FIRST LAW AND RELATED RESULTS

First Law: $Q = \Delta U - W$

C_P defined: $Q = nC_P\Delta T$ for $P = $ constant

C_V defined: $Q = nC_V\Delta T$ for $V = $ constant

Ideal gas: $U = \frac{1}{\gamma-1}nRT$ $\quad PV = nRT \quad \Delta U = nC_V\Delta T$

$\quad C_V = \frac{1}{\gamma-1}R \quad C_P = \frac{\gamma}{\gamma-1}R \quad C_P/C_V = \gamma \quad C_P = C_V + R$

ADIABATIC: $Q = 0$

$0 = \Delta U - W \quad P_1 V_1^{\gamma} = P_2 V_2^{\gamma} \quad T_1 V_1^{\gamma-1} = T_2 V_2^{\gamma-1}$

$Q = 0 \quad \Delta U = W = nC_V\Delta T \quad W = (P_2 V_2 - P_1 V_1)/(\gamma - 1)$

ISOBARIC: $P = $ constant

$Q = \Delta U - W \quad P\Delta V = nR\Delta T \quad V_2/V_1 = T_2/T_1$

$Q = nC_P\Delta T \quad \Delta U = nC_V\Delta T \quad W = -P\Delta V$

ISOTHERMAL: $T = $ constant

$Q = \Delta U - W \quad \Delta(PV) = 0 \quad P_1 V_1 = P_2 V_2$

$Q = nRT\ln(V_2/V_1) = P_1 V_1 \ln(P_1/P_2) \quad \Delta U = 0 \quad W = -Q$

ISOCHORIC: $V = $ constant

$Q = \Delta U \quad V\Delta P = nR\Delta T \quad P_2/P_1 = T_2/T_1$

$Q = nC_V\Delta T \quad \Delta U = nC_V\Delta T \quad W = 0$