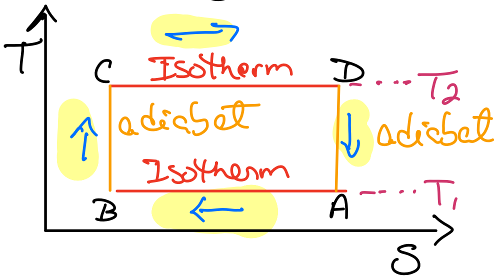
Carnot cycle part 2



The Carnot Cycle Integral:

$$\oint \delta q = \oint \delta w$$

Heat input = work done by system

$$\oint T\,ds = \oint p\,d\alpha$$

We can show that

$$\oint T\,ds = \int_A^B T\,ds + \int_B^C T\,ds + \int_C^D T\,ds + \int_D^A T\,ds$$

$$= T_1 \Delta S\Big|_A^B + 0 + T_2 \Delta S\Big|_C^D + 0$$

$$\oint T\,ds = \oint \delta q = \oint \delta w = T_1 \Delta S\Big|_A^B + T_2 \Delta S\Big|_C^D$$

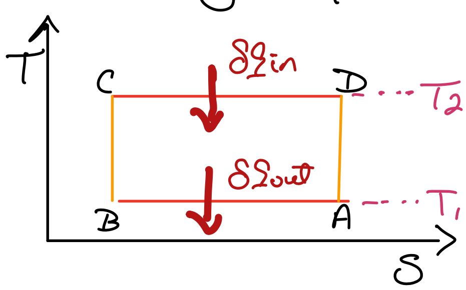
Define $\Delta S\Big|_A^B = S_B - S_A = -\Delta S$

$\Delta S\Big|_C^D = S_D - S_C = \Delta S$

$$\oint T\,ds = \oint \delta q = \oint \delta w = T_2 \Delta S - T_1 \Delta S$$

$$= (T_2 - T_1)\Delta S = \delta q_{in} - \delta q_{out}$$

eg



By definition $dS = \dfrac{\delta Q}{T}$

$$\oint \delta w = T_2 \left(\frac{T_2 - T_1}{T_2}\right) \Delta S$$

We mult. by ΔS in the num. and denom. of parenthesis

$$\oint \delta w = T_2 \left(\frac{T_2 \Delta S - T_1 \Delta S}{T_2 \Delta S}\right) \Delta S$$

$$= T_2 \left(\frac{\delta q_{in} - \delta q_{out}}{\delta q_{in}}\right) \Delta S$$

Define $\varepsilon = \dfrac{T_2 - T_1}{T_2} = \dfrac{\delta q_{in} - \delta q_{out}}{\delta q_{in}} = \dfrac{W}{\delta q_{in}}$ = Carnot Efficiency

Noting that $W = \oint \delta w = (T_2 - T_1)\Delta S$

By definition $\varepsilon < 1$