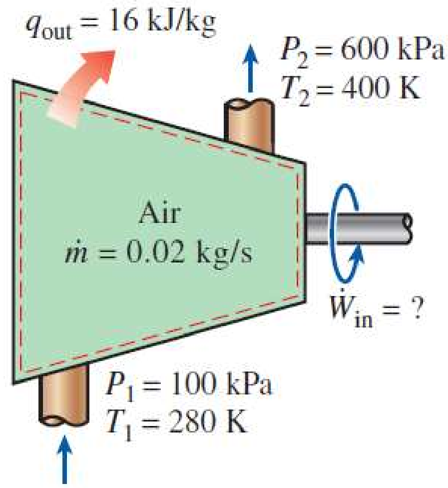

Given:
Air at 100 kPa and 280 K is compressed steadily to 600 kPa and 400 K. The mass flow rate of the air 0.02 kg/s, and a heat loss of 16 kJ/kg occurs during the process.

$q_{out} := 16 \frac{kJ}{kg}$ $\quad m' := 0.02 \frac{kg}{s}$

$P_1 := 100\ kPa$ $\quad P_2 := 600\ kPa$

$T_1 := 280\ K$ $\quad T_2 := 400\ K$

Required:
Assuming changes in potential and kinetic energy are negligible, determine the necessary power input to the compressor.

Solution:
Begining with the 1st Law

$$\frac{d}{d\,t} E_{sys} = \Sigma E'_{in} - \Sigma E'_{out}$$

For a steady flow device this becomes

$$0 = \Sigma E'_{in} - \Sigma E'_{out}$$

Assuming the compressor is rigid and changes in kinetic and potential energy are negligible, the 1st Law expression becomes

$$0 = W'_{in} + m'_{in} \cdot h_{in} - Q'_{out} - m'_{out} \cdot h_{out}$$

Rearranging yields

$$W'_{in} = m' \cdot \left(q_{out} + h_{out} - h_{in}\right) \qquad \text{when } m'_{in} = m'_{out}$$

Going to Table A-17 @ $T := T_1 = 280\ K$ and $T := T_2 = 400\ K$ shows

$h_1 := 280.13 \frac{kJ}{kg}$ $\quad h_2 := 400.98 \frac{kJ}{kg}$

The necessary power input is then given by

$$\boxed{W'_{in} := m' \cdot \left(q_{out} + h_2 - h_1\right) = 2.737\ kW}$$