TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

THE DEGREE OF BACHELOR OF TECHNOLOGY IN APPLIED PHYSICS (Electronics and Instrumentation) & BACHELOR OF TECHNOLOGY IN RENEWABLE ENERGY AND ENVIRONMENTAL PHYSICS.

BACHELOR OF TECHNOLOGY IN MEDICAL LABARATORY SCIENCES

ACH 4109: PHYSICAL CHEMISTRY

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES:APRIL2016

TIME:2HOURS

DATE: Pick DateSelect MonthPick Year

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

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

Do not write on the question paper.

PAPER TWO

Question ONE

A. with the help of equation State Gay-Lussac's (Charles) law. (2mark)

B. The volume of 2.00 grams of methane gas is 400 cm^3 at 27°C and a pressure of 152 cmHg. Determine the temperature at which the volume will be 500 cm^3 at the same pressure. (5 marks)

C. Define the term "buffer solution" (1 mark)

D. Explain the buffer action of a general weak acid HA and its salt (conjugate base). (4 marks)

E. The dissociation of hydrogen iodide gas is a "**bimolecular**" reaction which follows "**secondorder**" kinetics.

   i. Define the terms "**bimolecular**" and "**secondorder**" reactions. (3 marks)

   ii. Write a balanced chemical equation for the reaction. (1 mark)

   iii. Write the rate equation for the reaction. (2 mark)

F. 48.6 grams of Ammonia occupy a volume of 5.4 L at 45 ^{o}C. Calculate pressure it will exert using van deer walls equation.(given a =138.9Kpa L^2/ mol, b = 0.0371 L /mol R= O.8314 pa m^3/k.mol) .

$(P + a(n^2/ v^2) (V- n b) = n RT)$ **5 marks**

G. State Hess's law. (2 mark)

H. Calculate the enthalpy for this reaction:

$2C(s) + H_2(g) \rightarrow C_2H_2(g)$

Given the following thermochemical equations:

$C_2H_2(g) + (5/2)O_2(g) \rightarrow 2CO_2(g) + H_2O(\ell)$ $\Delta H° = -1299.5$ kJ

$C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H° = -393.5$ kJ

$H_2(g) + (1/2)O_2(g) \rightarrow H_2O(\ell)$ $\Delta H° = -285.8$ kJ

(5marks)

Question TWO

(a) (i) Define the term "isotherm" (1 mark)

(ii) Sketch the general Boyle's law isotherm (P-V) curve for an ideal gas, and explain the salient features of the curve. (5 marks)

(b) (i) Write an equation for the ionization equilibrium of an acid HA dissolved in water. (1 mark)

(ii) Give an expression for the ionization constant, K_a, of the acid in terms of concentrations (2 marks)

(iii) Define the term "**diprotic**" acid and the formulae and names of any TWO diprotic acids. (4 marks)

(c) (i) Define the term "reversible reaction" (1 mark)

(ii) For the reaction $N_2 + 3H_2 = 2NH_3$ at 500°C, the value of K_p with partial pressures in atmospheres, is 1.44 x 10^{-5}, assuming ideal gas behaviour. Determine the corresponding value of K_c with concentrations in moles per litre.

$\{K_p = K_c(RT)^{\Delta n}$; R = 0.082 lit-atm.deg^{-1}mole$^{-1}\}$ (6 marks)

Question THREE

(a) (i) State the kinetic theory of gases. (1 mark)

(ii) Using the kinetic theory, explain how an increase in temperature and decrease in volume, respectively affect the pressure of a given mass of gas. (4 marks)

(iii) State TWO main assumptions of the kinetic theory on which the derivation of ideal gas laws were based. (2 marks)

(iv) Give TWO reasons why real gases do not obey ideal gas laws, based on the assumptions in (iii) above. (2 marks)

(b) (i) State the "solubility product principle" (1 mark)

(ii) Using the solubility product principle, explain how the presence of a common ion influences the solubility of a sparingly soluble salt, e.g., Cl^- ion on solubility of AgCl (the common ion effect) (6 marks)

(c) 0.25 moles of A was mixed with 0.45 moles of B and allowed to react to form C. At equilibrium there were 0.16 moles of C in 1 liter vessel. Calculate Equilibrium constant K_x

Reaction : $A(g) + 2B(g) \rightleftharpoons C(g)$ **4 Marks**

Question FOUR

(a) (i) State "Boyle's law" and "Dalton's law of partial pressures". (2 marks)

(ii) A volume of 125 cm^3 of gas X measured at a pressure of 48 cmHg, and 150 cm^3 of gas Y at a pressure of 60 cmHg, are passed into a 500 cm^3 vessel. Calculate the total pressure of the mixture in the vessel at the same temperature. (8 marks)

(b) Define the following:

(i) Exothermic reaction (1 mark)

(ii) pH (1 marks)

(iii) pOH (1 mark)

(iv) Buffer capacity (1 mark)

(v) Heat of solution (1 mark)

(c) (i) State Le Chatelier's principle. (1 mark)

(ii) The Haber process for the industrial synthesis of ammonia gas, $N_2 + 3H_2 \rightleftharpoons 2NH_3$, is an exothermic reversible reaction. Explain how a decrease in temperature, and an increase in pressure, respectively, will affect the position of equilibrium. (4 marks)

Question FIVE

(a) (i) Define the terms "heat of combustion" and "heat of formation". (2 marks)

(ii) The standard heat of combustion of ethanol is – 1365 KJ at 25°C. Calculate its heat of formation from the elements in their standard states at the same temperature.

{The standard heats of formation of CO_2 and H_2O are – 394 KJ.mol^{-1} and – 285 KJ.mol^{-1}, respectively} (9 marks)

(b) Agiven mass of gas occupies a volume of 240 cm^3 at a pressure of 1.25 atm.

(i) Determine the change in volume if the pressure were altered to 0.75 atm. at the same temperature. (6 marks)

(ii) Determine the volume of double the given mass of gas at a pressure of 0.75 atm. (3 marks)