Gibbs free energy.

* German physicist Hermann Von Helmholtz c(1821-1894) was a Versatile scientist contribute his research to optics, thermodynamics, accounting and physiology.

* Let Us consider G_1, H_1 and s_1 represent the thermodynamic function in the Initial state. then the final state was mentioned as G_2, H_2 and s_2 in the final state. the temperature remain constant.

As we know that.

$$\boxed{G = H - Ts.} \longrightarrow \text{①}$$

∴ for the Initial and the final state it is Given by.

$$(G_2 - G_1) = (H_2 - H_1) - T.(s_2 - s_1) \longrightarrow \text{②}$$

$$\boxed{\Delta G = \Delta H - T\Delta s} \longrightarrow \text{②}$$

But at constant pressure the relation is mentioned as Internal energy 'U' therefore

$$\boxed{\Delta H = \Delta U + P\Delta V} \longrightarrow \text{③}$$

substitute eq No ③ in eq No ②.

$$\boxed{\Delta G = \Delta U + P\Delta V - T\Delta s} \longrightarrow \text{④}.$$

from the Internal energy relation W.k.T

$$\Delta A = \Delta U - T\Delta S$$

$$\Delta U = \Delta A + T\Delta S$$

from eq No ④

$$\Delta G = (\Delta A + T\Delta S) - T\Delta S + P\Delta V$$

$$\Delta G = \Delta A + P\Delta V$$ Where ΔA is equal to the Work function W_{max}

$$\Delta G = -W_{max} + P\Delta V$$

$$-\Delta G = W_{max} + P\Delta V$$

$P\Delta V$ is the Quantity Work done by the gas on expansion against the constant external pressure P.

$-\Delta G$ gives the maximum obtained Work from the system other than the system. The Work other than the system are called the NetWork.

$$\text{NetWork} = W - P\Delta V$$

$$= -\Delta G$$

$-\Delta G$ is the Network that can be obtained from the system at constant temp. and pressure The Quantity G is called the Gibbs function

Q) The Helmholtz equation

Let G_1 represents the free energy of a system in its Initial state at a temperature T.

Suppose the temperature arises, then it is mention as $\boxed{T + dT}$ where dT is infinitesimally small

Let the free energy for the New system arises as

$$\boxed{G_1 + dG_1}$$

Now the system is in the final stage then it is mentioned as. T_2 and G_2 and by the free energy is mentioned as

$$\boxed{G_2 + dG_2}$$

At the temperature $T + dT$ the pressure remains constant. all along for a closed system

then it is given by

Initial state = $dG_1 = -S_1 dT \rightarrow ①$

Final state $dG_2 = -S_2 dT \rightarrow ②$

Where S_1 and S_2 are the entropies of the system Initial and the final, then it is given by the relation

subetracting seq No ② from eq No ①

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

$$\boxed{\Delta G = -\Delta S \, dT} \longrightarrow ③$$

At the priessure Constant therefore

$$\left(\frac{\partial (\Delta G)}{\partial T}\right)_p = -\Delta S. \longrightarrow ④$$

Also from the relation.

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

$$\boxed{-\Delta S = \left(\frac{\Delta G - \Delta H}{T}\right)} \longrightarrow ⑤$$

Combine the equation No ④ and eq No ⑤

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

This is the final equationing the Gibbs Helmholtz equatoob

Application !!

* Nernest equation is the precursor for the Gibbs Hefeq
* clausiui - clapperon and Vant Hoff I sotherm can be determined
* EMF of the reversible Can be Calculated

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

Gibbs free energy for Water formation

Consider the reaction for the formation of Water

$$2H_{2(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(l)}$$

The Gibbs free energy relates the spontaneity of various reaction by looking at the change in enthalpy, temperature and entropy.

$$\boxed{\Delta G^0 = \Delta H^0 - T\Delta s}$$

It is an exothermic Reaction.
During the reaction the bonds are formed between the hydrogen gas and oxygen gas from Water.

Moles of a gas decreased and a liquid is formed so entropy is decreasing Well.

Formation of Water is a spontaneous reaction, so ΔG^0 must be Negative. Therefore Gibbs free energy is also a state function so looking at

$$\boxed{\Delta G^0_{reaction} = \sum \Delta G^0_{products} - \Delta G^0_{reactants}}$$

both the hydrogen and oxygen gas are in their standard state and have Gibbs free energy Zero. The Gibbs free energy for the Water is:

$$-273.13 \text{ kJmol}^{-1}$$

$$\Delta G^{\circ}_{reac} = -273.13 \text{ kJmol}^{-1} - 0 \text{ kJmol}^{-1}$$

$$\Delta G^{\circ}_{rxn} = -273.13 \text{ kJmol}^{-1}$$