No.
Date

R3

数学

[1]

(1) (i) $f'(x) = \dfrac{1}{(a-x)^2}$, $f''(x) = \dfrac{2}{(a-x)^3}$

(ii) $f^{(n)}(x) = \dfrac{n!}{(a-x)^{n+1}}$

(2) $g^{(n)}(x) = \dfrac{2\cdot n!}{(2-x)^{n+1}} + \dfrac{3\cdot n!}{(1-x)^{n+1}}$

[2]

(1) $-a^3+3a+2$

(2) $a \neq -1$

(3) $\dfrac{1}{(a+1)(a-2)}\begin{bmatrix} 1 & -1 & a-1 \\ -1 & a-1 & -1 \\ a-1 & -1 & 1 \end{bmatrix}$

(4) 7

[3]

(1) 定数 C_1, C_2 を用いると, $C_1 e^{-3x} + C_2 e^{2x}$

(2) $\dfrac{1}{50}\cos x + \dfrac{7}{50}\sin x$

(3) $y = C_1 e^{-3x} + C_2 e^{2x} + \dfrac{1}{50}\cos x + \dfrac{7}{50}\sin x$

[4]

(1) $\mathcal{L}\{\cos bt + i\sin bt\} = \mathcal{L}\{e^{ibt}\} = \int_0^\infty e^{-st} e^{ibt}\,dt = \int_0^\infty e^{-(s-ib)t}\,dt$

$$= \left[-\frac{1}{s-ib} e^{-(s-ib)t}\right]_0^\infty$$

$$= -\frac{1}{s-ib}(0-1) = \frac{1}{s-ib}$$

$$= \frac{s}{s^2+b^2} + i\frac{b}{s^2+b^2}$$

$$\therefore \mathcal{L}\{\cos bt + i\sin bt\} = \frac{s}{s^2+b^2} + i\frac{b}{s^2+b^2}$$

両辺を比較すると $\cos bt$ は実数部より,

$$\therefore \mathcal{L}\{\cos bt\} = \int_0^\infty e^{-st}\cos bt\,dt = \frac{s}{s^2+b^2}$$

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(2) $5e^{-2t}\cos 3t + \frac{4}{3}e^{-2t}\sin 3t = e^{-2t}\left(5\cos 3t + \frac{4}{3}\sin 3t\right)$

(3) $y(t) = -\frac{1}{8}\cos 3t + \frac{1}{8}\cos t$

R2年度　材料力学

[1]

(1) $$\delta = \frac{Pl}{A_1E_1 + A_2E_2 + A_3E_3}$$

(2) $$x = \frac{a(A_2E_2 + 2A_3E_3)}{A_1E_1 + A_2E_2 + A_3E_3}$$

(3) $$P_{max} = \frac{2(A_1E_1 + A_2E_2 + A_3E_3)}{E_1}\tau_a$$

[2]

(1) $$R_A = \frac{w_0 l}{2}$$

(2) $$F_{BC} = \frac{w_0}{2}\left\{l - \frac{(x-l)^2}{l}\right\}$$

(3) $$M_{BC} = \frac{w_0}{2}\left\{lx - \frac{(x-l)^3}{3l}\right\}$$

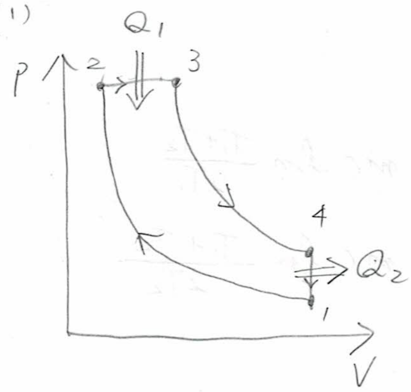
(4) $$V_{AB} = \frac{w_0 l}{48EI}x(-4x^2 + 29l^2)$$

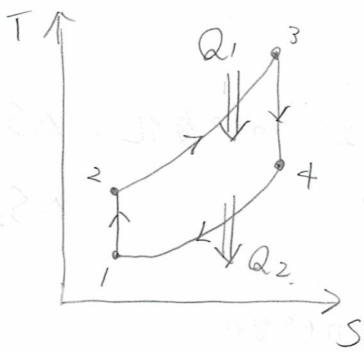
(5) $$V_{BC} = \frac{w_0}{48EI}\left\{\frac{(x-l)^5}{5l} - 2lx^3 + 23l^3x + 4l^4\right\}$$

2020 熱力学

[1]

(1)





(2)

$2 \to 3 \quad Q_1 = Q_{23} = H_3 - H_2 = mC_p(T_3 - T_2)$

$4 \to 1 \quad Q_2 = Q_{41} = U_4 - U_1 = mC_v(T_4 - T_1)$

(3) $T_1 \varepsilon^{\kappa-1} \rho$

(4) $\eta_{th}(\text{Diesel}) = 1 - \frac{1}{\kappa} \frac{\rho^{\kappa} - 1}{\varepsilon^{\kappa-1}(\rho - 1)}$

(5) (例)

1. 圧縮比を高くする．つまり，すきま容積を小さくする

2. 燃料噴射終わりのときのシリンダ容積とすきま容積との比である噴射締切比$\rho\left(\frac{V_3}{V_2}\right)$を1に近づける．行程容積を大きくなるように機関を大型化するか，燃料噴射圧力を高め，燃料噴射期間を短くする．

[2]

(1) $\dfrac{T_1 + T_2}{2}$.

(2) 高温熱源のエントロピー変化：$\Delta S_1 = mc \ln \dfrac{T_1 + T_2}{2T_1}$

低温　〃　　　　：$\Delta S_2 = mc \ln \dfrac{T_1 + T_2}{2T_2}$

(3) 系全体のエントロピー変化

$$\Delta S_t = mc \ln \frac{(T_1 + T_2)^2}{4T_1 T_2}$$

(4) 系全体のエントロピー変化において.

$$\frac{(T_1 + T_2)^2}{4T_1 T_2} - 1 = \frac{(T_1 - T_2)^2}{4T_1 T_2} > 0 \Rightarrow \frac{(T_1 + T_2)^2}{4T_1 T_2} > 1$$

そのため.

$$\Delta S_t > mc \ln 1 = 0.$$

系全体のエントロピーが増加しているので.
熱移動は不可逆変化である.

流体力学

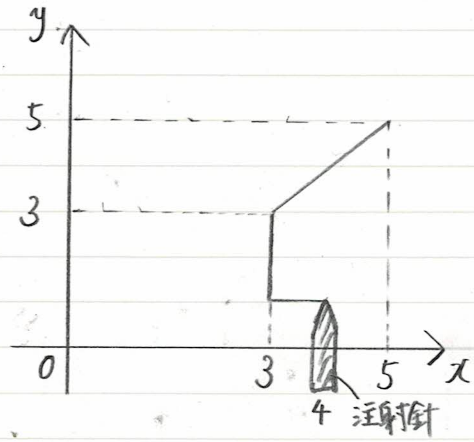
〔1〕

(1) 流脈線，下図A参照.

(2) 流跡線，下図B参照.

(3) b)

(4) $y = Ce^{-\frac{1}{2}x^2}$ (ただしCは積分定数)



図A

図B

〔2〕

(1) $u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} = -\frac{1}{\rho}\frac{\partial p}{\partial x} + \nu\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right)$

(2) $u^*\frac{\partial u^*}{\partial x^*} + v^*\frac{\partial u^*}{\partial y^*} = -\frac{\partial p^*}{\partial x^*} + \frac{\nu}{UD}\left(\frac{\partial^2 u^*}{\partial x^{*2}} + \frac{\partial^2 u^*}{\partial y^{*2}}\right)$, $p^* = p/\rho U^2$

(3) $Re = \frac{UD}{\nu}$

(4) $\tau_{xy} = \rho\nu\left(\frac{\partial v}{\partial x} + \frac{\partial u}{\partial y}\right)$

(5) $\tau_{xy} = \rho U^2 \frac{1}{Re}\left(\frac{\partial v^*}{\partial x^*} + \frac{\partial u^*}{\partial y^*}\right)$

(6) 10V，1倍