



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES**  
**UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE**  
**(PUBLIC & COMMUNITY HEALTH)**  
**1<sup>ST</sup> YEAR 1<sup>ST</sup> SEMESTER 2019**  
**KISUMU LEARNING CENTRE**

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**COURSE CODE: SCH 3111**

**COURSE TITLE: PHYSICAL CHEMISTRY**

**EXAM VENUE: STREAM: (BSc. Public & Commu. Health)**

**DATE: 15/08/2019 EXAM SESSION: 2.00-4.00PM**

**TIME: 2:00 HRS**

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**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**

**INSTRUCTIONS: Answer Question 1 and any other TWO questions**

**Useful data**

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

$$\text{Molar mass N}_2 = 28 \text{ g.mol}^{-1}$$

$$\text{Molar mass O}_2 = 32 \text{ g.mol}^{-1}$$

$$\text{Molar mass CO}_2 = 44 \text{ g.mol}^{-1}$$

$$\text{Molar mass CH}_4 = 16 \text{ g.mol}^{-1}$$

$$\text{Molar mass H}_2 = 2 \text{ g.mol}^{-1}$$

$$\text{Molar mass C}_3\text{H}_8 = 44.0 \text{ g.mol}^{-1}$$

**QUESTION ONE (30 marks)**

**1. Question 1**

- a) Define the term physical chemistry. [2 marks]
- b) Balance this chemical reaction  $\text{CH}_4(\text{g}) + \text{O}_2(\text{g}) \Rightarrow \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$  [2 marks]
- c) The pressure of nitrogen gas in 120 L tank is 22.3 atm at 25 °C, what is the volume of nitrogen at 3 atm and 25 °C? [3 marks]
- d) Differentiate between an ideal gas and real gas. [4 marks]
- e) Write the oxidation and reduction half reactions for the following reaction  $\text{Zn}(\text{s}) + \text{Cu}^{2+}(\text{aq}) \rightleftharpoons \text{Zn}^{2+} + \text{Cu}(\text{s})$  [2 marks]
- f) Differentiate between electrochemical and electrolytic cell. [4 marks]
- g) Write the expression of equilibrium constant for the reaction  $\text{C}_3\text{H}_8(\text{g}) + 5\text{O}_2(\text{g}) \rightleftharpoons 3\text{CO}_2(\text{g}) + 4\text{H}_2\text{O}(\text{g})$  [2 marks]
- h) Calculate the boiling point of benzene and water for aqueous solution whose concentrations is 1 molal. Given that the boiling point and  $k_b$  of water and benzene are 100 °C and 80.1 °C and 0.52 °C/m and 2.53 °C/m respectively. [4 marks]
- i) A mixture of 0.7 mol  $\text{H}_2$  and 0.7  $\text{I}_2$  was placed in a 1.4L stainless flask at 420 °C. Calculate the concentration of  $\text{H}_2$ ,  $\text{I}_2$  and  $\text{HI}$  at equilibrium, given that the equilibrium constant  $K_c$  for the reaction  $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$  is 54.3 at this temperature. [7 marks]

## QUESTION TWO (20 marks)

### Question 2

- a) Differentiate between molar concentration and molality. [2 marks]
- b) Calculate the mass of carbon dioxide produced when 32.0 g of propane is burned in a plentiful supply of air as per the reaction  $C_3H_8(g) + 5O_2(g) \rightleftharpoons 3CO_2(g) + 4H_2O(g)$  [6 marks]
- c) Balance the following chemical equations.
- $CO_2 + H_2O \rightarrow C_6H_{12}O_6 + O_2$
  - $Pb(NO_3)_2 + KI \rightarrow PbI_2 + KNO_3$  [4 marks]
- d) Find the amount of N atoms present in 24.5g of Nitrogen, given the molar mass of Nitrogen is  $28.01 \text{ gmol}^{-1}$  [4 marks]
- e) Name any **four (4)** types chemical reactions. [4 marks]

## QUESTION THREE (20 marks)

### Question 3

- a) At the start of a reaction, there is 2.50 mol  $O_2$ , 4.2 mol  $H_2$  and 0.65 mol  $H_2O$  in a 60.0L reaction vessel at  $110^\circ C$ . If the reaction equilibrium constant ( $K_c$ ) for reaction  $O_2 + 2H_2 \rightleftharpoons 2H_2O$  is 0.612 at  $110^\circ C$ . Determine whether the reaction is at equilibrium and if not, predict the direction of reaction. [6 marks]
- b) Name and briefly explain any **four** factor that affects the reaction rates. [4 marks]
- c)  $(CH_3COOCH_2CH_3)$  Ethyl ethanoate ( $0.04 \text{ mol dm}^{-3}$ ) hydrolyses during reaction with aqueous (NaOH) sodium hydroxide ( $0.2 \text{ mol dm}^{-3}$ ). If the rate of reaction is  $3 \times 10^2 \text{ mol dm}^{-3} \text{ s}^{-1}$ , calculate the rate constant k. [6 marks]
- d) Mention **four (4)** types of reaction orders. [4 marks]

## QUESTION FOUR (20 marks)

### Question 4

- a) State and give mathematical expression of the following gas laws:
- (i) Boyle's law
  - (ii) Charles' law
  - (iii) Avogadro's law [6 marks]
- b) A quantity of 3.2 moles of  $\text{NH}_3$  occupies 4.20L at  $50^\circ\text{C}$ . Calculate the pressure of the gas (in atm) using Van der Waal's equation. Given that the values of  $a$  and  $b$  for  $\text{NH}_3$  are  $4.17 \text{ atm}\cdot\text{L}^2/\text{mol}^2$  and  $0.0371 \text{ L/mol}$  respectively. [4 marks]
- c) In the synthesis of ammonia by the reaction  $3\text{H}_2(\text{g}) + \text{N}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$ . Find the volume of  $\text{NH}_3$  produced if  $100 \text{ cm}^3$  of  $\text{N}_2$  was consumed. [3 marks]
- d) How many grams of oxygen are there in a  $75.0\text{L}$  tank at  $25^\circ\text{C}$  when the oxygen pressure is  $15.0 \text{ atm}$ ? [3 marks]
- e)  $1.0\text{g}$  of air consists of approximately  $0.76\text{g}$  of nitrogen and  $0.24\text{g}$  of oxygen. Calculate the partial pressures and the total pressure when this sample occupies a  $1.0\text{L}$  container at  $20^\circ\text{C}$ ? [4 marks]

## QUESTION FIVE (20 marks)

### Question 5

- a)  $10\text{g}$  of salt was dissolved in  $100\text{g}$  of water thereby lowering the vapour pressure of water at  $20^\circ\text{C}$  from  $18.535 \text{ mmHg}$  to  $18.216 \text{ mmHg}$ . Calculate the molecular weight of the salt. [6 marks]
- b) Calculate the freezing of benzene and water for aqueous solution whose concentrations is  $1 \text{ molal}$ . Given that the freezing point and  $k_f$  of water and benzene are  $0^\circ\text{C}$  and  $5.5^\circ\text{C}$  and  $1.86^\circ\text{C/m}$  and  $5.12^\circ\text{C/m}$  respectively. [4 marks]
- c) A solution containing  $4.0\text{g}$  of alcohol in  $1\text{L}$  of dioxane was found to have osmotic pressure of  $3.3 \times 10^{-4} \text{ atm}$  at  $25^\circ\text{C}$ . Calculate the approximate molecular weight of the polymer. [4 marks]
- d) Describe colligative property of a solution and give its properties. [6 marks]