Molarity

- A method of expressing the concentration of a solution

$$Molarity = \frac{moles\ of\ solute}{volume\ (L\ or\ dm^3)\ of\ solution}$$

$$C = \frac{n}{V}$$

$$C = concentration\ (molarity)$$

$$n = number\ of\ moles$$

$$V = volume\ (L\ or\ dm^3)$$

Example: Determine the molarity of a solution that contains 25.0 g of sodium hydroxide in 300.0 mL of solution.

$$mol = \frac{mass}{molar\ mass} = \frac{25.0\ g\ NaOH}{39.99711\ g/mol} = 0.625\ mol$$

$$C = \frac{n}{V} = \frac{0.625\ mol}{0.3000\ L} = 2.08\ mol/L$$

Dilutions

The concentration of a solution is always decreased by the addition of more solvent (water).

Moles of solute before = Moles of solute after

$N_1 = N_2$

$$\boldsymbol{C_1V_1 = C_2V_2}$$

Example: How would you prepare 2.00 L of 0.100 M hydrochloric acid solution if the only solution you have available is 12.0 M hydrochloric acid?

Solution:

C_1 = 0.100 mol/L
V_1 = 2.00 L
C_2 = 12.0 mol/L
V_2 = ?

$$C_1V_1 = C_2V_2$$

$$V_2 = \frac{C_1V_1}{C_2} = \frac{(0.100 mol/L)(2.00 L)}{12.0 mol/L} = 0.0167 \ L \ or \ 16.7 \ mL$$

You would prepare the solution by dissolving 16.7 mL of 12.0 M HCl in enough water to make 2.00 L of solution.

Mixing Solutions

When two solutions are mixed, the concentration of the resulting solution is a value between the concentrations of the two original solutions.

$$C = \frac{n}{V}$$

$$C = \frac{total\ moles}{total\ volume}$$

$$C_{ab} = \frac{C_a V_a + C_b V_b}{V_a + V_b}$$

Mixing Solutions

Example: Determine the concentration of the solution that results when 200.0 mL of 0.100 mol/L sodium hydroxide is mixed with 700.0 mL of 3.00 mol/L sodium hydroxide.

Solution:

Solution A
C_a = 0.100 mol/L
V_a = 0.2000 L

Solution B
C_b = 3.00 mol/L
V_b = 0.7000 L

Moles of A
=(0.100 mol/L)(0.2000 L)
= 0.0200 mol

Moles of B
= (3.00 mol/L)(0.7000 L)
= 2.10 mol

$$C = \frac{total\ moles}{total\ volume} = \frac{0.0200\ mol + 2.10\ mol}{0.2000\ L + 0.7000\ L} = \frac{2.12\ mol}{0.9000\ L} = 2.36\ mol/L$$

or

$$C_{ab} = \frac{C_a V_a + C_b V_b}{V_a + V_b}$$

$$C_{ab} = \frac{(0.100\ mol/L)(0.2000\ L) + (3.00\ mol/L)(0.7000\ L)}{0.2000\ L + 0.7000\ L}$$

$$C_{ab} = \frac{0.0200\ mol + 2.10\ mol}{0.9000\ L}$$

$$C_{ab} = \frac{2.12\ mol}{0.9000\ L} = 2.36\ mol/L$$