



# Technical University of Mombasa

Faculty of Applied and Health Sciences

**DEPARTMENT OF PURE AND APPLIED SCIENCES**  
UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF  
TECHNOLOGY IN APPLIED CHEMISTRY

## **ACH 4106 : PHYSICAL CHEMISTRY I**

SPECIAL/SUPPLEMENTARY EXAMINATION

JULY 2013 SERIES

2

HOURS

Instructions to candidates:

This paper consist of **FIVE** questions

Answer question **ONE** (compulsory) and any other **TWO** questions

### **Question ONE**

- Differentiate between ideal and nonideal solution **(4marks)**
- Mixture of propanone and trichloromethane shows negative deviation from Roults Law sketch and label **(4marks)**
  - Pressure – composition curves
  - Boiling point – Composition curves
- Explain how temperature affect rate of solubility. **(3marks)**
- 3.1grams of urethane was dissolved in 68.44 grams of methanol  $\text{CH}_3\text{OH}$  raised the boiling point by  $0.32^\circ\text{C}$ . Given ebulliscope constant as  $0.88\text{K m}^{-1}$  Calculate: **(6marks)**
  - Rmm of urethane
  - Mole fraction of urethane

- (iii) Vapour pressure of solution given vapour pressure of methane as 23.48mmHg
- e) Calculate pH of a buffer solution containing 0.8m Acetic acid and 0.3M sodium acetate given ionization constant of acid as  $1.819 \times 10^{-5}$  **(4marks)**
- f) (i) State SIX assumptions made in Kinetic theory of gases. **(3marks)**
- (ii) The standard free energy change at 25°C was  $-24.7 \times 10^3 \text{J mol}^{-1}$  Calculate value of equilibrium constant  $K_p$ . **(4marks)**
- g) Proof that for gas molecules average KE is proportioned to absolute temperature. **(3marks)**

### Question TWO

- a) 28% of liquid A (Rmm-140) has vapour pressure of 160mmHg of 37°C. Given vapour pressure of water at 37°C as 150mmHg. Calculate vapour pressure of pure liquid. **(4marks)**
- b) The solubility of  $\text{CuBr}_2$  is  $2.0 \times 10^{-4}$  moles/litre at 25°C. Calculate its solubility product  $K_{sp}$ . **(3marks)**
- c) A given mass occupies 919ml in dry state of S.T.P. The same mass when collected over water at 15°C and 750mmHg pressure occupies are 1L volume. Calculate vapour pressure of water at 15°C. **(4marks)**
- d) Explain briefly deviation of gases at high pressure and low temperature. **(3marks)**
- e) State:-
- (i) Characteristic of dynamic equilibrium **(2marks)**
- (ii) Success of Lewis theory. **(2marks)**
- (iii) Limitation of Arrhenius theory **(2marks)**

### Question THREE

- a) Calculate partial pressure of chloride in the following reaction mixture **(3marks)**
- $$\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3 + \text{Cl}_2(\text{g}) \quad K_p = 1.05$$
- Given equilibrium partial pressure of  $\text{PCl}_5$  and  $\text{PCl}_3$  as 0.875 and 0.463 atmospheric respectively.
- b) Define the following terms
- (i) Common ion effect
- (ii) Organic indicators

(iii) Immiscible liquid

**(3marks)**

c) A buffer solution contain 0.2moles of Acetic acid and 0.25moles of potassium acetate per liter of solution. Calculate pH of solution if 0.5ml of 1M HCl is added. **(4marks)**

d) State:-

(i) Charles Law

**(2marks)**

(ii) Delton Law

**(2marks)**

e) 2gms of Neon was mixed with 1gram of Helium in 8 litre vessel exert ctatal pressure of 0.98 atmospheric calculate partial pressure of Neon **(3marks)**

f) Define :-

(i) Indicator

**(1.5marks)**

(ii) Acidic salt

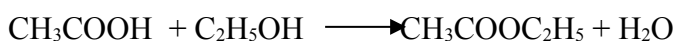
**(1.5mark)**

(iii) Electrolyte

**(1mark)**

#### **Question FOUR**

a) 40grams of acetic acid was mixed with 30grams of ethanol in 2L vessel to form water and ethyl acetate. At equilibrium there were 441grams of water. Calculate equilibrium constant  $K_x$  **(6marks)**



b) State

(i) Limitation of Arrhenius theory

**(2marks)**

(ii) Avogadros Hypothesis

**(2marks)**

(iii) Law of equilibrium

**(1mark)**

c) Define organic indicators and explain colour change of methyl orange indicator in Basic solution **(4marks)**

d) A buffer was prepared by mixing 0.1M acetic acid and 0.01M sodium acetate in 1 litre given dissociation constant of Acid as  $1.8 \times 10^{-5}$  calculate:- **(5marks)**

(i) pH of this buffer solution

(ii) pH change when 1ml of 1MNaOH is added to one litre of this buffer.

#### **Question FIVE**

- a) 48.6 grams of Ammonia occupies a volume of 5.4L at 45°C. Using Van der Waals equation calculate pressure it will exert given  $a = 138.9 \text{ KPa L}^2/\text{mol}$ ,  $b = 0.0371 \text{ L/mol}$

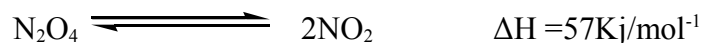
$$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$$

$$(P + a(n^2/v^2)) (V - nb) = nRT \quad \text{(4marks)}$$

- b) State :-

(i) Three assumptions made in deriving ideal gas equation (3marks)

(ii) Using Le Chatelier principle predict direction of equilibrium if volume and Temperature is decrease in the following equilibrium (2marks)



- c) Define

(i) Solubility

(ii) Solubility product (3marks)

- d) Discuss how the following factors affect rate of solubility

(i) Temperature (2marks)

(ii) Pressure (2marks)

- e) Derive ionic product  $K_w$  (2marks)