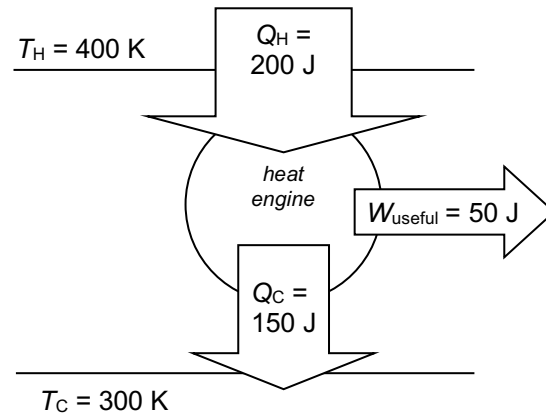


1. a) $\eta_{\text{Carnot}} = \frac{W_{\text{useful}}}{Q_H} = \frac{40 \text{ J}}{100 \text{ J}} = 0.40 = \underline{40 \%}$
- b) $\eta_{\text{Carnot}} = \frac{Q_H - Q_C}{Q_H} = \frac{100 \text{ J} - 60 \text{ J}}{100 \text{ J}} = 0.40 = \underline{40 \%}$
- c) $\eta_{\text{Carnot}} = \frac{T_H - T_C}{T_H} = \frac{500 \text{ K} - 300 \text{ K}}{500 \text{ K}} = 0.40 = \underline{40 \%}$

2. a), b) and d)



b) $Q_C = Q_H - W_{\text{useful}} = 200 \text{ J} - 50 \text{ J} = \underline{150 \text{ J}}$

c) $\eta_{\text{Carnot}} = \frac{W_{\text{useful}}}{Q_H} = \frac{50 \text{ J}}{200 \text{ J}} = 0.25 = \underline{25 \%}$

d) $\eta_{\text{Carnot}} = \frac{T_H - T_C}{T_H} \quad \eta_{\text{Carnot}} \cdot T_H = T_H - T_C$

$$T_C = T_H - \eta_{\text{Carnot}} \cdot T_H = T_H \cdot (1 - \eta_{\text{Carnot}}) = 400 \text{ K} \cdot (1 - 0.25) = \underline{300 \text{ K}}$$

3. The number above the fraction bar needs to be large. That is, for $\eta_{\text{Carnot}} = \frac{T_H - T_C}{T_H}$ the difference in temperature ($T_H - T_C$) ought to be as large as possible.

4. a) $\eta_{\text{Carnot}} = \frac{T_H - T_C}{T_H} = \frac{773 \text{ K} - 293 \text{ K}}{773 \text{ K}} = 0.621 = \underline{62.1 \%}$

b) $W_{\text{useful}} = \eta_{\text{Carnot}} \cdot Q_H = 0.62 \cdot 2'600 \text{ kJ} = 1'614 \text{ kJ} = \underline{1.61 \text{ MJ}}$

c) $Q_C = Q_H - W_{\text{useful}} = 2.6 \text{ MJ} - 1.6 \text{ MJ} = \underline{986 \text{ kJ}}$

$$5. \quad a) \quad \eta_{\text{Carnot}} = \frac{W_{\text{useful}}}{Q_{\text{H}}} = \frac{W_{\text{useful}}}{Q_{\text{C}} + W_{\text{useful}}} \quad \eta_{\text{Carnot}} \cdot (Q_{\text{C}} + W_{\text{useful}}) = W_{\text{useful}}$$

$$\eta_{\text{Carnot}} \cdot Q_{\text{C}} + \eta_{\text{Carnot}} \cdot W_{\text{useful}} = W_{\text{useful}}$$

$$\eta_{\text{Carnot}} \cdot Q_{\text{C}} = W_{\text{useful}} - \eta_{\text{Carnot}} \cdot W_{\text{useful}} = W_{\text{useful}} \cdot (1 - \eta_{\text{Carnot}})$$

$$Q_{\text{C}} = \frac{W_{\text{useful}} \cdot (1 - \eta_{\text{Carnot}})}{\eta_{\text{Carnot}}} = \frac{1.00 \text{ GJ} \cdot (1 - 0.30)}{0.30} = \underline{\underline{2.33 \text{ GJ}}}$$

$$b) \quad T_{\text{C}} = T_{\text{H}} \cdot (1 - \eta_{\text{Carnot}}) = 473 \text{ K} \cdot (1 - 0.30) = \underline{\underline{331 \text{ K}}} \quad \vartheta_{\text{C}} = \underline{\underline{58 \text{ }^{\circ}\text{C}}}$$

c) increase ϑ_{C} :

$$T_{\text{C}} = T_{\text{H}} \cdot (1 - \eta_{\text{Carnot}}) = 473 \text{ K} \cdot (1 - 0.60) = \underline{\underline{189 \text{ K}}} \quad \vartheta_{\text{C}} = \underline{\underline{-84 \text{ }^{\circ}\text{C}}}$$

decrease ϑ_{H} :

$$T_{\text{H}} = \frac{T_{\text{C}}}{1 - \eta_{\text{Carnot}}} = \frac{331 \text{ K}}{1 - 0.60} = 828 \text{ K} \quad \vartheta_{\text{H}} = \underline{\underline{555 \text{ }^{\circ}\text{C}}}$$