Science Starter

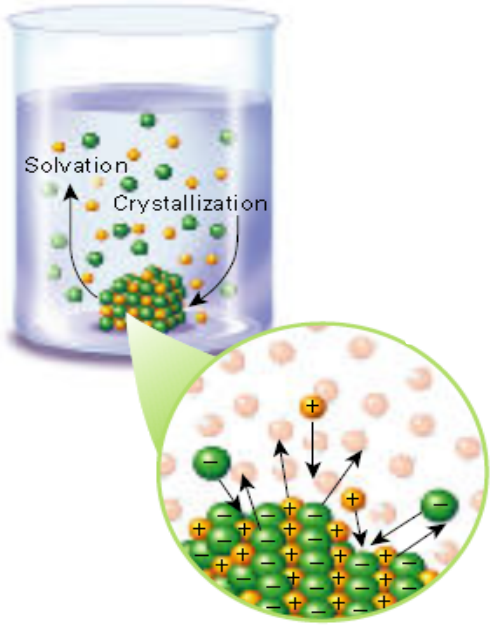
- Determine the number of moles in 13.9 grams of NaCl.

Solutions

Arbor Prep Chemistry

Basics of Solutions

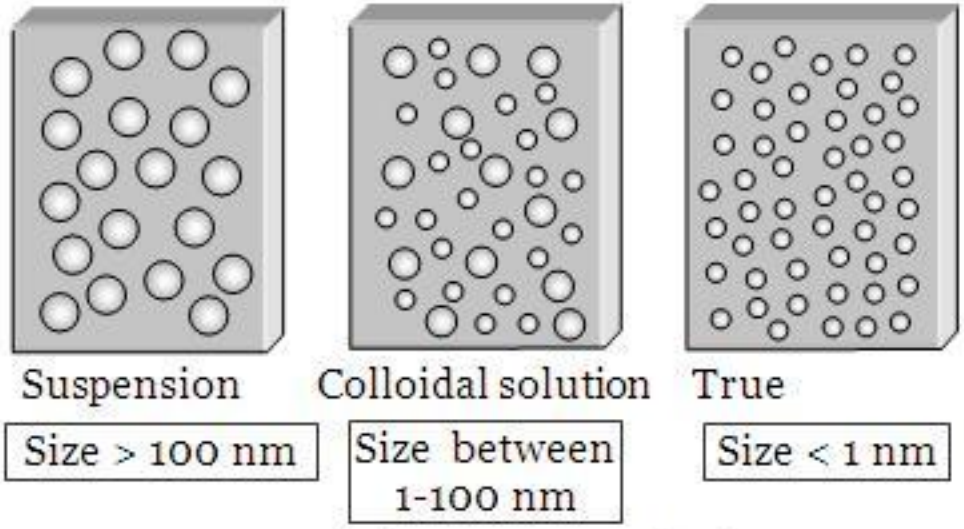
- The *solute* goes into the *solvent* to make the *solution*.
  - Solutes do not have to be solid crystals only.
    - How does your pop become carbonated?
  - Gold in silver for jewelry.
- 3 Factors help determine how solutes and solvents interact.
  - Stirring (agitation)
  - Heat (higher temperatures vs lower temperatures)
  - Surface area (large cubes of sugar vs small)



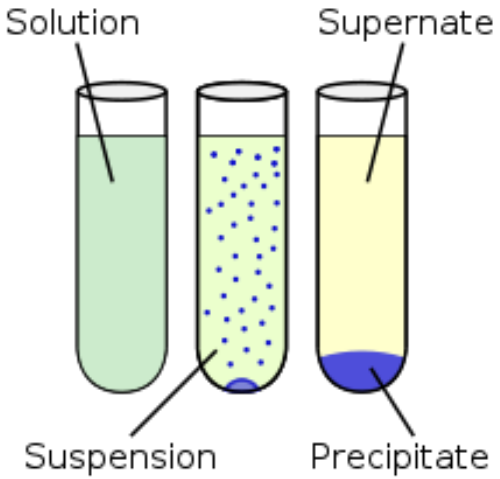
Colloids and Suspensions

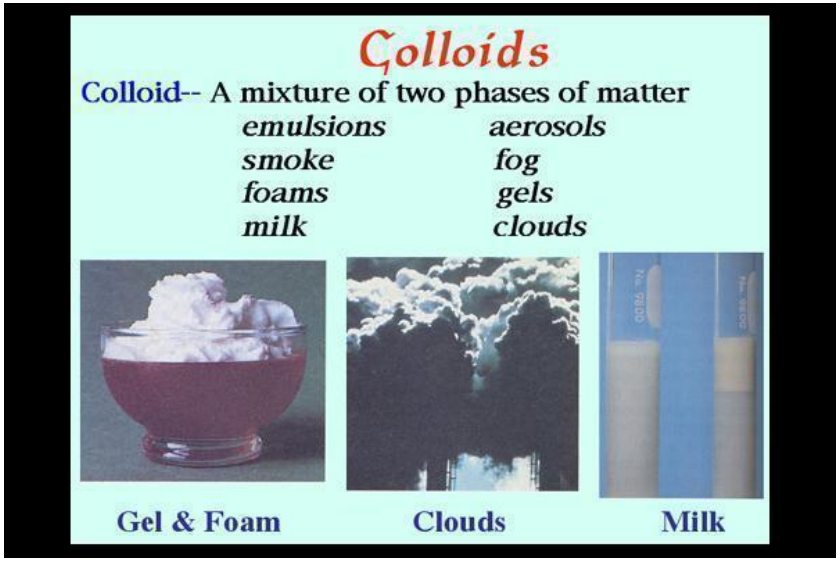
- Both are heterogeneous mixtures.
- If a solution has particles so large that they fall out of solution without constant agitation and stirring, it is known as a suspension.
  - Supersaturated solution
  - Sand and water
- If the particles are larger than the atom/molecular size, but small enough where they don't fall out of solution, this is known as a colloid. These often look cloudy and particles are small enough to not be filtered out.
  - Foam, emulsions, milk.

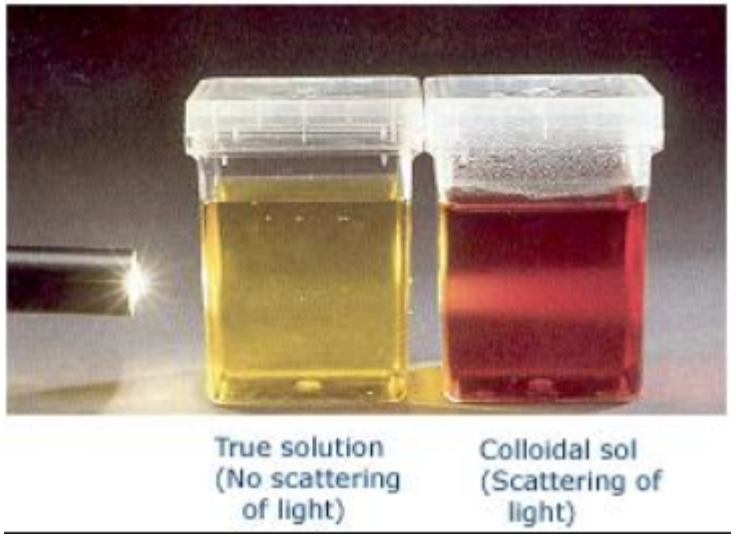
Colloids and Suspensions



Three types solutions

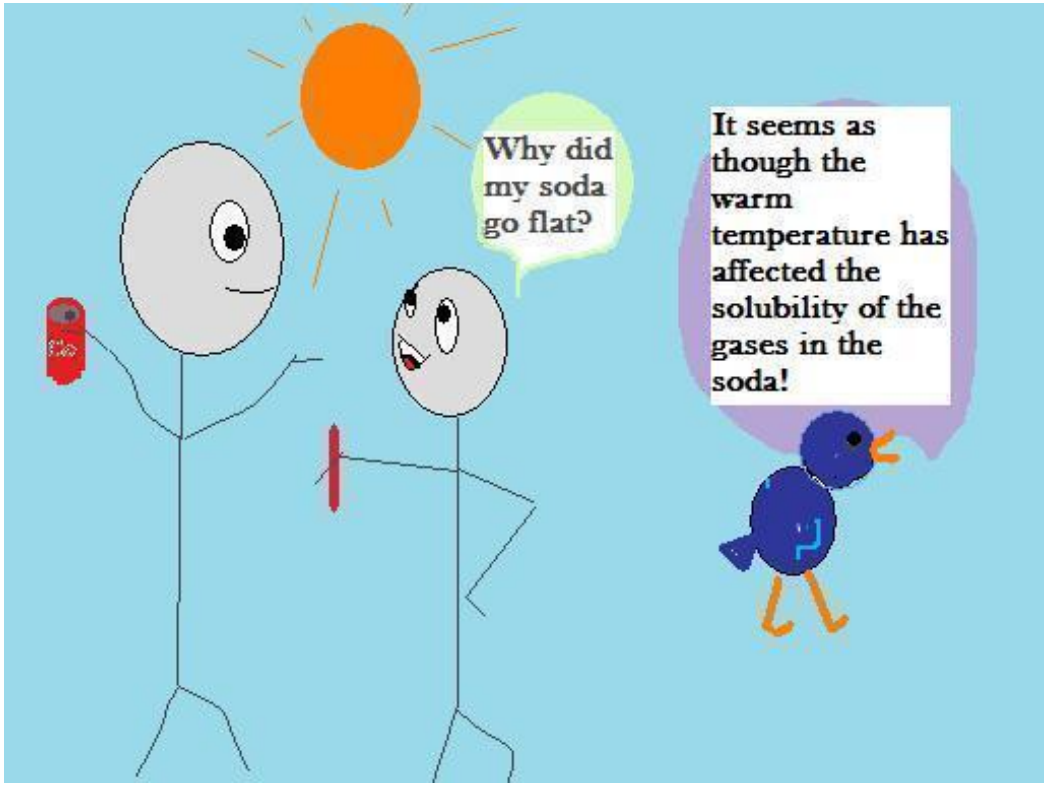


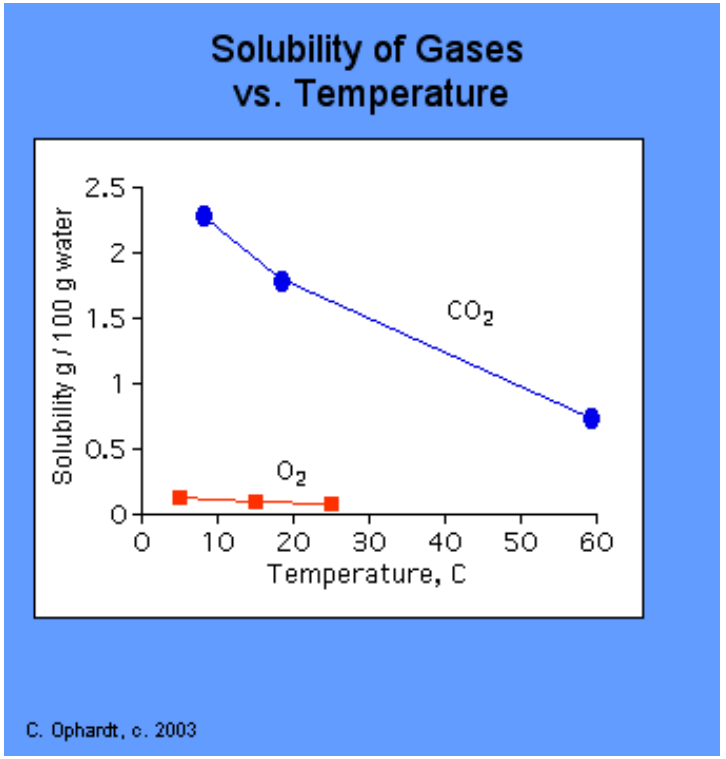




Solubility

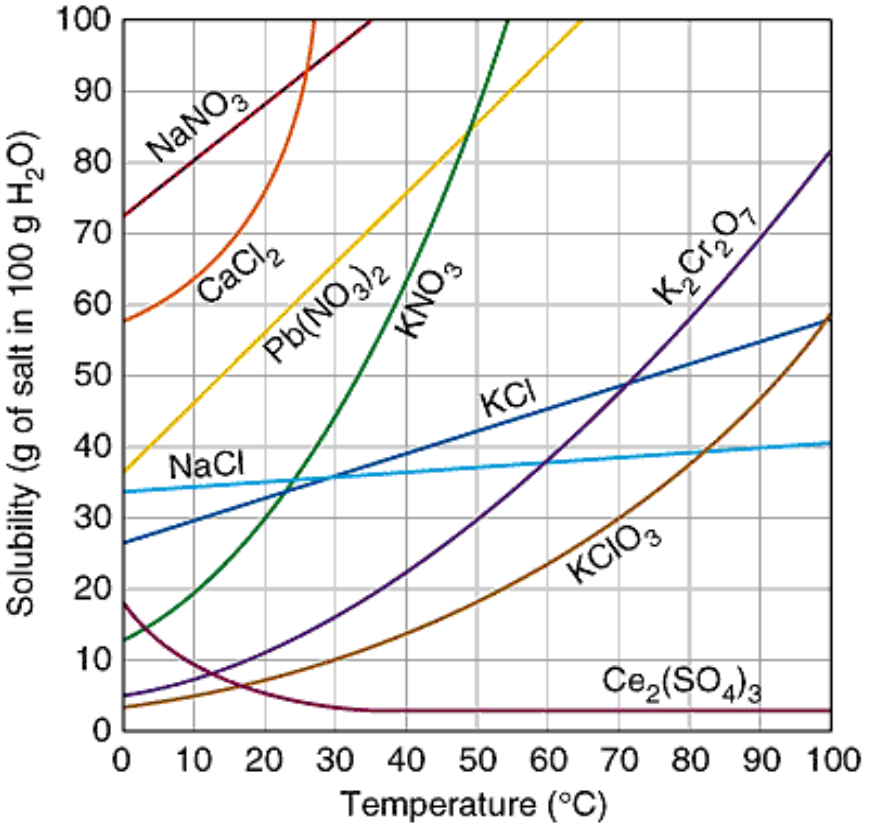
- The maximum amount of solute that can be dissolved in a solvent given a temperature and pressure.
  - This is expressed as the amount of grams of solute per 100mL of solvent.





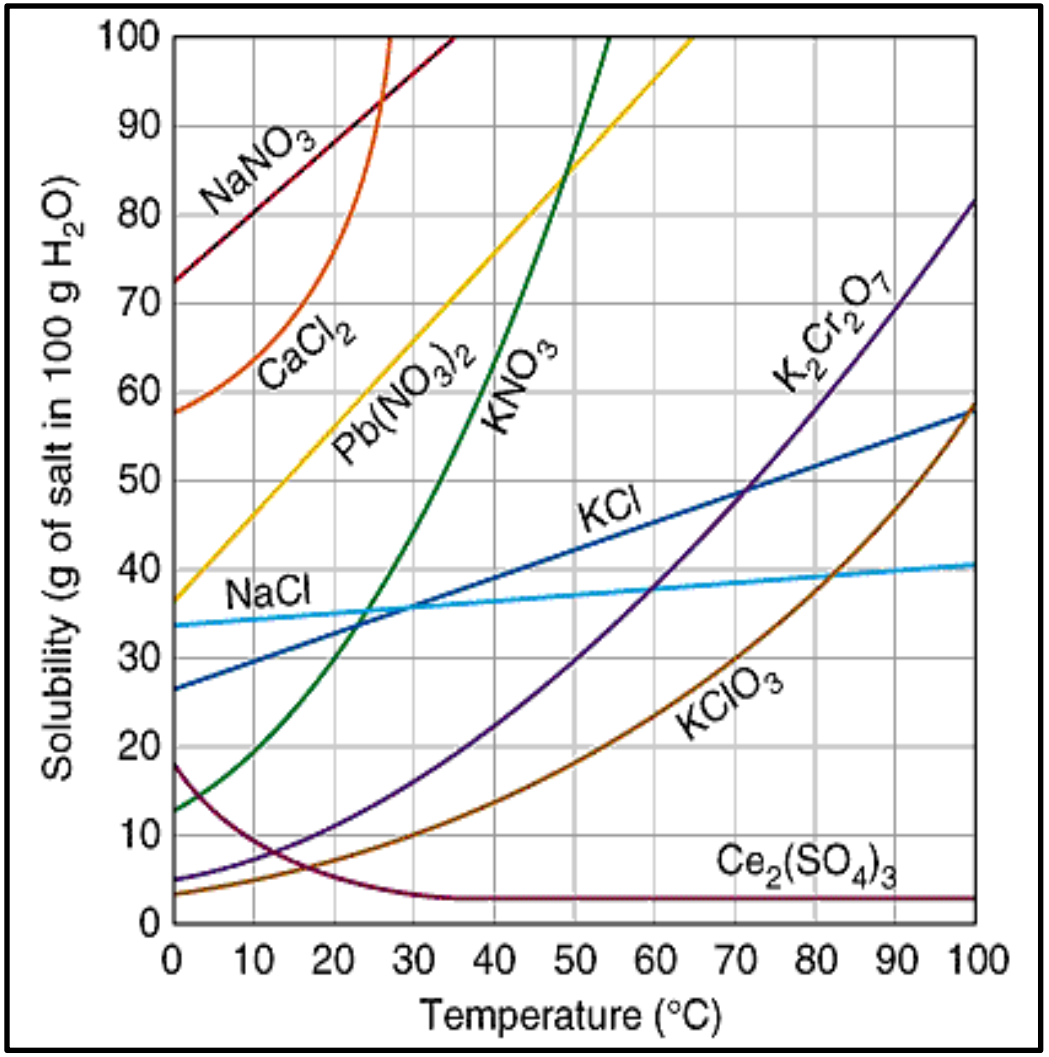
Saturation and Being Supersaturated

- A saturated solution is one that has maximum amount of solute per quantity of solvent.
  - If this happens-you will see more crystallization than solvation.
- An unsaturated solution is when the maximum amount of solute has not been met.



To determine solubility, match the temperature with the line.

Solubility Practice Examples

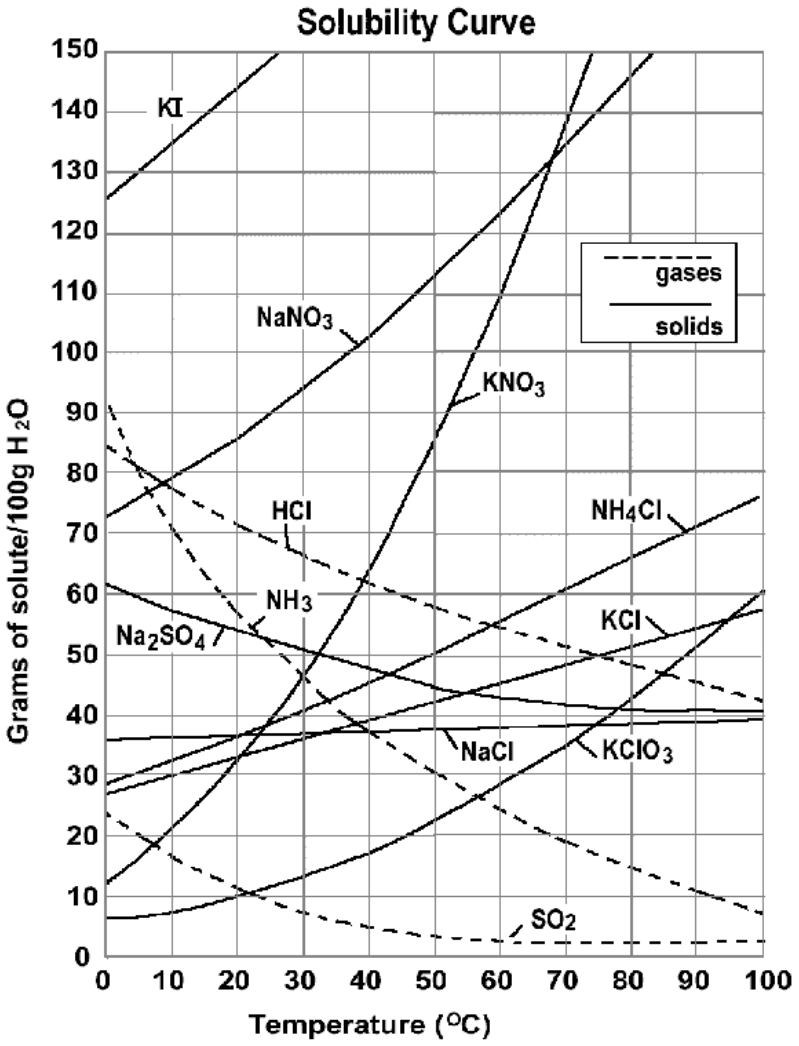


What mass of solute will dissolve in 100mL of water at the following temperatures. Also determine which of the three substances is most soluble in water at 15°C.

1. KNO_3 at 70°C
2. NaCl at 100°C
3. NH_4Cl at 90°C

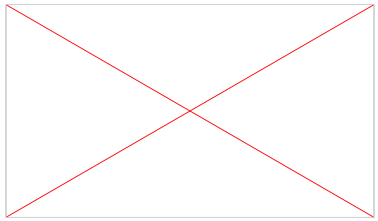
Gas Solubility

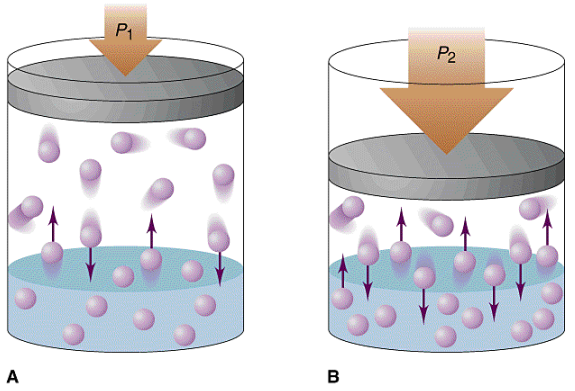
- Gases are a bit different because their particles are moving fast!!!
- Gases have LOW solubility at higher temperatures (flat pop when warm) compared to solids.
- There are a few exceptions for solids, but is a “general rule”.



Gas Solubility and Henry's Law

- Henry's Law is used to describe the solubility of a gas based on the pressure exerted above a liquid.





- As pressure increases, so does solubility, that is why when a pop is sealed-the carbonation stays.

Henry's Law Practice

1. The solubility of a gas in water is 0.16 g/L at 104 kPa. What is the solubility when the pressure of the gas is increased to 288 kPa? Assume the temperature remains constant.

2. A gas has a solubility in water at 0°C of 3.6 g/L at a pressure of 1.0 atm. What pressure is needed to produce an aqueous solution containing 9.5 g/L of the same gas at 0°C?

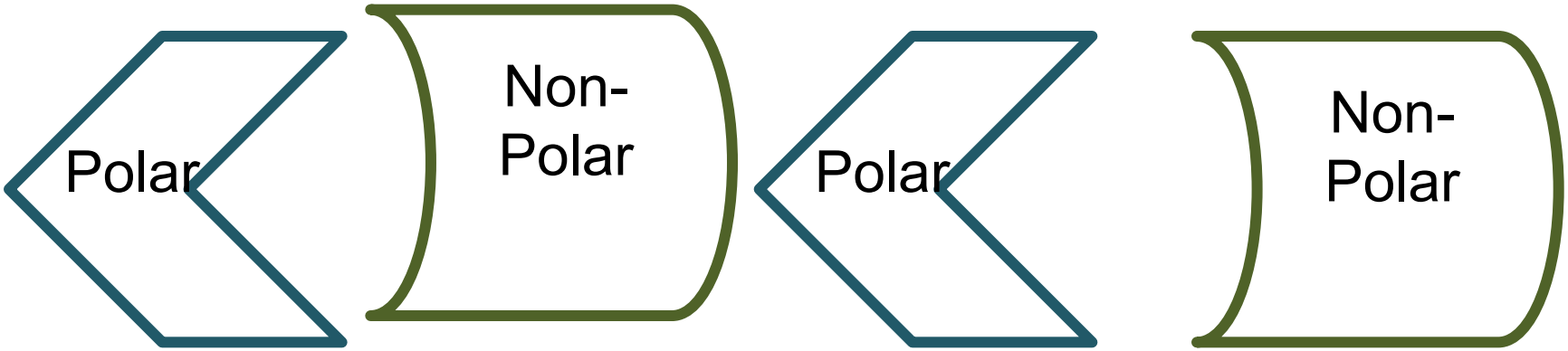
Miscible Vs Immiscible

- When two substances are not

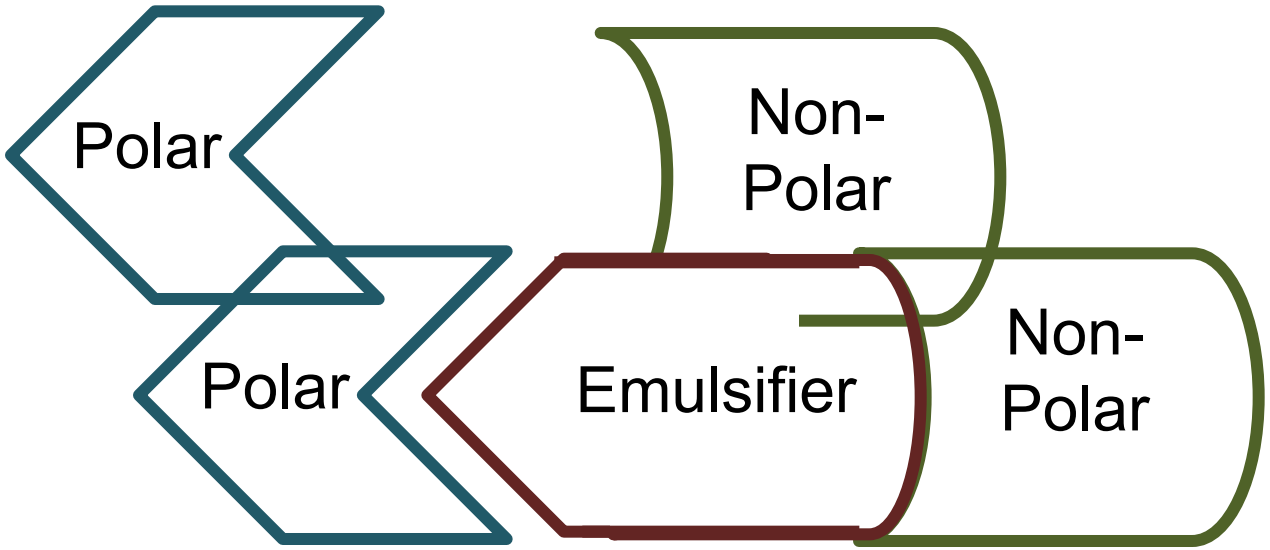
  soluble, they are said to be immiscible.

  - When they do, they are miscible. “Like dissolves Like”

- Two immiscible substances can be made into an **emulsion**. This is because an **emulsifier** has both polar and non-polar ends attracting unlike polarities.



How Emulsifiers Work



Calculating Concentrations

- Molarity (noted as M) is the number of moles of solute per Liter of solution.

- Molality (noted as m) is the number of moles of solute per Kg of solvent.

- How are molarity and molality different? How are they the same?

Practice with Molarity

How many liters of a 0.88 M solution can be made with 25.5 grams of lithium fluoride?

What is the concentration of a solution with a volume of 660 mL that contains 33.4 grams of aluminum acetate?

Practice With Molality

Use molality to answer the following:

a. What is the molality of 2.34grams of NaCl in 154ml of water? (density of water is 1g/mL)

b. 13.2 grams of KCl was used to make a 1.80m KCl in water. How much water was used?

Percent Concentration

% Concentrations can be done two different ways:

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

OR

$$\text{Percent by mass (\% (m/m))} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100\%$$

Paying attention to your question will help you tremendously.

Percent Concentration Practice

If 10 mL of propanone (or acetone (C_3H_6O)) is diluted with water to a total solution volume of 200 mL, what is the percent by volume of propanone in the solution?

A chemist dissolves 3.50 g of potassium iodate in 805.05 g of water. What is the percentage concentration of the solute in the solution?

Mole Fraction

- Another way of expressing solution concentration is called “mole fraction”. The mole fraction (symbolized by X) of the solute or of the solvent can be calculated using the following equations:

$$X_{solute} = \frac{mol_{solute}}{(mol_{solute} + mol_{solvent})} \qquad X_{solvent} = \frac{mol_{solvent}}{(mol_{solute} + mol_{solvent})}$$

Note: both the solute and the solvent must be converted to moles when finding the mole fraction!

Mole Fraction Practice

1. What is the mole fraction of NaCl if 14.25 g of NaCl is dissolved in 85.0 g of H_2O?

2. What is the mole fraction of water in the #1?

3. What did questions #1 and #2 add up to be?

4. In a certain salt water solution, the mole fraction of salt is 0.18. Find the mole fraction of water.

STAMP IT!!!

A student mixes 16.3 grams of NaOH (MW: 40.00g/mol) to make a 200mL aqueous solution. The mass of just the water present was 183.7grams.

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1. Determine the mole fraction of NaOH.

2. Determine the molarity of the solution.

3. Determine the molality of the solution.

4. Determine the %concentration by mass.