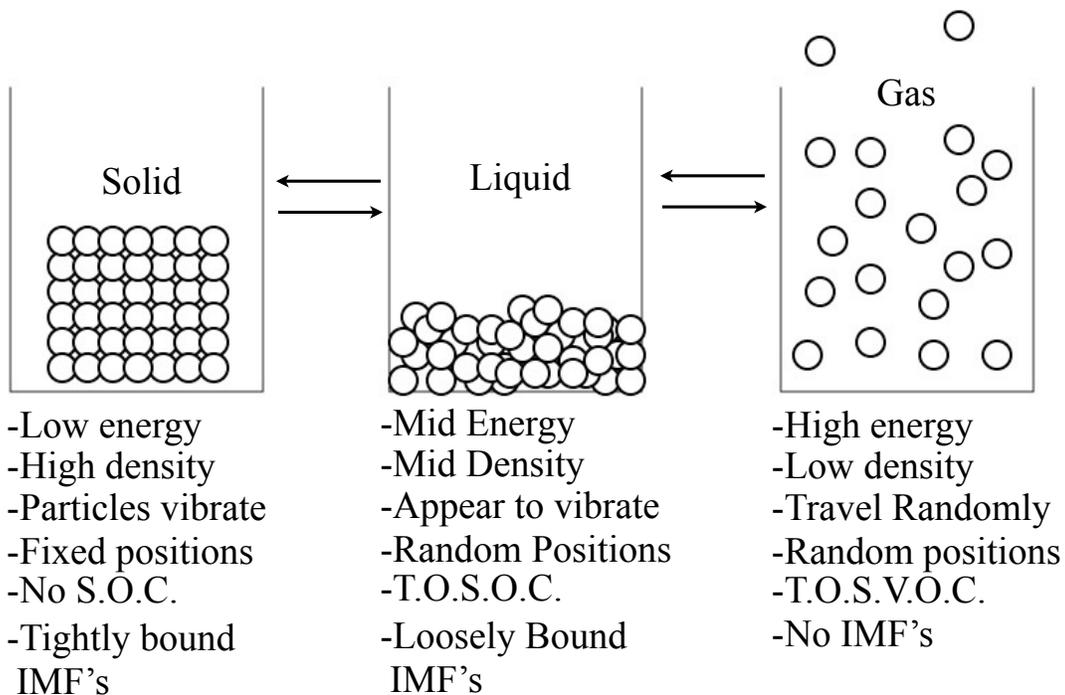


Ideal Gases & Gas Laws

Ideal Gases and Gas Laws

Phase Characteristics



Ideal Gases and Gas Laws

Ideal Gases

- When we study gases, their behaviors can be so complex that we can't study them mathematically, without using extremely complex equations.
- To avoid this, we use a simplified model for gases
 - This allows use of more simplified mathematics to describe their behaviors
 - The simplifications that we make do not significantly change our results, but they do greatly simplify the math
- Ideal Gases
 - A gas composed of particles with...
 - **Mass, but no volume**
 - The gas molecules are so spread out that their tiny size is insignificant
 - **No intermolecular forces**
 - The gas molecules are so spread out that they can't attract each other

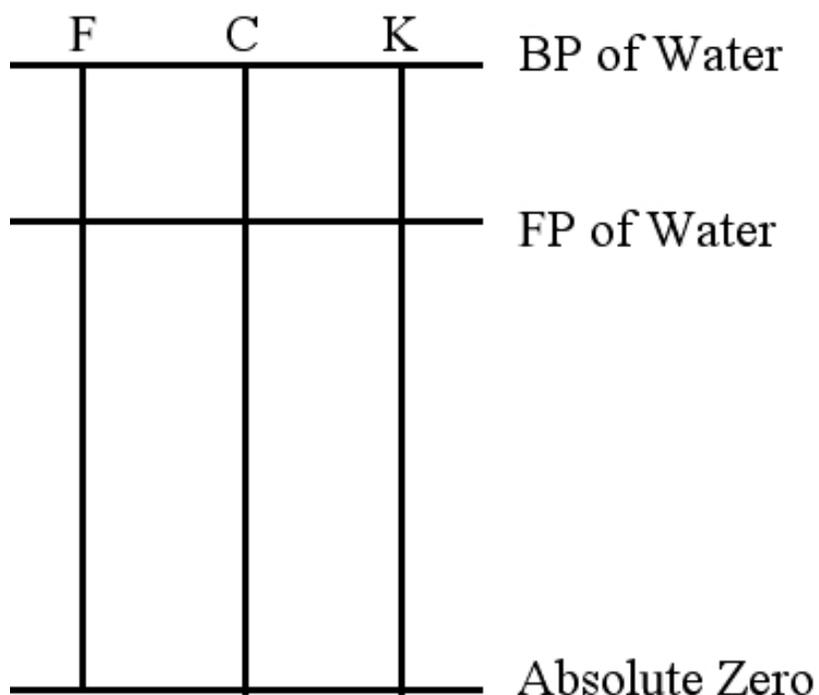
Ideal Gases and Gas Laws

STP

- In order to study gases, we must control the factors that influence the behavior of the gas
 - Temperature
 - Pressure
- To do this, we determine a standard for each
 - Standard Temperature
 - 0°C or 273 K
 - $\text{K} = \text{C}^{\circ} + 273$

Ideal Gases and Gas Laws

Standard Temperature



Ideal Gases and Gas Laws

STP

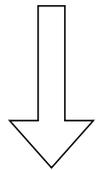
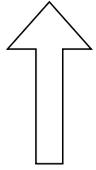
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 - Temperature
 - Pressure
- To do this, we determine a standard for each
 - Standard Temperature
 - 0°C or 273 K
 - $\text{K} = \text{C}^{\circ} + 273$
 - Standard Pressure
 - The pressure at sea-level on an average day
 - 14.69 psi
 - 760 mm Hg (Torr)
 - 1 atm
 - $101.3\text{ kpa (kilopascals)}$
- Now that we have identified the factors that influence the behavior of a gas, we are now ready to examine how adjusting them affects a gas

Ideal Gases and Gas Laws

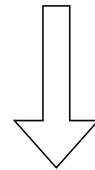
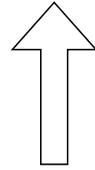
Charles' Law

- The volume of a gas, at constant pressure, varies directly with Kelvin temperature

Temperature



Volume



Ideal Gases and Gas Laws

Charles' Law

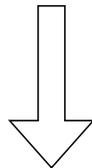
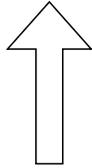


Ideal Gases and Gas Laws

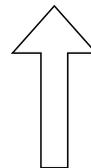
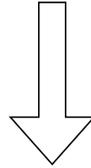
Boyle's Law

- The volume of a gas, at constant temperature, varies inversely with pressure

Pressure



Volume



Ideal Gases and Gas Laws

Boyle's Law



DEPTH	ABSOLUTE PRESSURE	GAUGE PRESSURE	AIR VOLUME	SURFACE VOLUME EQUIVALENT	EXAMPLE
0	1 ATM	0 ATM	1	1	60
10	2 ATM	1 ATM	1/2	2	30
20	3 ATM	2 ATM	1/3	3	20
30	4 ATM	3 ATM	1/4	4	15
40	5 ATM	4 ATM	1/5	5	12

Ideal Gases and Gas Laws

Problem Solving Strategy

- Determine which factors are causing the volume of the gas to change. These could be:
 - Pressure
 - Temperature
 - Both
- Remove any variables which remain constant
- Solve:

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

Ideal Gas Law

Avogadro's Principle

- Imagine a 30 gallon trash can, like the one at the front of our classroom. Estimate how many of each are required to fill it...
 - Tennis Balls
 - Volleyballs
- Our hypothesis...
 - It takes more small things to fill a space than it does big things

Ideal Gas Law

Avogadro's Principle

- Avogadro's Principle
 - Two *similar* gas samples will contain the same number of particles, because the particles are not in contact, but small rapidly moving objects.
 - *Similar*
 - Pressure
 - Temperature
 - Volume
- Ideal Gas Equation
 - $PV = nRT$
 - P = pressure (atm)
 - V = volume (liters)
 - n = number of moles
 - R = universal gas constant
 - (0.08206 L·atm/mol·K)
 - T = temperature (K)

Ideal Gases and Gas Laws

- 10.2 / 10.3 / 10.4 / 10.25 / 10.26 / 10.29 not d / 10.33 / 10.35 / 10.39