

**Given:**  $\text{kJ} := 1000\text{J}$

A Carnot heat engine receives 500 kJ of heat per cycle from a high temperature source at 652°C and rejects heat to a low temperature sink at 30°C.

**Required:**

Determine the thermal efficiency of this Carnot engine and the amount of heat rejected to the sink per cycle.

**Solution:**

The heat accepted by the heat engine is defined as

$$Q_{H,\text{rev}} := 500\text{kJ}$$

The temperatures of the high and low temperature reservoirs are defined as

$$T_H := 652^\circ\text{C} = 925.15\text{ K} \quad T_L := 30^\circ\text{C} = 303.15\text{ K}$$

The thermal efficiency of the Carnot engine is then found by

$$\eta_{\text{th,rev}} := 1 - \frac{T_L}{T_H} = 67.23\%$$

Using the definition of thermal efficiency, the heat rejected by the cycle may be found by

$$\eta_{\text{th}} = 1 - \frac{Q_L}{Q_H} \quad \text{or} \quad Q_{L,\text{rev}} := Q_{H,\text{rev}} \cdot (1 - \eta_{\text{th,rev}}) = 163.8\text{ kJ}$$