Key

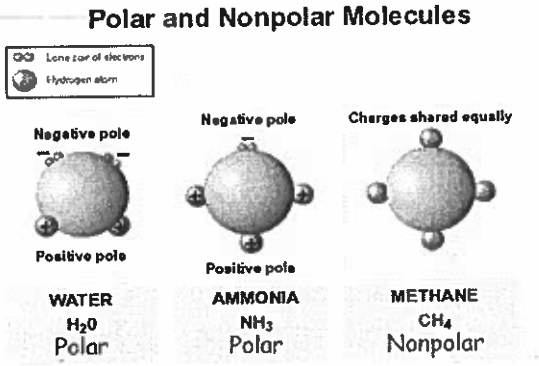
Solution Chemistry:

Polar Molecules:

- Asymmetrical shape
- Permanent dipoles (+ and – sides) exist due to uneven distribution of electrons
- Intermolecular dipole-dipole forces and hydrogen bonds (stronger dipole-dipole forces) are formed.

Non-Polar Molecules:

- Symmetrical shape
- No permanent dipoles
- Electrons are usually evenly distributed
- Only very weak intermolecular London forces due to temporarily unevenly distributed electrons



To do:
Read pg. 193 - 208
Pg. 201 #10
Pg. 208 #23, 25, 27

Types of Solvents:

- Polar Covalent – eg. Glycerine, water
- Non-polar covalent – eg. Paint thinner

Types of Solutes:

- Ionic (polar) – eg. Salt ($NaCl \rightarrow Na^+ + Cl^-$)
- Polar Covalent – ex. Sugar ($C_6H_{12}O_{11}$)
- Non-polar covalent – ex. Iodine(I_2)

"Like dissolves like"

- Polar or ionic solutes tend to dissolve in polar solvents
- Non-polar solutes tend to dissolve in nonpolar solvents

Nature of Solute and Solvent

Solute	Polar Solvent	Non-polar solvent
Polar	Soluble	Insoluble
Non-Polar	Insoluble	Soluble
Ionic	Soluble	Insoluble

Solution Chemistry Terms:
Soluble = dissolves
Insoluble (low solubility) = does not dissolve
miscible = two liquids that dissolve
immiscible = two liquids that do not dissolve (layer)

Why does like dissolve like?

- *Polar and ionic solutes* have relatively strong bonds (dipole-dipole forces, hydrogen bonds, or ionic bonds) holding the solid together and only *polar solvents* have sufficient attraction to the solute to be able to pull the solute out of a crystal and into solution

- *Non-polar solutes* require solvents with sufficient London forces to remove the solute from the solid crystal into solution; polar solvents tend to have small London forces while non-polar solvents tend to have large London forces.

Dissociation (ionization)

The separation of ions that occurs when an ionic compound dissolves in water.

Solute = ionic compound
Solvent = water

To do: Read pages 209-210
Do pg. 210 #28-29

Example: Sodium Phosphate dissolving in water

$$Na_3PO_{4(s)} \rightarrow 3\ Na^+_{(aq)} + PO_4^{3-}{}_{(aq)}$$

Concentration of Ions in Solution

1. What is the molar concentration of Aluminum and sulfate ions in a 0.40M solution of $Al_2(SO_4)_3$?

Step 1 – Write balanced dissociation equation

$Al_2(SO_4)_3 \rightarrow 2Al^{+3} + 3SO_4^{2-}$

Step 2 – Use mole ratio to find $[Al^{3+}]$

$0.40\ M \times \frac{2}{1} = 0.80\ M = [Al^{3+}]$

Step 3 – Use mole ratio to find $[SO_4^{2+}]$

$0.40\ M \times \frac{3}{1} = 1.2\ M = [SO_4^{2-}]$

2. What mass of $MgBr_{2(s)}$ must be added to make 1.50L of solution with $[Br^-] = 0.30M$?

24.3
35.5
35.5
95.3

Step 1 – write dissociation equation

$MgBr_2 \rightarrow Mg^{2+} + 2Br^-$

Step 2 – Find molarity of $MgBr_{2(s)}$

$0.30M \times \frac{1}{2} = 0.15M.\ MgBr_2$

Step 3 – Find moles

$n = cx\ V = 0.15\ M \times 1.50L = 0.23\ mol\ MgB$

Step 4 – Convert to grams

$0.23 mol\ MgBr_2 \times \frac{95.3g}{1\ mol} = 22g\ MgBr_2$

3. 50mL of $[Pb(NO_3)_2]$ = 0.10M and 40mL of $[Pb(CH_3COO)_2]$ = 0.20 M are combined. What are all final ion concentrations?

Step 1 – Use dilution formula to find the new $[Pb(NO_3)_2]$

$$C_{DIL} = \frac{0.10\,M \times 50\,mL}{90\,mL} = 0.056\,M.$$

Step 2 – Write the dissociation equation for $Pb(NO_3)_2$

$$Pb(NO_3)_2 \rightarrow Pb^{2+} + 2NO_3^-$$

Step 3 – Find the $[Pb^{2+}]$ and the $[NO_3^-]$ from diluted $[Pb(NO_3)_2]$

$[Pb^{2+}] = 0.056\,M$ $[NO_3^-] = 0.11\,M.$

Step 4 – Use the dilution formula to find the new $[Pb(CH_3COO)_2]$

$$C_{DIL} = \frac{0.20\,M \times 40\,mL}{90\,mL} = 0.089\,M.$$

Step 5 – Write the dissociation equation for $Pb(CH_3COO)_2$.

$$Pb(CH_3COO)_2 \rightarrow Pb^{2+} + 2CH_3COO^-$$

Step 6 - Find the $[Pd^{2+}]$ and the $[CH_3COO^-]$ from diluted $[Pb(CH_3COO)_2]$

$[Pb^{2+}] = 0.089M$ $[CH_3COO^-] = 0.18M$

To Do:
Read pages 211-210
pg. 212 #30 -32, 38

Step 6 – List all ion concentrations for your final answer. (add the two $[Pd^{2+}]$)

$[Pb^{2+}] = 0.056 + 0.089 = 0.15\,M$ $[NO_3^-] = 0.11M$ $[CH_3COO^-] = 0.18$

<u>Precipitation Reactions</u> – When two aqueous solutions are mixed to form a product with lower solubility (a solid precipitate).

Balanced **<u>formula equation</u>**:

$$Na_2SO_{4(aq)} + BaCl_{2(aq)} \rightarrow BaSO_{4(s)} + 2NaCl_{(aq)}$$

Balanced **<u>complete ionic equation</u>**:

$$2\,Na^+_{(aq)} + SO_4^{2-}{}_{(aq} + Ba^{2+}_{(aq)} + 2\,Cl^-_{(aq)} \rightarrow BaSO_{4(s)} + 2\,Na^+_{(aq)} + 2\,Cl^-_{(aq)}$$

Balanced **<u>net-ionic equation</u>**:

$$Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$$