10/13/08 Review

- Equipartition Theorem

For each mode of energy a particle picks up

$$\frac{1}{2} k_B T$$

of average energy

Monotonic gas (atom)

$$\epsilon_a = \frac{3}{2} k_B T$$

per atom

Diatomic gas

Vibration (2 modes)
rotation (2 modes)

but @ T_{room} Vibration not active because levels are quantized and diatomic molecule in $V=0$ or ground stat with no extractable Vibrational energy. Rotation is active

$$\Rightarrow \epsilon_a = \frac{5}{2} k_B T$$

- Molar Specific Heats

Const. Volume $C_V = \frac{3}{2} R$ monotonic gas

$= \frac{5}{2} R$ diatomic gas

Const. pressure $C_P = \frac{5}{2} R$ monotonic

$= \frac{7}{2} R$ diatomic

- Important processes
  - Isothermal $\Delta T = 0$
    for ideal gas $\Rightarrow \Delta E = 0$

$PV = \text{const}$

  - adiabatic $Q = 0$
    $\Delta E = -W$ (done by system)

$PV^{\gamma} = \text{Const.}$

$\gamma = \frac{C_P}{C_V}$

- Average velocity.

$$\frac{1}{2} m \langle v^2 \rangle = \frac{3}{2} k_B T$$

$$\Rightarrow \quad \langle v^2 \rangle = \frac{3 k_B T}{m}$$

$$v_{rms} = \sqrt{\langle v^2 \rangle}$$