./

Machakos University College

(A Constituent College of Kenyatta University)

University Examinations 2014

SCHOOL OF EDUCATION AND SCHOOL OF PURE AND APPLIED SCIENCES

First Year First Semester Examination for Bachelor of Education Science and Bachelor of Pure Science

SCH 101: Physical Chemistry

DATE **TIME 2 HOURS**

Instructions:

1. **This paper contains five (5) questions.**
2. **Answer question one (compulsory) and any other two questions.**

Question one (30 marks)-complusory.

(A) Using their respective equations, state Boyle's law, Charles law and the Avogadros law 3 marks.

(B) State Le Chateliers Principle and explain two ways in which stress can be caused on a chemical reaction at chemical equilibrium 3 marks.

(C) State and explain four assumptions of the Kinetic molecular theory 3 marks.

(D) What is the density (in grams per liter) of ammonia at STP if the gas in a 1.000 L bulb weighs 0.672 g at 25°C and 733.4 mm Hg pressure? 3 marks

(E) A sample of oxygen is collected by the downward displacement of water from an inverted bottle. The water level inside the bottle is equalized with that in the trough. Barometric pressure is found to be 758 mmHg, and the temperature of water is 23 ^{0}c. What is the partial pressure of oxygen? Vapour pressure of water at 23 ^{0}c is 11.8 mmHg 3 marks.

(F) State Raoults law and show how it can be expressed mathematically 2marks.

(G) Solutions are formed when a solute dissolves in a solution. Using sodium chloride as the solute and water as a solvent explain how a solution of the two substances is formed and sustained 3marks.

(H) With reference to the phenol-water system, triethylamine-water system and nicotine-water system explain how temperature as a factor influences the solubility of partially miscible liquids 3marks.

(I) Calculate the emf of the cell zn/zn^{2+} (0.001M)// Ag^+ (0.1M) /Ag. The standard potential of Ag/Ag^+ half-cell is +0.80 V and Zn/Zn^{2+} is -0.76 V 4marks.

(J) There are numerous applications of distribution law in the laboratory as well as in industry. State and explain three applications of the distribution law in the laboratory or industry 3marks

Question two (20 marks).

(a) Using examples differentiate between the Arrhenius concept, Bronsted lowry concept and the Lewis concept as used in the definition of acids and bases 4marks.

(b) Using examples explain what you understand by the term conjugate acid base pair. What is a buffer solution 4 marks.

(c) State law of mass action. Give the equilibrium constant expression for the reaction $N_2O_{5(g)}$------$NO_{2(g)} + O_{2(g)}$ 3marks

(d) Using examples explain the various classes of bronsted acids and bases 4 marks.

(e) If a solution has a pH of 5.50 at 25 ^{0}c, calculate its (OH^-) 4 marks.

(f) Differentiate between acid buffers and basic buffers with examples. What is an acid base indicator? Give two examples 4marks.

Question three (20 marks).

(a) Explain the five ways of expressing concentration 5marks

(b) State the Henrys law 1marks

(c) The solubility of pure oxygen in water at 20 ^{0}c and 1.00 atm is $1.38*10^{-3}$ mole/litre. Calculate the concentration of oxygen at 20 ^{0}c and partial pressure of 0.21 atm 4marks.

(d) Differentiate between dissolution and recrystalisation as used in the dissolving of solids in liquids 2marks.

(e) A mixture of water and bromobenzene distills at 95 ^{0}c, and the distillate contains 1.6 times as much bromobenzene as water by mass. At 95 ^{0}c the vapour pressure of water and bromobenzene are 640 mm Hg and 120 mmHg respectively. Calculate the molecular weight of bromobenzene 8marks.

Question four (20 marks)

(a) Explain what you understand by the term reversible reaction 2marks

(b) By using a clearly labeled graph explain what you understand by the term chemical equilibrium 4marks.

(c) Explain four chemical characteristics of chemical equilibrium 4marks.

(d) The value k_p at 25 0c for the reaction $2NO_{(g)} + CL_{2\ (g)}$ ------ $2NOCL_{(g)}$ is $1.9*10^3$ $atm^{-1.}$ Calculate the value of k_c at the same temperature 4 marks.

(e) With the help of Le Chateliers principle we can work out the optimum conditions for securing the maximum yield of products in industrial processes. Explain the conditions for the synthesis of ammonia (Haber process) 6 mark.

Question five (20 marks)

(a) Explain five conditions that have to be satisfied for the application of the Nernst`s distribution law 5marks.

(b) At 25^0 c an aqueous solution of iodine containing 0.0516 g $litre^{-1}$ is in equilibrium with a carbon tetrachloride (CCL_4) solution containing 4.412 g $litre^{-1}$. The solubility of iodine in water at 25^0 c is 0.34 g $litre^{-1}$. Find the solubility of iodine in carbon tetrachloride 5marks.

(c) What is a redox reaction?. Using sodium chloride solution, demonstrate how oxidation and reduction reactions occur in an electrochemical cell 5marks.

(d) Predict whether the reaction 2 Ag(s) + Zn^{2+} (aq) -----Ag^+ (aq) + Zn(s) is feasible or not. Consult the table for the Eo values 5marks.

BEST OF LUCK