



# THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

**A. M. E. C. E. A**

P.O. Box 62157

00200 Nairobi - KENYA

Telephone: 891601-6

**MAIN EXAMINATION**

**MAY – JULY 2019 TRIMESTER**

**FACULTY OF SCIENCE**

**DEPARTMENT OF CHEMISTRY**

**REGULAR PROGRAMME**

**CHEM 103: ACIDS AND BASES**

**Date: JULY 2019**

**Duration: 2 Hours**

**INSTRUCTIONS: Answer Question ONE and any other Two Questions**

- Q1. a) Using relevant structures, describe the neutralization of ethanedioic acid using sodium hydroxide **(4 marks)**  
b) Sketch a titration curve for the above reaction **(6 marks)**  
c) A solution contains 0.20 moles of acetic acid,  $\text{CH}_3\text{COOH}$ , and 0.10 moles of sodium acetate,  $\text{CH}_3\text{COONa}$ , made up to 1.0 L volume. Calculate the pH of the solution. [ $K_a$  for  $\text{CH}_3\text{COOH} = 1.8 \times 10^{-5}$ ] **(5 marks)**  
d) What is the pH of the previous solution if it was diluted to a volume of 10.0 L? **(4 marks)**  
e) What does this result tell us about buffer solutions? **(3 marks)**
- A 0.025 M solution of formic acid,  $\text{HCOOH}$ , has a pH of 2.75.  
e) Calculate the % ionization of this solution. **(4 marks)**  
f) Calculate the  $K_a$  for formic acid **(4 marks)**
- Q2. If 12.5 g of  $\text{Cu}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  is added to 500 mL of 1.00 M aqueous ammonia, what is the equilibrium concentration of  $\text{Cu}^{2+}_{(\text{aq})}$ ? **(8 marks)**  
a) Using relevant examples, explain the differences between a Bronsted- Lowry and Arrhenius acids **(6 marks)**

- b) The solubility of CaF (molar mass 78.1) at 18°C is reported to be 1.6 mg per 100 mL of water. Calculate the value of  $K$  under these conditions. **( 6 marks)**

Q3. Arrange the compounds of each series in order of increasing acidic strength; Sulfuric acid [H<sub>2</sub>SO<sub>4</sub>], fluorosulfonic acid (FSO<sub>3</sub>H), and sulfurous acid [H<sub>2</sub>SO<sub>3</sub>]. Explain why? **(8 marks)**

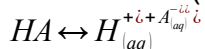
- a) Explain why blood can be considered a buffer **(7 marks)**  
 b) Nitrous acid, HNO<sub>2</sub> has a  $K_a$  value of  $6.0 \times 10^{-4}$ . Calculate the initial concentration of HNO<sub>2</sub> if a solution of this acid has a pH of 3.65. **(5 marks)**

Q4. Calculate the pH of a solution of the following basic salt solution if [ClO<sup>-</sup>] is 0.100M and the  $K_a$  is  $2.9 \times 10^{-8}$ :



- i) Phosphoric acid is a polyprotic acid.  
 a) Using relevant equations, explain how it dissociates in aqueous solution **(6 marks)**  
 b) Sketch a titration curve for the neutralization of phosphoric acid using sodium hydroxide **(6 marks)**

Q5. a) The ionization of a weak acid (HA) happens in the following way:



Using this equation, derive the Henderson- Hasselbach equation **(10marks)**

- b) Using the relationship between a weak acid and its conjugate base, explain why  $K_a K_b = K_w$  **(10 marks)**

**\*END\***