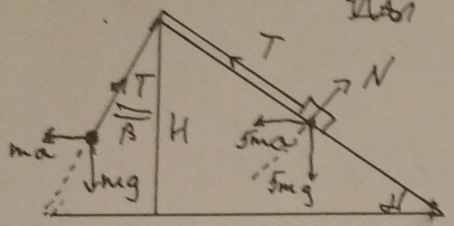
Часть 1

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

Шифр: **21202737**

ID профиля: **96704**

Вариант 8



Черновик

2-й закон Ньютона:

$$\begin{cases} ma' = mg\cos\beta + ma\sin\beta - T \\ 5ma' = T + 5ma\cos\alpha - 5mg\sin\alpha \end{cases}$$

$6ma' = mg(\cos\beta - 5\sin\alpha) + ma(\sin\beta + 5\cos\alpha)$

$a' = \dfrac{g(\cos\beta - 5\sin\alpha) + a(\sin\beta + 5\cos\alpha)}{6}$

$\cos\beta = \frac{5}{13} \Rightarrow \sin\beta = \frac{12}{13}$

$\cos\alpha = \frac{3}{5} \Rightarrow \sin\alpha = \frac{4}{5}$

$a' = \dfrac{g(4 - \frac{5}{13}) + a(3 + \frac{12}{13})}{6} = \dfrac{5g + 12a + 13\cdot 3a - 13\cdot 4g}{6\cdot 13}$

$\dfrac{51a - 47g}{78} = a'$

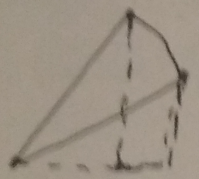
Чорновик

$C_V = \frac{i}{2} R \Delta T = \frac{5}{2} \nu R \Delta T$

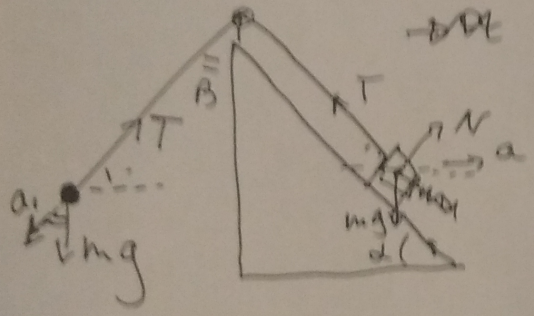
$C_p = \nu \Delta T = \frac{7}{2} \nu R \Delta T$

$C = 0 \Rightarrow Q = 0$ ⇒ $A = \Delta U = \frac{5}{2} \nu R \Delta T$

$A = \nu R \Delta T$



$\eta = \frac{Q_+ - Q_-}{Q_+} =$

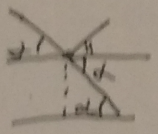


$mg\cos\beta - T' = ma_1$

$T\sin\beta = ma$

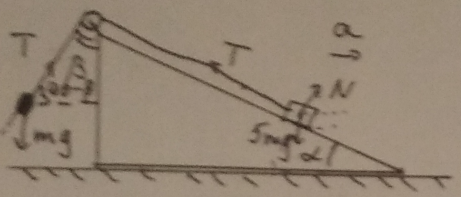
$N = mg\sin\alpha$

$T\cos\alpha - N\sin\alpha = mg\cos\alpha = ma_1$



Вариант 11-08 Чистовик (1)

№1



$\cos\beta = \frac{5}{13} \Rightarrow \sin\beta = \frac{12}{13}$

$\cos\alpha = \frac{3}{5} \Rightarrow \sin\alpha = \frac{4}{5}$

a_1 - ускорение вдоль нити

2ой 3-н Ньютона для шарика:

$mg - T\cos\beta = ma_1$

$ma = T\sin\beta$

2ой 3-н Ньютона для бруска

$5mg\cos\alpha = N$

$5ma = T - 5mg\sin\alpha$

$5m(a - a_1) = N\sin\alpha - T\cos\alpha$

2ой 3-н Ньютона для шарика:

$T\cos\beta = mg$

$T\sin\beta = ma$

$\Rightarrow \frac{a}{g} = tg\alpha = \frac{\sin\beta}{\cos\beta} = \frac{12}{5} \Rightarrow 2,4g = a \Rightarrow a = 24 м/с^2$

$T = \frac{mg}{\cos\beta}$

2ой 3-н Ньютона для бруска

$5mg\cos\alpha = N\cos\alpha + T\sin\alpha \Rightarrow 5mg = N\cos\alpha + mg\frac{\sin\alpha}{\cos\beta}$

$5ma' = N\sin\alpha - T\cos\alpha \qquad 5ma' = N\sin\alpha - mg\frac{\cos\alpha}{\cos\beta}$

$tg\alpha = \frac{m(5a' + g\frac{\cos\alpha}{\cos\beta})}{mg(5 - \frac{\sin^2\alpha}{\cos\beta})} \Rightarrow 5a' + g\frac{\cos\alpha}{\cos\beta} = 5g\frac{\sin\alpha}{\cos\alpha} - g\frac{\sin^2\alpha}{\cos\alpha\cdot\cos\beta}$

$a' = \frac{g}{5}\left(5\frac{\sin\alpha}{\cos\alpha} - \frac{\sin^2\alpha}{\cos\alpha\cdot\cos\beta} - \frac{\cos\alpha}{\cos\beta}\right) = \frac{g}{5}\left(\frac{20}{3} - \frac{4}{3}\cdot\frac{4}{5}\cdot\frac{13}{5} - \frac{3}{5}\cdot\frac{13}{5}\right)$

$a' = \frac{g}{5}\left(\frac{500}{75} - \frac{208}{75} - \frac{117}{75}\right) = \frac{g}{5}\cdot\frac{175}{75} = 0,47g \Rightarrow a' = 4,7 м/с^2$

$a - a' = 19,3 м/с^2$

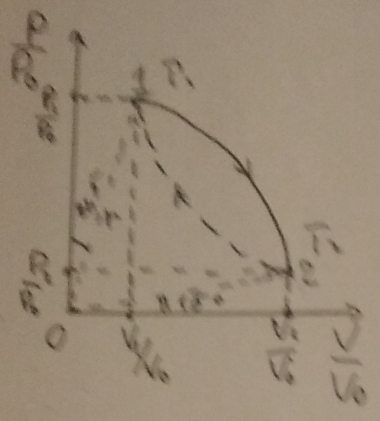
$S = H/\cos\beta \qquad \frac{(a-a')t^2}{2} = S \Rightarrow t = \sqrt{\frac{2S}{a-a'}} \approx \sqrt{\frac{2H\cdot 5}{19,3g\cdot 13}} = \sqrt{\frac{10H}{250g}}$

$t \approx \frac{1}{5}\sqrt{\frac{H}{g}}$

Ответ: 1) $a = 2,4g$; 2) $a_{отн} = 19,3g$ 3) $t \approx \frac{1}{5}\sqrt{\frac{H}{g}}$

Вариант 11-08 Ильговец ⑥

№2



$\frac{R}{R_0} : \frac{V_1}{V_0} = tg22,5$ $\frac{R}{R_0 r} = \sin 67,5^\circ$ $\frac{V_0}{V_0 r} \cdot \sin 22,5$

$\frac{V_0}{V_2} : \frac{R_0}{R} = tg15$ $\frac{R_0}{R_0 r} = \sin 15$ $\frac{V_2}{V_0 r} = \sin 75^\circ$

$\frac{V_0}{V_0 r} = \cos \sin 67,5$

уравнение Менделеева-Клапейрона:

$P_1 V_1 = \nu R T_1 = P_0 r \cdot \sin 22,5 \cdot V_0 \cdot r \cdot \sin 67,5$

$P_2 V_2 = \nu R T_2 = P_0 r \cdot \sin 15 \cdot V_0 \cdot r \cdot \sin 75$

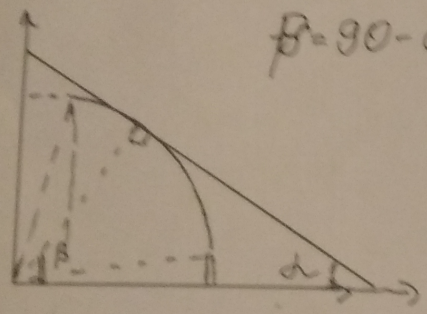
$T_1 - T_2 = \frac{P_0 V_0 r^2}{\nu R} (\sin 22,5 \cdot \sin 67,5 - \sin 15 \cdot \sin 75)$

$T_2 = \frac{P_0 V_0 r^2}{\nu R} \sin 15 \cdot \sin 75$

1) $\frac{T_1 - T_2}{T_2} = \frac{\sin 22,5 \cdot \sin 67,5 - \sin 15 \cdot \sin 75}{\sin 15 \cdot \sin 75}$

2) $C = 0 \Rightarrow Q = 0 = A + \Delta U \Rightarrow A = \frac{5}{2} \nu R (T_1 - T_2) \Rightarrow tg\alpha = \frac{5}{2}$

$\beta = 90 - \alpha \Rightarrow tg\beta = \frac{2}{5}$



3) $\eta = \frac{Q_+ - Q_-}{Q_+} =$

Ответ: 1) $\frac{T_1 - T_2}{T_2} = \frac{\sin 22,5 \cdot \sin 67,5 - \sin 15 \cdot \sin 75}{\sin 15 \cdot \sin 75}$

2) $tg\beta = \frac{2}{5}$ 3) $\eta = \frac{Q_+ - Q_-}{Q_+} =$

Часть 2

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

Шифр: **21202737**

ID профиля: **96704**

Вариант 8

$a = \frac{B^2 l^2 v}{mR}$

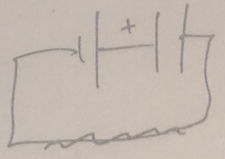
интегрируем

$v = v + a dt = v + \frac{B^2 l^2}{mR} dt$

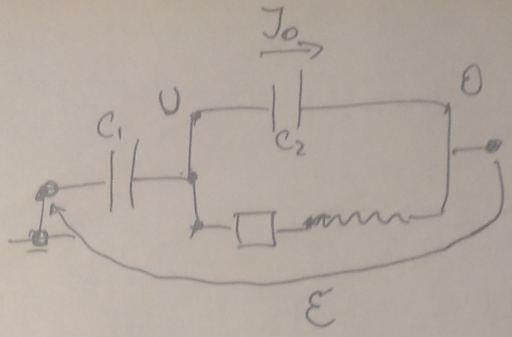
$f(v) \quad a(v) = \frac{dv}{dt}$

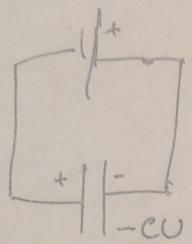
$v(a) = a dt$

Черновик



$A_\varepsilon =$





$A = 2CU \cdot \varepsilon$

$\frac{dC_2U}{dt} = J_0$

$dt = \frac{C_2U}{J_0}$

$J_0 = C_2 \frac{dU}{dt}$; $dU = \frac{J_0 dt}{C_2}$

$\frac{C_1(\varepsilon - U)}{dt} = J_0 + J$

$J_R = J_L =$

$U - U_R = L \frac{dJ}{dt}$

$U = L\frac{dJ}{dt} - U_R \quad dt$

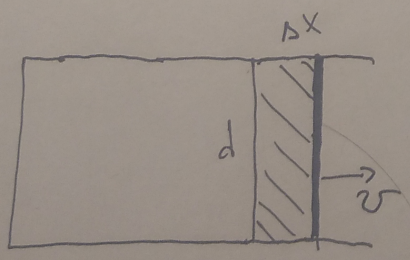
$U_R = U - L\frac{dJ}{dt}$

$dU = \varepsilon - \frac{dt(J_0+J)}{C_1}$

$C_2 U_R + \frac{J}{J_0} C_2 U = C_1 \varepsilon - C_1 U$

$\frac{J_0 dt}{C_2} = \frac{J_0 \varepsilon}{C_1} - \frac{J_0 dt}{C_1} - \frac{J dt}{C_1}$

$L \frac{dJ(J_0+J)}{C_2 U_R}$



$\varepsilon = \frac{B dS}{dt}$ $\quad dS = dx \cdot d$

$J = \frac{B dS}{dt R} = \frac{B dx \cdot d \cdot \upsilon}{dt \cdot R}$

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

$ma = F$

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

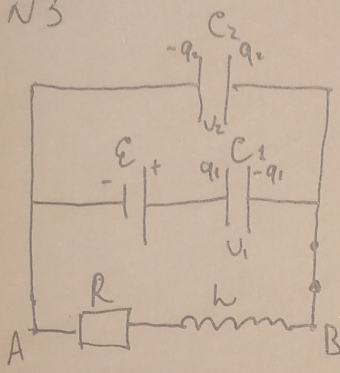
$\upsilon = a \cdot dt = \frac{B^2 d^2 dt}{mR}$ $\quad F_A = \frac{B^4 d^4 \cdot dt}{mR^2} = B^4 d^4$

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

$dt = \frac{dx}{d\upsilon}$

Чистовик Вариант 11-08 ①

№3



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

$q_2 = q_1$; $\Rightarrow \frac{q}{C} + \frac{q}{5C} = \mathcal{E} \Rightarrow 6q = 5C\mathcal{E}$

$q = \frac{5}{6}C\mathcal{E}$. $\Rightarrow U_1 = \frac{q}{C_1} = \frac{5\mathcal{E}}{6}$; $U_2 = \frac{q}{C_2} = \frac{\mathcal{E}}{6}$

ключ замкнули: в момент времени $t=0$ ток через катушку равен 0. $J_L = 0 = J_R \Rightarrow$ через резистор ток не течёт

$L\frac{dJ}{dt} = U_L = U_2 = \frac{\mathcal{E}}{6}$. Установившийся режим: $J_R = 0 = J_L$

$\Rightarrow U_{AB} = 0 \Rightarrow U_2' = 0$; $U_1' = \mathcal{E}$

$W_0 = \frac{CU_1^2}{2} + \frac{CU_2^2}{2}$; $W_1 = \frac{CU_1'^2}{2}$; $\frac{LJ^2}{2} = 0$

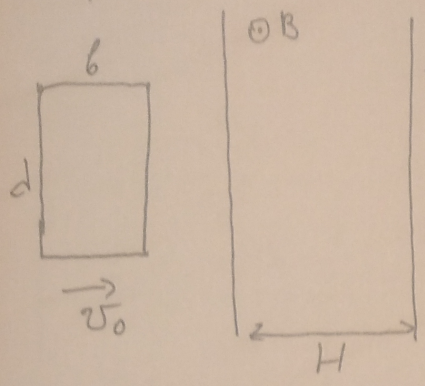
$A_\mathcal{E} = \left(\mathcal{E}_1 \cdot \frac{5}{6}\mathcal{E} - C_2\frac{\mathcal{E}}{6}\right)\mathcal{E} = 0 \Rightarrow Q = \Delta W = \frac{C\mathcal{E}^2}{2} - \frac{25C\mathcal{E}^2}{72} - \frac{5C\mathcal{E}^2}{72} = \frac{6}{72}C\mathcal{E}^2$

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

Ответ: $\frac{dJ}{dt} = \frac{\mathcal{E}}{6L}$ $Q = \frac{C\mathcal{E}^2}{12}$

Вариант 11-08

№4 Чистовик ②



1) $\mathcal{E}_i = \frac{d\Phi}{dt} = \frac{BdS}{dt}$; $J = \frac{\mathcal{E}_i}{R}$ — эдс индукции $l = d$

$F_{Ампера} = JBl = ma_x = m\frac{dv_0}{dt}$

$\frac{BdS}{dt} \Big/ dB$ — Рамка движется поступательно

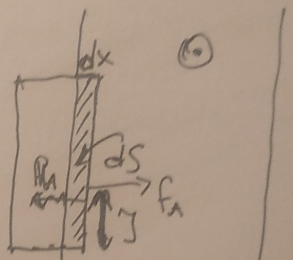
2) $S = b \cdot d = \frac{2d^2}{3}$

$dt = \frac{dx}{v}$; $dS = dx \cdot d \Rightarrow F_A = \frac{Bdx d \cdot v dB}{dx R}$

2ой З-Н Ньютона:

$F_A = ma \Rightarrow a = \frac{B^2 d^2 v_0}{mR}$

$f_A = \frac{B^2 d^2 v}{R}$.



ЗСЭ:

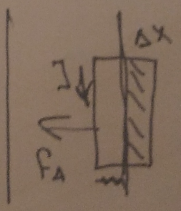
$\frac{mv_0^2}{2} = F_A \cdot b + \frac{mv_1^2}{2}$; F_A направлена против скорости рамки $\Rightarrow$ $A_{F_A} < 0$

$\frac{mv_1^2}{2} = \frac{mv_0^2}{2} + \frac{B^2 d^2 v_0 \cdot b}{R} \Rightarrow v_1 = \sqrt{v_0^2 + \frac{2B^2 d^2 v_0 b}{mR}} = \sqrt{v_0^2 + \frac{4B^2 d^3 v_0}{3mR}}$

На выходе из поля рамки ток потечёт в другую сторону т.к. Площадь рамки в поле будет уменьшаться.

$F_{A_2} = \frac{B^2 d^2 v_1}{R}$. ЗСЭ: $\frac{mv_2^2}{2} - \frac{mv_0^2}{2} = F_{A_2} \cdot b - F_{A_1} \cdot b \Rightarrow$

$\Rightarrow mv_2^2 = mv_0^2 + 2\frac{Bd^2}{R} \cdot b \left(\sqrt{v_0^2 + \frac{4Bd^3 v_0}{3mR}} - v_0\right)$

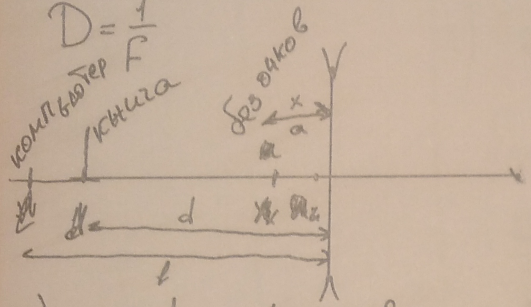


$v_2 = \sqrt{v_0^2 + \frac{4Bd^3}{3mR}\left(\sqrt{v_0^2 + \frac{4Bd^3 v_0}{3mR}} - v_0\right)}$

Ответ: $a = \frac{B^2 d^2 v_0}{mR}$; $v_1 = \sqrt{v_0^2 + \frac{4B^2 d^3 v_0}{3mR}}$; $v_2 =$

№5 Чистовик Вариант 11-08 (3)

$D = \frac{1}{F}$



Формулы тонкой линзы:

1) $D_{уд.} = \frac{1}{F_{уд.}} = \frac{1}{\infty} + \frac{1}{a} = \frac{1}{a}$ $a = x$

$D_{ат.} = \frac{1}{F_{ат.}} = \frac{1}{d} + \frac{1}{a} = \frac{a+d}{ad}$

$\frac{D_{ат}}{D_{уд}} = 2a$ $\frac{D_{уд}}{D_{ат}} = \frac{d}{d-a} = 5$

$5d - 5a = d \Rightarrow a = \frac{4}{5}d = 20см = X$

$D_{уд} = -\frac{1}{x} = -\frac{1}{20см} = -0{,}05\frac{1}{см}$

2) $D_3 = \frac{1}{l} - \frac{1}{x} = \frac{x-l}{lx}$

$D_3 = \frac{-30}{1000} = -0{,}03\frac{1}{см}$

Ответ: $X = \frac{4}{5}d = 20см$; $D_{удалённых\ предметов} = -\frac{5}{4d} = -0{,}05\frac{1}{см}$

$D_{для\ компьютера} = -0{,}03\frac{1}{см}$