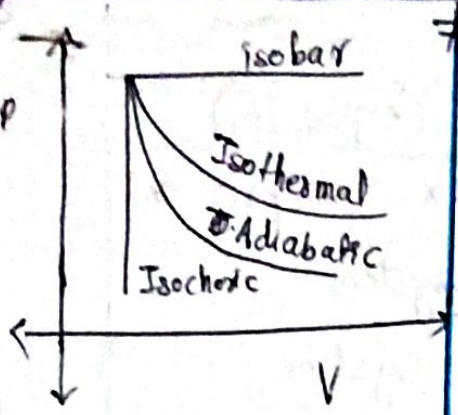


$W = -P_{ext}\,\Delta V$

$W = -\int_{V_1}^{V_2} P_{ext}\,\Delta V$

1 atm l = 101.3 J

1 dm^3 Bar = 100 J

1 Bar = 10^5 Pa

Work Dones

1) Isochoric Process ($\Delta V = 0$)

$W = 0$

2) Isobaric Process ($\Delta P = 0$)

$W = -P_{ext}\,\Delta V$

3) Isothermal Process

$W = -nRT\log_e\left(\frac{V_2}{V_1}\right)$

OR

$W = -2.303nRT\log_{10}\left(\frac{V_2}{V_1}\right)$

OR

$W = -2.303nRT\log_{10}\left(\frac{P_1}{P_2}\right)$

$P_1V_1 = P_2V_2$ ⇒ for isothermal

$P_1V_1^{\gamma} = P_2V_2^{\gamma}$ ⇒ for adiabatic

↳ Poisson's equation

4) Adiabatic Process ($Q = 0$)

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

OR

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

for irreversible adiabatic

$W = -P_{ext}\,\Delta V$

$\Delta U = \Delta q + \Delta W$

- Change in U
- Heat given to system
- Work done on the system

Enthalpy:

$H = U + PV$

In Chemical Rxn

$W = -\Delta n_g RT$

$\Delta H = \Delta U + \Delta n_g RT$

$\Delta S_{surroundings} = -\frac{\Delta H}{T}$

Work (W) & Heat (Q) ⇓ Path function

Enthalpy of Sublimation

$\Delta_{sub}H = \Delta_{fus}H + \Delta_{vap}H$

$\Delta_{fus}H$ = Enthalpy of fusion

$\Delta_{vap}H$ = Enthalpy of vapourization.

Entropy:

$\Delta S = \Sigma S_{product} - \Sigma S_{reactant}$

$\Delta S = \frac{q_{reversible}}{T}$

1 J = 4.184 cal

Extensive / Extensive = Intensive

In any cyclic process

→ change in [illegible] is

↳ state function → zero.

$\Delta q \neq 0$ & $\Delta W \neq 0$

Quantity	Sign	When applicable
W	−	Work done by the system (expansion)
W	+	Work done on the system (compression)
q	+	Heat absorbed by the system
q	−	Heat given out by the system
ΔU	+	Energy absorbed by the system
ΔU	−	Energy given out by the system

Extensive Property	Intensive Property
Mass, Volume, no. of moles, internal Energy, Heat capacity.	Density, M.P, B.P, Refractive index, Specific heat capacity, Viscosity.
① Energy → Enthalpy, → Entropy, → Gibb's free Energy	Concentration terms: → Molarity, molality, mole fraction, Normality
	Mole Entropy, Molar Enthalpy
	→ pH, Temperature, Surface tension.

$1m^3 = 10^3 dm^3 = 10^6 cm^3 = 10^6 mL = 10^3 L$

$1L = 1000 mL$; $1mL = 10^{-3} L$; $1L = 1dm^3 = 10^3 cm^3$

Bond Enthalpy & Enthalpy of Reaction.

$$\Delta H^\circ (\text{reaction}) = \sum_m \Delta H^\circ (\text{Reactant Bonds}) - \sum_n \Delta H^\circ (\text{Product Bonds})$$

Internal Energy $\propto$ Temperature. $\Delta U = n C_v \Delta T$

Heat at Const. Volume $q_v = U$ (Internal E.)

const. Pressure $q_p = H$ (Enthalpy)

Entropy:
Graphite > Diamond.

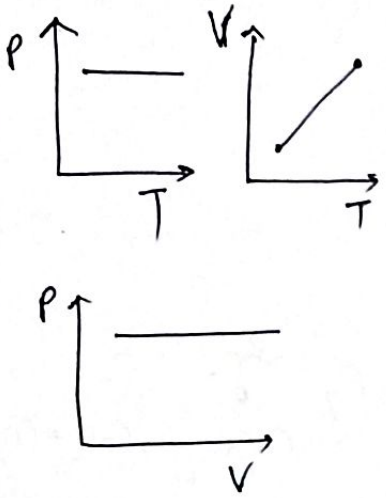
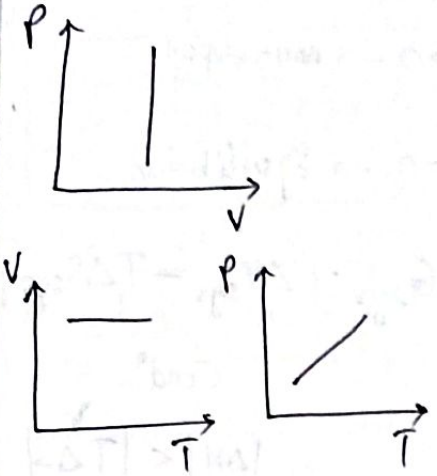
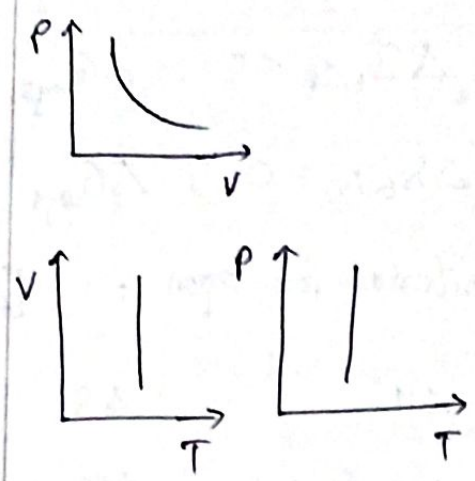
$$\Delta S_{fus} = \frac{\Delta H_{fus}}{T} \qquad \Delta S_{vap} = \frac{\Delta H_{vap}}{T} \qquad \Delta S_{sub} = \frac{\Delta H_{sub}}{T}$$

Entropy : gas > Liquid > Solid

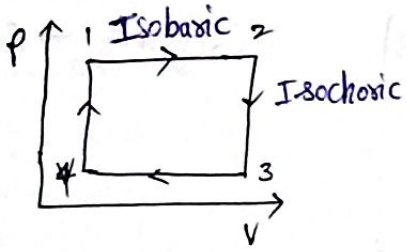
Bond formation ⟶ Energy release. (Exothermic)

Expand → Heating
Compress → Cooling

Processes $(PV = nRT)$

Isobaric ($\Delta P = 0$)	Isochoric ($\Delta V = 0$)	Isothermal ($\Delta T = 0$)
		

Cyclic: The process in which initial & final states are same with the formation of loop.



Calcu^{n} of Entropy in diff process:

$$\Delta S = n C_{v,m} \log_e\left(\frac{T_2}{T_1}\right) + nR \log_e\left(\frac{V_2}{V_1}\right)$$

$$\Delta S = n C_{p,m} \log_e\left(\frac{T_2}{T_1}\right) + nR \log_e\left(\frac{P_1}{P_2}\right)$$

Case I: In Isobaric process:

$$\Delta S = n C_{p,m} \log_e\left(\frac{T_2}{T_1}\right)$$

Case II: Isochoric process

$$\Delta S = n C_{v,m} \log_e\left(\frac{T_2}{T_1}\right)$$

Case 3: Isothermal

$$\Delta S = nR \log_e\left(\frac{V_2}{V_1}\right) = nR \log_e\left(\frac{P_1}{P_2}\right)$$

Irr adia

Rever. adia

$$\Delta S = \frac{q_{rev}}{T}$$

$\because q = 0$

$\therefore \Delta S = 0$

isoentropic processes.

Gibbs Helmholtz eqn: ① State fun^n ② Extensive

ZnO is photocatalyst.

$$\boxed{\Delta G = \Delta H - T\Delta S}$$

$$\Delta G_{sys} = -T\Delta S_{univ}$$

1) $\Delta S_{univ} > 0$; $\Delta G_{sys} < 0 \rightarrow$ spontaneous.

2) $\Delta S_{univ} < 0$; $\Delta G_{sys} > 0 \rightarrow$ non-spon.

3) $\Delta S_{univ} = 0$; $\Delta G_{sys} = 0 \rightarrow$ Equilibrium

Criteria for spon : $[\Delta G_{sys} = \Delta H_{sys} - T\Delta S_{sys}]$

ΔH	ΔS	Cond^n	Eg.
+ve (endo)	+ve	$\lvert\Delta H\rvert < \lvert T\Delta S\rvert$	$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$
+ve (endo)	-ve	Always non-sponta.	$3O_{2(g)} \rightarrow 2O_{3(g)}$
-ve (exo	+ve	Always sponta	$2O_{3(g)} \rightarrow 3O_{2(g)}$
- ve (exo)	- ve	$\lvert\Delta H\rvert > \lvert T\Delta S\rvert$	$CaO_{(s)} + CO_{2(g)} \rightarrow CaCO_{3(s)}$

Reactivity $\propto$ Bond length

1amu or $u = 1.6656 \times 10^{-24}$ g