CHEM 116
Lecture 4: Phase Changes and Phase Diagrams
9-11-08 (jr)

Gas Mixtures

- Gases in a mixture spread out until all available space is taken up.
- Each gas in a mixture behaves independently of the other.
    - Each gas exerts its own pressure, called the partial pressure.
- The sum of all of the partial pressures in a mixture equals the total pressure.

Gases spread out evenly, meaning the density of a gas in one part of a container is the same as in another part of the container.

Mole Fractions

- The mole fraction is the number of moles of a specific gas over the total moles of all gases in the mixture.
- The mole fraction of a gas multiplied by the total pressure is equal to the partial pressure of that gas (ie., the mole fraction is directly proportional to the partial pressure).
- Additionally, the mole fractions of two different gases should add up to 1.
- And the partial pressures of all the gases should add up to the total pressure.

Water Bath Diagram

- The pressure from the air = water pressure + water vapor pressure of the gas.
- Inside the jar, there will be the gas being produced from the reaction as well as water vapor (caused by water evaporation).
- Since evaporation is an important role in this experiment, the temperature is also very important
    - At hotter temperatures, more evaporation occurs so the vapor pressure of water is larger
        - Because more energy is present.
- The level of water inside the jar will also move down as more gas is created (pressure of gas created pushes down on water).

$$P_{atm} = P_{water} + P_{gas}$$

P_{water} is the vapor pressure of water, which you look up in the back of the book for the temperature the experiment is happening at (or else this value must be given to you in the problem if you don't have a table to look it up in)

Kinetic Molecular Theory assumptions:

- There are no attractive forces (characteristic of particle interaction)
- The volume of gas particles is not measured, only the total volume of container
- Particles never stop, they are in constant motion
    - Particles travel in straight lines and change velocities when they collide with each other (particles are elastic)

- Pressure arises when particles his the walls of the container
- The average kinetic energy is proportional to the temperature of the gas

Two Major Assumptions that can go wrong (Attraction and Volume)

- As pressure increases, attractive forces increase
- As pressure increases or when temperature decreases, particles get closer together and attraction increases
- As particles become larger, the volume become more and more considerable
- When pressure increases or temperature decreases, the fraction of the total volume that the particle takes up becomes less considerable.
- Important Indicators (usually when comparing 2 gases):
    - High Pressure
    - Low Temperature
    - Mass/size of particles

Ideal Behavior → Non-ideal behavior

He H_2 Ne O_2 Xe C_4H_{10} H_2O

-The more polar something is (e.g., H_2O), the less ideal it is.
-The smaller a molecule/atom is, the more ideal it is.
-Molecules that have bonds are less ideal than single atoms because bonded molecule can lose or gain vibrational bond energy within the molecule (less elastic) during the collisions.

- If you look at the boiling points of the listed elements and molecules, you will notice it also goes in the same order
    - This is because boiling point reflects attractions that keep molecules stuck together in the condensed phases (liquids & solids)