



# MACHAKOS UNIVERSITY COLLEGE

(A Constituent College of Kenyatta University)  
University Examinations for 2015/2016 Academic Year

**SCHOOL OF PURE AND APPLIED SCIENCES**

**DEPARTMENT OF PHYSICAL SCIENCES**

**SECOND SEMESTER EXAMINATION FOR**

**DIPLOMA IN ELECTRICAL ENGINEERING**

**DIPLOMA IN BUILDING AND CIVIL ENGINEERING**

**SCU 102: CHEMISTRY**

**DATE:**

**TIME:**

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**INSTRUCTIONS: Answer question one and any other two questions**

**Use: Atomic numbers for: H=1, N = 7, O = 8, C =6**

## **SECTION A**

### **QUESTION ONE (30MARKS)**

- a) Explain what is meant by Hybridization of atomic orbitals. Give an example. (5 marks)
- b) Using dots and crosses draw electronic structure of Ammonia ( $\text{NH}_3$ ). (5 marks)
- c) State the group and the period to which element P atomic number 18 belongs. (2 marks)
- d)
  - i) Define a base using Arrhenius theory
  - ii) Write an appropriate equation to show how  $\text{HCO}_3^-$  can act as Arrhenius acid. (4 marks)
- e) Deduce the value of the emf for the cell below operating under standard conditions

$$\text{Ag}^+_{\text{aq}} / \text{Ag}_s = + 0.79\text{V}$$

$$\text{Mg}^{2+}_{\text{aq}} / \text{Mg}_s = - 0.2.36\text{V} \quad (4 \text{ marks})$$

- f) Calculate the pH of 0.2 M  $\text{H}_2\text{X}$  acid. (4 marks)
- g) i) Give the conjugate base of  $\text{NH}_4^+$
- ii) Differentiate between a weak and a strong acid. Give an example of each.
- iii) Using s,p,d and f , Write down the electronic configuration of Copper, given that its atomic number is 30. (6 marks)

## SECTION B

### QUESTION TWO (20MARKS)

- a) Element Y has atomic number 21.
- i) Write electronic (spdf) configuration of Y.
- ii) State which block of the periodic table it belongs. (6 marks)
- b) The atomic nuclei of atoms X and Y contain:
- X- 7 neutrons, 7 protons
- Y- 14 neutrons, 12 protons
- i) Using s,p ,d, f write down the electronic configurations of X and Y.
- ii) Draw the structure of the Hydride of X. (6 marks)
- c) Draw dots and crosses diagram to show electronic structures of:
- i)  $\text{H}_2\text{O}$
- ii)  $\text{CH}_3$  (8 marks)

### QUESTION THREE (20 MARKS)

- a) X,Y and Z represent elements of atomic numbers 9, 19 and 16 respectively.
- i) Write down their electronic configurations using octet rule. (6 marks)
- ii) Predict the type of bond formed between:
- X and Y
  - X and Z (6 marks)
- b) Use dots and crosses to show how atoms in  $\text{CH}_3\text{CH}_3$  combine. (4 marks)
- c) An element Q has the following electronic arrangement  $1s^2 2s^2 2p^6 3s^2$ .
- i) Write down the atomic number of Q.
- ii) State with reasons whether Q is a metal or non-metal. (4 marks)

**QUESTION FOUR (20 MARKS)**

- a) Hypochlorous acid (HClO) is a weak monobasic acid with  $K_a = 3.2 \times 10^{-8} \text{ mol dm}^{-3}$ .
- Write an appropriate equation for its dissociation (3 marks)
  - Calculate the pH of the acid if its concentration is  $1.25 \times 10^{-2} \text{ M}$ . (4 marks)
- b) Write an equation to show that  $\text{HSO}_4^-$  can act as Bronsted-Lowry base. (3 marks)
- c) Calculate the pH of:
- $0.2 \text{ M H}_2\text{SO}_4$
  - $10^{-3} \text{ M HCl}$  (8 marks)
- d) State TWO advantages under Arrhenius theory. (2 marks)

**QUESTION FIVE (30 MARKS)**

- a) Define the following terms.
- Cathode
  - Electrolyte (6 marks)
- b) The following are standard electrode potentials for Magnesium, Iron and Mercury.
- $$\text{Mg}^{2+}_{(\text{aq})} + 2\text{e} \rightarrow \text{Mg}_{(\text{s})} \quad - 2.36 \text{ V}$$
- $$\text{Fe}^{2+}_{(\text{aq})} + 2\text{e} \rightarrow \text{Fe}_{(\text{s})} \quad - 0.44 \text{ V}$$
- $$\text{Hg}^{+}_{(\text{aq})} + \text{e} \rightarrow \text{Hg}_{(\text{s})} \quad + 0.78 \text{ V}$$
- $$\text{Cu}^{2+}_{(\text{aq})} + 2\text{e} \rightarrow \text{Cu}_{(\text{s})} \quad + 0.34 \text{ V}$$
- Draw a diagram to show an electrochemical cell by using Magnesium and Copper electrodes. (5 marks)
  - Write ionic equations for the reactions in each half cell. (4 marks)
  - Write down the overall cell equation. (2 marks)
  - Calculate the emf of the cell. (3 marks)