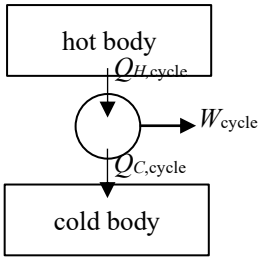
An internally reversible power cycle with a thermal efficiency of 40% receives 50 kJ of energy by heat transfer from a hot reservoir at 600 K and rejects energy by heat transfer to a cold reservoir at a temperature T_C. Determine the energy rejected and the temperature T_C.

SOLUTION:

We can determine the heat transfer to the cold reservoir using the power cycle thermal efficiency in terms of the heat transfers,



$$\eta = 1 - \frac{Q_{C,\text{cycle}}}{Q_{H,\text{cycle}}} \Rightarrow Q_{C,\text{cycle}} = (1-\eta) Q_{H,\text{cycle}} . \quad (1)$$

Using the given data,

η = 0.40,
$Q_{H,\text{cycle}}$ = 50 kJ,
$\Rightarrow$ $\boxed{Q_{C,\text{cycle}} = 30 \text{ kJ}}$.

The temperature of the reservoir can be found by noting that for a reversible cycle,

$$\left.\frac{Q_H}{Q_C}\right|_{\substack{\text{rev,}\\ \text{cycle}}} = \frac{T_H}{T_C} \Rightarrow T_C = T_H \left.\frac{Q_C}{Q_H}\right|_{\substack{\text{rev,}\\ \text{cycle}}} . \quad (2)$$

Using the parameters given above in addition to T_H = 600 K,

$\boxed{T_C = 360 \text{ K}}$.