Problem 2

Given: Power cycle at steady state with a thermal efficiency of 38%. The work done is 100 MW, and $T_c = 70°F$, $T_H = 900°F$

Determine: - The rate at which energy is discharged to the cooling water
- The minimum theoretical rate at which energy is discharged to the cooling water for the same work output

$$\eta = \frac{\dot{W}_{cycle}}{\dot{Q}_H} \qquad 0.38 = \frac{100\,MW}{\dot{Q}_H} \qquad \dot{Q}_H = 263.16\,MW$$

$$\dot{Q}_H = \dot{W}_{cycle} + \dot{Q}_C$$

$$263.16\,MW = 100\,MW + \dot{Q}_C$$

$$\boxed{\dot{Q}_C = 163.16\,MW}$$

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

$$\frac{\dot{W}_{cycle}}{\dot{Q}_H} = 1 - \frac{T_C}{T_H}$$

$$\frac{100\,MW}{\dot{Q}_H} = 1 - \frac{530^\circ R}{1360^\circ R} = 0.61$$

$$\boxed{\dot{Q}_H = 164\ MW}$$

$$\dot{Q}_H = \dot{W}_{cycle} + \dot{Q}_C$$

$$164\,MW = 100\,MW + \dot{Q}_C$$

$$\boxed{\dot{Q}_C = 64\,MW}$$