



# THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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

**MAIN EXAMINATION**

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**JANUARY – APRIL 2014 TRIMESTER**

**FACULTY OF SCIENCE**

**DEPARTMENT OF NATURAL SCIENCE**

**SCHOOL FOCUSED PROGRAMME**

**CHEM 104: CHEMICAL BONDING AND STRUCTURE**

**Date: APRIL 2014**

**Duration: 2 Hours**

**INSTRUCTIONS: Answer Question ONE and ANY OTHER TWO Questions**

- Q1. a) Explain the plum pudding model of an atom as suggested by Thomson in 1904. **(3 marks)**
- b) Derive a formula for determining the de Broglie wavelength and then use to determine the de Broglie wavelength of mass  $m = 1.0 \text{ kg}$  and moving with a velocity  $v = 10 \text{ m/s}$ . (Planck's constant =  $6.6 \times 10^{-34} \text{ J-s}$ ) **(4 marks)**
- c) What do you understand by wave – particle duality? **(3 marks)**
- d) What is a chemical bond? **(3 marks)**
- e) The Lewis theory of bonding cannot explain the bonding in  $\text{CH}_4$ . Explain. **(4 marks)**
- f) In a p orbital, the electron density changes with both the distance from the center of the atom and the direction. Explain using appropriate diagrams. **(3 marks)**
- g) Draw the resonance structures of  $\text{CO}_3^{2-}$ . **(3 marks)**

- h) Explain the importance of “wave interference” concept in bonding. **(4 marks)**
- i) What do you understand by Lattice energy? **(3 marks)**
- Q2. a) Starting from an atomic number, explain how one can use the four quantum numbers to determine the location of a particular element in the periodic table. **(5 marks)**
- b) List any **FOUR** major highlights of Dalton’s atomic theory. **(4 marks)**
- c) Differentiate between exothermic and endothermic bond formation reactions. **(4 marks)**
- d) Molecular orbital theory is superior to Valence Bond Theory. Using  $O_2$  illustrate the correctness of the above statement. **(7 marks)**
- Q3. a) Using bonds table approach, determine the Lewis Dot structure of  $ClO_4^-$ . **(8 marks)**
- b) Using an example, outline the sequence of steps necessary in determining the geometries of molecules. **(6 marks)**
- c) Explain the **THREE** main rules used in drawing contributing resonance structures. **(6 marks)**
- Q4. a) Explain the **FOUR** main guidelines in constructing a molecular orbital diagram. **(4 marks)**
- b) Draw a molecular orbital diagram for the molecule NO. **(6 marks)**
- c) Explain the following properties associated with metallic compounds:  
i) Malleability and ductility  
ii) Heat and electrical conduction  
iii) Shiny  
iv) Solids  
v) Photoelectric effect **(10 marks)**
- Q5. a) Discuss the Born-Haber cycle diagram and explain all the steps on it. **(12 marks)**

- b) What do you understand by electronegativity? **(4 marks)**
- c) Using metallic character as the main determinant, determine the location of metals and non-metals in the periodic table. **(4 marks)**

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