(2 pts)

Atkins 2.3 A constant volume gas thermometer with $V = 1e\text{-}3\ m^3$ contains 0.05 mol gas, which, it is assumed, obeys $PV = RT$. In fact, it is better described by $\left(P + \frac{a}{v^2}\right)(v - b) = RT$, where $v = \frac{V}{mol}$.

Take $a = 8 \times 10^{-4}$ and $b = 3 \times 10^{-5}$. It is calibrated at the triple point of water. By how much will it deviate at 100°C?

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

$$= \frac{(8.31\ J/mol\text{-}K)(373.15)}{\left(\frac{1e\text{-}3}{0.05}\right) - (3e\text{-}5)} - \frac{(8e\text{-}4)}{\frac{(1e\text{-}3)^2}{(0.05)^2}}$$

$$= \cancel{411612} \quad \cancel{411612} \quad 155279\ Pa.$$

$$P = \frac{RT}{v} = \frac{(8.31)(373.15)}{\left(\frac{1e\text{-}3}{0.05}\right)}$$

$$= 155049\ Pa$$

They differ by 230 Pa. The real gas pressure ~~reads~~ would read higher. So ~~the idea~~ by assuming it obeys an ideal gas eqn, we would over estimate the temperature. They differ by **0.55 degrees**.