

Problem 1

Given: A system undergoes a power cycle while receiving energy by heat transfer from a source at 1500K, and discharging energy by heat transfer to cooling water at 300K. The work for the cycle is 10 kW, while the heat transfer to the system is 10 kJ/cycle

Determine: The minimum ^{theoretical} number of cycles/min

$$\eta = \frac{\dot{W}_{\text{cycle}}}{\dot{Q}_H} \quad \dot{Q}_H = (10 \text{ kJ/cycle}) \left(n \frac{\text{cycles}}{\text{sec}} \right)$$

For the min theoretical number of cycles

$$\eta = \eta_{\text{max}} = 1 - \frac{T_c}{T_H}$$

$$\frac{10 \text{ kW}}{10n \text{ kW}} = 1 - \frac{300 \text{ K}}{1500 \text{ K}}$$

$$n = 1.25 \frac{\text{cycles}}{\text{sec}} \left(\frac{60 \text{ sec}}{\text{min}} \right) = \boxed{75 \text{ cycles/min}}$$