Thermodynamics

Internal Energy

$dU = nC_v dT$, $T\uparrow$, $U\uparrow$ (Temp $\propto$ Internal Energy)

$\downarrow$

State function
(i.e doesn't depend on path)

} All will have same ΔU.

Work Done

$W = \int P \cdot dV$

→ Area under (P-V) curve is work done by gas.

→ It depend upon: initial, final state and path dependent

(+) Vol. ↑

(−) Vol. ↓

Processes

Isobaric

P = const

$W = P(V_2 - V_1)$

Isochoric

V = const.

$W = 0$

Isothermal

T = const.

$W = nRT \ln\left(\frac{P_1}{P_2}\right)$

$= nRT \ln\left(\frac{V_2}{V_1}\right)$

Adiabatic

$Q_{exchange} = 0$

$W = \frac{P_2V_2 - P_1V_1}{1-\gamma}$

$= \frac{nR(T_2 - T_1)}{1-\gamma}$

Heat

Const. Volume

$\Delta Q = nC_v dT$

Const. Pressure

$\Delta Q = nC_p \Delta T$

$\Delta Q = W$

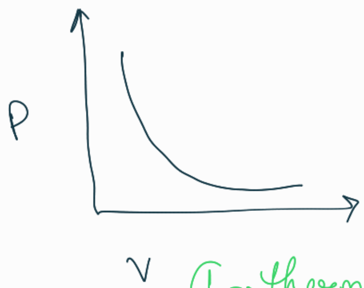
Const. Temp

Zeroth Law :- All three body will be in thermal equilibrium

1st Law :-

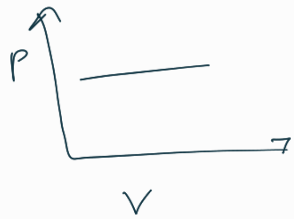
$$\boxed{\Delta Q = W + \Delta U}$$

Temp = const. then ΔU = const.

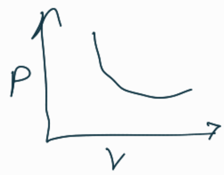


Isothermal

Isochoric



Isobaric



Adiabatic

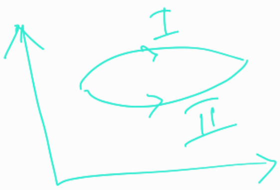
$$\frac{dP}{dV} = \frac{-P}{V}$$

$$\frac{dP}{dV} = \frac{-\gamma P}{V}$$

- Slope of Adiabatic > slope of isothermal
- Area of isothermal > Area of Adiabatic

- For cyclic process, $\Delta U = 0$

$$\boxed{\therefore \Delta Q = W}$$

- 

$$\boxed{\Delta U_{I} = \Delta U_{II}}$$

- polytropic process :-

(i) PV^{x} = const.

(ii) $W = \frac{P_2V_2 - P_1V_1}{1-x}$

$= \frac{nR(T_2 - T_1)}{1-x}$ → polytropic index

(iii) $C = C_v + \frac{R}{1-x}$