

510



(University of Choice)  
**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)  
MAIN CAMPUS**

**UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR**

**FIRST YEAR SECOND SEMESTER EXAMINATIONS**

**FOR THE DEGREE  
OF  
BACHELOR OF SCIENCE (ENGINEERING, PHYSICS, DISASTER PREPAREDNESS)**

**COURSE CODE: SCH 101**

**COURSE TITLE: FUNDAMENTALS OF CHEMISTRY II (MAIN EXAMINATIONS)**

**DATE: 28/ 4/2022**

**TIME: 12.00- 2.00 PM**

**INSTRUCTIONS TO CANDIDATES**

- Answer **ALL** questions

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 4 Printed Pages. Please Turn Over.

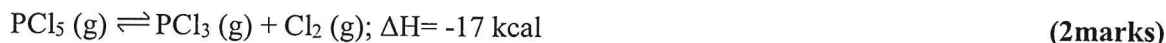
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**QUESTION ONE (17 marks)**

- a) i) State the deviations to ideal gases that lead to and the Van der Waals equation (3 marks)
- ii) Compare the pressure predicted for 0.8 litre of 0.5 moles CO<sub>2</sub> at 273K using:
- I) the ideal gas equation (2 marks)
- II) Van der Waal's equation ,  $a = 6.581 \text{ atm mol}^{-2}$  and  $b = 0.056 \text{ l mol}^{-1}$  (2 marks)
- c) It takes nitrogen gas 2 minutes to diffuse through an orifice. How much time will methane gas take to diffuse through the same orifice in seconds (2 marks)
- g) i) Sketch the graphic representation of Boyle's law (2 marks)
- ii) State the difference between Avogadro law and Avogadros hypothesis (3 marks)
- h) Explain 2 postulates of the kinetic molecular theory (3 marks)

**QUESTION TWO (17 marks)**

- a) State Le Chatelier's principle and apply it to the following equilibrium



- b) The value of  $K_p$  for the equilibrium;  $2\text{H}_2\text{O}(\text{g}) + 2\text{Cl}_2(\text{g}) \rightleftharpoons 4 \text{HCl}(\text{g}) + \text{O}_2(\text{g})$  is 0.035 atm at 400°C when the partial pressures are expressed in atmospheres. Calculate the value of  $K_c$  for the same reaction. (3 marks)
- c) With the aid of examples, explain the terms
- i) Homogenous equilibrium (2 marks)
- ii) Heterogenous equilibria (2 marks)
- d) Explain the Arrhenius theory of acids and bases. (2 marks)
- e) Find out the pH of a 0.1 M solution of sodium acetate in water:  $K_a$  of acetic acid is  $1.8 \times 10^{-6}$  (3 marks)
- f) Calculate the pH of a 0.05M solution of ammonium chloride. Dissociation constant of ammonium hydroxide is  $1.8 \times 10^{-5}$  (3 marks)

**QUESTION THREE (15marks)**

a) Define solubility of a salt (2 marks)

b) The  $K_{SP}$  of  $\text{CaF}_2$  is  $1.7 \times 10^{-10} \text{ mol}^3\text{l}^{-3}$  at  $25^\circ\text{C}$ . Calculate the solubility of  $\text{CaF}_2$  in 1 litre of water (3 marks)

c) A cell is prepared by dipping a copper rod in 1M  $\text{CuSO}_4$  solution and a nickel rod in 1M  $\text{NiSO}_4$  solution. The standard reduction potentials of copper electrode and nickel electrode are 0.34 volt and -0.25 volt respectively.

i) What will be the cell reaction? (3 marks)

ii) Which electrode will be positive? (2 marks)

iii) How will the cell be represented? (2 marks)

d) Can a solution of 1M copper sulphate be stored in a vessel made of nickel metal?

Given that  $E^\circ_{\text{Ni}, \text{Ni}^{2+}} = 0.25$  volt and  $E^\circ_{\text{Cu}, \text{Cu}^{2+}} = -0.34$  volt. Explain your answer. (3marks)

e) Calculate the electrode potentials (reduction potentials) of each of the following single electrodes at  $25^\circ\text{C}$  (3 marks)

(i)  $\text{Sn} \mid \text{Sn}^{2+} \quad a = 0.01 \quad E^\circ_{\text{Sn}, \text{Sn}^{2+}} = 0.14$  volt

(ii)  $\text{Ag} \mid \text{AgCl}, \text{Cl}^- \quad a = 0.0001 \quad E^\circ_{\text{AgCl}, \text{Cl}^-} = 0.22$  volt

The electrode reaction expressed as reduction reaction is

**Question 4 (19 marks)**

a) i) What is osmotic pressure (1 mark)

ii)  $300 \text{ cm}^3$  of an aqueous solution contains 1.56g of a polymer. The osmotic pressure of such solution at  $270^\circ\text{C}$  is found to be  $2.57 \times 10^{-3}$  bar. Calculate the molar mass of the polymer.  $R = 0.08314 \text{ lbarK}^{-1}\text{Mole}^{-1}$  (3 marks)

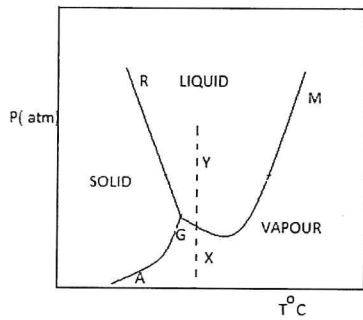
b) Briefly state the difference between molality and molarity. (2 marks)

c) Explain the following occurrences;

i) It takes longer for water to boil at Malindi than at Nyeri in Kenya (2 marks)

ii) The freezing point of 0.1M  $\text{NaCl}_{(\text{aq})}$  is lower than that of 0.1M  $\text{CH}_3\text{CH}_2\text{OH}_{(\text{aq})}$  (2 marks)

d) Study the phase diagram below and answer the questions that follow



- i) Describe the processes along RG (1 mark)
  - ii) What is the significance of point G (1 mark)
  - iii) Explain the transformation XY (3 marks)
- e) i) Draw and explain a vapour pressure-composition diagram for ethanol and water solution **(2 marks)**
- f) Briefly use the boiling point-composition diagram below to describe fractional distillation **(2 marks)**

