Dr. L. K. Mishra
Deptt of Chemistry

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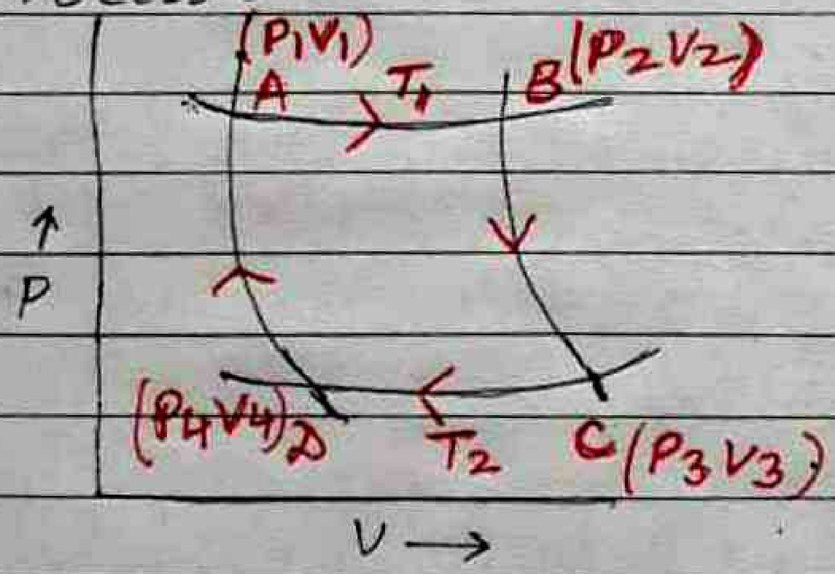
Deg II Chem. Hons. Paper – III

Topic:- Entropy (Thermodynamics)

Entropy Change in Reversible Processes :-

If a system undergoes a physical or a chemical process, there occurs a change in the entropy of a system and also in its local surroundings, This total change in the entropy of the system and its surroundings is called the entropy change of the process. Let us consider the entropy change in any reversible Process :-



Let us start with a Carnot cycle shown in figure. Let us consider the first stage represented by AB. In this process the working substance absorbs heat Q_1 from the reservoir at temperature T_1 (T_1)

This results in an increase in the entropy of the working substance given by

$$(S_B - S_A)_{system} = \frac{Q_1}{T_1} \quad \text{--- (1)}$$

The surroundings lose the same amount of heat Q_1 at the same temperature. The result is that there will be a change in the entropy of the surroundings as given by

$$(S_B - S_A)_{sur} = \frac{-Q_1}{T_1} \quad \text{--- (2)}$$

Therefore, the total change in the entropy due to an isothermal reversible process is given by (1) & (2)

$$(S_B - S_A)_{rev} = (S_B - S_A)_{system} + (S_B - S_A)_{sur}$$

$$= \frac{Q_1}{T_1} - \frac{Q_1}{T_1} = 0 \quad \text{--- (3)}$$

Hence the change of the entropy in a reversible isothermal process is zero

Now consider a reversible adiabatic curve BC. In this process the working substance does not transfer or take the heat from the surroundings ie $Q = 0$. Therefore, the change in entropy along reversible adiabatic BC is given by $(S_C - S_B)_{system} = 0$ — (4)

Similarly the surroundings donot undergo any heat change thus

$$(S_C - S_B)_{sur} = 0 \quad \text{——— (5)}$$

Therefore, the total change in entropy in any reversible adiabatic Process is obtained by (4) & (5)

$$(S_C - S_B)_{rev} = (S_C - S_B)_{system} + (S_C - S_B)_{sur} = 0$$

It means that the entropy change in a reversible adiabatic is also zero.

These adiabatics (like adiabatic BC) of Constant entropy are known as isentropics.