UNIVERSITY OF SWAZILAND

FINAL EXAMINATION PAPER

PROGRAMME :   B.Sc.   IN   AGRICULTURAL AND BIOSYSTEMS
ENGINEERING YEAR 1
B.Sc.   IN   AGRICULTURAL ECONOMICS AND
AGRIBUSINESS MANAGEMENT YEAR 1
B.Sc.   IN   AGRICULTURAL EDUCATION YEAR 1
B.Sc.   IN   AGRONOMY YEAR 1
B.Sc.   IN   ANIMAL SCIENCE YEAR 1
B.Sc.   IN   ANIMAL SCIENCE DAIRY OPTION YEAR 1
B.Sc.   IN   CONSUMER SCIENCE YEAR 1
B.Sc.   IN   CONSUMER SCIENCE EDUCATION YEAR 1
B.Sc.   IN   FOOD SCIENCE, NUTRITION AND
TECHNOLOGY YEAR 1
B.Sc.   IN   HORTICULTURE YEAR 1
B.Sc.   IN   TEXTILE AND APPAREL DESIGN AND
MANAGEMENT YEAR 1

COURSE CODE: CP 101

TITLE OF PAPER: INTRODUCTORY CHEMISTRY

SECTION:1   INORGANIC CHEMISTRY
SECTION:2   ORGANIC CHEMISTRY

TIME ALLOWED: TWO [2] HOURS

INSTRUCTIONS: ANSWER FOUR [4] QUESTIONS, TWO [2] QUESTIONS
FROM EACH SECTION.

NOTE: THIS PAPER CONTAINS SEVEN [7] PAGES INCLUDING
THE COVER PAGE.

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THE INVIGILATOR.

SECTION I : INORGANIC CHEMISTRY

QUESTION 1

(a)   Define or give brief descriptions of the following terms and phrases. Each answer carries two [2] marks.

(i)   Boiling point
(ii)   A solid
(iii)   A neutron
(iv)   Condensation
(v)   An ionic compound
(vi)   Covalent compound
(vii)   A liquid
(viii) A nucleus
(ix)   A proton
(x)   A shell

[20]

(b)   Calculate the percent elemental composition of calcite [$CaCO_3$] given the atomic masses of the following elements:

$$Ca = 40.0800 \quad amu$$
$$O \ = 15.9994 \quad amu$$
$$C \ = 12.305 \quad amu$$

Express the final answer to **three [3]** decimal places.   [5]

25]

QUESTION 2

(a)   Determine the mass of two [2] atoms of $^{238}_{92}U$ (Uranium) in grams given that the mass of the isotope is 238.050784 amu and that Avogadro's number is equal to 6.022045×10^{23} atoms per mole.
Show all calculations and express your final answer to **four [4]** decimal places.

[10]

(b)   Calculate the **atomic mass** of magnesium given the abundances and masses of its naturally occurring isotopes. <u>Show all calculations and round off the final answer to five [5] decimal places.</u>

Isotope	Abundance (%)		Mass (amu)
$^{24}_{12}Mg$	77.89	$\rightarrow$	23.985042
$^{25}_{12}Mg$	9.10	$\rightarrow$	24.985837
$^{26}_{12}Mg$	13.01	$\rightarrow$	25.982593

[10]

(c)   Calculate the formula mass of orthoclase feldspar $[KAlSi_3O_8]$ by using the following information:

$K = 39.0983$ amu   (atomic mass)
$Al = 26.9815$ amu   (atomic mass)
$Si_3 = 84.3566$ g   (molecular mass)
$O_2 = 31.9988$ g   (molecular mass)   [5]

[25]

QUESTION 3

(a)   How many atoms of hematite $[Fe_2O_3]$ are there if it has a mass of 30.02 grams, given the following information:

$Fe = 55.647$ amu
$O = 15.9994$ amu and
Avogadro's number $= 6.02 \times 10^{23}$ atoms per mole

[10]

(b)   Briefly explain how you would practically make a 1 N H_2SO_4 from a 16 M H_2SO_4 stock solution (using water as a solvent) in the laboratory. Clearly show your calculations. Use the following Atomic masses: $H = 1.00794$ amu. $S = 32.06$ amu. And $O = 15.9994$ amu.   [15]

[25]

SECTION 2 : ORGANIC CHEMISTRY

QUESTION 4

(a)   Define or briefly describe the following terms and phrases. Use a structural formula where necessary . Each answer carries two [2] marks.

(i)   An unsaturated hydrocarbon
(ii)   Hydrocarbon
(iii)   An alcohol
(iv)   An ether
(v)   An electrophile
(vi)   A meta-directing group
(vii)   Protein
(viii) An alkane
(ix)   A phenol
(x)   An alkene   [20]

(b)   Determine the molecular formula of an alkane containing twenty [20] carbon atoms

[2]

(c)   Determine the molecular formula of an alkene that contains twenty four [24] hydrogen atoms

[2]

(d)   What is the molecular formula of an alkyne that has ten [10] carbon atoms.
[1]

[25]

QUESTION 5

(a)   Write the IUPAC names of the following compounds. Each answer carries two [2] marks.

(i) $CH_3 - CH_2 - CH_2 - CH - CH_2 - CH_3$
                              $CH_2 - CH_3$

(ii) $CH_3 - CH_2 - CH - CH_2 - CH_2 - CH_3$
                      $CH_2 - CH_2 - CH_3$

(iii) $CH_3 - CH_2 - \underset{Cl}{CH} - \underset{Br}{CH} - CH_3$

(iv) $CH_3 - CH = CH - CH_2 - CH_2 - CH_3$

(v) $CH \equiv C - CH_2 - CH_3$

(vi) $CH_3 - CH_2 - CH_2 - CH_2 - OH$

(vii) $CH_3 - CH = CH - CH_2 - CH_3$

(viii) $CH_3 - CH_2 - CH_3$

(ix) $CH_3 - CH_2 - \underset{CH_3}{CH} - CH_3$

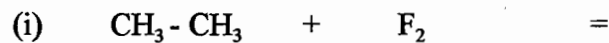(x) $CH_3 - CH_2 - CH_2 - \underset{O}{\overset{}{C}} - H$

[20]

(b)   Write **condensed** IUPAC **structural** formulae for the following compounds. Each answer carries one [1] mark.
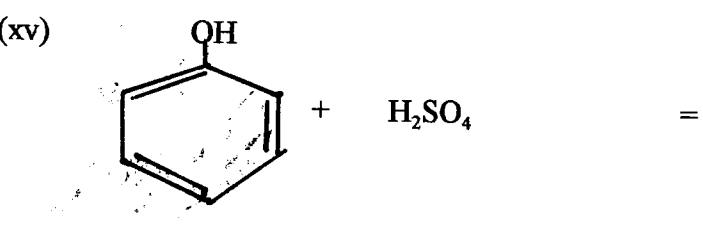
(i)   2 - heptanol
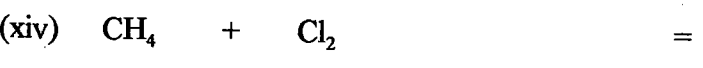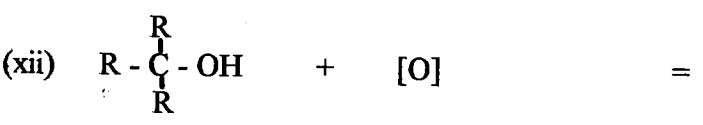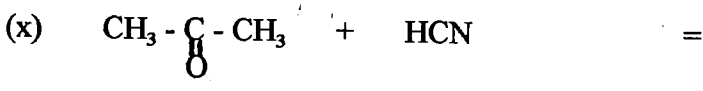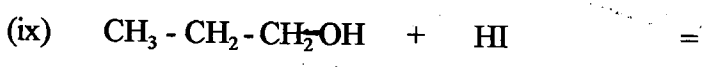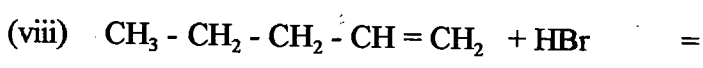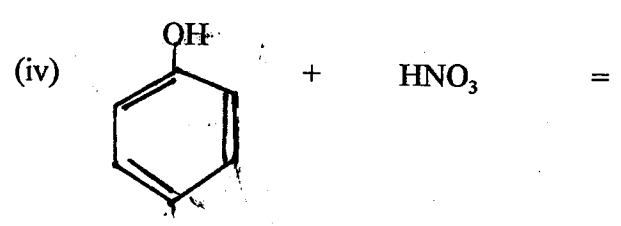(ii)   2 - iodo - heptane
(iii)   Cyclopentane
(iv)   2 - pentyne
(v)   Hexanone

[25]

QUESTION 6

(a)   Copy, complete and balance the following equations. Each answer carries one [1] mark.

(i) $CH_3 - CH_3$ + F_2 =

(ii) CH_2F_2 + F_2 =

(iii) $CH_2 = CH_2$ $+$ B_2 $=$

(iv)

    OH

            $+$ HNO_3 $=$

(v) $CH_3 - CH = CH_2$ $+$ HI $=$

(vi) $CH_2 = CH_2$ $+$ I_2 $=$

(vii) $CH_2 = CH_2$ $+$ $3O_2$ $=$

(viii) $CH_3 - CH_2 - CH_2 - CH = CH_2$ $+ HBr$ $=$

(ix) $CH_3 - CH_2 - CH_2 OH$ $+$ HI $=$

(x) $CH_3 - \underset{\underset{O}{\|}}{C} - CH_3$ $+$ HCN $=$

(xi) $CH_3 - CH_3$ $+$ $2O_2$ $=$

(xii) $R - \underset{\underset{R}{|}}{\overset{\overset{R}{|}}{C}} - OH$ $+$ $[O]$ $=$

(xiii) $CH_3 - CH_2 OH$ $+$ $3O_2$ $=$

(xiv) CH_4 $+$ Cl_2 $=$

(xv)

    OH

            $+$ H_2SO_4 $=$

[15]
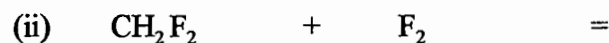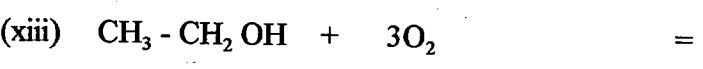
(b)　Write correct condensed structural formulae of the incorrectly written condensed ones for the following compounds. Each answer carries two[2] marks.

(i)　Propane　　　　$\neq$　　$CH_3\text{-}CH_3\text{-}CH_4$

(ii)　Propanal　　　　$\neq$　　$CH_3\text{-}CH_2\text{-}CH$

(iii)　Pentanol　　　　$\neq$　　$CH_3\text{-}CH_3\text{-}\underset{\underset{\displaystyle OH}{|}}{C}H\text{-}CH_2\text{-}CH_2$

(iv)　Methoxypentene　$\neq$　　$CH_3\text{-}O\text{-}CH=C\text{-}CH_2\text{-}CH\text{-}CH_3$

(v)　Hexanone　　　　$\neq$　　$CH_3\text{-}CH_2\text{-}CH_2\text{-}CH\text{-}\underset{\underset{\displaystyle O}{|}}{C}\text{-}CH_3$

[10]

[25]