lecture 2 - 1st law

- internal energy $U = U_t + U_p$ (kinetic + dynamic)
- transformations - reversible/irreversible
- work δW is an ordered transfer of energy
  reversible - $W_{AB} = -\int_A^B PdV$
- heat δQ is a "disordered" transfer of energy
- internal energy is a function of state (not work or heat)
- 1st law - conservation of energy
  $dU = \delta W + \delta Q$
- internal energy - state function
  $U = U(P,T)$ - any 2 variables

$$dU = \frac{\partial U}{\partial P}|_T dP + \frac{\partial U}{\partial T}|_P dT \tag{1}$$

- specific heat -

$$C_V = \frac{1}{M}\frac{\delta Q}{dT}|_V = \frac{1}{M}\frac{\partial U}{\partial T}|_V \tag{2}$$

$$C_P = \frac{1}{M}\frac{\delta Q}{dT}|_P = \frac{1}{M}[\frac{\partial U}{\partial T}|_P + P\frac{\partial V}{\partial T}|_P] \tag{3}$$

- ideal gas - $U(T)$ - Joule experiment
  $U = \frac{3}{2}Nk_BT$ - monoatomic
  $U = \frac{5}{2}Nk_BT$ - diatomic
  $C_P - C_V = \frac{Nk_B}{M}$
- Mayer relation

$$U = \frac{l}{2}Nk_BT \rightarrow \gamma = \frac{C_P}{C_V} = \frac{l+2}{l} \tag{4}$$

- reversible isothermal transformation of ideal gas

$$W = -Nk_B T \ln(V_2/V_1) \tag{5}$$

- reversible adiabatic transformation of ideal gas

$$PV^{\gamma} = const. \quad T = \frac{const}{V^{\gamma-1}} \tag{6}$$