Careful calculation of

$$\mu_{JT} = \frac{T(\partial V/\partial T)_p - V}{C_p}, \quad \text{when} \quad \left[P + a\left(\frac{n}{V}\right)^2\right]\left[V - nb\right] = nRT.$$

$$PV - Pnb + \frac{an^2}{V} - anb\left(\frac{n}{V}\right)^2 = nRT$$

Differentiate w.r.t. T at constant pressure:

$$P\left(\frac{\partial V}{\partial T}\right)_p - \frac{an^2}{V^2}\left(\frac{\partial V}{\partial T}\right)_p + \frac{2anbn^2}{V^3}\left(\frac{\partial V}{\partial T}\right)_p = nR.$$

So, $$\left(\frac{\partial V}{\partial T}\right)_p = \frac{nR}{P - \frac{an^2}{V^2} + \frac{2anb}{V}\frac{N^2}{V^2}}$$

So,

$$T\left(\frac{\partial V}{\partial T}\right)_p = \frac{nRT}{P - \frac{an^2}{V^2} + \frac{2anb}{V}\cdot\frac{n^2}{V^2}}$$

$$= \frac{\left(P + a\left(\frac{N}{V}\right)^2\right)\left(V - nb\right)}{P - \frac{an^2}{V^2} + \frac{2anb}{V}\cdot\frac{n^2}{V^2}}$$

$$\approx \frac{PV\left(1 + \frac{a}{P}\left(\frac{n}{V}\right)^2 - \frac{nb}{V}\right)}{P - \frac{an^2}{V^2} + \frac{2anb}{V}\cdot\frac{n^2}{V^2}} = \frac{V + \frac{a}{P}\cdot\frac{n^2}{V} - nb}{1 - \frac{an^2}{PV^2} + \frac{2anb}{V}\frac{n^2}{V^2}}$$

Thus, $$T(\partial V/\partial T)_p - V \approx \left(V + \frac{a.n}{RT} - nb\right)\left(1 + \frac{an^2}{PV^2}\right) - V$$

$$\cong V\left(\frac{na}{RTV} - \frac{nb}{V} + \frac{an^2}{PV^2}\right) = V\left(\frac{2na}{RTV} - \frac{nb}{V}\right)$$

$$= n\left(\frac{2a}{RT} - b\right)$$

Thus, $$\mu_{JT} = \frac{\frac{2a}{RT} - b}{C_p}.$$

The inversion temperature $T = \frac{2a}{Rb}$ can be used, along with $b = 4 \cdot \frac{4\pi R^3}{3}$ to obtain a.