



# **MACHAKOS UNIVERSITY**

**University Examinations 2016/2017**

**SCHOOL OF PURE AND APPLIED SCIENCES**

**DEPARTMENT OF PHYSICAL SCIENCES**

**FIRST YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF**

**BACHELOR OF EDUCATION (SPECIAL EDUCATION)**

**BACHELOR OF SCIENCE (MATHEMATICS)**

**BACHELOR OF EDUCATION (SCIENCE)**

**BACHELOR OF SCIENCE (BIOLOGY)**

**SCH 102: ORGANIC CHEMISTRY I**

**DATE: 5/6/2017**

**TIME: 2:00 – 4:00 PM**

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**INSTRUCTIONS:**

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

**PROVIDED:**

**Periodic table**

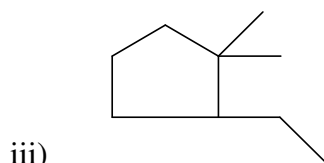
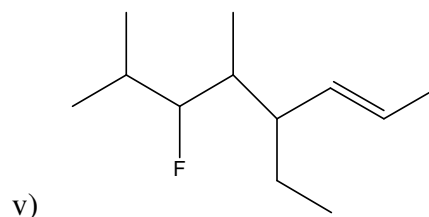
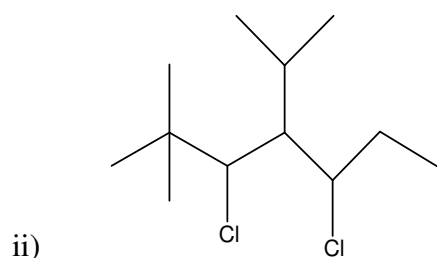
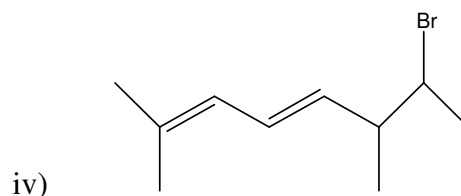
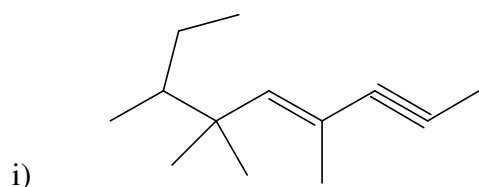
## SECTION A – COMPULSORY (30 MARKS)

1. a) Aspirin contains 60.00% Carbon, 4.48% Hydrogen and 35.52% Oxygen. It has a molar mass of  $180.17 \text{ g mol}^{-1}$ . Determine its:

i) Empirical formula (3 marks)

ii) Molecular formula (2 marks)

- b) Provide the IUPAC names for the following structures:



(5 marks)

- c) Draw the structures of the following named compounds:

i) 2,3,4-trimethyl-1,4-octadiene

ii) 3-ethyl-2,2-dimethylheptane

iii) 2-chloro-1-hexen-3-yne

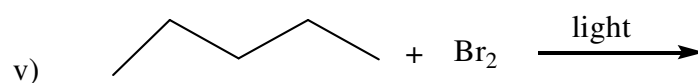
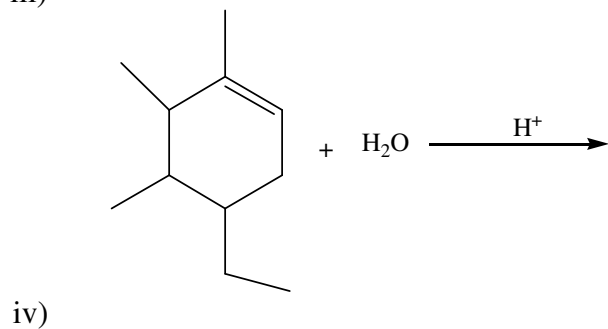
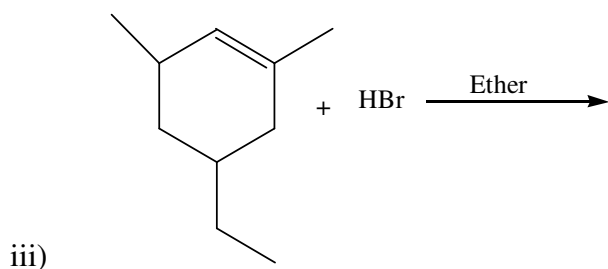
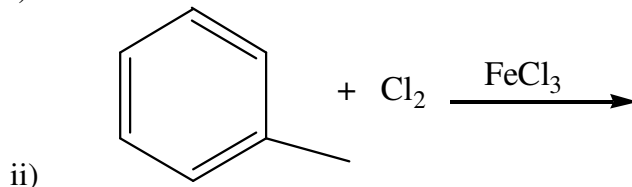
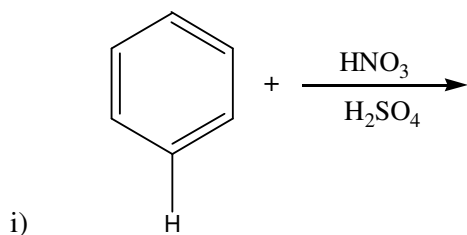
iv) 3-isopropyl-1,1-dimethylcycloheptane

v) 1-fluoro-5-ethyl-1,3-cyclohexadiene

(5 marks)

- d) The organic matter in a 3.776 g sample of a mercuric ointment is decomposed with  $\text{HNO}_3$ . After dilution, the  $\text{Hg}^{2+}$  is titrated with 21.30 mL of a 0.1144 M solution of  $\text{NH}_4\text{SCN}$ . Calculate the percentage of Hg (200.59 g/mol) in the ointment. (5 marks)

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



(10 marks)

**SECTION B: ANSWER ANY TWO QUESTIONS (20 MARKS EACH)**

2. a) Define the following terms as used in isomerism

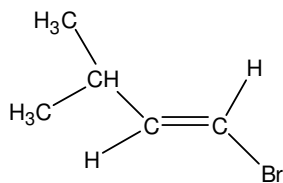
- i) Enantiomers
- ii) Stereoisomers
- iii) Optical isomers
- iv) Constitutional isomerism

(4 marks)

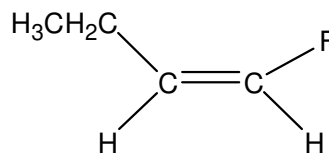
- b) Draw the structural formulae for the following molecules.
- Ortho*-nitrophenol
  - 3-phenylheptane
  - 2,3,4-tribromoaniline
  - para*-ethyltoluene
  - trans*-3-methyl-3-octene
  - m*-nitrochlorobenzene
- (6 marks)

- c) Provide the structures and names of two constitutional isomers of C<sub>4</sub>H<sub>10</sub>
- (2 marks)

- d) i) By assigning *cis* and *trans* name the following structures



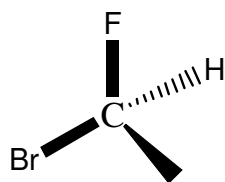
I



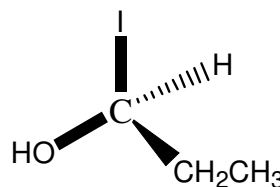
II

(4 marks)

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



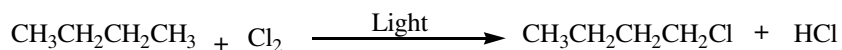
I



II

(4 marks)

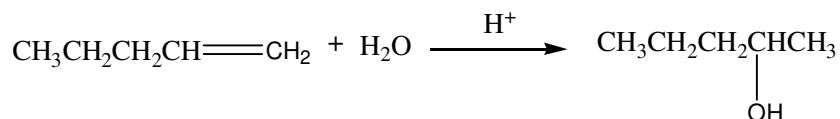
3. a) i) Define the term electrophile
- (1 mark)
- ii) Butane reacts with chlorine by a mechanism similar to that of chlorination of methane as shown below.



Write the equations for the chain-initiating, chain-propagating and chain-terminating steps for the above reaction.

(3 marks)

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



(4 marks)

- c) i) Distinguish the following terms:

I) Carbocation and Regiospecific reaction

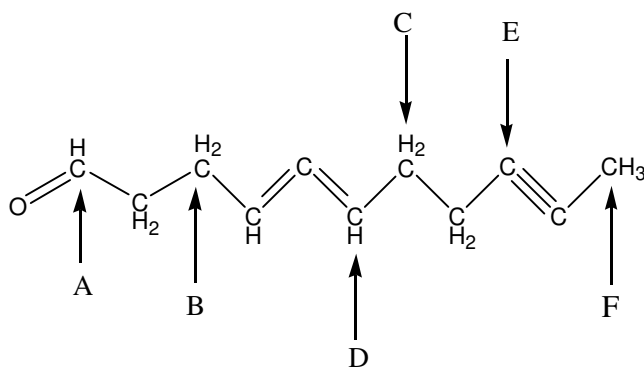
(2 marks)

II) S<sub>N</sub>1 and S<sub>N</sub>2 reactions

(2 marks)

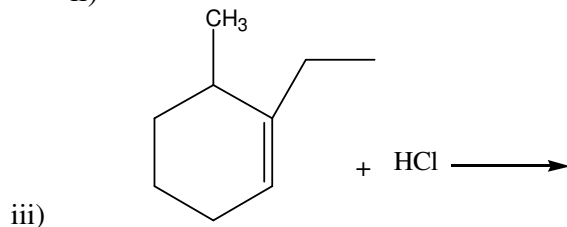
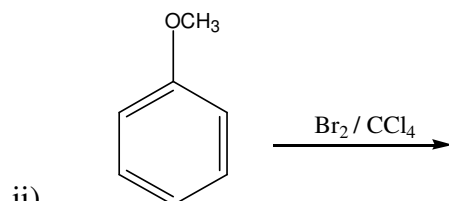
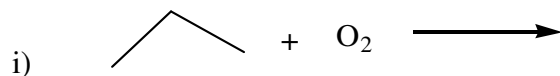
- ii) Explain **four** factors that influence the rates of S<sub>N</sub>1 and S<sub>N</sub>2 reactions
- (8 marks)

4. a) Identify the type of hybridization for each of the following labeled atoms in the following structure.



(3 marks)

- b) 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)
- c) 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)
- d) Complete the following reactions by giving the structures of the missing products:



(6 marks)

5. a) Describe simple chemical tests that would distinguish between:

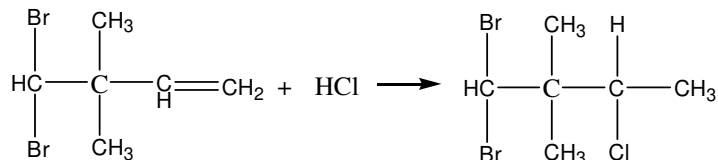
i) Hexane and 1-Hexene

(2 marks)

ii) 1-Hexyne and 1-Hexene

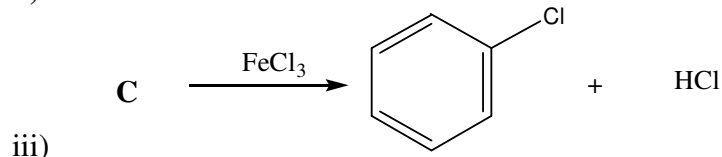
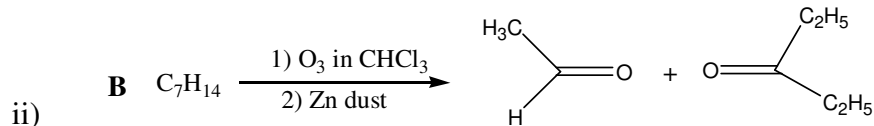
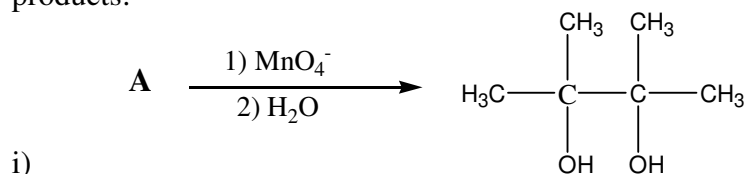
(2 marks)

b) Show the mechanism for the reactions given below:



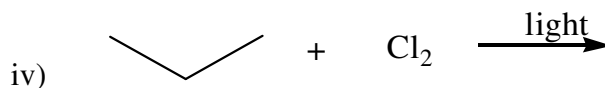
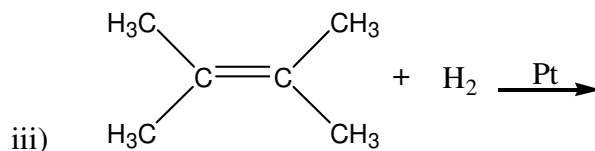
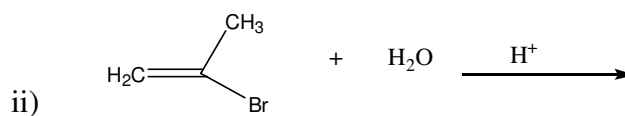
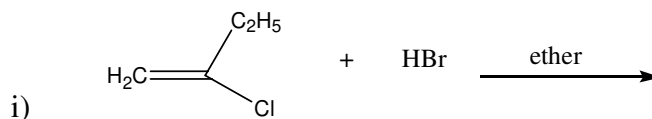
(4 marks)

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



(3 marks)

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



(7 marks)

e) Highlight **two** uses of alkenes

(2 marks)