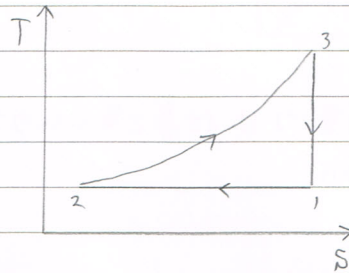
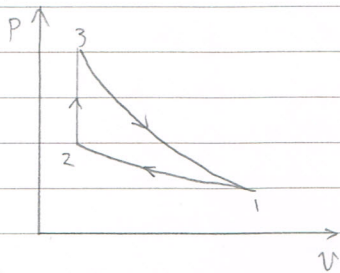


热力学 3回目

[1] (1)

(2) $2 \rightarrow 3$; 定容変化 $\therefore dV = 0$

$$dQ = dU + PdV \text{ かつ } dQ = dU$$

$$\therefore \text{吸熱量}; Q_1 = Q_{23} = U_3 - U_2 = mC_V(T_3 - T_2)$$

 $1 \rightarrow 2$; 等温変化 $\therefore dT = 0$

$$dQ = dU + PdV \text{ かつ } dQ = PdV$$

$$\therefore \text{放熱量}; Q_2 = -Q_{12} = \int_2^1 PdV = P_2V_2 \int_2^1 \frac{dV}{V} = P_2V_2 \ln\left(\frac{V_1}{V_2}\right) = mRT_2 \ln\left(\frac{P_2}{P_1}\right)$$

$$(3) \eta = \frac{W}{Q} = \frac{Q_1 - Q_2}{Q_1} = 1 - \frac{Q_2}{Q_1} = 1 - \frac{mRT_2 \ln\left(\frac{P_2}{P_1}\right)}{mC_V(T_3 - T_2)} = 1 - \frac{RT_2 \ln\left(\frac{P_2}{P_1}\right)}{\frac{R}{K-1}(T_3 - T_2)}$$

$$= \boxed{1 - \frac{T_2(K-1) \ln\left(\frac{P_2}{P_1}\right)}{T_3 - T_2}}$$

$$(4) P_1V_1 = P_2V_2 \text{ かつ } \frac{P_2}{P_1} = \frac{V_1}{V_2} = \frac{V_1}{V_3}$$

$$T_1V_1^{K-1} = T_3V_3^{K-1}$$

$$\frac{V_1}{V_3} = \left(\frac{T_3}{T_1}\right)^{\frac{1}{K-1}} = \frac{P_2}{P_1}$$

$$\eta = 1 - \frac{T_2(K-1) \ln\left(\frac{P_2}{P_1}\right)}{T_3 - T_2} = 1 - \frac{T_1(K-1) \ln\left(\frac{T_3}{T_1}\right)^{\frac{1}{K-1}}}{T_3 - T_1} = 1 - \frac{T_1 \ln\left(\frac{T_3}{T_1}\right)}{T_3 - T_1} = 1 - \frac{400 \cdot \ln 2}{800 - 400}$$

$$= 1 - 0.69 = \boxed{0.31}$$

$$[2] (1) S_1 = -\frac{Q_H}{T_H}, \quad S_2 = \frac{Q_L}{T_L}$$

$$\Delta S \geq S_1 + S_2 = -\frac{Q_H}{T_H} + \frac{Q_L}{T_L} \geq 0 \rightarrow Q_L \geq \frac{T_L}{T_H} Q_H$$

$$\therefore W_{\max} = Q_H - Q_{L\min} = \left(1 - \frac{T_L}{T_H}\right) Q_H$$

$$(2) \eta_{Lmax} = \frac{W_{max}}{Q_H} = \boxed{1 - \frac{T_L}{T_H}}$$

(3) 単位時間当たりの動力は仕事と等しいので、

$$W_{max} = \left(1 - \frac{T_L}{T_H}\right) Q_H$$

$$\rightarrow Q_H = \frac{W_{max}}{1 - \frac{T_L}{T_H}}$$

$$Q_{Lmin} = \frac{T_L}{T_H} Q_H = \frac{T_L}{T_H} \cdot \frac{W_{max}}{1 - \frac{T_L}{T_H}} = \frac{T_L}{T_H - T_L} W_{max}$$

$$Q_{Lmin} = M c_p \Delta T_f,$$

$$\therefore M = \boxed{\frac{T_L}{T_H - T_L} \cdot \frac{W_{max}}{c_p \Delta T}}$$

3 圧縮液: 1, 湿り蒸気: 2, 過熱蒸気: 3

$$(1) Q_e = h_2' - h_1 = 762.605 - 0.975 = 761.635 \div \boxed{761.6 \text{ (kJ/kg)}}$$

$$(2) Q_e = c_e \Delta T_f,$$

$$c_e = \frac{Q_e}{\Delta T} = \frac{Q_e}{T_2 - T_1} = \frac{761.6}{179.88 - 0} \div \boxed{4.2 \text{ (kJ/kgK)}}$$

$$(3) Q_2 = h_2'' - h_2' = 2776.2 - 762.605 \div \boxed{2013.6 \text{ (kJ/kg)}}$$

$$(4) (\text{過熱度}) = T_3 - T_s = 500 - 179.88 \div \boxed{320.1 \text{ (}^\circ\text{C)}}$$

$$(5) Q_3 = h_3 - h_2'' = 3478.3 - 2776.2 = \boxed{702.1 \text{ (kJ/kg)}}$$

$$(6) Q_3 = c_3 \Delta T_f,$$

$$c_3 = \frac{Q_3}{\Delta T} = \frac{Q_3}{T_3 - T_2} = \frac{702.1}{320.1} \div \boxed{2.2 \text{ (kJ/kgK)}}$$