

5.26 Power Cycle

$$\dot{W}_{\text{cycle}} = 40 \text{ kW}$$

$$\dot{Q}_C = 1000 \frac{\text{kJ}}{\text{min}} = 16.67 \text{ kW}$$

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

$$\dot{Q}_H = 40 \text{ kW} + 16.67 \text{ kW}$$

$$\dot{Q}_H = 56.67 \text{ kW}$$

$$\eta = 1 - \frac{\dot{Q}_C}{\dot{Q}_H} = 1 - \frac{16.67 \text{ kW}}{56.67 \text{ kW}} = \underline{0.705}$$

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

We know that

$$\eta \leq \eta_{\text{max}}$$

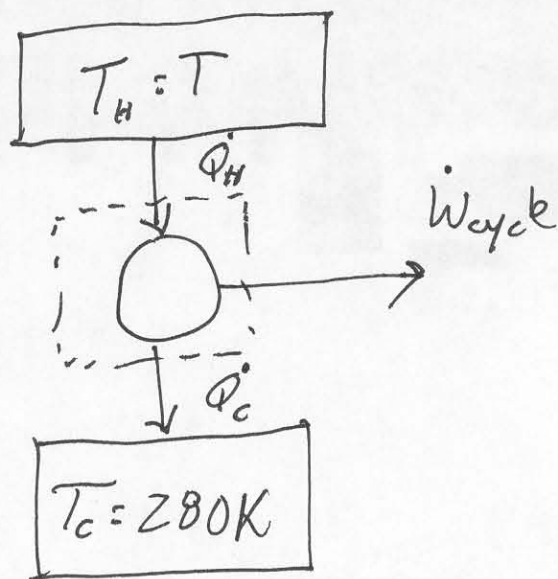
OR

$$0.705 \leq 1 - \frac{280 \text{ K}}{T}$$

which gives

$$0.295 \geq \frac{280 \text{ K}}{T} \Rightarrow T \geq 949 \text{ K}$$

So minimum theoretical T is 949K



The maximum value of η occurs when T_C is a minimum. Here $T_C = 280 \text{ K}$. We assume our cycle is perfect, therefore $\eta = \eta_{\text{max}}$ and $\eta = 0.705$.