RONGO
UNIVERSITY COLLEGE
Goldmine of Knowledge and Innovation

*(A Constituent College of Moi University)*

**OFFICE OF THE DEPUTY PRINCIPAL- ACADEMICS AND STUDENTS AFFAIRS**

# UNIVERSITY EXAMINATIONS

# 2013/2014 ACADEMIC YEAR

## FIRST YEAR FIRST SEMESTER EXAMINATION

## FOR

## THE DEGREE

## IN

## BACHELOR OF EDUCATION (SCIENCE)

**COURSE CODE: CHE 110**

**COURSE TITLE: BASIC CHEMISTRY/FUNDAMENTALS OF CHEMISTRY**

**TIME: 9.00AM-12.00NOON**

**DATE: 28/2/2014**

---

## INSTRUCTIONS TO CANDIDATES

- Answer **ALL** questions in this paper
- Do not write on the question paper.
- Switch off your mobile phones.
- Each question should begin on a fresh page
- Marks are shown at the end of each question
- Duration is 3 hours

**PLEASE TURN OVER**

**THIS PAPER CONSISTS (4) PRINTED PAGES**

**QUESTION ONE:**

Clearly explain the experiments leading to the discovery of (2 marks)

a. Neutron

b. Explain the operation of a mass spectrometer in the determination of isotopes and derive the mathematical expression; $m = \frac{H_o^2 r^2}{2V_o}$ for the mass spectrometer. Where $H_o$ = magnetic field strength, $V_o$ = electric field strength, m = mass of the isotope and r is the radius of the path taken by isotope in a magnetic field. (5 marks)

**QUESTION TWO:**

Using appropriate bond theories:

a. Explain the variable covalency of Iodine in the following compounds ICl, $ICl_3$, $IF_5$, $IF_7$ (4 marks)

b. Explain why Aluminum can form a complex ion $AlF_6^{3-}$ but Boron only forms a complex ion $BF_4^-$ (2 marks)

c. Explain why $SiF_4$ can form addition compound with ammonia while $CCl_4$ does not. (2 marks)

d. Using the molecular orbital theory, show the bond formation in $N_2$ molecule and hence give the bond order in nitrogen molecule. (3 marks)

e. Explain clearly the variation in boiling points in the following molecules $CH_4$, $H_2O$, $NH_3$, and HF. (3 marks)

**QUESTION THREE:**

The first, second, third and fourth energy shells of an atom may contain maximum of 2, 8, 18 and 32 electrons respectively.

a. Explain this arrangement in terms of quantum number. (4 marks)

b. Give the electronic configuration of the following elements, the atomic numbers are in bracket (3 marks)

i. Cr (24)

ii. Ag (47)

iii. Gd (64)

**QUESTION FOUR:**

Most chemical reactions are REDOX in nature.

a. Define the following terms as related to redox reactions

i. Disproportionation reaction (1 mark)

ii. Oxidizing agent (1 mark)

iii. Comproportionation reaction (1 mark)

iv. Equivalent weight (1 mark)

b. Write down a balanced ionic chemical equation for the oxidation of $Fe^{2+}$ ions using acidified solution of permanganate ion $MnO_4^-$ (show all your workings) (2 marks)

c. Explain why fluorine cannot undergo disproportionation reaction (2 marks)

d. Give the difference between voltaic and electrolytic cells (2 marks)

## QUESTION FIVE:

Chemical reactions are always accompanied by change in the heat content;

a. Define the *standard molar enthalpy change of formation* **(1 mark)**

b. State the *Hess' law* **(1 mark)**

c. The equation below shows the reaction between ammonia and fluorine.

$NH_{3\,(g)} + 3F_{2\,(g)} \longrightarrow 3HF_{(g)} + NF_3\,(g)$

i. Use the standard molar enthalpy change of formation ($\Delta H_f^{\circ}$ ) given below to calculate the molar enthalpy change for this reaction **(2 marks)**

| Compound | $NH_3$ | HF | $NF_3$ |
|---|---|---|---|
| $\Delta H_f^{\circ}$ kJ/mol | -46 | -269 | -114 |

ii. Use the average bond enthalpy data below to calculate the value of the standard enthalpy change for the same reaction **(2 marks)**

| Bond | N-H | F-F | H-F | N-F |
|---|---|---|---|---|
| Average bond enthalpy (kJ/mol) | 388 | 158 | 562 | 272 |

d. Explain the enthalpy changes that accompany the dissolution of an ionic compound and explain the factors that influence each **(2 marks)**

## QUESTION SIX:

Stoichiometry is an important branch of chemistry;

a. Give the difference between composition stoichiometry and reaction stoichiometry. **(2 marks)**

b. 1.375g of copper oxide was reduced by hydrogen gas to copper and 1.098g of copper was obtained. In another experiment, 1.178 of copper was dissolved in dilute nitric acid and the resultant copper nitrate was converted into copper oxide by ignition. The mass of copper oxide obtained was 1.476g. Show that these results prove the law of constant proportion. (5 marks)

c. Caffeine contains carbon, Hydrogen Nitrogen and Oxygen. On complete combustion, 1.500g sample of caffeine produced 2.737g of $CO_2$ and 0.6814g of $H_2O$. A separate further analysis of 2.500g sample of caffeine produced 0.8677g of $NH_3$. The molar mass of caffeine is 194.2g/mol. Determine the empirical formula hence the molecular formula of caffeine (H=1.008, C=12.011, N=14.01 O=16) **(5marks)**

**QUESTION SEVEN:**

The rate of a chemical equation depends on the concentration of reactants.

a. Briefly explain how titrimetric analysis method can be used to determine reaction rate titrimetric analysis **(2 marks)**

b. Give the major postulates of the collision theory of reaction **(2 marks)**

c. The data below were obtained when substances A and B in solution at constant temperature.

| [A] mol $dm^{-3}$ | [B] mol $dm^{-3}$ | Initial rate of formation of product mol $dm^{-3}$ $s^{-1}$ |
|---|---|---|
| 0.60 | 0.30 | $1.26\times10^{1}$ |
| 0.20 | 0.30 | $1.4\times10^{0}$ |
| 0.60 | 0.10 | $4.2\times10^{0}$ |

i. Determine the order of the reaction with respect to;

A **(2 mark)**

B **(2 marks)**

ii. Calculate the rate constant, k, giving appropriate units. **(2 marks)**

iii. Calculate the rate of reaction when [A]=0.17 mol $dm^{-3}$ and [B] =0.25 mol $dm^{-3}$ **(2 marks)**