

National Exams  
**04-BS-12, Organic Chemistry**  
**May 2015**

3 hours duration

Notes

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a CLOSED BOOK EXAM.  
Any non-communicating calculator is permitted.
3. Candidates may use any non-programmable calculator, ex. a Casio or Sharp model
4. ANSWER ALL FIVE PROBLEMS
5. Each problem is of equal value
6. Note that the questions (a), (b) of each problem can be treated independently

**Problem No. 1 (20 points)**

a) Draw the structural formulas for:

(i) Three secondary amines with the molecular formula  $C_4H_{11}N$

(6 points)

(ii) Two aldehydes with the molecular formula  $C_4H_8O$

(4 points)

(iii) Two carboxylic acid with the molecular formula  $C_4H_8O_2$

(4 points)

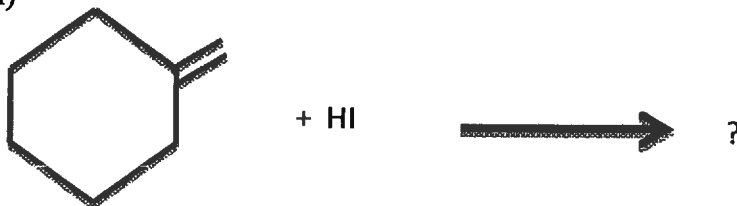
(iv) Three ketones with the molecular formula  $C_5H_{10}O$

(6 points)

**Problem No. 2 (20 points total)**

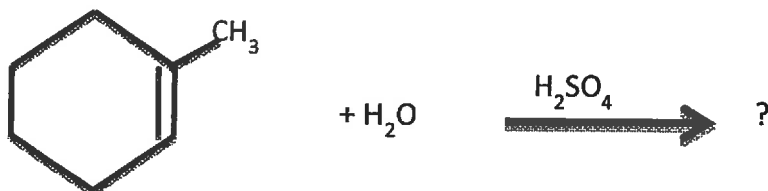
a) Complete the following chemical reactions

(i)



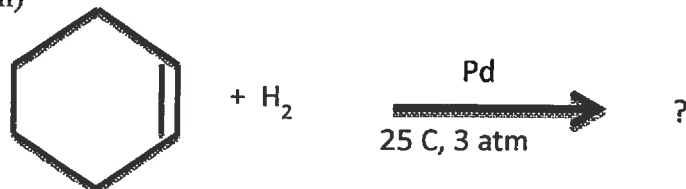
(5 points)

(ii)



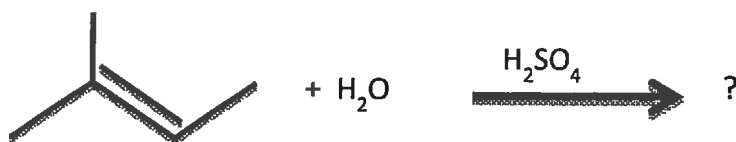
(5 points)

(iii)



(5 points)

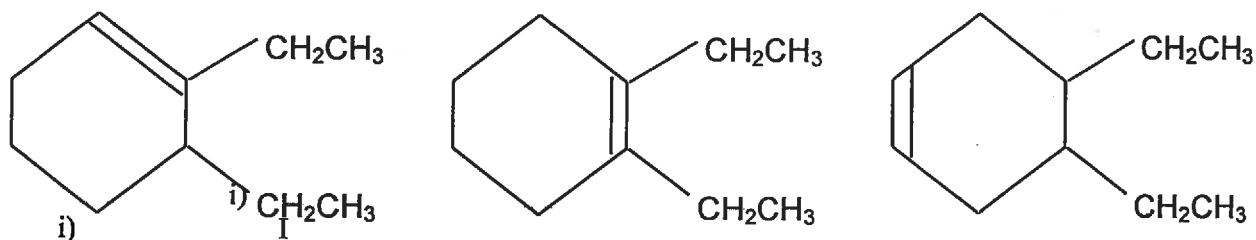
(iv)



(5 points)

**Problem No. 3 (20 points total)**

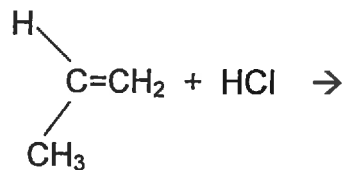
a) Which one of the following three compounds:



(i) Is the most stable?  
(5 points)

(ii) Is the least stable?  
(5 points)

b) Write the balanced equation of the mono-chlorination reaction of the methyl-2 propene as shown below, and explain concisely the mechanism of the reaction.

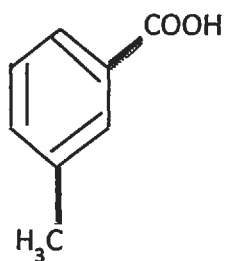


(10 points)

**Problem No. 4 (20 points total)**

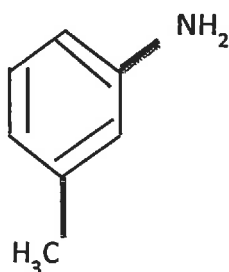
(a) From benzene, how would you prepare the following products? Show all the steps:

(i)



(5 points)

(ii)



(5 points)

b) Draw the following compounds and rank them in order of decreasing stability:

(i) Trans-3 hexene

(ii) Cis-3 hexene

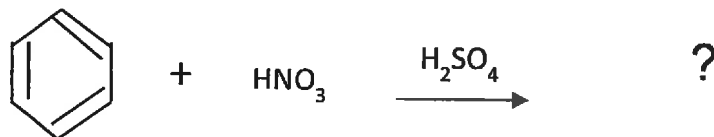
(iii) Cis-2,5-dimethyl-3 hexene

(10 points)

**Problem No. 5 (20 points total)**

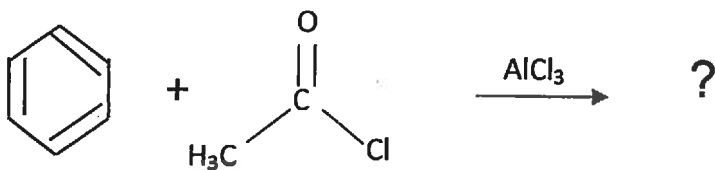
(a) Complete the chemical equations below and write the mechanism of each of the reactions:

(i)



(8 points)

(ii)



(8 points)

(b) Write the balanced equation of the combustion reaction of butane in pure oxygen.

(4 points)