UNITS OF CONCENTRATION

CHEM 251 SDSU

CONCENTRATION

- In analytical chemistry we are generally working with solutions and trying to quantify the amount of each solute in the solution.
- As such we need to express the amount of the solute in the solution (the concentration of the solute) when we describe the solution.
- There are a variety of units of concentration that we can use to express solute concentrations. The choice of units will depend on the specific situation/solution.
- With proper conversions, concentrations can be expressed in any of the ways that we will see shortly.

- It is important to recognize wether or not the denominator is the **solvent** or the **solution**.
- Conversions from mass to volume based concentrations can be done by using the solution density.
- For very dilute solutions (e.g. 10 ppm) the density of the solution can be approximated with the density of the solvent.
- Some assumptions may need to be made about the changes in volume upon mixing when they are not experimentally measured.

Table 2.4 Common Units for Reporting Concentration

Name	Units	Symbol
molarity	$\frac{\text{moles solute}}{\text{liters solution}}$	M
formality	$\frac{\text{moles solute}}{\text{liters solution}}$	F
normality	$\frac{\text{equivalents solute}}{\text{liters solution}}$	N
molality	$\frac{\text{moles solute}}{\text{kilograms solvent}}$	m
weight percent	$\frac{\text{grams solute}}{\text{100 grams solution}}$	% w/w
volume percent	$\frac{\text{mL solute}}{\text{100 mL solution}}$	% v/v
weight-to-volume percent	$\frac{\text{grams solute}}{\text{100 mL solution}}$	% w/v
parts per million	$\frac{\text{grams solute}}{10^6 \text{ grams solution}}$	ppm
parts per billion	$\frac{\text{grams solute}}{10^9 \text{ grams solution}}$	ppb

WEIGHT PERCENT CALCULATIONS

- A simpler approach to weight percent calculations is to simply do the ratio of the mass of the solute and solution then multiply by the respective factor.

$$\%\,{}^{w}\!/_{w} = \frac{x\ \ grams\ \ solute}{y\ \ grams\ \ solution} \times 100$$

$$ppm = \frac{x\ \ grams\ \ solute}{y\ \ grams\ \ solution} \times 10^{6}$$

$$ppb = \frac{x\ \ grams\ \ solute}{y\ \ grams\ \ solution} \times 10^{9}$$

P-FUNCTIONS

- p-Functions may seem a bit odd but you have already seen them, principally in the form of pH.
- The pH of a solution is a measure of the concentration of H^+ ions in a solution.
- Specifically the pH is measured in a log form, where:
  $pH = -\log[H^+]$ Remember: $[H^+]$ = mol/L of H^+
- Similar calculations can be made for any solute in solution, such as pNa, or pF which would be: **$pNa = -\log[Na^+]$ and $pF = -\log[F^-]$**

SAMPLE CALCULATIONS

- A solution is prepared by dissolving 25.0 mL of ethanol (d=0.784 g/mL) in 300. mL of water (d=0.999 g/mL) at 25°C.
- Determine the following:
  - The **molar** concentration of ethanol in water.
  - The **molal** concentration of ethanol in water.
  - The **ppt** concentration of ethanol in water.