

Answer

1-

- i- Chemical potential : the change in the Gibbs energy with the change in the mole of component I when T,P and the mole of other components are kept constant
- ii- Freezing point depression: the difference between the freezing points of the pure solvent and the solution containing the involatile solute
- iii- Molarity: it is the amount(mol) of the solute present in a unit volume of the solution
- iv- Partial molar property: the rate of change of the property with the amount of the component at constant T,P and mole of other component
- v- Vapour pressure of a liquid: the pressure exerted by the vapour in equilibrium with the liquid at a given temperature

2-

Chemical potential of ith component of a system is defined as

$$\mu_i = \left(\frac{\partial G}{\partial n_i} \right)_{T,P,n_j}$$

Differentiating this equation with respect to T at constant pressure and composition we get

$$\begin{aligned} \left(\frac{\partial \mu_i}{\partial T} \right)_{P,n_i} &= \frac{\partial}{\partial T} \left[\left(\frac{\partial G}{\partial n_i} \right)_{T,P,n_j} \right]_{P,n_i} \\ &= \frac{\partial}{\partial n_i} \left[\left(\frac{\partial G}{\partial T} \right)_{P,n_i} \right]_{T,P,n_j} \end{aligned}$$

Since G is a state and dG is exact differential

$$\text{And } \frac{\partial^2 G}{\partial T \partial n_i} = \frac{\partial^2 G}{\partial n_i \partial T}$$

The derivative $\left(\frac{\partial G}{\partial T} \right)_{P,n_i} = -S_i$, hence

$$\left(\frac{\partial \mu_i}{\partial T} \right)_{P,n_i} = - \left(\frac{\partial S_i}{\partial n_i} \right)_{T,P,n_j} = -S_{i,m}$$

On integration

$$\int_{\mu_1}^{\mu_2} d\mu_i = - \int_{T_1}^{T_2} S_{i,m} dT$$

$$\mu_i(T_2, P) - \mu_i(T_1, P) = - \int_{T_1}^{T_2} S_{i,m} dT$$

It is clear that chemical potential will decrease with increase of temperature

3-

A property is called extensive if its value is additive.

A property is called intensive if the system is divided into n parts, each part has the same value of the property.

Extensive property	intensive property
Enthalpy	Density
Volume	Temperature
Entropy	Molarity
No of moles	Pressure
	Viscosity

4-

For dilute solution

(i)

$$\pi V = n_2 RT = \frac{w_2}{M_2} RT$$

$$\pi = \frac{2}{69000} \times \frac{82 \times 300K}{100}$$

$$= 7.134 \times 10^{-3} atm$$

$$= 7.134 \times 10^{-3} \times 76 = 0.542 cm of mercury$$

(ii) π in centimeters of water

$$\pi = \rho gh \text{ dyn cm}^{-2}$$

$$= \left(\frac{\rho gh}{1013250} \right) atm$$

$$h = \frac{7.134 \times 10^{-3} \times 1013250}{1 \times 980.67} = 7.37 cm of solution$$

5-

$$\begin{aligned} \log x_2 &= \frac{\Delta H_{fus}}{2.303R} \left[\frac{1}{T_0} - \frac{1}{T} \right] \\ &= \frac{19290 \text{ J mol}^{-1}}{2.303 \times 8.314 \text{ J K}^{-1} \text{ mol}^{-1}} \left[\frac{1}{353 \text{ K}} - \frac{1}{298 \text{ K}} \right] \\ \therefore x_2 &= 0.298 \end{aligned}$$

This is the mole fraction of naphthalene in any ideal solution

