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**University Examinations 2015/2016**

FIRST YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

**SCH 3101: PHYSICAL CHEMISTRY I**

**DATE: AUGUST, 2016 TIME: HOURS**

**INSTRUCTIONS:** *Answer questions* ***one*** *Compulsory**and any other* ***two*** *questions*

*You may find the following data useful;*

* *Gas constant R = 8.31451 J/K.Mol = 8.20578 x* $10^{-2}$*l.atm/k.mol = 8.31451L.Kpa/K.mol*
* *Relative atomic masses: N = 14; O= 16; C = 12; H=1;Xe = 131; F = 19; Na = 23; Br = 80*
* *Avogadro Constant NA=6.02214 x* $10^{23}$*/mol*
* *Conversions*

*1J = 1kg.*$M^{2}/S^{2}$

*1 Torr = 133.3 Pa*

*1atm = 1.0135 x* $10^{5}$*pa*

*1 bar =* $10^{5}$*pa*

**QUESTION ONE - (30 MARKS)**

1. Define each of the following terms; (1½ Marks)
2. Autoprotolysis
3. Buffer solution
4. Bronsted acid
5. (i) Distinguish effusion from diffusion. (2 Marks)

(ii) Explain which of the two gases namely nitrogen dioxide and oxygen effuses faster through a hole of given size. (2 Marks)

(iii) What is the molar mass of an unknown gas that takes 2.7 times longer to effuse through a porous plug than it does for the same amount of XeF2 at the same temperature and pressure? (3 Marks)

1. (i) Distinguish between a real gas and an ideal gas. (2 Marks)

(ii) At what conditions of pressure do real gases behave like ideal gas? Briefly explain your answer using Van der Waal’s equation; (P + $\frac{an^{2}}{v^{2}}$) (V – nb) = nRT. (3 Marks)

1. State three assumptions on which kinetic molecular theory is based. (1½ Marks)
2. Classify each of the following as closed, open or isolated system. (1½ Marks)
3. Bomb Calorimeter
4. A mug of hot coffee
5. A stoppered volumetric flask containing dilute sulphuric acid
6. (i) What do you understand by the term solubility product? (1 Mark)

(ii) The molar solubility of silver chromate, Ag2CrO4 is 6.5 x $10^{-5}$mol/L. Determine the value of its solubility product. (3 Marks)

1. A 14.0g sample of NaOH was dissolved in 250 ml of distilled water. 100ml of solution was pipetted into 50ml of 0.20M HBr (aq)
2. What is the pH of the resulting solution at 250C? (3½ Marks)
3. What would be the pH change when an extra 5ml of NaOH solution is added to the resulting solution? (2 Marks)
4. Study the two half-reactions below and answer questions that follow; 
5. Is an acidified permanganate solution a more powerful oxidizing agent that an acidified dichromate solution under standard conditions? Explain. (2 Marks)
6. Write the chemical equation for the spontaneous reaction and determine the standard cell potential. (2 Marks)

**QUESTION TWO (20 MARKS)**

1. Describe the two types of electrochemical cells. (2 Marks)
2. (i) Write the chemical equation for the cell reaction resulting from the following half-reactions.

 (2 Marks)

(ii) Write the cell representation and draw a schematic picture of the cell and its contents, label the Anode and Cathode and indicate the direction of electrons flow. Assume that the cell contains a salt bridge filled with a KCl gel. (5 Marks)

(iii) What are the functions of salt bridge? (1 Mark)

1. Corrosion is an electrochemical process, and the electrochemical series has insight into why corrosion occurs and how it can be prevented. Describe any three ways by which corrosion can be prevented. (6 Marks)
2. (i) State law of mass action. (1 Mark)

(ii) Consider the equilibrium between H2 and Cl2 and HCl in reaction;

 

Given that the equilibrium molar concentration of H2 is 1.0 x 10 -17 mol/ l and that of Cl2 is 2.0 x 10 -16 mol/ l, what is the equilibrium molar concentration of HCl at 300K , given Kc = 4.0 x 10 31 for the reaction? (3 Marks)

**QUESTION THREE (20 MARKS)**

1. Explain three factors that affect solubility of a substance. (6 Marks)
2. Explain what happens to:
3. Concentration of H3O+ ions in an acetic acid solution when sodium acetate is added. (2 Marks)
4. The percentage of deprotonation of benzoic acid in a benzene solution when hydrochloric acid is added. (2 Marks)
5. The pH of ammonium solution when solid ammonium chloride is added to the ammonium solution. (2 Marks)
6. Distinguish between homogenous equilibrium and heterogeneous equilibrium. Give relevant example in each case. ( 4 Marks)
7. Calculate the molarities of H3O+ and $OH^{-}$ ions in 0.052M KOH(aq). (2 Marks)
8. Identify the Bronsted acid and base in the reaction;

  (2 Marks)

**QUESTION FOUR (20 MARKS)**

1. Distinguish between endothermic and exothermic process. (2 Marks)
2. Suppose we use an electric heater to raise the temperature of a sample of water to its boiling point in a constant pressure calorimeter. We bring the water to its boiling point and then continue until 35g of water has vaporized. We calculate from the power rating of the heater and the time taken that vaporization alone of the amount of H2O at 1000C requires 79kJ of heat. What is the enthalpy of vaporization of water at 1000C? (3 Marks)
3. Research on alternative fuels has shown that methanol produced from coal is a promising alternative to gasoline, for its combustion generate little pollution. When 0.515g of methanol, CH3OH, burns in excess of oxygen in a calibrated constant pressure calorimeter with a heat capacity of 551J/ 0C, the temperature of the calorimeter rises by 10.60C.
4. Calculate the reaction enthalpy for  (4 Marks)
5. Write the corresponding thermochemical equation. (2 Marks)
6. (i) What is the pressure of 10,0g of carbon dioxide in a container of volume 500ml at 100C (a = 3.59 L2-atm/$ mol^{2}$; b = 0.0432L/mol) (3 Marks)

(ii) Determine the percentage error assuming that carbon dioxide behave as ideal gas under same conditions. (3 Marks)

1. On the same grid sketch Maxwell speed distribution curves for CO2, N2 and H2 gases at 250C. (3 Marks)