.

(4 Marks)

\*\*\*\*\*END OF QUESTION PAPER\*\*\*\*\*

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