Solutions

Chapter 15

Mixtures

- Heterogeneous mixture- unevenly mixed substance (separation can be seen)
- Homogeneous mixture- evenly mixed substance (no separation can be seen)

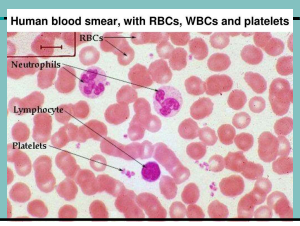
Suspensions

- ~Small but visible particles suspended or floating in a gas or liquid (heterogeneous mixture)
- Like a snow globe or dust or "shake before using"
- the particles are too big to float forever without being stirred
- If a suspension sits, the particles will settle
- Can be filtered out

Colloids or Colloidal Suspension

- ~mixture that appears uniform unless under magnification.
- Particles are a little larger than the wavelength of light
- Extremely light particles float almost indefinitely.
- Milk, blood, smoke
- These can be separated in a centrifuge

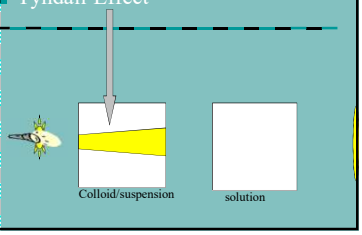
Blood under a microscope



Tyndall Effect

- ~Scattering of light by a colloid or suspension
- Both a colloid and a suspension have particles larger than the wavelength of light, so when light shines through it should be deflected every which way.
- This will make the beam of light visible.

Tyndall Effect

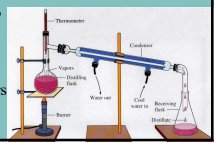


Solutions

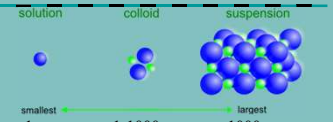
- Particles are smaller than the wavelength of light. Therefore, it will not scatter light.
- With solutions, no separation can be seen even under a high powered microscope.
- Cannot be separated by any filter or by a centrifuge.
- Can be separated by boiling/ melting points.
- salt water, metal alloys, air

Distillation

- Distillation is separating substances in a mixture by boiling point. A mixture is heated until it is boiling. Different components of the mixture will vaporize at different temperature,
- If you hold the temperature at the lowest boiling point and collect the vapors you can separate a mixture.



Particle size



- < 1 nm 1-1000 nm >1000 nm
- nm is a nanometer or $1x10^{-9}$ m

Parts of a solution

- Solvent- what the substance is dissolved in
- Solute- what is being dissolved
- Water is called the "universal solvent"
- because it dissolves a lot of substances and is very common.
- Water solutions are called aqueous.

Mass and volume

- In a solution, mass is conserved, however, volume is not.
- That is to say, the mass of a solution = mass of the solute + solvent.
- The volume of a solution may not equal the volume of the solute +solvent.

Example

- It is easy to think of sand and water (not a solution, but it works for the general concept)
- If you mix a liter of sand and a liter of water you get…
- A mixture that is more than one liter but less than 2 liters.
- Now this applies to solutions, if you mix 1 L of water with .5 liter of $Na_2 CO_3$ the resultant solution is more than 1 L but less than 1.5 L

Density of solutions

- Increasing the mass of the solution and not increasing the volume comparatively will increase the density.
- Dissolving solids into water almost always increases the density.
- How much the density increases, depends on how much is dissolved.

Solution misconceptions

- Solutions don't have to be a solid in a liquid.
- carbonated water is CO_2 dissolved in water, streams have dissolved O_2 in them.
- The solvent doesn't have to be water or even a liquid.
- Alloys (two or more metals) are a solution as is air. Several things dissolve in oils.

Gases

- Gases dissolved in water tend to decrease the density of the solution.
- Again the volume of the solution does NOT increase anywhere near the volume of the gas + water, but it does increase at a greater rate than the mass.

Liquids

- Liquids may increase or decrease the density of the solution dependent on whether they are more or less dense than the solvent.
- Rubbing alcohol will decrease the density of a water solution, where acetic acid will increase the density of a water solution.

Coke v. Diet Coke

- Coke cans sink in water, diet coke floats.
- That means a coke can is more dense than water, diet coke is less dense.
- Aluminum is more dense than water, but there is head space, a little air pocket, at the top of the can.
- Diet Coke (and all diet beverages) use artificial sweeteners like Nutrasweet.
- Nutrasweet is 200x sweeter than sugar, so you need to dissolve less in the solution, making it less dense

Concentration

- ~How much solute is present in a solution compared to the solvent.
- Molarity (M)- moles of solute per liter of solution. M = mol/L
- 2.1 M $AgNO_3$ means 2.1 mol of $AgNO_3$ for every one liter of solution

Other measures of concentration

Name	Abbrev.	What it is
molality	m	mol solute/kg solvent
parts per million	ppm	g solute/g solvent x 10^6
parts per billion	ppb	g solute/g solvent x 10^9
mole fraction	x	mol solute/mol solution
percent by mass	%	g solute/g solution x 100
percent by volume	%	mL solute/mL solvent x100