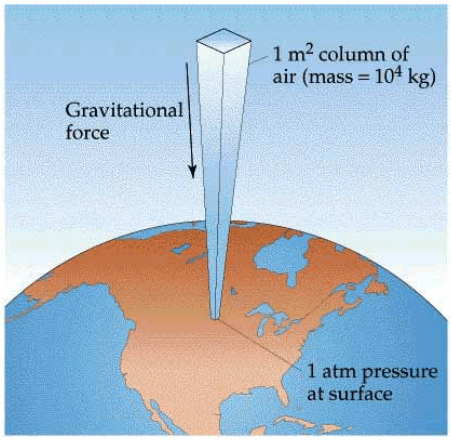
Pressure, Partial Pressure and Density

Pressure of Gases

Pressure

- Pressure is a force exerted on a given area

$$P = \frac{\text{Force}}{\text{Area}}$$



Pressure of Gases

Pressure

- Pressure is a force exerted on a given area

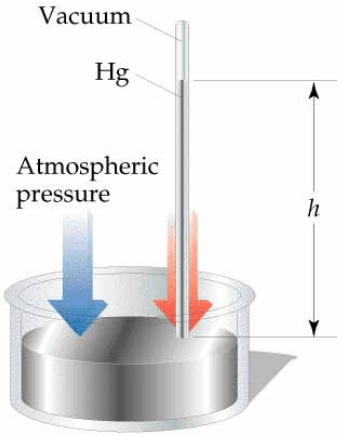
$$P = \frac{\text{Force}}{\text{Area}}$$

- This force is caused by the downward force of gravity acting on the air in our atmosphere
- The SI unit for pressure is the pascal (Pa)
  - 1 Pa = 1 N/m^2
  - We commonly use the kilopascal (kPa)

Pressure of Gases

Pressure

- Measuring atmospheric pressure
  - Directly measured with a barometer
  - A column of mercury supported by atmospheric pressure
- Values for Standard Pressure (1 atm)
  - 760 mm Hg
    - mm Hg = torr
  - 101.325 kPa
  - 1 atm



Mixtures of Gases

Dalton's Law of Partial Pressures

- The total pressure of a mixture of gases equals the sum of the pressures that each would exert if it were present alone
- We are going to express this reality both as a sum and as a fraction…

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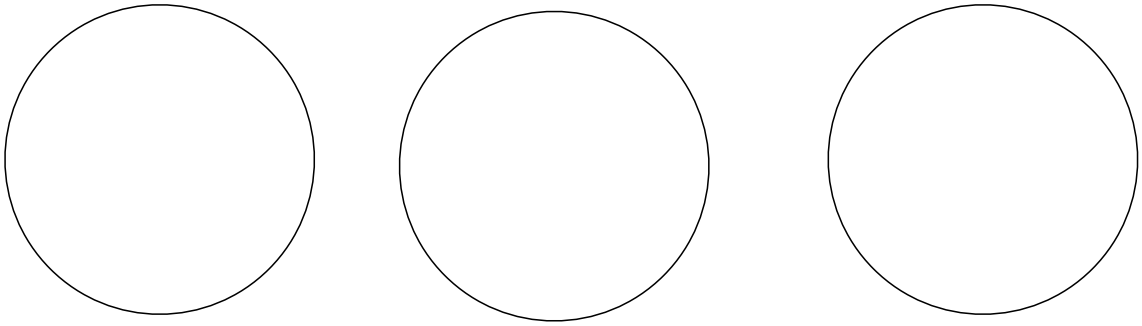
Dalton's Law of Partial Pressures

- The total pressure of a mixture of gases equals the sum of the pressures that each would exert if it were present alone
- We are going to express this reality both as a sum and as a fraction…
- $P_t = P_A + P_B + P_C + \ldots\ldots$
- The pressure that a gas contributes to a mixture is proportional to the number of moles it contributes to the mixture



Mixtures of Gases

Mole Fractions

- Because each gas in a mixture behaves independently, we can relate the amount of any component to its partial pressure.
- PV = nRT
- P = nRT/V
- For a mixture of gases, the ratio of pressures is equal to the ratio of moles of gas

$$\frac{P_a}{P_t} = \frac{n_a \cancel{RT/V}}{n_t \cancel{RT/V}} = \frac{n_a}{n_t}$$

Mixtures of Gases

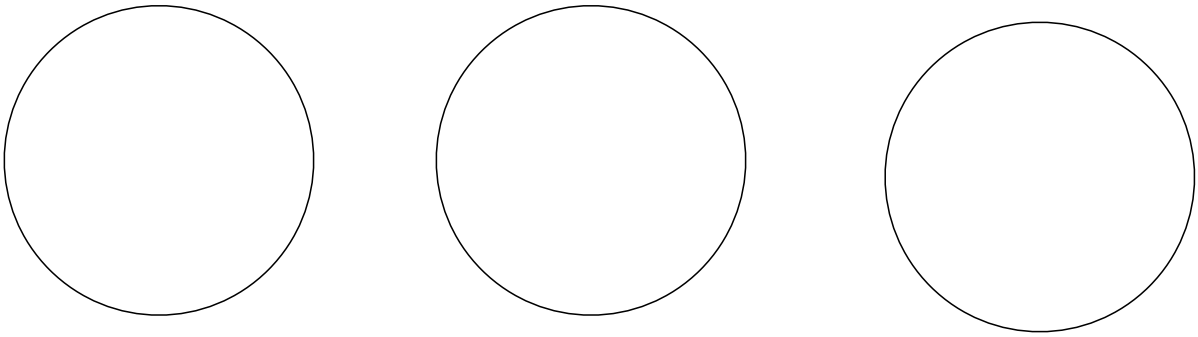
Mole Fractions

$$\frac{P_a}{P_t} = \frac{n_a}{n_t} = X$$

- The ratio n_a/n_t is referred to as the mole fraction (X)
  - A dimensionless number that expresses the ratio of moles of one component to the total number of moles of gas in a mixture

$$\frac{P_a}{P_t} = X$$

$$P_a = X_a P_t$$



Density of Gases

Reworking Pivnert for Density

- The ideal gas equation (with a little finagling) can be used to calculate the density of a gas...

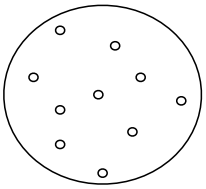
$$PV = nRT$$

Density of Gases

Reworking Pivnert for Density

$$D = \frac{MP}{RT}$$

- What does this equation tell us about the factors that affects a gas's density?
  - Density and molecular mass vary directly
  - Density and pressure vary directly
  - Temperature and density vary inversely



Mixtures of Gases

Homework

- 10.1 / 10.5 / 10.6 / 10.7 / 10.13 / 10.15a / 10.23 / 10.49 / 10.50 / 10.53 / 10.59 / 10.61 / 10.65 / 10.67 / 10.71