

# Часть 1

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

Шифр: **21200125**

ID профиля: **382384**

Вариант 8

Dano:  $(S \perp)$

Теменине

Чистобук

$(m), (m)$

$$\cos \alpha = \frac{3}{5}$$

$$\cos \beta = \frac{5}{13}$$

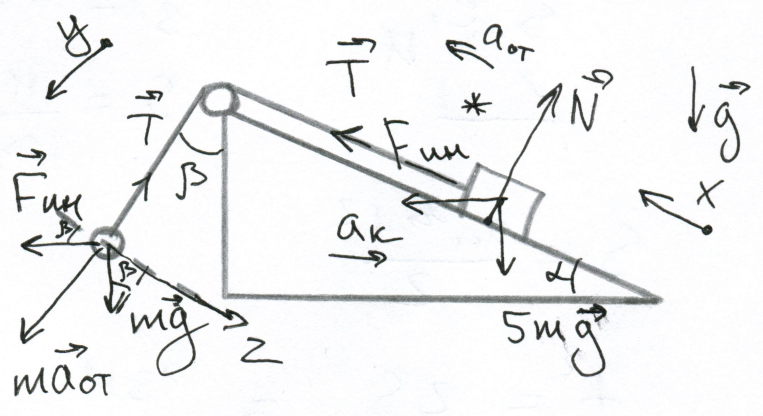
$(M)$

$a_k - ?$

$a_{от} - ?$

$t - ?$

1)



1.  $2 \text{ЗМ}$  на ось  $z$ : (где маятника)

$$F_{un} \cdot \cos \beta = mg \cdot \sin \beta$$

$$F_{un} = m \cdot a_k \Rightarrow$$

$$\cos \beta \cdot m a_k = mg \cdot \sin \beta$$

$$a_k = g \cdot \operatorname{tg} \beta$$

2.  $\cos \beta = \frac{5}{13}$

$$\sin \beta = \sqrt{1 - \left(\frac{5}{13}\right)^2} = \frac{12}{13} \Rightarrow \operatorname{tg} \beta = \frac{12}{5}$$

3.  $a_k = \frac{12}{13} g = \frac{12}{5} \cdot g = 2,4g$

Омбер:  $\{a_k = 2,4g\}$

2)  $2 \text{ЗМ}$  на ось  $x$ : (где груза)

(1)  $5m a_{от} = T + 5m a_k \cdot \sin \alpha \cos \alpha - 5mg \cdot \sin \alpha$

$2 \text{ЗМ}$  на ось  $y$ : (где маятника)

(2)  $m a_{от} = m a_k \cdot \sin \beta + mg \cos \beta - T$

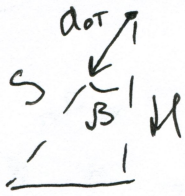
(1)+(2)  $6m a_{от} = m a_k \cdot \sin \beta + mg \cos \beta + 5m a_k \cos \alpha - 5mg \sin \alpha$

$6 a_{от} = a_k \cdot \sin \beta + g \cos \beta + 5 a_k \cos \alpha - 5g \sin \alpha$

$(a_{от} = \frac{5,8}{6} g \approx 1g \approx g)$

(1 стр.)

3)



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

$$S = \frac{H}{\cos \beta} = \frac{13H}{5}$$

$$S = \frac{a_{0T} t^2}{2}$$

$$t^2 = \frac{2S}{a_{0T}} = \frac{13H}{5g}$$

$$t = \sqrt{\frac{13H}{5g}}$$

устовик

$\Delta_2$

Задача

Дано:

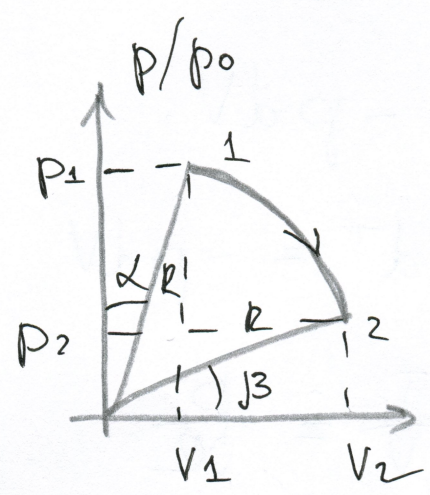
$$\alpha = 22,5^\circ$$

$$\beta = 15^\circ$$

$p_0, V_0$

$$C_v = \frac{5}{2} R$$

$$\alpha = \frac{T_1 - T_2}{T_2} \quad ?$$



$p_1, p_2, V_1, V_2$  -  
некоторые  
числа, но  
не обязательно  
или обратил

$$1) \begin{cases} p_1 = R \cdot \cos \alpha \\ V_1 = R \cdot \sin \alpha \end{cases} \quad \begin{cases} p_2 = R \cdot \sin \beta \\ V_2 = R \cdot \cos \beta \end{cases}$$

$$2) \text{ 1 точка: } p_1 \cdot p_0 \cdot V_1 \cdot V_0 = \gamma R T_1$$

$$\text{ 2 точка: } p_2 \cdot V_2 \cdot p_0 \cdot V_0 = \gamma R T_2$$

$$T_1 = \frac{p_1 V_1 \cdot p_0 V_0}{\gamma R} \quad ; \quad T_2 = \frac{p_2 V_2 \cdot p_0 V_0}{\gamma R}$$

$$\alpha = \frac{T_1 - T_2}{T_2} = \frac{\frac{p_1 V_1 p_0 V_0}{\gamma R} - \frac{p_2 V_2 p_0 V_0}{\gamma R}}{\frac{p_2 V_2 p_0 V_0}{\gamma R}} =$$

$$= \frac{p_1 V_1}{p_2 V_2} - 1 = \frac{R \cdot \cos \alpha \cdot R \cdot \sin \alpha}{R \cdot \sin \beta \cdot R \cdot \cos \beta} - 1 =$$

$$= \frac{2 \cdot \cos \alpha \cdot \sin \alpha}{2 \cdot \cos \beta \cdot \sin \beta} - 1 = \frac{\sin 2\alpha}{\sin 2\beta} - 1 = \frac{\frac{\sqrt{2}}{2}}{\frac{1}{2}} - 1 =$$

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$$\alpha = \sqrt{2} - 1$$

{ 3 стр }

Условие

$$3) 1. c \gg dT = dU + p dV \quad (1 \text{ закон сохранения энергии})$$

$$c = 0$$

$$dU = -p dV$$

$$\frac{5}{2} \nu R dT = -p dV$$

$$-\frac{5}{2} \frac{dT}{dV} = \frac{p}{\nu R}$$

$$-\frac{5}{2} \frac{dT}{dV} = \frac{T}{V}$$

$$-\frac{5}{2} \frac{dT}{T} = \frac{dV}{V}$$

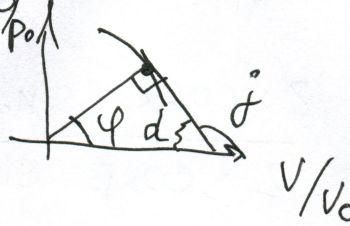
$$2. \frac{dT}{T} = \frac{dV}{V} + \frac{dp}{p} \quad (\text{Барометрическое уравнение})$$

$$-\frac{2}{5} \frac{dV}{V} - \frac{dV}{V} = \frac{dp}{p}$$

$$-\frac{7}{5} \frac{dV}{V} = \frac{dp}{p}$$

$$\frac{dp}{dV} = -\frac{7}{5} \frac{p}{V} = -\frac{7}{5} \frac{p_0}{V_0} \frac{p^*}{p_0} \frac{V_0^*}{V^*}$$

$$\text{tg } j = -\frac{7}{5} \text{tg } \varphi \frac{p_0}{V_0} \text{tg } \varphi$$



$$d = 180 - j$$

$$\text{tg } d = \frac{7}{5} \text{tg } \varphi \frac{p_0}{V_0}$$

4 стр

$$\varphi = 90 - d \Rightarrow d = 90 - \varphi$$

$$\operatorname{tg}(90 - \varphi) = \frac{4}{5} \operatorname{tg} \varphi \frac{\rho_0}{V_0}$$

$$\operatorname{ctg} \varphi = \frac{4}{5} \operatorname{tg} \varphi \frac{\rho_0}{V_0}$$

$$\frac{1}{\operatorname{tg} \varphi} = \frac{4}{5} \operatorname{tg} \varphi \frac{\rho_0}{V_0}$$

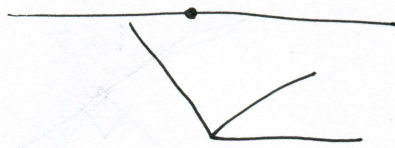
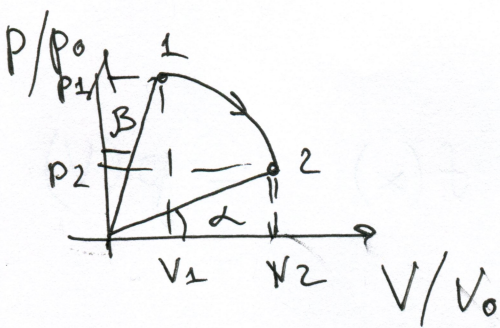
$$\operatorname{tg}^2 \varphi = \frac{5}{4} \frac{V_0}{\rho_0}$$

$$\operatorname{tg} \varphi = \sqrt{\frac{5}{4} \cdot \frac{V_0}{\rho_0}}$$

$$4) \quad \eta = \frac{A_2}{Q_u}$$

Условие

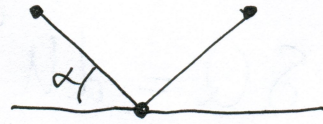
5 стр



$$C_v = \frac{5}{2} R$$

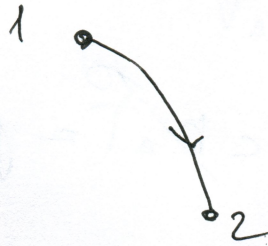
$$Q = 0$$

$$\frac{T_1 - T_2}{T_2}$$



$$25 - 169$$

$$144$$



$$\frac{R}{\cos \beta} =$$

$$R \cdot \cos \beta = p_1$$

$$p_2 = R \cdot \sin \alpha$$

$$p_1 V_1 = \nu R T_1$$

$$p_2 V_2 = \nu R T_2$$

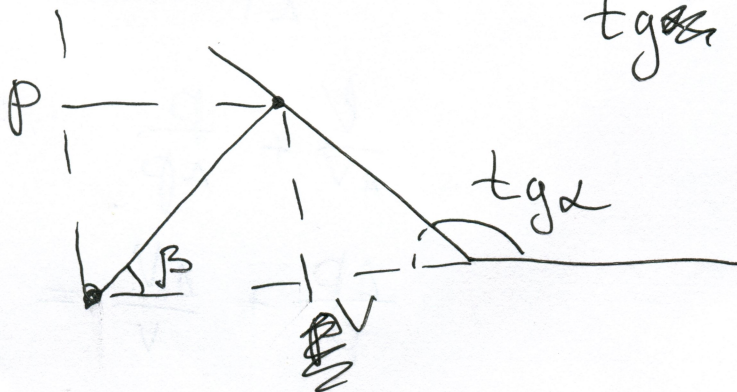
$$\frac{p_1 V_1 - p_2 V_2}{\nu R}$$

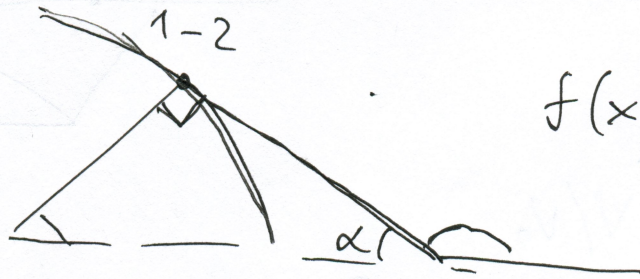
$$\frac{p_1 V_1}{p_2 V_2} - 1$$

$$\frac{\frac{p_1 V_1 - p_2 V_2}{\nu R}}{\frac{p_2 V_2}{\nu R}}$$

$$\frac{p_1}{p_2} \text{tg} \alpha$$

$$\text{tg} \alpha$$





$$f(x) = p(V)$$

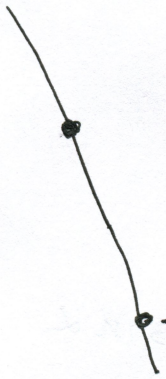
A

$$\delta Q = dU + p \Delta V = c R \Delta T = p \Delta V + \Delta U$$

$$\Delta U = -p \Delta V$$

$$\Delta U = p \Delta V$$

$$c R \Delta T = p \Delta V + \Delta V p + \frac{5}{2} R \Delta T$$



$$-p \Delta V = \frac{5}{2} R \Delta T$$

$$\frac{V}{\Delta V} = 3$$

$$-\frac{p}{R} = \frac{5}{2} \frac{\Delta T}{\Delta V}$$

$$-\frac{T}{V} = \frac{5}{2} \frac{\Delta T}{\Delta V}$$

$$\frac{\Delta p}{\Delta V}$$

$$\frac{p}{R} = \frac{T}{V}$$

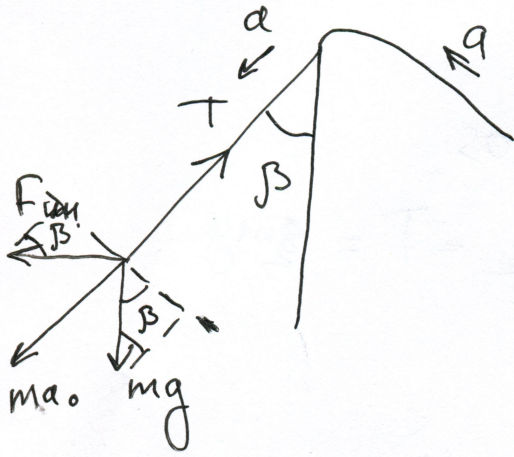
$$\operatorname{tg} \alpha = -\frac{p}{V}$$

$$\frac{T}{\Delta T} = -\frac{5}{2} \frac{\Delta V}{\Delta V}$$

$$\frac{V}{\Delta V} + \frac{p}{\Delta p}$$

$$\frac{\Delta p}{p} + \frac{\Delta V}{V} = \frac{\Delta T}{T}$$





$$g \left( 2,4 \cdot \frac{12}{13} + \frac{5}{13} + \right.$$

90

$$180 - \beta$$

$$90 - \beta$$

$$+ 3 \cdot 2,4 - 4$$

$$p \frac{\alpha p}{\alpha v}$$

$$\frac{p_0}{v_0}$$

$$\frac{16g - 25}{16g}$$

$$\frac{p}{p_0}$$

$$\frac{v}{v_0}$$

$F_u$

$mg$

$$\frac{\alpha p_0}{\alpha v_0}$$



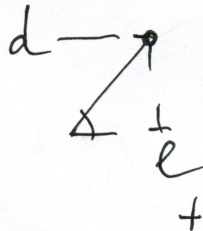
28,8

2,4 \cdot 3

$$2,4g \cdot \frac{12}{13} + g \cdot \frac{5}{13} + 12g \cdot \frac{3}{5} - 8g \cdot \frac{4}{5}$$

$7,2g - 4g$

$3,2g$



$$\frac{24}{12} \times \frac{12}{48} = \frac{24}{288} = \frac{1}{12}$$

$5g \cdot 4$

$3g$

~~$20g$~~

3ax

2,4g

$$2,4g \cdot \frac{12}{13} +$$

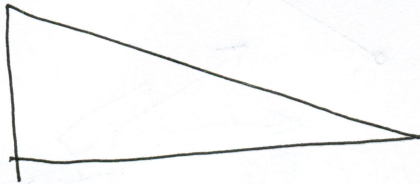
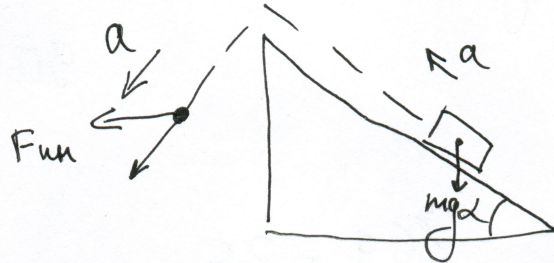
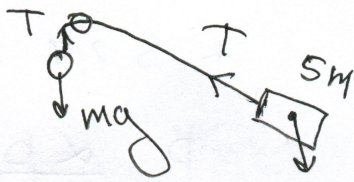
$$+ 3 \cdot 2,4g - 5g \cdot 4$$

3 \cdot 1,4g

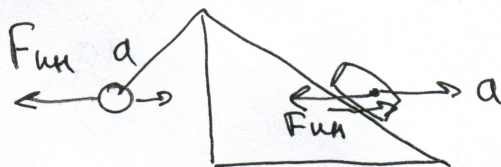


cos

$$5mg \sin \alpha = T = \frac{2}{3}mg$$



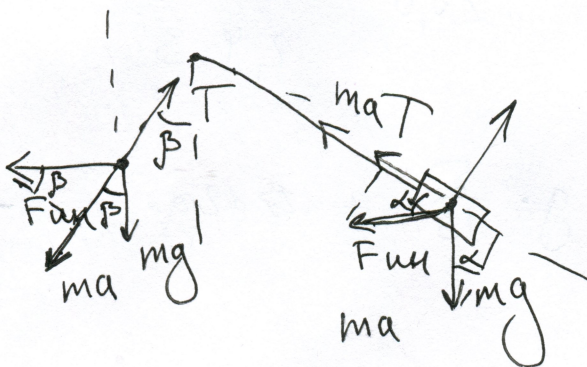
$$2,4g \cdot \frac{12}{13} + g \cdot \frac{5}{13}$$



$$7,2 - 4g$$

$$\vec{F} = m(\vec{a}_{\text{отн}} + \vec{a}_{\text{неп}})$$

$$7,2g - 4g$$



41,6

T

$$2,4 \cdot 12 + 5$$

$$ma_0 = m a_{\text{отн}} \cdot \sin \beta + mg \cdot \cos \beta$$

$$5m a_0 = T + 5 m a_{\text{отн}}$$

$$\frac{77,8}{13}$$

$$2,4g \cdot \frac{12}{13} + g$$

36,2

# Часть 2

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

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Вариант 8

53)

Дано:

$C_1 = C$

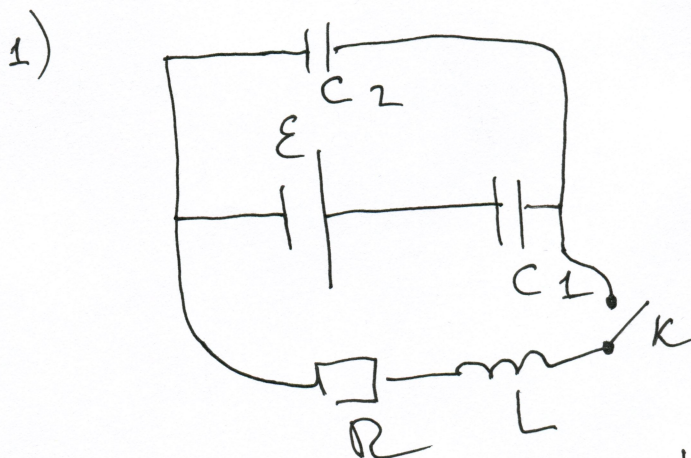
$C_2 = 5C$

1)  $I' - ?$

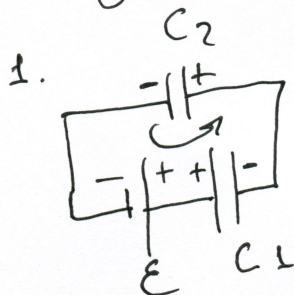
2)  $Q - ?$

3)  $U$ ,  $U_{C2}$  ~~и~~  $U_{C1}$  ~~и~~  $I_0$  ~~и~~  $I_{C2} - ?$

Решение:



1) Конфигурация "К разомкнута"



$I$  по Кирхгофа

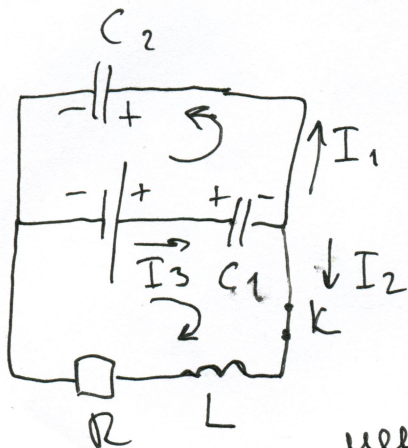
$\epsilon - U_{C2} - U_{C1} = 0$

$\epsilon = U_{C2} + U_{C1}$

2. ЗСЗ:  $0 = U_{C2} \cdot C_2 - U_{C1} \cdot C_1 \Leftrightarrow 5U_{C2} = U_{C1}$

$\epsilon = 6U_{C2} \Rightarrow U_{C2} = \frac{\epsilon}{6}; U_{C1} = \frac{5\epsilon}{6}$

2) Конфигурация "К замкнута"



$$\begin{cases} I_1 + I_2 = I_3 \\ \epsilon = U_{C2} + U_{C1} \\ \epsilon - U_{C1} = U_L + I_2 R \end{cases}$$

сразу после:  $U_{C2}$  и  $U_{C1}$  не

~~меняются скачком~~  $\Rightarrow U_{C2} = \frac{\epsilon}{6}; U_{C1} = \frac{5\epsilon}{6}$

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сразу после:  $I_L = I_2 = 0$

$$I_1 = I_3$$

$U_{C1}$  - не увеличивается скачком  $\Rightarrow U_{C2}$  тоже не  
повышается

$$\mathcal{E} - U_{C1} = U_L$$

$$\mathcal{E} - \frac{5\mathcal{E}}{6} = LI'$$

$$\frac{\mathcal{E}}{6} = LI'$$

$$I' = \frac{\mathcal{E}}{6L}$$

3) Состояние: вет. разрыв.  $\Rightarrow I_1 = I_3 = 0$ ;

$$U_L = 0.$$

$$I_2 = 0$$

$$U_{C1} = \mathcal{E}$$

$$U_{C2} = 0$$

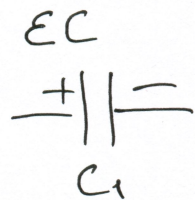
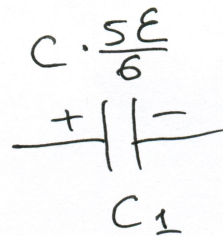
4) ЗУЭ:  $A_{\text{ист}} = \Delta W + Q$

$$Q = A_{\text{ист}} - \Delta W$$

$$A_{\text{ист}} = \frac{C\mathcal{E}}{6} \cdot \mathcal{E} = \frac{C\mathcal{E}^2}{6}$$

$$\Delta W = - \left( \frac{5C \cdot \mathcal{E}^2}{72} + \frac{C \cdot 25\mathcal{E}^2}{72} - \frac{C\mathcal{E}^2}{2} \right) =$$
$$= \frac{36C\mathcal{E}^2 - 30C\mathcal{E}^2}{72} = \frac{\mathcal{E}^2 C}{12} = \frac{C\mathcal{E}^2}{12}$$

$$Q = \frac{2C\mathcal{E}^2}{12} - \frac{C\mathcal{E}^2}{12} = \frac{C\mathcal{E}^2}{12}$$



5) состояние  $I_1 = I_0$ :

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$$I_2 + I_0 = I_3$$

2 стр

сечение

3 стр

$$\mathcal{E} - U_{C1} = U_L + I_2 R$$

$$U_{C2} = U_L + I_2 R - U_R$$

$$U_R = U_{C2} - U_L$$

$$U_R = \frac{q_2}{C_2} - L \frac{\Delta I_2}{\Delta t}$$

$$U_R = \frac{I_1 \Delta t}{C_2} - L \frac{\Delta I_2}{\Delta t}$$

$$I_2 R = \frac{I_1 \Delta t}{C_2} - L \frac{\Delta I_2}{\Delta t}$$

$$\mathcal{E} = \frac{q_1}{C_2} + \frac{q_2}{C_1}$$

$$C_2 C_1 \mathcal{E} = q_1 C_1 + q_2 C_2$$

№4

«металлик»

Решение

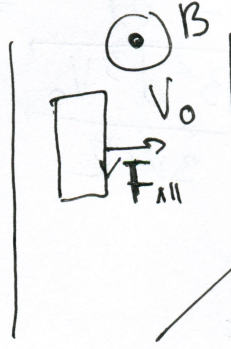
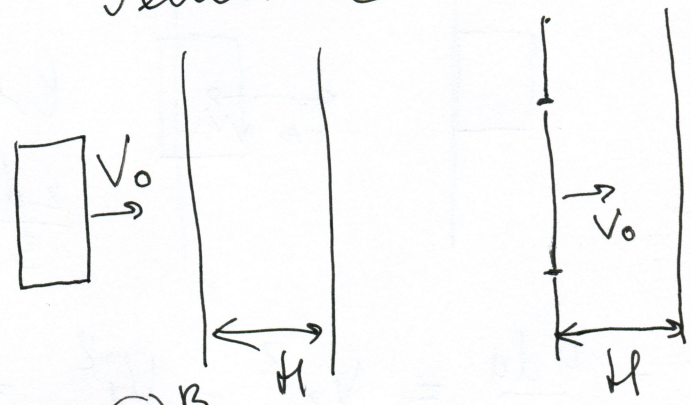
Дано:

(m), (d), (b)

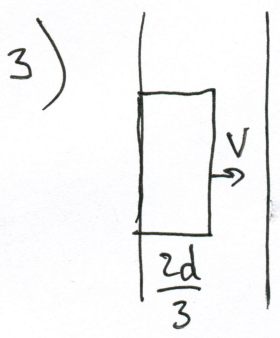
(R), (V<sub>0</sub>), H = 3d

$$b = \frac{2d}{3}$$

- 1) a - ?
- 2) V<sub>1</sub> - ?
- 3) V<sub>2</sub> - ?



~~F\_{AII} = 0~~  
 По направлению левой руки определяем что составляющая сос. Сила Лоренца по направлению левой руки направлена вниз => I будет мерь нуля же



$$\frac{2d}{3} = \frac{V_1^2 - V_0^2}{-2 \cdot a}$$

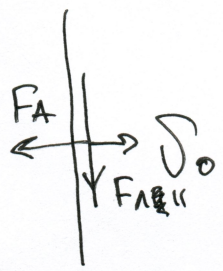
$$-\frac{4da}{3} = V_1^2 - V_0^2$$

$$V_1^2 = V_0^2 - \frac{4da}{3}$$

$$V_1 = \sqrt{V_0^2 - \frac{4B^2 d^3 V_0}{3mR}}$$

ускорение, когда рамка замкнута по цепи будет означивать из-за того, что появится еще E<sub>i</sub>

1)



2)

По направлению левой руки сила Ампера F<sub>A</sub> действует влево и равна:

$$F_A = BI \cdot d$$

$$F_A = ma \Rightarrow a = \frac{F_A}{m}$$

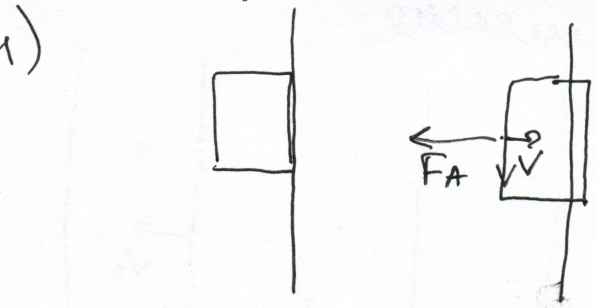
$$E_i = BV_0 d$$

$$I = \frac{E_i}{R} \Rightarrow a = \frac{B}{I} = \frac{BV_0 d}{R}$$

$$F_A = \frac{B^2 V_0 d^2}{R}$$

$$a = \frac{B^2 d^2 V_0}{mR}$$

которая компенсирует 1. (числовик)  
 $\Rightarrow$  рамка будет двигаться равномерно.



Из пункта 1 и 2 делаем вывод, что  $a = \frac{B^2 d^2 V_0}{mR}$

$$\frac{2d}{3} = \frac{V_2^2 - V_1^2}{-2a}$$

$$-\frac{4da}{3} = V_2^2 - V_1^2 \Rightarrow V_2 = \sqrt{V_1^2 - \frac{4da}{3}}$$

$$V_2 = \sqrt{V_0^2 - \frac{8 B^2 d^3 V_0}{3mR}}$$

5 стр



$$E - U_{C1} = U_L$$

$$3C3: 0 = U_{C2} \cdot C_2 \quad \cancel{U_{C1} \cdot C_1}$$

$$5 U_{C2} = U_{C1}$$

$$E = U_{C2} + U_{C1}$$

$$\frac{30}{72} CE^2 = W_H$$

$$q' = I$$

I<sub>0</sub>

$$U_{C2} = U_L +$$

$$q = C_2 U_{C2}$$

$$U_{C2} = U_L + I_2 R$$

$$\frac{q}{C_2} = L \frac{\Delta I}{\Delta t} + I_2 R$$

$$\frac{q \Delta t}{C_2} = L \Delta I + q_2 R$$

$$\frac{I \Delta t^2}{C_2} = L \Delta I + q_2 R$$

$$\mu/c^2 \cdot u$$

$$I_0 = I_3 - I_2$$

$$\mathcal{E} = U_{c1} + U_{c2}$$

$$U_{c2} = U_L + I_2 R$$

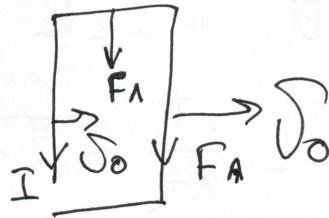
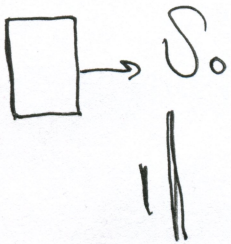
$$U_{c2} - U_L = U$$

$$U$$
  

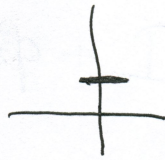
$$U \quad I \quad dt$$
  

$$U \quad dq$$

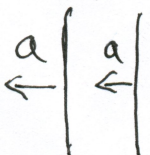
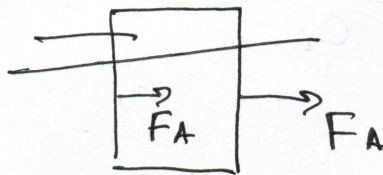
$$\frac{LI_2^2}{2} +$$



генератор Ампера  
со стержнем



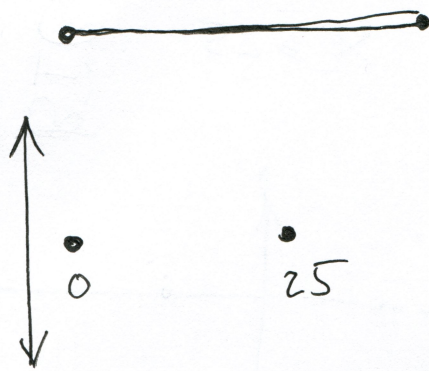
$$\frac{V^2}{2d} = \frac{V_0^2}{2d}$$



$$\frac{zd}{3}$$

$$\frac{zd}{3} = V_0$$

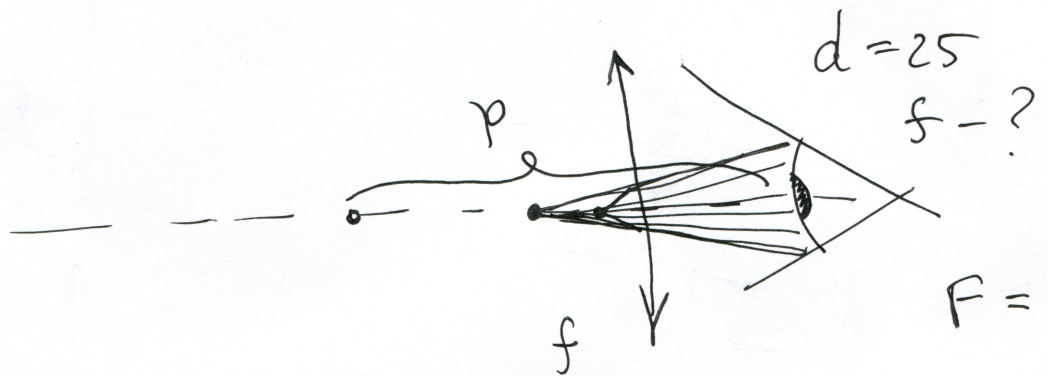
$$I_1 = I_3$$



$$\frac{1}{F} + \frac{1}{d}$$

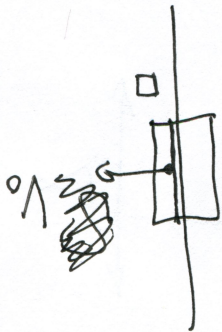
$$\frac{1}{F} = \frac{1}{d} + \frac{1}{f}$$

$$\frac{1}{F} + \frac{1}{d} + \frac{1}{f}$$

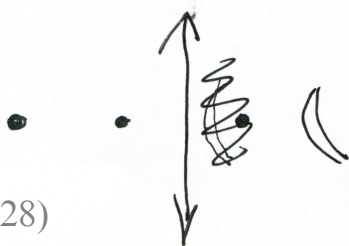
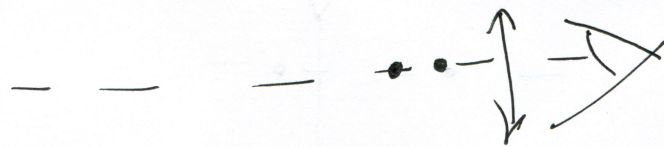


$$s_2 = p$$

$$s_2 = s = \frac{p}{F}$$

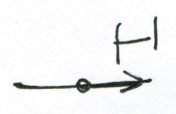
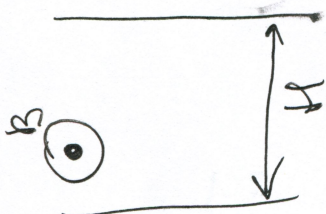


...



$$= \frac{F_2}{F_1}$$

ms7



BOT

$5F_1$

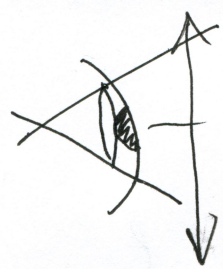
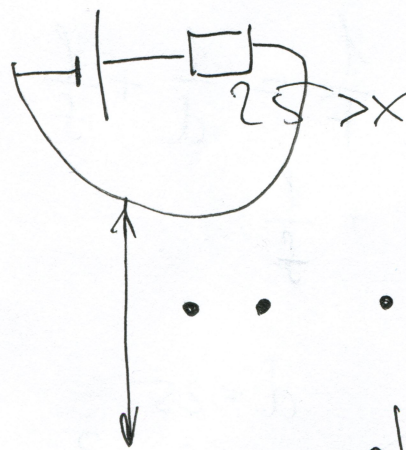
$F_{N11} = BOT$

$\frac{F_N \cdot \Delta S}{F_N \cdot \Delta S}$

$F_N \cdot \Delta S$

BOL

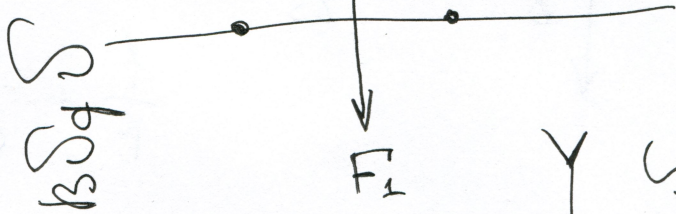
$\epsilon = BOL$



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

$x \geq 25$

BIL



BOS

$\frac{S \cdot \Delta S}{\phi}$

