

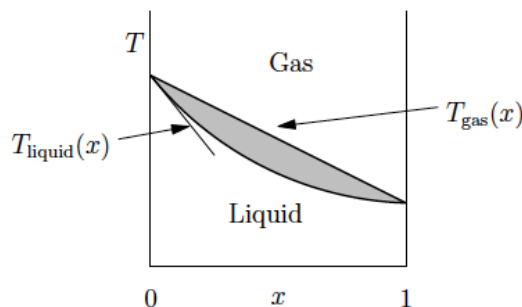
3. Distillation

Sketched below is the phase diagram of a mixture of two pure substances, A and B , at pressure $P = 1$ atm, where x is the mass fraction of A : $x = M_A/(M_A + M_B)$, and M_n is the mass of substance n . Assume that in the regime of interest, the boundaries of liquid-gas two-phase coexistence are given by the linear functions:

$$T_{\text{gas}}(x) = T_0 - T_1 x ,$$

$$T_{\text{liquid}}(x) = T_0 - 3T_1 x .$$

The shaded region indicates liquid-gas phase coexistence.



An open beaker initially contains a liquid mixture of total initial mass M , with A having initial mass fraction $x_i = 0.2$. The liquid is brought to its boiling temperature.

- Does the boiling increase or decrease the mass fraction of A in the liquid?
- The boiling is continued until the mass fraction x of A in the liquid is changed by a factor of two. At this point, what fraction of the initial total mass M remains? How does the mass fraction x of A change as a function of the total mass of the liquid remaining?