National Exams

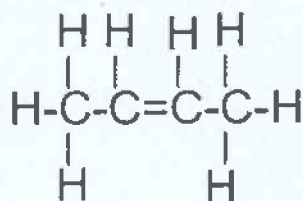**04-BS-12, Organic Chemistry**

May 2013

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.

3. No calculator is allowed.

4. ANSWER ALL FIVE PROBLEMS

5. Each problem is of equal value

6. Note that the questions (a), (b), (c), (d), (e), (f) or (g) of each problem can be treated independently
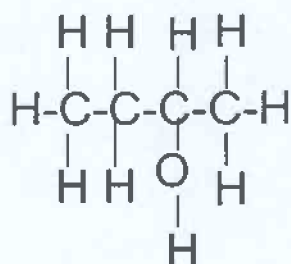
Problem No. 1 (20 points total)

Indicate and explain in a concise manner to which family of organic compounds, the following compounds belong?
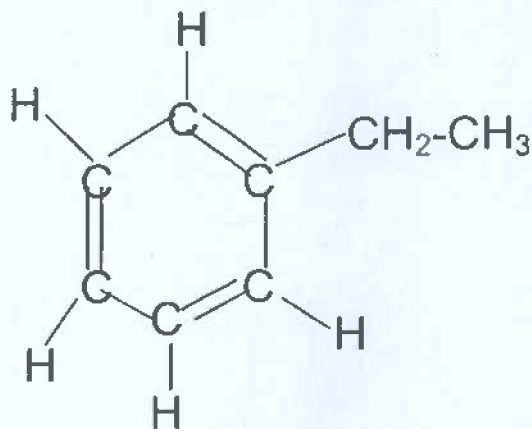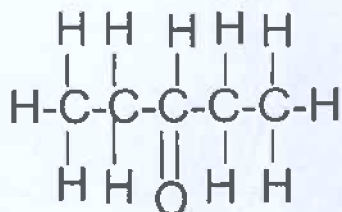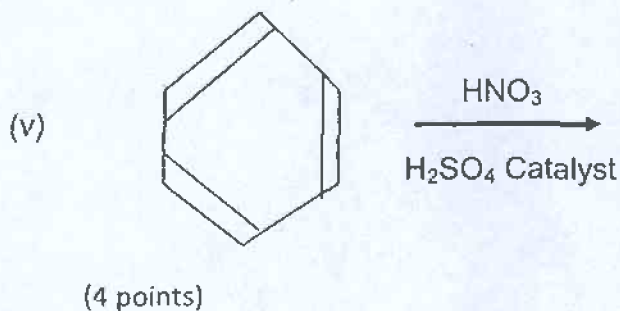
a) (5 points)

$$H-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-\underset{}{\overset{\overset{H}{|}}{C}}=\underset{}{\overset{\overset{H}{|}}{C}}-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-H$$

b) (5 points)

$$H-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-\underset{\underset{\underset{H}{|}}{\overset{}{O}}}{\overset{\overset{H}{|}}{C}}-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-H$$

c) (5 points)

d) (5 points)

$$H-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-\underset{\underset{O}{||}}{C}-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-H$$
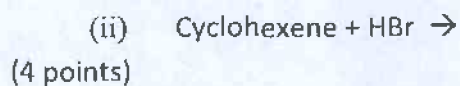
Problem No.2 (20 points total)

Write the expected products from the following chemical reactions:

(i)   2-methylpropene + Br_2 →
(4 points)

(ii)   Cyclohexene + HBr →
(4 points)

(iii)

$=CH_2$ $+ H_2$ $\xrightarrow{Pd}$

(4 points)

(iv)

$$\underset{}{CH_3CH_2\overset{\overset{\displaystyle CH_3}{|}}{C}=CHCH_3} \quad + \quad HCl \longrightarrow$$

(4 points)

(v)

$\xrightarrow[\text{H}_2\text{SO}_4 \text{ Catalyst}]{\text{HNO}_3}$
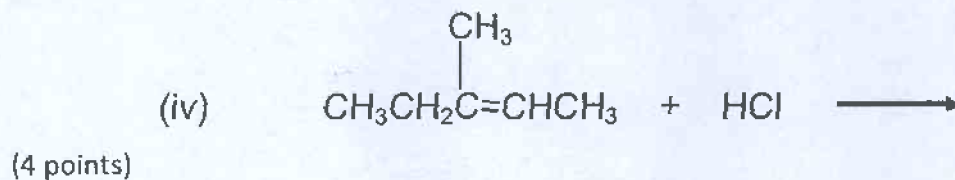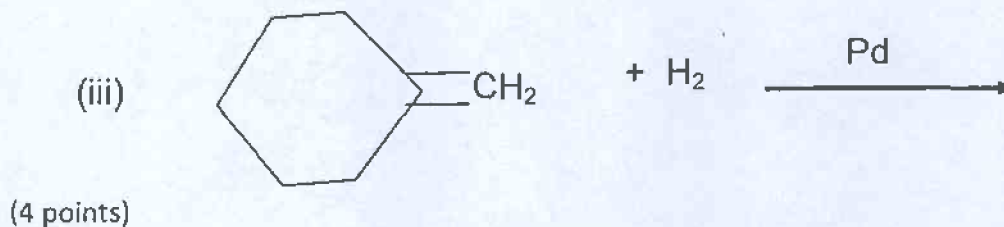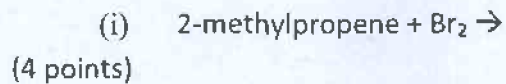
(4 points)

Problem No3. (20 points total)

(a) Propose a chemical structure for the compounds that have the following chemical formulas:

(i)   An amine having the formula C_3H_9N
(4 points)

(ii)   An alkyne having the formula C_4H_6
(4 points)
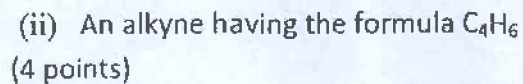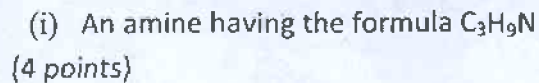
(iii) An ether that has the formula $C_4H_{10}O$

(4 points)

(b) Write a balanced equation for the complete combustion of 1-ethyl-3methyl cyclohexane (ie, reaction with oxygen)

(8 points)

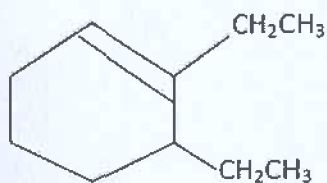## Problem No4. (20 points total)

(a) Write the chemical formula and draw the structure for both the CIS and TRANS isomers of 2-hexene

(5 points)

(b) Write the mechanism for the chemical reaction involving benzene:
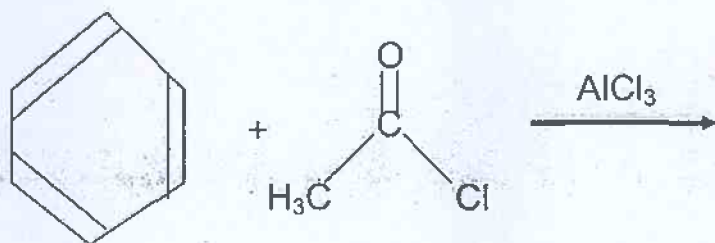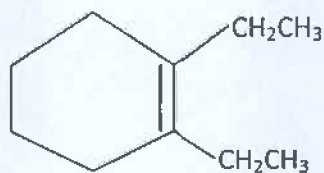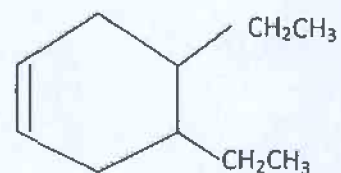

(10 points)

(c) Rank the following organic compounds in order of increasing stability. Which one of the three compounds is the least stable?
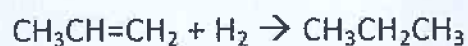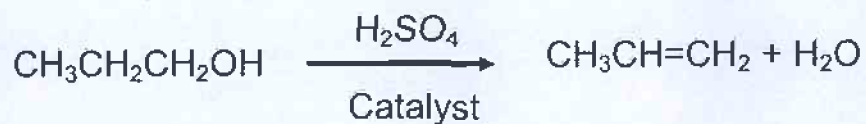

(a) (b) (c)

(5 points)

Problem N0. 5 (20 points total)

a) Draw five constitutional isomers having the molecular formula C_7H_{16}
(5 points)

b) Classify the following alkene reactions as addition, elimination, or substitution reactions:

(i) (5 points)

$$CH_3CH=CH_2 + H_2 \rightarrow CH_3CH_2CH_3$$

(ii) (5points)

$$CH_3CH_2CH_2OH \xrightarrow[\text{Catalyst}]{H_2SO_4} CH_3CH=CH_2 + H_2O$$

(iii) (5 points)

$$CH_3CH_2Cl + KOH \rightarrow CH_3CH_2OH + KCl$$