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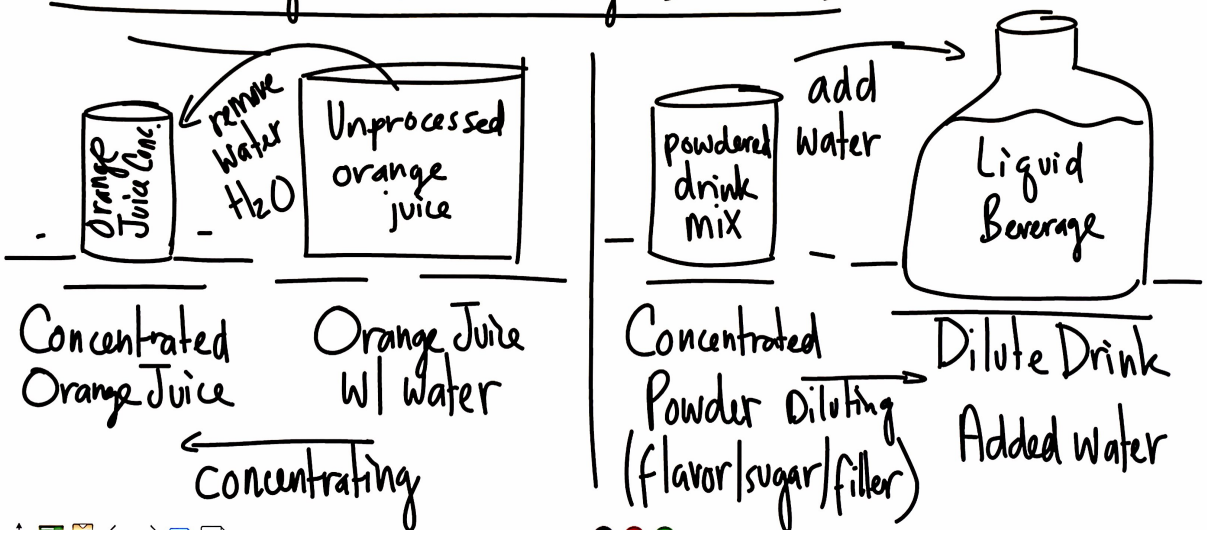
Concentrating and Diluting Solutions



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Dilution Process

Dilution: Add solvent (large part) to lower the concentration of solute (small part) in the solution.

Most common: Add more solvent

Dilution

V_{solute} ↑

M_{soln} ↓

Concentration

V_{solute} ↓

M_{soln} ↑

Concentration Process

Concentration: Remove solvent OR add solute (OR both) to increase conc. of soln.

Most common: Add solute (Difficult to remove solvent)

Dilution Equations

Standard Equation

$$\underbrace{M_1 V_1}_{\text{start}} = \underbrace{M_2 V_2}_{\text{final (after)}}$$

M_1 = start conc. M_2 = end conc.

V_1 = start volume V_2 = end volume

Start

M_1: $M_1 = \dfrac{M_2 V_2}{V_1}$

V_1: $V_1 = \dfrac{M_2 V_2}{M_1}$

Final

M_2: $M_2 = \dfrac{M_1 V_1}{V_2}$

V_2: $V_2 = \dfrac{M_1 V_1}{M_2}$

Start $M_1 = 2.50\text{M}$ (mol/L)

$V_1 = 0.70\text{L}$

Final $M_2 = \_\_\_\_\text{M}$

$V_2 = 1.30\text{L}$

(2.50M) M_1 dec. → M_2 (1.35M)

(0.70L) V_1 Inc. → V_2 (1.30L)

Dilution

$M_1 V_1 = M_2 V_2$

$M_2 = \dfrac{M_1 V_1}{V_2}$

$M_2 = \dfrac{2.50\frac{\text{mol}}{\text{L}} \cdot 0.70\text{L}}{1.30\text{L}}$

$M_2 = \dfrac{1.75\text{mol}}{1.30\text{L}} = \dfrac{1.35\text{mol/L}}{1.35\text{M "molar"}}$

Start $M_1 = 0.50M$, $V_1 = \_\_\_\_ L$

Final $M_2 = 1.75M$, $V_2 = 0.70L$

(0.50M) M_1 Inc. → M_2 (1.75M)

(2.46 L) V_1 dec. → V_2 (0.70L)

Concentration

$M_1V_1 = M_2V_2$

$V_1 = \frac{M_2V_2}{M_1}$

$V_1 = \frac{1.75\ mol/L \cdot 0.70L}{0.50\ mol/L}$

$V_1 = \frac{1.23\ mol}{0.50\ mol/L} = 2.46\ \frac{1}{1/L}$

$= 2.46\ L$

Molarity Equations

$Molarity = \frac{mol_{solute}}{V_{soln}}$

$mol_{solute} = Molarity \cdot V_{soln}$

$V_{soln} = \frac{mol\ solute}{Molarity}$

$M = mol/L$ $V_{soln} = L$ $mol_{solute} = mol$

Mass and Mol Conversions

Mass → Mol

$\_\_\_\_ g \left| \frac{1\ mol}{(MM)\ g} \right. = \_\_\_\_ mol$

Mol → Mass

$\_\_\_\_ mol \left| \frac{(MM)\ g}{1\ mol} \right. = \_\_\_\_ g$