UNIVERSITY OF NAIROBI
SECOND SEMESTER EXAMINATION 2018/2019
FIRST YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE
SCH 102: INTRODUCTION TO ORGANIC CHEMISTRY, CHEMISTRY OF ALKANES AND CYCLOALKANES AND
STEREOCHEMISTRY

Date: Time:

ANSWER ALL QUESTIONS

Q1. A). Identify all the functional groups that are present in strychnine.

\[ \text{Strychnine} \]

[5 Marks]

B). Indicate the hybridization as well the bond angles for the atoms labelled I – III in the following organic compound.

[6 Marks]

Q2. Answer the following

I. Draw a Lewis structure for each of the following compounds. Show your steps.

a) \( \text{C}_2\text{H}_6 \)  

b) \( \text{CH}_3\text{N} \)

[4 Marks]
II. Assign the formal charges for the atoms other than carbon and hydrogen in each of the following species. Show your calculation.

a) \( \text{CH}_3-\overset{\text{O}}{\text{C}}-\text{BF}_3 \)  

b) \( \text{CH}_3-\overset{\text{N}=\text{N}=\text{N}}{\text{C}}-\overset{\text{O}}{\text{C}} \)

[4 Marks]

III. Draw all resonance contributors of the following ion. In drawing each resonance structure, use curved arrows to indicate which pairs of electrons are shifted. Draw the resonance hybrid.

\[ \text{\textbf{Resonance Structure}} \]

[5 Marks]

IV. Redraw the following structure of glucose as a skeletal structure.

\[ \text{Glucose} \]

[2 Marks]

Q3. Answer the following

i. Arrange the following in order of increasing boiling points. Give your reasons.

\[ \text{I} \quad \text{II} \quad \text{III} \quad \text{IV} \]

[6 Marks]

ii. Explain why water (H\(_2\)O) is liquid while hydrogen sulfide (H\(_2\)S) is gas at room temperature.

[2 Marks]
iii. Which compound has the larger dipole moment, acetone or phosgene? Explain.

\[
\begin{align*}
\text{acetone} & \quad \text{Cl} \quad \text{Cl} \\
& \quad \text{phosgene}
\end{align*}
\]

[2 Marks]

Q4 Answer the following

I. Classify the following reactions as addition, elimination, substitution or rearrangement.

a) \[
\text{CH}_2\text{Cl} \quad \text{Base} \quad \rightarrow \quad \text{CH}_2\text{CH}_2\text{Cl} + \text{HCl}
\]

[2 Marks]

b) \[
\begin{align*}
\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{H} & \quad \text{HBr} \quad \rightarrow \quad \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}
\end{align*}
\]

[2 Marks]

II. Write equations and mechanism for the initiation, propagation and termination reactions leading to the formation of 1-chloroethylcyclopropane from propane and chlorine.

\[
\begin{align*}
\text{CH}_3\text{CH}_2\text{CH}_2\text{H} + \text{Cl}_2 & \quad \text{Light} \quad \rightarrow \quad \text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} + \text{HCl}
\end{align*}
\]

[5 Marks]

iii. In SCH 102 practicals you prepared the pain reliever aspirin by reacting salicylic acid with acetic anhydride as shown in the reaction scheme below. Identify the nucleophile and electrophile. Provide mechanism for reaction using electron-pushing arrows to indicate the flow of electrons in each step of the synthesis.

\[
\begin{align*}
\text{CH}_3\text{CO}_2\text{H} + \text{HO}_2\text{CCH}_3 & \quad \rightarrow \quad \text{CH}_3\text{CO}_2\text{H} + \text{CH}_3\text{CO}_2\text{H}
\end{align*}
\]

[7 MARKS]

Q5. Answer the following
I. Give the IUPAC name of the following compounds. Be sure to indicate stereochemistry where appropriate (e.g. R or S; cis or trans).

a) ![Structure a]

b) ![Structure b]

c) ![Structure c]

d) ![Structure d]

[1 Mark each]

II. Provide explicit conformational analysis explaining the most stable conformation between cis and trans-1-ethyl-4-methylcyclohexane. Which one is more stable?

[6 Marks]

Q6. Answer the following

I. Assign R or S configurations for each of the chiral carbons in the following molecule. Show your workout.

![Structure with Cl]

[2 Marks]

II. Draw all the stereoisomers that are possible for the compound whose three dimensional structure is given below. Identify the enantiomers and diastereomers.

![Structure with Br, OH, Cl, and O=Cl]

[8 Marks]