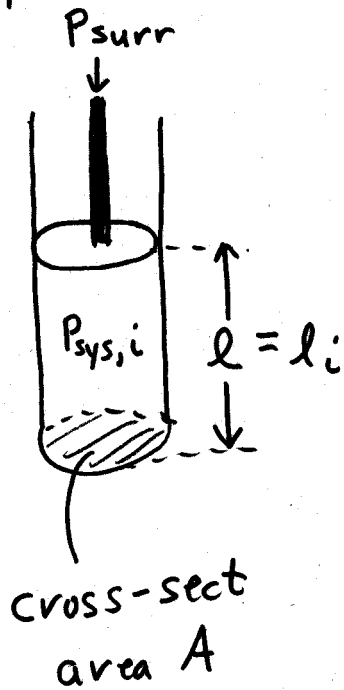
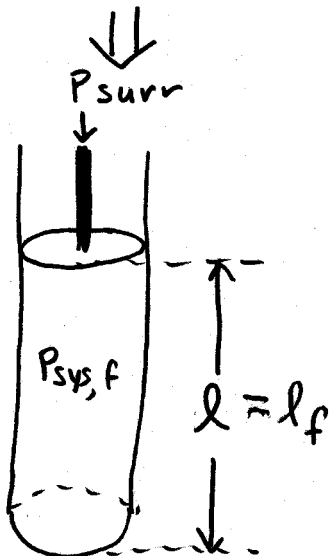


Work in gory (physics-like) detail:

Consider a piston sliding (free of friction and gravity!) in a cylinder, with a gas (the system) trapped underneath the piston:



At time t_i , say $P_{sys} > P_{surr}$.
Boundary will be pushed up until $P_{sys} = P_{surr}$
(i.e. until mechanical equilibrium has been achieved)



Now apply definition of work:

$$|W| = |F_{\text{surr}} (l_f - l_i)| = \left| \left(\frac{F_{\text{surr}}}{A} \right) (A (l_f - l_i)) \right|$$
$$= \left| \left(\frac{F_{\text{surr}}}{A} \right) (A l_f - A l_i) \right|$$

and $P_{\text{surr}} \equiv \frac{F_{\text{surr}}}{A}$ and $V_{\text{sys}} = A l$ (at any time)

$$V_f = A l_f \quad \text{and} \quad V_i = A l_i$$

$$\text{so } A l_f - A l_i = V_f - V_i \equiv \Delta V_{\text{sys}}$$

$$\therefore |W| = |P_{\text{surr}} \Delta V_{\text{sys}}|$$

↑ often omitted

So who cares??

Piston motion is the basis of engines!