

THARAKA



UNIVERSITY

COLLEGE

*(A Constituent College of Chuka University)*

## UNIVERSITY EXAMINATIONS

### EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF EDUCATION SCIENCE

#### CHEM 110: INORGANIC CHEMISTRY I

STREAMS: BED (SCI) P/T

TIME: 2 HOURS

DAY/DATE: TUESDAY 14/04/2020

2.30 PM – 4.30 PM

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#### INSTRUCTIONS:

- Question One is Compulsory
- Choose any other Two Questions from the remaining four Questions

#### QUESTION ONE (30 MARKS)

- (a) State four postulates of Dalton's atomic theory of matter [2 marks]
- (b) (i) Silver (Ag;  $Z = 47$ ) has 46 known isotopes, but only two occur naturally  $^{107}\text{Ag}$  and  $^{109}\text{Ag}$ . Given the following mass spectrometric data, calculate the atomic mass of silver: [4 marks]
- | Isotope           | Mass (amu) | Abundance (%) |
|-------------------|------------|---------------|
| $^{107}\text{Ag}$ | 106.90509  | 51.84         |
| $^{106}\text{Ag}$ | 108.90476  | 48.16         |
- (c) State whether the following set of quantum numbers are possible for an electron in an atom
- (2,0,0,+1/2)
  - (1,1,0,+1/2)
  - (0,0,0, - 1/2)
  - (2,1,-2,+1/2)
- (d) Give two differences between metals and non-metals. [2 marks]
- (e) Draw orbital diagrams for the following elements

- (i) Nickel [2 marks]
- (ii) Nitrogen [2 marks]
- (f) Explain with the aid of formal charges, the Lewis structure that is likely to be correct for  $\text{Cl}_2\text{O}$  molecule. [2 marks]
- (g) Write the ground state electronic configuration of the following species: [3 marks]
- (i) V (ii)  $\text{K}^+$  (iii)  $\text{Cl}^-$
- (h) Write short notes on;
- (i) The concept of electron cloud [2 marks]
- (ii) Electrovalent bond [2 marks]
- (iii) The dual nature of electrons [2 marks]
- (iv) Normality [2 marks]

**QUESTION TWO (20 MARKS)**

- (a) Nicotine (Molar mass = 160 g) contains carbon, hydrogen, nitrogen. If 5.250 mg nicotine is combusted completely it forms 14.242 mg  $\text{CO}_2$  and 4.083 mg  $\text{H}_2\text{O}$
- (i) Determine the empirical formula of nicotine [3 marks]
- (ii) Molecular formula of nicotine [2 marks]
- (b) (i) What is an orbita? [1 mark]
- (ii) State 4 characteristics of orbitals. [4 marks]
- (c) Electrons in atoms of elements are described by four quantum numbers
- (i) List the four quantum numbers [2 marks]
- (ii) State the significance of each quantum number [4 marks]
- (d) Draw the Lewis structures of the following compounds [4 marks]
- (i)  $\text{SCl}_2$
- (ii)  $\text{ClF}_3$
- (iii)  $\text{PCl}_5$
- (iv)  $\text{COCl}_2$

**QUESTION THREE (20 MARKS)**

- (a) Commercial hydrochloric acid is available as a 10.17 molar solution. How would you use this to prepare 500 mL of a 4.00 molar solution? [3 marks]

- (b) Acetic acid ( $\text{CH}_3\text{COOH}$ ) is contained in vinegar. 25 ml of vinegar solution was diluted to 250 ml. 25 ml of the diluted solution was neutralized by 16.5 ml of 0.1 M NaOH. Determine the acetic acid content in vinegar in g/L/ [3 marks]
- (c) Consider the following species  $\text{CO}_3^{2-}$  and  $\text{SF}_4$
- (i) Determine the molecular shapes of the species [2 marks]
- (ii) Determine the polarity of the molecules [2 marks]
- (d) Giving reasons, discuss the general trends in the periodic table for the following
- (i) Atomic radius [2 marks]
- (ii) Electron affinity [2 marks]
- (iii) Ionization energy [2 marks]
- (e) Define the following terms
- (i) Atomic Number (Z) [1 mark]
- (ii) Mass number (A) [1 mark]
- (f) Taking X as a general symbol for an element, indicate how Z and A are indicated on the symbol X. [2 marks]

**QUESTION FOUR (20 MARKS)**

- (a) (i) State the law of definite proportions. [1 mark]
- (ii) Calculate the percentage composition of Cu, Fe and S in  $\text{CuFeS}_2$  [3 marks]
- (b) Illustrate with an appropriate example in each case, briefly describe the basic ideas in the following types of chemical bonds.
- (i) Covalent bonds [2 marks]
- (ii) Ionic bonds [2 marks]
- (c) State the Pauli's Exclusion principle [1 mark]
- (ii) Based on the above principle, give the set of quantum numbers that define the 8th electron in sodium atom. [2 marks]
- (d) Discuss the following intermolecular forces:
- (i) Van der Waals [2 marks]
- (ii) Dipole-dipole [2 marks]

- (iii) Hydrogen bonding [2 marks]
- (e) Sodium vapor lamps are sometimes used for public lighting. They give off a yellowing light with a wavelength of 589 nm. What is the frequency of this radiation? [1 mark]
- (f) Calculate the wavelength of a neutron travelling at a speed of 4.15 Km/s. [2 marks]
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