

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**DEPARTMENT OF APPLIED CHEMISTRY**

**ORGANIC CHEMISTRY – SCH 1221**

**END OF THE SEMESTER EXAMINATIONS – MAY 2005**

**FOR CHEMICAL ENGINEERING (TCE) STUDENTS**

**TIME : THREE (3) HOURS**

**INSTRUCTIONS TO CANDIDATES:**

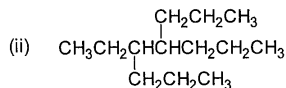
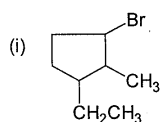
1. ANSWER ALL QUESTIONS FROM SECTION A AND ANY THREE FROM SECTION B. SECTION A CARRIES 40 MARKS AND EACH QUESTION IN SECTION B CARRIES 20 MARKS.
2. SHOW MECHANISM, CHEMICAL STEPS OR SYNTHESIS BY MEANS OF CURVED ARROWS.
3. GRAPH PAPER WILL BE PROVIDED ON REQUEST.

**TOTAL MARKS = 100**

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

**SECTION A :**

1. (a) Name the following compounds according to IUPAC rules.



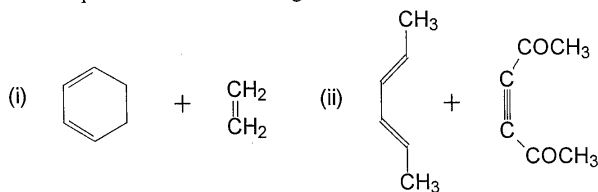
(2 Marks)

(b) Write structural formulae of the following compounds.

- (i) 3-propyl-4,7-dimethyl nonane  
 (ii) 3-methyl-1,3-pentadiene

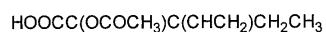
(2 Marks)

(c) Predict the products of the following Diels-Alders reactions.



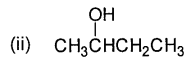
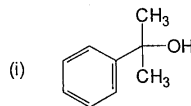
(2 Marks)

(d) Draw E and Z configuration for the following alkenes and indicate priority on the structure.



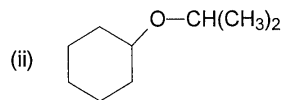
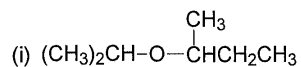
(4 marks)

(e) What Grignard reagents and what carbonyl compounds might you start with to synthesise the following alcohols



(4 Marks)

(f) Give starting materials and reagents, which would react under basic conditions to give the following ethers.

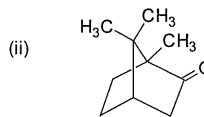
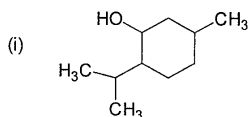


(4 Marks)

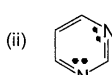
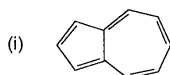
(g) What is plane polarized light?

(4 Marks)

(h) Mark with an asterisk (\*) all chiral centres present in the following compounds. (Marks will be deducted for the wrong marking).



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



(j) Assign R and/or S designation to each chiral centre(s) for 2-bromo-3-chloro butane and give the correct IUPAC name. Show your working

(k) Draw all possible isomers and give IUPAC names of a compound with molecular formula  $C_5H_{12}$ .

(3 Marks)

### SECTION B:

2. (a) Sketch a potential energy diagram for the rotations about the carbon-carbon bond in  $BrCH_2CH_2Br$ .

Use Newman projections to indicate locations of the various conformation isomers.

(10 Marks)

(b) What is the major product that you would expect to obtain from the Friedel-Craft reaction of benzene and bromobutane in the presence of iron(III)chloride?

Give your reason. Show all necessary steps involved in the reaction.

(10 Marks)

3. (a) Dehydrohalogenation of 2-chlorobutane with potassium hydroxide in ethanol yields a mixture of products. Write mechanism for the reaction and state which product you would expect to be predominant. Give your reason.

(8 Marks)

(b) Draw the most stable chair conformation for the following molecule and also indicate whether the molecule is cis or trans.

(i) 1-chloro-3-methyl cyclohexane

(ii) 1,4-diethyl cyclohexane

(4 Marks)

(c) Discuss Sp hybridization with an appropriate organic compound of your choice. Draw the orbital and indicate the shape of the bonded structure.

(8 Marks)

4. (a) With an appropriate example, write reaction mechanism for  $S_N^1$  reaction.

(4 Marks)

(b) Reaction of *o*-aminobenzoic acid with  $\text{NaNO}_2$  and  $\text{HCl}$  yields a diazonium salt that can be treated with sodium hydroxide to yield a neutral sodium salt of diazonium carboxylic acid (diazonium carboxylate).

(i) What is the structure of the neutral diazonium carboxylate?

(ii) Heating the diazonium carboxylate results in the formation of  $\text{CO}_2$ ,  $\text{N}_2$  and a high energy intermediate that reacts with 1,3-cyclopentadiene to yield Diels-Alder product.

Write chemical reaction steps from the starting of the reaction to the final product.

(6 Marks)

(c) Acid-catalysed dehydration of 1-methyl cyclohexanol Yields mixture of products, write reaction mechanism and indicate the major or only product, Give your reason.

(10 Marks)

5. (a) With an appropriate example write a reaction mechanism for nucleophilic substitution reaction.

(6 Marks)

(b) What are anomers?

(4 Marks)

Draw  $\alpha$  anomer and  $\beta$  anomer structures for D-glucose.

(4 Marks)

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

(i) Reduction of hex-2-yne with Lindler catalyst.

(ii) Oxidation of hex-2-ene with ozone

(6 Mark)

\*\*\*\*\*END OF EXAMINATION PAPER\*\*\*\*\*