Thermodynamics

Mob. no.- 8756319727
Chemistry department D. B. college (Jaynagar) GMail→ akhileshsingh021@gmail.com
B.Sc (II) (Hon)
Akhilesh kumar Singh

For ideal gas, Relation b/w Cp and Cv

$$H = E + PV$$

$$H = E + nRT$$

for $n = 1$ $\quad H = E + RT$

Differentiation w.r.t T

$$\frac{dH}{dT} = \frac{dE}{dT} + R$$

$$C_P = C_V + R$$

$$\boxed{C_P - C_V = R}$$ Mayer's formula

$$\boxed{\frac{C_P}{C_V} = \gamma}$$ Possion's Ratio

$$\frac{C_P}{C_V} - \frac{C_V}{C_V} = \frac{R}{C_V}$$

$$\gamma - 1 = R/C_V$$

$$C_V = \frac{R}{\quad}$$

for diatomic

$\gamma = 7/5 \quad C_v = 5/2 R \quad C_p = 7/2 R$

$\gamma = 4/3 \quad C_v = 3R \quad C_p = 4R$

Work done in different process:-

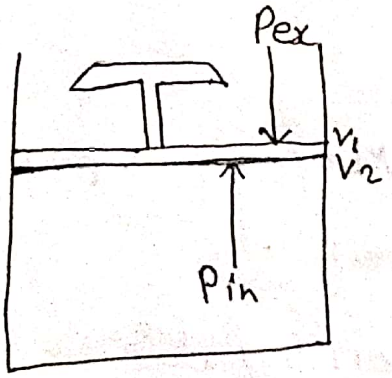
Isothermal Process: $\Delta T = 0$

$\Delta E = 0$

$q + w = 0$

$\boxed{W = -q}$

for Reversible isothermal Process:-



$W = -\int_{V_1}^{V_2} P_{ex}\, dV$

$= -\int_{V_1}^{V_2} (P_{in} + dP)\, dV$

$= -\int_{V_1}^{V_2} P_{in} dV - \int_{V_1}^{V_2} dP/dV$

$PV = nRT$

$P = \frac{nRT}{V}$

$W = -\int_{V_1}^{V_2} P_{in}\, dV$

$= -\int_{V_1}^{V_2} \frac{nRT}{V}\, dV$

$$= -nRT \int_{V_1}^{V_2} \frac{dV}{V}$$

$$= -nRT \left[\ln V \right]_{V_1}^{V_2}$$

$$= -nRT \left[\ln V_2 - \ln V_1 \right]$$

$$W = -nRT \ln \frac{V_2}{V_1}$$

T → const
$P \propto \frac{1}{V}$

$$\boxed{W = -2.303\, nRT \log_{10} \frac{V_2}{V_1}}$$

$$\boxed{W = -2.303\, nRT \log_{10} \frac{P_1}{P_2}}$$

$$q = -W$$

$$\boxed{q = +2.303\, nRT \log \frac{V_2}{V_1} = +2.30\, nRT \log \frac{P_1}{P_2}}$$

Adiabatic Process:—

$$\boxed{q = 0}$$

$$\Delta E = q + W$$

$\boxed{W = \Delta E}$ → heat at Const Volume

$$W = nC_v \Delta T$$

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

(4)

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

Irreversible Process :-

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

Isochoric $\Delta V = 0$

$$W = 0$$

Free Expansion $P_{ext} = 0$

$$W = 0$$

for chemical reacn. $W = -P_{ext}\Delta V$

$$W = -\Delta n_g RT$$

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