



JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES
UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF
EDUCATION (SCIENCE)
1ST YEAR 1ST SEMESTER 2018/2019
MAIN REGULAR

COURSE CODE: SCH 101

COURSE TITLE: BASIC PHYSICAL CHEMISTRY

EXAM VENUE: STREAM: (BED SCI)

DATE:

EXAM SESSION:

TIME: 2:00 HRS

Instructions:

- 1. Answer question 1 (Compulsory) in Section A and ANY other 2 questions in Section B.**
- 2. Candidates are advised not to write on the question paper.**
- 3. Candidates must hand in their answer booklets to the invigilator while in the examination room**

Useful data

$R = 0.0821 \text{ L atm. K}^{-1}\text{mol}^{-1}$

Molar mass K = 39.09 g.mol^{-1}

Molar mass Ne = 20.18 g.mol^{-1}

Molar mass N = 14 g.mol^{-1}

Molar mass O = 16 g.mol^{-1}

Molar mass Cl = 35.5 g.mol^{-1}

Molar mass H = 1.01 g.mol^{-1}

Molar mass of C = 12 g.mol^{-1}

Density of benzene = 0.879 g.cm^{-3}

Density of toluene = 0.867 g.cm^{-3}

$E^\circ \text{ Zn}^{2+}/\text{Zn} = -0.76 \text{ V}$

$E^\circ \text{ Fe}^{3+}/\text{Fe}^{2+} = 0.77 \text{ V}$

INSTRUCTIONS: Answer Question 1 and any other TWO questions

QUESTION ONE (30 MARKS)

1. (a) Define the following;
- (i) Cell potential
 - (ii) Equation of state
 - (iii) Colligative property
 - (iv) Electrolytic cells
 - (v) Reaction quotient
 - (vi) Raoult's law [12 marks]
- (b) When 5 g of KClO_3 is heated it decomposes according to the equation:
$$\text{KClO}_3 \rightarrow \text{KCl} + \text{O}_3$$
- i) Calculate the theoretical yield of Oxygen. [4 marks]
 - ii) Give the % yield if 1.78 g of O_2 is produced. [2 marks]
 - iii) How much oxygen would be produced if the percentage yield was 78.5 %? [4 marks]
- (c) Balance the following equations: $\text{NH}_4\text{NO}_3 \rightarrow \text{N}_2 + \text{O}_2 + \text{H}_2\text{O}$ [2 marks]
- (d) Carbon monoxide is formed when carbon dioxide reacts with solid carbon (graphite) as follows;
$$\text{CO}_2 + \text{C} \leftrightarrow 2\text{CO}; H = 172.5 \text{ kJ}$$
- Is a high or low temperature more favourable for the formation of carbon monoxide? [3 marks]
- (e) It requires 44 seconds for 2.5 L of an unknown gas to diffuse through a porous wall and it takes 64 seconds for the same volume of Ne gas to diffuse at the same temperature and pressure. What is the molar mass of the unknown gas? [3 marks]

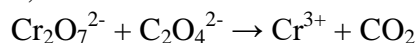
QUESTION TWO (20 MARKS)

2. (a) Give the Nernst equation and define all the terms in it. [4 marks]
- (b) A mixture of gases whose composition is as follows; 0.3 moles A, 0.25 moles B and 0.3 moles C have a total pressure of 2 atm. Calculate the partial pressures of the gases. [7 marks]
- (c) The equilibrium constant for the reaction below at 25 °C is
- $$\text{NO}_2 (\text{g}) \leftrightarrow \text{N}_2\text{O}_4 (\text{g})$$
- i) Write the expression for the equilibrium constant in this reaction. [2 marks]
 - ii) If the $[\text{NO}_2]$ in the equilibrium mixture at this temperature is $2 \times 10^{-2} \text{ M}$, what is the $[\text{N}_2\text{O}_4]$? [2 marks]
 - iii) Calculate the equilibrium constant for the above system at 25 °C. [2 marks]

(d) What is an ideal solution? [3 marks]

QUESTION THREE (20 MARKS)

3. (a) Write the balanced chemical reaction in acidic medium of the following using half reaction method; [8 marks]



(b) 4.5 moles of nitrogen was found in the lab to occupy 1.32 litres at 50 °C and a pressure of 18.40 atms. Calculate the pressure expected if the gas behaves as a perfect gas. [3 marks]

(c) A solution is made by mixing 62.6 mL of benzene (C₆H₆) with 80.3 mL of toluene (C₇H₈). Calculate the mole fraction of these two components. [5 marks]

(d) Sketch the isobar and isotherm that defines Charles and Boyle's law. [4 marks]

QUESTION FOUR (20 MARKS)

4. (a) i) Write the cell reaction for the voltaic cell: Zn(s)/Zn²⁺(aq)//Fe³⁺(aq)/Fe²⁺(aq)/Pt. [2 marks]

ii) Calculate the standard e.m.f of the above cell. [4 marks]

(b) Briefly describe the **FOUR** colligative properties. [8 marks]

(c) Consider the following equation $2 \text{NH}_3 (\text{g}) \leftrightarrow \text{N}_2 (\text{g}) + 3\text{H}_2 (\text{g})$ What is the effect on equilibrium if pressure is increased in this system? [2 marks]

(d) The lowering of vapour pressure of a solution of 108.2 g of substance W in 100 g of water at 20 °C is 24.79 Nm⁻². The vapour pressure of water at this same temperature is 2.338 kNm⁻². Calculate the molecular weight of X. [4 marks]

QUESTION FIVE (20 MARKS)

5. (a) Identify the reducing agent and oxidizing agent in the following reaction



(b) Distinguish the following terms:

(i) Electrolysis and electrochemistry

(ii) Limiting and excess reagent

(iii) Grahams law of effusion and diffusion [6 marks]

(c) Discuss any **THREE** factors affecting dissolution of solids. [6 marks]

(e) Urea, $(\text{NH}_2)_2\text{CO}$ is used as fertilizer. What is the molarity of an aqueous solution that is 3.42 m urea given that the density of urea solution is 1.045 g/ml. [4 marks]