Answer on Question #61147, Physics / Molecular Physics | Thermodynamics

A Carnot engine has an efficiency of 40%. Its efficiency is to be raised to 50%. By how much must the temperature of the source be increased if the sink is at 27 °C.

Find: ΔT – ?

Given:

$\eta_1=0.4$

$\eta_2=0.5$

$T_2=300$ K

Solution:

Efficiency of Carnot engine:

$\eta = \frac{T_1-T_2}{T_1}$ (1),

where T_1 is the absolute temperature of the

heater, T_2 is the absolute temperature of the fridge

Of (1) $\Rightarrow \eta T_1 = T_1 - T_2$ (2)

Of (2) $\Rightarrow T_1(1-\eta) = T_2$ (3)

Of (3) $\Rightarrow T_1 = \frac{T_2}{1-\eta}$ (4)

Of (4) $T_1^{'} = \frac{T_2}{1-\eta_1}$ (5)

Of (5) $T_1^{'} = 500\ \mathrm{K}$ (6)

Of (4) $T_1^{''} = \frac{T_2}{1-\eta_2}$ (7)

Of (7) $T_1^{''} = 600\ \mathrm{K}$ (8)

$\Delta T = T_1^{''} - T_1^{'}$ (9)

(6) and (8) in (9): ΔT=100 K

Answer:

100 K (100 °C)