SOUTH EASTERN KENYA UNIVERSITY

UNIVERSITY EXAMINATIONS 2016/2017

SECOND SEMESTER EXAMINATION FOR THE DEGREES OF BACHELOR OF SCIENCE (EDUCATION, CHEMISTRY, PUBLIC HEALTH AND GEOLOGY)

SCH 103: GENERAL AND PHYSICAL CHEMISTRY

DATE: 10 TH APRIL, 2017 **TIME: 4.00-6.00 P.M**

INSTRUCTIONS TO CANDIDATES

(a) Answer question One and any other Two questions

(b) Question 1 carries 30 marks while the other questions carry 20 marks each

(c) Illustrate your answers with well label diagrams where applicable

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Constants

R = 0.0820575 (L atm)/(mol K); 8.314 $Jmol^{-1}K^{-1}$; 0.08314Lbar$mol^{-1}K^{-1}$

Boltzmann's constant (k) = 1.3 81 x $10^{-23}JK^{-1}$

Faraday constant = 96500 $Cmol^{-1}$

QUESTION 1 [30 marks]

a. List three properties of gases. **[3 marks]**

b. State Boyle's law **[2 marks]**

c. Graphically represent Boyle's law for isotherms for an ideal gas and clearly show the effect of increasing temperature from T_1 to T_2 **[3 marks]**

d. Define the term:

i. Molality

ii. Buffer solution

iii. Salt

iv. Root mean square speed mean **[8 marks]**

e. i. Derive the Van der waals equation for n moles of a gas. **[4 marks]**

ii. Explain the terms a and b as used in the above equation, e (i). **[2 marks]**

f. One mole of Nitrogen gas at 27 ^{o}C occupies 30.0 Litres. Calculate the Pressure of the gas using;

i. Ideal gas equation **[3 marks]**

ii. Van der waals equation (a= 1.387 $L^2atmmol^{-2}$; b=0.0387 $Lmol^{-1}$) **[5 marks]**

QUESTION 2 [20 marks]

a. According to Maxwell-Boltzmann distribution of a gas, show that; **[10 marks]**
$PV= \frac{1}{3}nN_AmC^2$

b. Given CO (g) molecules at 25 ^{o}C, find:
(C= 12; O= 16)

i. most probable speed **[3 marks]**

ii. mean speed **[3 marks]**

iii. root mean square speed in Km/h **[4 marks]**

QUESTION 3 [20 marks]

a. What is the molality of a 3.50 M H_2SO_4 solution with density 1.23 g/ml and 98 % pure? (H=1, S= 32, O= 16) **[6 marks]**

b. The heat of formation of benzene is given by
$6C_{(s)} + 3H_{2(g)} \rightarrow C_6H_{6(L)}$ $\Delta H_f = +49$ kJ/mol
Given
$\Delta H_f CO_{2(g)} = -393.5$ KJ/mol

$\Delta H_f H_2O_{(L)} = -286$ KJ/mol

ΔH_V H_2O (g) = -241.8 kJ/mol

ΔH_v $C_6H_{6\ (g)}$ = 33.6 kJ/mol

Calculate the;

i. heat of combustion of benzene **[5 marks]**

ii. heat for the reaction **[5 marks]**
$C_6H_{6\ (g)}$+15/2 O_2 (g)→ 6CO_2 (g)+ 3H_2O (g)

c). Name the acid and base in the chemical reaction below and explain. **[5 marks]**

$NH_3 + 2H_2O \rightarrow NH_4OH + H_3O^+$

QUESTION 4 [20 marks]

a. Calculate the vapour pressure of pentane (mw=72) containing 250 g in a mix with 1200 g of heptane (mw = 100 g) at 20 ^oC. The vapour pressure of the mixture and heptane are 112 mmHg and 36 mmHg respectively. **[10 marks]**

b. Find the solubility of AgCl in mol/L in a solution of 0.15 M $MgCl_2$. K_{sp} for AgCl is 1.8×10^{-10} **[7 marks]**

c. Find $[H^+]$ in 0.003M NaOH. **[3 marks]**

QUESTION 5 [20 marks]

a. The K_{sp} of $Ca(OH)_2$ is 7.9×10^{-6} find the P_H of the saturated solution of $Ca(OH)_2$. **[10 marks]**

b. An electrochemical cell consists of an Fe^{2+}/Fe half cell with $[Fe^{2+}]$ = 0.031 M and a Sn^{2+}/Sn half-cell with unknown concentration $[Sn^{2+}]$. The electromotive force of the cell was measured at 25^oC to be 0.35 V.

$Ni^{2+}(aq) + 2e \rightarrow Ni\ (s)$ $\quad E^o_{cell} = -0.24$ V

$Cu^{2+}(aq) + 2e \rightarrow Cu(s)$ $\quad E^o_{cell} = +0.34$ V

i. Write down the cell representation **[2 marks]**

ii. Calculate the concentration of Sn^{2+} in the Sn^{2+}/Sn half-cell **[5 marks]**

iii. Calculate the equilibrium constant for the reaction **[3 marks]**