Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY (ANALYTICAL AND INDUSTRIAL OPTION)

BTAC 13M

ACH 4106 : PHYSICAL CHEMISTRY I

SEMESTER EXAMINATION

DECEMBER 2013 SERIES 2 HOURS

Instructions to candidates:

This paper consist of FIVE questions
Answer question ONE (compulsory) and any other TWO questions

QUESTION ONE

a) State:

(i) Law of equilibrium
(ii) Raults law
(iii) Le Chateliers principle
(iv) Limitation of Lewis theory
(v) Success of Arrhenius theory
(vi) Characteristics of Reversible reactions

(12marks)

b) Calculate :-

(i) Partial pressure of H_2S for the following equilibrium given partial pressure of

$CH_4(g)$ as 0.20, $CS_2(g)$ as 0.52 and $H_2(g)$ as 0.1

$CH_4(g) + 2H_2S(g) \rightarrow CS_2(g) + 4H_2(g)$ $Kp = 4.2 \times 10^{-3}$ at 500K **(4marks)**

(ii) pH of $Ca(OH)_2$ solution given its solubility product as $4.2 \times 10^{-6}(mol\ dm^3)^3$ **(5marks)**

c) 66.0grams of Vinyl ether C_3H_6O was dissolved in 46.0grams of water and volume of solution made to 120ml. Calculate :-

(i) Molality of the solution **(2marks)**
(ii) Boiling point of the solution given ebuliscapic constant of water as 0.52˚C Kg/m **(2marks)**
(iii) Vapour pressure of the solution given vapour pressure of water as 23.48mmHg **(2marks)**

d) Identify the class of the following Lewis acids:-

I. CO_2
II. SF_4
III. $AlCl_3$

(2marks)

QUESTION TWO

a) Different between positive and negative deviation in non –ideal solution **(4marks)**
b) Define organic indicators and explain color change of phenolphalein indicator in acidic media **(4marks)**
c) Calculate the value of K_C for the following reaction

$2A + 3B \rightleftharpoons 3C + 4D$ $Kp = 0.05$ at 127˚C

(4marks)

d) A solution of 0.142 grams of Napthalein in 20.25grams of Benzane elevate the Boiling point of Benzene by 0.284 Kelvin. Calculate Relative molecular moles of Napthalein given ebuliscopic constant as 0.52 ˚Clg/m **(4marks)**
e) Define

(i) Buffer solution
(ii) Acidic salt
(iii) Double salt
(iv) Colligative properties

(4marks)

QUESTION THREE

a) Define an alkaline Buffer **(2marks)**

b) A solution is prepared by dissolving 45grams of compound X in enough H_2O water to make IL volume of solution. If osmotic pressure of this solution is 10mmHg at 25˚C. Calculate molar mass of solute [R = 0.0821 atm L/K mol]. **(4marks)**

c) Explain briefly how HCl acts as Lewis acid is the following reaction

$NH_3(g) + HCl \rightleftharpoons NH_4^+ + Cl^-$ **(4marks)**

d) 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 litre vessel calculate equilibrium constant Kx

Rxn $A(g) + B(g) \rightleftharpoons 2C(g)$ **(6marks)**

e) A buffer was prepared by mixing weak acid HA and its salt NaA^-. With the help of reaction. Explain briefly how this buffer will behave when acid is added **(4marks)**

QUESTION FOUR

a) When NaOH is mixed with acetic acid Hydrolysis occurs. Write the reaction and expression of hydrolysis constant Kh **(4marks)**

b) Calculate dissociation constant of acid in abuffer solution of pH 3.74 obtained on mixing 0.1m acetic acid and 0.01m sodium acetate in one litre vessel. **(4marks)**

c) Determine the value and units of the universal gas constant at 0˚C given density and molar mass of the gas as $1.785x10^3 g/m^3$ and 39.95 grams per mole. **(4marks)**

d) Calculate the solubility product K_{SP} of CuBr given its solubility at 25˚C as 2.0×10^{-4}mol/litre **(4marks)**

e) Giving example explain the common ion effect **(4marks)**

QUESTION FIVE

a) State:

i) Characteristic of true liquid solutions. **(3marks)**

ii) Assumption made in deriving ideal gas equation. **(2marks)**

b) 0.15 mole of sulfur dioxide occupies a volume of $4.5x\ 10^{-4}\ m^3$ of 300 Kelvin. Using Van der Wall equation. Calculate the pressure it will exert given

($a = 0.689 PaL^2/mol$, $b = 5.64 \times 10^{-5}$ atm $Lmol^{-1}$) R = 8.314 joule/k.mol. **(5marks)**

Vander Wall equation $(P + a(n^2/V^2)(V-nb) = nRT$

c) Use le chatelier principle to predict direction of the following equilibrium when pressure and temperature are decrease **(2marks)**

$N_2 + 3H_2 \rightleftharpoons 2NH_3(g)$ $\Delta H = -92.2Kj$

d) A buffer solution was prepared by mixing 0.01m sodium acetate in one litre. Given dissociation constant of acid as 1.8×10^{-5}. Calculate pH change when 1ml of 1m NaOH is added to one litre of this buffer **(4marks)**

e) Mixture of propane and trichloromethane shows negative deviation from Rault's law sketch and label pressure – composition curves. **(4marks)**