

SUBJECT - CHEMISTRY

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CLASS - B.Sc(Hons) PART-III

PAPER - V

TOPIC - chemical potential vary with temperature and pressure?

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Q How does chemical potential vary with temperature and pressure?

Ans The variation with temperature: The variation of chemical potential of Component i of a system with temperature can be derived by differentiating the equation (1) with respect to T and equation (2) with respect to n_i -

$$\left(\frac{\partial G}{\partial n_i} \right)_{T, P, n_1, n_2, \dots} = \mu_i \quad \text{--- (1)}$$

$$\text{and } \left(\frac{\partial G}{\partial T} \right)_{P, N} = -S \quad \text{--- (2)}$$

The results are

$$\frac{\partial^2 G}{\partial n_i \partial T} = \left(\frac{\partial \mu_i}{\partial T} \right)_{P, N} \quad \text{--- (3)}$$

$$\text{And } \left(\frac{\partial^2 G}{\partial T \partial n_i} \right) = \left(\frac{\partial S}{\partial n_i} \right)_{T, P, n_1, n_2, \dots} = \bar{S}_i \quad \text{--- (4)}$$

where \bar{S}_i is the partial molar entropy of Component i

Hence from eq (3) & (4) we have -

$$\left(\frac{\partial \mu_i}{\partial T} \right)_{P, N} = \bar{S}_i \quad \text{--- (5)}$$

Eqn (5) shows the variation of chemical potential (μ_i) of Component i with temperature (T).

Variation with pressure: The Variation of Chemical potential of Component i with pressure can be derived by differentiating eqn. (1) with respect to pressure and eqn (2) with respect to n_i -

$$\left(\frac{\partial G}{\partial n_i} \right)_{T, P, n_1, n_2} = \mu_i \quad (1)$$

$$\left(\frac{\partial G}{\partial P} \right)_{T, N} = V \quad (2)$$

The results are -

$$\frac{\partial^2 G}{\partial P \partial n_i} = \left(\frac{\partial \mu_i}{\partial P} \right)_{T, N} \quad (3)$$

$$\text{And } \left(\frac{\partial^2 G}{\partial n_i \partial P} \right) = \left(\frac{\partial V}{\partial n_i} \right)_{T, P, n_1, n_2} = \bar{V}_i \quad (4)$$

where \bar{V}_i is the partial molar volume of Component i

Hence from eqn (3) & (4) we have

$$\left(\frac{\partial \mu_i}{\partial P} \right)_{T, N} = \bar{V}_i \quad (5)$$

Eqn. (5) gives the variation of chemical potential (μ_i) of Component i with pressure (P).