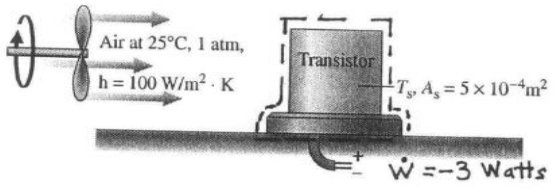
PROBLEM 6.63

KNOWN: Steady-state data are provided for a transistor cooled convectively.

FIND: Determine for the transistor the heat transfer rate and the outer surface temperature.

SCHEMATIC & GIVEN DATA:



ENGR. MODEL

1. The transistor is the closed system.
2. The system is at steady state.
3. No heat transfer occurs through the base of the transistor.

ANALYSIS: (a). An energy rate balance reads $\cancel{\frac{dE}{dt}}^{0} = \dot{Q} - \dot{W} \Rightarrow \dot{Q} = \dot{W} = -3$ watts ←

(b) Since cooling occurs convectively, $\dot{Q} = -hA[T_s - T_{air}]$, where the minus sign is introduced because heat transfer is from the transistor and $T_s > T_{air}$. Solving

$$T_s = T_{air} - \left[\frac{\dot{Q}}{hA}\right] = 298\text{K} - \left[\frac{-3\text{ W}}{\left(100\frac{\text{W}}{\text{m}^2\cdot\text{K}}\right)\left(5\times10^{-4}\text{m}^2\right)}\right] = 358\text{K}\ (85^\circ\text{C})$$ ←