



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF APPLIED CHEMISTRY

BACHELOR OF SCIENCE HONOURS DEGREE

END OF FIRST SEMESTER EXAMINATIONS – JUNE 2010

ORGANIC CHEMISTRY I –SCH 1102

FOR TTE STUDENTS

TIME: 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 EACH QUESTION ON A NEW PAGE. (NOT EACH PART OF THE 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 **FIVE 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?

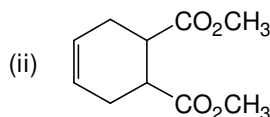
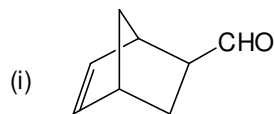
(4 Marks)

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



(4 Marks)

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



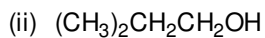
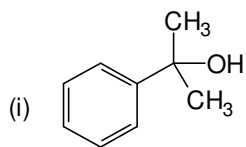
(4 Marks)

(e) Draw the structures for the starting materials which would react under basic conditions to give the following ether. Write reaction mechanism for any one of the ethers.

- (i) methyl propyl ether
- (ii) ethyl phenyl ether

(6 Marks)

(f) What Grignard reagents and what carbonyl compounds might you start with to synthesise the following alcohol. Write reaction mechanism for any one of the alcohols.



(6 Marks)

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

(4 Marks)

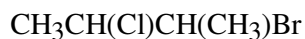
(h) Draw all the optically active compounds with formula $\text{C}_5\text{H}_{11}\text{Br}$.

(2 Marks)

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

(3 Marks)

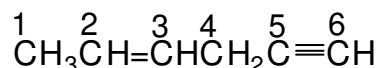
- (j) Assign R and/or S designation to each chiral centre in the following compound.



(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 the presence of an acid. Write reaction mechanism for the reaction and wherever possible indicate the type of reaction that has taken place. Give IUPAC names for the products formed.

(12 Marks)

3. (a) An organic compound A, of molecular weight 122, has the following composition by mass: C, 78.7%; H, 8.2%; and O, 13.1%

(i) Calculate its empirical formula (3 Marks)

(ii) Calculate its molecular formula. (2 Marks)

- (b) The n.m.r. spectrum of A is given below,

Identify the parts of the molecule responsible for each group of peaks. Use your answer to deduce a structure for A, explaining your reasoning.

(7marks)

(c) Explain what effect you would expect the addition of a small amount of D_2O to have on the n.m.r. spectrum of A.

(2 Marks)

(d) 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) Write reaction mechanism for the reaction between benzene and bromobutane in presence of aluminium (III) chloride catalyst? Indicate with a good reason the major product. This type of reaction is called Friedel-Craft alkylation. Indicate the limitations of this reaction?

(10 Marks)

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

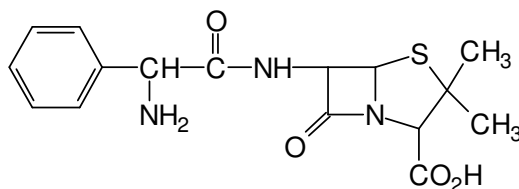
(i) A compound with R configuration is the (+) dextro rotatory enantiomers.

(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.

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



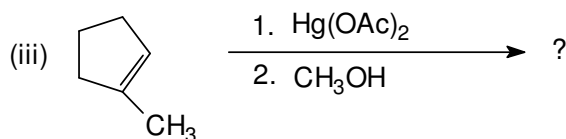
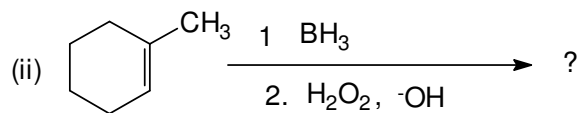
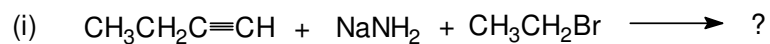
(4 Marks)

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.

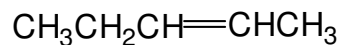
(4 Marks)

(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!!!