

$$2) a) \left(\frac{\partial T}{\partial P}\right)_{S, N} = \frac{\partial(T, S, N)}{\partial(P, T, N)} \frac{\partial(P, T, N)}{\partial(P, S, N)}$$

$$\frac{2/2}{=} = -\left(\frac{\partial S}{\partial P}\right)_{T, N} \left(\frac{\partial T}{\partial S}\right)_{P, N}$$

$$= -\left(\frac{\partial S}{\partial P}\right)_{T, N} / \left(\frac{\partial S}{\partial T}\right)_{P, N}$$

$$\text{but: } \left(\frac{\partial S}{\partial P}\right)_{T, N} = \left(\frac{\partial V}{\partial T}\right)_{P, N} = V\alpha$$

$$\left(\frac{\partial S}{\partial T}\right)_{P, N} = C_p / T$$

$$\Rightarrow \left(\frac{\partial T}{\partial P}\right)_{S, N} = \frac{TV\alpha}{C_p} \quad \checkmark \quad \#$$

$$b) \left(\frac{\partial T}{\partial P}\right)_{S, N} = \frac{T \left(\frac{\partial V}{\partial T}\right)_{P, N}}{C_p}, \quad V = \frac{NRT}{P} \quad \& \quad C_p = \frac{5}{2} NR$$

$$= \frac{T NR}{\frac{5}{2} NR P} = \frac{2}{5} \frac{T}{P} \quad \#$$

$$\Rightarrow \int \frac{dT}{T} = \frac{2}{5} \int \frac{dP}{P} \Rightarrow \ln T = \frac{2}{5} \ln P + \text{constant}$$

$$T = C P^{2/5}, \text{ where } C \text{ is constant}$$

$$\frac{T}{P^{2/5}} = \text{constant} \quad \#$$

$$\Rightarrow \frac{PV}{NR P^{2/5}} = \text{constant} \quad \checkmark \quad N \& R \text{ are constant}$$

$$P^{3/5} V = \text{constant}$$

$$P \sqrt{5/3} = \text{constant} \quad \#$$