



MACHAKOS UNIVERSITY

Supplementary University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES
DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SECOND SEMESTER EXAMINATION FOR
BACHELOR OF EDUCATION (SCIENCE)
SCH 102: ORGANIC CHEMISTRY I

DATE: 26/7/2019

TIME: 8:30 – 10:30 AM

INSTRUCTIONS:

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

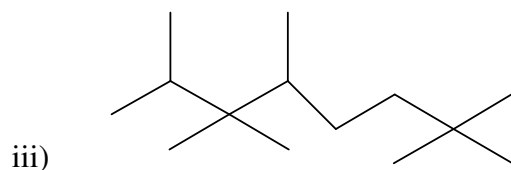
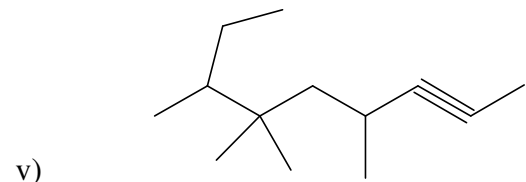
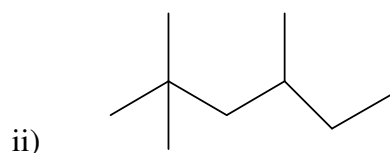
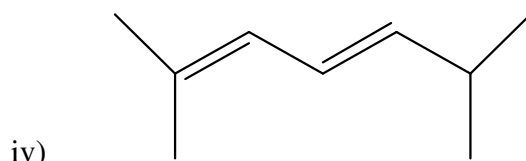
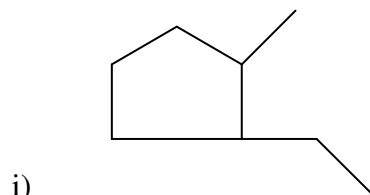
Section A - Compulsory.

Q1. a) Draw the structures of the following named compounds:

- i) 2,3,4-trimethyl-1,4-heptadiene
- ii) 3-ethyl-2-methyloctane
- iii) 2-Bromo-1-penten-4-yne
- iv) 2,2,4-trimethylheptane
- v) 1-Chloro-5-ethyl-1,4-cyclohexadiene

(5 marks)

b) Provide the IUPAC names for the following structures:



(5 marks)

c) Caffeine has an elemental analysis of 49.48% carbon, 5.190% hydrogen, 16.47% oxygen, and 28.85% nitrogen. It has a molar mass of 194.19 g/mol. Calculate its:

i) Empirical formula **(3 marks)**

ii) Molecular formula **(2 marks)**

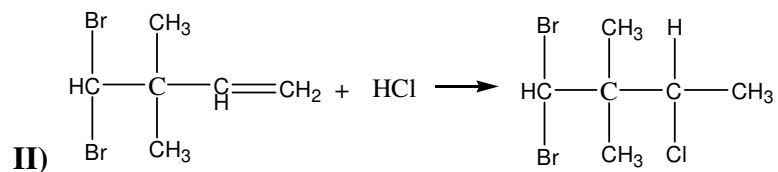
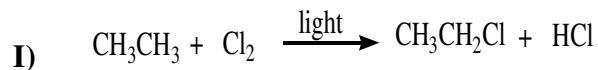
d) I) Describe simple chemical tests that would distinguish between:

i) Butane and 1-butene

ii) 1-butyne and 1-butene

(4 marks)

II) Show the mechanism for the reactions given below:



(6 marks)

- e) The combustion of an unknown substance produced 9.62 mg carbon dioxide and 3.94 mg of water. Another sample of the same unknown substance weighing 5.32 mg produced 13.49 mg of silver chloride in a halogen analysis.

i) Calculate the number of moles of carbon dioxide liberated (C =12, O =16)

(1 mark)

ii) Determine the quantity in grams of carbon element present in the carbon dioxide liberated in 1(e)(i) above.

(1 mark)

iii) Calculate the number of moles of water produced in this experiment

(1 mark)

iv) Calculate the number of moles of silver chloride produced and hence the amount of chloride ions produced in grams (atomic weight of Ag and Cl are 108.0 and 35.5 respectively).

(2 marks)

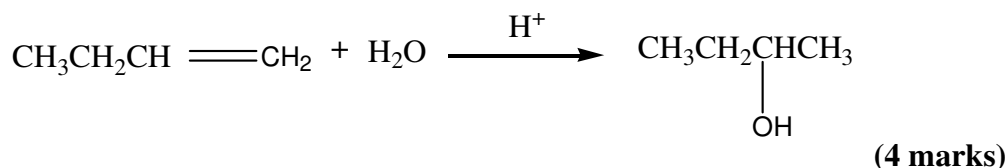
Section B
Answer any two questions

- Q2.** a) i) Define the term nucleophile (1 mark)
- ii) The reaction below proceeds by a mechanism similar to that of chlorination of methane.



Write the equations for the chain-initiating, chain-propagating and chain-terminating steps for the above reaction. (3 marks)

- b) Butene react with water in the presence of sulphuric acid to produce 2-butanol as the major product as shown below. Show the reaction mechanism for the reaction.

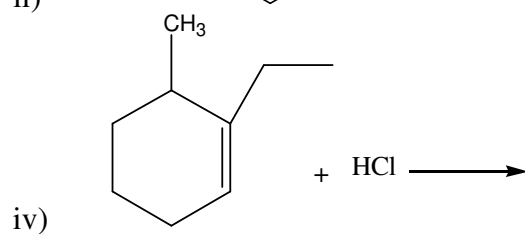
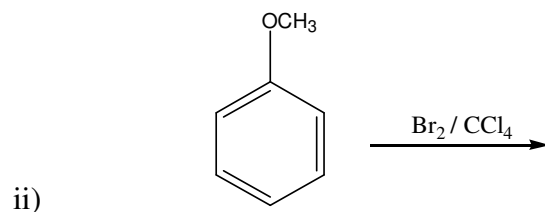
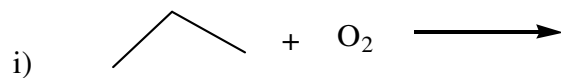


- c) i) Distinguish the following terms:
- I) Carbocation and Radical reaction
- II) E1 and E2 reactions (4 marks)
- ii) Explain **four** factors that influence the rates of $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ reactions (8 marks)

- Q3.** a) i) Define the term functional group (1 mark)
- ii) Identify **four** reasons why functional groups are important in organic chemistry (4 marks)

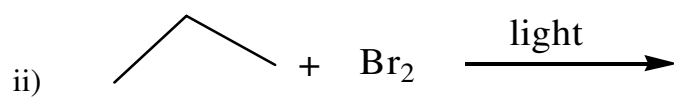
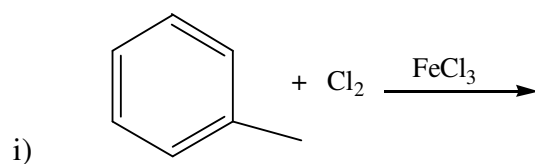
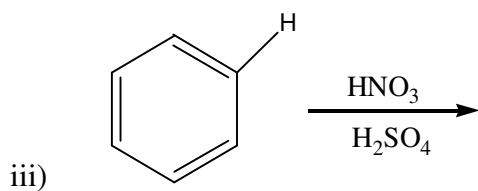
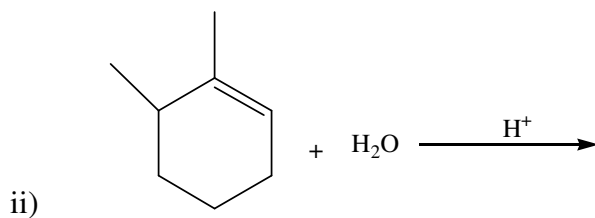
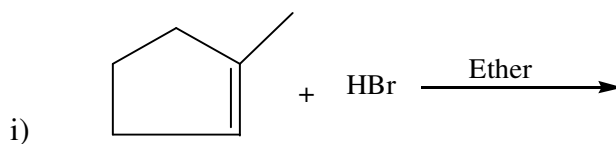
iii) Write the functional groups of ethers, amides, carboxylic acids and esters (4 marks)

- b) An alcohol and ether have the same molecular formula $\text{C}_2\text{H}_6\text{O}$. Draw their structural formulae indicating their functional groups. (2 marks)
- c) Explain why pentane has a higher boiling point (36°C) than 2-methylbutane and 2,2-dimethylpropane which boils at 28°C and 9.5°C respectively. (3 marks)
- d) Complete the following reactions by giving the structures of the missing reactants and products:



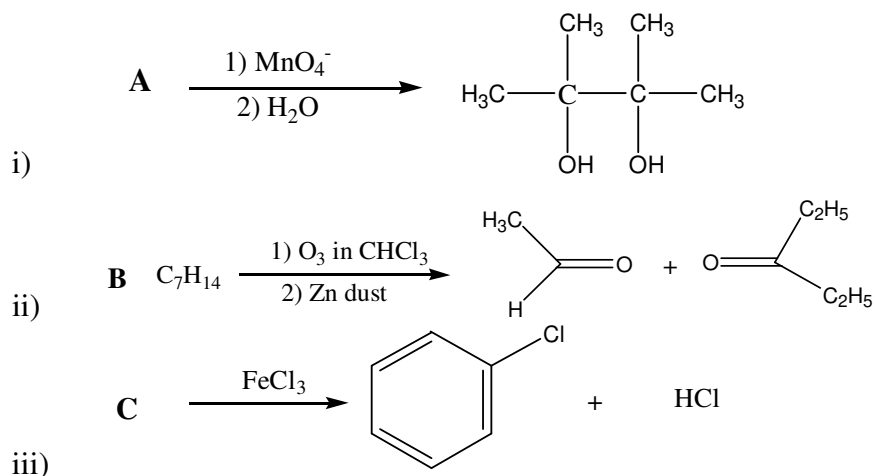
(6 marks)

Q4. a) Identify the product(s) of each of the following reactions (more than one compound may be formed).



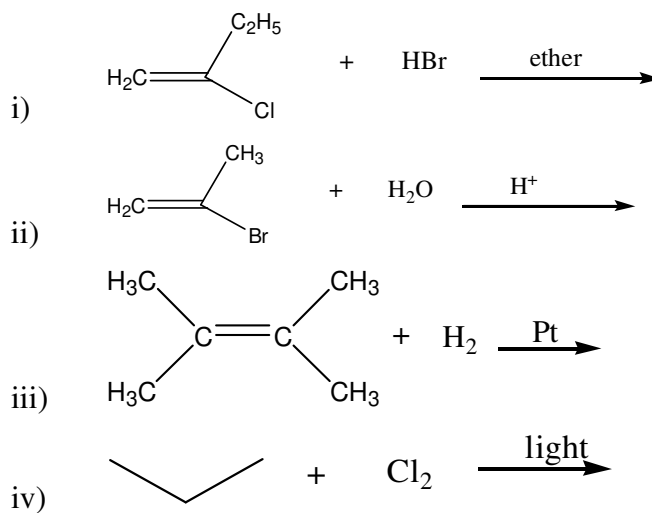
(10 marks)

- b) Deduce the structural formulae for the alkenes **A**, **B** and **C** that give the following products:



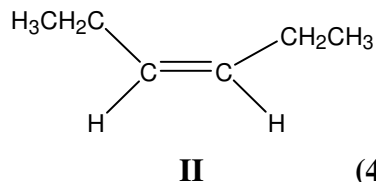
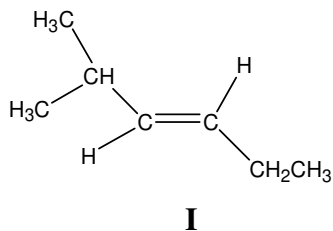
[3 marks]

- c) Provide the products of the following reactions showing the major and the minor products where appropriate.



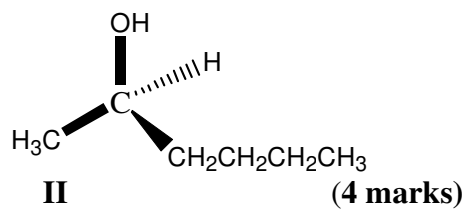
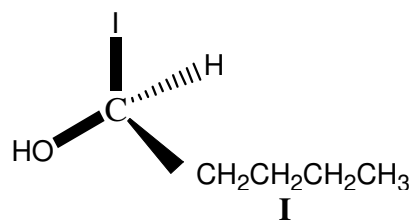
[7 marks]

- Q4.** a) i) Differentiate between structural and optical isomerism (2 marks)
- ii) Provide the structures and names of **four** constitutional isomers of C_7H_{16} (4 marks)
- iii) By assigning *cis* and *trans* name the following structures



(4 marks)

- b) i) Using the (R) and (S) configurations, name the following compounds:



- c) Draw the structural formulae for the following molecules.

- i) *Meta*-nitrophenol
- ii) 3-phenyloctane
- iii) 2,5-dibromoaniline
- iv) *para*-methyltoluene
- v) *trans*-3-methyl-3-heptene
- vi) Nitrobenzene

(6 marks)