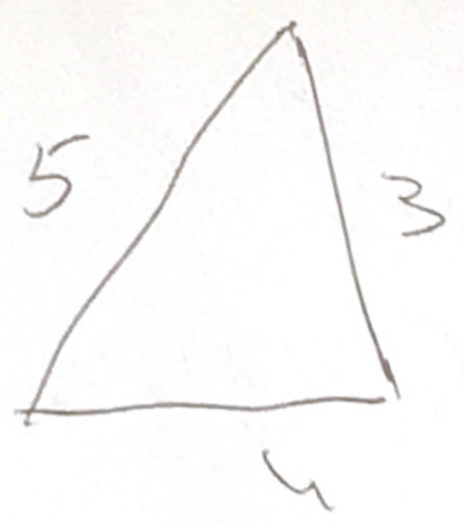
Часть 1

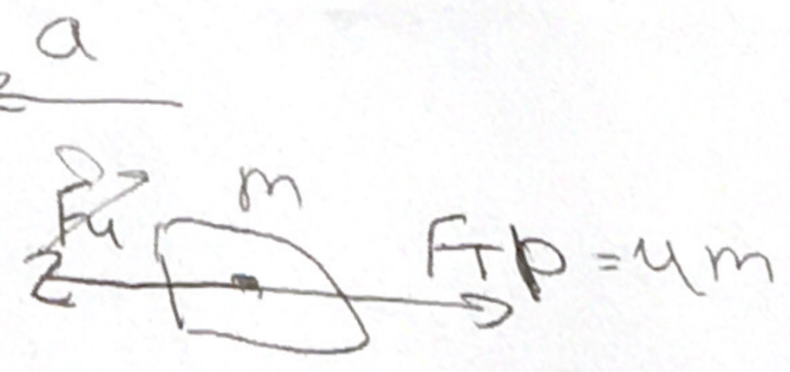
Олимпиада: **Физика, 9 класс (1 часть)**

Шифр: **21206401**

ID профиля: **342823**

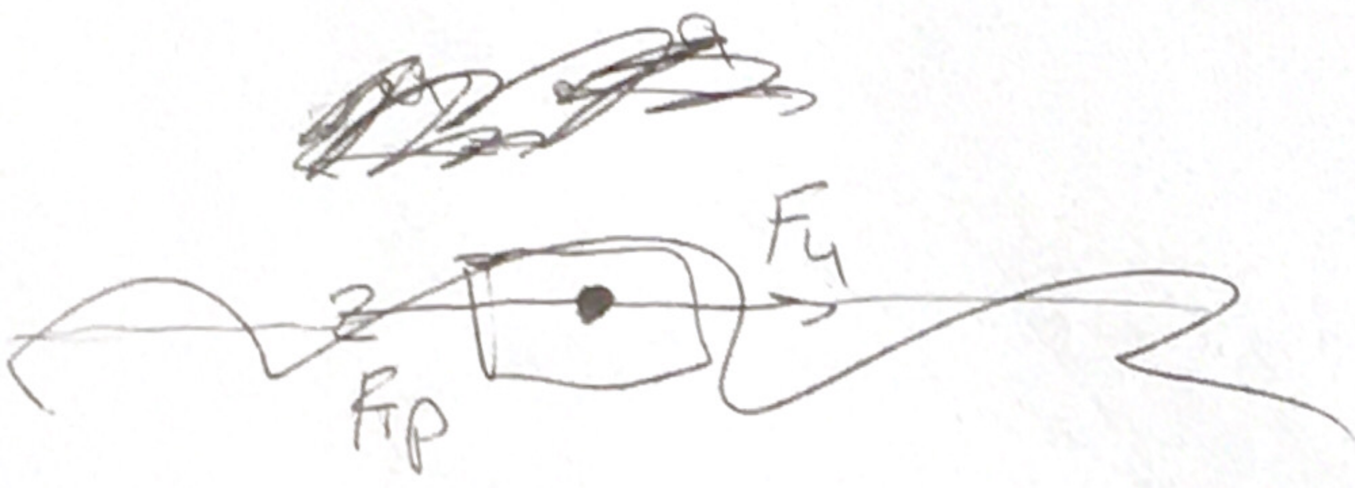
Вариант 4





$F_{тр} = \mu m$

$F_u = \frac{V_0}{t} \cdot m$



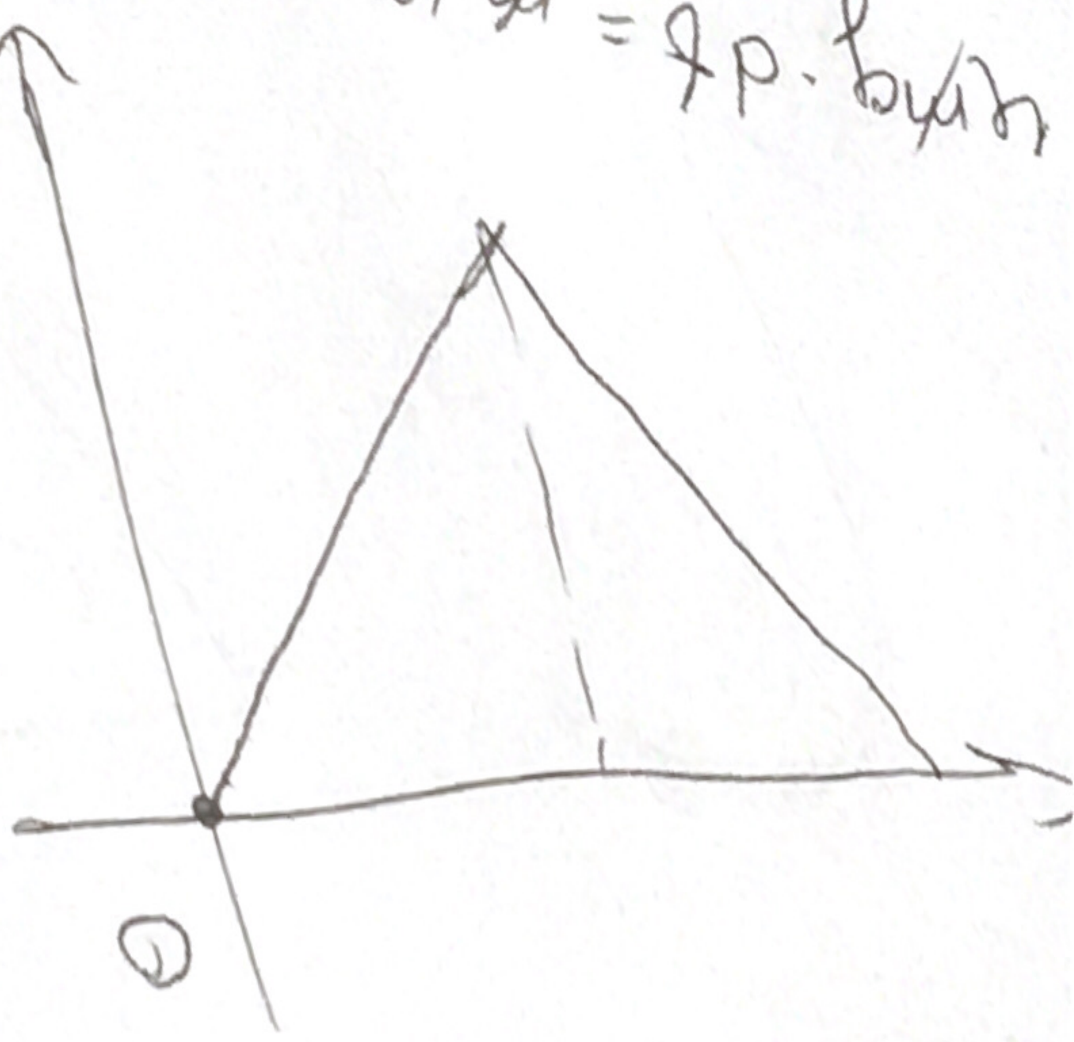
$F_u - F_{тр} = m$

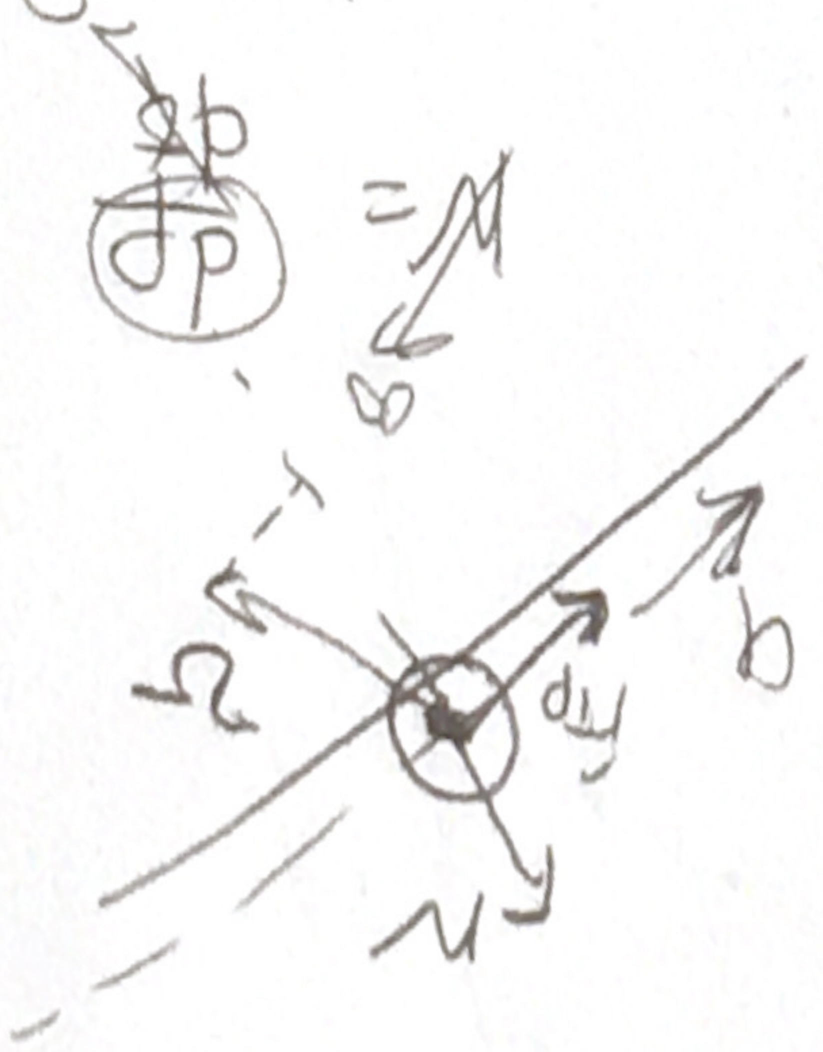
$\frac{V_0}{t} - \mu$

$D = \frac{\partial p}{\Omega p} = b_n$

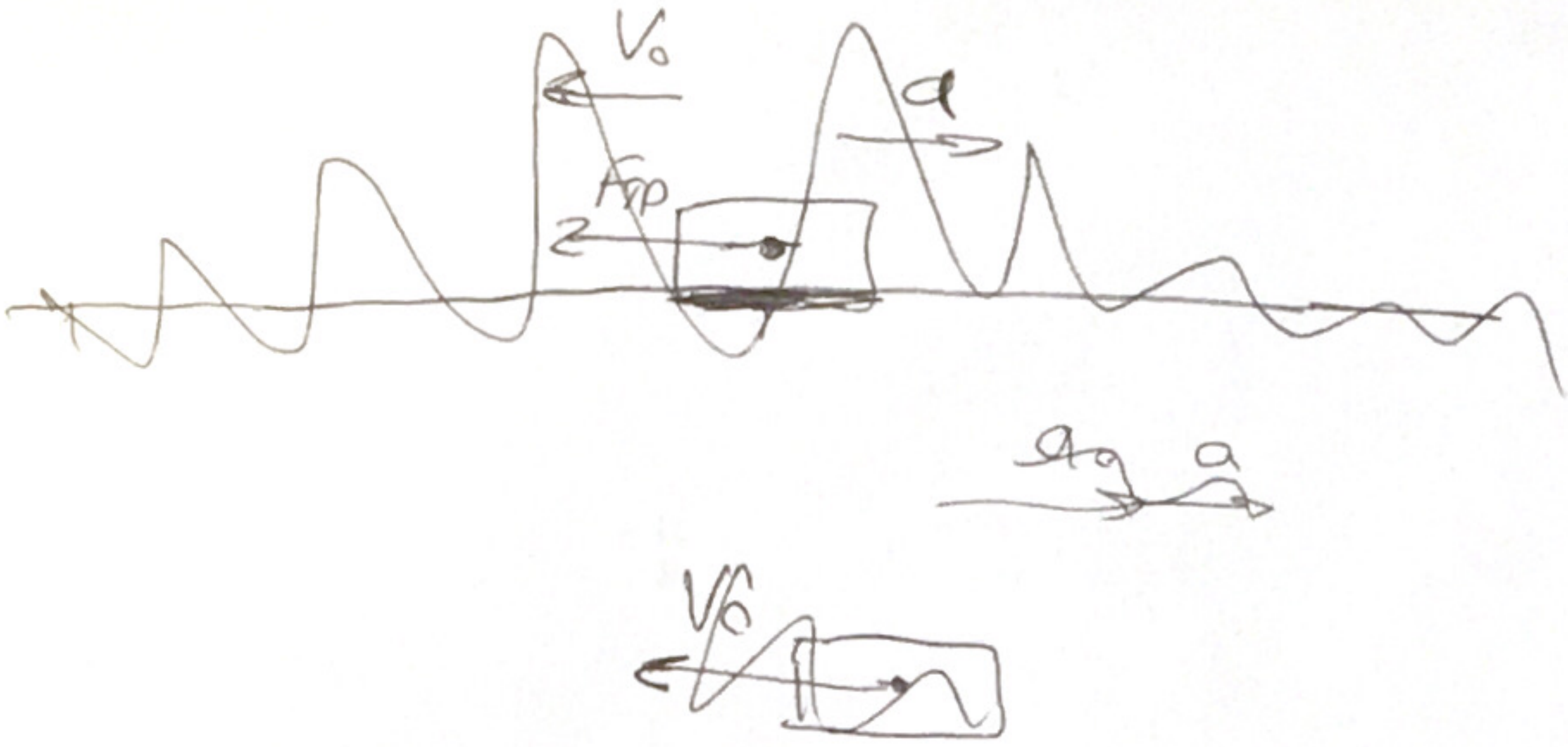
$= dp$

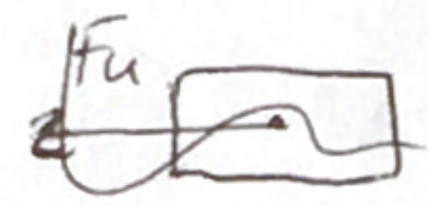
$\frac{\partial p}{dp} = -1$

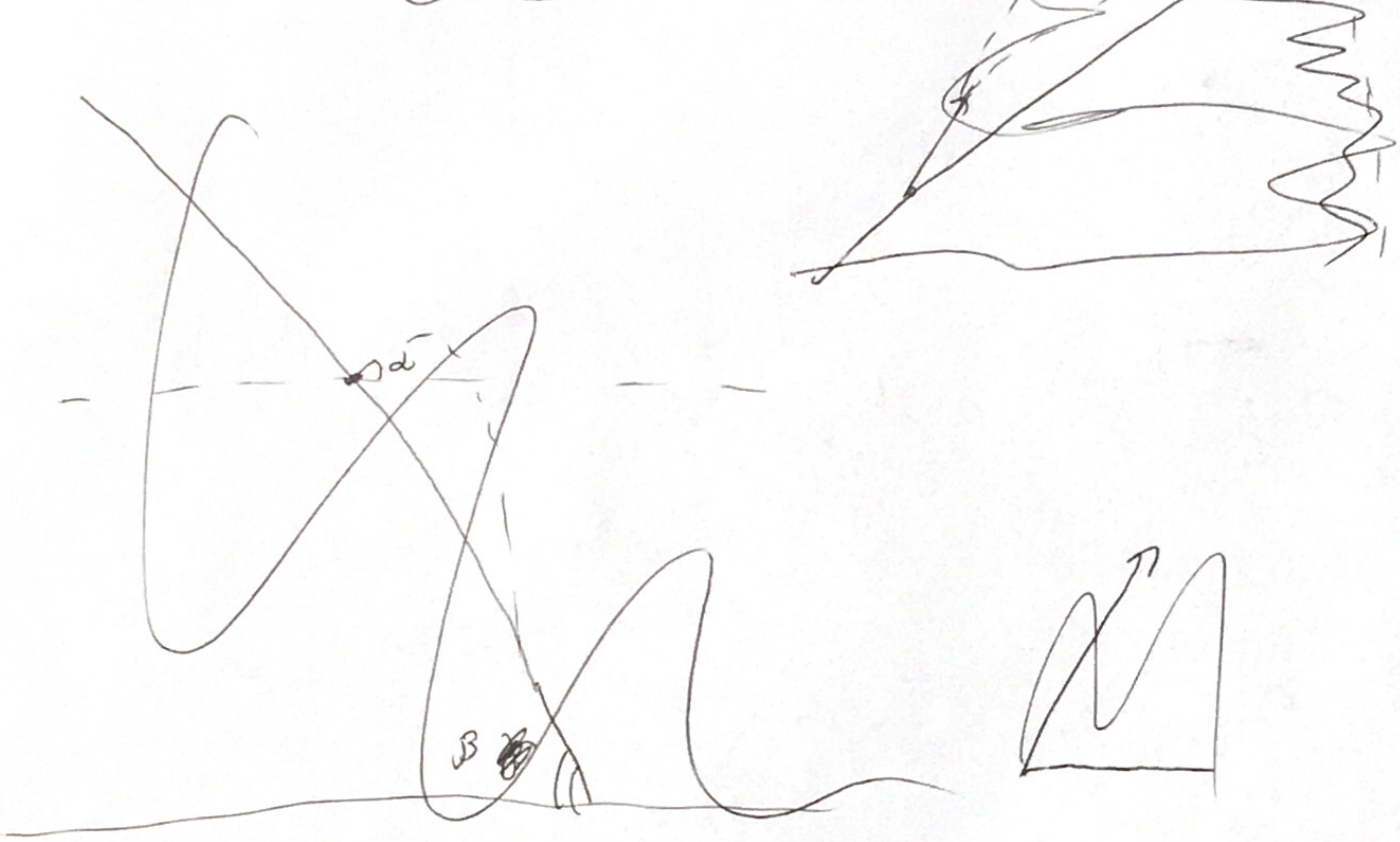




Черновик.

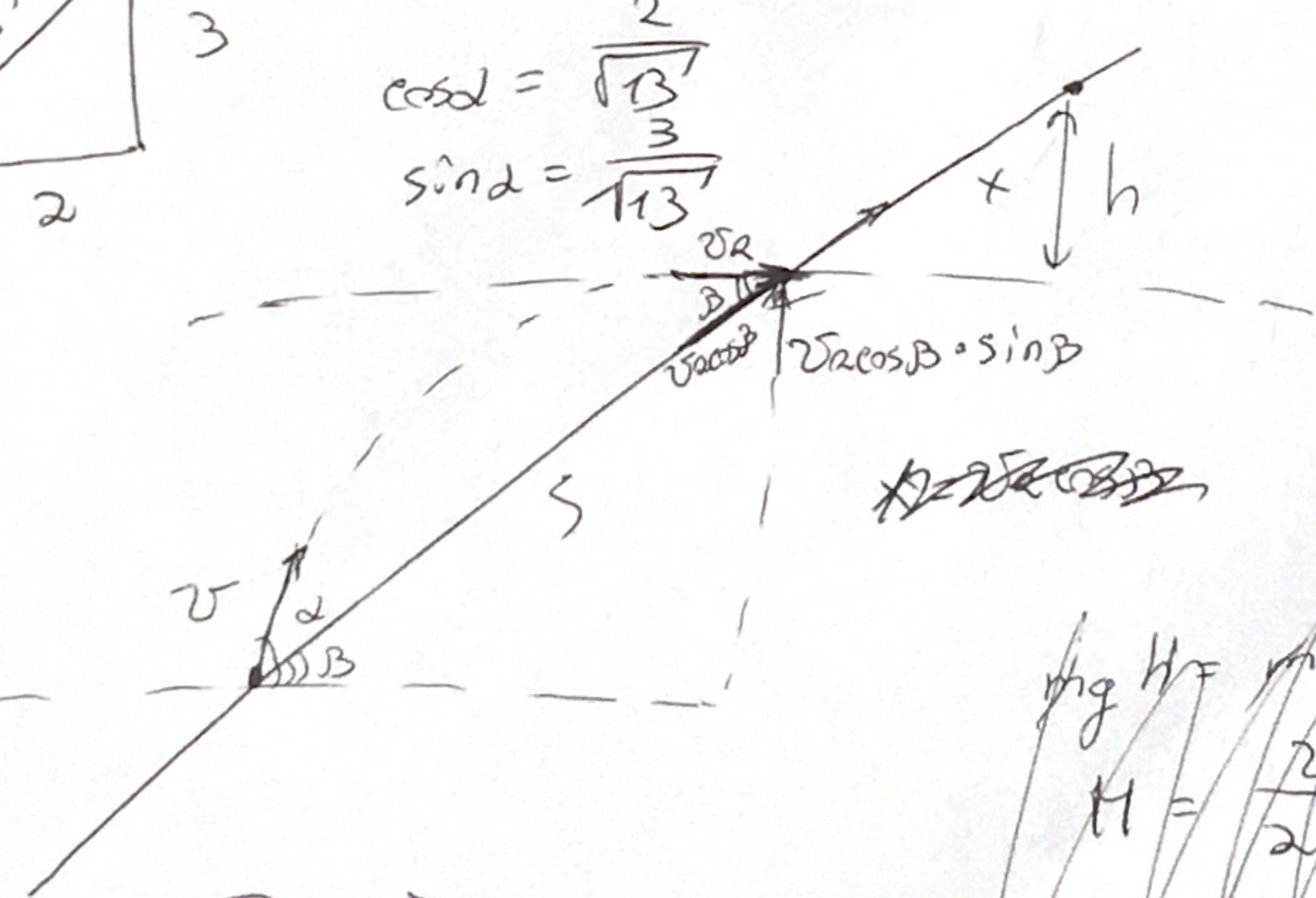


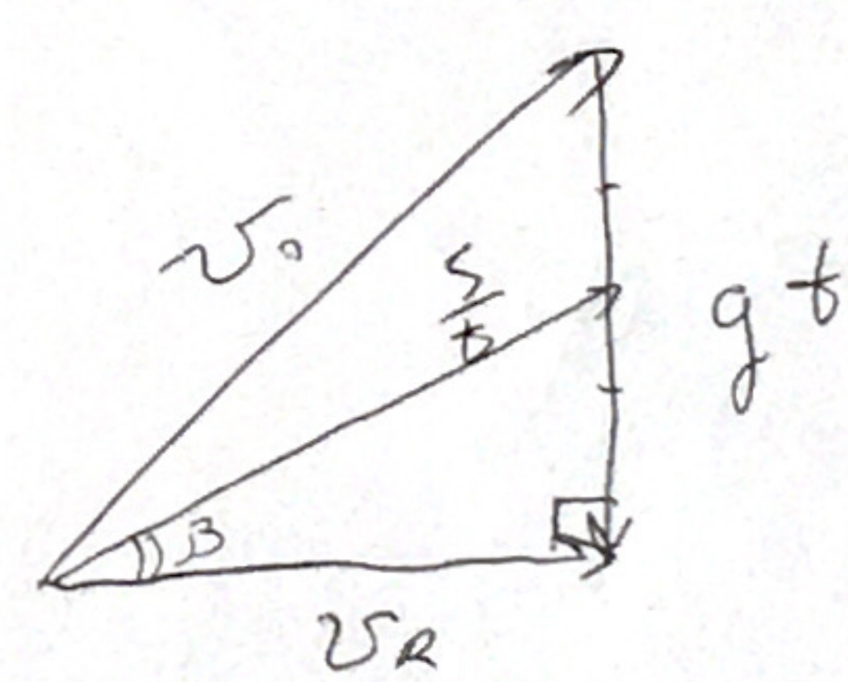




$\cos\alpha = \frac{2}{\sqrt{13}}$

$\sin\alpha = \frac{3}{\sqrt{13}}$





$v_R = v_0 \cos\alpha$

$tg\,\beta = \frac{gt}{2 v_0 \cos\alpha}$

$v_{RY} = 0$

$0 = v_{RY} = v\sin\alpha - gT$

$T = \frac{v\sin\alpha}{g}$

$\cancel{mgH = m\frac{v^2}{2}}$

$\cancel{H = \frac{v^2}{2g}}$

$\cancel{T}$

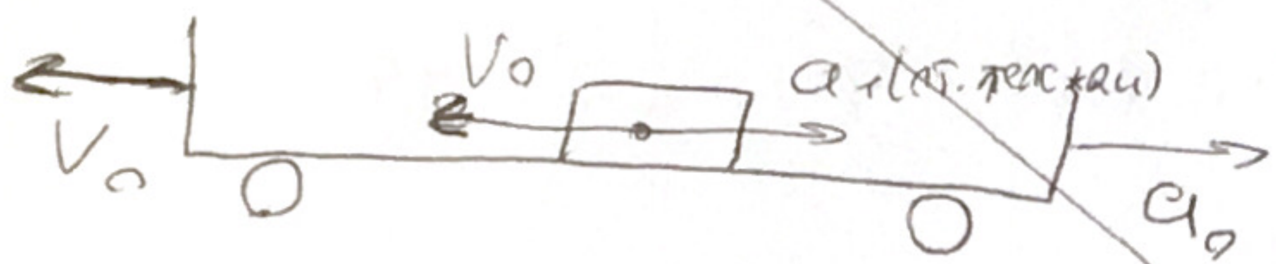
$\frac{(v_R\cos\beta)^2}{2} = g\,x\sin\alpha$

~~Чистовик~~ Черновик.

№2.

1) $L = \frac{V_0 + V_k}{2} t = \frac{V_0 t}{2} = \frac{5м/с \cdot 4с}{2} = 10м$

2)

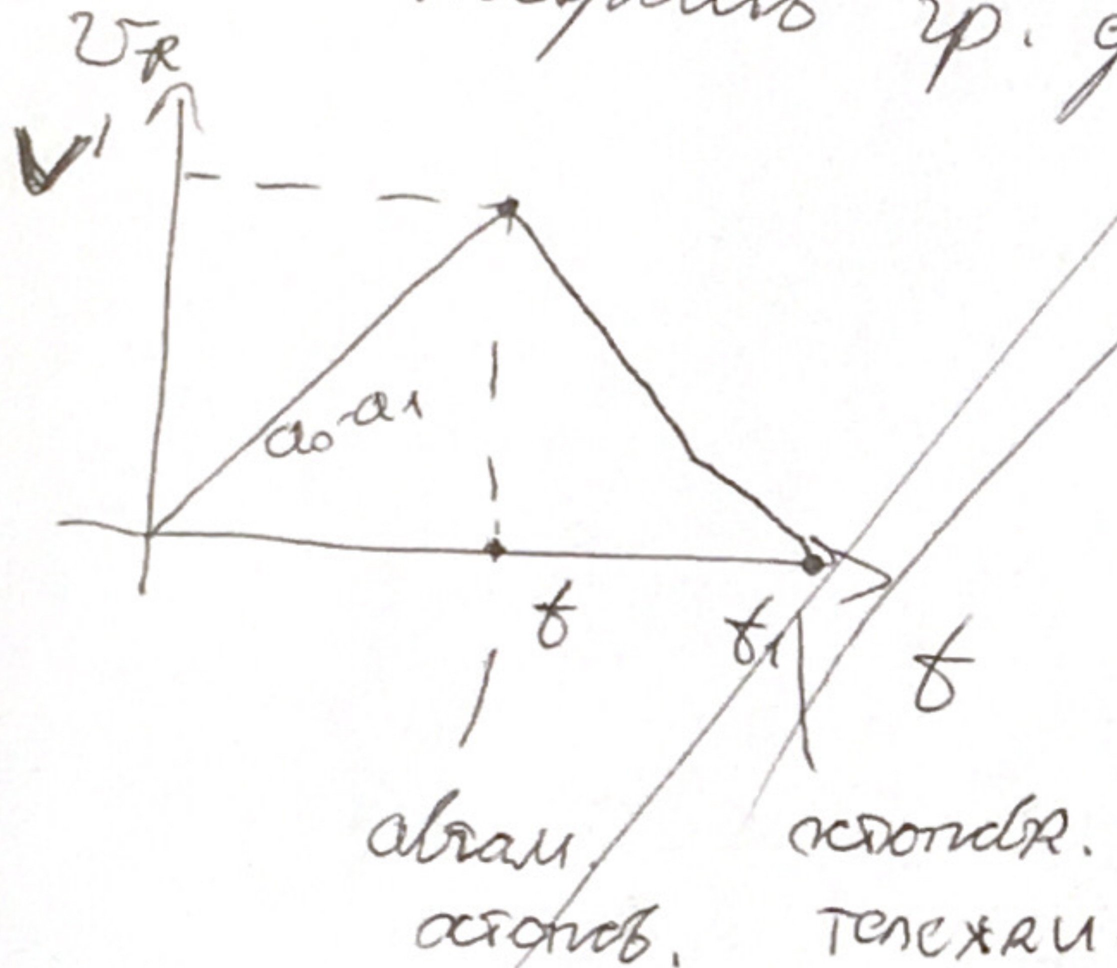


$S_{бп} = S + L = 12{,}5м$

$S_{бп} = \frac{v_0^2}{2a_n}$

$a_n = \frac{2S_{бп}}{2v_0^2} = \frac{2 \cdot 12{,}5}{2 \cdot 5^2} = 0{,}5 м/с^2$

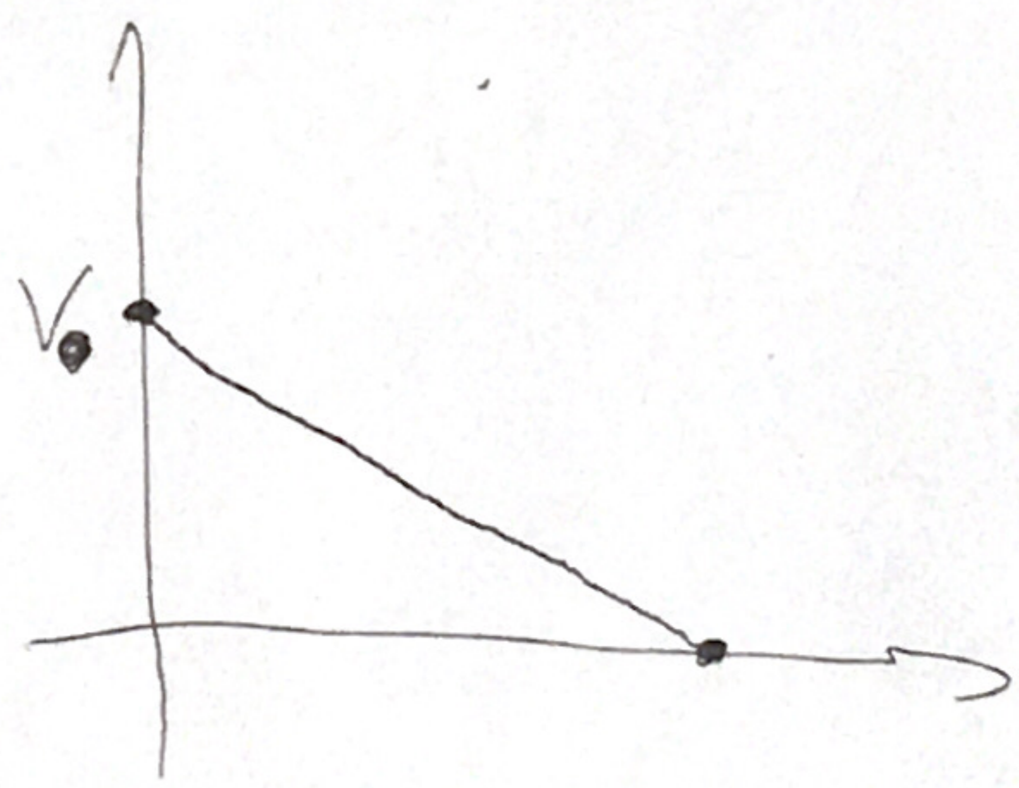
3) Если построить гр. ~~движения~~ скорости v_k от времени (в. СО автомобиля

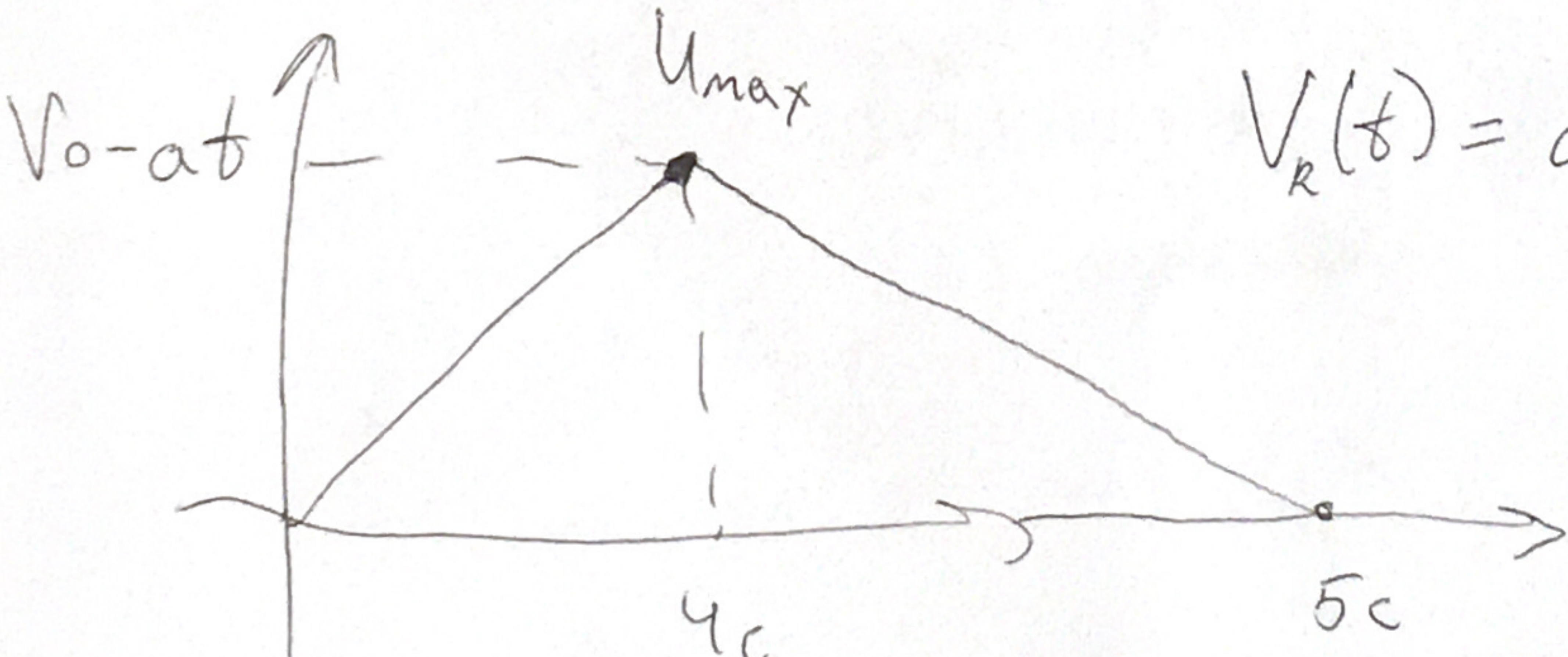


1) $\tau = t_1 - t$

2) $V' = V_0 - a_1 t$

3) $0 = V' - a_1 \tau$





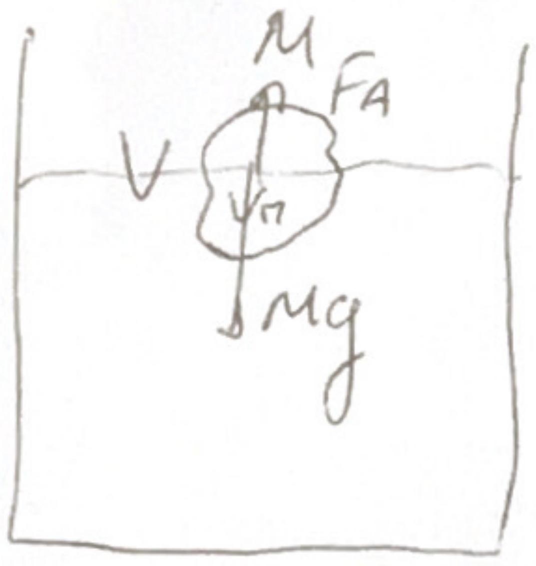
$V_k(t) = a_0 t - a t = (a_0 - a) t$

$V_0 = a\, t_{дк}$

~~м~~ Чистовик.

№1.

1)

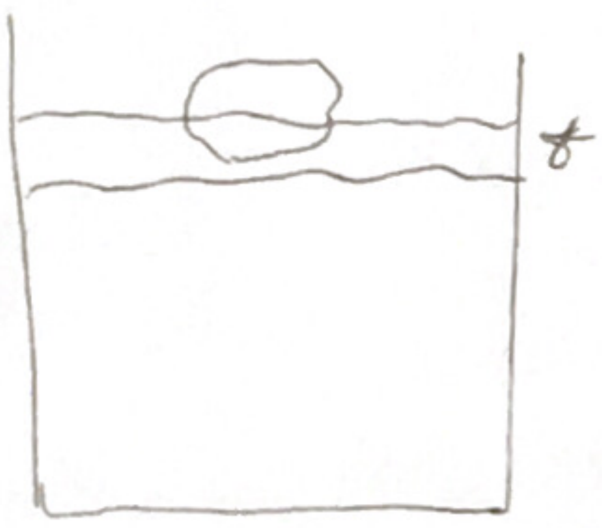


$$Mg = F_A$$

$$Mg = \rho_0 g V_п$$

$$V_п = \frac{M}{\rho_0} = \frac{0,36 кг}{900 \frac{кг}{м^3}} = 0.0004 м^3 = 4\cdot10^{-4} м^3 = 400 см^3$$

2)



1) Уравнение тепл. равновесия $t_л = 0°C$

2) $Q_л = \lambda \Delta m$

$$Q_В = cm(t - t_л) = cmt$$

$$Q_л = Q_В$$

$$\lambda \Delta m = cmt$$

$$\Delta m = \frac{cmt}{\lambda}$$

3) $V_п' = \dfrac{M - \Delta m}{\rho_0}$

$$\Delta V_п = \frac{M}{\rho_0} - \frac{M - \Delta m}{\rho_0} = \frac{\Delta m}{\rho_0} = \frac{cmt}{\lambda \rho_0}$$

$$t = \frac{\lambda \rho_0 \Delta V_п}{cm} = \frac{3,36\cdot10^5 \frac{Дж}{кг}\cdot 1000 \cdot 120\cdot10^{-6} м^3}{4,2\cdot10^3 \frac{Дж}{кг\,°C}\cdot 0,4 кг} = 24°C$$

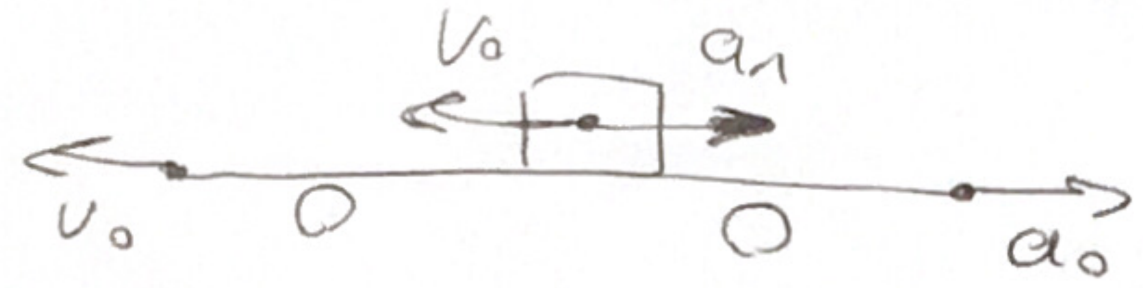
3)

Чистовик.

№2.

1) $L = \frac{V_0 + \overset{\to 0}{V_k}}{2} t = \frac{V_0 t}{2} = \frac{5 \cdot 4}{2} = 10 м$

2)



$S_к = S + L = 12{,}5 м$

$a_л = \frac{2S_к}{\tau^2} = 1 м/с^2$

3) Найдём время $t_{дк}$ - движения коробки:

$t_{дк} = \frac{v_0}{a_л} = 5с$

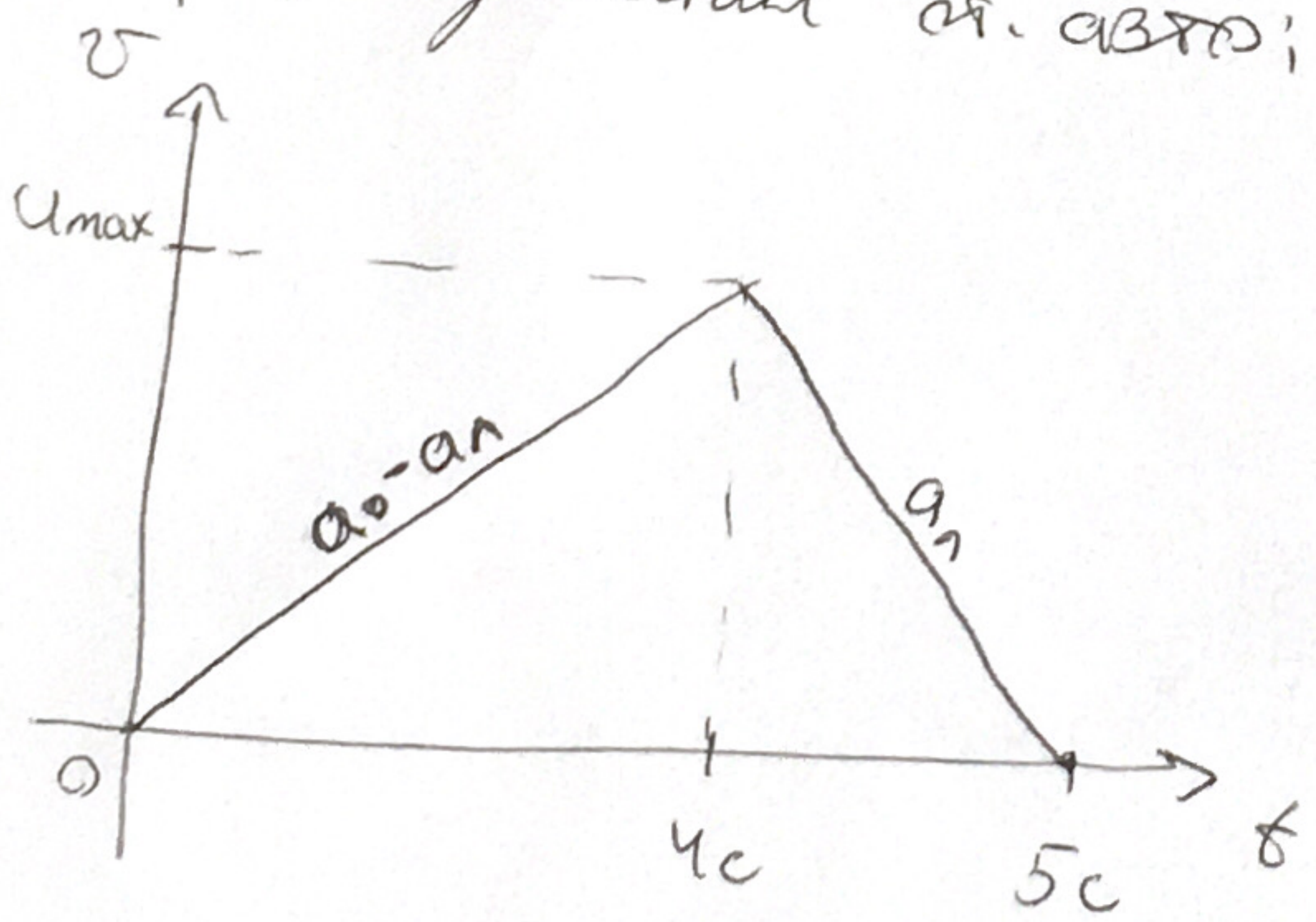
4) Когда авто замедлилась скорость коробки увелич, ~~когда~~ когда автом. ост. $v_к \downarrow$; тогда $\tau = t_{дк} - T = 1с$

5) Макс. скорость была, когда автомоб. остановился:

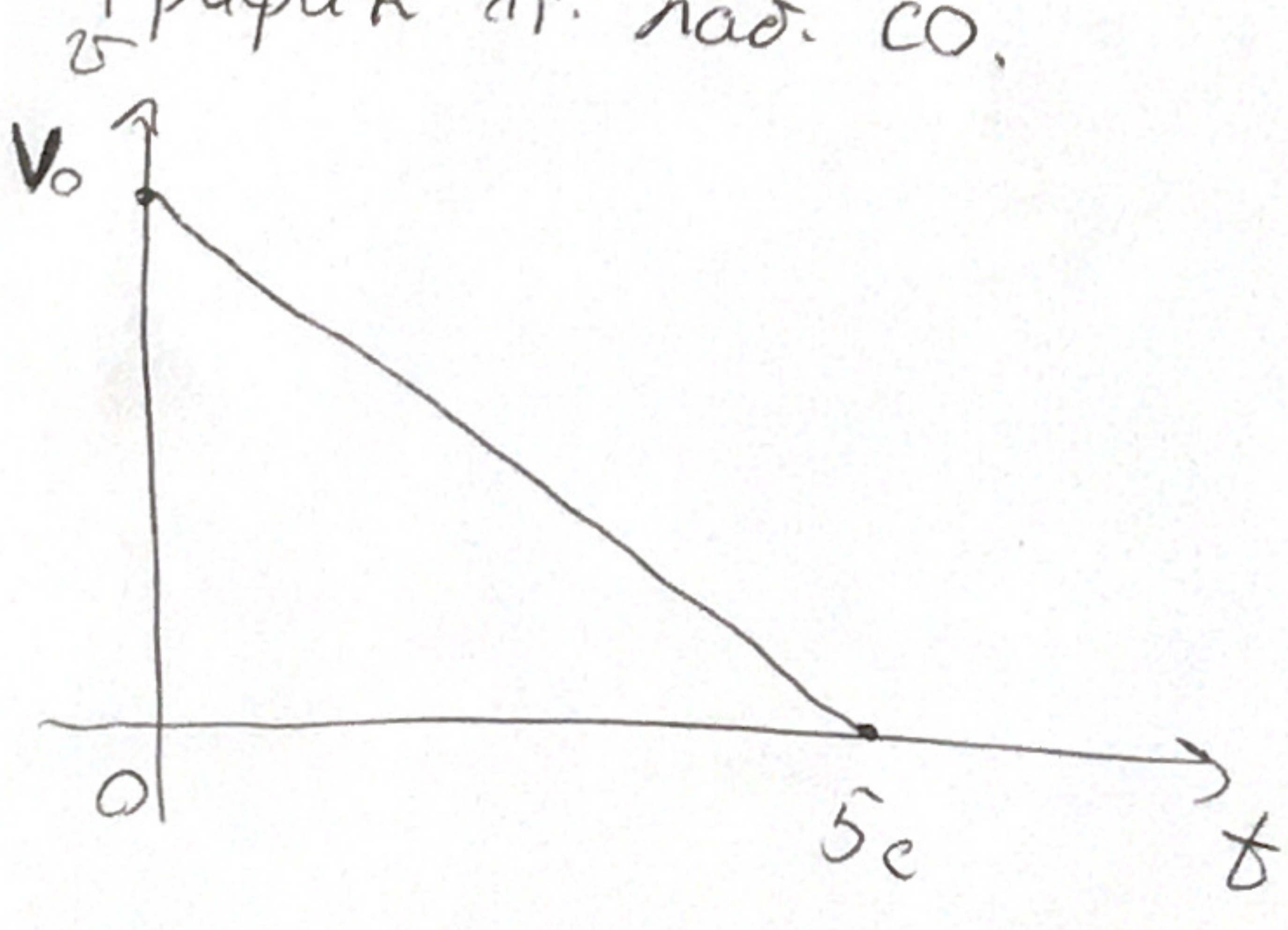
$U_{max} = V_0 - a_л T$

$U_{max} = 5 - 1 \cdot 4 = 1 м/с$

6) График движения от. авто:



7) График от. лаб. СО.

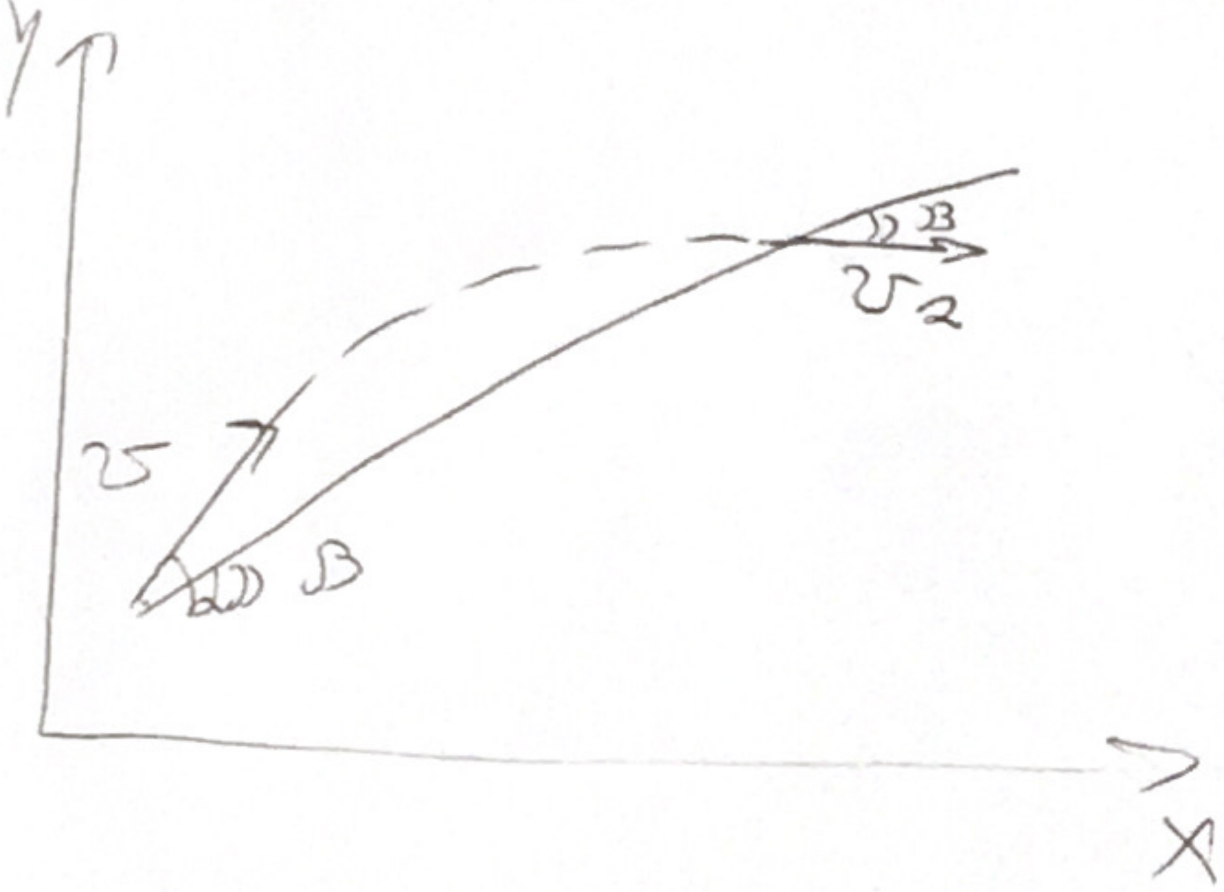


Чистовик

№3.

1) Т.к. $tg\,\alpha = 1{,}5$; $\sin\alpha = \frac{3}{\sqrt{13}}$; $\cos\alpha = \frac{2}{\sqrt{13}}$

2)

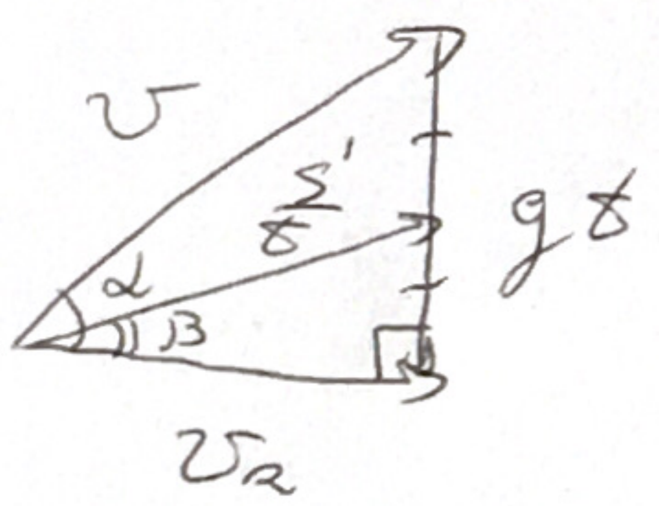


Oy: $v_{ky} = 0$

$v_{ky} = v\sin\alpha - gT$

$$T = \frac{v\sin\alpha}{g} = \frac{10\cdot 3}{\sqrt{13}\cdot 10} \approx 0{,}83\,c$$

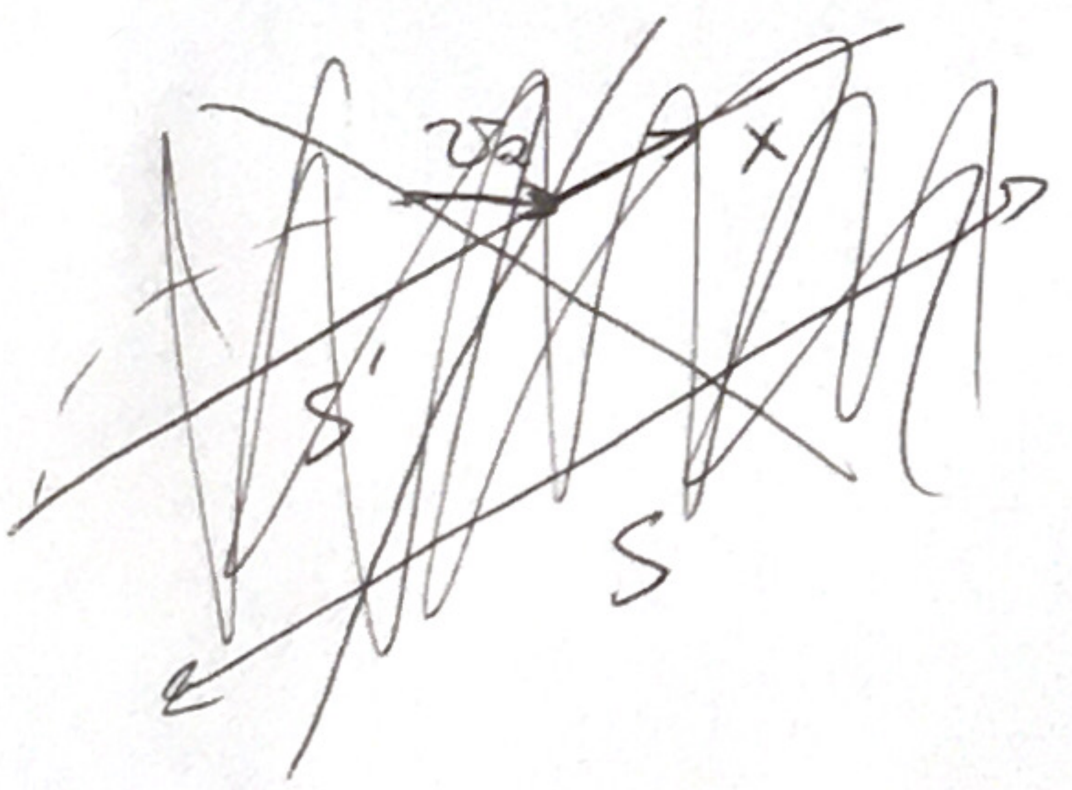
3) Построим вект. диаграмму:

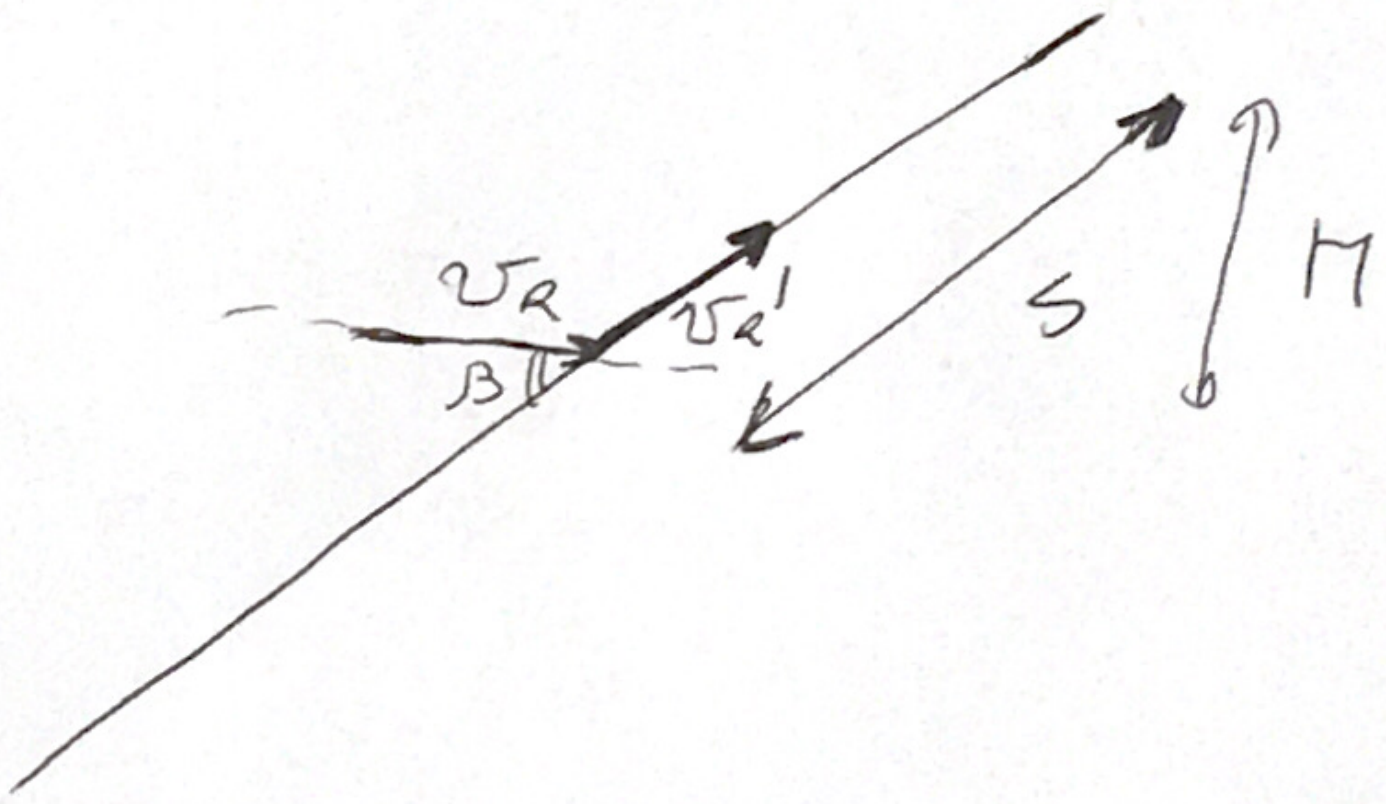


1) $v_k = v\cos\alpha$

2) $$tg\,\beta = \frac{gt}{2v_k} = \frac{gT}{2v\cos\alpha} = \frac{g\,\frac{v\sin\alpha}{g}}{2v\cos\alpha} = \frac{tg\,\alpha}{2} = 0{,}75$$

4)





1) $v_k' = v_k\cos\beta$

2) ЗСЭ: $mgH = \frac{mv_k'^2}{2}$

$2gS\sin\beta = v_k^2\cos^2\beta$

$$S = \frac{v_k^2\cos^2\beta}{2g\sin\beta} = \frac{v^2\cos^2\alpha\cdot\cos^2\beta}{2g\sin\beta} = \frac{10^2\cdot\frac{4}{13}\cdot\frac{16}{25}}{2\cdot 10\cdot\frac{3}{5}} \approx 1{,}64\,м$$

5) ~~Ответ~~ 4) С такой же скоростью $v_k' = v_k\cos\beta$, ведь $F_{тр}$ не успеет повлиять на скорость скольжения вначале.

Часть 2

Олимпиада: **Физика, 9 класс (2 часть)**

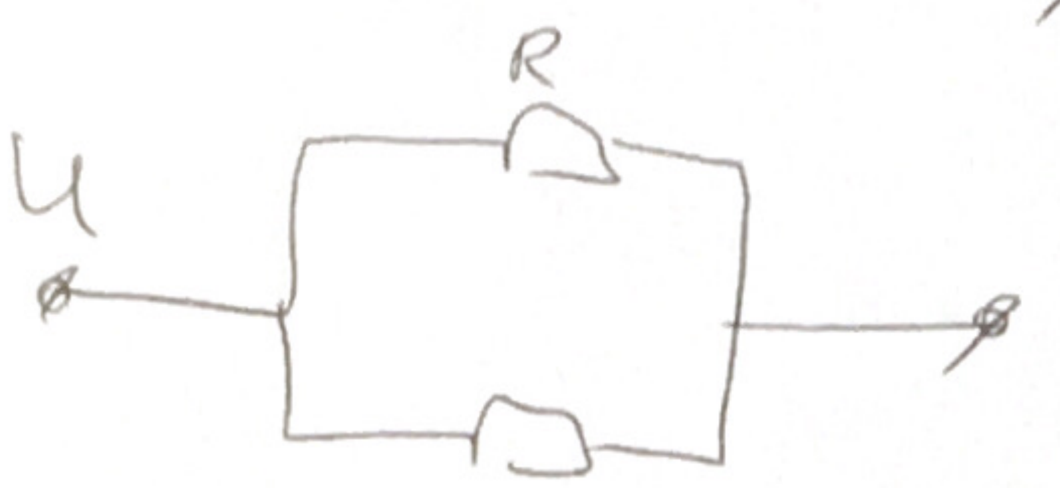
Шифр: **21206401**

ID профиля: **342823**

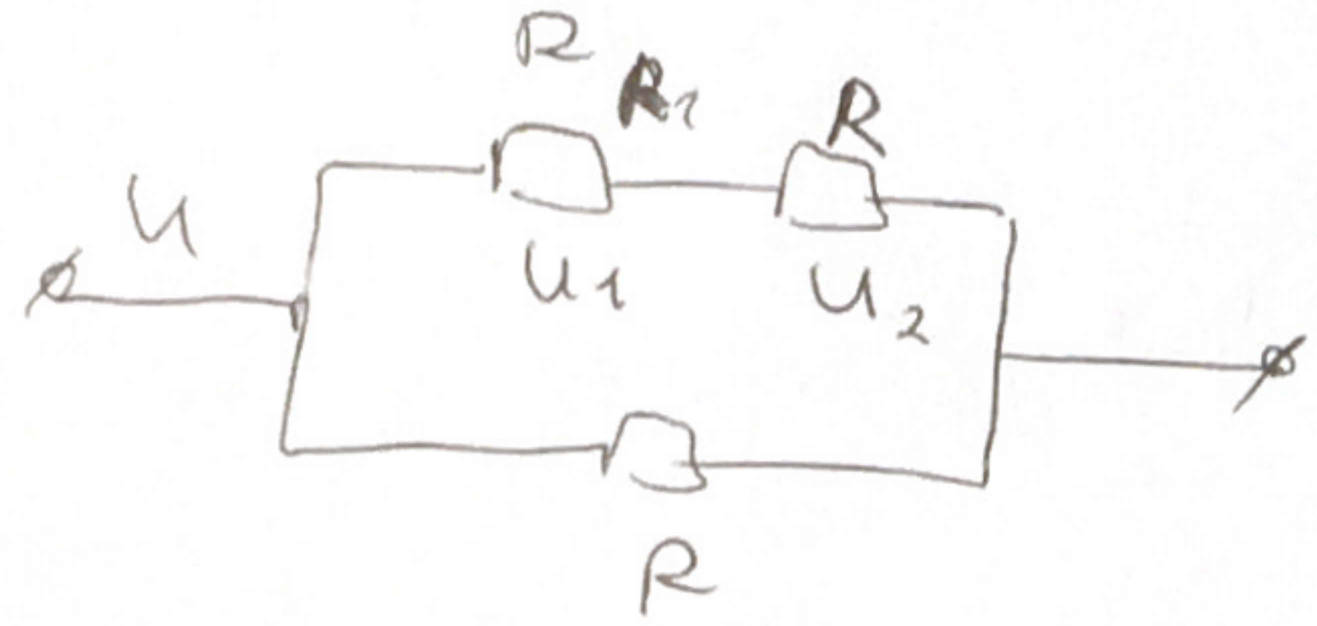
Вариант 4

Чистовик.

№5.

1) 

$$P = \frac{U^2}{R_э} = \frac{U^2}{\frac{R}{2}} \Rightarrow R = \frac{2U^2}{P} = \frac{2 \cdot 16В^2}{2Вт} = 16\,\Omega$$

2) 

1) $P_{max} = \frac{U_1^2}{R_1}$

2) $U_1 + U_2 = U$

3) $\frac{U_1}{R_1} = \frac{U_2}{R}$

2; 3: $\frac{U_1}{R_1} = \frac{U - U_1}{R}$

$$U_1 R = U R_1 - U_1 R_1$$

$$U_1 = \frac{U R_1}{R + R_1}$$

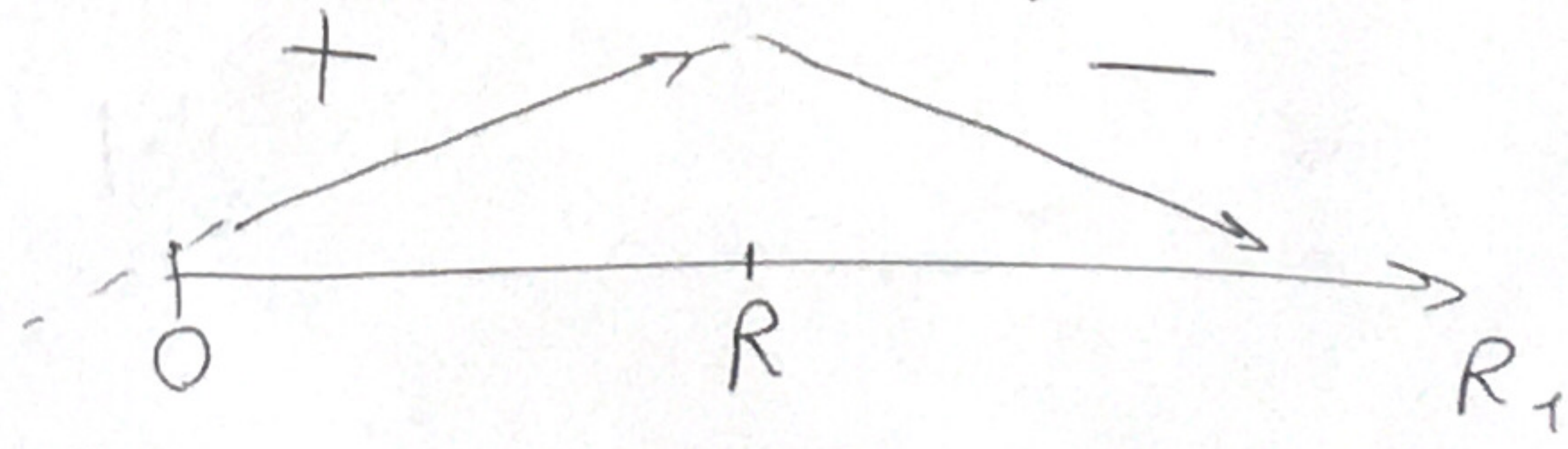
$$P_{max} = \frac{U^2 R_1^2}{(R+R_1)^2 R_1} = \frac{U^2 R_1}{(R+R_1)^2}$$

$$P_{max}' = \frac{U^2}{(R+R_1)^4} \cdot \left((R+R_1)^2 - R_1 \cdot 2(R_1+R)\right) =$$

$$= \frac{U^2}{(R+R_1)^4}\left(R^2 + \cancel{2RR_1} + R_1^2 - 2R_1^2 - \cancel{2RR_1}\right) =$$

$$= \frac{U^2}{(R+R_1)^4}\left(R^2 - R_1^2\right)$$

Р-рим знаки производной при $R_1 \geq 0$.



Значит, что при $R_1 = R$, $P_{max} \to max$.

3) $P_{max}(R_1 = R) = \frac{U^2 R}{(R+R)^2} = \frac{U^2 R}{4R^2} = \frac{U^2}{4R} = 0{,}25Вт$

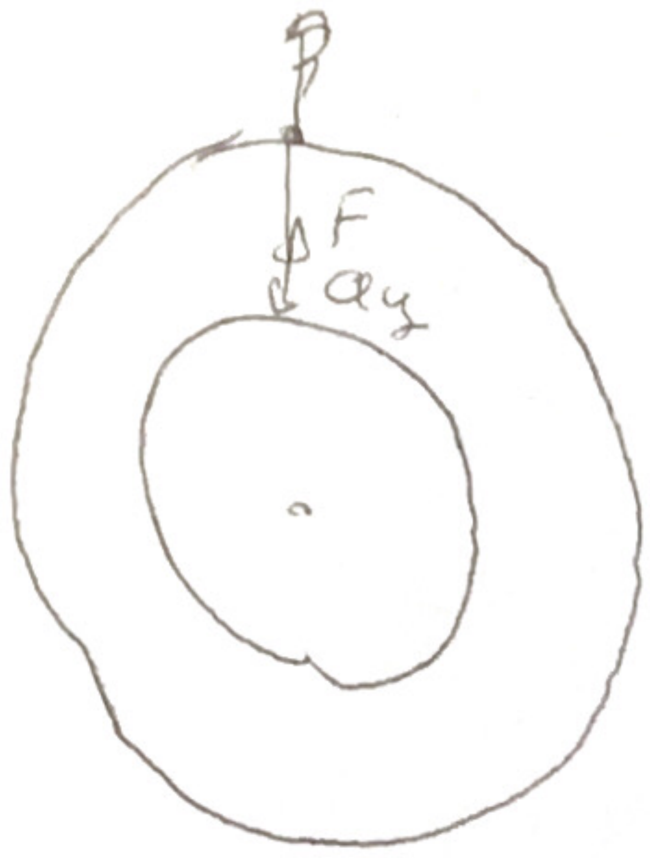
Ответ: 1) $R = 16\,\Omega$ 2) $R_1 = R = 16\,\Omega$ 3) ~~$P_{max}(R$~~ $P_{max R_1} = 0{,}25Вт$

1

Чистовик.

№4.

1)



1) $a_y = \frac{v^2}{\sqrt{2}R}$

2) $F_ц = ma_y$

$$G\frac{Mm}{2R^2} = m\frac{v^2}{\sqrt{2}R}$$

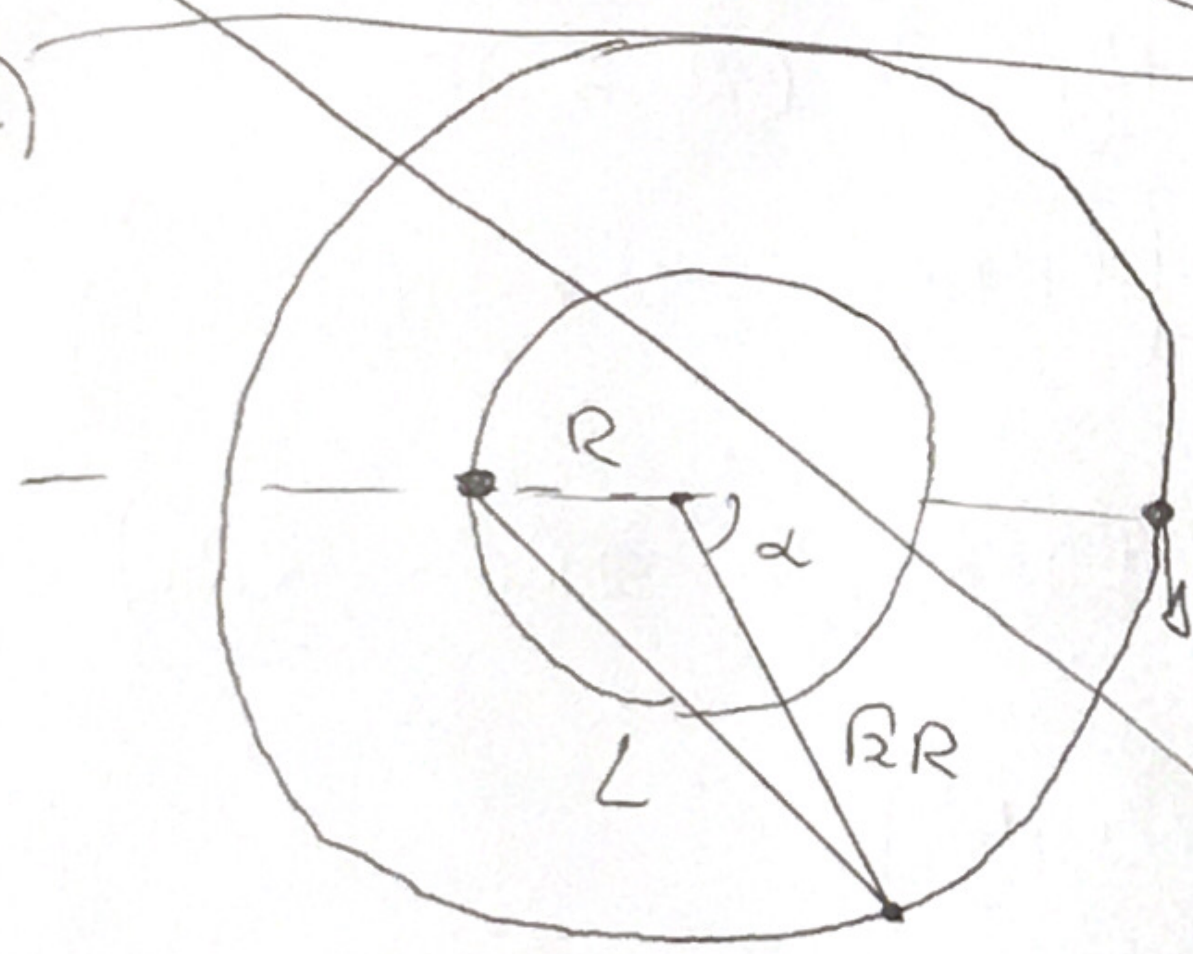
$$\frac{g}{2} = \frac{v^2}{\sqrt{2}R}$$

3) $T = \frac{2\pi\sqrt{2}R}{v} = \frac{2\pi\sqrt{2}R}{\sqrt{\frac{\sqrt{2}gR}{2}}} =$

$$= \sqrt{\frac{2\cdot 4\cdot\pi^2\cdot 2R^2R}{\sqrt{2}gR}} = 4\pi\sqrt{\frac{R}{\sqrt{2}g}} = 4\pi\sqrt{\frac{R\sqrt{2}}{2g}} \approx$$

$\approx 2,35$ч

2)



1) $L = \sqrt{R^2+2R^2-2\sqrt{2}R^2\cos(180^\circ-\alpha)} =$

$$= R\sqrt{3+2\sqrt{2}\cos\alpha}$$

$$V = L'(\alpha) = R\frac{-\cancel{2}\sqrt{2}\sin\alpha}{\cancel{2}\sqrt{3+2\sqrt{2}\cos\alpha}}$$

[illegible]

$$L''(\alpha) = R\frac{\sqrt{3+2\sqrt{2}\cos\alpha}\,(-\sqrt{2}\cos\alpha) - \frac{\cancel{2}\sin^2\alpha}{\cancel{2}\sqrt{3+2\sqrt{2}\cos\alpha}}}{3+2\sqrt{2}\cos\alpha}$$

$L''(\alpha)=0$

$$\sqrt{3+2\sqrt{2}\cos\alpha}\,(\sqrt{2}\cos\alpha) = -\frac{\sin^2\alpha}{\sqrt{3+2\sqrt{2}\cos\alpha}}$$

$$(3+2\sqrt{2}\cos\alpha)(\sqrt{2}\cos\alpha) = -\sin^2\alpha$$

$$3\sqrt{2}\cos\alpha + 4\cos^2\alpha = -\sin^2\alpha$$

$$3\sqrt{2}\cos\alpha + 4\cos^2\alpha = -1+\cos^2\alpha$$

$$3\cos^2\alpha + 3\sqrt{2}\cos\alpha + 1 = 0$$

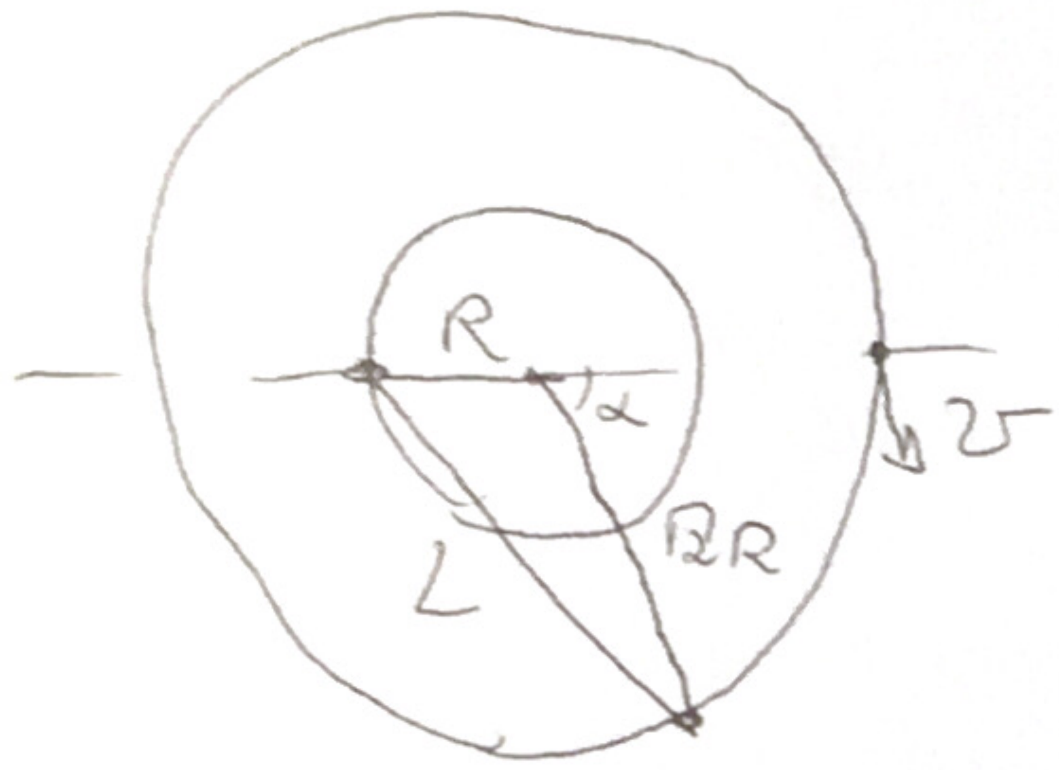
$$\cos\alpha = \frac{-3\sqrt{2}\pm\sqrt{18-12}}{6} = \frac{-3\sqrt{2}\pm\sqrt{6}}{6} =$$

$$\cos\alpha = \pm\frac{\sqrt{6}}{6} - \frac{\sqrt{2}}{2}$$

Чистовик

№4.

2)



1) $L = R\sqrt{3+2\sqrt{2}\cos\alpha}$

2) $\alpha = \dfrac{v t}{\sqrt{2}R} = \dfrac{\sqrt{\frac{gR\sqrt{2}}{2}}\, t}{\sqrt{2}R} = \sqrt{\dfrac{g\sqrt{2}}{4R}}\, t$

$$L = R\sqrt{3+2\sqrt{2}\cos\left(\sqrt{\frac{g\sqrt{2}}{4R}}\, t\right)}$$

3) $V = L' = R\,\dfrac{-\cancel{2}\sqrt{2}\sin\left(\sqrt{\frac{g\sqrt{2}}{4R}}\, t\right)\cdot\sqrt{\frac{g\sqrt{2}}{4R}}}{\cancel{2}\sqrt{3+2\sqrt{2}\cos\left(\sqrt{\frac{g\sqrt{2}}{4R}}\, t\right)}} =$

$= -R\,\dfrac{\sin\left(\sqrt{\frac{g\sqrt{2}}{4R}}\, t\right)\cdot\sqrt{\frac{g\sqrt{2}}{4R}}}{\sqrt{3+2\sqrt{2}\cos\left(\sqrt{\frac{g\sqrt{2}}{4R}}\, t\right)}}$

4) $L'' = -R\left(\dfrac{\cos\left(\sqrt{\frac{g\sqrt{2}}{4R}}\, t\right)\cdot\frac{g\sqrt{2}}{4R}\cdot\sqrt{3+2\sqrt{2}\cos\left(\sqrt{\frac{g\sqrt{2}}{4R}}\, t\right)} - \dfrac{\sin^2\left(\sqrt{\frac{g\sqrt{2}}{4R}}\, t\right)\cdot\frac{g\sqrt{2}}{4R}}{\sqrt{3+2\sqrt{2}\cos\left(\sqrt{\frac{g\sqrt{2}}{4R}}\, t\right)}}}{3+2\sqrt{2}\cos\left(\sqrt{\frac{g\sqrt{2}}{4R}}\, t\right)}\right)$

$L'' = 0$:

$\dfrac{\sin^2\left(\sqrt{\frac{g\sqrt{2}}{4R}}\, t\right)}{\sqrt{3+2\sqrt{2}\cos(x)}} = +\cos(x)\cdot\sqrt{3+2\sqrt{2}\cos x}$

$\sqrt{\dfrac{g\sqrt{2}}{4R}}\, t = x$

$\sin^2 x = \cos x\left(\sqrt{3+2\sqrt{2}\cos x}\right)^2$

$1-\cos^2 x = \cos x\left(3+2\sqrt{2}\cos x\right)$

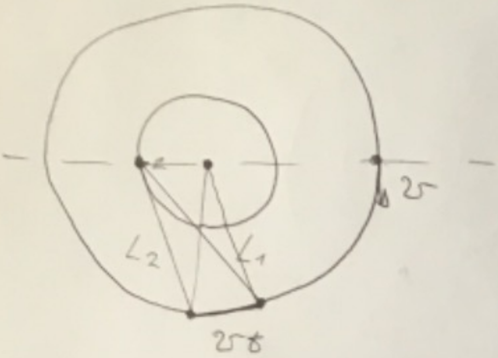
$1 = 3\cos x + (2\sqrt{2}+1)\cos^2 x$

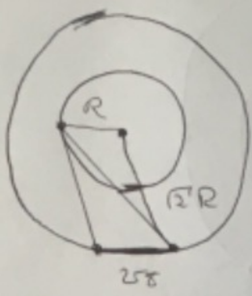
Решаем ур. от. ~~cos x~~ cos x как квадратное.

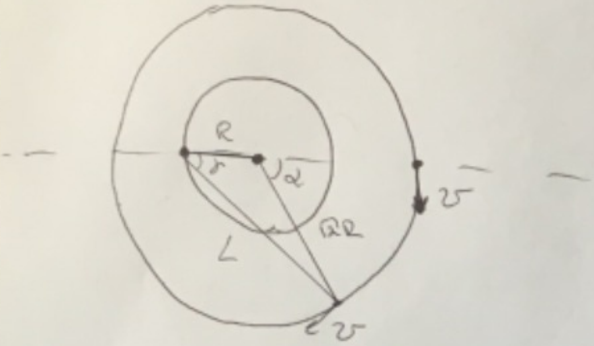
$\cos x = \dfrac{-3 \pm \sqrt{9+8\sqrt{2}+4}}{2(2\sqrt{2}+1)}$

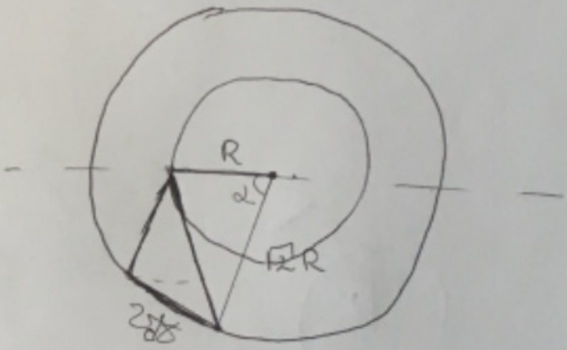
3

Черновик.









$$\frac{L}{\sin\alpha} = \frac{\sqrt{2}R}{\sin\gamma} = \frac{R}{\sin(\gamma+\alpha)}$$

$$\alpha = 2\pi - \omega t$$

$$\frac{\sqrt{2}}{\sin\gamma} = \frac{\cancel{R}}{\sin(\gamma+\alpha)}$$

$$\frac{\sin\gamma}{\cos\gamma} = \frac{\sin\gamma}{\sqrt{1-\sin^2\gamma}}$$

$$\frac{\sin^2\gamma}{1-\sin^2\gamma}$$

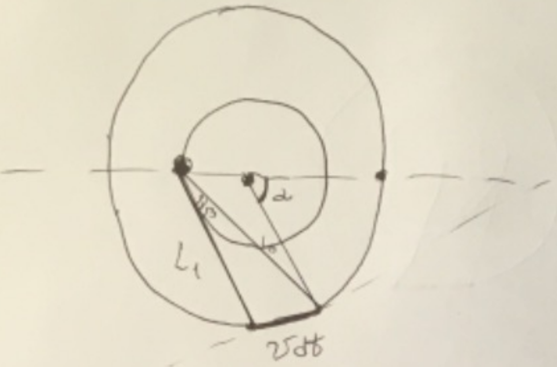
$$\sqrt{2}\left(\cancel{\sin}\gamma\cos\alpha + \cos\gamma\sin\alpha\right) = \cancel{\sin}\gamma$$

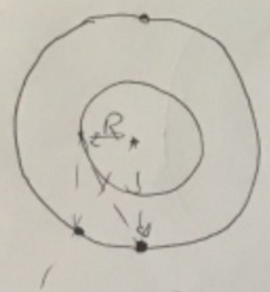
$$1 = \sqrt{2}\left(\cos\alpha + \frac{\sin\alpha}{tg\gamma}\right) \qquad tg\gamma = \frac{\sin\alpha}{\frac{\sqrt{2}}{2} - \cos\alpha} = k$$

$$\sin^2\gamma = k - k\sin^2\gamma$$

$$\sin^2\gamma = \frac{k}{1+k} = \frac{\frac{\sin\alpha}{\frac{\sqrt{2}}{2}-\cos\alpha}}{\frac{\sin\alpha}{\frac{\sqrt{2}}{2}-\cos\alpha}+1} = \frac{\sin\alpha}{\sin\alpha + \frac{\sqrt{2}}{2} - \cos\alpha}$$

Черновик.





$$\frac{v^2}{\sqrt{2}R} = \frac{g}{2}$$

$$v = \sqrt{\frac{gR\sqrt{2}}{2}}$$

$$(vdt)^2 = L_0^2 + L_1^2 - 2L_0L_1\cos\beta$$

$$L = R\sqrt{3 - 2\sqrt{2}\cos(mt)}$$

$$L' = R\,\frac{-\cancel{2}\sqrt{2}\cos(mt)'}{\cancel{2}\sqrt{3-2\sqrt{2}\cos(mt)}} = +R\,\frac{\sqrt{2}\,mt\,\overset{\sin}{\cancel{\cos}}(mt)}{\sqrt{3-2\sqrt{2}\cos(mt)}}$$

$$\cancel{\cos}\ \alpha = \frac{vt}{\sqrt{2}R} = \frac{\sqrt{\frac{gR\sqrt{2}}{2}}\,t}{\sqrt{2}R} = \sqrt{\frac{g\cancel{R}\sqrt{2}\,t^2}{4R^{\cancel{2}}}} = \frac{t}{2}\sqrt{\frac{g\sqrt{2}}{R}}$$

$$\frac{\sqrt{\frac{g\sqrt{2}}{R}}}{2}\,t = mt$$

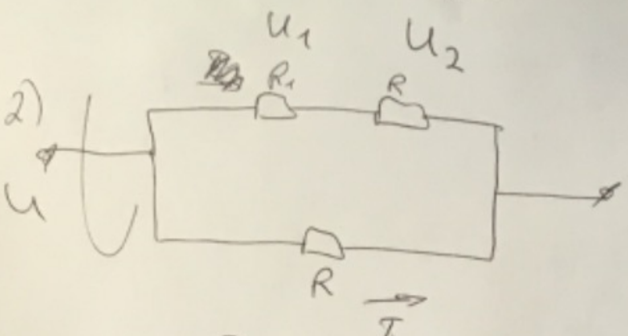
$$\frac{\sin(x+dx) - \sin x}{dx}$$

$$\frac{\sin x\cos dx + \cos x\sin dx - \sin x}{dx}$$

$$\frac{\sin x(\overset{1}{\cos dx} - 1) + \cos x\,\overset{1}{\frac{\sin dx}{dx}}}{}\quad 0$$

N5. Черновик.

2)



$U_1+U_2=U$

$P_{max}=\frac{U_1^2}{R_1}$

$\frac{U_1}{R_1}=\frac{U_2}{R}$

$\frac{U_1}{R_1}=\frac{U-U_1}{R}$

$U_1R=UR_1-U_1R_1$

$U_1=\frac{UR_1}{R_1+R}$

$P_{max}=\frac{U_1^2}{R_1}=\frac{\left(\frac{UR_1}{R_1+R}\right)^2}{R_1}=\frac{U^2R_1^{\cancel{2}}}{\cancel{R_1}(R_1+R)^2}=\frac{U^2R_1}{(R_1+R)^2}$

$P_{max}(R_1)=U^2\frac{R_1}{(R_1+R)^2}$

$P_{max}(R_1)'=U^2\cdot\frac{(R_1+R)^2-R_1\cdot2(R_1+R)}{(R_1+R)^4}=\frac{U^2}{(R_1+R)^4}\left(R_1^2+\cancel{2RR_1}+R^2-2R_1^2-\cancel{2RR_1}\right)=$

$=\frac{U^2}{(R_1+R)^4}\left(R^2-R_1^2\right)$

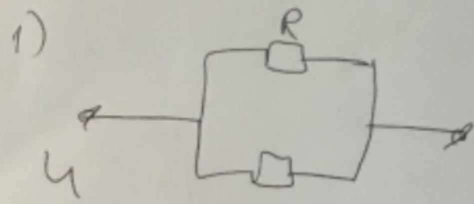
$R_1=R$

$\frac{U^2}{4R}$

$\cancel{\frac{U^2\cdot 3R}{2R\cdot R}}=\frac{3U^2}{2R}=$

9,5 + 7 = 7,5

1)



$P=\frac{U^2}{R_э}=\frac{2U^2}{R}$

$R=\frac{2U^2}{P}$

$(x+b)^2$

$((x+y)^2)'$

$\frac{-(x+b)^2+(x+dx+b)^2}{dx}=(x+y)^2$

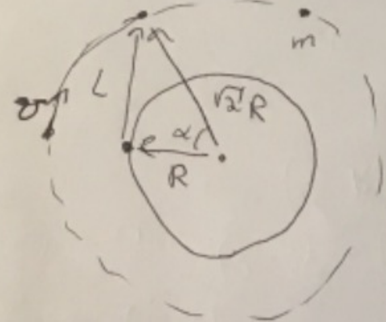
$\frac{(x+dx+b-x-b)(x+dx+b+x+b)}{dx}$

$x+dx+b+x+b$

$2x+2b$

$2(x+b)$

Черновик.



$$w = \frac{v}{\sqrt{2}R}$$

$$\alpha = wt = \frac{v}{\sqrt{2}R}t$$

$$m_1\frac{v^2}{\sqrt{2}R} = G\frac{Mm_1}{2R^2} = g\frac{m_1}{2}$$

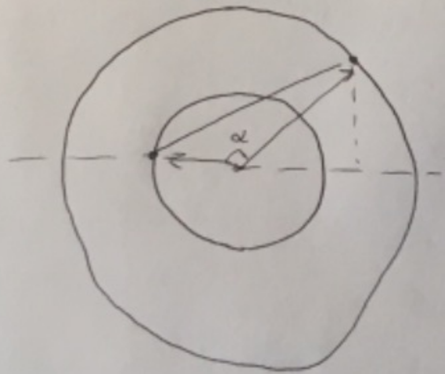
$$v^2 = \frac{gR\sqrt{2}}{2}$$

$$L = \sqrt{R^2 + 2R^2 - 2\sqrt{2}R^2\cos\alpha} =$$

$$= R\sqrt{3 - 2\sqrt{2}\cos\alpha} =$$

$$= R\sqrt{3 - 2\sqrt{2}\cos\left(\frac{vt}{\sqrt{2}R}\right)}$$

$$G\frac{Mm_1}{R^2}$$



$$L = R\sqrt{3 - 2\sqrt{2}\cos\left(\frac{vt}{R\sqrt{2}}\right)} =$$

$$= \left(3 - 2\sqrt{2}\cos\left(\frac{vt}{R\sqrt{2}}\right)\right)' =$$

$$= -2\sqrt{2}\cos\frac{vt}{R\sqrt{2}} =$$

$$= +2\sqrt{2}\left(\frac{vt}{R\sqrt{2}} \cdot \sin\frac{vt}{R\sqrt{2}}\right) =$$

$$= \frac{2vt}{R} \cdot \sin\frac{vt}{R\sqrt{2}}$$

$$\frac{2t}{R}\sin\frac{vt}{R\sqrt{2}} + \cos\frac{vt}{R\sqrt{2}} \cdot \frac{2vt}{R}$$

Черновик.

№4.

$\alpha = wt = \frac{vt}{\sqrt{2}R}$

$\cos\alpha = \cos\frac{vt}{\sqrt{2}R} = \pm\frac{\sqrt{6}}{6} - \frac{\sqrt{2}}{2}$

$t = \frac{\arccos\left(+\frac{\sqrt{6}}{6} - \frac{\sqrt{2}}{2}\right) \times \sqrt{2}R}{v}$

3) $V = L'(\alpha) = R\frac{-\sqrt{2}\sin\alpha}{\sqrt{3+2\sqrt{2}\cos\alpha}} = R\frac{-\sqrt{2}\sqrt{1-\left(\frac{\sqrt{6}}{6}-\frac{\sqrt{2}}{2}\right)^2}}{\sqrt{3+2\sqrt{2}\left(\frac{\sqrt{6}}{6}-\frac{\sqrt{2}}{2}\right)}}$

$V = R\frac{\sqrt{2-\frac{12}{36}+\frac{\sqrt{6}\cdot\sqrt{2}\cdot 4}{36\cdot 2} - \frac{4}{4}}}{\sqrt{3+\frac{2\sqrt{12}}{6}-2}} = \frac{\sqrt{1-\frac{1}{3}+\frac{\sqrt{12}}{3}}}{\sqrt{1+\frac{\sqrt{12}}{3}}}R =$

$= \frac{\sqrt{\frac{2}{3}-\frac{2\sqrt{3}}{3}}}{\sqrt{1}}R$

Черновик.