

(10)

**EMBU UNIVERSITY COLLEGE**  
(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF NAIROBI)

FIRST SEMESTER EXAMINATIONS 2013/2014

FIRST YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN  
WATER RESOURCES MANAGEMENT

AWM 106: WATER CHEMISTRY

**DATE: DECEMBER 2, 2013**

**TIME: 11.00 – 1.00PM**

**INSTRUCTIONS**

**Answer Question ONE and any other TWO**

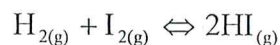
**QUESTION ONE**

- a) Differentiate between the following terms (5 marks)
- Meteoric water and connate water
  - Colloidal and true solutions
  - Aldehyde and ketone
- b) Consider the general reaction at 100 °C
- $$2\text{ICl}_{(g)} \rightleftharpoons \text{I}_{2(g)} + \text{Cl}_{2(g)}$$
- Write equilibrium expression for the reaction (2 marks)
  - What would be the effect of adding more  $\text{I}_2$  to the equilibrium? Explain (3 marks)
- c) In a titration reaction, 25 ml of 0.1M HCl was added to dissolve a 10 g  $\text{CaCO}_3$  rock. To the resultant solution, it was noted that 10 ml of 0.1M NaOH neutralized the excess HCl. Calculate the percentage content of  $\text{CaCO}_3$  in the rock (5 marks)
- d) Calculate the pH of the following solution (5 marks)
- 0.2M  $\text{H}_2\text{SO}_4$
  - 0.1M  $\text{CH}_3\text{COOH}$  ( $K_a = 1.85 \times 10^{-5}$ )

- e) Write down the electron configuration of the following elements using the inert gas core abbreviated Orbital diagram representation (5 marks)
- Ti (22)
  - Cr(24)
  - Cu(29)
  - Al(13)
  - Cl(17)
- f) Briefly describe how the following affect the chemical composition of natural waters (5 marks)
- Geology of a region
  - Climate of a region

### QUESTION TWO

- a) Consider the reaction at 700 °C



At equilibrium, the following are the concentration;  $\text{HI} = 0.21\text{M}$ ,  $\text{H}_2 = \text{I}_2 = 0.017\text{M}$

- Calculate the equilibrium constant for the reaction at 700 °C (4 marks)
  - If more HI is added to make its concentration 0.46 M, what will be the new concentrations when the equilibrium is established again? In what direction will the equilibrium shift? (8 marks)
- b) Balance the following reactions using the half equation method
- $\text{Br}_2 \longrightarrow \text{Br}^- + \text{BrO}_3^-$  in basic medium (4 marks)
  - $\text{MnO}_4^- + \text{Cl}^- \longrightarrow \text{Mn}^{2+} + \text{Cl}_2$  in Acidic Medium (4 marks)

### QUESTION THREE

- a) Briefly explain the procedures for identification of the following functional groups
- Aldehydes (2 marks)
  - Esters (2 marks)
  - Carboxylic acid (2 marks)
- b) Comment on the following aspects in relation to chemical reactivity (10 marks)
- Enthalpy changes
  - Entropy
  - Activation energy
  - Stability (thermodynamic and Chemical stability)
- c) Briefly explain the hydrogen bonding phenomenon in  $\text{H}_2\text{O}$  (4 marks)

#### QUESTION FOUR

- a) Write down the coordination formula of the following complex compounds/ions. In each case, give a systematic name
- $\text{NaCN.Ni(CN)}_2$
  - $\text{MgCl}_2.7\text{H}_2\text{O}$
  - $\text{Na}_2\text{CrCl}_4.2\text{H}_2\text{O}$  (6 marks)
- b) In (a) above, calculate the Effective atomic number and coordination number of the central metal/ion (6 marks)
- c) Explain the bonding of water using Valence Bond Theory (8 marks)

#### QUESTION FIVE

Write short notes on the interaction of matter by the following radiations (20 marks)

- Microwave
- Infrared
- Visible light
- Ultraviolet

---END---