[tex164] Paramagnetic FD gas IV: heat capacity C_{VH}

Calculate a parametric expression for the heat capacity $C_{VH} \doteq (\partial U/\partial T)_{VHN}$, which is more directly amenable to experimental probing than C_{VM}. Confirm that that the result can be brought into the following compact form:

$$C_{VH} = \frac{\mathcal{D}}{2}\frac{Vk_B}{\lambda_T^{\mathcal{D}}}\left[\left(\frac{\mathcal{D}}{2}+1\right)\sum_\sigma f_{\mathcal{D}/2+1}(z_\sigma) + \frac{[f_{\mathcal{D}/2}(z_+)f_{\mathcal{D}/2-1}(z_-) - f_{\mathcal{D}/2}(z_-)f_{\mathcal{D}/2-1}(z_+)]\ln(z_-/z_+)}{f_{\mathcal{D}/2-1}(z_+)+f_{\mathcal{D}/2-1}(z_-)} - \frac{\mathcal{D}}{2}\frac{[f_{\mathcal{D}/2}(z_+)+f_{\mathcal{D}/2}(z_-)]^2}{f_{\mathcal{D}/2-1}(z_+)+f_{\mathcal{D}/2-1}(z_-)}\right].$$

One intermediate step involves the calculation of $(\partial z_\sigma/\partial T)_{VHN}$ for $\sigma = \pm$. Use the expressions for N and H in [tsc16] to carry out this step.

Solution: