



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF APPLIED CHEMISTRY

BACHELOR OF SCIENCE HONOURS DEGREE

END OF FIRST SEMESTER EXAMINATIONS – FEBRUARY 2010

ORGANIC CHEMISTRY I – SCH 1102

FOR APPLIED CHEMISTRY STUDENTS

TIME – THREE (3) HOURS

INSTRUCTION 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. START NEW QUESTION ON A NEW PAGE. (NOT EACH PART OF A QUESTION.)
3. SHOW MECHANISM, CHEMICAL STEPS OR SYNTHESIS BY MEANS OF CURVED ARROWS.
4. GRAPH PAPER WILL BE PROVIDED ON REQUEST.

TOTAL MARKS = 100

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

SECTION A:

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

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

(2 Marks)

(b) What is plane-polarised light?

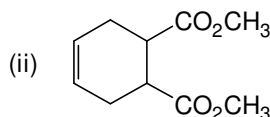
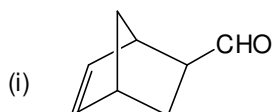
(4 Marks)

(c) Draw E and Z configurations for the following compounds.



(4 Marks)

(d) Draw dienes and dienophiles for the synthesis of the following compounds:



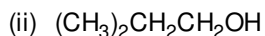
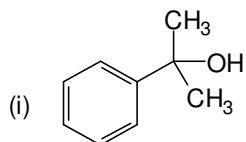
(4 Marks)

(e) Draw the structures for the starting materials which would react under basic conditions to give the following ethers.

- (i) methyl phenyl ether
- (ii) Ethyl 2-methylpropyl ether

(6 Marks)

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

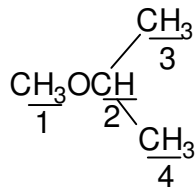


(4 Marks)

(g) With an appropriate example, write reaction mechanism for unimolecular nucleophilic substitution reaction

(4 Marks)

(h) Predict the splitting pattern you would expect from the underlined protons indicated in the following molecules.

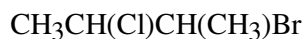


(4 Marks)

(i) Draw resonance structures of an allylic cation formed by protonation of 1,3-butadiene.

(3 Marks)

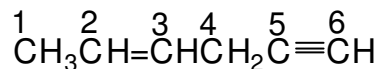
(j) Assign R and/or S designation to each chiral centre in the following compound.



(5 Marks)

SECTION B:

2. (a) In the following molecule, indicate the kind of hybridization you might expect for each carbon atom.



(3 Marks)

(b) Select any one carbon atom of your choice from the above compound (indicate which one) and explain in detail the hybridisation.

(5 Marks)

(c) In the reaction of 1-bromobutane with hydroxide (-OH), 1-butanol and other products are formed. 1-butanol however does not normally react with chloride ion (Cl^-) but does so in presence of an acid. Write reaction mechanism for the reaction and wherever possible indicate the type of reaction takes place. Give IUPAC names for the products formed.

(12 Marks)

3. (a) A liquid L contains 54.4% carbon, 9.1% hydrogen and 36.4% oxygen by mass. The mass spectrum and the infra-red spectrum of liquid L are given in Fig 1 and Fig 2 respectively. Relative atomic mass: C = 12; H = 1 and O = 16). From the above information:

- (i) Calculate empirical formula (3 Marks)
- (ii) Calculate molecular formula. (2 Marks)
- (iii) Propose a structure for the liquid L from the information given in Fig 1 and Fig 2. (2 Marks)
- (iv) From the proposed structure, predict the splitting pattern you would expect for proton in nmr spectrum. (3 Marks)

(b) Draw all the optically active compounds with formula $C_5H_{11}Cl$.

Suggest IUPAC names for the compounds.

(4 Marks)

(c) Write reaction mechanism for the dehydration of 2-methyl-2-butanol and giving reasons which product would you expect to be prominent.

(6 Marks)

4. (a) Radical chlorination of pentane is a poor way to prepare 1-chloropentane but radical chlorination of neopentane $(CH_3)_4C$; is a good way to prepare neopentyl chloride, $(CH_3)_3CCH_2Cl$. Write reaction mechanism for both reactions and explain this difference.

(10 Marks)

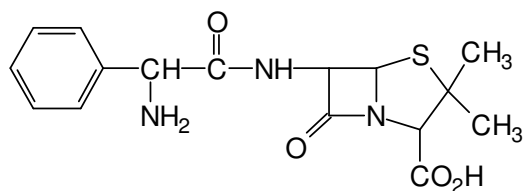
(b) Indicate whether the following statements are true or false. Draw an appropriate structure and explain your answer.

- (i) A compound with S configuration is the (-) laevo rotatory enantiomers.
- (ii) An optically inactive molecule may be made up of a chiral centre/s.

(6 Marks)

(c) Mark with an asterisk (*) the chiral centres of the following compound.

Mark will be deducted for each wrong asterisk. How many stereoisomers do you expect?



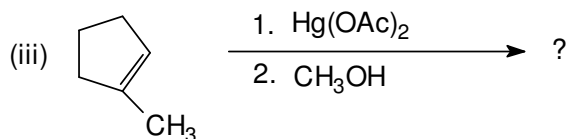
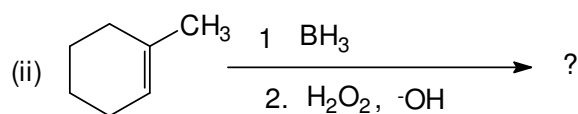
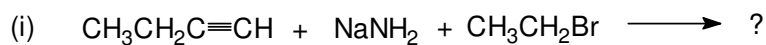
(4 Marks)

5. (a) Hydrogenation of (S) -3-amino hex-1-yne gives optically active 3-hexylamine of opposite configuration (R) to that of the original substance.

With the aid of Fischer projections, explain this observation.

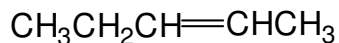
(4 Marks)

- (b) Draw the structures and give IUPAC names of the major products of the following reactions. (No mechanism required).



(6 Marks)

- (c) What carbonyl compound and what phosphorus ylide might you use to prepare the following alkene. Write reaction mechanism for the reaction. What is the name of this reaction? What is the importance of the reaction?



(10Marks)

END OF QUESTION PAPER!!!