РЗ 2. Закон Ньютона

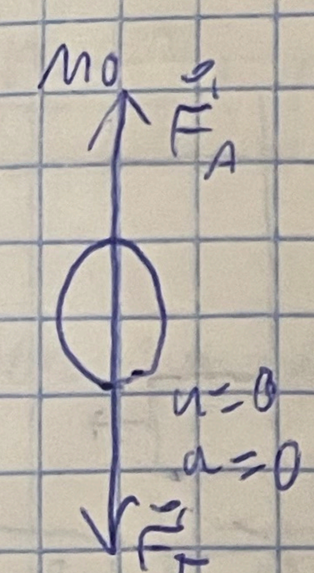
П-45 физ ⑦

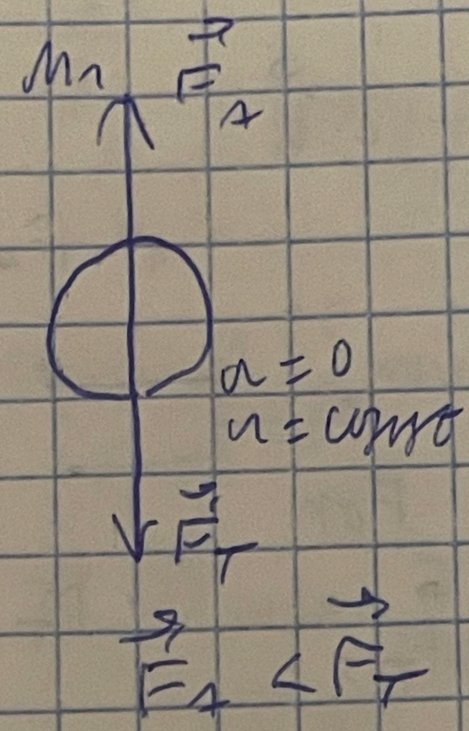
① Дано:

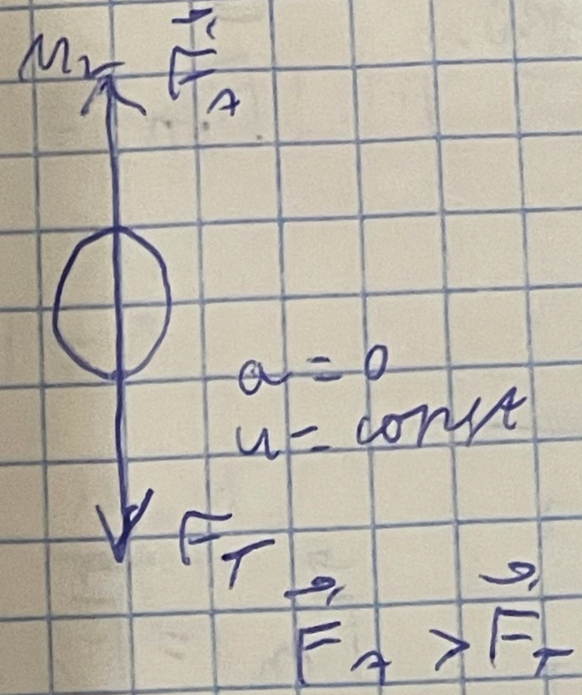
M_0

M_1

M_2







$M_0: \vec{F}_A = \vec{F}_T \Rightarrow F_A = M_0 g$

$M_1: \vec{F}_A + \vec{F}_T + \vec{F}_{on} = m\vec{a}$

$\vec{F}_{on} = \vec{F}_A + \vec{F}_T \Rightarrow F_{on} = M_0 g + M_1 g = g(M_0 - M_1)$

$M_2: \vec{F}_A + \vec{F}_T + \vec{F}_{on} = m\vec{a}$

$\vec{F}_T = \vec{F}_A + \vec{F}_{on}$

$M_2 g = M_0 g + g(M_0 - M_1)$

$M_2 g = g(2M_0 - M_1) \Rightarrow M_2 g = 2M_0 g - M_1 g$

$M_2 = 2M_0 - M_1$

Ответ: $M_2 = 2M_0 - M_1$

(2) Дано:

m_k

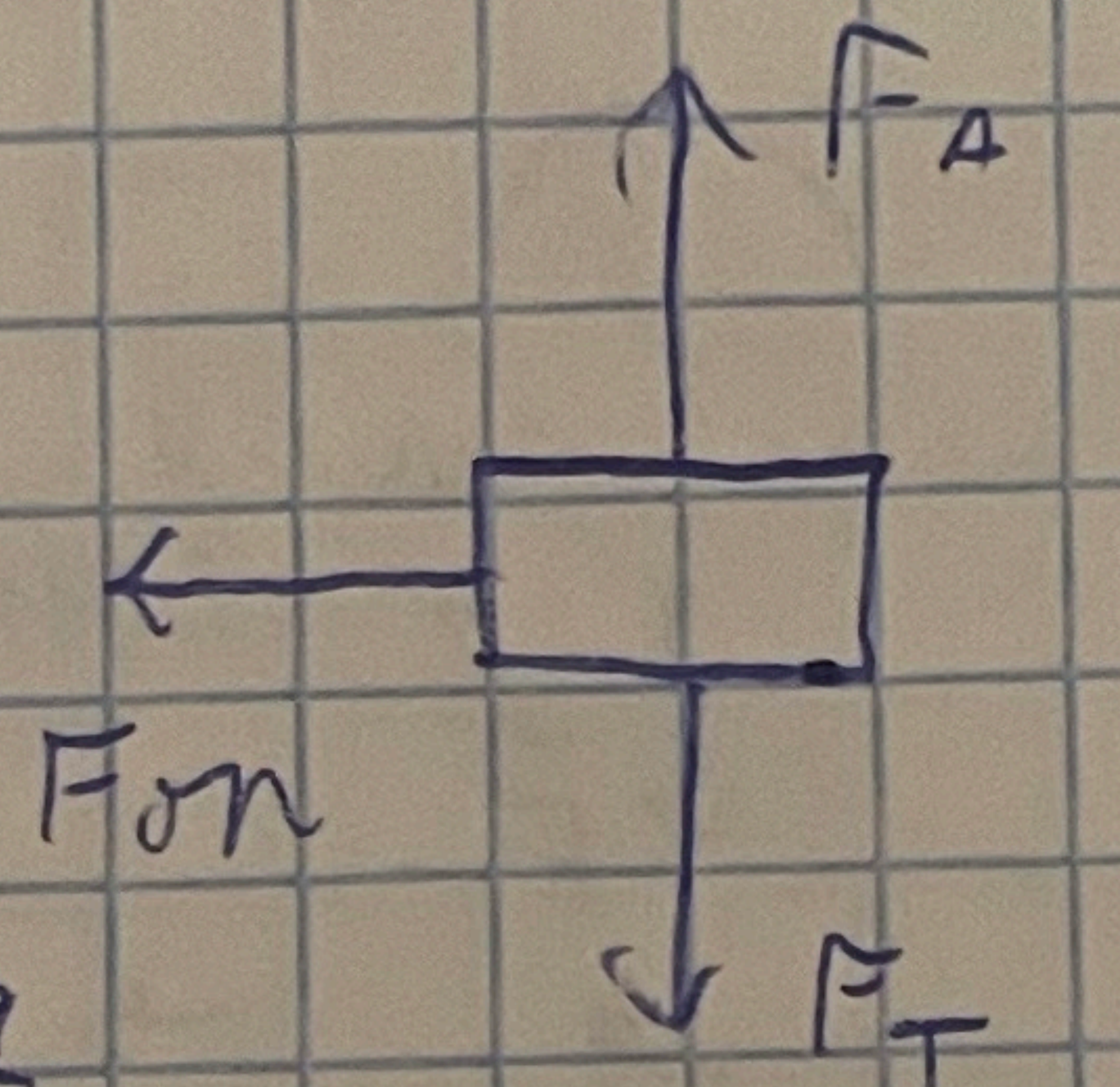
V_0

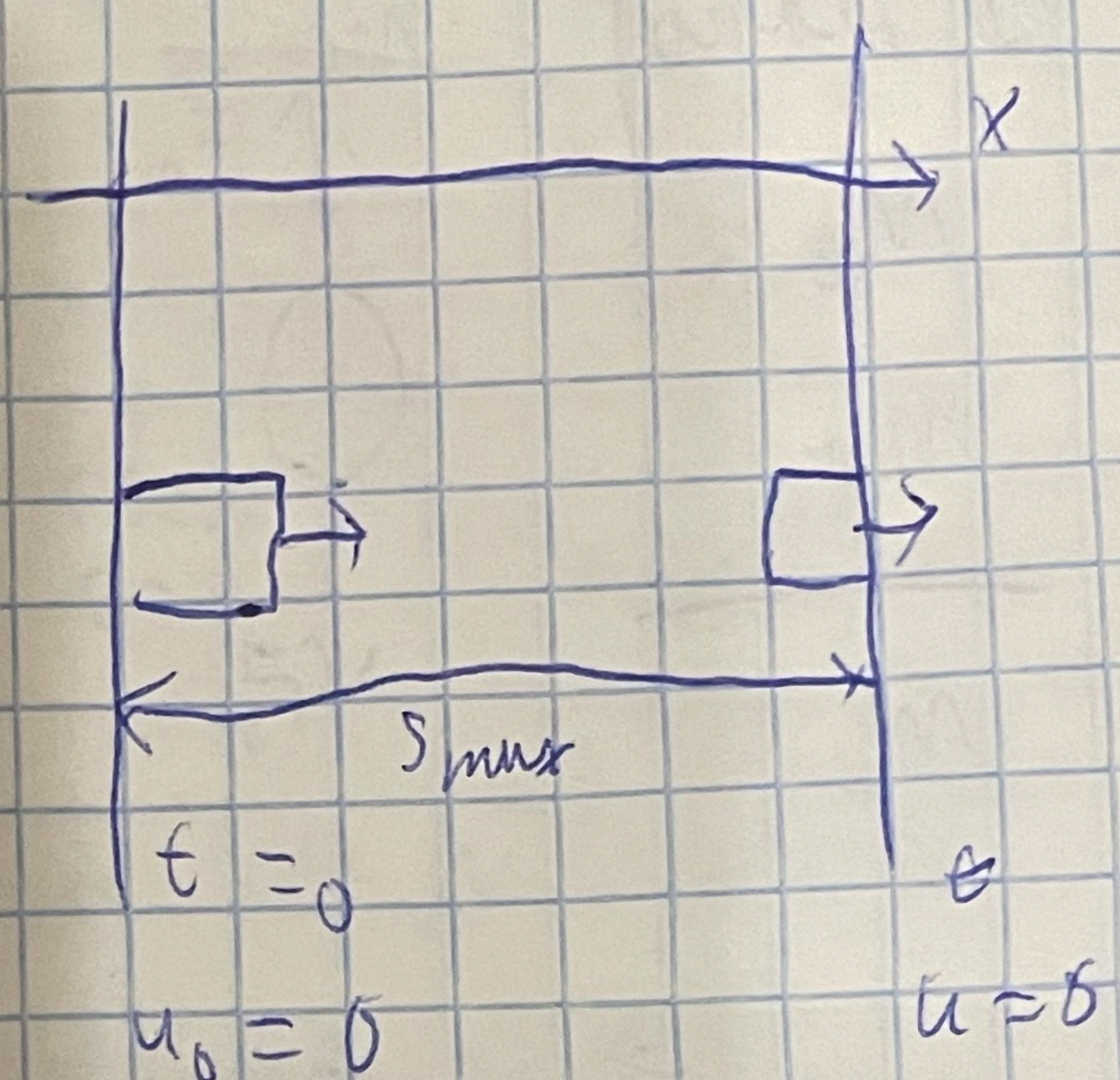
$V(t)$ — ?

$V(S)$ — ?

S_{max} — ?

$\vec F_{on} = -2\vec u$





$\vec F_{on} = \vec F_A + \vec F_T =$

$= ma$

$OX: -2u = m_k \vec a$

$$m_k \frac{du}{dt} = -2u \Rightarrow \frac{du}{dt} = \frac{-2u}{m_k} \Rightarrow \frac{du}{u} = \frac{-2}{m_k} dt$$

$$\int_{u_0}^{u(t)} \frac{du}{u} = \int_0^t -\frac{2}{m_k} dt \Rightarrow \underline{u(t) = u_0 e^{-\frac{2}{m_k}t}}$$

$$S(t) = \int_0^t u(t)\,dt = \int_0^t u_0 e^{-\frac{2}{m_k}t}\,dt =$$

$$= \left| \begin{matrix} v = -\frac{2}{m_k}t \\ dx = 1(-2m_k)\,dv \end{matrix} \right| = u_0 \cdot \left(\frac{-m_k}{2}\right) \int_0^t e^v\,dx =$$

$$= -\frac{u_0 m_k}{2} e^v = -\frac{u_0 m}{2e^{\frac{2t}{m_k}}} \Bigg|_0^t = \frac{m_k + u_0}{2} - \frac{u_0 m_k}{2e^{\frac{2t}{m_k}}}$$

17-15 [illegible]

$$S(t)=\frac{m_k u_0}{2}\left(1-e^{-\frac{2t}{m_k}}\right) \Rightarrow u(S)=u_0\left(1-\frac{2S}{m_k u_0}\right)$$

Коли катер зупиниться: $u(S_{max})=0$

$$0=u_0\left(1-e^{-\frac{2t}{m_k}}\right) \Rightarrow S_{max}=\frac{m_k u_0}{2}$$

Відповідь: $u(t)=u_0 e^{-\frac{2t}{m_k}}$; $u(S)=u_0-\frac{2S}{m_k}$;

$$S_{max}=\frac{m_k u_0}{2}$$

1п-45 вар

③ Дано

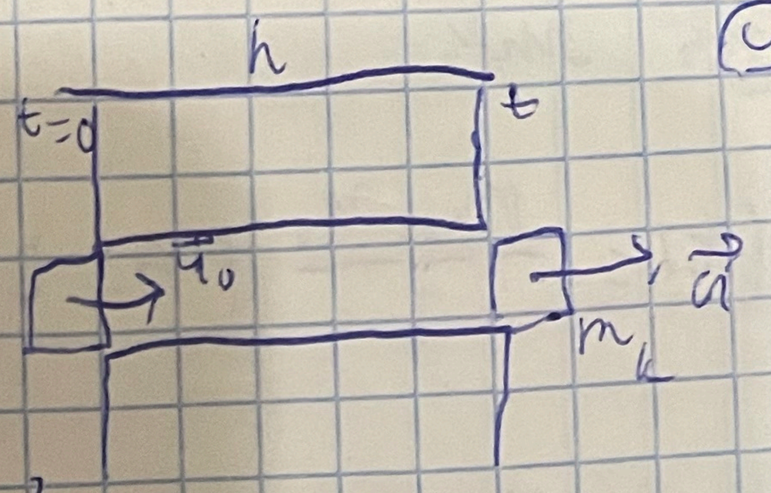
u_0

h

u

$F_{on} = -2u^2$

$t - ?$



④

$$\vec{F}_{on} = m\vec{a}$$

$$Ox: m_к\vec{a} = -2u^2$$

$$m_к\frac{du}{dt} = -2u^2 \Rightarrow \int_{u_0}^{u(t)} \frac{du}{u^2} = -\frac{2}{m_к}\int_0^t dt \Rightarrow u(t) = \frac{m_к u_0}{m_к + 2u_0 t}$$

$$h = \int_0^t u(t)\,dt \Rightarrow h(t) = \int_0^t \frac{m_к u_0}{m + 2u_0 t}\,dt =$$

$$= \left| \begin{array}{l} v = m_к + 2u_0 t \\ dt = \frac{dv}{u_0 2} \end{array} \right| = \frac{m_к \ln|2tu_0 + m_к|}{2}\Bigg|_0^t =$$

$$\Rightarrow h(t) = \frac{m}{2}\ln\left(1 + \frac{2u_0 t}{m_к}\right); \quad u = \frac{m_к u_0}{m_к + 2u_0 t} =$$

$$\Rightarrow t = \frac{m_к}{2}\left(\frac{1}{u} - \frac{1}{u_0}\right).$$

Ответ: $\frac{m_к}{2}$

№ 45 дано

$$v = \frac{m_k u_0}{m_k + 2u_0 t} \Rightarrow \frac{u_0}{v} = 1 + \frac{2u_0 t}{m_k}$$

$$h = \frac{m_k}{2} \ln\left(1 + \frac{2u_0 t}{m_k}\right) \Rightarrow h = \frac{m_k}{2} \ln\left(\frac{u_0}{u}\right) \Rightarrow$$

$$= \frac{m_k}{2} = \frac{h}{\ln\left(\frac{u_0}{v}\right)}.$$ Тоді отримаємо:

$$t = \frac{m_k}{2}\left(\frac{1}{u} - \frac{1}{u_0}\right) \Rightarrow t = \frac{h}{\ln\left(\frac{u_0}{u}\right)}\left(\frac{1}{u} - \frac{1}{u_0}\right)$$

Відповідь: $t = \frac{h(u_0 - u)}{u_0 \cdot u \cdot \ln\left(\frac{u_0}{u}\right)}$

(4) Дано:

$R = 10$ м

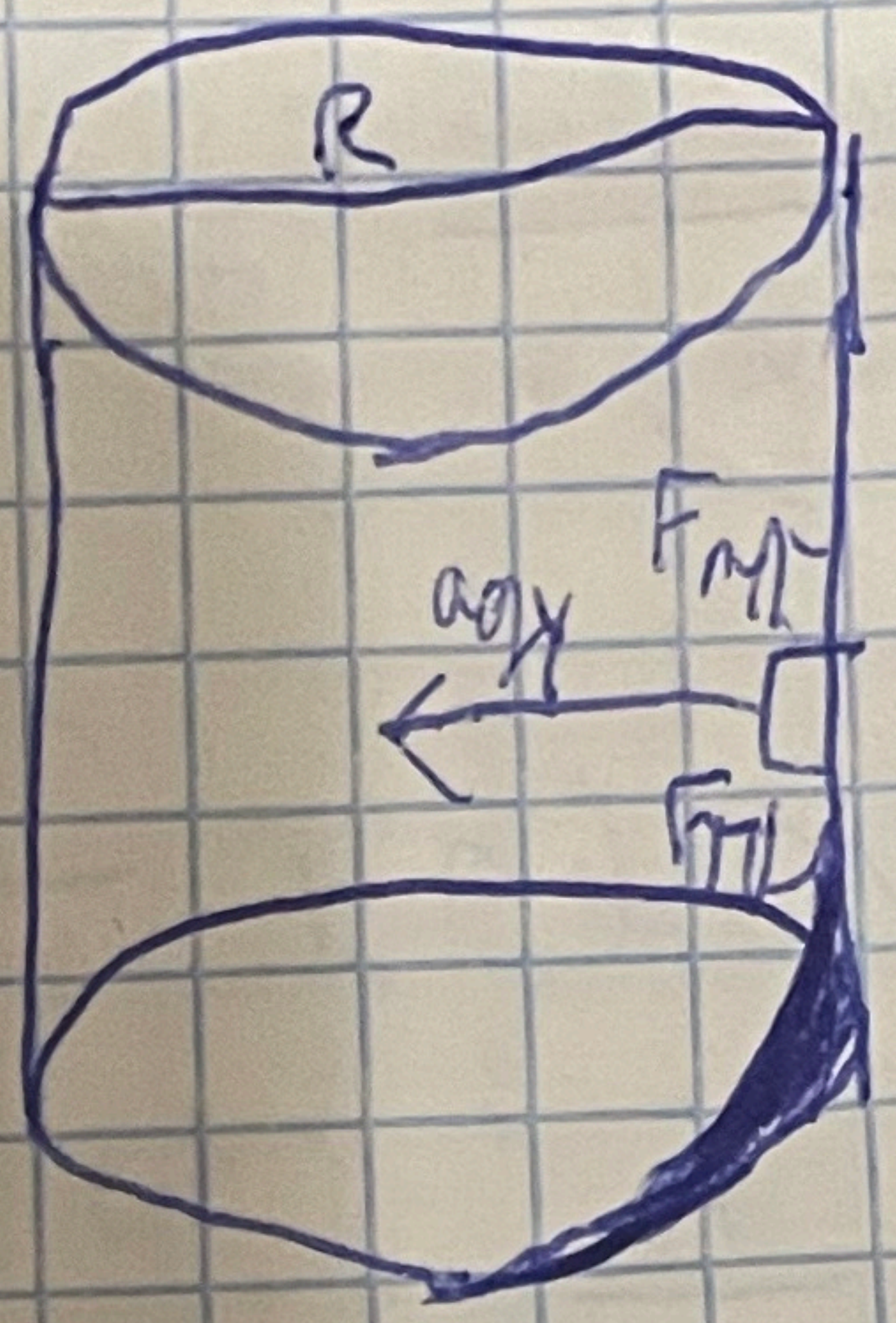
$μ = 0{,}25$

$g = 9{,}8\ \frac{м}{с^2}$

$υ$ – ?

$F_{тер.}$ макс.

рівн F_T



$$\vec F_{тер} + \vec F_т + \vec N = m\vec a$$

OX: $\vec N = m\vec a_{доц}$ ⇒ OX: $\vec N = m\frac{υ^2}{R}$ ⇒

OY: $\vec F_{тер} - \vec F_T = 0$; OY: $\vec F_{тер} = \vec F_{max}$

⇒ OX: $\vec N = m\frac{υ^2}{R}$ ⇒ $\frac{mg}{μ} = m\frac{υ^2}{R}$ ⇒

OY: $μ\vec N = mg$

$$⇒ υ = \sqrt{\frac{Rg}{μ}}$$

$$υ = \sqrt{\frac{10 \cdot 9{,}8}{0{,}25}} = 14\sqrt{2} \approx 20\ м/с$$

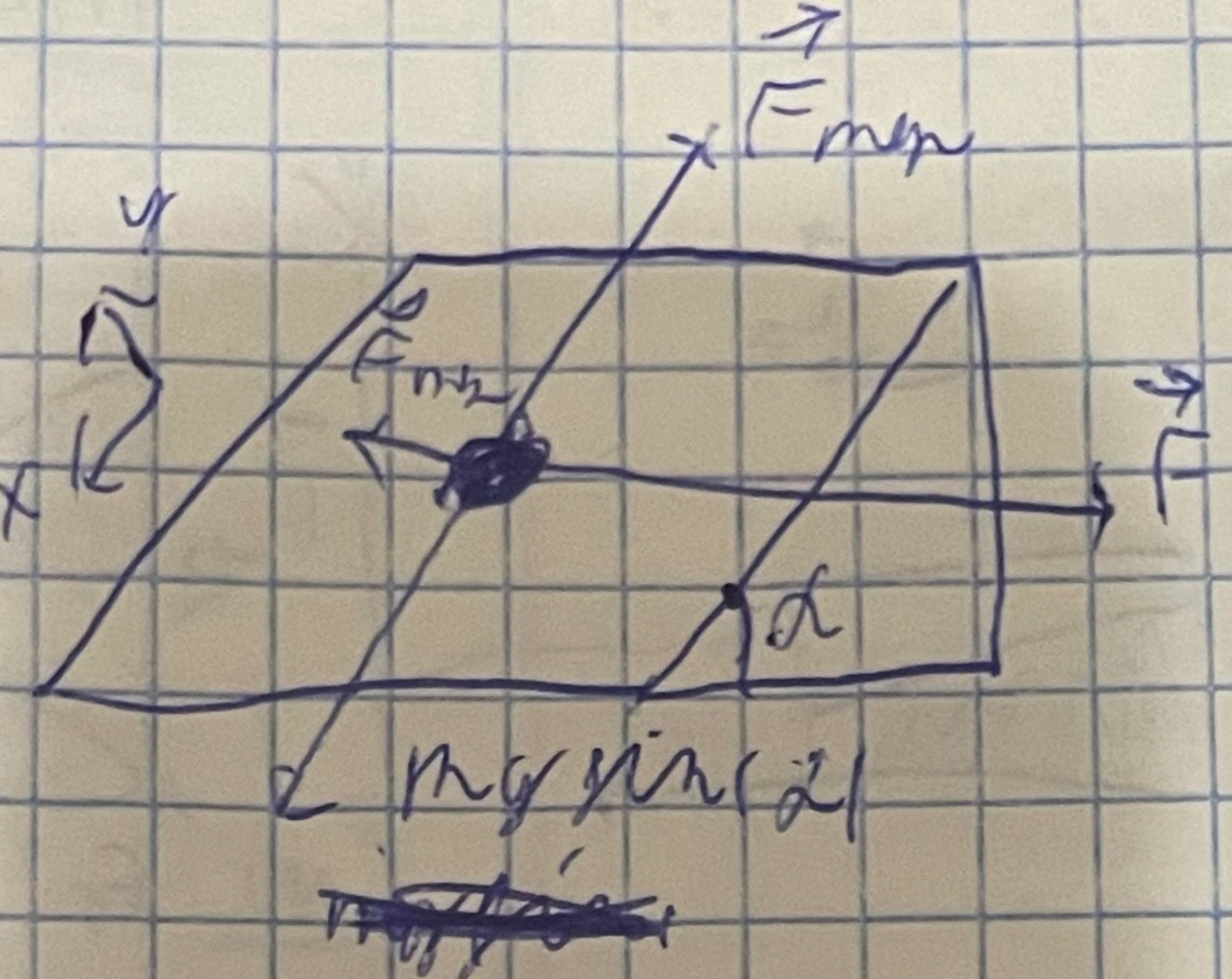
Відповідь: $υ = 20$ м/с

(п-95 зноб

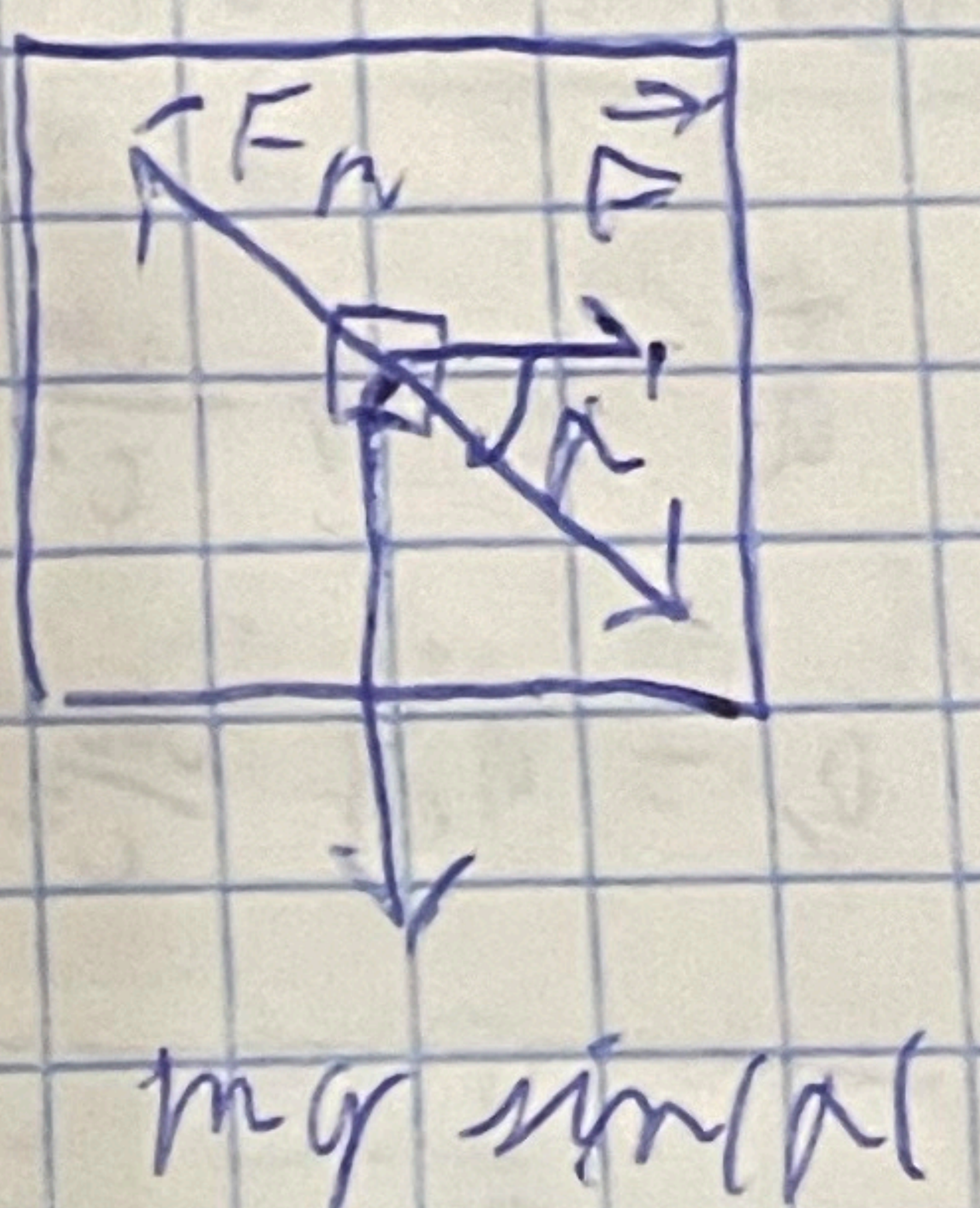
(5) Дано:

α, m, μ

$F - ?$



Зверху:



$OX: F'_{тр} = mg \sin(\alpha) = 0$

$OY: N - mg\cos(\alpha) = 0$

$F_т^2 = F^2 + (mg\sin(\alpha))^2 \Rightarrow F^2 = F_т^2 - (mg\cos(\alpha))^2 \Rightarrow$

$\Rightarrow (\mu mg\cos(\alpha))^2 - (mg\sin(\alpha))^2$

$F = mg\sqrt{\mu^2\cos^2(\alpha) - \sin^2(\alpha)}$

$\sin(\beta) = \frac{mg\sin(\alpha)}{F_т} = \frac{mg\sin(\alpha)}{\mu mg\cos(\alpha)} = \frac{tg(\alpha)}{R}$

$\beta = \arcsin\left(\frac{tg\,\alpha}{\mu}\right)$

Відповідь: $F = mg\sqrt{\mu^2\cos^2(\alpha) - \sin^2(\alpha)}$

$\beta = \arcsin\left(\frac{tg\,\alpha}{\mu}\right)$