CARNOT'S THEOREM

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According to this theorem,

“The efficiency of a Carnot reversible engine is maximum and is independent of the nature of the working substance.”

Or

“The efficiency of all reversible heat engines operating between the same two temperatures is the same and no irreversible heat engine working between the same two temperatures can have a greater efficiency than Carnot heat engine.”

$\eta_A > \eta_B$

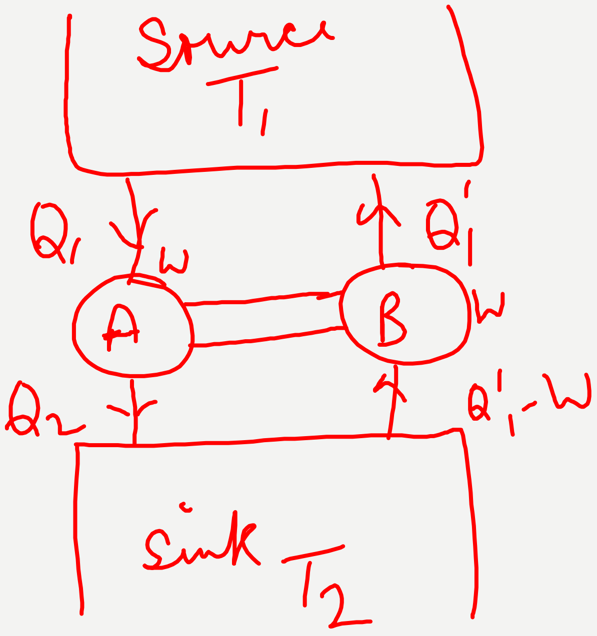
The net loss of heat from the sink

$= (Q_1' - W) - (Q_1 - W)$

$= Q_1' - Q_1$ — (1)

Net gain of heat by the source

$= (Q_1' - Q_1)$ — (2)



$\eta_A = \frac{W}{Q_1}$ $\eta_B = \frac{W}{Q_1'}$

$$\left\{ \begin{array}{l} Q_2 = Q_1 - W \\ Q_2' = Q_1' - W \end{array} \right\}$$

$$\eta_A > \eta_B$$

$$\Rightarrow \frac{\omega}{Q_1} > \frac{W}{Q_1'}$$

$$\Rightarrow Q_1' > Q_1$$

THERMODYNAMIC TEMPERATURE

$$\eta = f(\theta_1, \theta_2)$$

$$\eta = \frac{Q_1 - Q_2}{Q_1}$$

$$\Rightarrow \frac{Q_1 - Q_2}{Q_1} = f(\theta_1, \theta_2)$$

$$\Rightarrow 1 - \frac{Q_2}{Q_1} = f(\theta_1, \theta_2)$$

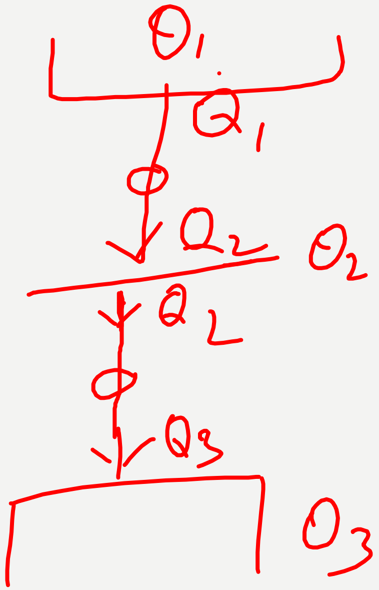
$$\Rightarrow \frac{Q_2}{Q_1} = 1 - f(\theta_1, \theta_2)$$

$$\Rightarrow \frac{Q_1}{Q_2} = \frac{1}{1 - f(\theta_1, \theta_2)}$$

$$= F(\theta_1, \theta_2) \quad \text{--- (1)}$$

$$(\theta_1 > \theta_2 > \theta_3)$$

$$\frac{Q_2}{Q_3} = F(\theta_2, \theta_3) \quad \text{--- (2)}$$



$$\frac{Q_1}{Q_3} = F(\theta_1, \theta_3) \quad \text{--- (3)}$$

$$\frac{Q_1}{\cancel{Q_2}} \times \frac{\cancel{Q_2}}{Q_3} = F(\theta_1, \theta_2) \times F(\theta_2, \theta_3)$$

$$\Rightarrow \frac{Q_1}{Q_3} = F(\theta_1, \theta_2) \times F(\theta_2, \theta_3) \quad \text{--- (4)}$$

From eq^n (3) & (4)

$$\boxed{F(\theta_1, \theta_3) = F(\theta_1, \theta_2) \times F(\theta_2, \theta_3)} \quad \text{--- (5)}$$

$$\left.\begin{aligned} F(\theta_1, \theta_2) &= \frac{\phi(\theta_1)}{\phi(\theta_2)} \\ F(\theta_2, \theta_3) &= \frac{\phi(\theta_2)}{\phi(\theta_3)} \\ F(\theta_1, \theta_3) &= \frac{\phi(\theta_1)}{\phi(\theta_3)} \end{aligned}\right\} \quad \text{--- (6)}$$

$$\frac{Q_1}{Q_2} = F(\theta_1, \theta_2) = \frac{\phi(\theta_1)}{\phi(\theta_2)}$$

$$[\phi(\theta) = \tau]$$

$$\phi(\theta_1) = \tau_1$$

$$\phi(\theta_2) = \tau_2$$

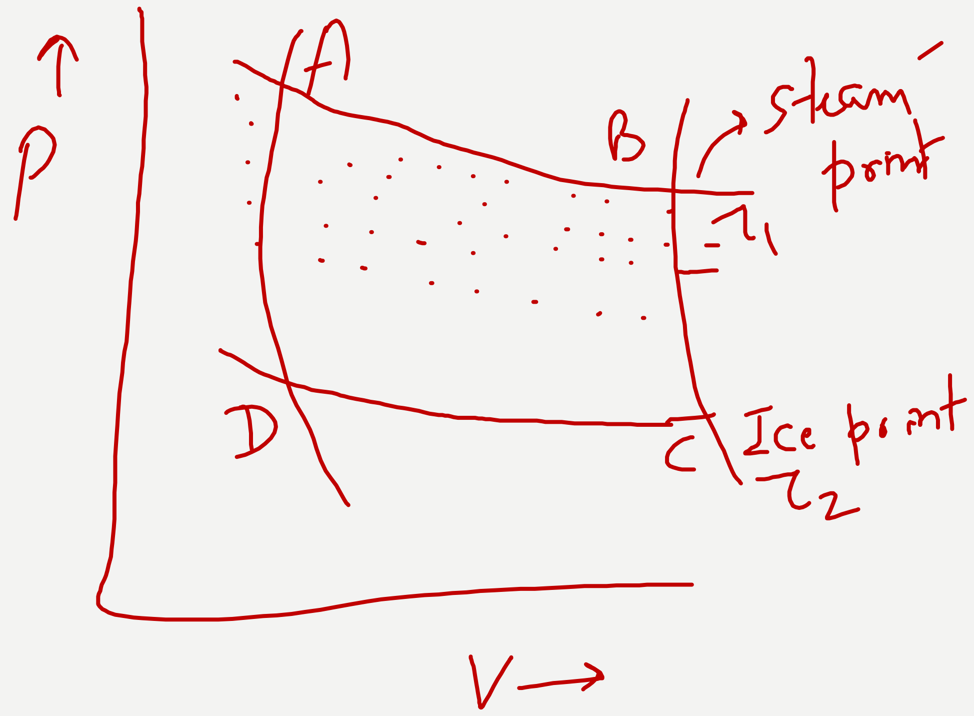
$$\Rightarrow \boxed{\frac{Q_1}{Q_2} = \frac{\phi(\theta_1)}{\phi(\theta_2)} = \frac{\tau_1}{\tau_2}}$$

KELVIN'S THERMODYNAMIC SCALE OF TEMPETAURE

$$\eta = 1 - \frac{Q_2}{Q_1} = 1 - \frac{\tau_2}{\tau_1} \quad — (7)$$

$$\tau_2 = 0 \Rightarrow Q_2 = 0$$

Absolute Zero



WORK SCALE AND PERFECT GAS SCALE

$$\eta = 1 - \frac{Q_2}{Q_1} = 1 - \frac{T_2}{T_1} \quad - (8)$$

(7) & (8) $\quad \frac{T_1}{T_2} = \frac{\tau_1}{\tau_2} \quad - (9)$

$\boxed{\tau_2 = 0} \Rightarrow Q_2 = 0 \Rightarrow \boxed{T_2 = 0}$

$T_1 \rightarrow$ Boiling pt. $\quad T_2 \rightarrow$ ice $\quad T_1 - T_2 = 100$

$\longrightarrow \tau_1 - \tau_2 = 100$

$$1 - \frac{\tau_2}{\tau_1} = 1 - \frac{T_2}{T_1}$$

$$\Rightarrow \frac{\tau_1 - \tau_2}{\tau_1} = \frac{T_1 - T_2}{T_1}$$

$$\frac{100}{\tau_1} = \frac{100}{T_1}$$

$$\Rightarrow \boxed{\tau_1 = T_1}$$

THANKYOU