$$\ln \hat{\phi}_i = \ln\left(\frac{v}{v-b}\right) + \frac{b_i}{v-b} - \frac{2\sum_j y_j a_{ji}}{RT^{3/2}b} \ln\left(\frac{v+b}{v}\right) + \frac{ab_i}{RT^{3/2}b^2}\left(\ln\left(\frac{v+b}{v}\right)\frac{b}{v+b}\right) - \ln Z$$

$$\ln \hat{\phi}_i = \ln\left(\frac{v}{v-b}\right) + \frac{b_i}{v-b} - \frac{2\sum_j y_j a_{ji}}{RT^{3/2}b} \ln\left(\frac{v+b}{v}\right) + \frac{ab_i}{RT^{3/2}b^2}\left(\ln\left(\frac{v+b}{v}\right) - \frac{b}{v+b}\right) - \ln Z$$