

**KABARAK**



**UNIVERSITY**

**EXAMINATIONS**

**2008/2009 ACADEMIC YEAR**

**FOR THE DEGREE OF BACHELOR OF EDUCATION  
SCIENCE**

**COURSE CODE: CHEM 412**

**COURSE TITLE: ADVANCED STEREOCHEMISTRY &  
REACTION MECHANISM**

**STREAM: SESSION VIII**

**DAY: WEDNESDAY**

**TIME: 2.00 – 4.00 P.M.**

**DATE: 08/04/2009**

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**INSTRUCTIONS:**

**Attempt all questions.**

**Each question = 17 ½ Marks**

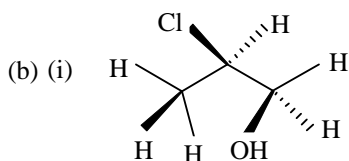
**PLEASE TURN OVER**

**QUESTION ONE [17 ½ Marks]**

(a) Define each of the following terms [4 mks]

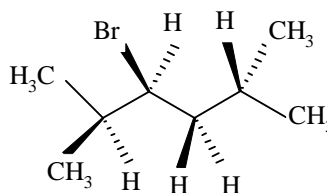
- (i) Enantiomer
- (ii) Chiral centre
- (iii) Racemic mixture
- (iv) Optical activity

(b) Identify the chiral centres of the following molecules (Use asterisk \*) [4 mks]

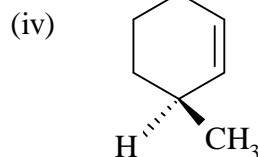
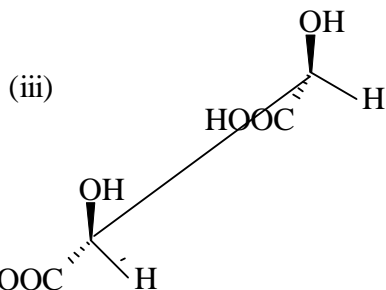
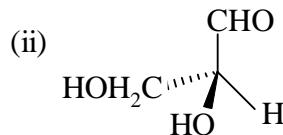
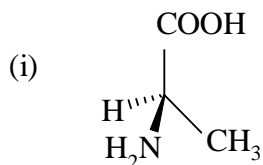


(ii) 3 - Methylcyclopent-1-enol

(iii) 2-chloro-2-methylbutane (iv)



(c) Assign R and S configurations to the following molecules [8 mks]



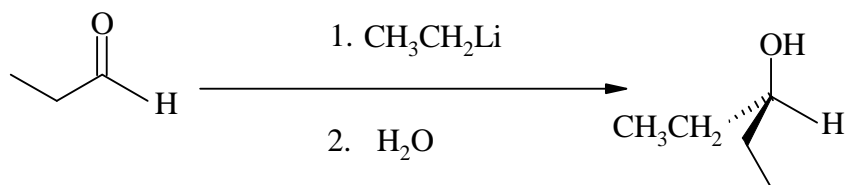
(d) Briefly explain the effect of plane-polarized light when it is passed through a 50:50 racemic mixture [1 ½ mks]

**QUESTION TWO** [17 ½ Marks]

- (a) Define the following terms: [3 mks]
- (i) Conformations
  - (ii) Conformational analysis
- (b) (i) Draw the axial and equatorial conformations of ethylcyclohexane [1 mk]
- (ii) With a reason state the most stable configuration of ethylcyclohexane [1 ½ mks]
- (c) The Gibbs free energy difference between the axial and equatorial conformers of methylcyclohexane is 7.6 kJ/mol. Show mathematically that at equilibrium the equatorial conformer is 95% and the axial conformer is 5% of the mixture [T = 25°C, R = 0.082058 L.atm K<sup>-1</sup> mol<sup>-1</sup>] [6 mks]
- (d) Briefly explain the following terms [6 mks]
- (i) 1,3 - steric strain
  - (ii) Torsional strain
  - (iii) Diastereomers

**QUESTION THREE** [17 ½ Marks]

- (a) Define the following terms [5 mks]
- (i) HOMO
  - (ii) LUMO
  - (iii) Nucleophile
  - (iv) Leaving group
  - (v) Mechanism
- (b) (i) Using molecular orbitals explain how acetone (CH<sub>3</sub>)<sub>2</sub>C=O can act as both an electrophile and a nucleophile [4 mks]
- (c) Consider the following reaction



(i) State the importance of the reagents H<sub>2</sub>O and THF in the reaction

[2 mks]

(ii) Using curly arrows propose a mechanism for the above reaction

[4 ½ mks]

(iii) With the help of frontier molecular orbitals show the HOMO - LUMO interactions in the above reaction

[2 mks]

#### QUESTION FOUR [17 ½ Marks]

(a) Define the following terms:

[4 mks]

(i) Electrocyclic reactions

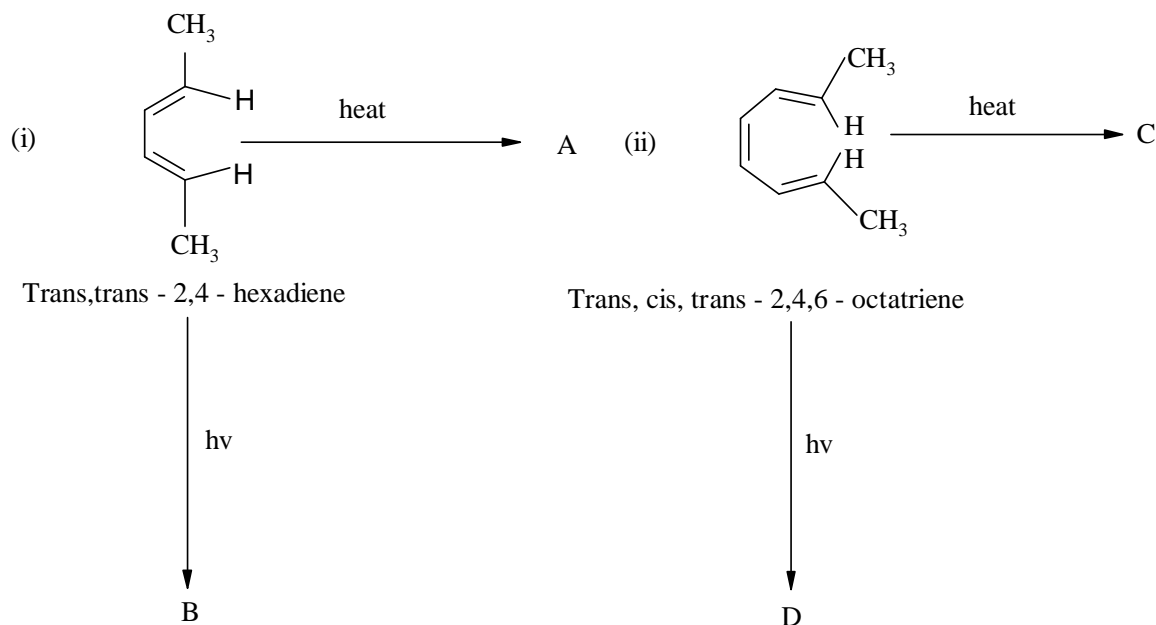
(ii) Concerted reaction

(iii) Stereospecific reaction

(iv) Conrotatory process

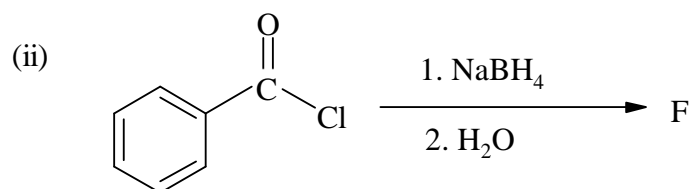
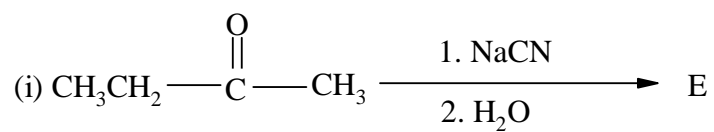
(b) With the aid of orbital diagrams show the products A, B, C and D of the following reactions:

[8 mks]



(c) State the products of the following reactions:

[2 mks]



(d) Using NaCN as HOMO and acetone as LUMO explain the term Burgi – Dunitz trajectory [3 ½ mks]