Solutions

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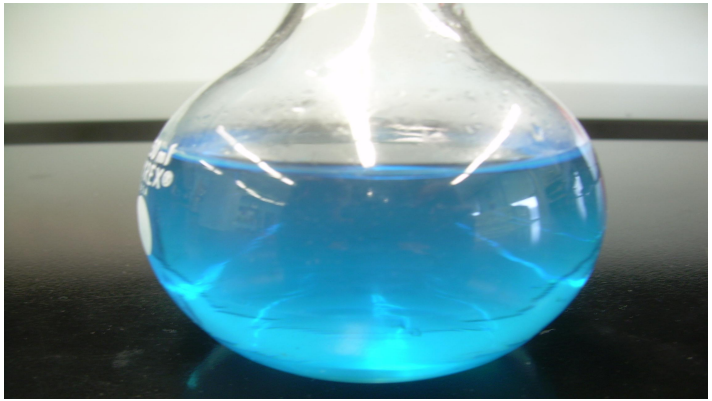
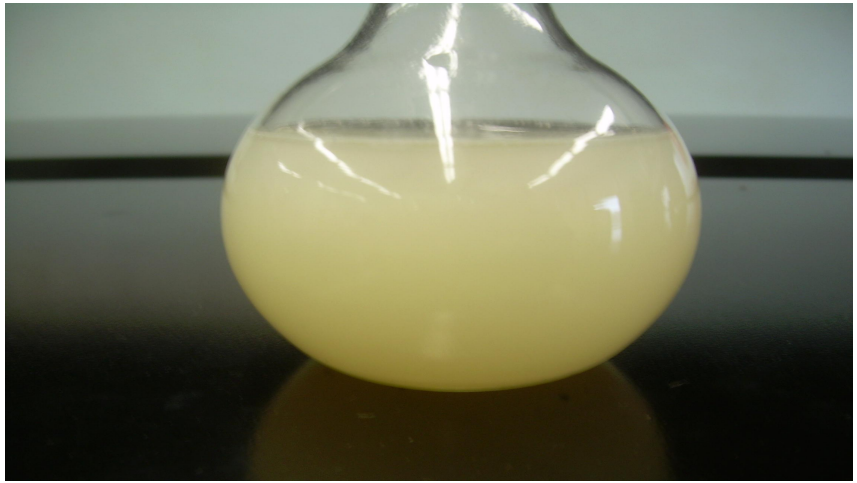
Definition of a solution

- **Solutions are defined as homogeneous mixtures.**
  - homogeneous means that it is uniform throughout because it is a mixture of very small particles – molecules or ions.
  - Solutions are clear (transparent), and do not separate on standing.



Suspensions

- **Suspensions are defined as heterogeneous mixtures**.
  - Heterogeneous means that it is NOT uniform. The particles of the suspended substance are much larger than in a liquid.
  - Suspensions are cloudy (opaque), and separate upon standing.



Colloidial Suspensions

Colloid (or Colloidial suspensions)

- Heterogeneous mixtures that are cloudy but do not tend to separate out.

- Particle size is intermediate between solutions and suspensions.

Types of Colloids

Dispersion medium	Dispersed phase	Colloidal name	Example
Gas	Liquid	Aerosol	Fog
Gas	Solid	Solid Aerosol	Smoke
Liquid	Gas	Foam	Whipped cream
Liquid	Liquid	Emulsion	Salad dressing
Liquid	Solid	Sol	Paint
Solid	Gas	Solid foam	Cake
Solid	Liquid	Gel	Jelly
Solid	Solid	Solid Sol	Colored glass

https://study.com/academy/lesson/classification-of-colloids-methods-examples.html

Parts of a solution

- **Solute** – the dissolved substance. Usually the part present in the smaller amount.

- **Solvent** – the dissolving substance. Usually the part present in the larger amount.
  - In a sugar solution, sugar is the solute and water is the solvent.
  - In air, oxygen is the solute and nitrogen is the solvent.

What is the solvent and solute in seawater?

Types of Solutions

- Solid dissolved in a liquid – the most common type.
- Gas dissolved in a liquid – CO_2 is dissolved in soda
- Gas dissolved in a gas – Example would be air (oxygen dissolved in nitrogen)
- Liquid dissolved in a liquid – Examples would be alcoholic drinks (beer, wine).
- Solid dissolved in another solid – Examples would be alloys (bronze, brass, steel)

Solubility

- A measure of the amount of solute that will dissolve in a given amount of solvent.
  - Depends on the type of solute and solvent
  - Depends on temperature.
  - Depends on pressure (for gases).

Solubility: Effects of Solute/Solvent

- General Rule: “Like dissolves Like”.
  - Polar solutes dissolve in polar solvents.
  - Non-polar solutes dissolve in non-polar solvents.

- How would you clean a paint brush with oil paint on it?
  - Since oil paint is non-polar, you need a non-polar solvent like turpentine or kerosene. (most substances derived from oil are non-polar).

Examples of Temperature Effects

- Does sugar dissolve better in hot water or cold water?
  - Sugar (solid) is more soluble in hot water than cold water.
- Is carbon dioxide (in soda) more soluble when the soda is warm or cold?
  - carbon dioxide is less soluble in warm water than cold water.

Effect of Temperature

- **Temperature** – the solubility of most solids increase as the temperature increases. The solubility of gases decrease as temperature increases.

  Examples:

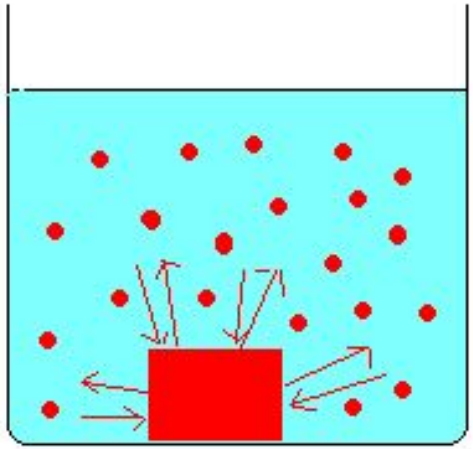
  Solubility of KNO_3 (solid) in water (lab) increases as temp. increases.

  Solubility of dissolved oxygen (gas) in water decreases as temperature increases.

Saturated Solutions

- **Saturated Solutions** – a solution where the maximum amount of solute has dissolved.

A SATURATED SYSTEM IS AT EQUILIBRIUM



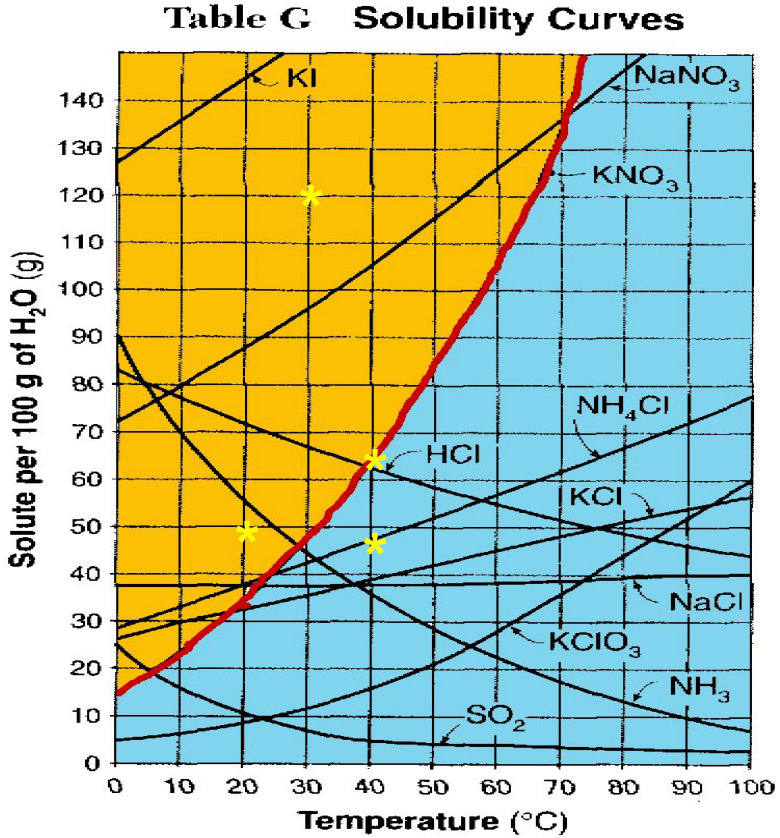
RATE OF DISSOLVING = RATE OF CRYSTALLIZATION

Unsaturated/Supersaturated

- **Unsaturated solution** –An unsaturated solution has the ability to dissolve more solute.

- **Supersaturated solution** – a solution which contains more solute than it normally should.

Solubility Curves



50g of KNO3 is dissolved in 100g of water at 40C. What kind of solution results?
unsaturated

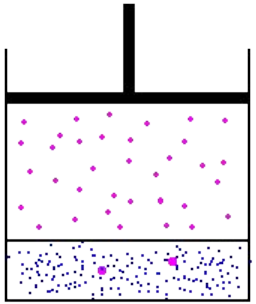
50g of KNO3 is dissolved in 100g of water at 20C. What kind of solution results?
supersaturated

60g of KNO3 is dissolved in 50g of water at 30C. What kind of solution results? supersaturated

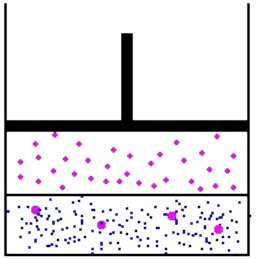
65g of NaNO3 is dissolved in 100g of water at 40C. What kind of solution results?
saturated

Solubility: Pressure

- The greater the pressure of a gas above a liquid, the greater the solubility of the gas in the liquid.



Low pressure equilibrium



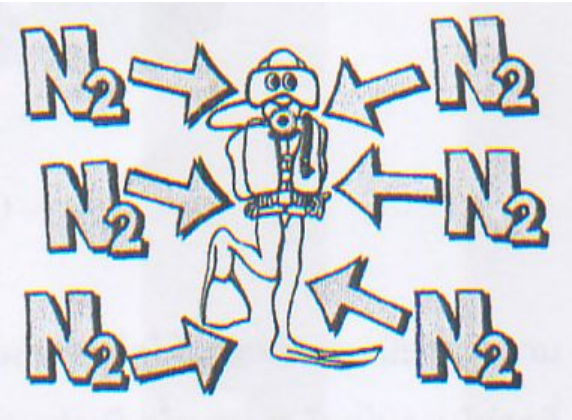
Double the pressure equilibrium

Pressure has NO EFFECTS on the solubility of liquids or solids.

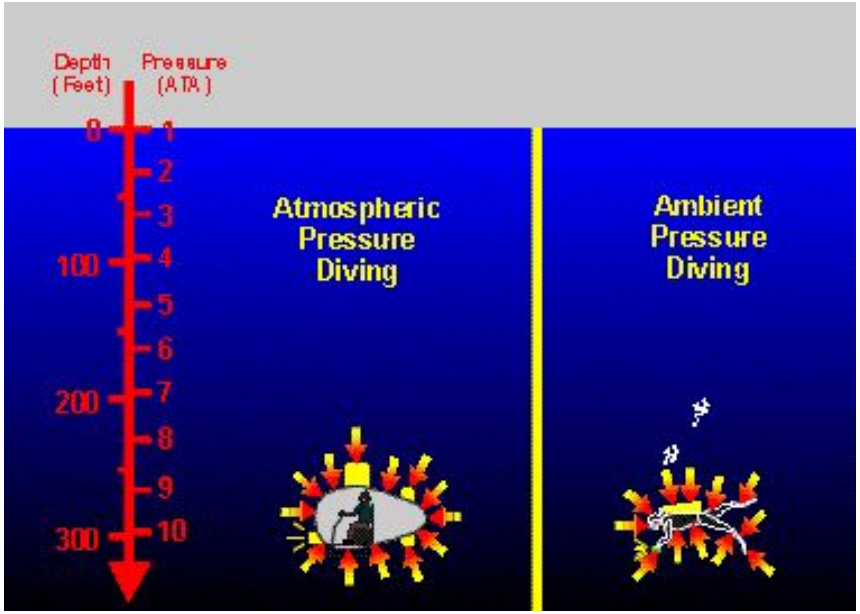
Pressure Effects on Scuba Divers

Increased pressure associated with going underwater can result in

- Nitrogen narcosis (the rapture of the deep)
- The bends (when divers come up to rapidly)

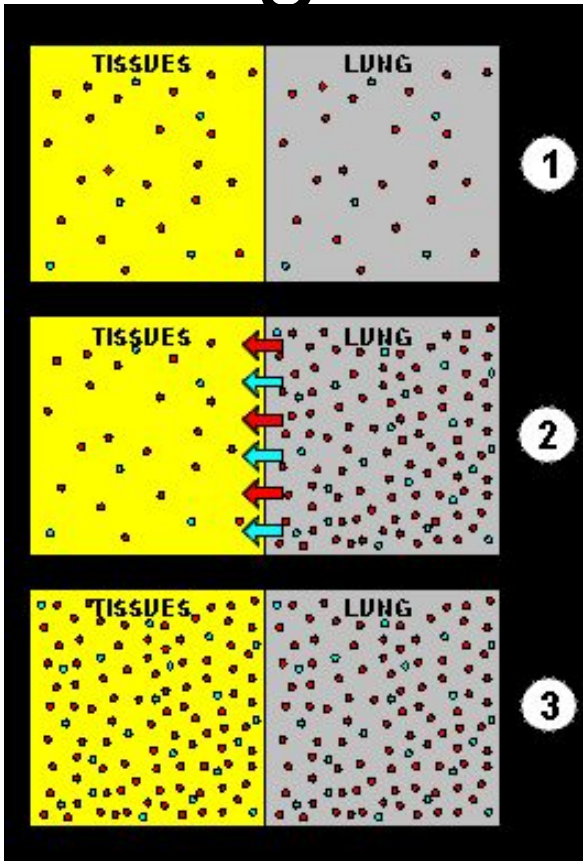


Pressure increases with depth



Solubity of Nitrogen

The deeper the diver goes down the greater the pressure of N2 in the lungs, and the more N2 dissolves in the blood.



Percent Concentration

- **Percent concentration** –Percent concentration is most often expressed using mass.
- $$\text{percent solution} = \frac{\text{mass of solute}}{\text{mass of the solution}} \times 100$$

Parts per million (ppm)

- Part per million – another quantitative way of indicating the solute/solution ratio. The formula for ppm can be found in Table T.

$$\text{parts per million (ppm)} = \frac{\text{mass of solute}}{\text{mass of the solution}} \times 1{,}000{,}000$$

Molarity

- Molarity (M) – the most important concentration unit for Regents chemistry. It provides another quantitative way of indicating the solute/solution ratio. The formula for Molarity can also be found in Table T.

$$\text{Molarity} = \frac{\text{moles of solute}}{\text{liters of solution}}$$

Practice

- Calculate the concentration of the following using all three concentration units:
  - Solution 1 - 30 grams of NaCl dissolved in 95 grams of water to form 100 mL of solution.
  - Solution 2 - 60 grams of NaCl dissolved in 95 grams of water to form 105 mL of solution.