[tex124] **Latent heat and response functions**

Consider a discontinuous transition between phases 1 and 2 of a simple fluid. The latent heat is $L(T)$ and the coexistence curve is $p = p(T)_{\text{coex}}$.

(a) Show that the rate at which the latent heat changes along the transition curve depends on the heat capacity C_p and the thermal expansivity α_p of the coexisting two phases as follows:

$$\left(\frac{dL}{dT}\right)_{\text{coex}} = C_p^{(2)} - C_p^{(1)} + L(T)\left[\frac{1}{T} - \frac{V_2\alpha_p^{(2)} - V_1\alpha_p^{(1)}}{V_2 - V_1}\right].$$

(b) Simplify this expression when phase 2 is a classical ideal gas, in which case we have $V_2 \gg V_1$, $\alpha_p^{(2)} \gg \alpha_p^{(1)}$, and an explicit result for the T-dependence of $\alpha_p^{(2)}$.