Mohamed Khider Uinversity **Department Of Agronomy**
Faculty Of Exct Sciences And Natural **First Year State Engineering**

Chemistry exam

Exercise 1:

Part 1:

1- Write the electronic configuration in terms of the noble gas notation for:
- Magnesium (Mg), atomic number (12).
- Zinc (Zn), atomic number (30).

2- For each element, determine:
- The number of valence electrons.
- The position in the periodic table (period and group).

3- Explain the significance of the four quantum numbers (n, l, m, s) and specify their values for the last electron in magnesium and zinc.

4- Predict the most stable ion of magnesium and zinc, justifies your answer based on the electronic configuration.

Part 2:

1- Draw the Lewis structure for the ammonia molecule (NH_3), where N (Z = 7) and H (Z
2- Determine the type of bonds in the molecule (covalent or ionic) based on the electronegativities of nitrogen and hydrogen.
Data:
- Electronegativity of nitrogen: 3.04.
- Electronegativity of hydrogen: 2.2.

3- According to Gillespie's rule (AXnEm), determine:
- The values of n and m for NH_3.
- The type of hybridization of the central atom in NH_3.

Exercise 2:

A 10 mL solution of hydrochloric acid (HCl) with a concentration of 0.1 mol/L is diluted to a volume of 100 mL.

1. Calculate the new concentration of the solution after dilution.
2. Write the dissociation equation in water. Specify the type of dissociation (partial or complete).
3. Write the following equations:

   - Conservation of mass.
   - Charge neutrality.
   - Ionic product of water.
4. Calculate the pH of the solution, explaining the approximations applied.

Exercise 3:

Part 1: Isobaric transformation (constant pressure)
An ideal gas expands from a volume V_1 = 2.0 L to a volume V_2 = 5.0 L, under constant pressure P = 1.0 atm.

Calculate the work (W) done by the gas in joules.

Part 2: Isochoric transformation (constant volume)
If heat Q = 500 J is transferred to a closed system at constant volume, calculate the change in internal energy (ΔU) in joules.

Part 3: Isothermal transformation (constant temperature)
A gas contains n = 1.0 mol at a temperature T = 300 K.

1. Calculate the work done in joules during the expansion of the gas to double its volume ($V_2 = 2V_1$).

$$R = 0.082 \frac{latm}{molk}$$

$$R = 8.31 j/molk$$