11.55 $\beta = \frac{1}{v}\left(\frac{\partial v}{\partial T}\right)_p$ $\qquad K = \frac{-1}{v}\left(\frac{\partial v}{\partial P}\right)_T$

(a) Ideal Gas $\quad pv = RT$

$$v = \frac{RT}{P} \Rightarrow \left(\frac{\partial v}{\partial T}\right)_P = \frac{R}{P} \; ; \quad \left(\frac{\partial v}{\partial P}\right)_T = \frac{-RT}{P^2}$$

$$\beta = \frac{\cancel{P}}{\cancel{R}T}\frac{\cancel{R}}{\cancel{P}} \qquad \boxed{\beta = \frac{1}{T}}$$

$$K = \frac{-\cancel{P}}{\cancel{RT}}\left(\frac{-\cancel{RT}}{P^{\cancel{2}}}\right) \qquad \boxed{K = \frac{1}{P}}$$

(b) $\quad p(v-b) = RT \qquad p = \frac{RT}{v-b}$

$$v - b = \frac{RT}{P} \Rightarrow v = \frac{RT}{P} + b$$

$$\left(\frac{\partial v}{\partial T}\right)_P = \frac{R}{P} \qquad \left(\frac{\partial v}{\partial P}\right)_T = \frac{-RT}{P^2}$$

$$\beta = \left(\frac{1}{\frac{RT}{P}+b}\right)\frac{R}{P} = \left(\frac{1}{\frac{RT}{P}+b}\right)\frac{\cancel{R}}{\cancel{R}T/v-b} = \frac{v-b}{T}\left(\frac{1}{\frac{RT}{P}+b}\right)$$

simpler to write $\quad \boxed{\beta = \frac{v-b}{vT}}$

$$K = \frac{-1}{v}\left(\frac{-RT}{P^2}\right) = \frac{1}{v}\frac{\cancel{RT}(v-b)^2}{(RT)^{\cancel{2}}} = \frac{(v-b)}{vP}$$

$$\boxed{K = \frac{v-b}{vP}}$$