

Example problems ON 2ND LAW OF THERMO.

1. A steam engine takes in $20,000 \text{ J}$ of heat from a heat source and discards 8000 J to a heat sink. How much work is done by this engine and what is the efficiency?

Solution: If the engine operates cyclically
then $\Delta U = (Q_H - Q_C) - W = 0$

$$\Rightarrow W = Q_H - Q_C = 20,000 \text{ J} - 8,000 \text{ J} = \underline{12,000 \text{ J}}$$

$$\epsilon = \frac{W}{Q_H} = \frac{12,000}{20,000} = \underline{0.6 \text{ OR } 60\%}$$

2. A Carnot heat engine operates between $T_H = 800 \text{ K}$ and $T_C = 300 \text{ K}$. If the engine takes in 5000 J of heat from the high temperature source, how much work is done by this engine, and how much heat is discarded to the low T_C source?

Solution: $\epsilon_{\text{carnot}} = 1 - T_C/T_H = 1 - 300/800 = 0.625$

$$\epsilon = \frac{W}{Q_H} \Rightarrow W = \epsilon \cdot Q_H = 0.625 \cdot 5000 = \underline{3125 \text{ J}}$$

$$Q_H - Q_C = W \Rightarrow Q_C = Q_H - W = \overset{5000}{3125} - 3125 = \underline{1875 \text{ J}}$$