- for a real gas:

$$\mu = (T, P) = \mu^\circ(T) + RT \ln \frac{f}{f^\circ}$$

* f = fugacity (effective pressure that a real gas exerts)
- $G_m^{real} < G_m^{ideal}$ $f < P$ (attractive range)
- $G_m^{real} > G_m^{ideal}$ $f > P$ (repulsive range)
- fugacity and pressure related

$$dG_m = V_m dP$$

- after some substitutions what you get is:

$$\ln f = \ln P + \int_0^P \frac{z-1}{P'} dP' \text{ or } f = P \exp\left[\int_0^P \left(\frac{z-1}{P'}\right) dP'\right]$$

or

$$f = \gamma(P, T) P$$

~ γ is fugacity coefficient

- under typical lab conditions, fugacity of a gas can be set equal to its partial pressure if P, V, and T are not close to their critical values.

8.1 What Determines the Relative Stability of the Solid, Liquid, and Gas Phases?

- diff substances are at diff phases depending on factors such as temp + pressure.
- reminder Gibbs energy, $G(T, P, n)$

$$\mu = \left(\frac{\partial G}{\partial n}\right)_{T,P} = \left(\frac{\partial [nG_m]}{\partial n}\right)_{T,P} = G_m$$

changes in P and T:

$$\left(\frac{\partial \mu}{\partial T}\right)_P = -S_m \text{ and } \left(\frac{\partial \mu}{\partial P}\right)_T = V_m$$