〔1〕

問1　$\omega_s = 7 \times 10^{-5}\ \mathrm{rad/s}$

問2　$R_s = \sqrt[3]{\dfrac{GM}{{\omega_s}^2}}$

問3　張力の大きさ：　$mR_1{\omega_s}^2 - G\dfrac{mM}{{R_1}^2}$

問4　最小の r'：　$\sqrt[3]{\dfrac{2GM}{{\omega_s}^2}}$

問5　(a)　$F_i = G\dfrac{M\Delta m}{{r_i}^2} - \Delta m \cdot r_i{\omega_s}^2$

(b)　$\Delta m = \lambda \Delta r$

(c)　$\displaystyle\sum_{i=1}^{N} F_i = -GM\lambda\left(\frac{1}{R_2} - \frac{1}{R_0}\right) - \frac{1}{2}\lambda{\omega_s}^2\left({R_2}^2 - {R_0}^2\right)$

(d)　$F = 0$

問6　$\dfrac{R_2}{R_0} = \dfrac{\sqrt{1 + \left(\dfrac{2R_s}{R_0}\right)^3} - 1}{2}$

記号：(え)

〔２〕

問１　$P_{\mathrm{A}}(t) = \dfrac{V^2}{r}\sin^2\omega t$

問２　$I_{\mathrm{r}} = \dfrac{2\overline{P_{\mathrm{A}}}}{V}$

問３　$I_C = \omega CV$

問４　$I_R = \sqrt{\left(\dfrac{2\overline{P_{\mathrm{A}}}}{V}\right)^2 + (\omega CV)^2}$

問５　$\overline{P_{\mathrm{B}}} = R\left\{\left(\dfrac{2\overline{P_{\mathrm{A}}}}{V}\right)^2 + (\omega CV)^2\right\}$

問６　$V_{\min} = \sqrt{\dfrac{2\overline{P_{\mathrm{A}}}}{\omega C}}$

$\overline{P_{\mathrm{B}}} = 4\overline{P_{\mathrm{A}}}\omega CR$

問７　記号：(え)

〔3〕

問1　$\Delta Q = \dfrac{3}{2}nR\Delta T$

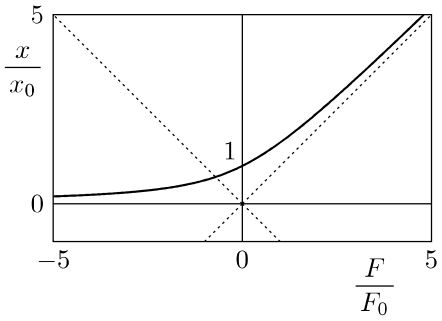
問2　$x = \sqrt{\dfrac{nRT}{k}}$

問3　$\Delta Q = 2nR\Delta T$　　$C = 2nR$

問4　$x = \dfrac{F + \sqrt{F^2 + 4knRT}}{2k}$

問5　$\dfrac{x}{x_0} = \dfrac{F}{2F_0} + \sqrt{\left(\dfrac{F}{2F_0}\right)^2 + 1}$

問5のグラフ



問6　(a)　$\dfrac{k_{\text{eff}}}{k} = 1$

(b)　$\dfrac{k_{\text{eff}}}{k} = 2$

問7　(a)　$U = \dfrac{1}{2}kr^2$

(b)　$\dfrac{Mv^2}{r} = kr$

(c)　$E = kr^2$

(d)　$\lambda_{\text{B}} = \dfrac{h}{r\sqrt{kM}}$

(e)　$r_n = \sqrt{\dfrac{nh}{2\pi\sqrt{kM}}}$

(f)　$E_n = \dfrac{nh}{2\pi}\sqrt{\dfrac{k}{M}}$