Determination of absolute entropy of gases and liquids:

Suppose we want to find absolute entropy of a gas at T°C under atmospheric pressure. Then

(i) The crystalline solid is heated from absolute zero to its fusion point. ie from T=0 to T = T_f. Where T_f is fusion point. Then

$$\Delta S_1 = \int_0^{T_f} (C_p)_s \cdot \frac{dT}{T} \quad \text{—(1)}$$

where $(C_p)_s$ = Heat Capacity of solid.

(ii) The entropy in changing solid into liquid.

$$\Delta S_2 = \frac{\Delta H_f}{T_f} \quad \text{—(2)}$$

Where ΔH_f = Molar Latent heat of fusion.

(iii) The liquid is heated from its fusion point to boiling point (T_b). Then.

$$\Delta S_3 = \int_{T_f}^{T_b} (C_p)_l \cdot \frac{dT}{T} \quad \text{—(3)}$$

(iv) The entropy changing from liquid to gase at T_b is given by

$$\Delta S_4 = \frac{\Delta H_v}{T_b} \quad \text{—(4)}$$

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where, ΔH_v = Molar Latent heat of vaporisation.

(v) Entropy involved in heating gas from T_b to Temp T, is given by

$$\Delta S_5 = \int_{T_b}^{T} (C_p)_g \cdot \frac{dT}{T} \quad \text{——(5)}$$

where $(C_p)_g$ = Heat Capacity of Substance in gaseous State.

The absolute entropy (S_T) of gas at temp. T is

$$S_T = \Delta S_1 + \Delta S_2 + \Delta S_3 + \Delta S_4 + \Delta S_5$$

$$S_T = \int_0^{T_f} (C_p)_s \cdot \frac{dT}{T} + \frac{\Delta H_f}{T_f} + \int_{T_f}^{T_b} (C_p)_l \frac{dT}{T} + \frac{\Delta H_v}{T_b} + \int_{T_b}^{T} (C_p)_g \cdot \frac{dT}{T} \quad \text{——(6)}$$

The absolute entropy (S_T) of a liquid at temp T is

$$S_T = \Delta S_1 + \Delta S_2 + \Delta S_3$$

$$S_T = \int_0^{T_f} (C_p)_s \cdot \frac{dT}{T} + \frac{\Delta H_f}{T_f} + \int_{T_f}^{T} (C_p)_l \frac{dT}{T} \quad \text{——(7)}$$

The absolute entropy S_T of a solid at temp. T is

$$S_T = \int_0^{T} (C_p)_s \cdot \frac{dT}{T} \quad \text{——(8)}$$

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