What is a solution?

Solute

Solvent

Solution

Unsaturated

Saturated

Super saturated

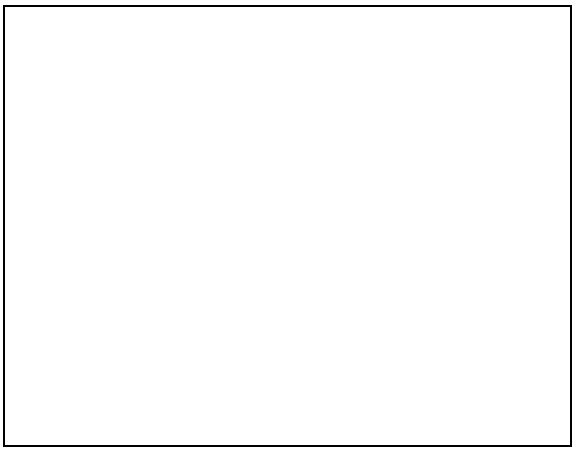
Miscible

Colloids

Tyndall Effect

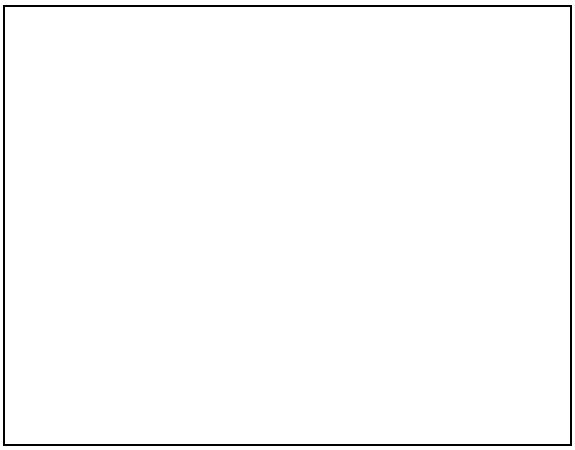
Particulate Diagrams

Draw a picture of what a solution of NaCl looks like.

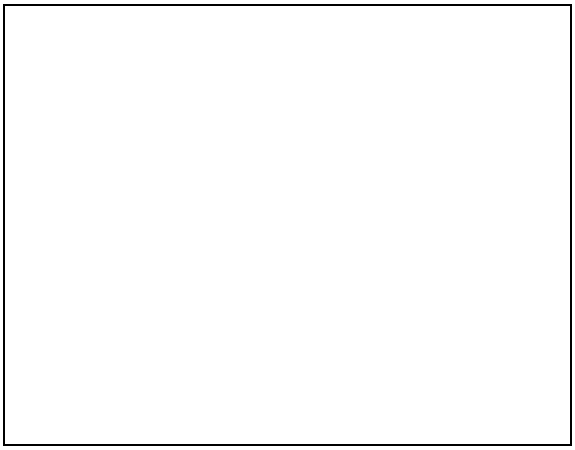


Draw a picture of what a “Saturated” solution of NaCl looks like.

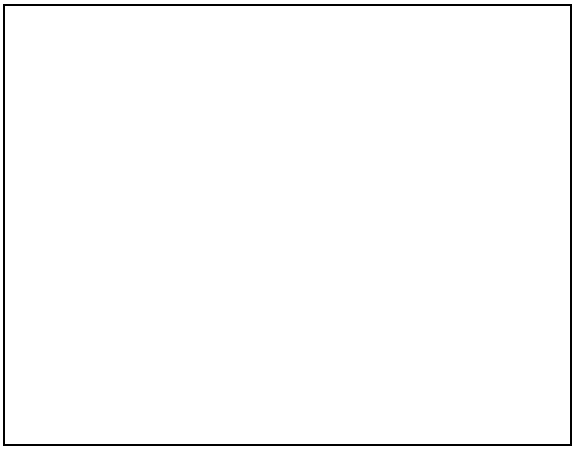
Draw a picture of what an “Unsaturated” solution of NaCl looks like.



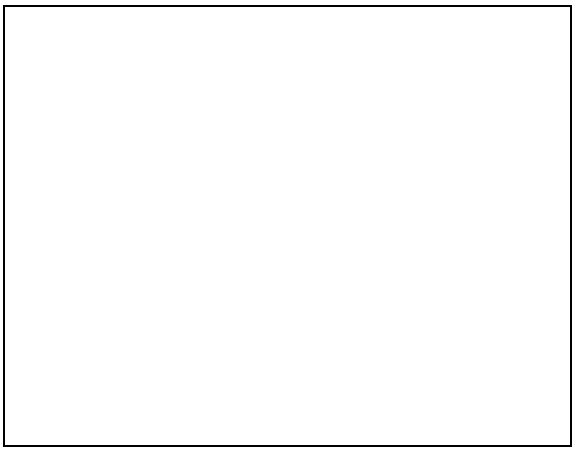
Draw a picture of what an “Immiscible” mixture looks like.



Draw a particulate diagram showing what a calcium ion looks like interacting with water molecules in a solution.



Draw a particulate diagram showing what a fluoride ion looks like interacting with water molecules in a solution.



Solution Concentration
We need a mathematical way to express how much "stuff" is in a solution.

1) Molarity

2) Molality

3) Mass Percent

4) Mole Fraction

1) A solution is prepared by adding 5.84 g of H_2CO to 100.0 g of water. The final volume of the solution is 104.0 mL.

a. What is the molarity of the solution?

b. What is the molality of the solution?

c. What is the mass percent of H_2CO in the solution?

d. What is the mole fraction of H_2CO in the solution?

2) The typical Hydrogen Peroxide (H_2O_2) that is used in beauty shops is 6% by mass. Calculate the mole fraction, molarity, and molality of 500 mL of H_2O_2.

What does 6% mean?

Mole Fraction

Molarity

Molality

3) The "proof" is the unit used to measure alcohol concentration in an ethanol(C_2H_5OH) in water solution. A typical hard liquor is 80.0 proof.

a) What is the mass percent of ethanol in the solution?

b) What is the molality of the solution?

c) What is the molarity of the solution?

d) What is the mole fraction of ethanol in the solution?

Solution Formation

Preparation of Solute

Preparation of Solvent

Formation of Solution

Enthalpy of Solution

Enthalpy of Hydration

Factors Affecting Solubility

Structure

Temperature

Pressure

Henry's Law

In an Equation:

Vapor pressure

Molecules are in a constant state of motion and escape. Sometimes blocking the leaving area can slow them down.

Raoult's Law

What does this mean? We love a graph!

Ideal Solutions

Non–Ideal Solutions

Now to Mixtures:
Heptane and Hexane form an almost ideal solution.

For this ideal solution only the number of molecules matter!

What if they were non–ideal solutions?

Solvents and solutes that attract each other will experience a negative deviation from Raoult's Law. Water and acetone show significant hydrogen bonding. Ethanol and hexane are both volatile and repel each other.

The vapor, no matter what, will always be richer in the more volatile liquids!

Colligative Properties of Solutions.

What is a colligative property?

What are the four colligative properties?

1. 3.

2. 4.

Vapor Pressure Lowering

Picture an ideal solution. Take non−volatile, non−electrolytes and put them together.

Boiling Point Elevation and Freezing Point Depression:

The normal boiling point is when the vapor pressure is equal to the applied atmospheric pressure. What happens when the vapor pressure is lowered? Phase Diagrams again!

Ideally one mole of any non−volatile non−electrolytic solute in a given amount of solvent will have the same effect on colligative properties as any other substance.

Equations:

Kb	molal boiling point elevation constant	= 0.512°C kg/mole for water
Kf	molal freezing point depression constant	= 1.86°C kg/mole for water

Qualitative Effects
Cooking Noodles

Salting Highways after a snow

Ice Cream Machine

Anti freeze in a car radiator

Quantitative Examples

1) What is the vapor pressure of a benzene/toluene solution if the mole fraction of benzene is 0.30 and that of toluene is 0.70? The vapor pressure of benzene is 73 torr and that of toluene is 27 torr.

2) The molal boiling and freezing point constants for water are 0.512°C kg/mol and 1.86°C kg /mole respectively. We are going to discuss an ideal 0.050 molal solution of sand that does not dissociate.

a) What is the freezing point of the solution?

b) What is the boiling point of the solution?

3) A solution was prepared by dissolving 18.00 g of glucose in 150.0 g of water. It had a boiling point of 100.34°C. What is the molecular weight of glucose?

4) Ethylene glycol contains carbon, hydrogen, and oxygen. It is 38.7% carbon and 9.80% hydrogen. When 100.0 grams of it is placed in 900 grams of water the freezing point is lowered by 3.33 degrees. What is the molecular formula?

5) Solid sulfur is a molecular solid of the formula S_x. The addition of 0.24 g of sulfur to 100 g of carbon tetrachloride (K_f = 29.8°C kg/mole) lowered its freezing point by 0.28°C. Find the value of X in sulfur's formula.

Osmosis

The passage of solvent molecules through a semi–permeable membrane from a *more dilute* to a *more concentrated* solution. This is Solvent flow only!

Osmotic Pressure is the external pressure exactly sufficient to oppose osmosis and stop it.

Desalination Plants

Hypertonic

Crenation

Hypotonic

Lysis

Pickles

Electrolytes

But wait! Some of them pair up again!

What do the equations look like now?

Consider the following 0.10 M solutions in water:

Glucose KCl $CaCl_2$ $FeBr_3$ Acetic Acid

Place them in order by size of boiling point elevation:

From the following solutions:

$C_6H_{12}O_6$(x=0.01) NaCl (x=0.01) $CaCl_2$(x=0.01)

Choose the solution with:

Highest freezing point

Lowest freezing point

Highest boiling point

Lowest boiling point

Highest osmotic pressure