Solutions

Solutions: Basic Definitions

- _____ – substance that is being dissolved
- _____– substance that dissolves the solute
- _____– a mixture of substances that has a uniform composition; a homogeneous mixture

Solutions: Basic Definitions

- _____– when a substance will dissolve in another substance (salt & water)
- _____– when a substance will not dissolve in another substance (sand & water)

Solutions: Basic Definitions

- _____ – when two liquids are soluble in each other (alcohol & water)
- _____ – when two liquids are not soluble in each other (oil & water)
- _____ – dissolved in water

Solutions: Basic Definitions

- _____ - If the amount of solute dissolved is less than the maximum that could be dissolved
- _____ - solution which holds the maximum amount of solute per amount of the solution under the given conditions
- _____ - solutions that contain more solute than the usual maximum amount and are unstable.

Solutions: Basic Definitions

- _____– mixture containing particles that will settle out is left undisturbed (cornstarch & water)
- _____– heterogeneous mixture that will not settle out if left alone (blood)
- _____– colloid in which a liquid is suspended in another liquid (mayo)

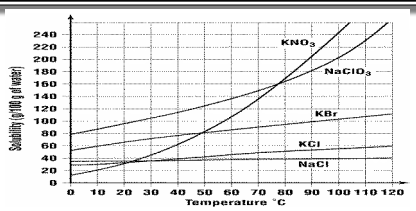
Solutions: Basic Definitions

- _____ – solution that conducts an electric current
- _____ – solution that does not conduct an electric current

Supersaturated Solutions

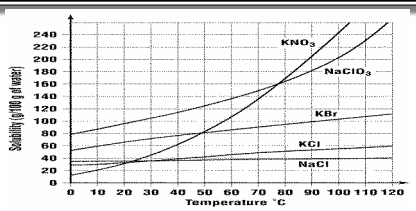
- They cannot permanently hold the excess solute in solution and may release it suddenly.
- Supersaturated solutions are made by dissolving a solute in the solution at an elevated temperature and then slowly cooling the solution.

Reading Solubility Graphs



According to the graph above, about how many grams of KBr are needed to make a saturated solution in 100 g of water at 30° C?

Reading Solubility Graphs



According to the graph above, what kind of solution would you have if you dissolved 10 g of KCl in 100 g of water at 0°C?

Solubility

- _____ – process of surrounding solute particles with solvent particles to form a solution
- The rule for dissolving solutions is _____
- Polar substances will dissolve in polar solvents
- Non polar substances will dissolve in non polar solvents
- Non polar will NOT dissolve in polar and vice versa

Increasing the Rate of Solution

1. Agitation
2. Increasing Temperature
3. Increasing Surface Area

Agitation

- Increases the speed of the particles
  - speeds up the dissolving process in solids.

Increasing Temperature

- More collisions of particles as temperature increases.

Particle Size (Increasing Surface Area)

- Smaller particles dissolve faster than larger particles.
  - more surface area
  - Sugar cube vs. ½ teaspoon sugar
  - Teaspoon will dissolve faster

Solubility of a gas

- **Two main factors that affect the solubility of a gas in a liquid**

1. Temperature
   - Normally, the higher the temperature, the faster a solute will dissolve…NOT with a gas!
   - In a gas, the cooler the temperature, the faster the gas will dissolve

Solubility of a gas

- **The second factor affecting the solubility of a gas is pressure**

2. Pressure
   - The higher the pressure, the more gas that will dissolve
   - Think of a coke bottle…What will happen if you leave the lid off?

Henry's Law

- The solubility of a gas is directly proportional to the pressure
- The higher the pressure, the more gas will dissolve
- $\frac{S_1}{P_1} = \frac{S_2}{P_2}$

S = solubility (g/L)

P = pressure

Example

- If 0.85 g of a gas at 4.0 atm of pressure dissolves in 1.0 L of water at 25°C, how much will dissolve in 1.0 L of water at 1.0 atm of pressure at the same temperature?

Another Example

- The solubility of a gas is 2.0 g/L at 50.0 kPa. How much gas will dissolve in 1.5 L at 10.0 kPa?

Concentration

- Concentration expresses a ratio that compares an amount of the solute with an amount of the solution or the solvent.

% by Mass

- Remember …
- % = $\frac{\text{part}}{\text{whole}} \times 100$
- % by mass = $\frac{\text{mass solute}}{\text{mass solution}} \times 100$

Example

- What is the % by mass of a solution with 3.6 g of NaCl dissolved in 100.0 g of water?

% by Volume

- Remember …
- % = $\frac{\text{part}}{\text{whole}} \times 100$
- % by volume = $\frac{\text{volume solute}}{\text{volume solution}} \times 100$

Example

- What is the % by volume of 75.0 ml of ethanol dissolved in 200.0 ml of water?

Molarity

- _____ is defined as the number of moles of solute per liter of solution.
- Molarity = moles of solute/liter of solution
- M = mol/L

Molarity Examples

- Calculate the molarity of a solution made by dissolving 23.4 g of sodium sulfate in 125 ml of solution

Molarity Examples

- Calculate the molarity of a solution made by dissolving 5.00 g of $C_6H_{12}O_6$ in enough water to make 100.0 ml of solution

Molarity Examples

- How many grams of Na_2SO_4 are required to make 0.350 L of a 0.500 M solution of Na_2SO_4?

Dilution

- When chemists purchase solutions, they generally purchase "_____ *solutions*" which are extremely concentrated solutions
- This way a chemist can dilute the strong solution to any concentration that they wish. This stops the chemist from having to buy several concentrations

Dilution Equation

- $M_1V_1 = M_2V_2$
- M_1 = initial molarity
- V_1 = initial volume
- M_2 = final molarity
- V_2 = final volume
- The units for V_1 & V_2 do not matter as long as they are the same
- M_1 & M_2 MUST be in molarity

Dilution Problems

- Suppose we want to make 250 ml of a 0.10 M solution of CuSO4 and we have a stock solution of 1.0 M CuSO4. How many mL of 1.0 M $CuSO_4$ would you need?

More Dilution Problems

- How many ml of 3.0 M H_2SO_4 are required to make 450 ml of a 1.0 M solution?