CHUKA UNIVERSITY

UNIVERSITY EXAMINATIONS
EXAMINATION FOR THE AWARD OF CERTIFICATE IN

CHEM 00102: BASIC CHEMISTRY

STREAMS: CERT **TIME:2 HOURS**

DAY/DATE: TUESDAY 17/12/2024 **2.30 P.M. –4.30 P.M.**

INSTRUCTIONS: ***ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.***

QUESTION ONE (30 MARKS)

(a) Boron (B; $Z = 5$) has two naturally occurring isotopes. Find the percent abundances of ^{10}B and ^{11}B given these data: atomic mass of B = 10.81 amu, isotopic mass of ^{10}B = 10.0129 amu, and isotopic mass of ^{11}B = 11.0093 amu. (5 marks)

(b) State the difference between an emulsion and gel and discuss two types of emulsions. (6 marks)

(c) With the aid of a diagram show the type of bonding in CO_2. (3 marks)

(d) Distinguish between stereoisomers and constitutional isomers (2marks)

(e) Draw the Constitutional isomers of pentane (3marks)

(e) State the thermal properties of water. (2 marks)

(f) Derive the relationship between pOH, pH and pK_w. (3 marks)

(g) State the applications of radioisotopes and controlled radiation in agriculture. (4 marks)

(h) Distinguish between lyophobic and lyophilic colloids. (2 marks)

QUESTION TWO (20 MARKS)

a) Discuss the following trends in the periodic table. (6 marks)

i. Ionization energy
ii. Electronegativity

b) Name the following compounds. (5 marks)

i. $CH_3CH_2CHClCH_2CH_3$
ii. $CH_2=C=CHCH=CH_2$
iii. CH_3CHFCH_2F
iv. $CH_2=CHCH_2CH(CH_3)_2$
v. $CH_3C\equiv CCH_3$

c) Discuss the factors that contributes to the polar nature of water. (6 marks)

d) Write short notes on catalysis. (3 marks)

QUESTION THREE (20 MARKS)

a. Discuss two methods of purification of colloids. (8 marks)

b. A research chemist adds a measured amount of HCl gas to pure water at 25^0C and obtains a solution with $[H_3O^+]$ =3.0× $10^{-4}M$. Calculate $[OH^-]$ and state whether it's a neutral, acidic or basic solution. (4 marks)

c. Ethylene reacts with ozone to form smog, according to the following equation. $C_2H_{4(g)} + O_{3(g)} \rightleftharpoons C_2H_4O_{(g)} + O_{2(g)}$ and the results obtained after every 10 seconds are listed below;

Time (s)	Concentration of O_3 (mol/L)
0.0	3.20×10^{-5}
10.0	2.42×10^{-5}
20.0	1.95×10^{-5}
30.0	1.63×10^{-5}
40.0	1.40×10^{-5}
50.0	1.23×10^{-5}
60.0	1.10×10^{-5}

With the aid of a graph determine the rate of reaction. (4 marks)

d. In an art restoration project, a conservator prepares copper plate etching solutions by diluting concentrated HNO_3 to 2M, 0.3M, and 0.0063M HNO_3. Calculate$[H_3O^+]$, pH, $[OH^-]$and pOH of the three solutions at 25^0C (4 marks)

QUESTION FOUR (20 MARKS)

a) Discuss the intermolecular forces of attraction. (6 marks)

b) Discuss the contributions of isotopes and radiation techniques towards strengthening national capabilities in terms of expertise and training. (9 marks)

(i) Plant nutrition

(ii) Mutation

(iii) Food preservation

c) Hydrogen gas has a nonpolluting combustion product (water vapor). It is used as a fuel aboard the space shuttle and in earthbound cars with prototype engines:

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$ (5 marks)

I. Express the rate in terms of changes in $[H_2]$, $[O_2]$, and $[H_2O]$ with time.

II. When $[O_2]$, is decreasing at 0.23mol/L at what rate is $[H_2O]$ increasing.
