b)

if T is cooled and piston could move (say with P = const) then volume would decrease
$\Rightarrow$ top will not move.

i. top rest as is and process is constant volume.

initial

$$P_2 V_2 = m_2 R T_2$$

final

$$P_f V_f = m_f R T_f$$

$$\left.\begin{array}{l} V_2 = V_f \\ m_2 = m_f \end{array}\right\}$$

$\Rightarrow$

$$\frac{P_f}{P_2}\frac{V_f}{V_2} = \frac{m_f}{m_2}\frac{T_f}{T_2}$$

$$\frac{P_f}{P_2} = \frac{T_f}{T_2} = \frac{T_f}{T_i}\,\frac{1}{\frac{L_2 A_2}{L_1 A_1 + L_2 A_2}}$$

$$\frac{P_f}{P_2} = \frac{T_f}{T_i}\,\frac{L_1 A_1 + L_2 A_2}{L_2 A_2}$$

↳ but $P_2 = P_i$

$\Rightarrow$

$$\boxed{\frac{P_f}{P_i} = \left(\frac{L_1 A_1}{L_2 A_2} + 1\right)\frac{T_f}{T_i}}$$