SUBJECT - CHEMISTRY

CLASS - B.Sc (Hons) PART - III

PAPER - V

TOPIC - The absolute entropy

Dr Hari Mohan prasad Singh
Department of Chemistry
Dr. L.K.V.D College Tajpur Samastipur

Q Calculate the absolute entropy of steam at 1 atm pressure and 100°C. Discuss the assumptions involved.

Ans The third law of thermodynamics is used to determine the absolute entropy of liquid or gaseous substances. In every case, we start with crystalline solid at 0K. Its absolute entropy is taken as zero. The total absolute entropy of a substance in a particular state at a given temperature will be the sum of all entropy changes the substance has to undergo in order to reach the particular state from crystalline solid at absolute zero. In our case, following steps are involved -

(i) Entropy change (ΔS_1) in heating of crystalline ice from 0K to its fusion temperature (T_f) ie $\Delta S_1 = \int_0^{T_f} C_{ps} d\ln T$ where C_{ps} is the heat capacity of ice.

(ii) Entropy change (ΔS_2) in the conversion of ice to water

s.e $$\Delta S_2 = \frac{\Delta H_f}{T_f}$$

where ΔH_f is the molar latent heat of fusion,

(iii) Entropy change (ΔS_3) in heating water from its T_f to its boiling point (T_b) s.e

$$\Delta S_3 = \int_{T_f}^{T_b} C_{pl} \cdot d\ln T$$

where C_{pl} is the heat capacity of water.

(iv) Entropy change (ΔS_4) in changing water to vapour state i.e

$$\Delta S_4 = \frac{\Delta H_v}{T_b}$$

where ΔH_v is the molar heat of vapourisation.

(v) Entropy change in heating the vapour to 373K (273+100°C) i.e

$$\Delta S_5 = \int_{Tb}^{T} C_{pg} \cdot d\ln T$$

where C_{pg} is the heat capacity of the steam.

Absolute entropy of steam at 1 atm. pressure at 100°C (S_T) =

$\Delta S_1 + \Delta S_2 + \Delta S_3 + \Delta S_4 + \Delta S_5$.