



THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

AUGUST - DECEMBER 2015 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

REGULAR PROGRAMME

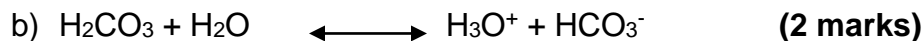
CHEM 103: ACIDS AND BASES

Date: DECEMBER 2015

Duration: 2 Hours

INSTRUCTIONS: Answer Question ONE and ANY OTHER TWO Questions

- Q1. a) i Using Arrhenius and Bronsted lowry theory define the terms
ii Acid. **(3 marks)**
- iii Base. **(3 marks)**
- li Explain the relationship between Arrhenius, Bronsted Lowry and Lewis theories of acids and base. **(6 marks)**
- b) i Define the term PH. **(1 mark)**
- ii In a sample of lemon juice $[H^+]$ is 3.8×10^{-4} M. What is the pH of the sample. Is the solution acidic or basic. **(3 marks)**
- iii A solution formed by dissolving an antacid tablet has a pH of 9.18. Calculate $[H^+]$ **(3 marks)**
- c) i What is meant by conjugate acid. **(1 mark)**
- ii Identify the conjugate acids and bases in the following in water
a) $H_2SO_4 + H_2O \rightleftharpoons HSO_3^- + H_3O^+$ **(2 marks)**



- d) i Define the term solubility product (ksp) for a sparingly soluble salt. (1 mark)
- ii The solubility of calcium fluoride, CaF_2 in water is $1.40 \times 10^{-5} \text{ mol dm}^{-3}$ at 298K. Calculate the solubility products. (3 marks)
- iii State any TWO applications of solubility products. (2 marks)

Q2. a) Consider the ionization of a weak acid HA.



Derive the relation $\text{PH} = \text{pka} + \log \left[\frac{\text{A}^-}{\text{HA}} \right]$ (6 marks)

- b) The pH of a 0.10M solution of HA was found to be 2.8. Calculate
- i Dissociation constant (K_a) of HA. (6 marks)
- ii Percent (%) ionization of HA. (3 marks)
- c) How would you prepare a buffer solution with HA. (5 marks)

Q3. a) Briefly explain THREE factors that affects the strength of an acid.

(6 marks)

b) Calculate the pH of 0.01M $\text{Ba}(\text{OH})_2$ a strong base. (4 marks)

c) What are the characteristics of salts that produce basic or acid solutions. (5 marks)

d) Briefly, explain the ionization of water. (3 marks)

e) A sample of fertilizer has a pH of 8.54. Calculate the hydrogen ion concentration of this fertilizer. (2 marks)

Q4. a) Define the following terms

i Buffer solution. (1 mark)

ii Common ion effect. (1 mark)

- b) i Calculate the pH of a buffer made from 0.24M NH_3 and 0.20M NH_4Cl $k_b = 1.8 \times 10^{-5}$ **(5 marks)**
- ii Suppose 0.001 mol NaOH is added to 1.0l of the solution in (i) above, what will be the pH of the resulting solution? **(5 marks)**
- c) A 0.056g quantity of acetic acid is dissolved in enough water to make 50ml of solution.
- i Calculate the concentration of $[\text{H}^+]$ (CH_3COO^-) and (CH_3COOH) at equilibrium. Given $k_a = 1.8 \times 10^{-5}$ **(6 marks)**
- ii Calculate the pH of the solution. **(2 marks)**
- Q5. a) Sketch the titration for the following reactions
- i Dilute HCl and dilute NaOH. **(2 marks)**
- ii Dilute CH_3COOH and dilute NaOH **(2 marks)**
- iii Dilute CH_3COOH and dilute NH_4OH **(2 marks)**
- b) What are the pH and percent hydrolysis of a 0.10M NH_4Cl solution given $k_a = 5.6 \times 10^{-10}$ **(4 marks)**
- c) Solid NaF is added in tiny increments to a solution containing 0.1M CaCl_2 and 0.1M MgCl_2 , CaF_2 and MgF_2 are rather insoluble with solubility product of $[\text{Ca}^{2+}][\text{F}^-]^2 = 3.9 \times 10^{-11}$ and $(\text{Mg}^{2+})[\text{F}^-]^2 = 6.6 \times 10^{-9}$
- i Which salt CaF_2 or MgF_2 precipitates first? **(2 marks)**
- ii When the first trace of the second precipitate appears what are the concentrations of Ca^{2+} and Mg^{2+} **(5 marks)**
- d) The solubility of CuBr_2 is 2.0×10^{-4} M at 25°C . Calculate the k_{sp} value of CuBr_2 **(3 marks)**

END