

Properties of Solutions Ch. 13 p. 395

Solute + Solvent = Solution
↓ ↓
s, l or g A substance that
that is dissolved that solute is
dissolved in
(usually water)

Effects of Solution Formation

1. Agitation
2. Temperature
3. Physical state of solute
(solid - powder dissolves quicker than crystal)

Solubility - S p. 402

Solvation (dissolving) = Desolvation (crystals)

- occurs when the solution is saturated

Saturated - more solute in solvent; (concentrated)

Unsaturated - Less solute in solvent; (dilute)

p. 404

$S = \frac{\text{g of solute}}{\text{100 g of solvent}}$ (at particular T) $\rightarrow 1 \text{ mL} = 1 \text{ g} = 1 \text{ cc} = 1 \text{ cm}^3$

Miscible



Liquids dissolve in each other

vs.

Immiscible



Liquids are insoluble in each other

Factors of Solubility - p. 408

For most substances (most s and l), solubility will increase as T increases. In some, however, the reverse occurs.

For gases, solubility decreases with an increase in T always.

Ex. CO₂ in soda

Henry's Law: Solubility of a liquid is directly proportional to the P of the gas above the liquid. (p.407)

*So as P decreases, so does S decreases.

$$\frac{S_1}{P_1} = \frac{S_2}{P_2}$$

T is constant
 S - g/L
 P - atm

Molarity - p. 412

- how dilute or concentrated a solution is

M = molarity (# of mol of solute dissolved in 1 L of solution)

M = mol of solute

$$\frac{\text{L of solution}}{\text{L of solution}} \times \text{g} \times \frac{1 \text{ mol}}{\text{gfm}}$$

0.4M NaCl (dilute)

1.0 M NaCl (conc.)

Make a solution containing 0.90 g NaCl per 100 mL of solution. What is its M?

$$M = \frac{\text{mol}}{\text{L}} \quad \downarrow \quad .100 \text{ L}$$

$$\frac{.90 \text{ g NaCl} \times 1 \text{ mol NaCl}}{58 \text{ g NaCl}} = .0155 \text{ mol}$$

Percent Solutions

- concentration of solute can be expressed as % solution by volume.

$$\% \text{ by volume (v/v)} = \frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100$$

If alcohol is diluted to 300 mL and we started with 200 mL, what is the % by volume of alcohol?

$$\% \text{ by volume} = \frac{200 \text{ mL}}{300 \text{ mL}} \times 100 = 67\% \quad (\text{alcohol by v/v})$$

To dissolve solids in liquids, we sometimes use % by mass (of solute) in a solution.

$$\% \text{ by mass/volume} = \frac{\text{mass(g)}}{\text{volume (mL usually 100 mL)}} \times 100$$

How many g of AgNO₃ do you need to prepare 3.0 L of 3.0 % AgNO₃ (m/v) solution?

$$\frac{3.0 \text{ g}}{100 \text{ mL}} \times \frac{1000 \text{ mL}}{1 \text{ L}} = 30 \text{ g/L (solubility)}$$

$$3.0 \text{ L} \times \frac{30 \text{ g}}{1 \text{ L}} = 90 \text{ g of AgNO}_3$$

Making Dilutions

moles of solute doesn't change when a solution is diluted.

$$M_1 \times V_1 = M_2 \times V_2 \quad (\text{V-units are L})$$

How would you prepare 600 L of 0.50 M magnesium nitrate from a stock solution of 3.0 M magnesium nitrate?

$$M_1 = 3.0$$

$$V_1 = ?$$

$$M_2 = .50$$

$$V_2 = 600 \text{ L}$$

$$(3.0)(V_1) = (.50)(600)$$

$$V = 100 \text{ L or } 1.0 \times 10^2 \text{ L}$$