



TECHNICAL UNIVERSITY OF MOMBASA

School of Applied and Health Sciences
DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN BIOCHEMISTRY

BACHELOR OF TECHNOLOGY IN INDUSTRIAL MICROBIOLOGY

BACHELOR OF SCIENCE IN FOOD AND QUALITY ASSURANCE

BSB 24S, BTMB 24S AND BSFQ 23S.

ACH 4109: FUNDAMENTALS OF PHYSICAL CHEMISTRY

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: JULY 2025 SERIES

TIME: 2 HOURS

DATE: JULY 2025

Instructions to Candidates

You should have the following for this examination

Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

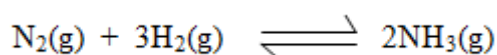
Question One (30 Marks)

- a) Outline two causes of deviation of gases from the ideal behavior. **(2 marks)**
- b) Define mixture **(2 marks)**
- c) With the help of graph, state Boyle's and Charles law of gases **(4 marks)**

- d) 0.18398 moles of CO and 0.22046 moles of H₂ were feed into 1L flask. Reaction proceed to equilibrium where 0.051716 moles of CH₃OH were formed. Determine the value of equilibrium constant (K_c)



- e) The boiling point elevation of a solution prepared by dissolving 3.1 grams of urethane in 68.44 grams of methanol CH₃OH is 0.32 °C. Calculate
- Molar mass of urethane given ebulliscopic constant as 0.88°Cm⁻¹
 - Mole fraction of urethane (5 marks)
- f) Discuss the effect of adding HCL on dissociation and PH of the equilibrium of sodium acetate $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$ (4 marks)
- g) Calculate the pH of a saturated solution of Cu(OH)₂, with K_{sp} = 1.6 x 10⁻¹⁹ (5 marks)
- h) The equilibrium pressure of Ammonia, Nitrogen and Hydrogen as 2.9 X 10⁻⁴ atm, 8.9 X 10⁻¹ atm 2.9 X 10⁻³ atm respectively alculate (i) k_p (ii) k_c at 35 °c (5 marks)



Question Two (20 Marks)

- a) Define
- Arrhenius, Bronsted and Lewis concept of acids (4 marks)
 - Acidic salt and Acidic Buffer (2 marks)
- b) Using examples explain the term conjugate acid base pair. (4 marks).
- c) 1.00 kg of Compound Y of molar mass 62 was added to a solution containing 5.00 kg of water. What is the boiling point of the solution obtained? Data: The molal elevation boiling point constant K_b= 1.86 °C kg mol⁻¹ . (4 marks)
- d) 453 mL of hydrogen at 18° C exert 780. mm Hg. Calculate the volume it will occupies at STP (4 marks)
- e) Define homogeneous mixture (2 marks)

Question Three (20 Marks)

- a) Dinitrogen tetraoxide exist in equilibrium with nitrogen dioxide At temperature above its boiling point, using le chatelier principle explain how the equilibrium will readjust itself if

- Pressure is decrease
- Temperature is increase
- Concentration of $\text{NO}_2(\text{g})$ withdrawn



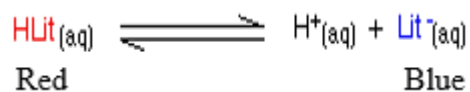
- b) A buffer solution was prepared by mixing 2.5 moles of Weak acid ($K_a = 1.8 \times 10^{-5}$) and 2.5 moles of its salt to give 1 L of solution, Find the pH of the buffer solution and PH change when 2 mL of 6M NaOH is added to this buffer (4 marks)
- c) Differentiate between Boiling point and Boiling (3 marks)
- a) Define partial pressure (2 marks)
- b) 1.24 moles of hydrogen gas was blended with 2.91 moles of oxygen gas. Calculate respective partial pressure if the total pressure is 104 kilopascals. (4 marks)
- c) State and explain four assumptions made in Kinetic molecular theory (4 marks)

Question Four (20 Marks)

- a) Calculate the pressure exerted by 0.8 moles of nitrogen dioxide (NO_2) which occupies 20 m^3 at 300K, using Van der Waals equation. (4 marks)
- [Data $a = 0.535 \text{ Nm}^2 \text{ mol}^{-1}$, $b = 4.42 \times 10^{-5} \text{ m}^3 \text{ mol}^{-1}$, $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$]
- Van der Waals equation $(P + a(n^2/v^2))(V - nb) = nRT$
- b) Calculate Enthalpy of combustion per mole when 3 g of glucose (molar mass 180 g/mol) was burn in constant volume calorimeter containing 1.2 kg of water. During experiment temperature of water rose from 19°C to 25.5°C . [Heat capacity of calorimeter = $2.21 \text{ KJ } ^\circ\text{C}^{-1}$, Specific heat of water = $4.184 \text{ J } ^\circ\text{C}^{-1} \text{ g}^{-1}$] (4 marks)
- c) Determine the amount of heat release per mole during combustion of 1 g of butane (C_4H_{10}). [ΔH_f° of C_4H_{10} , CO_2 and H_2O as -147.6 , -393.5 and $-285.5 \text{ kJ mol}^{-1}$ respectively] (4 marks)
- d) Air at 1 atmospheric and 25°C ($V = 0.02479 \text{ m}^3$) was compressed to 5 bar, Apply Boyles and Charles law to calculate final volume and final temperature (5 marks)

- e) Litmus indicator is an acidic indicator and its dissociation is represented below.

Using Le Chatelier's principle explain its colour change in alkaline media. **(3 marks)**



Question Five (20 Marks)

- a) 20 g of nitrogen gas and 10 g of helium gas are placed together in a 5 L container at 25°C. Calculate the partial pressure of each gas and the total pressure of the gas mixture. **(5 marks)**
- b) With the help of equation State Dalton and Raoult's law **(4 marks).**
- c) Differentiate between Amphoteric and amphoteric substance **(3 marks)**
- d) Calculate the concentration of hydroxyl and hydrogen ions for a solution with pH of 6.8 at 25 °C calculate **(4 marks)**
- e) Determine equilibrium constant K_p for the following reaction **(4 marks)**

