

CHUKA



UNIVERSITY

**UNIVERSITY EXAMINATION
RESIT/SUPPLEMENTARY / SPECIAL EXAMINATIONS
EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE**

CHEM 110: INORGANIC CHEMISTRY I**STREAMS:****TIME: 2 HOURS****DAY/DATE: FRIDAY 05/11/2021****11.30 A.M - 1.30 P.M.****INSTRUCTIONS:**

- Answer question One (Compulsory) and any other Two questions

QUESTION ONE [30 MARKS]

- (a) State each of the following: **(1 Mark)**
- (i) the law of multiple proportions (ii) the law of definite composition
- (b) Magnesium has three naturally occurring isotopes, Mg-24 (23.99 amu), Mg-25 (24.99 amu) and Mg-26 (25.98 amu). Calculate the atomic mass for magnesium given that the isotopic abundance of Mg-24 and Mg-26 are 78.70% and 11.17%, respectively **(3 Marks)**
- (c) Given the following sets of electron quantum numbers (n, l, m_l, m_s), indicate those that cannot occur, and explain your answer **(4 Marks)**
- (i) 1, 1, 0, - ½ (ii) 4, 2, -2, 0 (iii) 2, 3, 2, +½ (iv) 4, 0, 2, +½
- (d) Write the Lewis structures of each of the following species. In each case the central atom is underlined **(6 Marks)**
- (i) XeF₄ (ii) ClO₃⁻ (iii) PCl₃ (iv) H₃O⁺
- (e) Calculate the mass percent of each element present in propanoic acid (CH₃CH₂COOH) **(3 Marks)**
- (f) Calculate each of the following quantities:

- (i) the volume in milliliters of 2.26 M potassium hydroxide that contains 8.42 g of the solute
(3

Marks)

- (ii) the number of Cu^{2+} ions in 52 L of a 2.3 M copper (II) chloride solution (2 Marks)
 (iii) the molarity of 275 mL of solution containing 135 mmol of glucose (1 Marks)
 (g) Calculate the wavelength in nanometers of the line in the Pfund series that results from the transition $n = 7$ to $n = 5$ (2 Marks)
 (h) Write the ground state electronic configuration of each of the following species (3 Marks)
 (i) P (ii) Ti^{4+} (iii) Sn
 (i) Draw the orbital diagram for each of the following species (2 Marks)
 (i) O (ii) Co

QUESTION TWO [20 MARKS]

- (a) Calculate:
 (i) the wavelengths, in meters, of radiation with a frequency of 5.60×10^{15} Hz (2 Marks)
 (ii) the energy of a photon with a wavelength of 492 nm (2 Marks)
 (iii) the de Broglie wavelength of a proton moving at a speed of 2.50×10^7 m/s (2 Marks)
 (b) Arrange the following ions in order of increasing ionic radii: (i) Ca^{2+} , K^+ , Al^{3+} ; (ii) Se^{2-} , Br^- , Te^{2-} (3 Marks)
 (c) Define electronegativity and arrange the following elements in order of increasing electronegativity. B, Na, F, O (3 Marks)
 (d) A sucrose ($\text{C}_{11}\text{H}_{22}\text{O}_{11}$) solution that is 45.0% sucrose by mass has a density of 1.203 g/mL at 25°C. Calculate:
 (i) the molality of the solution (2 Marks)
 (ii) the molarity of solution (2 Marks)
 (iii) the mole fraction of sucrose (2 Marks)
 (e) State the postulates of Dalton's atomic theory (2 Marks)

QUESTION THREE [20 MARKS]

- (a) Consider the following species: SO_3^{2-} , ClF_3 , NO_3^- , BF_3 , and ClO_2

- (i) Write the Lewis structure of each of the species **(5 Marks)**
 (ii) Determine the molecular geometry and the bond angles of the ClF_3 molecule **(1 ½ Marks)**
 (iii) Write the resonance forms of the NO_3^- ion **(1½ Marks)**
 (iv) Determine the polarity of the BF_3 molecule **(1 Mark)**
 (b) Discuss the Bohr model of the structure of the hydrogen atom **(5 Marks)**
 (c) Define electron affinity and arrange the following elements in order of increasing values of electron affinity. Justify your order. K, Br, Cs, Cl **(3 Marks)**
 (d) State the type(s) of intermolecular forces that are present in each of the following species **(3**

Marks)

(i) CH_3OH

(ii) CO_2

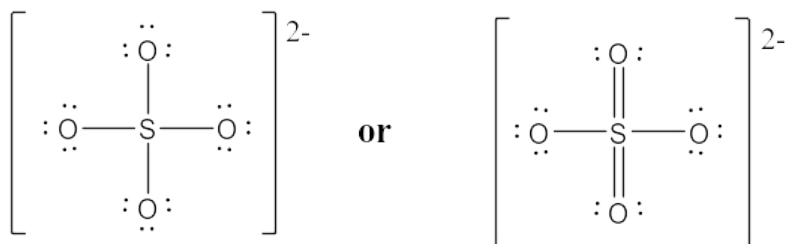
(iii) CH_3F

QUESTION FOUR [20 MARKS]

(a) Vitamin C (MM = 176.12 g/mol) is a compound composed of carbon, hydrogen and oxygen. When a 1.000 g sample of vitamin C is burned in air, 1.50 g CO_2 and 0.41 g H_2O are obtained.

- (i) Determine the empirical formula of vitamin C **(5 Marks)**
 (ii) Determine the molecular formula of vitamin C **(2 Marks)**
 (b) For each of the following pairs, chose the member with the lower boiling point. Explain your reason in each case **(4½ Marks)**
 (i) HI or HBr **(ii) CH_4 or H_2O (iii) N_2 or Cl_2**
 (c) With the aid of formal charges, explain which Lewis formula is more likely to be correct **(3**

Marks)



- (d) Determine the total capacity for electrons in: (i) $n = 4$ (ii) d sublevel (iii) p orbital
(1½

Marks)

(e) An aqueous solution of urea, $\text{CO}(\text{NH}_2)_2$, is labelled 2.577m. Calculate:

(i) the concentration of urea in ppm (2 Marks)

(ii) the mole fraction of water (2 Marks)

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