Часть 1

Олимпиада: **Физика, 11 класс (1 часть)**

Шифр: **21200243**

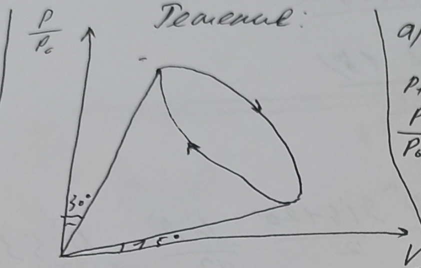
ID профиля: **328851**

Вариант 5

Вариант 11-05 Чистовик (2)

Дано: $\alpha = 15^\circ$, $\beta = 30^\circ$

Решение:



а) $\frac{P_1}{P_0} = R_1 \cos 30^\circ$

$P_1 = R_1 P_0 \cos 30^\circ$

$\frac{P_2}{P_0} = R_1 \sin 15^\circ$; $P_2 = R_1 P_0 \sin 15^\circ$

$\frac{V_1}{V_0} = R_1 \sin 30^\circ$; $V_1 = R_1 V_0 \sin 30^\circ$

$\frac{V_2}{V_0} = R_1 \cos 15^\circ$ $V_2 = R_1 V_0 \cos 15^\circ$

$P_1 V_1 = \nu R T_1$ $\quad T_1 = \frac{P_1 V_1}{\nu R}$

$P_2 V_2 = \nu R T_2$ $\quad T_2 = \frac{P_2 V_2}{\nu R}$

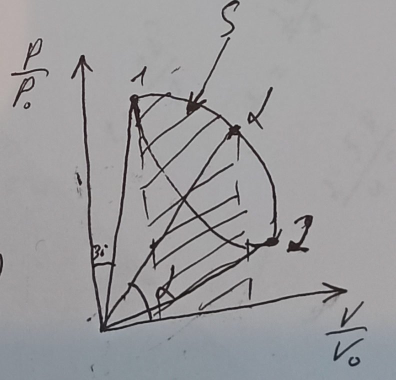
$\frac{T_1}{T_2} = \frac{P_1 V_1}{P_2 V_2} = \frac{R_1 P_0 \cos 30^\circ \cdot R_1 V_0 \sin 30^\circ}{R_1 P_0 \sin 15^\circ \, R_1 V_0 \cos 15^\circ} = \frac{\cos 30^\circ \cdot \sin 30^\circ}{\frac{1}{2} \cdot 2 \cdot \sin 15^\circ \cos 15^\circ} = \frac{\cos 30^\circ \cdot \sin 30^\circ}{\frac{1}{2} \sin 30^\circ} =$

$= 2 \cos 30^\circ = \frac{\sqrt{3}}{2} \cdot 2 = \sqrt{3}$

$\frac{T_1}{T_2} = \sqrt{3} \Rightarrow T_1 = \sqrt{3}\, T_2$

б) $\frac{P}{P_0} = R \sin \alpha$

$\frac{V}{V_0} = R \cos \alpha$



$Q(\alpha) = \Delta U + A = \frac{3}{2} \nu R (T_\alpha - T_1) + A(\alpha)$

$A = \int_1^\alpha P\, dV = S$

$A = \frac{P_0 V_0}{S} = \frac{1}{2}\left(\frac{\pi R^2}{3} - \frac{R^2 \sin 120^\circ}{2} - \left[\frac{\pi R^2 \alpha}{180} - \frac{R^2 \sin^2 \alpha}{2}\right]\right)$

$Q(\alpha) - \frac{3}{2} P_0 V_0 R^2 \left(\cos\alpha \cdot \sin\alpha - \frac{\sqrt{3}}{4}\right) + \frac{1}{2} P_0 V_0 \left(\left(\frac{\pi R^2}{3} - \frac{R^2 \sin 120^\circ}{2}\right) - \left(\frac{\pi R^2 \alpha}{180} - \frac{R^2 \sin \alpha}{2}\right)\right)$

$\frac{dQ}{d\alpha} = \frac{3}{2} P_0 V_0 R^2 \cdot \cos 2\alpha - \frac{1}{2} P_0 V_0 \frac{\pi R^2}{180} + \frac{1}{2} P_0 V_0 R^2 \cos 2\alpha =$

$= 2 P_0 V_0 R^2 \cos 2\alpha - \frac{1}{2} P_0 V_0 \frac{\pi}{180} R^2$

Ответ: $\sqrt{3}$

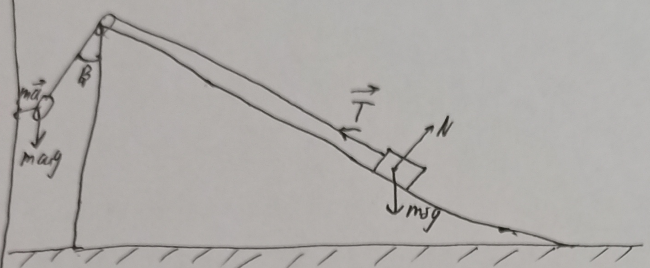
Вариант 11-05 Чистовик. Физика.

№1

Решение

Дано:
$\cos\alpha = \frac{12}{13}$
$m_ш = m$
$m_б = 13m$
и
$\cos\beta = \frac{4}{5}$

$a_{кл}$ - ?
$a_{бр}$ - ?
T - ?



Перейдем в систему отсчета, связанную с клином

$mg\cos\beta + ma_к\sin\beta - T = ma_ш$ (1)

брусок:

$T + 13ma_к\cos\alpha - 13mg\sin\alpha = 13ma_б$ (2)

$a_ш = a_б$ (3) ; $mg\sin\beta - ma_к\cos\beta = 0$. (4)

Из уравнения (4): ~~m~~$a_к\cos\beta =$ ~~m~~$g\sin\beta$

$a_к = g\cdot tg\beta$; $a_к = 4{,}16$ м/с^2

$mg\cos\beta - mg\,tg\beta\cdot\sin\beta + 13mg\,tg\beta\cdot\cos\alpha - 13mg\sin\alpha - 13ma = ma$

$g(\cos\beta - tg\beta\sin\beta + 13tg\beta\cos\alpha - 13\sin\alpha) = 14a$

$a_б = \frac{g}{14}(\cos\beta - tg\beta\sin\beta + 13tg\beta\cos\alpha - 13\sin\alpha)$ $a_б = 3{,}1$ м/с^2

$\frac{H}{\cos\alpha} = a_ш\frac{t^2}{2}$

$t = \sqrt{\frac{2H}{\cos\alpha\cdot a_ш}}$

Ответ: 4,16 м/с^2, 3,1 м/с^2;

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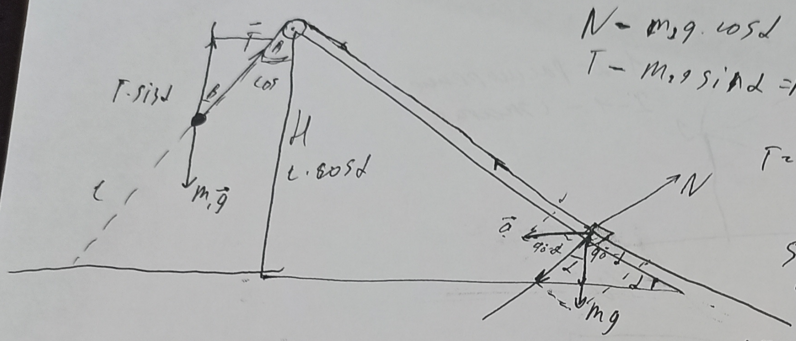
Черновик физика. 11-05. (4)



$N - m_2 g \cdot \cos\alpha = m_1 a \cdot \cos\alpha$

$T - m_2 g \sin\alpha = m_2 a \sin\alpha$

$T = m_2 a \sin\alpha + m_2 g \sin\alpha$

$\sin\beta = \frac{3}{5}$

$\cos\beta = \frac{4}{5}$ $\frac{9}{20}$

$\frac{10}{14}\left(\frac{4}{5} - \frac{3}{4}\cdot\frac{3}{5} + \frac{13\cdot3\cdot12}{4\cdot12} - \frac{13\cdot5}{13}\right)$

$\frac{10}{14}(0{,}8 - 0{,}45 + 9 - 5$

1) акл

$T\sin\beta - m_1\vec{g} = m_1 a \sin\alpha$

$\frac{144}{169} - \frac{169}{169} = \frac{25}{169} = \frac{5}{13}$

$(m_2 a \sin\alpha + m_2 g \sin\alpha)\sin\beta - m_1 g = m_1 a \sin\alpha$

4,30 3,1 м/с²

Ответы: $1 = \frac{16}{25}$

~~6 м/с²~~ ~~$\frac{4{,}647\cdot3}{5}$~~

~~2,1 м/с²~~ 1) 1,647

2) 2,94

3) 0,35 Нс.

$13 a \sin^2\alpha + 13 g \sin^2\alpha - g = a \sin\alpha$

$a(13\sin^2\alpha - \sin\alpha) + 13 g \sin^2\alpha - g = 0$

1) $a = \frac{g - 13 g \sin^2\alpha}{13\sin^2\alpha - \sin\alpha} = \frac{10 - \frac{13\cdot10\cdot25}{13\cdot13}}{\frac{13\cdot25}{13\cdot13} - \frac{5}{13}} = \frac{-923}{\frac{20}{13}} = 6$ м/с²

$l = \frac{H}{\cos\beta}$

2) $a_{0r} =$ ~~$a\sin\alpha = 2{,}3$~~. $1{,}647\cdot\frac{5}{13} = 2{,}94$

$l \cdot м^{-1} \cdot Нм.$

3)

$l = \frac{at^2}{2}$

$a(13a\cdot\sin\alpha\cdot\sin B$

30

$t = \frac{2l}{a} = \frac{2\cdot\frac{H}{\cos B}}{a}$

$a = \frac{g - 13g\cdot\sin\alpha\cdot\sin B}{13\sin\alpha\cdot\sin B - \sin\alpha} = \frac{10 - 13\frac{13\cdot10\cdot5\cdot3}{13\cdot5}}{13\cdot\frac{5}{13}\cdot\frac{3}{5} - \frac{5}{13}} =$

$\frac{2\cdot5\cdot4}{4\cdot2{,}94}$

$\frac{20}{3-\frac{5}{13}} = \frac{20\cdot13}{34} = 7{,}647$

34

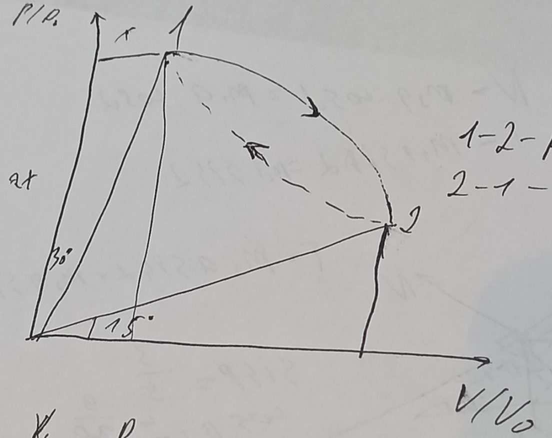
Черновик. Вариант. (3)

$10 \frac{\sin\alpha}{\cos\alpha}$

$10 \cdot \frac{5}{12} = \frac{50}{12}$

4,16

$\frac{10}{14}$



1-2 - расширение
2-1 - сжатие.

$\frac{V_1}{V_0} = \frac{P_1}{P_0}$

$t = \sqrt{\frac{2H}{\pi \cdot \cos\beta \cdot a_{ц}}} = \sqrt{\frac{2 \cdot H \cdot 5}{4 \cdot 3,1}}$

$Q = A' + U$, $t =$

$\frac{PV}{T} = const.$

$t =$

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(5) $\frac{dQ}{d\alpha} = 0 \rightarrow 2P_0\sigma_0 R^2 \cos 2\alpha = \frac{1}{2} P_0 \sigma_0 R^2$

$\cos(2\cdot 60) \le \cos 2\alpha = \frac{1}{4} \le \cos(2\cdot 15) = \frac{\sqrt{3}}{2}$

$\alpha = \frac{1}{2}\arccos\frac{1}{4}$

(6) $A_{расш} = P_0\sigma_0 \cdot \frac{1}{2}\left(\frac{\pi R^2}{3} - \frac{R^2 \sin 120^\circ}{2} - \frac{\pi R^2}{12} + \frac{R^2 \sin 30^\circ}{2}\right) =$

$= \frac{P_0\sigma_0}{8} R^2 (\pi - \sqrt{3} + 1)$

$\frac{A_ц}{A_п} = \frac{1 + \frac{3}{2}\left(\frac{1}{4} - \frac{\sqrt{3}}{4}\right)}{\frac{1}{2}(\pi - \sqrt{3} + 1)}$

Часть 2

Олимпиада: **Физика, 11 класс (2 часть)**

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Вариант 5

Чистовик ⑤ Пло...

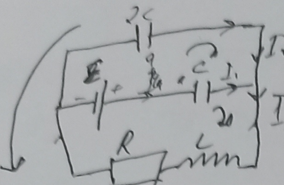
Т.

Черновик ① Вариант 11-05 $\varepsilon_s - u_2 = I_0 R$

№3

$\varepsilon + u_1 + u_2 = IR = 0.$

$\varepsilon + u_1 + \varepsilon_{is} = I_1 R \quad I_1 = I_2 + I_3$



$q = Cu$ если $C < 2C$, то

a $q = Cu$ $\quad 2C > C.$

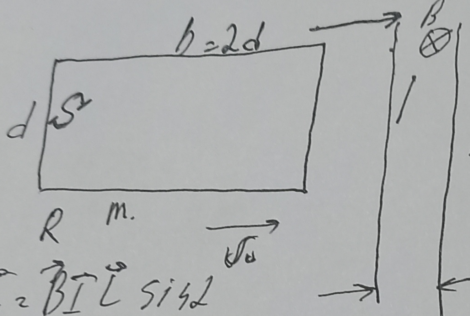
$q = 2Cu$

$\varepsilon_{is} = L \frac{dI}{dt}$

$\varepsilon = IR \quad R = \frac{\varepsilon}{I} \quad u = IR \quad R = \frac{u}{I}$

BIL

№4



$F_A = BLv_0 \sin\alpha =$

$\vec{B} L v$ $\quad S_{рамки} = d \cdot 2 \cdot d = 2d^2$

$F = qd \quad a = 0.$

$\sin\alpha = 1$

$ma = F_A$

$a = \frac{BLv_0}{m} = \boxed{\frac{Bdv_0}{m}}$

$H = \frac{d}{3}$

$\vec{F_A} = \vec{B} I \vec{L} \sin\alpha$

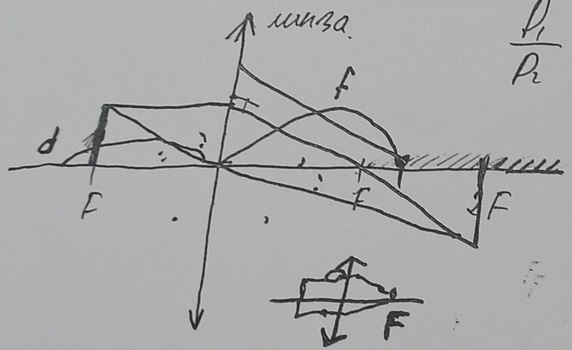
$F_A = q \vec{v} \vec{B} \sin\alpha$

$v_k = v_0 + at$

$S = v_0 t + \frac{at^2}{2}$

$h = H = \frac{d}{3}$

N.5



$\frac{D_1}{D_2} = 2 \quad \frac{\frac{1}{F_1}}{\frac{1}{F_2}} = \frac{F_2}{F_1} = 2 \Rightarrow \frac{D_1}{D_2} = \frac{F_2}{F_1} = 2$

$u = IR$

$F_{gg} = 2F_{бл}$

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

$\frac{1}{0{,}5} = 2 \quad u = \varphi_A - \varphi_B$

b =

1) с расстояния 25см, 2 диоптрия.

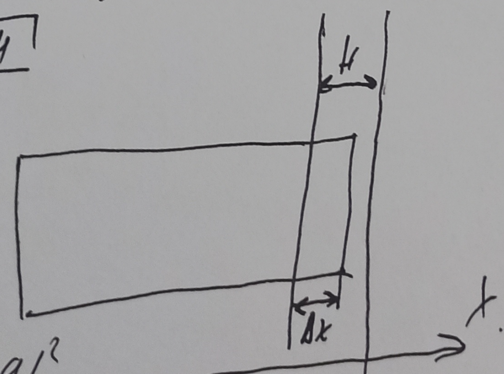
2) 2 дптр.

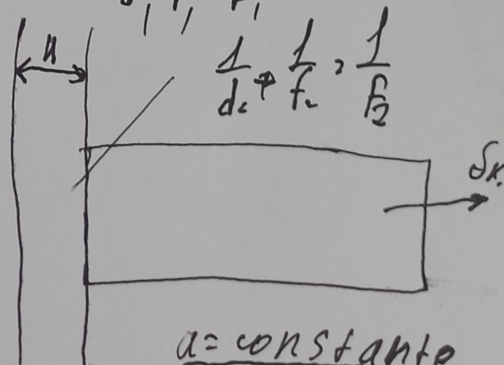
BLI = F

$v_k = \sqrt{v_0^2 - \frac{2Bdv_0 H}{m}}$

$\frac{1}{d_1} + \frac{1}{f_1} = \frac{1}{F_1}$

$\frac{1}{d_2} + \frac{1}{f_2} = \frac{1}{F_2}$





a = constante

a ≠ constante.

$H = v_0 t + \frac{at^2}{2}$

$v_k = \sqrt{v_H^2 - 2aH} = \sqrt{v_0^2 + \frac{2Bdv_0 \cdot H}{m}}$

$H = \frac{v_k^2 + v_H^2}{2a} \quad v_k^2 = 2aH + v_H^2$

...ик Вариант 11-05 (3)

№4

Дано: $m; l; S_0; R; B$

a - ?

V_1 - ?

Положен...

Чистовик (2) страница Вариант 11-05

№3.

Дано:

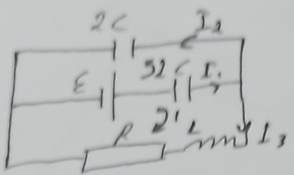
$C_1 = C$

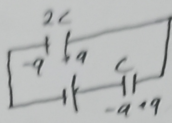
$C_2 = 2C$

$\frac{dI}{dt}$ - ?

Q - ?

I - ?





$$\varepsilon = \frac{q}{C} + \frac{q}{2C}$$

$$q\left(\frac{1}{C} + \frac{1}{2C}\right) = \varepsilon$$

$$q = \frac{2\varepsilon C}{3}$$

$$\begin{cases} I_1 = I_2 + I_3 \\ \text{контур1}: \varepsilon = \frac{q_1}{C} + L\frac{dI}{dt} + I_3 R \\ \text{контур2}: \varepsilon = \frac{q_1}{C} + \frac{q_2}{2C} \end{cases}$$

Контур 1 $(t=0)$: $q_1(0) = \frac{2\varepsilon C}{3}$

$I_3(0) = 0$

$$\varepsilon = \frac{2\varepsilon}{3} + L\frac{dI_3}{dt}\Big|_{t=0} + 0$$

$$(1)\quad \frac{dI_3}{dt}\Big|_{t=0} = \frac{\varepsilon}{3L}$$

$$\left.\begin{aligned} I_3(t\to\infty) &= 0 \\ \frac{dI}{dt}(t\to\infty) &= 0 \end{aligned}\right| \to \varepsilon = \frac{q_1(\infty)}{C} \qquad \begin{aligned} q_1(t\to\infty) &= \varepsilon C \\ q_2(t\to\infty) &= 0. \end{aligned}$$

t_0 - момент замыкания ключа.

$$E(t_0) = \frac{q_1^2(t_0)}{2C} + \frac{q_2^2(t_0)}{4C}$$

$$E(t\to\infty) = \frac{q_1^2(t\to\infty)}{2C} = \frac{\varepsilon^2 C}{2}$$

$$A_{ист} = \Delta q\cdot\varepsilon = [q_1(t\to\infty) - q_1(t_0)]\varepsilon = \left(\varepsilon C - \frac{2}{3}\varepsilon C\right)\varepsilon = \frac{\varepsilon^2 C}{3}$$

$$\text{З.С.Э.}: Q = E t_0 + A_{ист} - E(t\to\infty) = \frac{4\varepsilon^2\cdot C^2}{9\cdot 2C} + \frac{4\varepsilon^2\cdot C^2}{9\cdot 4C} + \frac{\varepsilon^2 C}{3} - \frac{\varepsilon^2 C}{2} =$$

$$\varepsilon^2 C\left(\frac{2}{9} + \frac{1}{9} + \frac{1}{3} - \frac{1}{2}\right) = \frac{\varepsilon^2 C}{6}\quad (2)$$

Чистовик ⑤ Продолжение 3

$$\frac{I_1}{L} + \frac{I_2}{2L} = 0$$

$$2I_1 = -I_2 \rightarrow I_2 = -2I_1$$

$$I_1 = \underbrace{-2I_1}_{I_2} + I_3 \Rightarrow I_3 = 3I_1$$

$$I_1 = I_0$$

$$I_3 = 3I_0$$

Ответ: $\frac{\varepsilon}{3L}$; $\frac{\varepsilon^2 C}{6}$; $3I_0$

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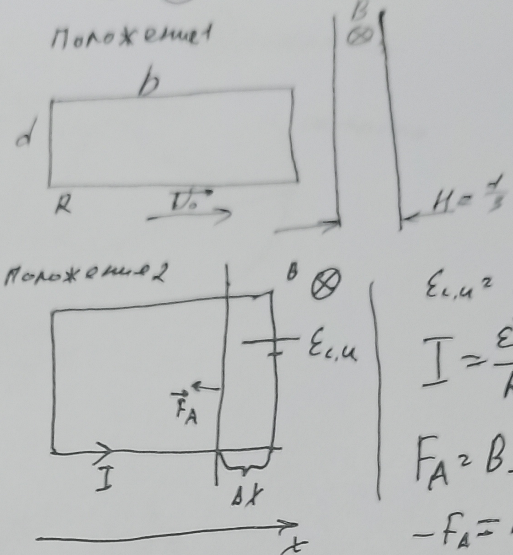
Чистовик Вариант 11-05 (3)

Дано:
$m; d; \upsilon_0; R; B$

a - ?
V_1 - ?
V_2 - ?



$\mathcal{E}_{c.u} = \frac{\Delta \Phi}{\Delta t} = \frac{B d \Delta x}{\Delta t} = B d \upsilon_0$

$I = \frac{\mathcal{E}_{c.u}}{R} = \frac{B d \upsilon_0}{R}$

$F_A = B I d = \frac{B^2 d^2 \upsilon_0}{R}$

$-F_A = ma$

$a = -\frac{F_A}{m} = -\frac{B^2 d^2 \upsilon_0}{R \cdot m}$

~~$H = \frac{\upsilon_к^2 - \upsilon_н^2}{2a}$~~

~~$2Ha + \upsilon_н^2 = \upsilon_к^2$; $\upsilon_к = \upsilon_1$; $\upsilon_н = \upsilon_0$~~

~~$\sqrt{\upsilon_0 + \frac{2\frac{d}{3} B^2 d^2 \upsilon_0}{R \cdot m}} = \upsilon_к$~~

~~$\upsilon_к = \sqrt{\upsilon_0 + \frac{2 B^2 d^3 \upsilon_0}{3 \cdot R \cdot m}}$~~

$V = -\frac{B^2 d^2}{m \cdot R} \upsilon$

$\upsilon = \upsilon_0 \cdot e^{-\frac{B^2 d^2}{mR} \cdot t}$

$x(t) = \int_0^t V_0 e^{-\frac{B^2 d^2 t}{mR}} dt =$

$-\frac{V_0 mR}{B^2 d^2} \cdot e^{-\frac{B^2 d^2}{mR} t} \Big|_0^t =$

$= \frac{V_0 mR}{B^2 d^2} \left(1 - e^{-\frac{B^2 d^2}{mR} t}\right)$

$$\begin{cases} \frac{d}{3} = \frac{\upsilon_0 mR}{B^2 d^2}\left(1 - e^{-\frac{B^2 d^2}{mR} t}\right) \\ V_1 = V_0 e^{-\frac{B^2 d^2}{mR} t} \end{cases}$$

$\frac{d}{3} = \frac{V_0 mR}{B^2 d^2}\left(1 - \frac{V_1}{V_0}\right)$

$1 - \frac{V_1}{V_0} = \frac{d^3 B^2}{3 V_0 mR} \rightarrow V_1 = V_0 \left(1 - \frac{d^3 B^2}{3 V_0 mR}\right)$

$\frac{V_2}{V_1} = \frac{\upsilon_1}{\upsilon_0}$.

Ответ: $-\frac{B^2 d \upsilon_0}{R \cdot m}$; $\upsilon_0 \left(1 - \frac{d^3 B^2}{3 \upsilon_0 mR}\right)$..

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Чистовик Вариант 11-05. (4)

№ 5

$b = 25$ см

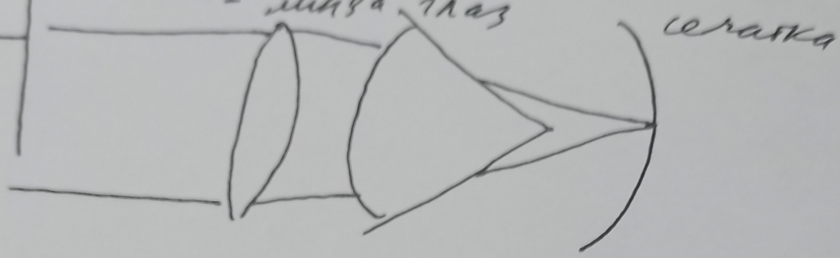
$\frac{D_2}{D_1} = 2$

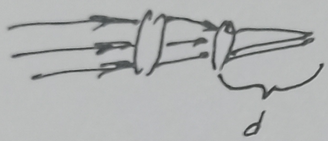
$x - ?$ $D_2 - ?$

$D - ?$

Решение.

Очки 1





Очки 2