



MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS
2023/2024 ACADEMIC YEAR
FIRST YEAR, SECOND SEMESTER

SCHOOL OF PURE APPLIED AND HEALTH SCIENCES
BACHELOR OF SCIENCE CHEMISTRY AND BED
SCIENCE
END-OF-SEMESTER EXAMINATION

COURSE CODE: CHE 1207-1

COURSE TITLE: ADVANCED CHEMICAL BONDING

DATE: 21/5/24

TIME: 1100-1300HRS

INSTRUCTIONS TO CANDIDATES

1. Answer **all questions** in **section A** and **two questions** in **section B**
2. Do not write on the question paper
3. Use of mobile phones in the exam room is prohibited
4. **Constants:** Avogadro's number = 6.022×10^{23} , Electronic charge = $1.602 \times 10^{-19}\text{C}$, Permittivity of medium = $8.854 \times 10^{-12}\text{C}^2\text{m}^{-1}\text{J}^{-1}$

Section A: Answer all questions
Question one

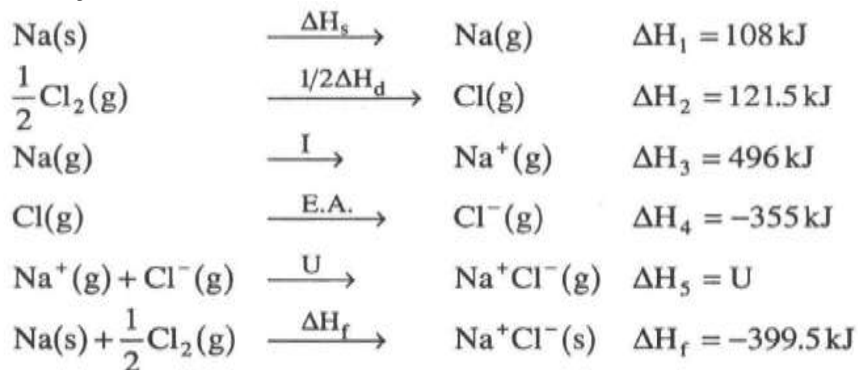
- a. Define the following terms. **4 marks**
- i. Hybridization.
 - ii. Bond order
 - iii. Bond length
 - iv. Electronegativity
- b. Write the resonance structure of; **3 marks**
- i. CO_3^{2-}
 - ii. SO_3
 - iii. NO_2
- c. The octet rule states that atoms share electron pairs until they have acquired an octet of valence electrons.
- i. Draw the Lewis structure of SO_4^{2-} ; **2 marks**
 - ii. Does S in SO_4^{2-} obey the octet rule? **1 mark**
 - iii. Calculate the formal charge of each atom in SF_6 **2 marks**
 - iv. Explain your answer in (ii) above. **3 marks**
- d. Calculation of lattice energy of NaCl using Born-Landé equation; $A=1.748$, $r_0 = 0.281 \text{ nm}$, $n=8$, N_A Avogadro's number (6.022×10^{23}), e^- Electronic charge ($1.602 \times 10^{-19} \text{ C}$), ϵ_0 - Permittivity ($8.854 \times 10^{-12} \text{ C}^2\text{m}^{-1}\text{J}^{-1}$). **5 marks**
- e. What do you understand by bond pairs and lone pairs of electrons? Illustrate by giving one example of each type. **2 marks**
- f. Although geometries of NH_3 and H_2O molecules are distorted tetrahedral, the bond angle in water is less than that of ammonia. Discuss. **2 marks**
- g. Both CO_2 and H_2O are triatomic molecules, although the shape of H_2O molecule is bent while that of CO_2 is linear. Explain this based on the dipole moment. Hint dipole moment of $\text{CO}_2=0\text{D}$ while $\text{H}_2\text{O}=1.84\text{D}$. **4 marks**
- h. Discuss the essential conditions for the overlap of atomic orbitals. **2 marks**

SECTION B, Answer Any two questions

Question 2

- a. Discuss the mechanism of chemical bond formation. **3 marks.**

- b. Given the information below, answer the following with regards to the Born-Haber cycle



- Draw a diagram and explain five enthalpy change steps equivalent to the direct formation of NaCl. **3 marks**
- Calculate the lattice energy for the formation of NaCl. **2 marks**
- List the factors that affect the magnitude of the lattice energy in solids. **2 marks**

Question 3

- Draw the molecular energy diagram of O_2 , O_2^- and O_2^+ . **6 marks**
 - Write the electron configuration in terms of bonding and anti-bonding molecular orbitals. **1.5 marks**
 - calculate the bond order of O_2 , O_2^- and O_2^+ . **1.5 marks**
 - Indicate the magnetic properties of O_2 , O_2^- and O_2^+ . **1 mark**

Question 4

- Explain five limitations of the Valency Bond Theory. **5 marks**
- Differentiate between bonding molecular orbitals and antibonding molecular orbitals. **3 marks**
- Explain two factors that favor the formation of ionic bonds. **2mks**

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