$$\frac{k}{2}\Delta\ell^2 - mg\Delta\ell - \frac{3m^2g^2}{2k} = 0$$

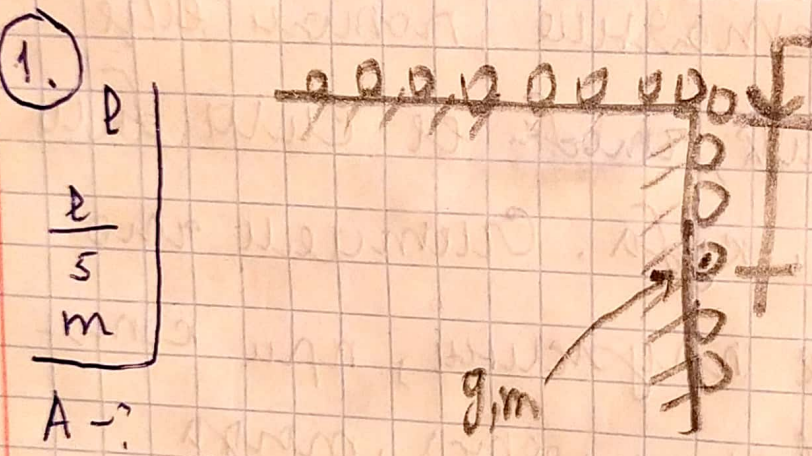
$$2{,}5\,\Delta\ell^2 - 0{,}05\Delta\ell - \frac{3}{2}\cdot 100\cdot\frac{0{,}005^2}{5} = 0$$

$\Delta\ell > 0 \qquad \Delta\ell = 0{,}03$ м

Ответ: $\Delta\ell = 0{,}03$ м

ДЗ – 8

1.



$$E_п = \frac{mg}{5}\cdot\frac{\ell}{10} = \frac{mg\ell}{50}$$

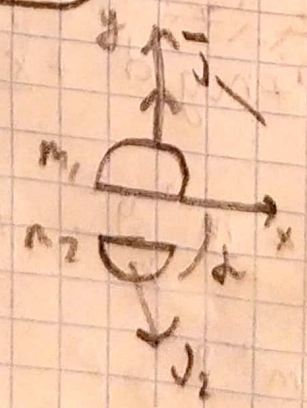
$$A_т = -\Delta E_п = -\left(0 - \left(-\frac{mg\ell}{50}\right)\right)$$

$$\boxed{A = -A_т = \frac{mg\ell}{50}}$$

2. J, m_1, m_2

$J_1, \vec{J}_1, \vec{\omega}$

$\vec{J}_2 - ?$



$\sum \bar{p} = \overline{const}$

$m\bar{J} = m_1\bar{J}_1 + m_2\bar{J}_2$

X: $mJ = 0 + m_2 J_2 \cdot \cos\alpha$

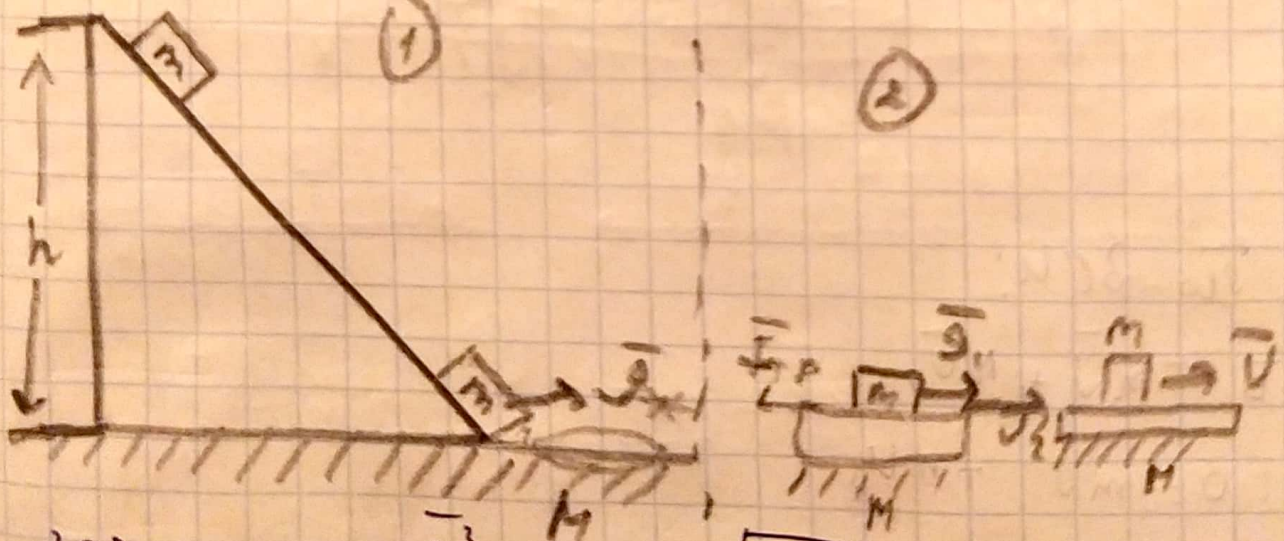
y: $0 = m_1 \bar{V}_1 - m_2 J_2 \cdot \sin\alpha$

$$\begin{cases} mJ = m_2 J_2 \cos\alpha \\ m_1 J_1 = m_2 J_2 \sin\alpha \end{cases}$$

$$\frac{m_1 J_1}{m J} = tg\alpha \Rightarrow \alpha = arc\,tg\left(\frac{m_1 J_1}{(m_1+m_2)J}\right)$$

$$J_2 = \frac{m_1 J_1}{m_2 \sin\alpha}$$

③ h, M, m



ЗСЭ: $mgh = \frac{m\vartheta_x^2}{2} \Rightarrow \vartheta_x = \sqrt{2gh}$

ЗСИ: $m\vartheta_x = (m+M)V \Rightarrow V = \frac{m}{m+M}\vartheta_x$

ЗСЭ: $\frac{(m+M)V^2}{2} + V = \frac{m+M}{2}V^2 + A_{тр}$

$$A_{тр} = mgh - \frac{(m+M)}{2} \cdot \frac{m^2}{(m+M)^2} \cdot 2mgh =$$

$$= \left(m - \frac{m^2}{(m+M)}\right) gh = -\frac{mM}{m+M} gh$$

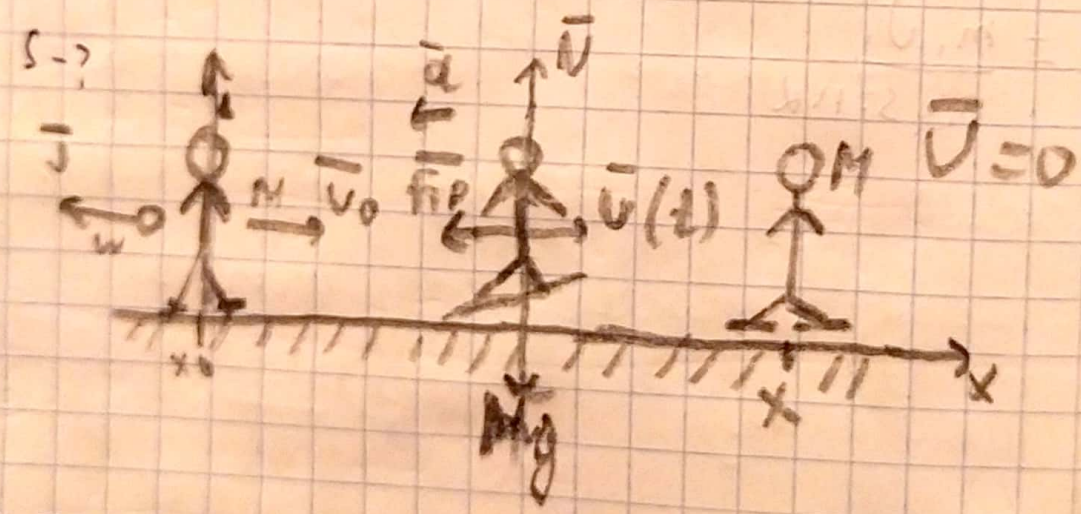
(4)

$M = 70$ кг

$m = 3$ кг

$J = 8$ м/с

$\mu = 0{,}02$



1) ЗСИ:

$\bar{D} = m\bar{J} + M\bar{v}_0$

x: $0 = -mJ + Mv_0$

$v_0 = \frac{m}{M} J$

2) $\bar{\Sigma} f = M\bar{a}$

$M\bar{g} + \bar{N} + \bar{f}_{тр} = M\bar{a}$

$x: -f_{тр} = -Ma$ $\quad y: -Mg + N = 0$

$a = \frac{f_{тр}}{M}$, $\quad N = Mg$

$f_{тр} = \mu N = \mu mg \Rightarrow a = \mu g$

3) $\frac{dv}{dt} = -\mu g_t$ $\quad \frac{dx}{dt} = v_0 - \mu g t$

$\int_{v_0}^{v} dv = -\mu g \int_0^t dt$ $\quad \int_{x_0}^{x} dx = v \int_0^t dt - \mu g \int_0^t t\,dt$

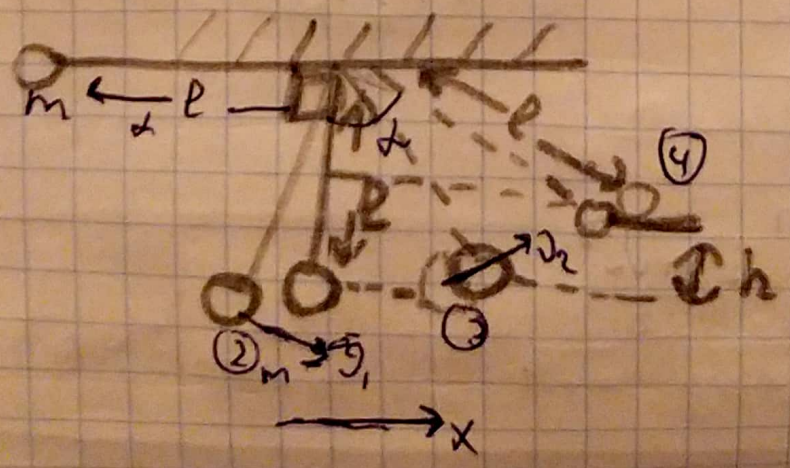
$v - v_0 = -\mu g t$ $\quad x - x_0 = vt - \mu g \frac{t^2}{2}$

$v = v_0 - \mu g t$ $\quad S(t) = x - x_0 = v_0 t - \mu g \frac{t^2}{2}$

$v(t_{ост}) = 0 = v_0 - \mu g t_{ост}$ $\quad S(t_{ост}) = v_0 t_{ост} - \mu g \frac{t_{ост}^2}{2} =$

$t_{ост} = \frac{v_0}{\mu g}$ $= \frac{m}{M} J \cdot \frac{\frac{M}{m} J}{\mu g} - \frac{\mu g \cdot \left(\frac{M}{m} J\right)^2}{2(\mu g)^2} = \frac{m^2}{M^2} \frac{J^2}{2\mu g} \approx$ 0,3м

5) ①



α - ?

1) ЗСЭ: $mgl = \frac{m\vartheta_1^2}{2}$

$\vartheta_1 = \sqrt{2gl}$

2) ЗСИ: $m\bar{\vartheta}_1 = 2m\bar{\vartheta}_2$

$x: \vartheta_1 = 2\vartheta_2 \Rightarrow \vartheta_2 = \frac{\vartheta_1}{2} = \sqrt{\frac{gl}{2}}$

3) ЗСЭ: $\frac{2m\vartheta_2^2}{2} = 2mgh$

$h = \frac{\vartheta_2^2}{2g} = l - l\cos\alpha$

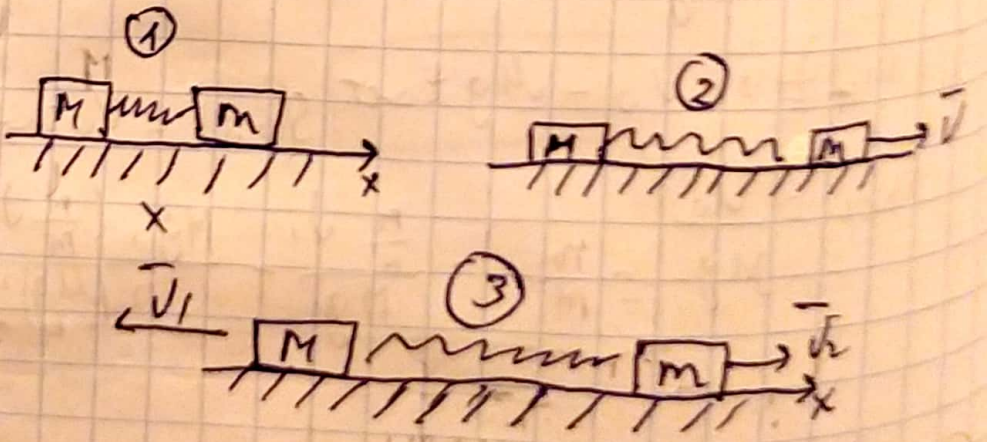
$\cos\alpha = \frac{l - \vartheta_2^2}{\frac{2g}{l}} = 1 - \frac{\vartheta_2^2}{2gl} = 1 - \frac{gl}{2 \cdot 2gl} = 1 - \frac{1}{4} = \frac{3}{4}$

$\alpha = 41°$

⑥. m, M

V

$J_2 - ?$



$$\begin{cases} \frac{kx^2}{2} = \frac{mJ^2}{2} \\ \frac{kx^2}{2} = \frac{M_1V_1^2}{2} + \frac{mJ_2^2}{2} \end{cases}$$

3) ЗСИ: $\vec{P} = \text{const}$

$X: 0 = -MV_1 + mV_2 \Rightarrow MV_1 = mV_2 \qquad V_1 = \frac{m}{M} V_2$

$\frac{MV^2}{2} = \frac{M \cdot m^2}{2M^2} V_2^2 + \frac{mV_2^2}{2}$

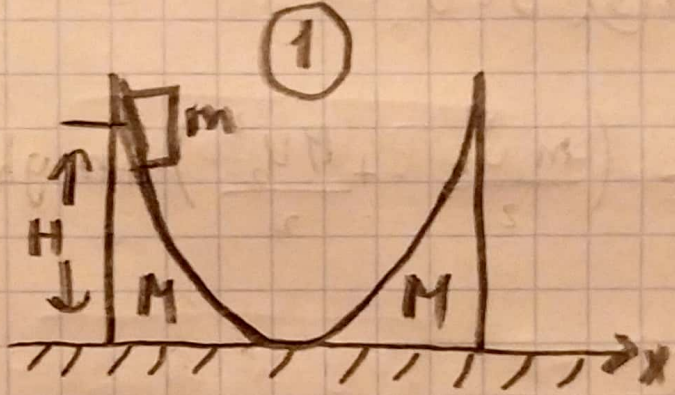
$V_2^2 = \frac{V^2}{\frac{m}{M}+1} \Rightarrow V_2 = V \cdot \sqrt{\frac{M}{m+M}}$

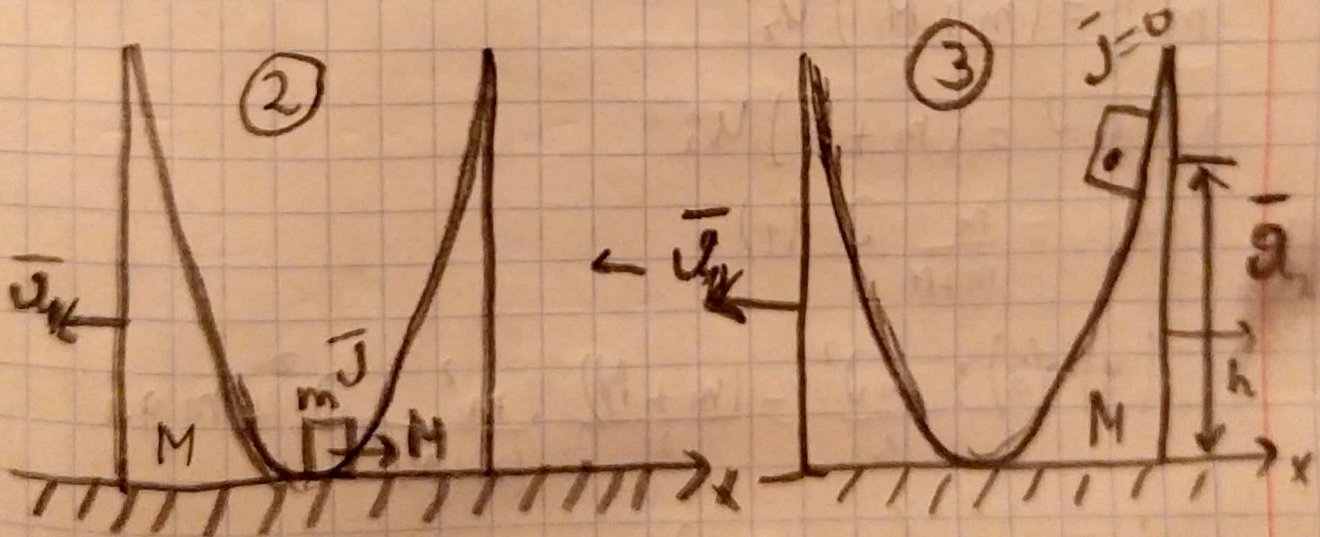
7. $M = 1{,}6$ кг

$m = 0{,}4$ кг

$H = 1$ м

$h - ?$





1) ① → ② ЗСЭ

$mgH = \frac{MH_1^2}{2} + \frac{mg^2}{2} \quad (1)$

ЗСИ:

$0 = M\vec{V}_1 + m\vec{V}$

$X: 0 = -MV_1 + mV \quad V_1 = \frac{m}{M} V \quad (2)$

(2) → (1)

$$mgH = \frac{M\left(\frac{m}{M}J\right)^2}{2} + \frac{m}{2}J^2$$

$$mgH = \frac{m^2J^2}{M2} + \frac{mJ^2}{2}$$

$$J^2 = \frac{2gH}{\frac{m+M}{M}} \quad (*)$$

2) ② → ③ ЗСЭ:

$$\frac{mJ^2}{2} = \left(\frac{mJ_2^2}{2} + \frac{MU_2^2}{2}\right) + mgh$$

ЗСИ:

$$m\bar{J} = (m+M)\bar{U}_2$$

$$x: mJ = (m+M)U_2$$

$$U_2 = \frac{m}{m+M}J \quad (4)$$

$$(4) \to (3): \frac{mJ^2}{2} = \frac{(m+M)}{2} \cdot \frac{m^2}{(m+M)^2}J^2 + mgh$$

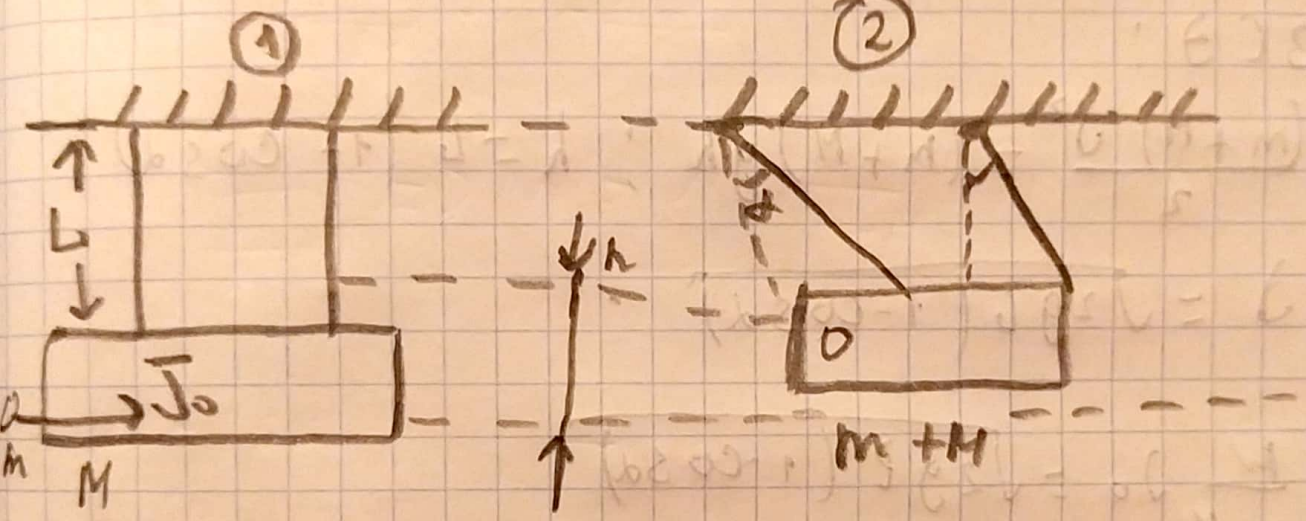
$$h = \frac{J^2}{2g}\left(1 - \frac{m}{m+M}\right)$$

$$h \overset{(*)}{=} \frac{2gH \cdot M}{(m+M)2g}\left(\frac{M}{m+M}\right) = H \cdot \frac{M^2}{(m+M)^2} = 0{,}64\text{м}$$

(8) m; M, $m \ll M$

L, d,

$v_0 = ?$ $\frac{W}{E_{k0}} = ?$



1) (1) → (1*) – Момент когда пуля попало в тело

ЗСЭ:

$$\frac{m v_0^2}{2} = \frac{(m+M) v^2}{2} + W(1)$$

ЗСИ: $m v_0 = (m+M) v$

$$v = \frac{m}{m+M} v_0 (2)$$

$$(1) \to (2): \frac{m v_0^2}{2} = \frac{(m+M) m^2 v_0^2}{2 (M+M)^2} + W$$

$$\frac{v_0^2}{2}\left(m - \frac{m^2}{m+M}\right) = W$$

$$\frac{v_0^2}{2} \cdot \frac{mM}{m+M} = W (3)$$

$$\frac{W}{E_{k0}} = \frac{W}{\frac{m J_0^2}{2}} = \frac{\frac{J_0^2}{2}\,\frac{mM}{m+M}}{\frac{m J_0^2}{2}} = \frac{M}{m+M} \to 1$$

2) (1) → (2)

ЗСЭ:

$$\frac{(m+M)\,J^2}{2} = (m+M)\,gh \;;\; h = L(1-\cos\alpha)$$

$$J = \sqrt{2gL(1-\cos\alpha)}$$

$$\frac{M}{m+M} J_0 = \sqrt{2gL(1-\cos\alpha)}$$

$$J_0 = \frac{m+M}{m}\sqrt{2gL(1-\cos\alpha)} = \sqrt{2gL(1-\cos\alpha)} +$$

$$+ \frac{M}{m}\sqrt{2gL(1-\cos\alpha)}$$