THERMODYNAMICS MINDMAPS..

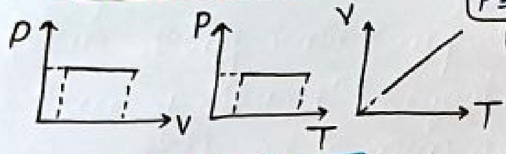
Zeroth Law and Thermodynamic Process :→

• **Zeroth Law**: If A is in thermal equilibrium of B and B is in thermal eq.^{m} of C, then A and C are also in thermal eq.^{m} (A and C at same temp.)

• **Thermodynamic Process** :

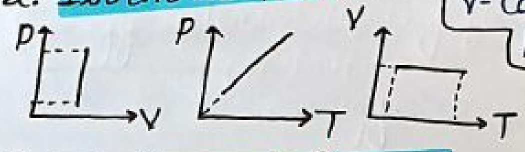
1. **Isobaric Process** :

$\boxed{P = \text{Constant}}$ $\boxed{V \propto T}$



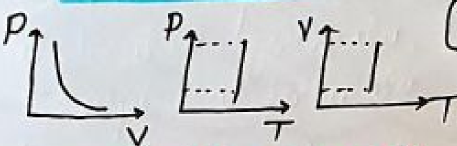
2. **Isochoric Process** :

$\boxed{V = \text{Constant}}$ $\boxed{P \propto T}$



3. **Isothermal Process** :

$\boxed{T = \text{Constant}}$ $\boxed{PV = \text{Constant}}$



4. **Adiabatic process** :

$\boxed{PV^{\gamma} = \text{Constant} / TV^{\gamma-1} = \text{Constant}}$

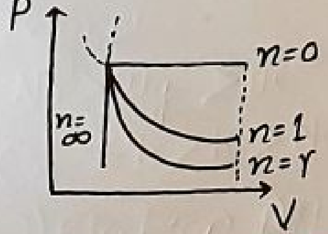
$\boxed{\gamma = \frac{C_P}{C_V} = \frac{f+2}{f}}$

Polytropic Process and Internal Energy →

• **Polytropic Process** :

$\boxed{PV^n = \text{Constant}}$

$n = 0 \rightarrow$ Isobaric, $\boxed{n = \gamma \rightarrow \text{Adiabatic}}$.
$n = 1 \rightarrow$ Isothermal, $\boxed{n = \infty \rightarrow \text{Isochoric}}$.



$\boxed{\frac{dP}{dV} = -\frac{nP}{V}}$

• **Internal Energy** :

$\boxed{U = \frac{f}{2} nRT}$

$f = 3 \rightarrow$ monoatomic
$f = 5 \rightarrow$ di-atomic
} for rigid molecules

f = degree of freedom

Laws Of Thermodynamics →

• **First Law** : $\boxed{Q = \Delta U + W}$

→ For adiabatic process : $\boxed{Q = 0}$

$\boxed{W = -\Delta U}$ & $\boxed{\gamma = \frac{f+2}{f}}$

for monoatomic gas, $\boxed{\gamma = 5/3}$
for di-atomic gas, $\boxed{\gamma = 7/5}$

→ for isothermal process :

$\boxed{\Delta T = 0}$ $\boxed{\Delta U = 0}$ $\boxed{Q = W}$

→ for isochoric process :

$\boxed{W = 0}$ $\boxed{Q = \Delta U}$

• **Heat Engine** →

$\boxed{\eta = \frac{W}{Q_1} = 1 - \frac{T_2}{T_1}}$ η = Efficency.

• **Refrigerator** →

$\boxed{\alpha = \frac{Q_2}{W} = \frac{T_2}{T_1 - T_2}}$ α = Coeff. of performance.

• **Second Law** :-

① **Clausius** : No process is possible whose sole result is the transfer of heat from a colder object to hotter object.

② **Kelvin-Plank** : No process is possible whose sole result is the absorption of heat from a reservoir and then complete conversion into work.

Molar Specific Heat Capacity →

$\boxed{C = \frac{Q}{n\Delta T}}$ $\boxed{C_P = \frac{Q}{n\Delta T} = R\left[\frac{f}{2} + 1\right]}$

$\boxed{C_V = \frac{Q}{n\Delta T} = \frac{f}{2} R}$

For polytropic process :

$\boxed{C_n = C_V + \frac{R}{1-n}}$ $\boxed{C_n = \frac{R}{(\gamma - 1)} + \frac{R}{(1-n)}}$

Work Done by Gas → $\boxed{W = \int_{V_1}^{V_2} P\,dV}$

1. **Isochoric Process:** $\boxed{dV = 0 \longrightarrow W = 0}$
2. **Isobaric Process:** $\boxed{W = \int_{V_1}^{V_2} P\,dV = nR(T_2 - T_1)}$
3. **Isothermal Process:**

$$\boxed{W = nRT\ln\left[\frac{V_2}{V_1}\right] = 2.303\,nRT\log_{10}\left[\frac{V_2}{V_1}\right].}$$

4. **Polytropic Process:**

$$\boxed{W = \frac{nR(T_2 - T_1)}{1-n} = \frac{P_2V_2 - P_1V_1}{1-n}}$$

for adiabatic process: $\underline{n = \gamma}$

$\boxed{\text{Work done = area under P-V curve.}}$

- **Work Done for Cyclic Process:** —

Work Done ⟶ (+ve) for clockwise process.

Work Done ⟶ (−ve) for anti-clockwise process.