# KIBABII UNIVERSITY

## UNIVERSITY EXAMINATIONS
## 2016/2017 ACADEMIC YEAR

### FIRST YEAR SECOND SEMESTER

### SUPPLEMENTARY/SPECIAL EXAMINATIONS

### FOR THE DEGREE OF B.ED (SCIENCE)

**COURSE CODE:** SCH 101

**COURSE TITLE:** FUNDAMENTALS OF CHEMISTRY II

**DURATION: 2 HOURS**

**DATE: 26TH SEPTEMBER 2017 TIME: 3 – 5PM**

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**INSTRUCTIONS TO CANDIDATES**

This paper consists of **FIVE** questions. Answer question **ONE** which is **COMPULSORY(30 marks)** and any other **TWO** questions from questions two, three, four and five (**20 marks each**)

## QUESTION ONE (30 MARKS)

1.

a) When 0.08 moles CO, 0.14 moles of $H_2$, and 0.08 moles of $CH_4$ are placed in a 1-L vessel at temperature $T$ and allowed to come to equilibrium. The mixture is found to contain 0.01 moles $H_2O$ for the reaction:

$$CO\,(g) + 3\,H_2\,(g) \rightarrow CH_4\,(g) + H_2O\,(g)$$

What is the equilibrium constant, $K$? **[04]**

b) 1.000 mole of $H_2$ gas and 1.000 mole of $I_2$ vapor are introduced into a 5.00-liter sealed flask. The mixture is heated to a certain temperature and the following reaction occurs until equilibrium is established.

$$H_2(g) + I_2(g) \rightleftarrows 2HI(g)$$

At equilibrium, the mixture is found to contain 1.580 mole of HI.

i. What are the concentrations of $H_2$, $I_2$ and HI at equilibrium? **[03]**
ii. Calculate the equilibrium constant $K_c$. **[02]**

c) State the ***Le Châtelier's principle.*** **[01]**

d) State three factors that influence equilibrium: **[03]**

e) Consider the reactions below. Explainhowincrease in pressurewouldaffectthedirection of thereaction.

a) $2SO_2(g) + O_2(g) \rightleftarrows 2SO_3(g)$, **[02]**
b) $PCl_5(g) \rightleftarrows PCl_3(g) + Cl_2(g)$; **[02]**
c) $CO(g) + H_2O(g) \rightleftarrows CO_2(g) + H_2(g)$; **[02]**

f) State Raoult's law. **[01]**

g) What is the vapor pressure of the pure solvent if the vapor pressure of a solution of 10 g of sucrose ($C_6H_{12}O_6$) in 100 g of ethanol ($C_2H_6O$) is 55 mmHg? **[04]**

h) Calculate osmotic pressure for 0.10 M $Na_3PO_4$ at 20°C. **[02]**

i)..Calculate molarity if solution in water (300 K) has osmotic pressure of 3.00 atm. **[02]**

j)Hemoglobin is a large molecule that carries oxygen in human blood. A water solution that contains 0.263 g of hemoglobin (Hb) in 10.0 mL of solution has an osmotic pressure of 7.51 torr at 25$oC$. What is the molar mass of the hemoglobin? **[02]**

## QUESTION TWO (20 MARKS)

2. a) Air is primarily a mixture of nitrogen $N_2$ molecules (molecular mass 28.0u) and oxygen $O_2$ molecules (molecular mass 32.0u). Assume that each behaves as an ideal gas and determine the rms speeds of the nitrogen and oxygen molecules when the temperature of the airis 293K.

**[05]**

b) Calculate the pressure exerted by 84.0 g of ammonia, $NH_3$, in a 5.00 L container at 200. °C using the van der Waal's equation. The van der Waal's constants for ammonia are: a = 4.17 atm $L^2\ mol^{-2}$ b =$3.71x10^{-2}$ $Lmol^{-1}$ **[05]**

c) If sulfur dioxide were an "ideal" gas, the pressure at 0°C exerted by 1.000 mol occupying 22.41 L would be 1.000 atm. Use the van der Waals equation to estimate the "real" pressure. ( a = 6.865 $L^2$ atm/$mol^2$ and b = 0.05679 L/mol) **[05]**

d) What are the assumptions made for an ideal gas? **[03]**

e) For gases; hydrogen, ammonia and chlorine state with reasons which gas is closest to ideal behavior at stp. **[02]**

## QUESTION THREE (20 MARKS)

2 a) Define the following terms;

i) Phase Equilibrium: **[02]**

ii) Binary Isomorphous Systems: **[02]**

iii) Binary Eutectic Systems: **[02]**

iv) Component of a system: **[02]**

v) Solubility Limit: **[02]**

b) Draw a schematic representation of the one-component phase diagram for $H_2O$. The projection of the phase diagramto show information at 1 atm generating a temperature scale labeled with the familiar transformation temperatures for $H_2O$ (melting at 0°C and boiling at 100°C). **[10]**

## QUESTION FOUR (20 MARKS)

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a)Define the term pH **[01]**

b) Calculate the PH of the following solutions:

i) 1.5M HF solution whose $K_a = 7.0 \times 10^{-4}$ **[04]**

ii) Sulphuric acid solution whose concentration is $2.4 \times 10^{-3}$ M **[03]**

iii) Sodium hydroxide solution whose concentration is $2.4x10^{-3}$ **[04]**

c)

i. What is a buffer solution **[02]**

ii. How is buffer solution prepared? **[02]**

iii. What is the pH of a solution of 0.400M formic acid in 1.000M sodium formate?

( Take $H_20 + HCOOH \leftrightarrow H_3O^+ + HCOO^-$ $(K_a = 1.80 \times 10^{-4})$ **[04]**

## QUESTION FIVE (20 MARKS)

5

a) Differentiate by defining between empirical formula and molecular formula of a compound

**[02]**

b) The percentage of copper in a sample was determined by dry ashing. The results obtained were tabulated as below.

| Quantity | Mass (g) |
|---|---|
| Mass of empty porcelain boat | 14.4 |
| Mass of boat + copper oxide | 18.4 |
| Mass of boat + reduced copper | 17.6 |

Use the information to determine the formula of the oxide of copper.(*take Cu = 63.5gmol$^-$ and O = 16gmol$^-$)* **[06]**

c) A hydrocarbon has a percent composition by mass of 85.7% of carbon and the rest hydrogen. Determine the empirical formula of the hydrocarbon. If the molecular mass of the compound is 56. Calculate its molecular formula. **[06]**

d) Discuss the sources of error during gravimetric analysis. **[06]**