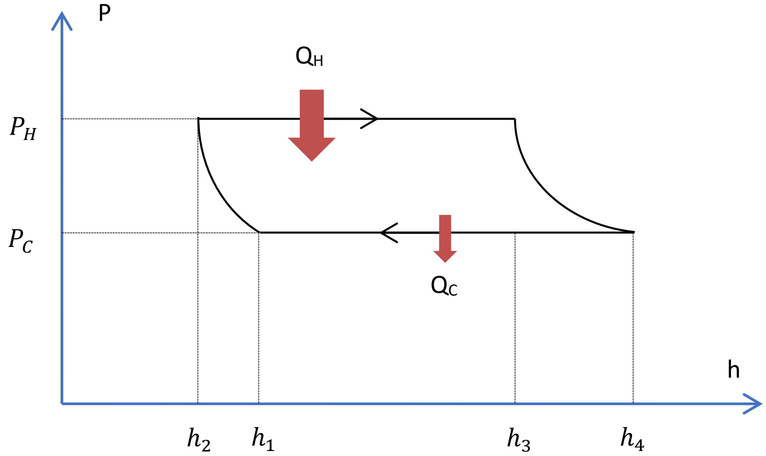
Mass-lifting heat engine

This heat engine cycle below is the **Brayton** cycle (this is the same as the jet engine cycle). The theoretical efficiency is

$$e_{theo} = 1 - \left(\frac{P_C}{P_H}\right)^{1-1/\gamma}$$

Here, gamma is a constant, $\gamma = 1 + \frac{2}{d}$, and $d = 5$ for air at room temperature.



Note that in this cycle the volume has been replaced by the height of the piston h

$$V = Ah + V_0$$

Here, A is the area of the piston and V_0 is the volume of air in the pipes and heat exchange cylinder.

In a calculation of work, we use $\Delta W = \int PdV = A \times \int Pdh$; thus, work is the area of the piston, A, times the area under the P vs. h graph.

Similarly, in a change in volume such as $(V_3 - V_2) = A \times (h_3 - h_2)$ the constant V_0 goes away.

To get the efficiency from the experimental data in this lab we use $e = \frac{|\Delta W_{Net}|}{|\Delta Q_H|}$.

The work, $|\Delta W_{Net}| = A \times area\ within\ cycle$.

The heat input, $|\Delta Q_H|$, happens during the isobaric process at higher pressure $|\Delta Q_H| = NC_P(T_3 - T_2) = \frac{7}{2}P_H(V_3 - V_2) = \frac{7}{2}P_H(h_3 - h_2) \times A$. Thus, the experimental efficiency is

$$e_{exp} = \frac{area\ within\ cycle}{\frac{7}{2}P_H(h_3 - h_2)}$$

Compare the two efficiencies!