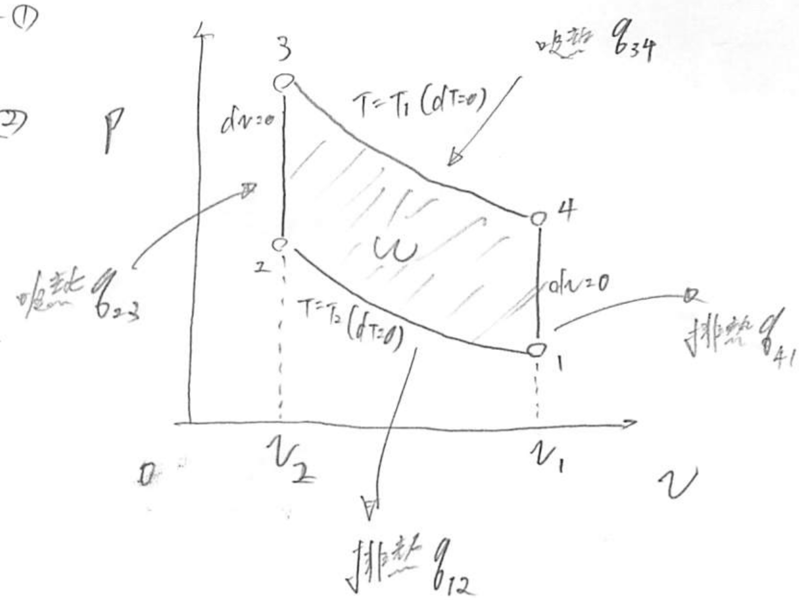
[redacted]

v線図から,

最高: $P_{max} = P_3 = (RT_{③})/v_{③} = (RT_1)/v_2$ —①

最低: $P_{min} = P_1 = (RT_{①})/v_{①} = (RT_2)/v_1$ —②



最高圧力比 ε^*

$$\varepsilon^* = \frac{P_{max}}{P_{min}} = \frac{P_3}{P_1} \quad \text{—Ⓐ}$$

また, $w = Q_{in} - Q_{out}$

$= (q_{23} + q_{34}) - (q_{41} + q_{12})$

($q_{23} = q_{41}$ より,)

$= q_{34} - q_{12}$ —③

$dq = du + pdv$

$du = 0$ ($T_1 - T_2 = 0$ だから, $C_v(T_1 - T_2) = 0$)

$= pdv$

$$q_{34} = \int_3^4 pdv = \int_3^4 \frac{RT}{v} dv$$

$= RT_1 \ln\left(\frac{v_④}{v_③}\right)$

$= RT_1 \ln\left(\frac{v_1}{v_2}\right)$ —④

$$q_{12} = \int_1^2 pdv = \int_1^2 \frac{RT}{v} dv$$

$= RT_2 \ln\left(\frac{v_1}{v_2}\right)$ —⑤

④,⑤を③に代入して,

$w = RT_1 \ln\left(\frac{v_1}{v_2}\right) - RT_2 \ln\left(\frac{v_1}{v_2}\right)$

$= R \ln\left(\frac{v_1}{v_2}\right) \cdot (T_1 - T_2)$ —⑥

⑥より, $\frac{w}{R(T_1 - T_2)} = \ln\left(\frac{v_1}{v_2}\right)$

$$\Rightarrow \frac{v_1}{v_2} = e^{\frac{w}{R(T_1 - T_2)}} \quad \text{—Ⓑ}$$

Ⓐ,Ⓑ,①,②から,

$$\varepsilon^* = \frac{P_3}{P_1} = \frac{RT_1/v_2}{RT_2/v_1} = \frac{T_1 v_1}{T_2 v_2} = \frac{T_1}{T_2} \cdot \frac{v_1}{v_2}$$

$$\varepsilon^* = \frac{T_1}{T_2} \cdot e^{\frac{w}{R(T_1 - T_2)}} \quad //$$

別紙

エネルギー変換工学（第6回）

(1) $\eta = \frac{Q_{in} - Q_{out}}{Q_{in}}$ —(A)

$2 \to 3 : |Q_{23}| = C_V \Delta T$

$= C_V (T_1 - T_2)$ —(B)

$4 \to 1 : |Q_{41}| = C_V (T_1 - T_2)$ —(C)

~~(A)(B)(C)~~

$\eta = 1 - \frac{Q_{out}}{Q_{in}}$ —

$1 \to 2 : Q_{12} = \int_1^2 dQ$

$dQ = dU + PdV$

$C_V \Delta T (=0)$

$dQ = PdV$

$Q_{12} = \int_1^2 PdV$

$PV = TR \Rightarrow P = \frac{TR}{V}$ $\to Q_{12} = \int_1^2 \frac{TR}{V} dV$

$Q_{12} = \int_1^2 \frac{T_2 R}{V} dV = T_2 R \ln\left(\frac{V_2}{V_1}\right)$ —(D)

同様に。

$3 \to 4 : Q_{34} = \int_3^4 dQ = \int_3^4 PdV$

$= \int_3^4 \frac{T_1 R}{V} dV = T_1 R \ln\left(\frac{V_4}{V_3}\right)$ —(E)

(A)(B)(C)(D)(E)より、

$Q_{out} = Q_{41} + Q_{12}$

$Q_{in} = Q_{23} + Q_{34}$

Date