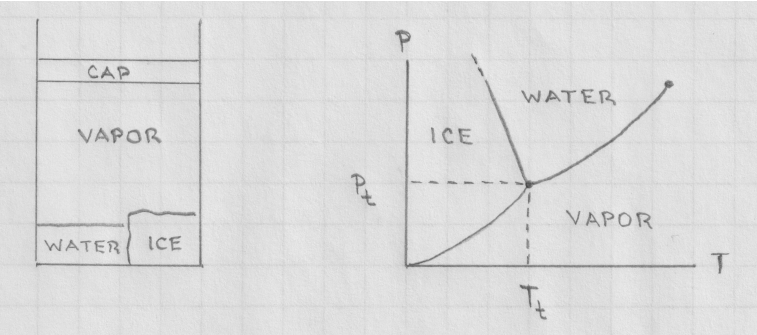
[tex206] Destabilization of triple-point equilibrium I

A cylindrical vessel with a mobile (piston-like) cap of some weight contains $m_s = 1\text{g}$ of ice, $m_l = 1\text{g}$ of water, and $m_g = 1\text{g}$ of H_2O vapor at triple-point equilibrium. The cylinder has heat conducting walls all around and there is no friction. When the weight of the cap is slightly reduced, it slowly moves upward and stops at a higher position. During this quasistatic process the temperature stays the same while the pressure is minimally smaller. Assume the volumes taken up by water and ice to be negligible compared to the volume of the vapor.

(a) Give a detailed description of what happens inside the cylinder while the cap moves upward and what the content looks like once the cap has come to a rest.
(b) Calculate the mass of each phase remaining in the container at the new equilibrium.
(c) Calculate the work done by the vapor on the cap.
(d) Calculate the heat transfer through the wall of the cylinder.

Triple-point data: temperature $T_t = 273\text{K}$, pressure $p_t = 611\text{N/m}^2$, vapor density $\rho = 600\text{g/m}^3$, latent heats $L_{lg} = 2495\text{J/g}$, $L_{sl} = 335\text{J/g}$, $L_{sg} = L_{sl} + L_{lg}$.



Solution: