

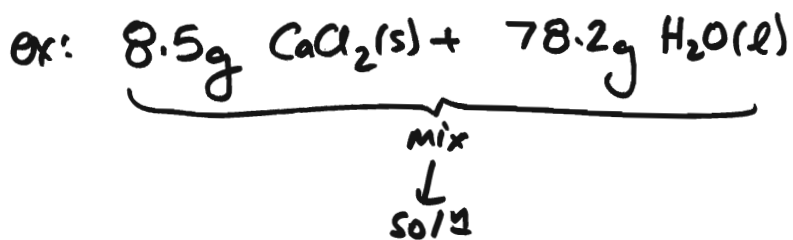
Concentration Units

Quantitative measures:

3 common units —

- (1) Percent by mass, % (w/w)
- (2) Molarity, $\frac{\text{mol}}{\text{L}}$ or M
- (3) Molality, $\frac{\text{mol}}{\text{kg}}$ or m

i) % by mass = $\frac{\text{mass of solute}}{\text{mass of soln}} \times 100$



$$\% \text{ by mass} = \frac{8.5\text{g}}{8.5\text{g} + 78.2\text{g}} \times 100 = 9.8\% (\text{w/w})$$

sol = solute + solvent

Q. How many mol of H_2SO_4 in 85.0g of a 37.1% (w/w) aqueous soln?

$\frac{37.1\text{g H}_2\text{SO}_4}{100\text{g solution}}$

$$85.0\text{g soln} \times \frac{37.1\text{g H}_2\text{SO}_4}{100\text{g soln}} \times \frac{1\text{mol H}_2\text{SO}_4}{98.09\text{g H}_2\text{SO}_4} = 0.321\text{mol H}_2\text{SO}_4$$

2. Molarity. (Molar conc)

$$= \frac{\# \text{mol solute}}{\# \text{L of soln}}$$

ex: 0.31mol HCl in 0.72L soln

$$\text{molar conc of HCl} = [\text{HCl}] = \frac{0.31\text{mol HCl}}{0.72\text{L}}$$

$$\Rightarrow [HCl] = 0.43 \frac{\text{mol}}{\text{L}} HCl$$

$$= 0.43 M HCl$$

→ conv. factor!! $\frac{0.43 \text{ mol HCl}}{1 \text{ L}}$

ex: 3.20 mL of a 0.120 M soln contains 0.054 g of an unknown substance.

Q. What's the molar mass of this substance?

$$M = \frac{\#g}{\#mol}$$

$$\frac{3.20 \text{ mL}}{1000 \text{ mL}} \times \frac{0.120 \text{ mol}}{1 \text{ L}} = 3.84 \times 10^{-4} \text{ mol}$$

$$M = \frac{0.054 \text{ g}}{3.84 \times 10^{-4} \text{ mol}} = 141 \text{ g/mol}$$

3. Molality, or molal conc.

$$= \frac{\# \text{ mol solute}}{\text{Kg of solvent}} \quad \text{units: } \frac{\text{mol}}{\text{kg}} \text{ or } m$$

% (w/w)	M	m
$\frac{\text{g solute}}{\text{g soln}} \times 100$	$\frac{\# \text{ mol solute}}{\# \text{ L soln}}$ ↑ changes w/ T	$\frac{\# \text{ mol solute}}{\# \text{ Kg solvent}}$
T-independent	is T-dependent - 1 M soln, say, will change conc as T-change!	T-independent. ***

ex: 950g H₂O + 25g NaCl.

Q. What's % (w/w) + molal conc?

$$\% (w/w) = \frac{25 \text{ g}}{950 \text{ g} + 25 \text{ g}} \times 100 = 2.6\% (w/w)$$

$$\text{Molal conc} = \frac{\# \text{mol NaCl} \leftarrow ? \text{ 25g}}{\# \text{kg H}_2\text{O}}$$

0.95kg

$$\frac{25\text{g NaCl}}{58.44\text{g NaCl}} \cdot \frac{1\text{mol NaCl}}{1\text{mol NaCl}} = 0.427789... \text{ mol NaCl}$$

$$= 0.428 \text{ mol NaCl} \quad \checkmark \text{ Guard digit.}$$

$$\text{molal conc} = \frac{0.428 \text{ mol}}{0.95 \text{ kg}} = 0.45 \text{ m}$$

Converting
conc. units.

% (w/w) $\xleftrightarrow{d = \frac{m}{V}}$ molarity

molal conc

masses.

volume.

ex: convert 5.42M $\text{NaHCO}_3(\text{aq})$
w/ a $d = 1.19\text{g/mL}$ to molal conc!

MOU↑

WED↓