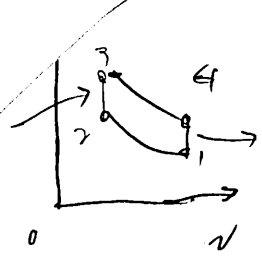

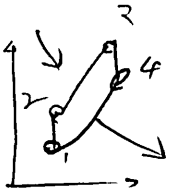

$$\eta = 1 + \frac{Q_{in} + Q_{out}}{Q_{in}}$$

$$Q_{in} = C_v(T_2 - T_3) < 0$$

$$Q_{out} = C_v(T_4 - T_1) > 0$$

$$\eta = \frac{C_v(T_2 - T_3) + C_v(T_4 - T_1)}{C_v(T_4 - T_1)}$$

$$= 1 + \frac{C_v(T_2 - T_3)}{C_v(T_4 - T_1)}$$

$$1 + \frac{T_2 - T_3}{T_4 - T_1}$$

$3 \to 4 : T_3 V_3^{k-1} = T_4 V_4^{k-1}$ 代入 (1) (2)

$1 \to 2 : T_1 V_1^{k-1} = T_2 V_2^{k-1}$

$$\rightarrow r = \frac{V_2}{V_1} = \frac{V_3}{V_4}$$

$$\left(\frac{V_2}{V_1}\right)^{k-1} = \frac{T_1}{T_2} = r$$

$$\Rightarrow r^{1-k} = \frac{T_2}{T_1}$$

$$T_4 = \left(\frac{V_3}{V_4}\right)^{k-1} T_3 = \left(\frac{V_2}{V_1}\right)^{k-1} T_3$$

$$T_2 = \left(\frac{V_1}{V_2}\right)^{k-1} T_1$$

$$\rightarrow \eta = 1 + \frac{\left(\frac{V_1}{V_2}\right)^{k-1} T_1 - T_3}{\left(\frac{V_2}{V_1}\right)^{k-1} T_3 - T_1}$$

$$= 1 - \frac{T_3 - \left(\frac{V_1}{V_2}\right)^{k-1} T_1}{\left(\frac{V_2}{V_1}\right)^{k-1} T_3 - T_1} = 1 - \frac{T_3 - \left(\frac{1}{r}\right)^{k-1} T_1}{r^{k-1} T_3 - T_1}$$

$$= 1 - \frac{(r^{k-1} T_3 - T_1)\left(\frac{1}{r^{k-1}}\right)}{(r^{k-1} T_3 - T_1)} = 1 - \frac{1}{r^{k-1}} = 1 - r^{1-k}$$

$$\eta = \frac{Q_{in} + Q_{out}}{Q_{in}}$$

$$= 1 + \frac{Q_{out}}{Q_{in}}$$

$$Q_{out} = \int_2^3 dQ = C_v(T_2 - T_3) = C_v(T_1 - T_4)$$

$$Q_{out} = \int_1^4 dQ = C_v(T_1 - T_4)$$

$$Q_{in} = \int_3^4 dQ = \int_3^4 (du + P dv) = \int_3^4 P dv$$

$$= \int_3^4 \frac{RT}{V} dv$$

$$= RT_{in} \int_3^4 \frac{1}{V} dv$$

$$= RT_{in} \ln\left(\frac{V_4}{V_3}\right)$$

$dQ = du + P dv$

$\int_3^4 du = \int_3^4 C_v dT = 0$

$$Q_{out} = \int_1^2 dQ = \int_1^2 (du + P dv)$$

$$= \int_1^2 (C_v \Delta T + P dv)$$

$$= RT_{out} \ln\left(\frac{V_2}{V_1}\right)$$

$$\eta = 1 + \frac{Q_{out}}{Q_{in}} = 1 + \frac{RT_o \ln\left(\frac{V_2}{V_1}\right)}{RT_i \ln\left(\frac{V_4}{V_3}\right)}$$

$$= 1 + \frac{T_o \ln\left(\frac{V_2}{V_1}\right)}{T_i \ln\left(\frac{V_4}{V_3}\right)}$$

$V_3 = V_2$

$V_4 = V_1$

$$= 1 + \frac{T_o \ln\left(\frac{V_2}{V_1}\right)}{T_i \ln\left(\frac{V_1}{V_2}\right)}$$

$$= 1 - \frac{T_o}{T_i}$$

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

ここに文字を入力する。