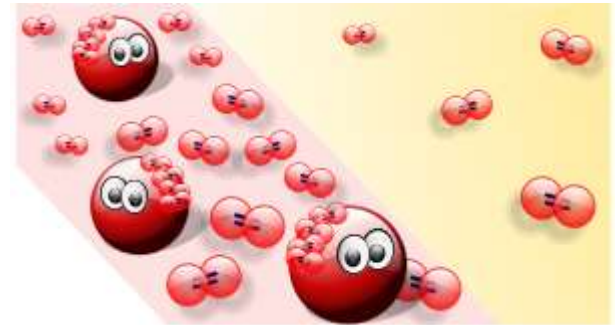
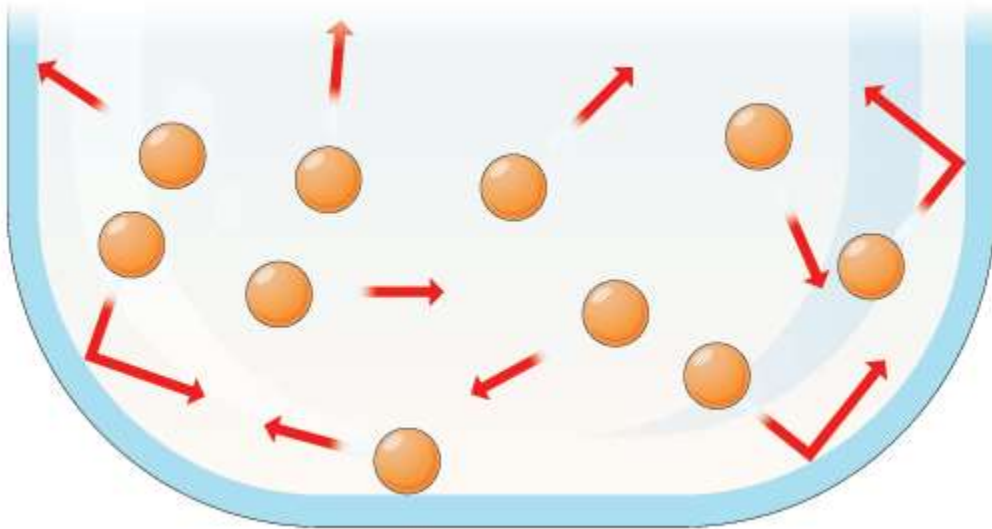
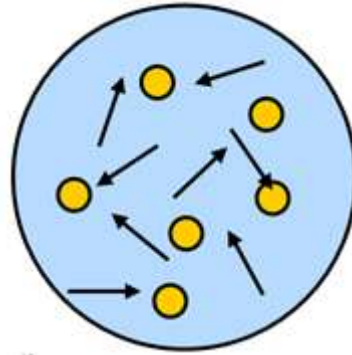


Gases



- Ideal Gases



- Real Gases



Ideal gas law

For calculations related to this slide refer to the [book](#)

Boyle's law: $V \propto \frac{1}{P}$ (constant n, T)

Charles's law: $V \propto T$ (constant n, P)

Avogadro's law: $V \propto n$ (constant P, T)

Boyle's Law

$$PV = k$$

Charles's Law

$$\frac{V}{T} = k$$

P and V
change
 n, R, T
are
constant

Ideal
Gas Law

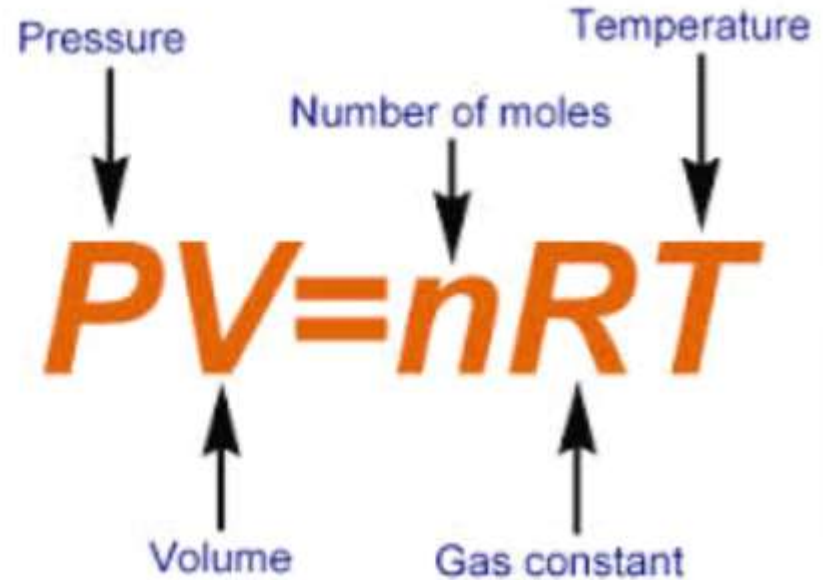
$$PV = nRT$$

T and V
change
 P, n, R
are
constant

$P, V,$ and T
change
 n and R
are
constant

Combined
Gas Law

$$\frac{PV}{T} = k$$



Molar gas constant:

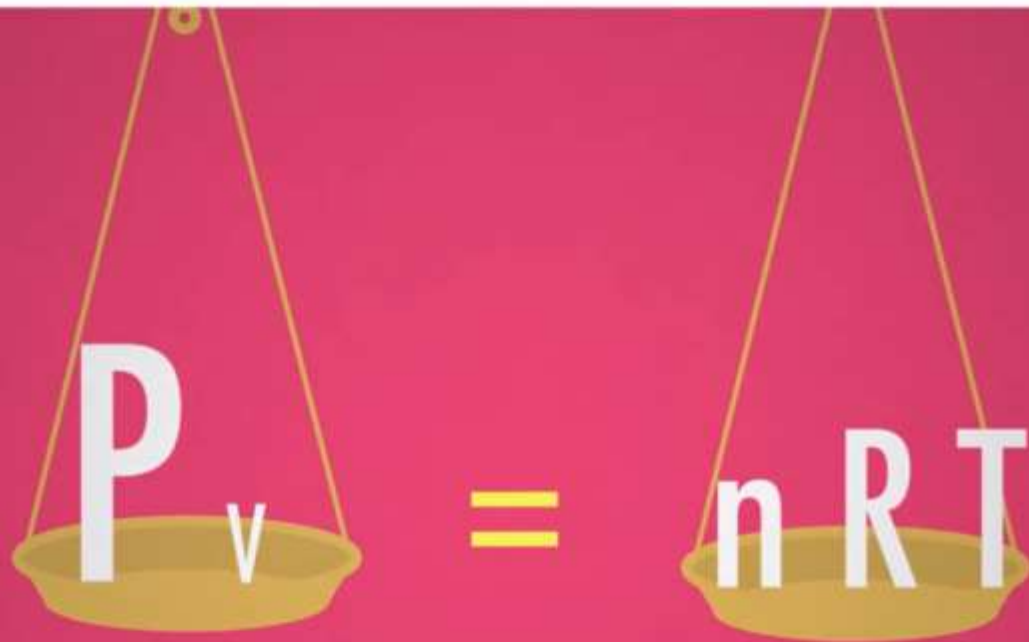
$$R = \frac{PV}{T}$$

= 0.08205 liter atm/mole K

= 8.314×10^6 erg/mole K

= 1.987 cal/mole deg

10/31/2015



Molecular weight

- ▶ Molecular weight can be determined using ideal gas law

$$PV = \frac{g}{M}RT$$

$$M = \frac{gRT}{PV}$$

If 0.30 g of ethyl alcohol in the vapor state occupies 200 mL at a pressure of 1 atm and a temperature of 100°C, what is the molecular weight of ethyl alcohol? Assume that the vapor behaves as an ideal gas. Write

$$M = \frac{0.30 \times 0.082 \times 373}{1 \times 0.2}$$

$$M = 46.0 \text{ g/mole}$$

The van derWaals Equation for Real Gases

$$\left(P + \frac{an^2}{V^2} \right) (V - nb) = nRT$$

internal pressure per mole resulting from the intermolecular forces of attraction between the molecules

incompressibility of the molecules, that is, the ***excluded volume***, which is about four times the molecular volume

- ▶ When the volume of a gas is large, the molecules are well dispersed. Under these conditions, a/V^2 and b become insignificant with respect to P and V , respectively. Under these conditions, the van der Waals equation for 1 mole of gas reduces to the ideal gas equation, $PV = RT$, and at low pressures, real gases behave in an ideal manner.

Refer to the book example 2-5 chapter 2

Liquefaction of Gases

- ▶ When a gas is cooled, it loses some of its kinetic energy in the form of heat, and the velocity of the molecules decreases.
- ▶ *critical temperature*: Above which it is impossible to liquefy a gas irrespective of the pressure applied
- ▶ *critical pressure*: The pressure required to liquefy a gas at its critical temperature which is also the highest vapor pressure that the liquid can have.
- ▶ The further a gas is cooled below its critical temperature, the less pressure is required to liquefy it.
- ▶ The critical temperature of water is 374°C, or 647 K. and its critical pressure is 218 atm,
- ▶ **At critical temperature ΔH_v of water = ???**

Aerosols

- ▶ Advantages of aerosols. [refer to the book]
- ▶ Gases can be liquefied under high pressures in a closed chamber as long as the chamber is maintained below the critical temperature.
- ▶ When the pressure is reduced, the molecules expand and the liquid reverts to a gas.
- ▶ **Propellant:** material that is liquid under the pressure conditions existing inside the container but that forms a gas under normal atmospheric conditions.
- ▶ If the drug is nonvolatile, it forms a fine spray as it leaves the valve orifice; at the same time, the liquid propellant vaporizes off.
- ▶ Chlorofluorocarbons and hydrofluorocarbons
- ▶ nitrogen and carbon dioxide.
- ❑ Metered dose inhalation products???