

UGANDA MARTYRS UNIVERSITY

FACULTY OF SCIENCE

DEPARTMENT OF NATURAL SCIENCES

END OF SEMESTER FINAL ASSESMENT

SEMESTER 1, 2023/2024

COURSE: BACHELOR OF SCIENCE WITH EDUCATION

YEAR: ONE

EXAM: *BASIC INORGANIC CHEMISTRY*

SEMESTER: I

DATE: 12th DECEMBER, 2023

TIME: 9:30am – 12:30pm.

DURATION: 3 HOURS

INSTRUCTIONS

- This paper consists of *SEVEN* questions.
- Attempt any five (5) Questions
- Begin each question on a fresh sheet of paper.
- All questions carry equal marks.

(atomic number of N=7, C=12, O=8, H=1 S=16, F=9)

Question one

(a) Explain;

- (i) Why do atoms combine (2 marks)
- (ii) Modes of chemical composition (4 marks)
- (iii) Electrovalence (2 marks)
- (iv) Factors governing the formation of ionic bonds (6 marks)

(b) (i) Draw the Lewis structure of;

- (ii) CO_3^{2-} (2 marks)
- (ii) NO_3^- (2 marks)
- (iii) SO_4^{2-} (2 marks)

Question two

(a) Explain the following terms

- (i) Bond length (2 marks)
- (ii) Covalent radius (2 marks)
- (iii) Formal charge (2 marks)

(b) Determine the formal charge of carbonate ion (CO_3^{2-}) and explain the significance of formal charge (4 marks)

(c) State the main postulates of the valence shell electron pair repulsion (VSEPR) theory (6 marks)

(d) Using VSEPR theory, draw the shapes of the following molecules

- (i) SO_3^{2-} (2 marks)
- (ii) PO_4^{3-} (2 marks)

Question three

(a) Define the term hybridization (2 marks)

(b) Explain the following types of hybridization of carbon

- (i) SP^3 hybridisation (4 marks)
- (ii) SP^2 hybridisation (4 marks)
- (iii) SP hybridization (4 marks)

(c) Distinguish between a sigma bond and a pi (π) bond (6 marks)

Question four

- (a) Explain the silent features of molecular orbital theory (7 marks)
- (b) Draw the molecular orbital energy level diagram and write the electronic configuration of,
(i) Oxygen molecule (O_2) (atomic number of oxygen is 8) (5 marks)
(ii) Nitrogen molecule (N_2) (atomic number nitrogen is 7) (5 marks)
- (c) Calculate the bond order of fluorine molecule and use it to explain the nature of the bonds and other properties of the molecule (3 marks)

Question five

- (a) State and illustrate the Heisenberg uncertainty principle (5 marks)
- (b) Give the difference between electromagnetic waves and matter waves (5 marks)
- (b) what values of the azimuthal and magnetic quantum numbers are allowed for principle quantum number of 4 and state the number of orbital's allowed in $n=4$ (5 marks)
- (c) Does Bohr model obey uncertainty principle (5 marks)

Question six

- (a) Describe the Bohr Model of the Hydrogen atom (8 marks)
- (b) Show that the energy of electron in the orbit of hydrogen is $E = -\frac{2\pi^2 Me^4}{n^2 h^2}$ (Given that the potential energy of the electron is the sum of its kinetic energy and potential energy) (8 marks)
- (c) Explain the shortcomings of Bohr Theory (4 marks)

Question seven

- (a) (i) What is an orbital (2 marks)
(ii) Which d-orbital does not have lobes? Draw its shape (2 marks)
(iii) Compare the shapes of 1s and 2s orbital (4 marks)
- (b) Explain the Pauli Exclusion Principle (4 marks)
- (c) what information do you get from the principal quantum number about an atom (4 marks)

END