Solutions

Solutions: Basic Definitions

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

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

Supersaturated Solutions

- They cannot permanently hold the excess solute in solution and may release it suddenly.
- Supersaturated solutions, as you might imagine, have to be prepared carefully.
- Generally, this is done by dissolving a solute in the solution at an elevated temperature, at which solubility is higher than at room temperature, and then slowly cooling the solution.

Increasing the Rate of Solution

1. _____
2. Increasing _____
3. Increasing _____

Agitation

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

Increasing Temperature

- More collisions of particles as temperature increases.
- Sugar–water solutions you can dissolve more sugar in a given amount of water if you increase the temperature.

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. _____

- 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. _____

- 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 _____ 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?

Hydrates

- _____– a compound with a specific number of water molecules bound to it
- In a hydrate the formula of the compound is written first with a dot and the number of water molecules attached to it

Hydrates

- Examples:
  - $CaCl_2 \cdot 2H_2O$
    - _____
  - $CuSO_4 \cdot 5H_2O$
    - _____
  - $Na_2CO_3 \cdot 10\ H_2O$
    - _____

Hydrates

- When calculating the molecular weight of hydrates, you must also calculate the waters
- $CaCl_2 \cdot 2H_2O$
- $CuSO_4 \cdot 5H_2O$

Concentrated Versus Dilute

- Chemists never apply the terms *strong* and *weak* to solution concentrations.
- These terms are used in chemistry to describe the chemical behavior of acids and bases.
- Instead, use the terms _____ and _____ .

Concentration

- Concentration units can vary greatly.
- They express a ratio that compares an amount of the solute with an amount of the solution or the solvent.
- For chemistry applications, the concentration term _____ is generally the most useful.

Molarity

- Molarity is defined as the number of _____ of solute per _____ of solution.
- Molarity = moles of solute/liter of solution
- Note that the volume is the total solution volume that results, not the volume of solvent alone.

Molarity Examples

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

Molarity Examples

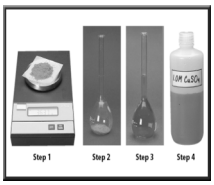
- Calculate the molarity of a solution made by dissolving 5.00 g of $C_6H_{12}O_6$ in enough water to make 100.0 ml of solution

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?

Making Solutions

- Assuming you're making an aqueous solution, you need to know only three things when working quantitatively:
  1. the concentration
  2. the amount of solute
  3. the total volume of solution needed.



Preparing 1 L of an NaCl Solution

- How would you prepare 1.0 L of a 0.15*M* sodium chloride solution?

Dilution

- When chemists purchase solutions, they generally purchase "_____ " 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 would we prepare the solution?

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?

More Dilution Problems

- How would you make it?