

Understanding Normality, Molarity, and Molality

1. Molarity (M)

Definition:

Molarity is the number of **moles of solute** dissolved per **liter of solution**.

Formula:

Molarity (M) = $\frac{\text{Moles of solute}}{\text{Volume of solution in liters}}$

Applications of Molarity:

- Used in **chemical reactions** to calculate how much reagent is needed.
- Important in **pharmaceutical calculations** for dosage and formulation.
- Used in **titration** to determine the unknown concentration of a solution.

Example Problem:

Q: Calculate the molarity of a solution prepared by dissolving 10 g of NaCl (Molar mass = 58.5 g/mol) in 500 mL of solution.

A:

Moles of NaCl = $10 / 58.5 = 0.1709 \text{ mol}$

Volume = 500 mL = 0.5 L

Molarity (M) = $0.1709 / 0.5 = 0.3418 \text{ M}$

2. Molality (m)

Definition:

Molality is the number of **moles of solute** per **kilogram of solvent**.

Formula:

Molality (m) = $\frac{\text{Moles of solute}}{\text{Mass of solvent in kg}}$

Applications of Molality:

- Used when temperature varies, because **molality is not temperature dependent**.
- Important in determining **colligative properties** such as boiling point elevation and freezing point depression.

- Preferred in **thermodynamic studies** of solutions.

Example Problem:

Q: Calculate the molality of a solution made by dissolving 15 g of KCl (Molar mass = 74.5 g/mol) in 200 g of water.

A:

Moles of KCl = $15 / 74.5 = 0.2013 \text{ mol}$

Mass of water = 200 g = 0.2 kg

Molality (m) = $0.2013 / 0.2 = 1.0065 \text{ m}$

3. Normality (N)

Definition:

Normality is the number of **gram equivalents** of solute per **liter of solution**.

Formula:

Normality (N) = $\frac{\text{Weight of solute (g)} \times n\text{-factor}}{\text{Equivalent weight} \times \text{Volume in liters}}$

Applications of Normality:

- Commonly used in **acid-base titrations** and **redox reactions**.
- Used to express concentrations of **ionic species** in solutions.
- Helpful in calculating **equivalent points** in titration.

Example Problem:

Q: Calculate the normality of a solution containing 49 g of H_2SO_4 (equivalent weight = 49 g/eq, n-factor = 2) in 1 liter of solution.

A:

Normality (N) = $(49 \times 2) / (49 \times 1) = 2 \text{ N}$

4. Comparison Table

Property	Molarity (M)	Molality (m)	Normality (N)
Unit	mol/L	mol/kg	eq/L
Based on	Volume of solution	Mass of solvent	Equivalent of solute
Affected by Temperature	Yes	No	Yes

Property	Molarity (M)	Molality (m)	Normality (N)
Use	General lab use	Accurate experiments	Titration, Reactions

5. Summary of Applications in Pharmacy

- **Molarity:** Common in drug concentration, dilution, and preparation of IV fluids.
- **Molality:** Preferred for temperature-dependent studies like stability testing.
- **Normality:** Critical for titrations in quality control labs and standardizations.
- Accurate understanding helps ensure **patient safety**, **drug efficacy**, and **compliance** with regulatory standards.