



# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

DPT 15S

ACH 2207: PHYSICAL CHEMISTRY

END OF SEMESTER EXAMINATION

**SERIES: APRIL 2016**

**TIME: 2 HOURS**

**DATE:** Pick Date Select Month Pick Year

## Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

**Do not write on the question paper.**

## Question ONE

- (a) List four factors that affect the position of equilibrium in a reversible reaction (4 marks)
- (b) An endothermic reaction between compounds A and B forming product C and D is accompanied by enthalpy change of 242 KJ. Give an energy level diagram of this reaction (4 Marks)
- (c) (i) Give the equation which represents Boyle's Law and Charles's Law combined (1 Mark)
- (ii) Sample of gas occupies  $140 \text{ cm}^3$  at  $28^\circ\text{C}$  and  $750 \text{ mmHg}$ . The gas is heated to  $35^\circ\text{C}$  and its pressure increased to  $756 \text{ mmHg}$ . Find its final volume (5marks)
- (d) State four units of expressing pressure of gases (4Marks)
- (e) Find the numerical value of  $pK_w$ ,  $pOH$  and  $PH$  in each of the following
- (i)  $0.02 \text{ M H}_2\text{SO}_4$  (5Marks)
- (ii) Distilled water (3Marks)
- (ii)  $0.04 \text{ M NaOH}$   $K_w = 1 \times 10^{-14}$  (4Marks)

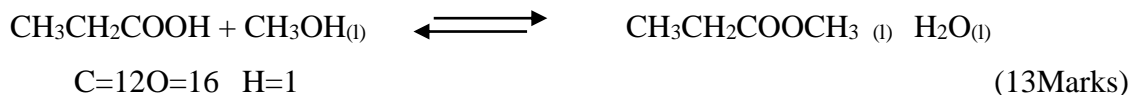
## Question TWO

300cm<sup>3</sup> of 2 M (Molarity) HCl solution was added into a beaker containing 33.6 g of magnesium carbonate powder.

- (a) Determine which reactant was in excess (6marks)
- (b) Calculate the mass (or volume) of the insufficient reactant that need to be added to complete the reaction (4 marks)
- (c) Calculate the volume of carbon dioxide produced if 33.6g of MgCO<sub>3</sub> completely reacted with HCl at 45<sup>0</sup>C and 758MMHg pressure given Mg = 24, C =12, O=16, H=1, Cl=35.5, Standard pressure-760mmHg, Standard temperature=273k and Molar volume of a gas at STP = 22.4 lit. (5Marks)

## Question THREE

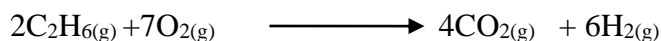
- (a) Define the term homogeneous equilibrium (1 Mark)
- (b) In an esterification experiment 9.6g methanol CH<sub>3</sub>OH was heated with 37g of propanoic acid CH<sub>3</sub>CH<sub>2</sub>COOH. 18.5g of the acid remained at equilibrium
- (i) Calculate the equilibrium constant



- (ii) State one change that can be made on this equilibrium system to increase the yield of the ester product (1Mark)

## Question FOUR

- (a) (i) State Dalton's Law of Partial Pressures (1 Mark)
- (ii) A volume of 250ml of gas P measured at 0.30 atm and 300 ml of gas Q at a pressure of 0.40 atm are passed into a container whose volume is 750ml. Determine the total pressure of the mixture in the new vessel at the same temperature (5 Marks)
- (b) (i) State Gay Lussac's Law (3Marks)
- (ii) A mixture of 200cm<sup>3</sup> of ethane and 880cm<sup>3</sup> of oxygen was exploded. The reaction taking place is represented by the equation.



Determine the volume composition of the final gaseous mixture (6Marks)

### Question FIVE

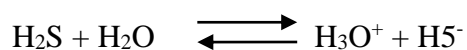
(a) Define

(i) Arrhenius base (1Mark)

(ii) Bronsted acid (1 Mark)

(iii) Conjugate acid of a base (1 Mark)

(b) Given the equation



Identify

(i) Bronsted acid (1 Mark)

(ii) Conjugate acid of the base (1 Mark)

(iii) Conjugate pair (1 Mark)

(c) Distinguish ionization energy from atomization energy and give their corresponding equations using sodium metal (4 Marks)

(d) Given the following K<sub>sp</sub> data

$$\text{BaCO}_3 \quad \text{K}_{\text{sp}} = 5.0 \times 10^{-9}$$

$$\text{CaCO}_3 \quad \text{K}_{\text{sp}} = 4.5 \times 10^{-9}$$

$$\text{MgCO}_3 \quad \text{K}_{\text{sp}} = 1.66 \times 10^{-6}$$

(i) Identify the most soluble carbonate 1 Mark

(ii) Write dissolving equation for BaCO<sub>3</sub> 2 Marks

(iii) Calculate the concentration of CO<sub>3</sub><sup>2-</sup> ion in a saturated solution of CaCO<sub>3</sub> 6 Marks