



GARISSA UNIVERSITY

UNIVERSITY EXAMINATION **2017/2018** ACADEMIC YEAR **TWO**
FIRST SEMESTER EXAMINATION

SCHOOL OF EDUCATION, ARTS AND SOCIAL SCIENCES

FOR THE DEGREE OF BACHELOR OF EDUCATION (ARTS)

COURSE CODE: CHE 210

COURSE TITLE: ATOMIC STRUCTURE AND BONDING

EXAMINATION DURATION: 3 HOURS

DATE: 13/12/17

TIME: 09.00-12.00 PM

INSTRUCTION TO CANDIDATES

- The examination has SIX (6) questions
- Question ONE (1) is COMPULSORY
- Choose any other THREE (3) questions from the remaining FIVE (5) questions
- Use sketch diagrams to illustrate your answer whenever necessary
- Do not carry mobile phones or any other written materials in examination room
- Do not write on this paper

This paper consists of FOUR (4) printed pages

please turn over



QUESTION ONE (COMPULSORY)

(a) What are the main postulates of Valence Shell Electron Pair Repulsion theory [8 marks]

(b) Write the SPDF Shorthand formation electronic configuration of the following elements/atoms/ions

Cr=24, Fe=26, Cl=17, Ar=18, Mg=12, Ba=56 [6 marks]

i. Cr

ii. Fe

iii. Cl⁻

iv. Ar

v. Mg²⁺

vi. Ba

(c) State the main postulates of Dalton atomic theory [3 marks]

(d) What is meant by hybridisation of atomic orbitals? Describe the shapes of Sp, Sp², Sp³ hybrid orbitals. [6 marks]

(e) Define Hydrogen bond, compare Hydrogen bond with van der Waals forces [2 marks]

QUESTION TWO

(a) What do you understand by bond pairs and lone pairs of electrons? Illustrate by giving one example of each type. [3 marks]

(b) State the Valence bond theory and molecular orbital theory [3 marks]

(c) What is meant by the term first ionization energy of an atom [2 marks]

(d) Describe the trend of the following properties across a period and down a group in the periodic table of elements(4 marks)

(e) Effective nuclear charge (Z*)

(f) Ionization Energy

(g) State what each of the following rules that govern electron configurations states

i. Aufbau Principle [1 mark]

ii. Pauli Exclusion Principle [1 mark]

iii. Hund's Rule [1 mark]



QUESTION THREE

- (a) What are the postulates of Bohr atomic Theory? state the difference between his theory and Quantum Mechanical Atomic model theory **[4 marks]**
- (b) Using orbital Box Notation write the electron configuration of the following species (0=8, Br=35, Zn=30, Cs=55, Hg=80, Xe=54, Pb=82) **[7 marks]**
- O^{2-}
 - Br
 - Zn^{2+}
 - Cs^+
 - Hg^{2+}
 - Xe
 - Pb
- (c) Why are anions always larger than the corresponding atoms? **[2 marks]**
- (d) Why are cations always smaller than the corresponding atoms? **[2 marks]**

QUESTION FOUR

- (a) A sample of iron from a meteorite was found to contain the isotopes ^{54}Fe , ^{56}Fe and ^{57}Fe . The relative abundances of the isotopes in this sample of iron were found to be 5.8 %, 91.6 %, 2.6 %. Calculate the relative atomic mass of iron in this sample **[3 marks]**
- (b) Draw the Lewis structures for the following molecules and ions : **[8 marks]**
- H_2S ,
 - $SiCl_4$,
 - BeF_2 ,
 - CO_3^{2-}
- (c) What is resonance structure and illustrate with an example **[4 marks]**

QUESTION FIVE

- (a) Define lattice energy, ionization energy, and electron affinity. State Hess's law states **[5 marks]**
- (b) Calculate the lattice energy of $MgCl_2(s)$ using the following given values **[7 marks]**

$$\Delta H_{at}Mg = +147.7 \text{ kJ mol}^{-1}$$

$$\Delta H_{at}Cl = +121.7 \text{ kJ mol}^{-1}$$

$$\Delta H_{IE 1} Mg = + 738 \text{ kJ mol}^{-1}$$

$$\Delta H_{IE 2} Mg = + 1451 \text{ kJ mol}^{-1}$$

$$\Delta H_{Ea1} Cl = -348.8 \text{ kJ mol}^{-1}$$

$$\Delta H_{f}MgCl_2 = -641.3 \text{ kJ mol}^{-1}$$



(c) Explain the trends of Lattice energy enthalpies according to the following factors

- i. The size of the ions **[1.5 marks]**
- ii. The charge on the ion **[1.5 marks]**

QUESTION SIX

(a) State three main fajan rules of Polarizability in predicting whether a chemical bond is expected to be predominantly ionic or covalent **[3 marks]**

(b) Why is the second ionization energy of sodium much greater than the first **[2 marks]**

(c) Use VSEPR theory to predict the shape of the following molecules. (Central atom listed first).

Give the name of the molecular shape

- i. SO_4^{2-} ion **[5 marks]**
- ii. BrF_5 **[5 marks]**

