Ideal Gas Law & Gas Stoichiometry

Ideal Gas Law

P V = n R T

- P = Pressure (atm)
- V = Volume (L)
- T = Temperature (K)
- n = number of moles
- R = 0.0821 L atm / mol K

PV = nRT

- Calculate the number of moles of a gas contained in a 3.0 L vessel at 300.0K with a pressure of 1.50 atm

Example

Dinitrogen monoxide (N_2O), laughing gas, is used by dentists as an anesthetic. If 2.86 mol of gas occupies a 20.0 L tank at 23°C, what is the pressure (mmHg) in the tank in the dentist office?

Note: 1atm = 760 mm Hg

Permutations of the Ideal Gas Law

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

- P = Pressure (atm)
- V = volume (L)
- m = mass of the gas (g)
- R = 0.0821 L atm / mol K
- T = Temperature (K)
- M = molecular mass

Example

- What is the pressure 2.0 g of nitrogen gas in a 5.0 L container at 300.0 K?

Permutations of the Ideal Gas Law

$$P = \frac{DRT}{M}$$

- P = pressure (atm)
- D = density (g/L)
- R = 0.0821 L atm / mol K
- T = temperature (K)
- M = molecular mass

Example

- What is the molar mass of a gas that has a density of 1.40 g/L at STP?
  - NOTE – STP is standard temperature and pressure
  - At STP temperature is 273 K and pressure is 1.00 atm

Avogadro's Principle

- _____– equal volumes of gases at equal temperature and pressure contain the same number of particles
- _____– the volume of gas that 1 mole of a substance occupies at STP
- At STP 1 mol of a gas = _____
- New conversion factor at STP ONLY!

$$\frac{1 \text{ mol}}{22.4 \text{ L}}$$

Example

- Calculate the volume 0.881 mol of a gas will occupy at STP.

Example

- Calculate the volume that 2.000 kg of methane would occupy at STP.