Gas Laws
Kinetic Molecular theory(KMT):Used by scientists to compare behavior of a real gas to ideal gas
Ideal Gas: Perfect gas: Particles move in random motion
In conditions of low temperatures and high pressure real gas can change phase

- Hydrogen is close to an ideal gas because it has the lowest mass and lowest size
- Under what conditions of temperature and pressure will a real gas act like an ideal gas: at high temperature, low pressure
- The gas will not phase change, weakening force of attraction

Avogadro's Hypothesis: Equal volume of different gases at the same conditions of temperature and pressure contain the same number of molecules. At STP, one mole of any gas occupies 22.4 L and contains 6.02 * 10^23 molecules
Perfect/Ideal Gas (does NOT exist):

1. Gas particles (atoms or molecules) move in straight line motion, they change direction when they collide with the wall of their system or with each other. Must have the same amount of energy to run in constant motion.
2. Collisions are elastic, no energy lost, all energy is transferred. Real gas use heat, perfect gas doesn't
3. At absolute zero, the ideal gas is a gas, but it is motionless. Distance between particles in absolute zero decreases, no kinetic energy. Ideal gas, no forces of attraction, no phase change. At lower temperature the gas has higher force of attraction
4. Distance between particles, is too great compared to the size of the particles. Increase pressure real gas particles are closer in
5. Ideal gas, no mass, no volume, does not occupy space, dimensionless point. Real gas: mass,volume, occupies space and force of attraction. Indirect relationship of pressure and volume.
6. At constant temperature, pressure and volume are indirectly proportional. P= 1/V. PV= K. Boyle's Law.

- The gas that behaves most like an ideal gas is the lightest gas, which is Hydrogen.

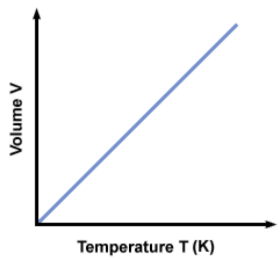
Charles' law of temperature vs Volume: at constant pressure, temperature (IN KELVIN) and volume are directly proportional.
Pressure Increases: (T=K) P= 1/V

1. Distance between particles decreases
2. Volume of the system decreases
3. Collision increase
4. Pressure of gas particles on the walls of the state increases
5. Concentration increases- number of gas particles per unit area

As temperature decreases and pressure increases the force of attraction between gas particles increases, and phase changes from gas to solid

Charles Law: States that the volume of a fixed mass of gas is directly proportional to its Kelvin temperature if the pressure is kept constant

- On a graph the Kelvin Scale starts at the origin, while on Celsius it doesn't start at the origin
- As the temperature of an enclosed gas increases, the volume increases if the pressure is constant



$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

ALWAYS HAVE ANSWER IN KELVIN

- At constant pressure, as the temperature increases the volume of the balloon increases
- The volume increased as the distance between the particles increased
- As the balloon is placed in hot water. at constant pressure. its volume increases because of stronger collisions of the gas on the inside of the balloon, because kinetic energy increases
  - Temperature decreases, volume decreases, kinetic energy decreases, velocity decreases, collision decreases

Boyle's Law: For a given mass of gas at constant temperature, the volume of the gas varies inversely with pressure

- Kinetic theory tells you that there is empty space between the particles in a gas. **If the temperature is constant, as the pressure of a gas increases, the volume decreases.** In turn, as the pressure decreases, the volume increases.

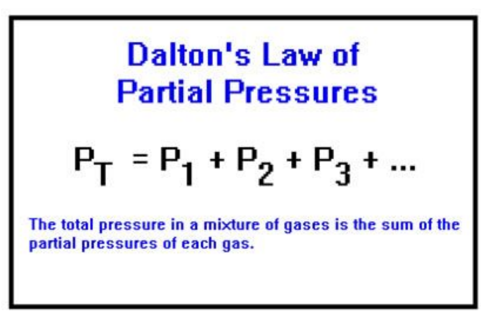
$$P_1V_1 = P_2V_2$$

P = Pressure of the gas
V = Volume of the gas

Temperature must be constant

Dalton's Law of partial pressure:Total pressure of system equals sum of partial pressure in system

- Gas pressure results from collisions of particles in a gas with an object,
- IF the number of particles increases in a given volume, more collisions occur.
- IF average kinetic energy of particles increases in a given volume, more collisions occur. In both cases pressure increases. Gas pressure depends only on number of particles in a given volume and on their average kinetic energy. Particles in a mixture of gases at the same temperature have the same average kinetic energy. So the kind of particle is not important
- **In a mixture of gases, the total pressure is the sum of the partial pressure of the gases.**



Volume is constant then # of gas particles increase, collisions increase, pressure on walls increases

- If the percent composition of a mixture of gases does not change, the fraction of the pressure exerted by a gas does not change as the total pressure changes.

Gas Lussac's Law: States that the pressure of a gas is directly proportional to the Kelvin temperature if the volume remains constant

- As temperature of an enclosed gas increases, pressure increases if the volume is constant

Combined Gas Law: A single expression that combines Boyle's' law, Charle's Law and Gay- Lussac's law

- If volume is constant then the number of gas particles increase, collisions increase, pressure on the walls increases

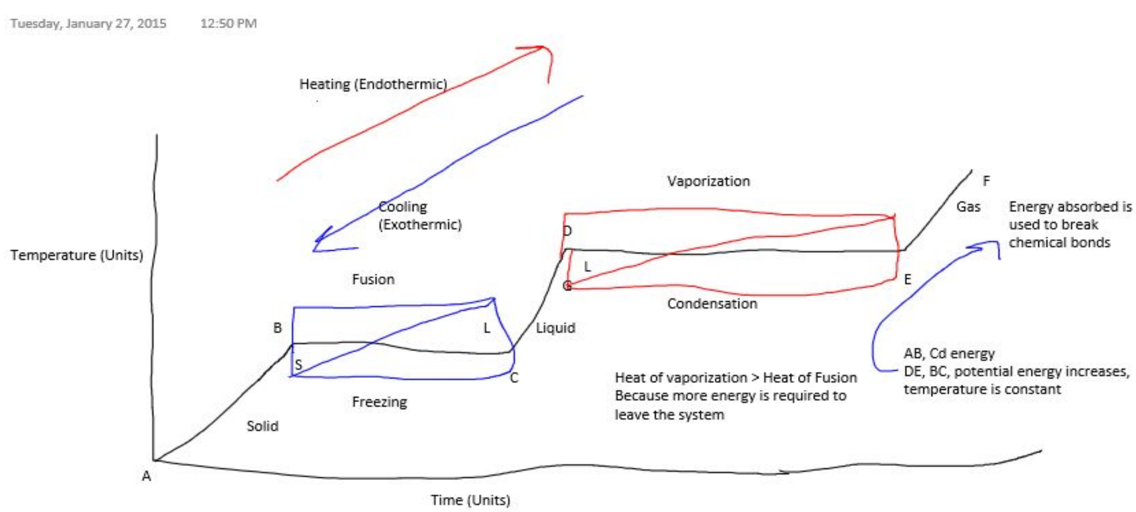
Double the number of gas particles

1. Concentration is double, amount of particles per unit area
2. KE Increases
3. Collisions increase
4. Distance decreases between particles
5. Pressure on the walls of the system increases

At constant pressure, as temperature increases, kinetic energy increase, distance between particles increase, velocity increase, concentration decrease, pressure on the walls of the system increases---------volume increases

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Phase-change diagram



Vapor pressure

Why liquid boils: Atmospheric pressure is greater than the vapor pressure

- Purpose for heating any liquid is to make its vapor pressure equal
- The term vapor refers to the gas phase of a substance that is ordinarily a solid or liquid at that temperature.

*The first liquid to boil has the weakest force of attraction: propanol has the strongest vapor pressure

- 150 kPa below sea level
- Below sea level, the atmospheric pressure is greater, therefore the boiling point is greater as the vapor pressure must be increased to equal the vapor pressure and you would need to heat the liquid at a higher temperature to make its vapor pressure equal, boiling point for water will be above 100 degrees Celsius
- 150 kPa Boiling Point of Water: 111 degrees Celsius
- Ethanoic Acid: Highest boiling point, weaker vapor pressure, stronger force of attraction
- The more kinetic energy, the more vapor pressure
- A liquid boils when atmospheric pressure equals vapor pressure

Relationship between vapour pressure, atmospheric pressure, & boiling point: Every liquid has a vapor pressure. at boiling point, vapor pressure = atmospheric pressure

at temperatures below boiling point, vapor pressure dependent upon temperature. molecules in liquid have energy to escape surface of the liquid and become a gas molecule. as temperature closes in on boiling point, more molecules will have energy to escape surface of the liquid.