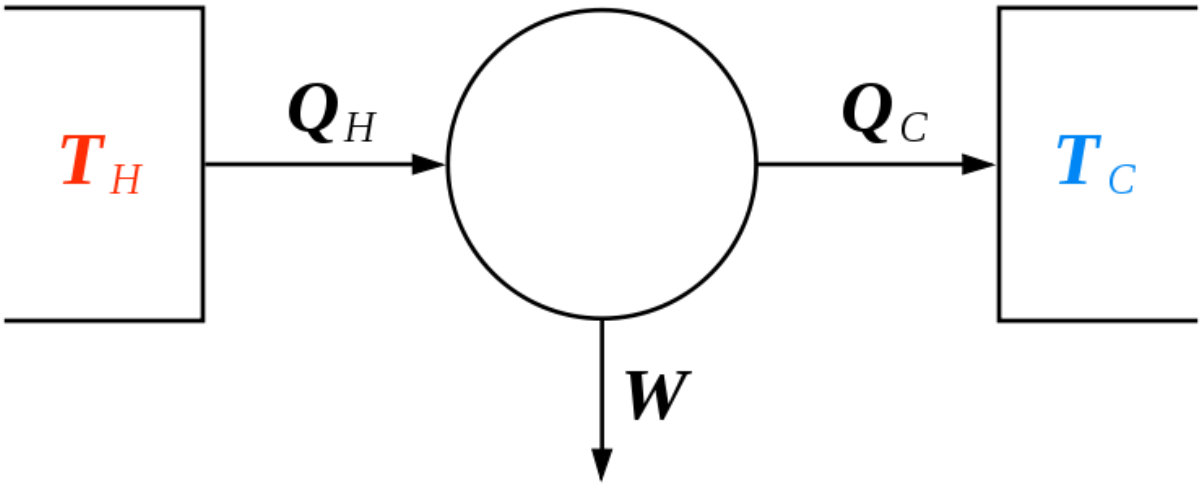
Solve. A Carnot engine performs 2000 j of work and rejects 4000 j of heat of the sink if the difference of temp b/w the source and sink is 85 degree find the temp of the source and sink?

Solution.
Carnot's theorem is a formal statement of this fact: No engine operating between two heat reservoirs can be more efficient than a Carnot engine operating between the same reservoirs.

This maximum efficiency η is defined to be:

$$\eta = \frac{W}{Q_h} = 1 - \frac{T_c}{T_h}$$



where

W is the work done by the system (energy exiting the system as work),

Q_h is the heat put into the system (heat energy entering the system),

T_c is the absolute temperature of the cold reservoir, and

T_h is the absolute temperature of the hot reservoir.

In our case,

$$W = 2000J$$

$$Q_c = 4000J$$

$$T_h - T_c = 85°\text{C}$$

The work done by the system:

$$W = Q_h - Q_c$$

So

$$Q_h = W + Q_c = 2000 + 4000 = 6000J$$

$$\eta = \frac{W}{Q_h} = \frac{2000}{6000} = \frac{1}{3}$$

From the other side:

$$\eta = 1 - \frac{T_c}{T_h} = \frac{T_h - T_c}{T_h} = \frac{1}{3}$$

$$\frac{85}{T_h} = \frac{1}{3}$$

So

$$T_h = 85 \cdot 3 = 255℃$$

$$T_c = T_h - 85 = 255 - 85 = 170℃$$

Answer:

$$T_h = 255℃$$

$$T_c = 85℃$$