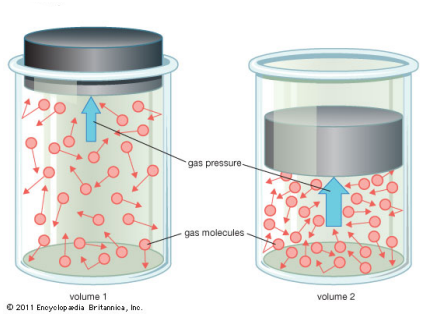
5.3 - The Ideal Gas Law



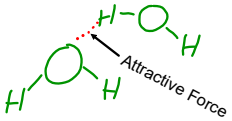
Ideal Gases

Different gases have different expansion properties, depending on how they interact.

At low pressures, however, all gases exhibit identical expansion behavior.

Non-interactive gases are called Ideal Gases (a theoretical condition), and are considered to have:

1. no mass,
2. no electrostatic interactions,
3. no volume,
4. no collisions.



Who's Heard of STP?

Not the Stone Temple Pilots (90's era grunge band).

Stands for: **S**tandard **T**emperature and **P**ressure

Defined: 0 degrees Celsius (273 K), and 1.0 atm (1.0 E 5 Pa) of pressure.

The utility of STP is that a lot of gas problems start at STP before changes occur (temp, pressure, volume, amount of gas).

Ideal Gas Law

So far we have dealt with two parameters of gases simultaneously.

The Ideal Gas Law unites all four parameters, relating moles, pressure, temperature, & volume!

$PV = nRT$	P = pressure (atm) V = volume (L) n = number of moles of gas (mol) R = Universal Gas Constant: $0.0821 \frac{L \bullet atm}{K \bullet mol}$ T = temperature (Kelvins)

The Universal Gas Constant (R) is a factor that ties the four variables together at ANY condition.

1. Ideal Gas Example

If the pressure exerted by a gas at 298 K in a volume of 0.044 L is 3.81 atm, how many moles of gas are present?

Ideal Gas Law:

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{3.81\,atm \bullet 0.044\,L}{0.0821 \frac{L \cdot atm}{K \cdot mol} \bullet 298\,K} = 0.00685\,moles$$

2. Volume Change Example

A sample containing 0.350 moles of argon at 13.0ºC and pressure of 568 torr is heated to 56.0ºC and a pressure of 897 torr. What volume change occurred?

List known values (and conversions):

n = 0.350 mol (constant)
P_1 = 568 torr = 0.747 atm
P_2 = 897 torr = 1.18 atm
T_1 = 13.0 ºC = 286 K
T_2 = 56.0 ºC = 329 K

Find initial and final volumes, then calculate the difference.

Homework:

Read 5.4 in your book.

5.3 Booklet Problems
Due: Next Class