Principle of Adiathermal work.

the amount of work required to change the state of a thermally isolated system depends solely on the initial and final states.

Internal Energy

$dU = dQ + dW$. for a closed system

Work done by a pV system

$$W = \int -p\,dV$$

Heat Capacities

— constant volume

$$C_V = \frac{dQ_V}{dT} = \frac{d(U+pV)}{dT}\Big|_V = \frac{\partial U}{\partial T}\Big|_V$$

— constant pressure

$$C_p = \frac{dQ_p}{dT} = \frac{\partial U}{\partial T}\Big|_p + p\frac{\partial V}{\partial T}\Big|_p$$

$C_p > C_V$

Adiabatic Index

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