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Topic :- Thermodynamics

Gibbs - Helmholtz equation :-

Gibbs-Helmholtz equation is applicable to both Physical and Chemical change. This can be derived from the Second Law of Thermodynamics by using free energy equation

Let us suppose that G_1 represents the free energy of a system in its initial state at temperature T. suppose that temperature rises to $T + dT$ where dT is infinitesimally small. Let the free energy at this new temperature is $G_1 + dG_1$

Now suppose that when the system is in its final state, its free energy is given by G_2 at T and $G_2 + dG_2$ at the temperature $T + dT$. If Pressure is constant all along then

$$dG_1 = -S_1 dT \quad \text{---(1)}$$

and $$dG_2 = -S_2 dT \quad \text{---(2)}$$

S_1 and S_2 are the entropies of

of the system in the initial and final state of the system subtracting eq (1) from eq. (2) we get

$$d(G_2 - G_1) = -(S_2 - S_1)\,dT$$

or $$d(\Delta G) = -\Delta S\, dT$$

As the pressure is constant

$$\left[\frac{\partial(\Delta G)}{\partial T}\right]_P = -\Delta S \quad \text{---} \quad (3)$$

As we know that

$$-\Delta S = \frac{\Delta G - \Delta H}{T}$$

$$\therefore \left[\frac{\partial(\Delta G)}{\partial T}\right]_P = \frac{\Delta G - \Delta H}{T}$$

$$\therefore \Delta G = \Delta H + T\left(\frac{\partial(\Delta G)}{\partial T}\right)_P$$

This equation is known as the Gibbs - Helmholtz equation.

It is applicable to all Processes occuring at Constant Pressure

It has been used to calculate the heat change, (ΔH) for a reaction taking Place at Constant Pressure Provided the values of free energy change at two different temp, are known