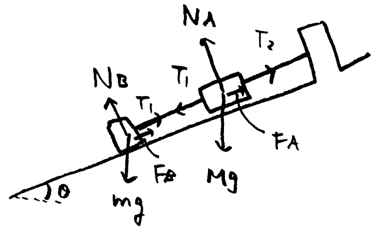
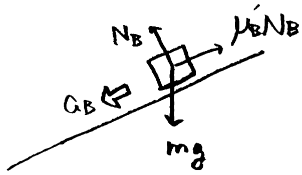
1 I



$$\begin{cases} N_A = Mg\cos\theta \\ T_1 + Mg\sin\theta = F_A + T_2 \end{cases}$$

$$\begin{cases} N_B = mg\cos\theta \\ mg\sin\theta = F_B + T_1 \end{cases}$$



(1) $N_A = \underline{Mg\cos\theta}$

(2) $T_1 = \underline{mg\sin\theta - F_B}$

$T_2 = T_1 + Mg\sin\theta - F_A = \underline{(m+M)g\sin\theta - F_A - F_B}$

$$\begin{cases} m a_B = mg\sin\theta - \mu_B' N_B \\ N_B = mg\cos\theta \end{cases}$$

(3) $a_B = \underline{g(\sin\theta - \mu_B'\cos\theta)}$

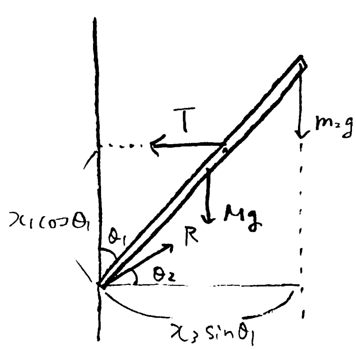
$\because\ s = \frac{1}{2}a_B t^2,\quad v_B = a_B t$ より

$v_B = \sqrt{2gs(\sin\theta - \mu_B'\cos\theta)}$

II (4) Aまわりのモーメントのつりあい

$F x_1 = m_1 g x_2 + m_2 g x_3$ $\qquad F = \underline{\dfrac{(m_1 x_2 + m_2 x_3)g}{x_1}}$

(5) $F x_1 = m_1 g x_2 + m_2 g x_3 + Mg\dfrac{x_3}{2}$ $\qquad F = \underline{\dfrac{(Mx_3 + 2m_1x_2 + 2m_2x_3)g}{2x_1}}$



モーメントのつりあい

$T x_1\cos\theta_1 = m_2 g x_3\sin\theta_1 + Mg\cdot\dfrac{x_3}{2}\sin\theta_1$

力のつりあい

$$\begin{cases} T = R\cos\theta_2 \\ m_2 g + Mg = R\sin\theta_2 \end{cases}$$

(6) $T = \underline{\dfrac{(2m_2 + M)x_3 g\tan\theta_1}{2x_1}}$

$$T = \frac{(2m_2 + 2m_2)\cancel{\chi_3}\, g \tan\frac{\pi}{3}}{\cancel{\chi_3}} = 4m_2 g \times \sqrt{3} = 4\sqrt{3}\, m_2 g = R\cos\theta_2$$

$$m_2 g + 2m_2 g = R\sin\theta_2 = 3m_2 g$$

$$\frac{\sin\theta_2}{\cos\theta_2} = \frac{\frac{3m_2 g}{R}}{\frac{4\sqrt{3}\, m_2 g}{R}} = \frac{\sqrt{3}}{4}$$

$$\cos\theta_2 = \frac{4}{\sqrt{16+3}} = \frac{4}{\sqrt{19}} \qquad R = \frac{4\sqrt{3}\, m_2 g}{\cos\theta_2} = \sqrt{57}\, m_2 g$$

2 I (ア) $R_1 \times (1-\ell_1) = R_2 \times \ell_1$　　$R_2 = \dfrac{1-\ell_1}{\ell_1} R_1$

(イ) $E \times \dfrac{R_2}{R_1+R_2} = (1-\ell_1)E$

(ウ) $E \times \dfrac{1-\ell_2}{\ell_2+(1-\ell_2)} = (1-\ell_2)E$

(エ) R_2, R_3 の合成抵抗は $\dfrac{1}{\frac{1}{R_2}+\frac{1}{R_3}} = \dfrac{R_2R_3}{R_2+R_3}$

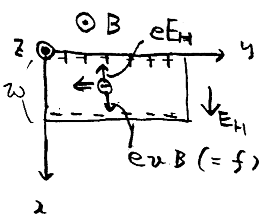
$R_1 : \dfrac{R_2R_3}{R_2+R_3} = \ell_2 : 1-\ell_2$ より $\dfrac{R_2R_3\ell_2}{R_2+R_3} = R_1(1-\ell_2)$.

$R_3 = \dfrac{(1-\ell_2)R_1R_2}{\ell_2R_2-(1-\ell_2)R_1}$

II (オ) $V = I \times \rho \times \dfrac{\ell}{hw}$ より $\rho = \dfrac{hwV}{I\ell}$

(カ) $I = envhw$ より $n = \dfrac{I}{evhw}$

(キ) $P = I^2R = VI$, ジュール熱



(ク) $evB = eE_H = f$　　$E_H = \dfrac{f}{e}$

(ケ) $V_H = E_H w$

(コ) $F = BI\ell$. x軸正の向き.

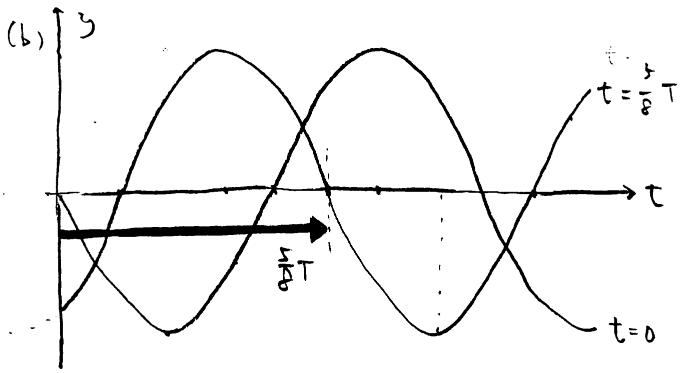
$$\left(\begin{aligned} F &= evB \times nhw\ell \\ &= B\ell \times envhw \\ &= B\ell \times I. \end{aligned}\right)$$

③ (a) $T=\frac{2\pi}{\omega}$,

Lの位置で $\frac{5T}{8}$ 遅れているので $L=\frac{5}{8}\lambda$　　$\underline{\lambda=\frac{8}{5}L}$

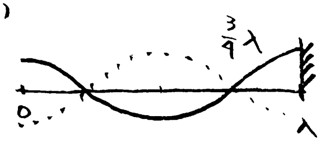
$v=\frac{\lambda}{T}=\frac{8}{5}L\times\frac{\omega}{2\pi}=\underline{\frac{4L\omega}{5\pi}}$

(b)



⑧

(c)

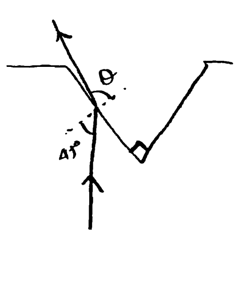


$x=\frac{3}{4}\lambda$は節なので　$\underline{0}$

II (d). スリットの幅が狭いため光が回折したから

(e) S_0S_1とS_0S_2に光路差が存在するから.

(f)



$\frac{\sin 45°}{\sin\theta}=\frac{1}{n}$　　$\sin\theta=n\sin 45°=\frac{n}{\sqrt{2}}\geq 1$

となるとき全反射を起こす.

$\therefore\ \underline{n\geq\sqrt{2}}$

$\boxed{4}$ A: $PV = nRT$

(積) $Q_{AB} = 0 + \frac{3}{2}nR(T_B - T) = \frac{3}{2}nR(2T - T) = \frac{3}{2}nRT$

B $2P \cdot V = nRT_B$ $\quad T_B = \frac{2PV}{nR} = 2T$

(圧) $Q_{BC} = 2P(4V - V) + \frac{3}{2}nR(T_C - T_B) = \frac{5}{2}nR(T_C - T_B) = \frac{5}{2}nR(8T - 2T) = 15nRT$

C $2P \cdot 4V = nRT_C$, $\quad T_C = 8T$

(積) $Q_{CD} = 0 + \frac{3}{2}nR(T_D - T_C) = -6nRT$

D $P \cdot 4V = nRT_D$, $\quad T_D = 4T$

圧 $Q_{DA} = P \cdot (4V - V) + \frac{3}{2}nR(T - T_D) = \frac{5}{2}nR(T - T_D) = -\frac{15}{2}nRT.$

(あ) $2T$, $8T$, $4T$.

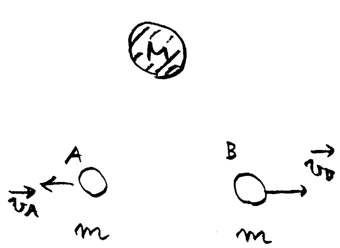
(い) ①

(う) $Q_1 = Q_{AB} + Q_{BC} = \frac{3}{2}nRT + 15nRT = \underline{\frac{33}{2}nRT}$

$Q_2 = -Q_{CD} - Q_{DA} = 6nRT + \frac{13}{2}nRT = \underline{\frac{27}{2}nRT}$ //

(え) $e = \frac{Q_1 - Q_2}{Q_1} = \frac{\frac{6}{2}}{\frac{33}{2}} = \underline{\frac{2}{11}}$ //

II (あ) 運動量, 質量数, 陽子数, 電気量



$E = (M - 2m)c^2$

$\vec{v_B} = -\vec{v_A}$

運動量が保存し、かつ、分裂前の

運動量が 0だったから.