* Boltzmann Plank's Equation

OR Probability and Entropy

OR Statistical basic for 3rd law of Thermodynamics

Let us consider two systems 'A' & 'B' having entropies S_A & S_B and W_A and W_B are the no of configuration (Probability).

Since, Entropy is the measure of randomness of the molecular systems and thus larger is the randomness, greater is the no. of configuration. Therefore Entropy may be considered as a Universal function of configurations. (ie. Probability).

Thus, $S = f(W)$ ——— (1)

for systems - A

$$S_A = f(W_A) \quad \text{——— (2)}$$

& for systems - B

$$S_B = f(W_B) \quad \text{——— (2)}$$

When the systems - A & B Combined.

$$S_{Total} = S_A + S_B$$

and Probability —

$$W_{Total} = W_A \times W_B$$

$$\therefore S_{Total} = f(W_{Total}) = f(W_A \cdot W_B) \quad \text{——— (4)}$$

and $S_{Total} = S_A + S_B = f(W_A) + f(W_B)$ ——— (5)

on Compairing Eqs — (4) and (5) —

$$f(W_A \cdot W_B) = f(W_A) + f(W_B)$$

& Simply —

$$f(W) = K \ln W$$

Where K = Universal Constant known as Boltzmann Constant.

from Eq^{n} — (1) we may write -

$$\boxed{S = K \ln W} \quad \text{—— (6)}$$

This Eq^{n} — (6) is known as Boltzmann-Plank's Equation.

This equation gives the statistical interpretation of entropy which forms on the basis of 3rd law of thermodynamics.

which states that —

At absolute zero (0k), all the molecules would occupy the ground states and there is only one way of arranging the molecules in the various energy levels.

Thus, from Eq^{n} — (6)

$$S = K \ln W = K \ln 1 = 0$$

$$\therefore \boxed{S = 0}$$