

Часть 1

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

Шифр: **21204461**

ID профиля: **173448**

Вариант 4

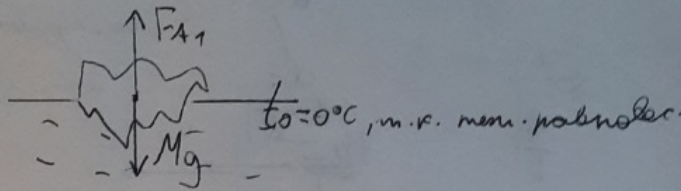
Турбулент

пробл. 19кл.

1. $M = 0,36 \text{ кг}$

$\rho_0 = 1000 \frac{\text{кг}}{\text{м}^3}$ $\rho_1 = 900 \frac{\text{кг}}{\text{м}^3}$

$V_{\text{пл}} = ?$



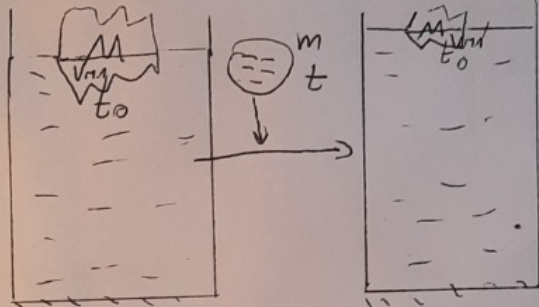
$Mg = F_{A1}$

$Mg = \rho_0 g V_{\text{пл}}$

$V_{\text{пл}} = \frac{Mg}{\rho_0 g} = \frac{M}{\rho_0} = \frac{0,36 \text{ кг}}{1000 \frac{\text{кг}}{\text{м}^3}} = \boxed{0,00036 \text{ м}^3} = 0,36 \text{ гн}^3 = 360 \text{ см}^3$

2) $m = 0,4 \text{ кг}$ $V_1 = 120 \text{ см}^3$ $t = ?$

$\lambda = 336000 \frac{\text{Дж}}{\text{м}}$ $c_b = 4200 \frac{\text{Дж}}{\text{кг} \cdot \text{°C}}$



используем $V_{\text{пл}}$

$V_{\text{пл}} = V_{\text{пл}} - V_1$
 $\frac{M - \Delta m_1}{\rho_0} = \frac{M}{\rho_0} - V_1$
 $M - \Delta m_1 = M - V_1 \rho_0$
 $\Delta m_1 = V_1 \rho_0$

$c_b \cdot m(t - t_0) = \lambda \Delta m_1$

$c_b \cdot m \cdot t = \lambda \Delta m_1 = \lambda V_1 \rho_0$

$t = \frac{\lambda V_1 \rho_0}{c_b \cdot m} = \frac{336000 \frac{\text{Дж}}{\text{м}} \cdot 0,00012 \text{ м}^3 \cdot 1000 \frac{\text{кг}}{\text{м}^3}}{4200 \frac{\text{Дж}}{\text{кг} \cdot \text{°C}} \cdot 0,4 \text{ кг}} = \frac{40320 \frac{\text{Дж}}{\text{кг}}}{1680 \frac{\text{Дж}}{\text{кг}}} = \boxed{24 \text{ °C}}$

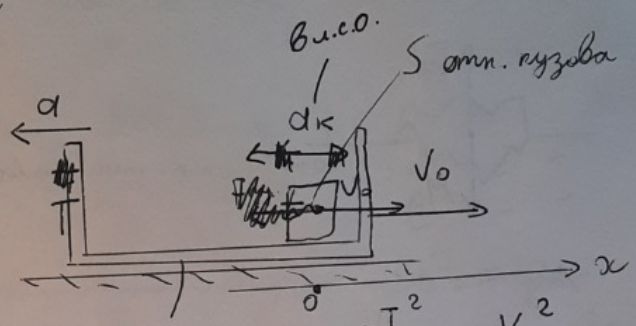
ответ. $\boxed{1}$

Учробоу

физ., 9 кл.

2.

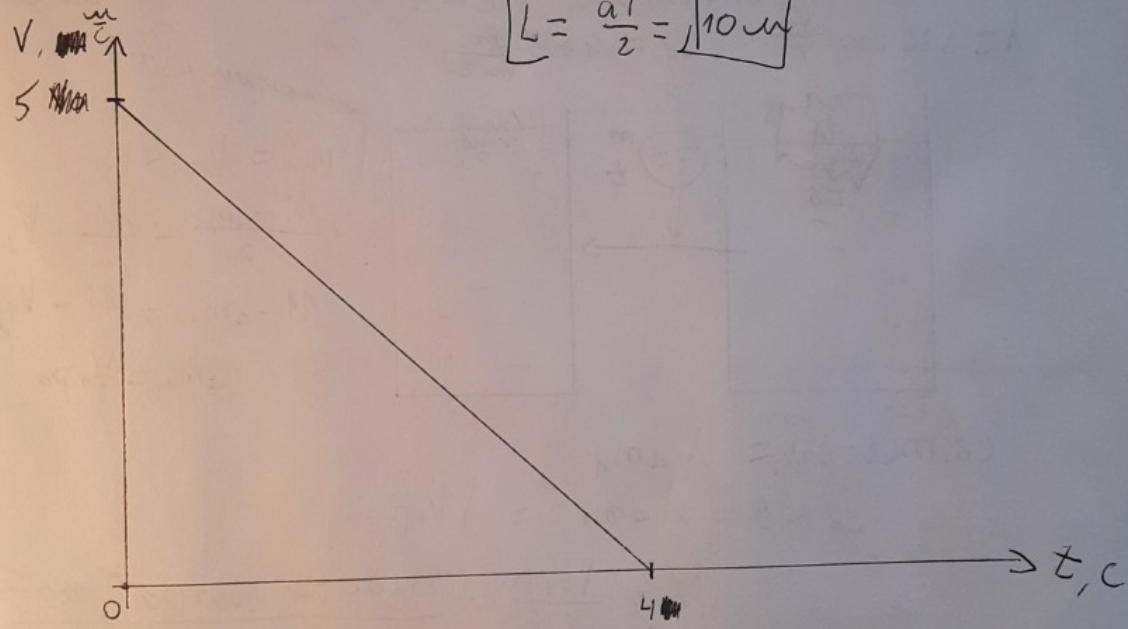
$T = 40$ $s = 2,5 \text{ м}$ $L = ?$ $a_{\text{к.м.}} = ?$ $\omega = ?$ $U_{\text{max}} = ?$ $g = 10 \frac{\text{м}}{\text{с}^2}$
 $V_0 = 5 \frac{\text{м}}{\text{с}}$



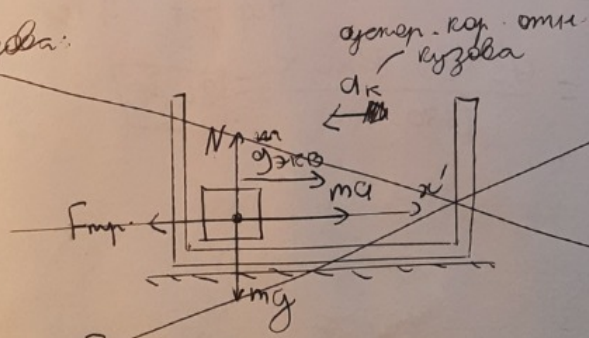
$L = \frac{aT^2}{2} = \frac{V_0^2}{2a}$

$V_0 = aT \quad a = \frac{V_0}{T} = 1,25 \frac{\text{м}}{\text{с}^2}$

$L = \frac{aT^2}{2} = 10 \text{ м}$



~~оmn. кызба:~~



~~но нп. телест
g_{x'k} = a~~

~~$mg = N$
 $F_{\text{fr}} = ma$
 $N = \mu F_{\text{fr}}$~~

~~$0_{x'}: ma - F_{\text{fr}} = ma_{\text{к}}$~~

~~$mg = \mu ma$~~

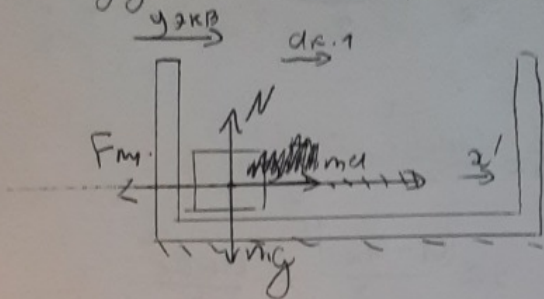
comp. 2

Турмобек

пуш, 9 м

омм. кызба:

нонр. эрбел:
 $g_{\text{к.1}} = g$



$$N = mg$$

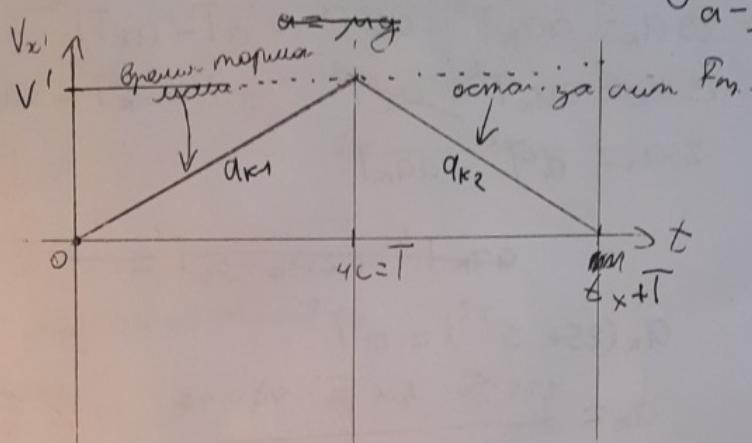
$$F_{\mu} = \mu N = \mu mg$$

$$0x' : ma - F_{\mu} = mg_{\text{к.1}} \quad ma + mg_{\text{к.1}}$$

$$ma = F_{\mu} = \mu mg \quad ma - F_{\mu} = a_{к.1} m$$

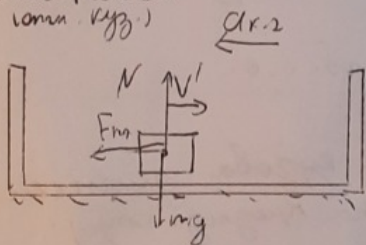
$$ma - \mu mg = a_{к.1} m$$

$$a - \mu g = a_{к.1}$$



осмонбара:

кыб. мөргө осмонбара
 u c.o. кыб. $t \rightarrow$ u.c.o.



$$N = mg$$

$$F_{\mu} = \mu N = \mu mg$$

$$F_{\mu} = a_{к.2} m$$

$$\mu mg = a_{к.2} m$$

$$mg = a_{к.2}$$

$$a - a_{к.2} = a_{к.1}$$

$a_{к.1}$ - үзөңг. ^т мөхөмөт омм. кызба

$a_{к.2}$ - үзөңг. (мөхөмөт. в кыраакы) в u.c.o.

$$a_{к.1} = g - a_{к.2} \quad a - a_{к.1} = a_{к.2}$$

$$a_{к.1} = a_{к.2}$$

смп. 3

Зусмовен

пуз., 9 км.

$$s = a_{k1} T = a_{k2} t_x \quad s = \frac{a_{k1} T^2}{2} + \frac{a_{k2} t_x^2}{2}$$

$$a_{k1} = a - a_k$$

$$a_{k1} T = a_{k2} t_x$$

$$s = \frac{a_{k1} T^2}{2} + \frac{a_{k2} t_x^2}{2}$$

$$(a - a_k) T = a_{k2} t_x \quad s = \frac{(a - a_k) T^2}{2} + \frac{a_{k2} t_x^2}{2}$$

$$2s = a T^2 - a_k T^2 + a_{k2} \left(\frac{(a - a_k) T}{a_{k2}} \right)^2 \quad | \cdot a_{k2}$$

$$2s a_{k2} = a a_{k2} T^2 - a_k a_{k2} T^2 + (a T - a_k T)^2$$

$$2s a_{k2} = a a_{k2} T^2 - a_k a_{k2} T^2 + a^2 T^2 - 2 a a_k T^2 + a_k^2 T^2$$

$$2s a_{k2} = a^2 T^2 - a a_k T^2$$

$$a a_k T^2 + 2s a_{k2} - a^2 T^2 = 0$$

$$a_k (2s + a T^2) = a^2 T^2$$

$$a_k = \frac{1,25 \frac{m}{c^2} \cdot 1,25 \frac{m}{c^2} \cdot 4 \cdot 4}{5m + 1,25 \frac{m}{c^2} \cdot 4 \cdot 4} = \frac{25 \frac{m^2}{c^2}}{25m} = 1 \frac{m}{c^2}$$

$$\boxed{a_k = 1 \frac{m}{c^2}} \text{ - генер. коп. в лад. с.о.}$$

• за врем τ сред. коп. в с.о. пузоба умесел.
(см. график на предид. стр.)

$$\tau = t_x$$

$$v' = a_{k1} T = a_{k2} t_x$$

$$(a - a_k) T = a_{k2} t_x$$

$$\tau = \frac{(a - a_k) T}{a_{k2}} = \frac{1,25 \frac{m}{c^2} - 1 \frac{m}{c^2}}{1 \frac{m}{c^2}} \cdot 4c$$

$$\boxed{\tau = \frac{1}{4} \cdot 4c = 1c}$$

$$\boxed{U_{\max \text{ с.о.}} = v' = a_{k2} t_x = a_{k2} \tau = 1 \frac{m}{c^2} \cdot 1c = 1 \frac{m}{c}}$$

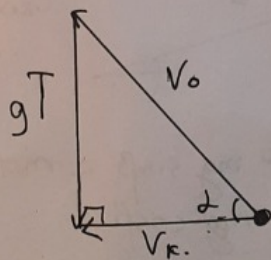
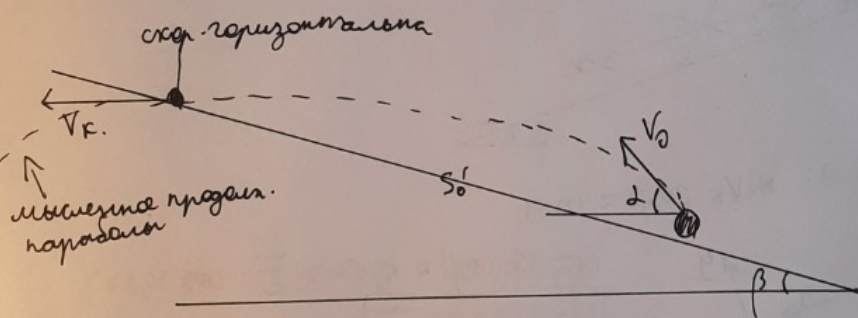
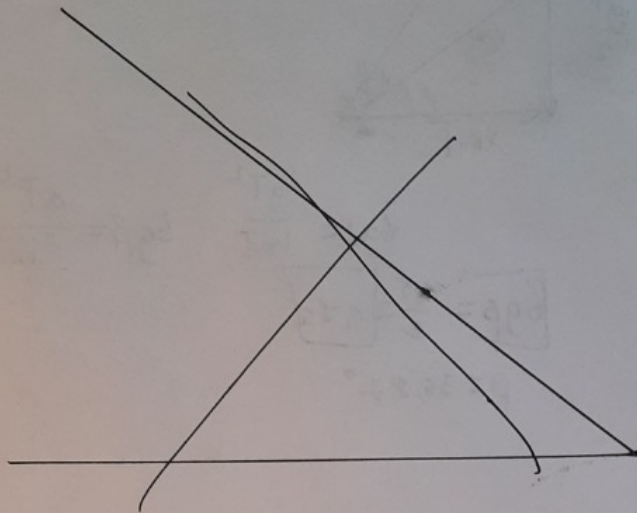
стр. $\boxed{4}$

Умовован

пуз., 9 км.

3. $V_0 = 10 \frac{m}{c}$ α $tg \alpha = 1,5$
 $T = ?$, $tg \beta = ?$, $s = ?$; $\mu = 0,5$, $V = ?$

$g = 10 \frac{m}{c^2}$



$tg \alpha = 1,5$
 $\alpha = 56,31^\circ$

$\sin \alpha = 0,83205$

$\sin \alpha = \frac{gT}{V_0}$

$gT = V_0 \sin \alpha$

$T = \frac{V_0 \sin \alpha}{g} = 0,832 \text{ c}$

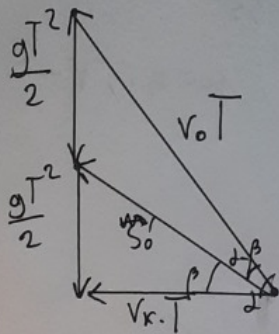
смп. [5]

$tg \alpha = \frac{gT}{V_K}$

$V_K = \frac{gT}{tg \alpha} = \frac{10 \frac{m}{c^2} \cdot 0,83205 \text{ c}}{1,5} = 5,547 \frac{m}{c}$

тормоз

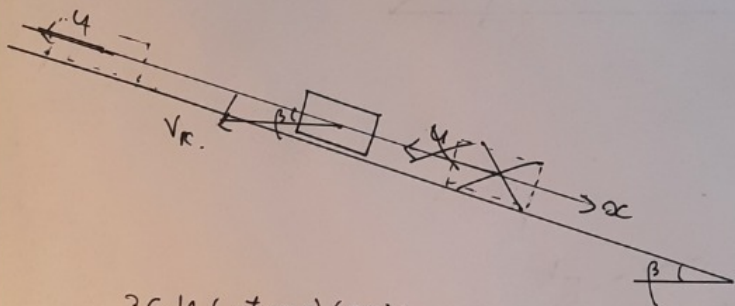
quiz, 983



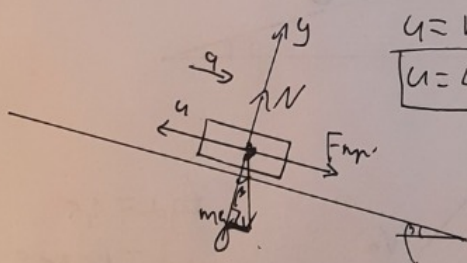
$$\operatorname{tg} \alpha = \frac{g T^2}{v_k T} \quad \operatorname{tg} \beta = \frac{g T^2}{2 v_k T} = \frac{\operatorname{tg} \alpha}{2}$$

$$\operatorname{tg} \beta = \frac{1,5}{2} = 0,75$$

$$\beta = 36,87^\circ$$



ЗСН (at → 0) (0x): $m v_k \cos \beta = m u$



$$u = v_k \cos \beta = 5,547 \frac{\text{м}}{\text{с}} \cdot \cos 36,87^\circ$$

$$u = 4,4376 \frac{\text{м}}{\text{с}}$$

коэф. трения
составляет

$$\mu = 0,5$$

2.3. З. по осм: 1) x: $F_{tr} + mg \sin \beta = ma$

2) y: $N = mg \cos \beta$

$$F_{tr} = \mu N$$

$$\mu mg \cos \beta + mg \sin \beta = ma$$

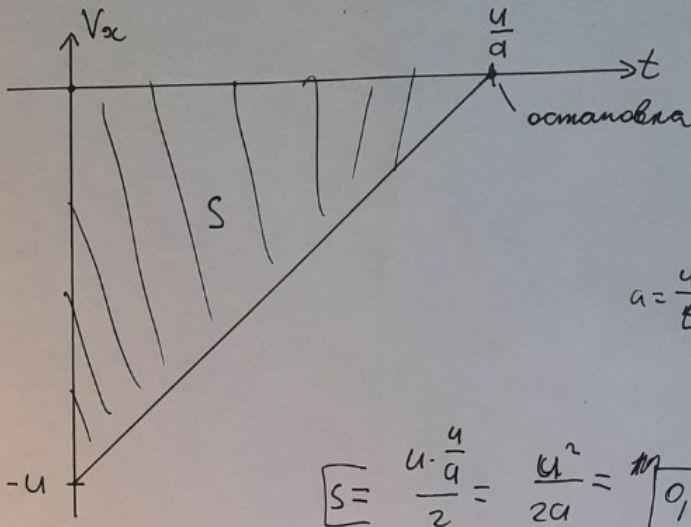
$$g (\mu \cos \beta + \sin \beta) = a$$

$$a = 10 \frac{\text{м}}{\text{с}^2} (0,5 \cdot 0,8 + 0,6) = 10 \frac{\text{м}}{\text{с}^2}$$

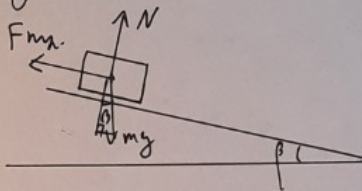
ответ: 6

Торможение

пуз, 92.



когда $v_x = 0$:



$$N = mg \cos \beta \quad (y) \quad \text{23. ст.}$$

$$F_{тр} = mg \sin \beta \quad (x)$$

Док: $F_{тр} \stackrel{?}{>} \mu N$
(при остановке)

$$F_{тр} \quad \vee \quad \mu N$$

$$mg \sin \beta \quad \vee \quad 0,5 mg \cos \beta$$

$$\sin \beta \quad \vee \quad 0,5 \cos \beta$$

$$0,6 \quad \vee \quad 0,5 \cdot 0,8$$

$$0,6 \quad \vee \quad 0,4$$

$$0,6 > 0,4$$

$$F_{тр} > \mu N$$

\Rightarrow блок не поедет назад,

~~когда скорость у него 0~~
остановится наверху склона

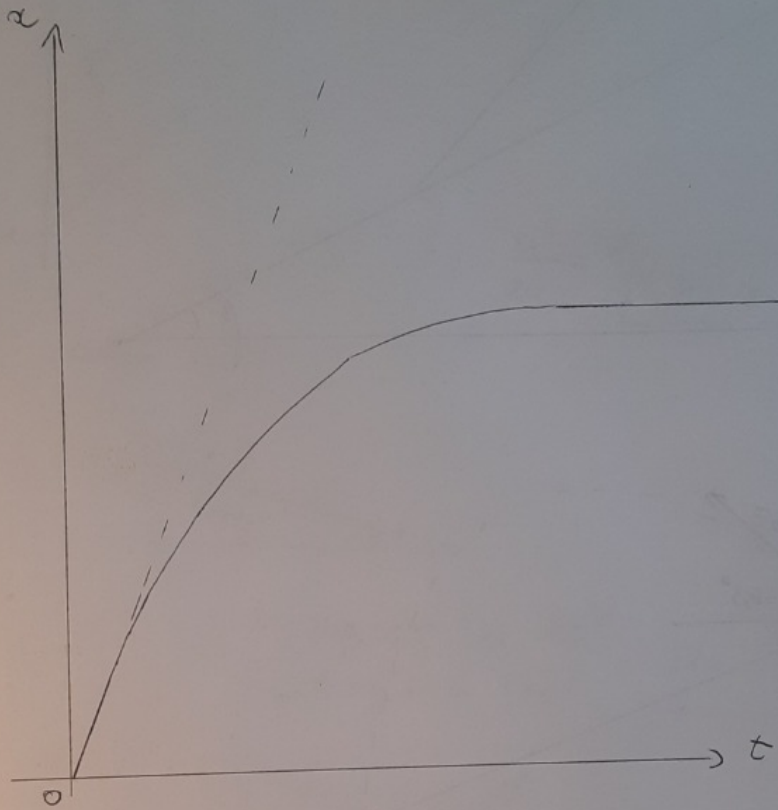
спр. 7

Теплообмен

разг. гр.

32

~~~~~



comp. —

Тучное

$V_{0x}$

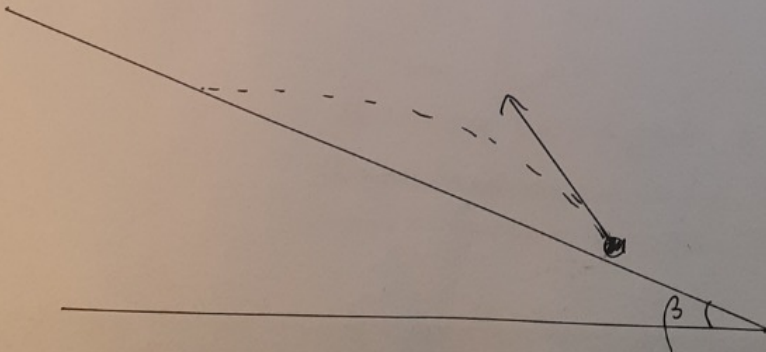
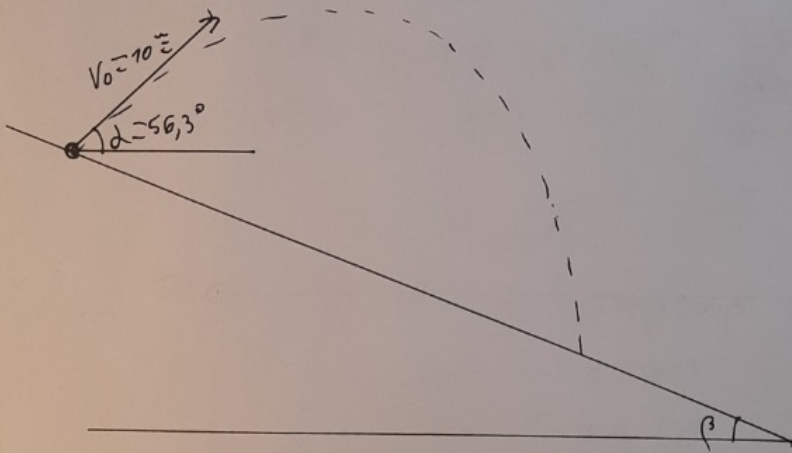
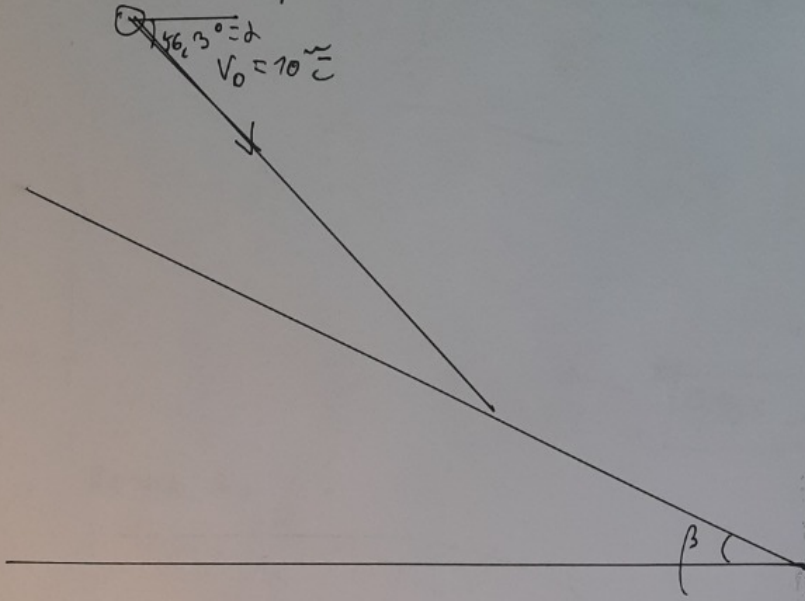
u

раз, 92

Тучное

раз, 92

$\alpha = 56,3^\circ$   
 $V_0 = 10 \vec{e}$



cmp.

# Часть 2

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

Шифр: **21204461**

ID профиля: **173448**

Вариант 4

Тучмабур

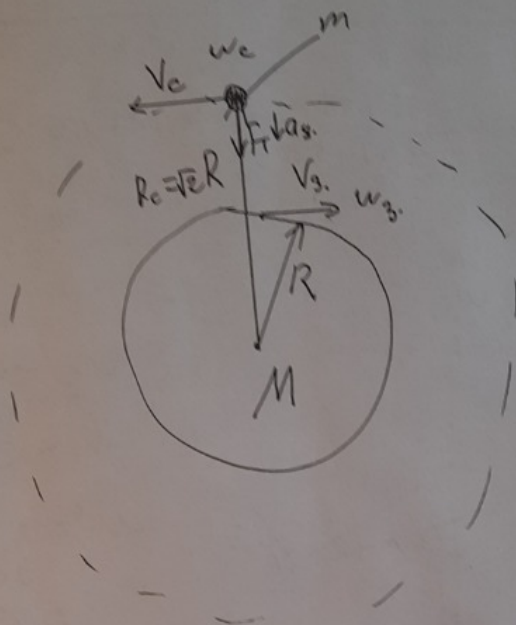
9.11.2019, 9h.

4.  $R = 6400 \text{ km}$   $R_c = \sqrt{2}R$   $g = 10 \frac{\text{m}}{\text{s}^2}$

$T_1 = ?$   $T_2 = ?$   $V = ?$

$T_3 = 24 \text{ ч.}$

$\frac{1}{2}$   
 $\frac{1}{4}$



$$\omega_3 = \frac{2\pi}{24 \text{ ч.}} = \frac{2\pi}{T_3} \quad v_3 = \omega_3 R_c = \frac{2\pi R_c}{T_3}$$

2.3. Ж. гур орнмунка:  $F_T = m a_s$

$$\text{① } \frac{GMm}{R_c^2} = m a_s \quad a_s = \frac{v_c^2}{R_c} = \omega_c^2 R_c$$

$$GM = R_c \cdot \frac{v_c^2}{R_c}$$

$$v_c^2 = \frac{GM}{R_c}$$

$$v_c^2 = \frac{gR^2}{\sqrt{2}R} = \frac{gR}{\sqrt{2}}$$

$$g = G \frac{M}{R^2} \quad GM = gR^2$$

$$\frac{GMm}{R_c^2} = m \omega_c^2 R_c$$

$$GM = \omega_c^2 R_c^3$$

$$gR^2 = \omega_c^2 2\sqrt{2}R^3$$

$$g = \omega_c^2 2\sqrt{2}R \quad \text{чмр. } \boxed{1}$$

Ускорение

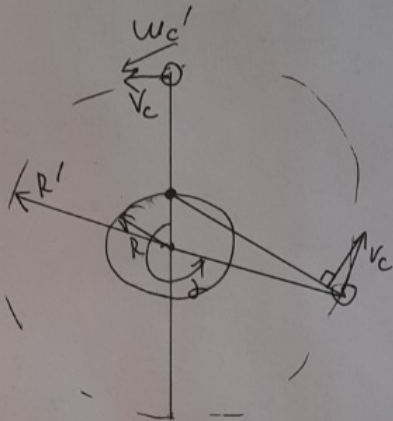
quiz, 9km

$$\omega_c = \sqrt{\frac{g}{2\sqrt{2} \cdot R_{\text{ш}}}} = \sqrt{\frac{10 \frac{\text{м}}{\text{с}^2}}{2\sqrt{2} \cdot 6400000 \text{ м}}}$$

$$\omega_c = \sqrt{\frac{10 \frac{1}{\text{с}^2}}{18.7019321}} = \frac{3,1623 \frac{1}{\text{с}}}{4254,64} = 0,00074326 \frac{1}{\text{с}}$$

$$T_c = \frac{2\pi}{\omega_c} = \frac{6,283185}{0,00074326 \frac{1}{\text{с}}} = 8453,55 \text{ с} = 2,35 \text{ ч}$$

опп. радиусам:



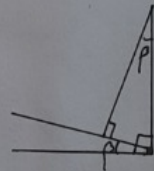
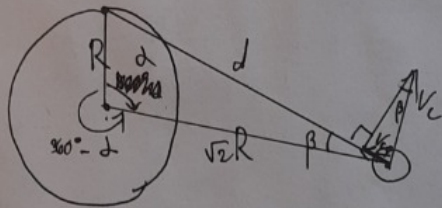
$$\omega_c' = \omega_c + \omega_3$$

$$\omega_3 = \frac{2\pi}{T_3} = 0,0007272 \frac{1}{\text{с}}$$

$$\omega_c' = 0,00074326 \frac{1}{\text{с}} + 0,0007272 \frac{1}{\text{с}} = 0,00147046 \frac{1}{\text{с}}$$

$$v_c = R \omega_c' = 7385 \frac{\text{м}}{\text{с}}$$

внеш. ман. Gen:



$$\sin \beta = \frac{v_{c0}}{d}$$

$$m. \cos: d^2 = R^2 + 2R^2 - 2R\sqrt{2}R \cos \alpha$$

$$m. \sin: \frac{d}{\sin \alpha} = \frac{R}{\sin \beta} = \frac{R v_c}{v_{c0}}$$

$$d v_{c0} = R v_c \sin \alpha$$

$$\left( \frac{d v_{c0}}{R v_c} \right)^2 = \sin^2 \alpha$$

$$d^2 v_{c0}^2 = R^2 v_c^2 \sin^2 \alpha$$

cmp. 2

# Zuordnung

quiz, 9R

$$\frac{R^2 v_c^2 \sin^2 \alpha}{v_{co}^2} = 3R^2 = 2\sqrt{2}R^2 \cos \alpha$$

$$R^2 \left(\frac{v_c}{v_{co}}\right)^2 \sin^2 \alpha (1 - \cos^2 \alpha) = R^2 (3 - 2\sqrt{2} \cos \alpha)$$

hieraus  $k = \frac{v_c}{v_{co}}$ , mo hieraus kann man  $\min k$ ,  
mit  $k^2$

$$k^2 = \frac{3 - 2\sqrt{2} \cos \alpha}{1 - \cos^2 \alpha}$$

ein  $\cos \alpha = 0$ :  $k^2 = \frac{3}{1} = 3$

ein  $\cos \alpha = 0,01$ :  $k^2 = 2,972$

ein  $\cos \alpha = 0,1$ :  $k^2 = 2,745$

ein  $\cos \alpha = 0,2$ :  $k^2 = 2,536$

ein  $\cos \alpha = 0,9$ :  $k^2 = 2,392$

ein  $\cos \alpha = 1$ :  $k^2 = 8,622$

ein  $\cos \alpha = 0,99$ :  $k^2 = 3,210$

ein  $\cos \alpha = 0,95$ :  $k^2 = 2,5902$

ein  $\cos \alpha = 0,92$ :  $k^2 = 2,4789$

ein  $\cos \alpha = 0,91$ :  $k^2 = 2,4328$

ein  $\cos \alpha = 0,905$ :  $k^2 = 2,4076$

ein  $\cos \alpha = 0,902$ :  $k^2 = 2,4076$

$$\Rightarrow 0,900 < \cos \alpha < 0,902$$

$$25,8^\circ > \alpha > 25,6^\circ$$

$$\alpha \approx 25,7^\circ$$

$$k^2 = \frac{3 - \sqrt{2} \cdot 0,90108}{1 - 0,81194} = \frac{0,45136089}{0,1880602} = 2,4$$

$\cos \alpha = 0,2$ :  $k^2 = 2,536$

$\cos \alpha = 0,9$ :  $k^2 = 2,392$

$\cos \alpha = 0,5$ :  $k^2 = 2,114$

$\cos \alpha = 0,7$ :  $k^2 = 2,000$   $\alpha = 46^\circ$

$\cos \alpha = 0,6$ :  $k^2 = 2,0358$   $\alpha = 53^\circ$

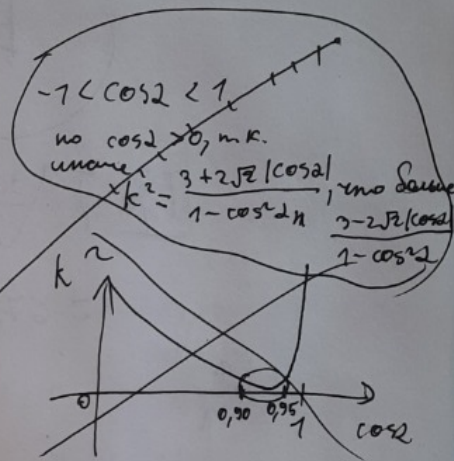
$\cos \alpha = 0,8$ :  $k^2 = 2,048$   $\alpha = 37^\circ$

ein  $\cos \alpha = 0,995$ :  $k^2 = 3,210$

$k^2 = 3,210$

$\cos \alpha = 0$ :  $k^2 = \frac{3}{1} = 3$

comp. [3]



# Турбореактор

опред., гр.

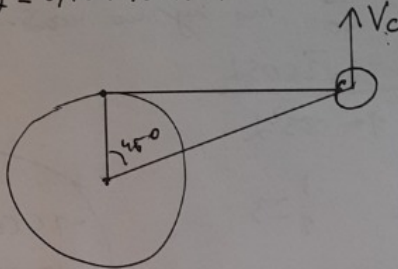
$$\begin{aligned}
 \cos \alpha = 0,69: k^2 &= 2,001 \\
 \cos \alpha = 0,71: k^2 &= 2,000034 \\
 \cos \alpha = 0,75: k^2 &= 2,008 \\
 \cos \alpha = 0,70710678\dots: k^2 &= 2 \text{ (идеально)}
 \end{aligned}
 \left. \vphantom{\begin{aligned} \cos \alpha = 0,69: k^2 = 2,001 \\ \cos \alpha = 0,71: k^2 = 2,000034 \\ \cos \alpha = 0,75: k^2 = 2,008 \end{aligned}} \right\} \gg k^2 = 2 \quad \alpha = 45^\circ$$

$$k = \sqrt{2}$$

$$\frac{V_c}{V_{c0}} = \sqrt{2}$$

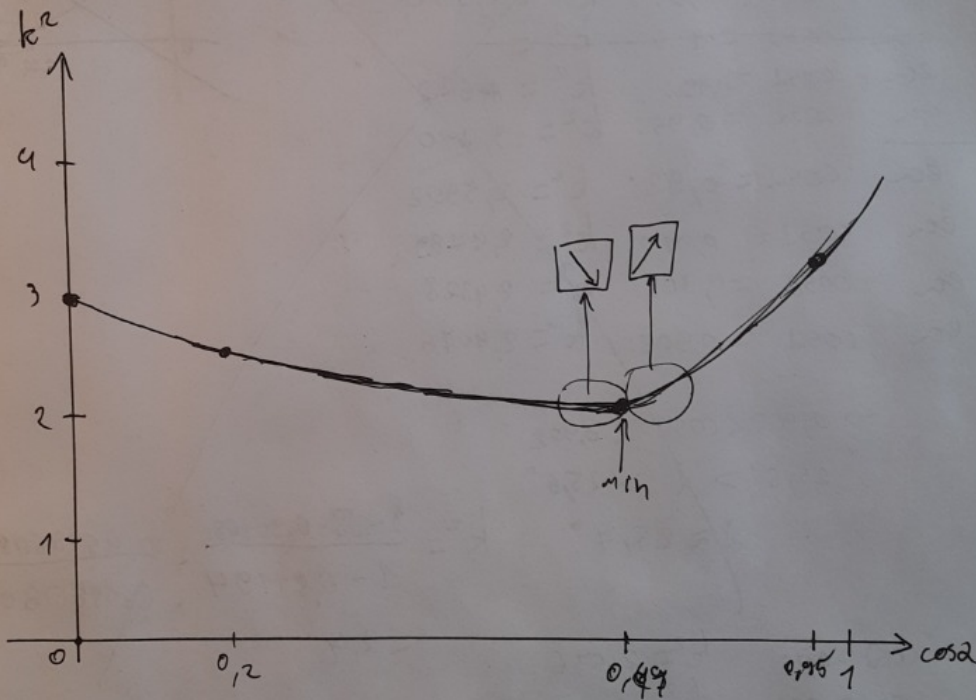
$$V_{c0} = \frac{V_c}{\sqrt{2}} = \boxed{5222 \frac{\text{м}}{\text{с}}}$$

или макс скорость протек.



$$\boxed{\frac{T_{max}}{T}} = \frac{360^\circ - 45^\circ}{360^\circ} \cdot \frac{2\pi}{\omega_c} = \frac{360^\circ - 45^\circ}{360^\circ} = \frac{5,49779}{9,0081598} \cdot 2$$

$$= 6738 \text{ с} = \boxed{1,872}$$

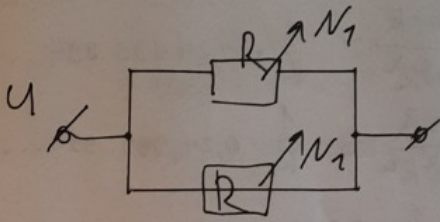


Смп. [4]

Зачем?

опред., гр.

5.  $U = 4B$      $P = 2B$      $R_{12} R_1^2$



$$N_1 = \frac{U^2}{R}$$

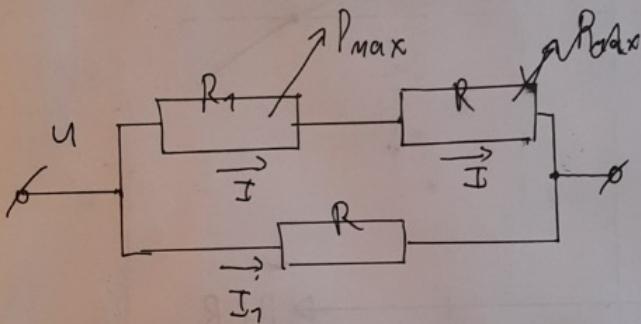
$$P = 2N_1 = 2 \frac{U^2}{R} = \frac{2U^2}{R}$$

$$RP = 2U^2$$

$$R = \frac{2U^2}{P} = \frac{2 \cdot 16B^2}{2B} = \frac{16B}{A}$$

$R = 16 \Omega$

$R_1 - ?$      $P_{max} - ?$



$$P_{max} = I^2 R_1$$

~~$P_{max}$  при  $I_{max}$~~

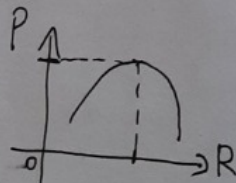
$$(R_1 + R)I = RI_1 = U$$

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

$$P_{max} = \frac{U^2 R_1}{(R_1 + R)^2} = \frac{U^2 R_1}{R_1^2 + R^2 + 2R_1 R_2}$$

$$P_{max} = U^2 k$$

$$P_{max} \text{ при } k = \frac{R_1}{(R_1 + R)^2} \text{ max}$$



смп. 5



## Задача

физ., 9 кл.

пусть  $R_1 = R$ , то  $k = \frac{R}{(2R)^2} = \frac{R}{4R^2} = \frac{1}{4R} = \frac{1}{R} \cdot 0,25000000 \dots$

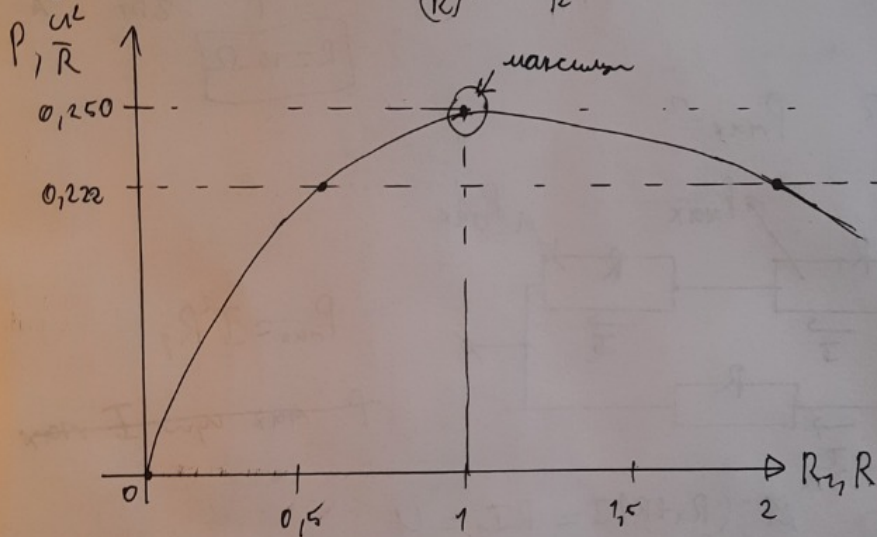
пусть  $R_1 = 1,001R$ , то  $k = \frac{1,001R}{2,001^2 R^2} = \frac{1}{R} \cdot 0,24999994 \dots$

пусть  $R_1 = 0,999R$ , то  $k = \frac{0,999R}{1,999^2 R^2} = \frac{1}{R} \cdot 0,24999994 \dots$

пусть  $R_1 = 2R$ , то  $k = \frac{2R}{(3R)^2} = \frac{1}{R} \cdot 0,222 \dots$

пусть  $R_1 = 0,5R$ , то  $k = \frac{0,5R}{(1,5R)^2} = \frac{1}{R} \cdot 0,222 \dots$

пусть  $R_1 = 0$ , то  $k = \frac{0}{(R)^2} = \frac{1}{R} \cdot 0$



$$\Rightarrow R_1 \text{ на } P_{\max} = R, \quad P_{\max} = U^2 \cdot \frac{1}{R} \cdot \frac{1}{4} = \frac{U^2}{4R} = \frac{16B^2}{4 \cdot 16\Omega} = 0,25 \text{ Вт}$$

Отв.:  $R_1 = 16 \Omega$ ,  $P_{\max} = 0,25 \text{ Вт}$

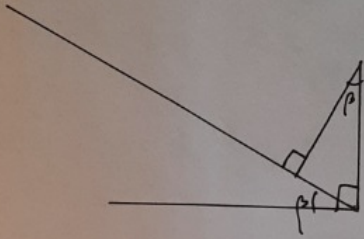
$$L = \frac{I}{R}$$

$$v = \omega R$$

Терновик

разг., разг.

$$\frac{1}{0,5} = 2$$



$$\frac{2,971715}{0,9999}$$

0,1:

$$1 - 0,1 \cdot 0,1 = 1 - 0,01 = 0,99$$

$$\frac{0,96}{0,21}$$

$$8 \sqrt{\cdot} \cdot \cdot - 3$$

$$0,915$$

$$1 - 0,81 = 0,19$$

$$0,9025$$

$$0,0975$$

$$0,1536$$

$$0,1719$$

$$3,210$$

$$2,5902$$

$$2,4789$$

$$0,180975$$

$$0,999$$

$$0,001999$$

$$0,902 | 0,186396$$

$$0,01999$$

$$0,5 \cdot 0,5 = 0,25 \quad 0,75$$

$$\frac{0,7}{0,51}$$

$$\cos \alpha = 0,6:$$

$$\frac{2,0358}{0,64} = 2,0358$$

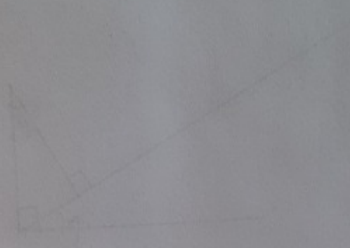
$$0,8 : \frac{0,36}{0,36} =$$

comp. —

Теплообмен

quiz, 92u

0,69 (0,5239) 2,001  
0,7 2,000 2,000  
0,71 (0,4959) 2,000338  
0,75 (0,4375) 2,008



cmp. —