Answer on Question #76189 - Chemistry - Physical Chemistry

Question:

Derive the integrated form of clausius-clapeyron equation

Solution:

$$\left(\frac{\partial p}{\partial T}\right)_{\Delta G} = \frac{\Delta S}{\Delta V}$$

It is the Clapeyron equation. The Clapeyron equation is thermodynamically accurate. It does not contain approximations. There is another version of the Clapeyron equation that we obtain:

$$\left(\frac{\partial p}{\partial T}\right)_{\Delta G} = \frac{\Delta H}{T\Delta V}$$

This Equation is useful when we want to integrate dp to find p as a function of T. Integration of equations is the easiest if we can make a approximation either ΔS or ΔH is reasonably constant in the temperature range. However, ΔH usually changes slower with temperature than ΔS, so approximation is better when we integrate equation. Prepare equation for integration:

$$dp = \frac{\Delta H}{T\Delta V}dT$$

To integrate equation we must know how ΔH and ΔV depend on temperature:

$$p_2 - p_1 = \frac{\Delta H}{\Delta V}\ln\frac{T_2}{T_1}$$

$$p = p_1 + \frac{\Delta H}{\Delta V}\ln\frac{T}{T_1}$$