

So, efficiency of Carnot's heat engine

$$\eta = \frac{W}{Q_1} \Rightarrow \eta = \frac{\cancel{\mu R \log_e \left(\frac{V_2}{V_1} \right)} (T_1 - T_2)}{\cancel{\mu R T_1 \log_e \left(\frac{V_2}{V_1} \right)}}$$

$$\eta = \frac{T_1 - T_2}{T_1} \Rightarrow \eta = \frac{T_1}{T_1} - \frac{T_2}{T_1}$$

$$\boxed{\eta = 1 - \frac{T_2}{T_1}} \quad \text{--- (10)}$$

Conclusion:-

1. efficiency of Carnot's heat engine is independent of the nature of the working substance. It depends only upon temp. of the source and temp. of the sink.
2. $\eta = \frac{(T_1 - T_2)}{T_1} \Rightarrow \eta \propto \text{Temp. difference between source and the sink}$

$$\eta \propto \frac{1}{T_1} \Rightarrow T_1 \uparrow, \eta \downarrow$$

3. For $\eta = 100\%$ i.e. for $\eta = 1 \Rightarrow \frac{T_2}{T_1} = 0$

i.e. for $\eta = 100\%$, $T_2 = 0 \text{ K}$