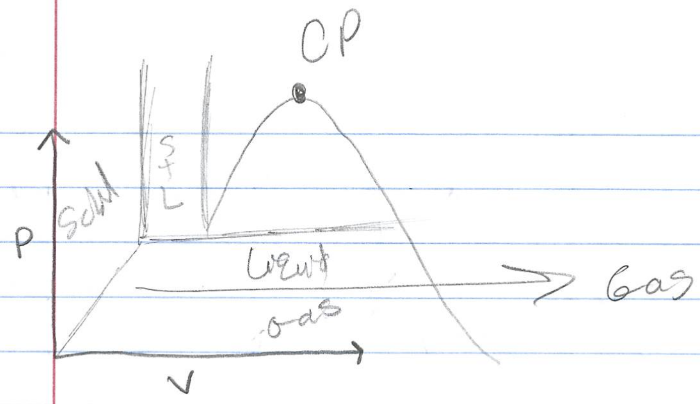

P-V diagram displays single and two phase coexistence region, acritical point, and a triple line.

$T_1 < T_2 < T_3 < T_4$

P-V-T diagram for ideal gas in section.

8.5- Providing a theoretical basis for the P-T Phase diagram

$$\mu_\alpha(P,T) = \mu_\beta(P,T)$$

$P,T \rightarrow P \alpha dP$

$$\mu_\alpha(P,T) + d\mu_\alpha = \mu_\beta(P,T) + d\mu_\beta$$

↳ for two phases to remain in equilibrium

$$d\mu_\alpha = d\mu_\beta$$

Because $d\mu$ can be expressed in terms of dT and dP

$$d\mu_\alpha = -S_{m\alpha}dT + V_{m\alpha}dP \quad \& \quad d\mu_\beta = -S_{m\beta}dT + V_{m\beta}dP$$

$d\mu$ can be equated yinlang

$$(S_{m\beta} - S_{m\alpha})dT = (V_{m\beta} - V_{m\alpha})dP \text{ or}$$

$$-S_{m\alpha}dT + V_{m\alpha}dP = -S_{m\beta}dT + V_{m\beta}dP$$

Clapeyron equation

$$\frac{dp}{dT} = \frac{\Delta S_m}{\Delta V_m} = \frac{S_{m\beta} - S_{m\alpha}}{V_{m\beta} - V_{m\alpha}}$$

$$\Delta G_{fusion} = \Delta H_{fusion} - T\Delta S_{fusion} = 0$$

$$\left(\frac{dP}{dT}\right)_{fusion} = \frac{\Delta S_{fusion}}{\Delta V_{fusion}} \approx \frac{22 \text{ J/m k}}{\pm 4.0 \times 10^{-6} \text{ m}^3/\text{m}}$$

$$= \pm 5.5 \times 10^6 \text{ Pa te}^{-1} = \pm 5.5 \text{ bar k}^{-1}$$

$$\left(\frac{dP}{dT}\right)_{vaporization} = \frac{\Delta S_{vaporization}}{\Delta V_{vaporization}} \approx \frac{95 \text{ J mol}^{-1} \text{ k}^{-1}}{2 \times 10^{-2} \text{ m}^3 \text{ mol}^{-1}} = 4.8 \times 10^3 \text{ Pa k}^{-1}$$

8.6- Using Clausius-Clapeyron equation to Calculate vapor pressure as a function of T

$$\int_{P_i}^{P_f} dP = \int_{T_i}^{T_f} \frac{\Delta S_{fusion}}{\Delta V_{fusion}} dT = \int_{T_i}^{T_f} \frac{\Delta H_{fus}}{\Delta V_{fus}} \frac{dT}{T} \approx \frac{\Delta H_{fus}}{\Delta V_{fus}} \int_{T_i}^{T_f} \frac{dT}{T}$$

$$P_f - P_i = \frac{\Delta H_{fus}}{\Delta V_{fus}} \frac{T_f}{T_i} = \frac{\Delta H_{fus}}{\Delta V_{fus}} \ln \frac{T_i + \Delta T}{T_i} \approx \frac{\Delta H_{fus}}{\Delta V_{fus}} \frac{\Delta T}{T_i}$$

Clausius - Clapesson Equation:

$$\frac{dP}{dT} = \frac{\Delta S_{vap}}{\Delta V_{vap}} \approx \frac{\Delta H_{vap}}{\Delta V_{vap}} = \frac{P \Delta H_{vap}}{RT^2} \Bigg\} \quad \int_{P_i}^{P_f} \frac{dP}{P} = \frac{\Delta H_{vap}}{R} \times \int_{T_i}^{T_f} \frac{dT}{T^2}$$

$$\ln \frac{P_f}{P_i} = -\frac{\Delta H_{vap}}{R} \times \left(\frac{1}{T_f} - \frac{1}{T_i} \right)$$

$$\frac{dP}{P} = \frac{\Delta H_{vap}}{R} \frac{dT}{T^2}$$

8.7 — The vapor pressure of a pure substance depends on the applied pressure

$$\mu_{liquid}(T,P) = \mu_{gas}(T,P)$$

$$\left(\frac{d\mu_{liquid}(T,P)}{\partial P} \right)_T = \left(\frac{d\mu_{gas}(T,P)}{\partial P} \right)_T \left(\frac{\partial P}{\partial P} \right)_T$$

$$V_m = V_m^{gas} \left(\frac{\partial P}{\partial P} \right)_T \quad \text{or} \quad \left(\frac{\partial P}{\partial P} \right)_T = \frac{V_m^{liquid}}{V_m^{gas}}$$

$$\frac{RT}{P} dP = V_m^{liquid} dP \quad \text{or} \quad RT \int_{P^*}^{P} \frac{dP'}{P'} = V_m^{liquid} \int_{P^*}^{P} dP'.$$

$\hookrightarrow$ Integrate

$$RT \ln \left(\frac{P}{P^*} \right) = V_m^{liquid} (P - P^*)$$

$$\ln \left(\frac{P}{P^*} \right) = \frac{V_m^{liq} (P - P^*)}{RT}$$