

Thermo HW 3.1

6-16 $Q_{in} = 1.3 \text{ kJ}$ $\eta = 35\%$

$$\eta = \frac{W_{out}}{Q_{in}}$$

$$W_{out} = \eta Q_{in} = 0.35(1.3)$$

$$W_{out} = 0.455 \text{ kJ}$$

6-43. $Q_c = 15000 \frac{\text{kJ}}{\text{h}}$ $Q_h = 22000 \frac{\text{kJ}}{\text{h}}$

$$\text{COP} = \frac{Q_c}{W_{in}} \quad W_{in} = Q_h - Q_c$$

$$W_{in} = 22000 - 15000 = 7000$$

$$\text{COP} = \frac{15000 \frac{\text{kJ}}{\text{h}}}{7000 \frac{\text{kJ}}{\text{h}}} = 2.14$$

6-56 $\text{COP} = 2.4$ $Q_H = 12000 \text{ kWh}$

$$W_{in} = \frac{Q_H}{\text{COP}} \rightarrow \frac{12000}{2.4} = 5000 \text{ kWh}$$

$$\text{Cost}_{\text{resist}} = 1200(0.12) = \$144$$

$$\text{Cost}_{\text{heat}} = 500(0.12) = \$60$$

$$144 - 60 = \$84$$

6-84 The claim is invalid

because Carnot efficiency of the engine is less than thermal efficiency, which is impossible

6-101

$$\text{COP}_{\text{HP}} = 12.5 \quad T_H = 29^\circ\text{C} \quad W_{\text{net, in}} = 2.15 \text{ kW}$$

$$\text{COP}_{\text{HP}} = \frac{T_H}{T_H - T_L} \quad \text{COP}_{\text{HP}} = \frac{Q_H}{W_{in}}$$

$$T_H = 297\text{K} \quad 12.5 = \frac{297\text{K}}{297\text{K} - T_L}$$

$$T_L - 297 = \frac{297}{12.5} \rightarrow T_L = 297 - 23.76$$

$$T_L = 273.24\text{K}$$

$$\text{COP} = \frac{Q_H}{W_{in}} \rightarrow Q_H = 2.15(12.5)$$

$$Q_H = 26.875 \text{ kW}$$