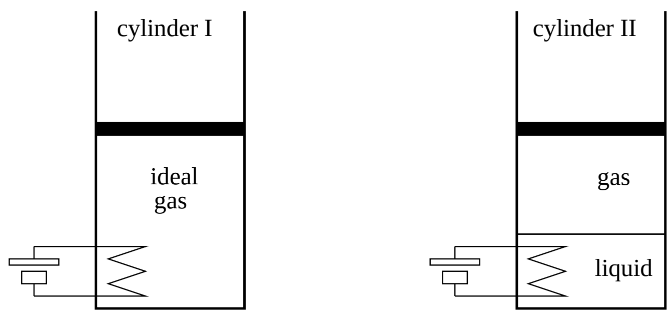
[tex159] Effects of heat input

Identical cylinders I and II with insulating, rigid walls are capped by insulating disks. The pressure in each cylinder is stabilized at a constant value by the weight of the cap, which can move up or down with no wall friction.

(a) Cylinder I contains 1mol of a monatomic classical ideal gas $[pV = RT,\ U(T) = \frac{3}{2}RT]$. The gas is initially in thermal equilibrium at pressure p_0, temperature T_0, and volume V_0. Now we inject an amount ΔQ of heat via a heating coil. The system equilibrates at pressure p_0, temperature $T_1 = T_0 + \Delta T$ and volume $V_1 = V_0 + \Delta V$. Find the changes ΔT and ΔV as functions of ΔQ.

(b) Cylinder II contains a simple substance in coexisting gaseous and liquid phases with mass densities ρ_g and ρ_l, respectively. The latent heat of evaporation (per unit mass) is L. The initial thermal equilibrium state is specified by pressure p_0, temperature T_0, total volume V_0, gaseous mass $m_0^{(g)}$, and liquid mass $m_0^{(l)}$. We again inject an amount ΔQ of heat via a heating coil, here small enough that both phases are still present when a new equilibrium has been reached at pressure p_0, temperature $T_1 = T_0 + \Delta T$, volume $V_1 = V_0 + \Delta V$, and masses $m_1^{(g)} = m_1^{(g)} + \Delta m$, $m_1^{(l)} = m_1^{(l)} - \Delta m$. Find the changes ΔT, ΔV, and Δm as functions of ΔQ.



Solution: