

Answer on Question #45596, Physics, Molecular Physics | Thermodynamics

A Carnot engine has an efficiency of 0.5 while working between a source at 400K and a sink at TK. The temperatures of both the source and the sink are changed. Calculate the efficiencies of the engine when temperatures are (a) increased by 100C and (b) decreased by 100C. Interpret your result physically.

Solution

Let us first find temperature of sink. From formula for Carnot engine:

$$\frac{400 - T}{400} = 0.5$$

$$T = 200 \text{ K}$$

(a) Increasing both temperatures will give efficiency

$$\frac{500 - 300}{500} = 0.4$$

(b) Decreasing both temperatures will give efficiency

$$\frac{300 - 100}{300} = \frac{2}{3}$$

Physical interpretation: Efficiency of Carnot engine depends not on absolute but on relative temperatures of source and sink. When increasing both temperatures on the same value we make them relatively closer one to other and efficiency decreases, when decreasing them temperatures become relatively farther and efficiency increases.