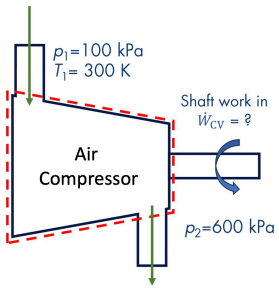
Example

An air compressor with isentropic efficiency of 60% compresses air with the conditions below. What is the exit temperature?

Assume constant c_p=1.005 kJ/kgK and c_v=0.718 kJ/kgK, k= c_p/c_v=1.4



$c_p = 1.005\ kJ/kg.K$

$c_v = 0.718\ kJ/kg.K$

$k' = c_p/c_v = 1.4$

Isentropic: $\left(\frac{T_2}{T_1}\right) = \left(\frac{P_2}{P_1}\right)^{(k-1)/k}$

$$T_{2s} = 300\,[k]\left(\frac{600\,[kPa]}{300\,[kPa]}\right)^{\frac{1.4-1}{1.4}} = 500.55\,[k]$$

$$\eta_c = \frac{w_s}{w_a} = \frac{h_{2s}-h_1}{h_{2a}-h_1} = \frac{c_p(T_{2s}-T_1)}{c_p(T_{2a}-T_1)}$$

$$\eta = \frac{T_{2s}-T_1}{T_{2a}-T_1}$$

$$T_{2a} = T_1 + \frac{(T_{2s}-T_1)}{\eta_c}$$

$$= 300\,[k] + \frac{(500.55 - 300\,[k])}{0.6}$$

$$= \boxed{634.25\,[k]}$$