KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER
SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF B.RB, BPH, BAB, BAE AND BSc (CHEM)

COURSE CODE: SCH 121*

COURSE TITLE: INTRODUCTION TO PHYSICAL CHEMISTRY

DATE: 30/09/2021 **TIME: 2:00-4:00PM**

INSTRUCTIONS TO CANDIDATES:

TIME: 2 HOURS

ANSWER **QUESTION ONE** AND **ANY TWO** OF THE REMAINING

KIBU OBSERVES ZERO TOLERANCE TO examination cheating

Question one (30marks)

(a)Define the following terms **(3 marks)**

i. Physical chemistry
ii. Colligative properties
iii. Degree of dissociation

(b) A gas occupies a volume of 0.2L at 25°C and pressure of 1 atm. What volume will it occupy at 17°C and 760mmHg pressure? **(2 marks)**

(c) Deduce the physical significance of gas constant R **(3 Marks)**

(d) (i) State the law of mass action **(1 mark)**

(ii) The equilibrium constant K_c for the reaction $H_2 + I_2 \rightarrow 2HI$ is 60 at 450°C. Determine the value of K_p for the above reaction(R=8.3142) **(2 Marks)**

(e) i) State Ostwald law of dilution **(2 mark)**

(ii) State the four factors that affect the degree of dissociation **(4 marks)**

(f) 2.0g of methane was completely burnt in air and the amount of heat produced raised the temperature of 500mL of water from 22.0°C to 39°C. Determine the molar heat of combustion of methane(C=12, H=1, Specific heat capacity of water=4.18J/g/°C) **(3 Marks)**

g) State three differences between metallic and electrolytic conductors **(3 marks)**

(h) Is it possible to store zinc (ii) nitrate solutions in a iron container? Explain ($(Zn^{2+} + 2e \rightleftharpoons Zn\ (-0.76v),\ Fe^{2+} + 2e \rightleftharpoons Fe(-0.44V)$) **(2marks)**

(i) When a current was passed through $AgNO_3$solution for 15 minutes, 0.325g of silver was deposited at the cathode. Calculate the amount of current passed (1F = 96487 C mol^{-1}, Ag=108) **(2 marks)**

(j) (i) In chromatography what is retention factor (Rf) **(1 mark)**

(ii) If a compound travels 2.1 cm and the solvent front travels 2.8 cm determine the retention factor **(2 Mark)**

Question two (20 marks)

a) i) Deduce Vander Waal equation of real gases. **(5marks)**

b)) The ionization constant for certain acid HA is $4.5x10^{-4}$ at 298K. What concentration of acid would be required to produce a hydrogen ion concentration of $3.2x10^{-3}$M? What would be the degree of ionization? **(10 mark)**

c) (i) State any two colligative properties **(2 mark)**

(ii) A mixture of water and bromobenzene (C_6H_5Br) distills at 95°C, and the distillate contains 1.6 times as much C_6H_5Br as water by mass. At 95°C the vapour pressure of water and C_6H_5Br are 640 mm Hg and 120 mm Hg respectively. Calculate the molecular weight of bromobenzene. (3 marks) **(3 marks)**

d) State Lechateliers principle **(2 marks)**

ii) Briefly explain the effect of the following on equilibrium

a) Temperature **(2 marks)**

b) Concentration **(2 marks)**

Question three (20 marks)

(i) Calculate the pH value of a solution containing 0.2 moles of NH_4OH and 0.25 moles of NH_4Cl. ($K_b = 1.8 \times 10^{-5}, K_w = 10^{-14}$) **(5 marks)**

(ii) a) What is a buffer solution **(2 marks)**

b) How many moles of sodium ethanoate must be dissolved in one litre of 0.05M ethanoic acid to give a buffer solution of pH=4 ($K_a = 1.8 \times 10^{-5}$M/L **(4 marks)**

c) Briefly explain how a buffer solution of a weak acid with its salt such as acetic acid (CH_3COOH) and sodium acetate (CH_3COONa) resists a change in pH when;

(ci) A solution of strong acid eg HCl is added **(2 marks)**

(Cii) A solution of strong base (OH-) is added **(2 marks)**

(iii) Define the term acid using the following concepts

a) Bronsted-Lowry **(1 mark)**

b) Lewis concepts **(1 mark)**

iv) Given that the solubility product of Mg $(OH)_2$ is 1.2×10^{-11}. Calculate the solubility of Mg $(OH)_2$ **(3 marks)**

Question Four (20 marks)

(i) . If C is the original concentration of the electrolyte and α is the degree of dissociation, using $AB \rightleftharpoons A^+B^-$ Derive mathematical representation of Ostwald dilution law $\left(\alpha = \sqrt{\frac{K_a}{C}}\right)$ **(10marks)**

(ii)A sample of a gas weighing $0.0286 \times 10^{-3} Kg$ occupies a volume of $0.05 \times 10^{-3} m^3$ at apressure of 1 atm and temperature of 25°C. Find the molar mas of the gas **(10marks)**

Question Five (20 marks)

a) One of the uses of electrochemistry in manufacture of dry cells (Leclanche cell)

i) State why the cells are called dry cells **(1 mark)**

ii) Write the Cathodic and anodic reactions taking place when the cell is in use

Cathodic reaction **(2 marks)**

Anodic reaction **(2 marks)**

iii) What is the role of Zinc (II) chloride in the paste used **(1 mark)**

iv) Dry cells are examples of primary cell. What does this mean **(1 mark)**

b) A solution of 0.1M acetic acid is found to be dissociated to an extent of 1.43%. Calculate the dissociation constant of the acid **(8 marks)**

c)) A sample of the black mineral hematite, an oxide of iron found in many iron ores, contains 34.97 g of iron and 15.03 g of oxygen. What is the empirical formula of hematite? **(5 marks)**