Maxwell thermodynamic relation

Gibb's function → Gibb's function (G) is the energy liberated or absorbed in reversible process at constant pressure and constant temperature.

From the defination of enthalpy

$$H = U + PV$$

Change in enthalpy

$$dH + dU + d(PV)$$

$$dH = dU + Pdv + Vdp$$

$$dH = Tds + Vdp$$

If the process is isothermal

$$Tds = d(TS)$$

$$dH = d(TS) + Vdp$$

$$dH - d(TS) = Vdp$$

$$d(H - TS) = Vdp$$

Here $(H - Ts) = G$ is known as Gibb's function

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Sem III Unit IV

Maxwell thermodynamic relation

G remains constant if a thermodynamic process remains isothermal as well as isobaric

$dG = 0$ when the $dp = 0$

$$G = H - TS$$

$$dG = dH - d(TS)$$

$$= dH - Tds - sdT$$

$$dG = Tds + Vdp - Tds - sdT$$

$$dG = Vdp - SdT$$

Partial differenciation with respect to variables P & T

$$\left(\frac{\partial G}{dT}\right)_P = -S, \quad \left(\frac{\partial G}{\partial P}\right)_T = V$$

As dG is a perfect differential

$$\frac{\partial}{\partial P}\left(\frac{\partial G}{\partial T}\right)_P = \frac{\partial}{\partial T}\left(\frac{\partial G}{\partial P}\right)_T$$

$$\left(\frac{\partial V}{\partial T}\right)_P = -\left(\frac{\partial G}{\partial P}\right)_T$$

This equation is known as Maxwell's thermodynamic relation.