EQ. DE Van der Waals

$$\left[P + a\left(\frac{n}{V}\right)^2 \right](V - nb) = nRT$$

para 1 mol $n = 1 \Rightarrow V = \bar{V}$

$$\left(P + \frac{a}{\bar{V}^2} \right)(\bar{V} - b) = RT$$

ou

$$P = \frac{RT}{\bar{V} - b} - \frac{a}{\bar{V}^2}$$

FORÇAS ATRATIVAS REDUZEM A PRESSÃO $P \downarrow$

$Z < 0$

FORÇAS REPULSIVAS

$P \uparrow$

$Z > 0$

Z = FATOR DE COMPRESSIBILIDADE

$$Z = \frac{\bar{V}}{\bar{V}_{ideal}} = \frac{P\bar{V}}{RT} = \frac{1}{\left(1 - b/\bar{V}\right)} - \frac{a}{RT\bar{V}}$$

$$\left(1 - b/\bar{V}\right)^{-1} = 1 + \frac{b}{\bar{V}} + \left(\frac{b}{\bar{V}}\right)^2 + \cdots$$

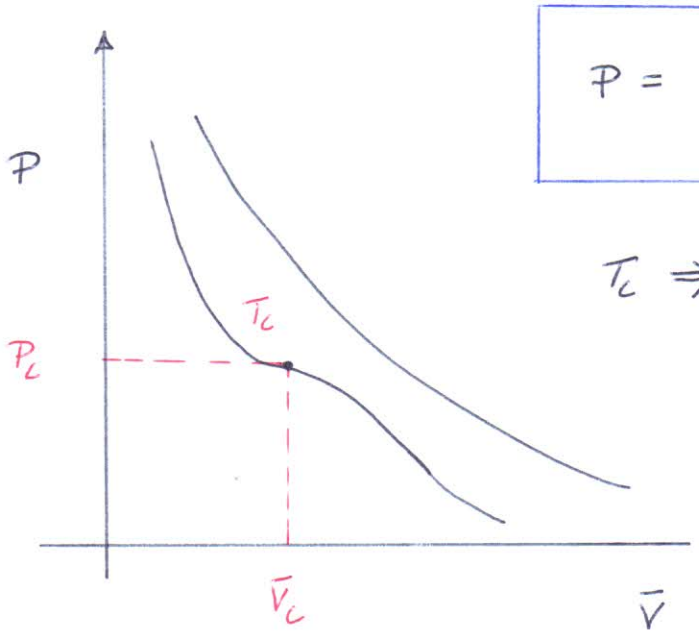
Assim $b/\bar{V} << 1$ (PRESSÕES BAIXAS)

$$Z = 1 + \left(b - \frac{a}{RT}\right)\frac{1}{\bar{V}} + \left(\frac{b}{\bar{V}}\right)^2 + \cdots$$

Z em termos de P, T

$$Z = 1 + \left(b - \frac{a}{RT}\right)\frac{P}{RT} + \frac{a}{(RT)^3}\left(2b - \frac{a}{RT}\right)P^2 + \cdots$$

PONTO CRÍTICO – GÁS VAN DER WAALS



$$P = \frac{RT}{\bar{V}-b} - \frac{a}{\bar{V}^2}$$

$T_c \Rightarrow$ PONTO DE INFLEXÃO

$$\left(\frac{\partial P}{\partial \bar{V}}\right)_T = 0$$

$$\left(\frac{\partial^2 P}{\partial \bar{V}^2}\right)_T = 0$$

Resolvendo

$$\bar{V}_c = 3b \qquad P_c = \frac{a}{27b^2} \qquad T_c = \frac{8a}{27Rb}$$

ou

$$b = \frac{RT_c}{8P_c} \qquad a = \frac{27(RT_c)^2}{64P_c}$$

LEI DOS ESTADOS CORRESPONDENTES

EQ. ESTADO COM VARIÁVEIS REDUZIDAS

$\pi = P/P_c \qquad \tau = T/T_c \qquad \phi = \bar{V}/\bar{V}_c$

$$\pi = \frac{8\tau}{3\phi - 1} - \frac{3}{\phi^2}$$