



**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<sup>TH</sup> 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

---

**Constants**

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

**Boltzmann's constant (k) =  $1.381 \times 10^{-23} \text{ JK}^{-1}$**

**Faraday constant =  $96500 \text{ Cmol}^{-1}$**

**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 °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<sup>2</sup>atmmol<sup>-2</sup>; b=0.0387 Lmol<sup>-1</sup>) [5 marks]

**QUESTION 2 [20 marks]**

- a. According to Maxwell-Boltzmann distribution of a gas, show that; [10 marks]  

$$PV = \frac{1}{3}nN_A m C^2$$
- b. Given CO (g) molecules at 25 °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<sub>2</sub>SO<sub>4</sub> 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  

$$6C_{(s)} + 3H_{2(g)} \rightarrow C_6H_{6(l)} \quad \Delta H_f = +49 \text{ kJ/mol}$$
 Given  

$$\Delta H_f CO_{2(g)} = -393.5 \text{ KJ/mol}$$

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

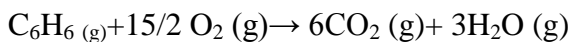
$$\Delta H_v \text{H}_2\text{O (g)} = -241.8 \text{ kJ/mol}$$

$$\Delta H_v \text{C}_6\text{H}_6 \text{(g)} = 33.6 \text{ kJ/mol}$$

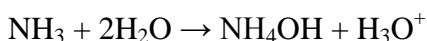
Calculate the;

i. heat of combustion of benzene [5 marks]

ii. heat for the reaction [5 marks]



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



#### **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 °C. The vapour pressure of the mixture and heptane are 112 mmHg and 36 mmHg respectively. [10 marks]

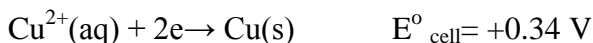
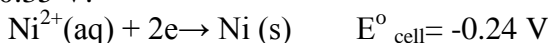
b. Find the solubility of AgCl in mol/L in a solution of 0.15 M MgCl<sub>2</sub>. K<sub>sp</sub> for AgCl is  $1.8 \times 10^{-10}$  [7 marks]

c. Find [H<sup>+</sup>] in 0.003M NaOH. [3 marks]

#### **QUESTION 5 [20 marks]**

a. The K<sub>sp</sub> of Ca(OH)<sub>2</sub> is  $7.9 \times 10^{-6}$  find the P<sub>H</sub> of the saturated solution of Ca(OH)<sub>2</sub>. [10 marks]

b. An electrochemical cell consists of an Fe<sup>2+</sup>/Fe half cell with [Fe<sup>2+</sup>] = 0.031 M and a Sn<sup>2+</sup>/Sn half-cell with unknown concentration [Sn<sup>2+</sup>]. The electromotive force of the cell was measured at 25°C to be 0.35 V.



i. Write down the cell representation [2 marks]

ii. Calculate the concentration of Sn<sup>2+</sup> in the Sn<sup>2+</sup>/Sn half-cell [5 marks]

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

