Problem 6.129

C.V. Cylinder volume.

Continuity Eq.6.15: $m_2 - m_1 = m_{in}$

Energy Eq.6.16: $m_2u_2 - m_1u_1 = m_{in}h_{line} + Q_{CV} - {}_1W_2$

Process: P_1 is constant to stops, then constant V to state 2 at P_2

State 1: P_1, T_1 $\quad m_1 = \dfrac{P_1V}{RT_1} = \dfrac{300 \times 0.25}{0.287 \times 290.2} = 0.90$ kg

State 2:

Open to $P_2 = 400$ kPa, $T_2 = 350$ K

$$m_2 = \frac{400 \times 1}{0.287 \times 350} = 3.982 \text{ kg}$$

$m_i = 3.982 - 0.90 =$ **3.082 kg**

Only work while constant P

$${}_1W_2 = P_1(V_2 - V_1) = 300(1 - 0.25) = \textbf{225 kJ}$$

Energy Eq.: $Q_{CV} + m_ih_i = m_2u_2 - m_1u_1 + {}_1W_2$

$$Q_{CV} = 3.982 \times 0.717 \times 350 - 0.90 \times 0.717 \times 290.2 + 225$$

$$- 3.082 \times 1.004 \times 600 = \textbf{-819.2 kJ}$$

We could also have used the air tables A.7.1 for the u's and h_i.