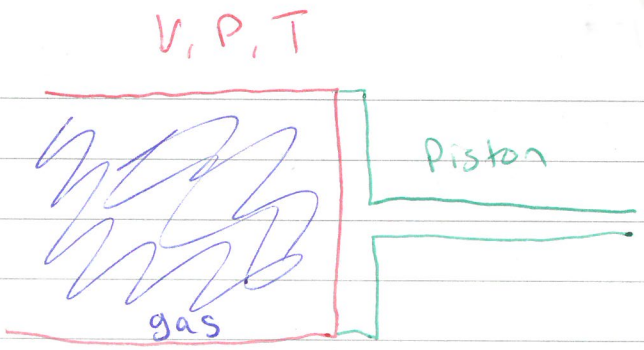
Derivation of Mayer's relation



$\int P dV$

First law of thermodynamics: $\Delta U = \Delta Q_{in} + W_{on}$

Constant volume: $\Delta U = \Delta Q_1 = \frac{\Delta Q_1}{\Delta T} \Delta T = C_v \Delta T$

constant pressure: $\Delta U = \Delta Q_2 - P\Delta V$

$\Delta Q_2 = \Delta U + P\Delta V = \frac{\Delta Q_2}{\Delta T} \Delta T = C_p \Delta$

$\therefore \Delta U = C_v \Delta T = C_p \Delta T - P\Delta V$

$C_v \Delta T = C_p \Delta T - P\Delta V$

$(C_p - C_v)\Delta T = P\Delta V$

$C_p - C_v = \frac{P\Delta V}{\Delta T}$

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

$\therefore nR = \frac{P\Delta V}{\Delta T}$

$$\boxed{C_p - C_v = nR}$$