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Deg II. Chem. Hons, Paper - III

Topic :- Thermodynamics

Entropy :-

Clausius introduced the thermodynamic function called entropy.

(1) **δQ is not a Perfect differential**

We know that Q is not a state function and change in its value depends upon the nature of Path by which the thermodynamic change is accomplished. In mathematical language we can say that δQ is not Perfect differential and so it cannot be written as a Perfect differential dQ.

(2) **$\delta Q/T$ is a Perfect differential**

Clausius deduced the quantity $\delta Q/T$ as a Perfect differential and gave it the name entropy

Let us consider a number of isothermals at temperatures T_1, T_2, T_3 etc on the Pressure-Volume diagram as shown in fig - (1)

Let A_1B_1 and A_2B_2 be the two adiabatics which intersects these

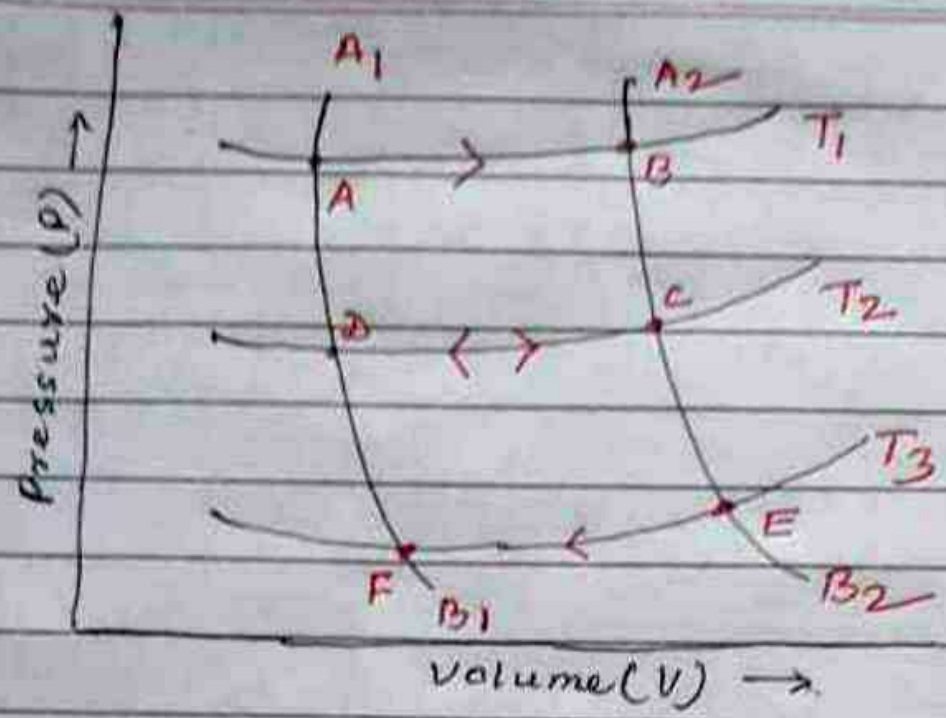
isothermals in Point A and B, C and D, E and F etc. Then all along the adiabatics A_1B_1 and A_2B_2 there is a change in volume and temperature with change in Pressure. Let ABCD and DCEF represent the Carnot's reversible cycle. Now Consider a Cycle ABCD for its working substance between temperature T_1 and T_2. Let Q_1 be the heat absorbed from A to B at temperature T_1 and Q_2 be the heat rejected from C to D at temperature T_2 then from the theory of Carnot cycle —

$$\frac{Q_2}{Q_1} = \frac{T_2}{T_1} \quad \text{or} \quad \frac{Q_2}{T_2} = \frac{Q_1}{T_1} \quad \text{— (1)}$$

Similarly, Considering the cycle CDFE, If Q_2 is the quantity of heat taken at temperature T_2 and Q_3 is the quantity of heat rejected at temperature T_3 then $\frac{Q_2}{T_2} = \frac{Q_3}{T_3}$ ——— (2)

From (1) and (2) we get

$$\frac{Q_1}{T_1} = \frac{Q_2}{T_2} = \frac{Q_3}{T_3} = \text{... Constant}$$



In going from one adiabatic to the other heat energy is either absorbed or liberated. The amount of heat absorbed or liberated is not constant but depends upon the temperature. Higher the temperature, more is the heat absorbed or liberated and vice-versa.

In general if Q represents the amount of heat liberated or absorbed at a temperature T in going from one adiabatic to the other then Q/T = Constant

The constant ratio (Q/T) is called the change in entropy between the states represented by two adiabatics.