

National Exams

04-BS-12, Organic Chemistry

December 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**.
No calculator is allowed.
3. **ANSWER ALL FIVE PROBLEMS**
4. Each problem is of equal value
5. 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)

a) 10 points

2,2,4—trimethyl pentane also called iso-octane, is the standard of excellence used for determining the octane rating of gasoline. Draw the structural and condensed formula of this molecule.

b) 6 points

Classify each of the carbon atoms in the following structures as either primary, secondary or tertiary

i) 2,2-dimethyl butane

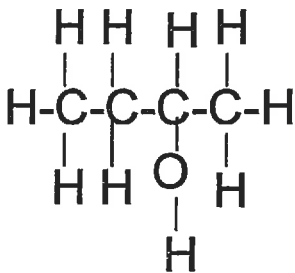
ii) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)\text{CH}_3$

iii) Hexane

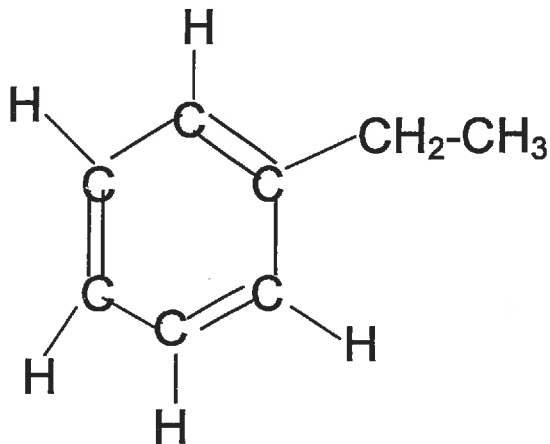
a) (4 points)

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

i)



ii)



Problem No. 2 (20 points total)

a) 10 points

i) Provide a concise definition of an isomer (also called structural or constitutional isomer)

i) Draw all the constitutional isomers having the molecular formula C_6H_{14}

b) 5 points

Write the combustion reaction of cyclohexane in the presence of excess molecular oxygen, to produce carbon dioxide and water and large amounts of energy as heat.

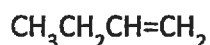
c) 5 points

Write the balanced equation of the mono-chlorination reaction of propane.

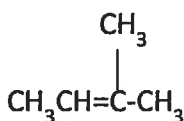
Problem No. 3 (20 points total)

a) 10 points

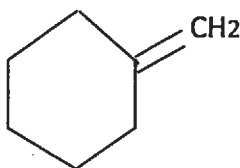
What would be the major product obtained from the addition of HBr to each of the following compounds?



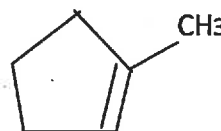
(i)



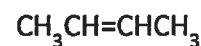
(ii)



(iii)



(iv)



(v)

b) 4 points

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

(i) An amine having the formula C_3H_9N

(ii) An ether that has the formula $C_4H_{10}O$

c) 6 points

Propose a synthesis method for ethanol (CH_3CH_2OH) from methanol (CH_3OH)

Problem No. 4 (20 points total)

(a) 10 points

What is structure of the products of the reaction of 1 mole of pentyne-2 with the following reactants?

(i) 1 mole of H_2 in the presence of $Pd/BaSO_4$

2

(ii) 2 moles of H_2 in the presence of nickel

2

(iii) 1 mole of Cl_2

2

(iv) 1 mole of HCl

2

(v) 2 moles of HCl

2

b) 10 points

i) Write the structural formula of the isomers of the alcohol of formula $C_4H_{10}O$

4

ii) What simple reactions would permit to identify them?

4

iii) Show that one of these reactions is an oxidation-reduction reaction

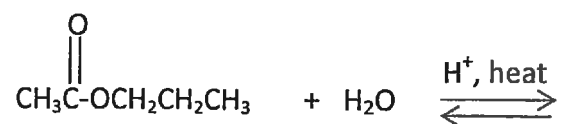
2

Problem NO. 5 (20 points total)

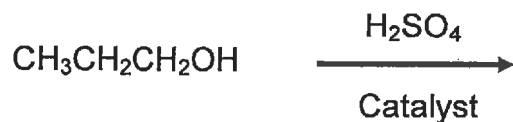
a) 10 points

Complete each of the following reactions and provide expected products:

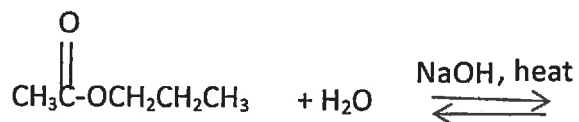
i)



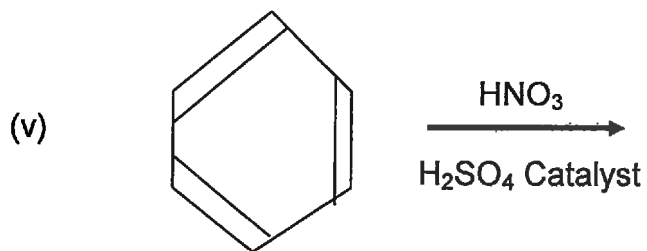
ii)



iii)



iv)



b) 4 points

What are the products of dehydration of:

i) 3-methyl-2-butanol?

ii) CH₃CH₂OH?

c) 6 points

Write the balanced equations for the hydrogenation of:

- i) 1-butene
- ii) cis-2 butene
- iii) Dimethylacetylene