A short guide to chapter 9, the chemistry of solutions

Some definitions first:

solution - a homogeneous mixture of two or more substances.

solute - the dissolved substance or the least abundant component in the solution.

solvent - the dissolving agent or the most abundant component in the solution.

solubility - the maximum amount of solute that will dissolve in a specified amount of solvent under stated conditions (temperature), in units of grams of solute per 100 grams of solvent, usually water.

miscible - capable of mixing to form a solution, generally liquid solute and liquid solvent

Properties of solutions:

1) homogeneous mixture
2) variable composition (concentration)
3) solute is molecular or ionic in size
4) transparent
5) uniform distribution of solute - no settling over time
6) solute separated by physical means; example, evaporation

What affects solubility?

1) Nature of solvent and solute (like dissolves like), intermolecular forces, compare salt and water vs. oil and water vs. ethanol and water
2) Temperature (energy) - Have you ever made rock candy (sugar crystals)?
3) Partial Pressure (greatest effect shown with dissolved gases) - Where’s the fizz come from in soda pop?

What affects the rate of dissolution?

1) Particle size (the smaller, the faster)
2) Temperature
3) Concentration (unsaturated, saturated, supersaturated)
4) Agitation (kinetic effect)

Units for Solutions:

Weight % (w/w) = \( \frac{\text{grams of solute}}{\text{grams of solute} + \text{grams of solvent}} \) X 100

= \( \frac{\text{grams of solute}}{\text{grams of solution}} \) X 100

Weight/Volume % (w/v) = \( \frac{\text{grams of solute}}{\text{milliliters of solution}} \) X 100
Volume % (v/v) = \( \frac{\text{volume of liquid solute}}{\text{volume of solution}} \times 100 \)

Molarity (M, mol/L) = \( \frac{\text{moles of solute}}{\text{liters of solution}} \)

Parts per million (ppm) = \( \frac{\text{part}}{\text{total parts}} \times 10^6 \)

the unit for the part and the total parts must be the same, so

ppm by mass = \( \frac{\text{mass of solute (g)}}{\text{mass of solution (g)}} \times 10^6 \)

ppm by volume = \( \frac{\text{volume of solute (mL)}}{\text{volume of solution (mL)}} \times 10^6 \)

A great test of your conversion skills is to determine the

weight %
ppm by mass
molarity

for a 75.0% (w/v) NaCl solution whose density is 1.21 g per mL of solution.

Dilution:

\[ M_1 V_1 = M_2 V_2 \]

What does this mean?

Moles of solute at beginning of dilution = Moles of solute at end of dilution

Electrolyte- any substance that dissolves in water to give a solution that conducts electricity