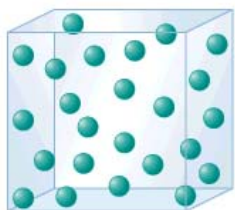


Gases

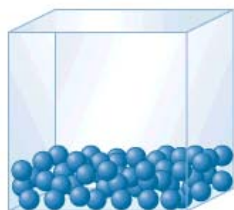
Part 7

Phases of Matter



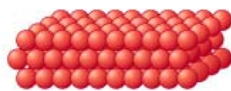
Gas

Molecules far apart
and disordered
Negligible interactions
between molecules



Liquid

Intermediate
situation



Solid

Molecules close
together and ordered
Strong interactions
between molecules

Kinetic Molecular Theory (“Ideal Gases”)

- 1) The molecules of a gas are in continual, and random, motion of varying speeds.
- 2) The **average kinetic energy** of the gas molecules is directly proportional to the temperature of the gas.
- 3) The gas molecules collide with each other and with the walls of their container, but kinetic energy is conserved.
- 4) The separation between gas molecules is much larger than the molecules themselves (KMT assumes the molecules have no volume).
- 5) The molecules do not stick together after collisions because there is no attractive energy between them.
- 6) The collisions between the molecules and the walls of the container give rise to the pressure.

Same thing again

1. Gas molecules moving in straight lines
2. Temperature related to $KE(1/2 mv^2)$
3. Molecules act like billiard balls, collisions are elastic.
4. Volume of molecules small compared to volume of the gas. **An ideal gas molecule has no volume.**
5. Gas molecules do not stick to each other. **Ideal gases have no attraction.**
6. Pressure is related to collisions with the side wall of the container.

Properties of Gases

- Volume, V: measured in liters (L)
- Amount, n: measured in moles
- Temperature, T: measured in kelvin (K)
 - $K = C + 273.15$
- Pressure, P: measured in atmospheres (atm)
 - $760 \text{ torr} = 760 \text{ mm Hg} = 1 \text{ atm}$
 - $14.70 \text{ lb/in}^2 = 1 \text{ atm}$

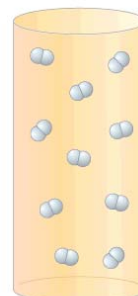
Pressure in a closed system

- $P = \text{force/area}$
- in a closed system, the force is the molecules hitting the sidewall of the container.
- The area is the area of the walls of the container

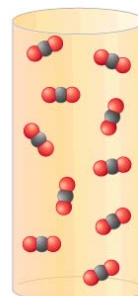
<http://mc2.cchem.berkeley.edu/Java/molecules/index.html>

2 tanks, equal T, V, P and n

All gases tend to act the same. There are no attractive forces to differentiate a H_2 and a CO_2 .



H_2

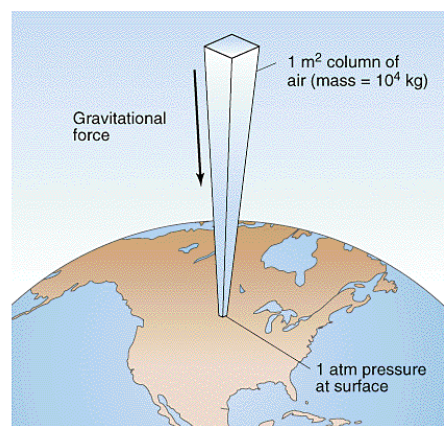


CO_2

Pressure in an open system

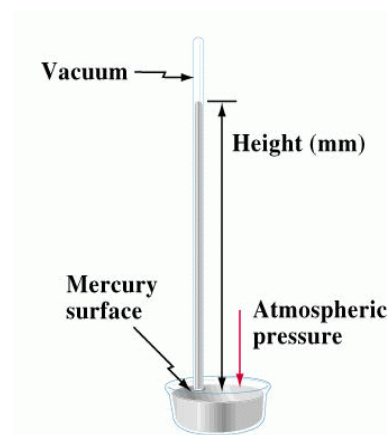
What is the pressure of the atmosphere on your book sitting on your desk?

- Pressure = force/area.
- The area is the area of the top of the book.
- Imagine a column of gas extending from your book to the top of the stratosphere. The force comes from the weight of that gas pushing down. ($F = mg$ where $g = 9.8 \text{ m/s}^2$).



Barometer

- measuring P
- Hg in tube feels weight of 1 atm
- Hg in bottom of tube feels weight of 760 mm Hg
- Which is denser air or Hg?



Describing Gases (Ideal Gas Law)

• Since all gases act mostly like ideal gases, they follow the same behavior, described by

$$PV = nRT$$

$R = 0.08206 \text{ L atm/mole K}$.

What is the volume of one mole of air at STP, 1.00 atm and 0 ° C?

Henry's Law

- **The solubility of a gas in a liquid is directly proportional to the partial pressure of that gas above the liquid.**
- **Important in the carbonation of soda.**
- **The Bends.**