Molecular Biology Laboratory

Lab 3: Preparation of Buffers and Solutions

Buffer: is a solution that resists significant changes in pH when an acid or base is added. It typically contains a weak acid and its conjugate base (or a weak base and its conjugate acid) in substantial concentrations. The components of the buffer react with added H+ or OH- ions, converting them into weak acids or bases, which then maintain a stable pH for biological systems and chemical processes.

Buffers are solutions that contain mixtures of weak acids and bases that make them relatively resistant to pH change

1- **Molecular Weight**: is simply the weight of all the atoms in a substance. A molecule is a stable group of two or more atoms and is electrically neutral.

Example: How do you calculate the molecular weight of H_2O?

M. wt = 1×2 + 1×16

= 18 grams/mole

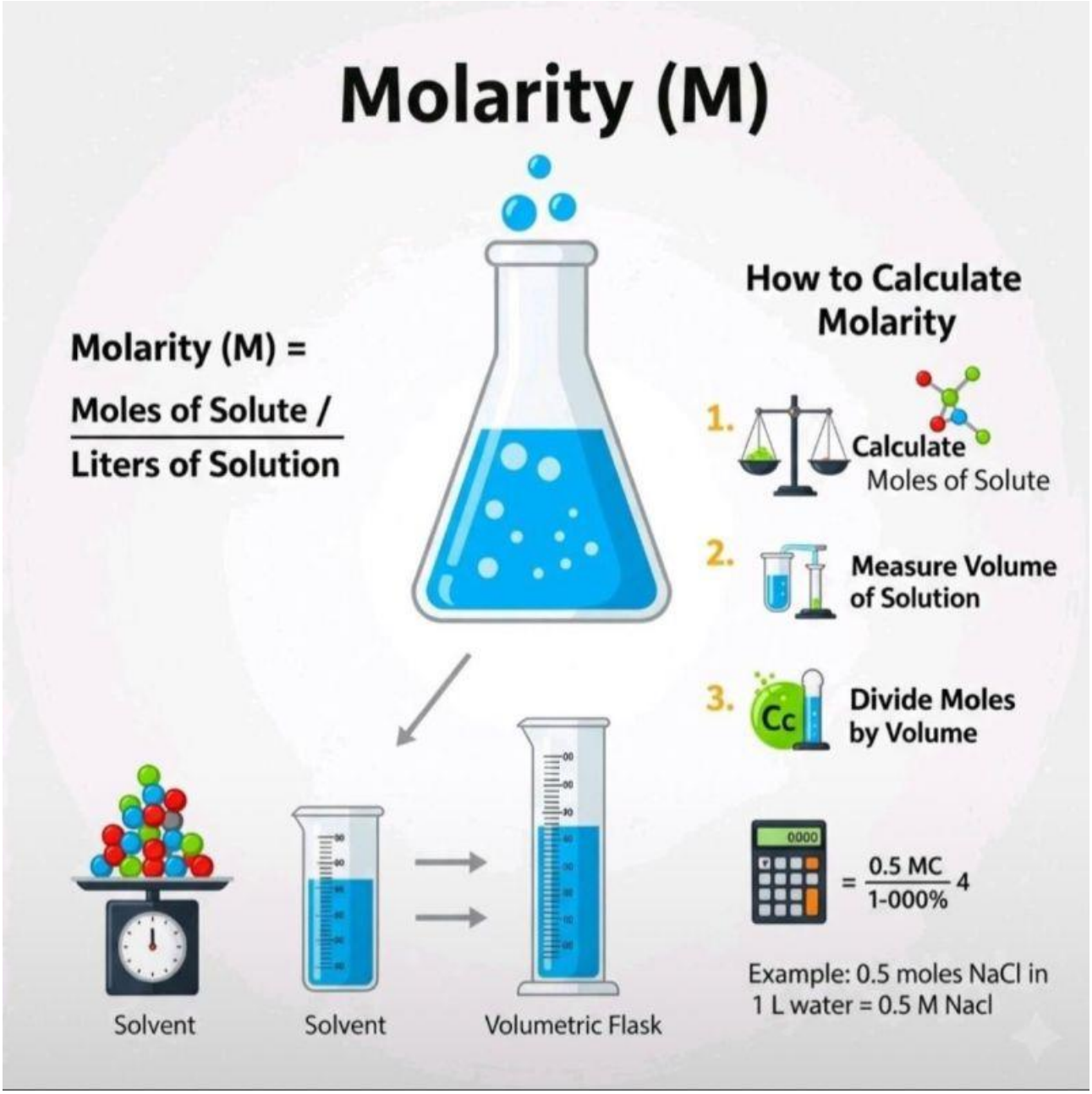
What is the molecular weight of octane, C_8H_{10}?
Answers: The molar mass of octane is just 8 times the mass of carbon plus 10 times the mass of hydrogen:
(8 × 12.01) + (10 × 1.01) = **106.18 grams/mole**.

$$\textbf{Moles} = \frac{\textbf{weight}}{\textbf{molecular weight}}$$

2- **Molarity(M):** is defined as the number of moles of solute per liter of solution.

$$M = \frac{Wt}{M.Wt} \times \frac{1000}{V} \quad \text{OR} \quad \text{Molarity} = \frac{\text{moles of solute}}{\text{liters of solution}}$$

- It is a volumetric measurement expressed as mol/L? Because it depends on the solution volume, molarity can change with temperature and pressure since volume expands or contracts.
- Molarity is affected by temperature because volume changes.
- Units of Molarity in mol/L.



Example: Determine the molarity when 3.0 moles of sucrose are dissolved to make 2.0 liters of solution.

$$\frac{3.0 \text{ mol}}{2.0 \text{ liters}} = \text{X} = 1.5 \text{ M}$$

Example: Attended solution a 0.2M of sodium chloride (NaCl) and the volume of 500mL, note that the molecular weight 58.5 for salt???

$$\text{M}=\frac{Wt}{M.Wt} \times \frac{1000}{V}$$

$$0.2=\frac{Wt}{58.5} \times \frac{1000}{500} \longrightarrow \text{Wt= 5.85 gm}$$

Example: If you have 10.0 grams of NaCl, table salt, and dissolve it in 500 ml of water, what is the Molarity of the solution?

First, work out the number of moles of salt. NaCl has a molecular weight of 58.43 g/mole, so we have

10.0 g/58.43 g/mole = 0.171 moles of NaCl

Next, convert the volume to liters, since it is in milliliters

500 ml * 1 liter/1000 ml = 0.500 liter

Now simply use the equation above

molarity (*M*) = moles solute/liters of solution

M* = 0.171 moles/0.500 L = 0.342 *M

3- **Normality**: is the gram equivalent weight of a solute per liter of solution. It may also be called the equivalent concentration.

$$\text{N}=\frac{Wt}{Eq.Wt} \times \frac{1000}{V}$$

***** Equivalent Weight of acid:**

$$\text{Eq.Wt of acid}=\frac{\text{M.wt of acid}}{\text{No.of H2 group}}$$

***** Equivalent Weight of base**

Eq.Wt of base= $\frac{\text{M.wt of base}}{\text{No.of OH group}}$

Example: Attended a solution of Mg $(OH)_2$ with Normality 0.2N and the volume of 200mL note that weight Molecular = 58**.**

$$N=\frac{Wt}{Eq.Wt}\times\frac{1000}{V} \longrightarrow 0.2=\frac{Wt}{58/2}\times\frac{1000}{200}$$

Wt=1.16gm

There is a very simple relationship between normality and molarity:

Relation between Normality and Molarity

Here is Normality formula in terms of molarity

$$Normality = n \times Molarity$$

where,
n = number of H^+ in Acid ,
OH^- in base and for salt,
charge present in ionic forms

Difference Between Normality and Molarity

Molarity	Normality
number of moles of solute per liter of solution.	number of gram equivalent of solute per liter of solution.
Molarity is a measurement of the Moles in the total volume of the solution,	Normality is a measurement of the gram equivalent in relationship to the total volume of the solution.
Unit is $Moles\,L^{-1}$	Unit is $eq\,L^{-1}$

When the point of equality, the number of equivalent weights affair for the first solution is equal to the number of equivalent weights affair for the second solution, in other words:

$M_1V_1=M_2V_2$
$N_1V_1=N_2V_2$
$C_1V_1=C_2V_2$

Percentages:

1- $W/W=\frac{\text{Wt of solute}}{\text{Wt of solution}}\times 100$

Example: Solution consists of dissolving 10 grams of sodium hydroxide per 100 grams of water. Calculate the percentage of sodium hydroxide? Block solution **10+100=110grams.**

$$W/W = \frac{10}{110}\times 100$$

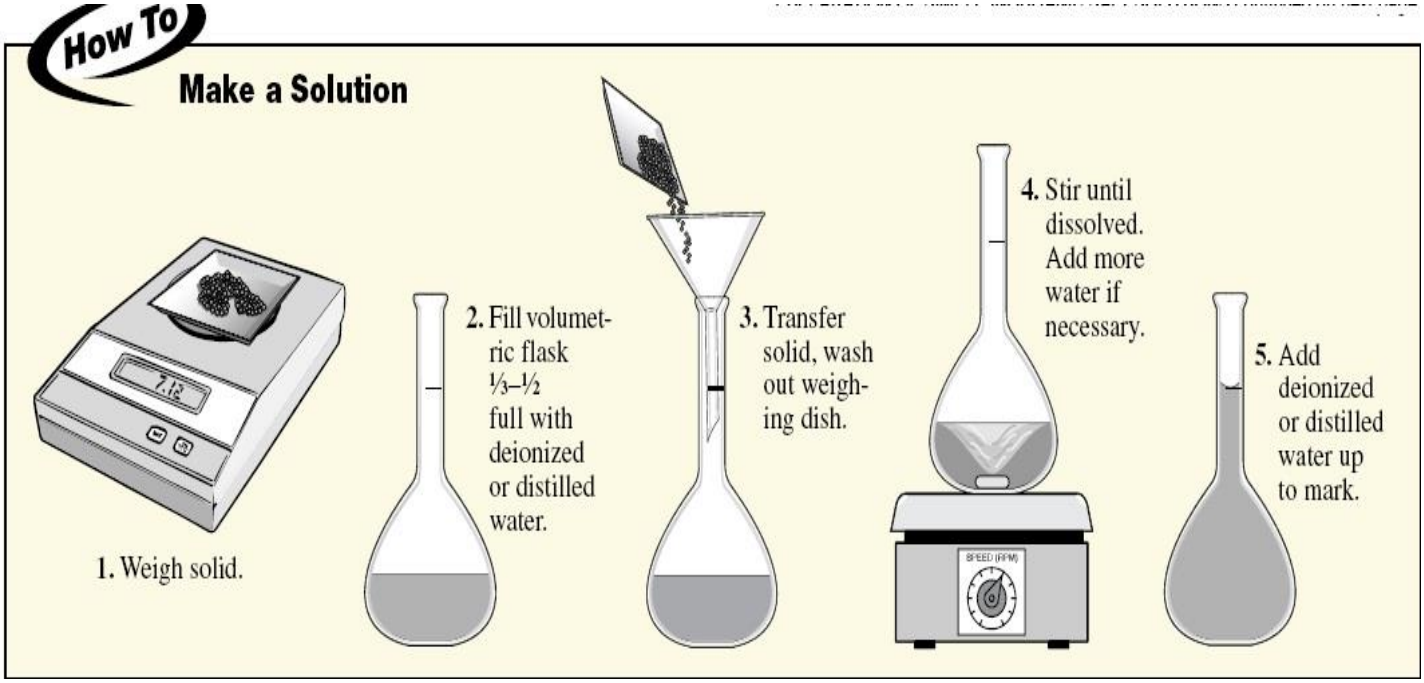
$$W/W = 9.1\ \%$$

2- $Wt/V(\%)=\frac{\text{Wt.of solute}}{\text{Volum of solvent}}\times 100$

For example, when it is said that a solution of sugar in water concentration $10\%\ (w/v)$. This means that 10 gm of sugar dissolved in 100mL of water

3- $V/V=\frac{\text{Volum of solute}}{\text{volum of solution}}\times 100$

For example, when it is said that a certain solution consists of alcohol and water and the concentration of alcohol 40%(v/v), this means that in every 100mL of solution is that there is alcohol 40mL and 60mL water.



Home Work:

* How many uL of 1 M Tris-HCl pH 8.0 would you use to make 5 mL at 50 mM?

1- Prepare (250mL) of a solution consists of (2% Triton X-100), (2M EDTA), (30mM) Tris-HCL. Adjust pH to (8). M. Wt. of EDTA = 372, stock solution of Tris-HCL= (4M)

2- Prepare (250mL) of a solution consists of (5% glucose), (5M EDTA), (30mM) Tris-HCL. Adjust pH to (8). M. Wt. of Tris-HCL = 121, stock solution of EDTA = (7M) .