Часть 1

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

Шифр: **21200242**

ID профиля: **804204**

Вариант 5

Чистовик ① ВАРИАНТ 11-05

№1

$\cos\alpha = \frac{12}{13}$

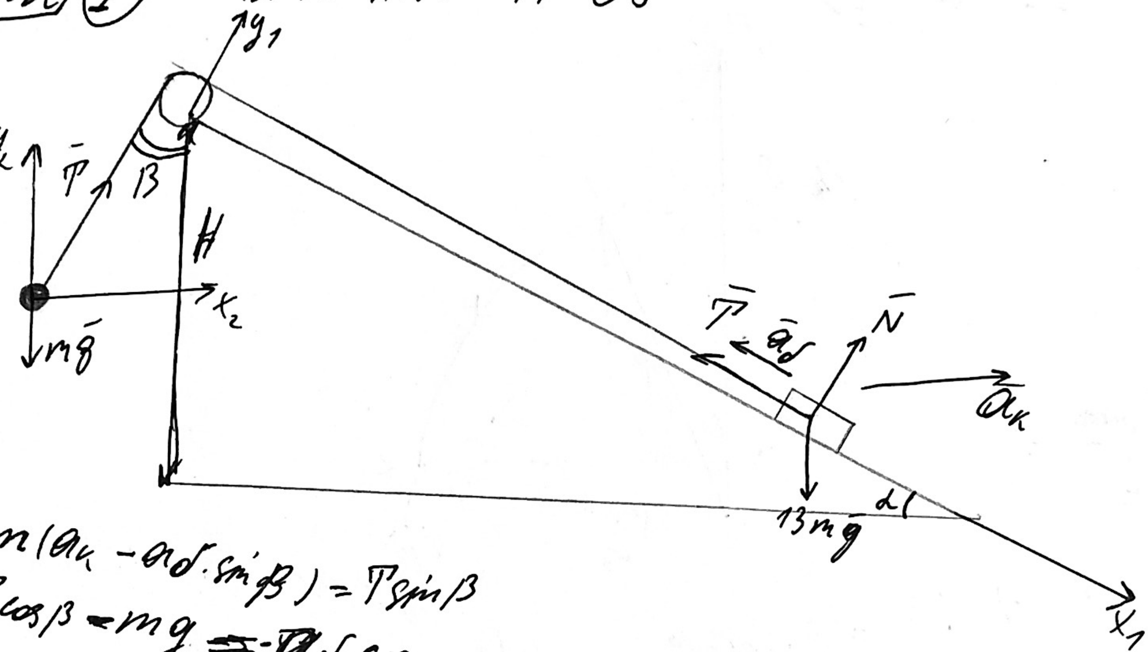
$m, 13m$

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

1) $a_к$ - ?

2) $a_б$ - ?

3) t - ?



1)

$x_2: m(a_к - a_б \cdot \sin\beta) = T\sin\beta$

$y_2: T\cos\beta - mg = -a_б \cdot \cos\beta \cdot m$

$T = \frac{m(g - a_б\cos\beta)}{\cos\beta} \Rightarrow m(a_к - a_б \cdot \sin\beta) = tg\beta\, m(g - a_б\cos\beta)$

$a_к = tg\beta \cdot g - \cancel{a_б\sin\alpha} + \cancel{a_б\sin\alpha}$

$\boxed{a_к = tg\beta \cdot g = \frac{3}{4}g}$

2) $X_1: m(a_к \cdot \cos\alpha - a_б) = 13mg \cdot \sin\alpha - T$

$\cancel{m}(a_к \cdot \cos\alpha - a_б) = 13\cancel{m}g\sin\alpha - \frac{\cancel{m}(g - a_б\cos\beta)}{\cos\beta}$

$a_к \cdot \cos\alpha - a_б = 13g\sin\alpha - \frac{g}{\cos\beta} + a_б$

$a_б = \frac{a_к \cdot \cos\alpha - 13g\sin\alpha + \frac{g}{\cos\beta}}{2} = \frac{\frac{12}{13} \cdot \frac{3}{4}g - 13 \cdot \frac{5}{13}g + \frac{5}{4}g}{2} = \frac{\frac{9}{13}g - 5g + \frac{5}{4}g}{2} =$

$= \frac{36 - 260 + 65}{52 \cdot 2}g \approx \boxed{-1{,}53g}$

3) $S = \frac{at^2}{2}$ $a = |a_б|$, т.к. нить нерастяжима.

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

$\frac{H}{\cos\beta} = \frac{a_б t^2}{2} \Rightarrow t = \sqrt{\frac{2H}{\cos\beta\, a_б}} = \sqrt{\frac{5H}{2a_б}} = \sqrt{\frac{5H}{3g}}$

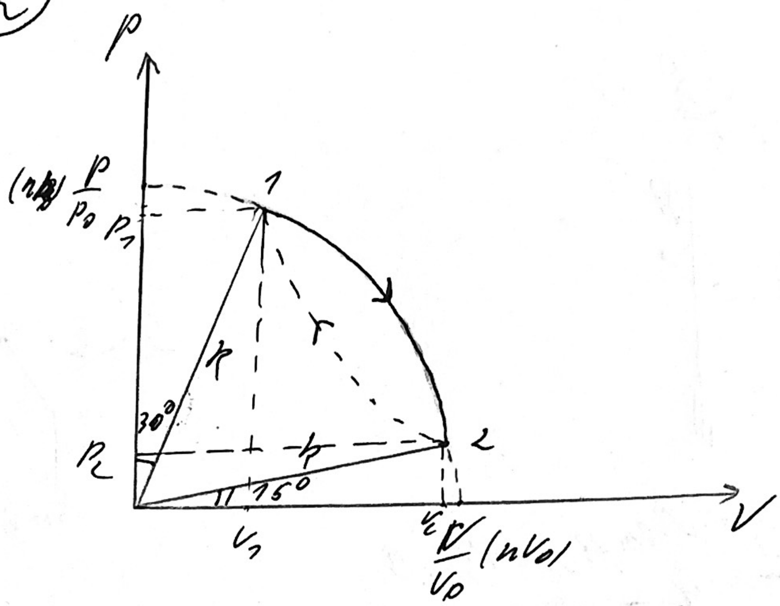
Ответ: 1) $a_к = \frac{3}{4}g$

2) $a_б = 1{,}53g$

3) $t = \sqrt{\frac{5}{3}\frac{H}{g}}$

Чистовик 2

$30°$
$15°$
$Q_{21} = 0.$
1) $\frac{T_1}{T_2} - ?$
2) $\lambda - ?$
3) $\frac{A_{цикл}}{A_{12}} - ?$



1) (·) 1: $P_1 = R \cdot \cos 30°$ (·) 2: $P_2 = R \cdot \sin 15°$
$V_1 = R \cdot \sin 30°$ $V_2 = R \cdot \cos 15°$

Ур-ние состояния:

$\begin{cases} P_1 V_1 = \nu R T_1 \\ P_2 V_2 = \nu R T_2 \end{cases}$

$\frac{P_1 V_1}{P_2 V_2} = \frac{T_1}{T_2}$ $\left(\frac{T_1}{T_2} = \frac{R \cdot \cos 30° \cdot R \cdot \sin 30°}{R \sin 15° \cdot R \cos 15°} = \frac{\cos 30° \sin 30°}{\sin 15° \cos 15°} \approx 1{,}7 \right)$

$A_{1-2} = \frac{1}{4}\pi R^2 - R^2 \cdot \cos 30 \sin 30° - R^2\left(\frac{\pi}{12} - \frac{1}{4}\sin 60°\right) - R^2\left(\frac{1}{24}\pi - \frac{1}{4}\right)$

$R^2 = P_i^2 + V_i^2$ $R = nV_0$ или $R = nP_0$

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2) $Q = A + \Delta U$
$Q = \nu \cdot C_V \cdot \Delta T$ $\Rightarrow A + \Delta U = 0$ $\Delta U_{12} = -\Delta U_{21}$
$\Delta U = -A$

$2-1$ $Q = 0.$ $A_{21} = -\Delta U$
$\Delta U_{21} = \frac{3}{2}\nu R \Delta T = \frac{3}{2}(P_1 V_1 - P_2 V_2) = \frac{3}{2} \cdot 0{,}7 P_2 V_2$

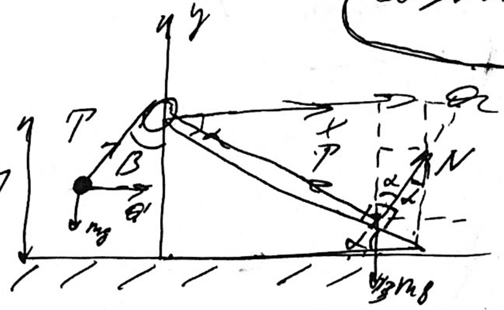
Ответ: 1) $\approx 1{,}7$ $\left(\frac{\cos 30° \cdot \sin 30°}{\sin 15° \cdot \cos 15°}\right)$

$\cos\alpha = 12/13$ (Чемпионат 7) 144+25

$m,\ 13m$

$\cos\beta = 4/5$

$a - ?$



$x: ma' = T\cdot\cos\beta$

$y: T\cdot\sin\beta = mg$

$T = \frac{5}{3}mg$

$a_k^x = \frac{5}{3}mg\cdot\frac{4}{5}$

$a_k^x = \frac{4}{3}g$

$13m\ x:$

$h = \frac{a''t^2}{2}$

$x:\ m(a_k - a_0) = N\cdot\sin\alpha - T\cos\alpha$

$y:\ N\cdot\cos\alpha = 13mg$

~~$N = \frac{13}{12}mg$~~

~~$m(a_k - a_0) = \frac{65}{12}mg - \frac{5}{3}mg\cdot\frac{12}{13} =$~~

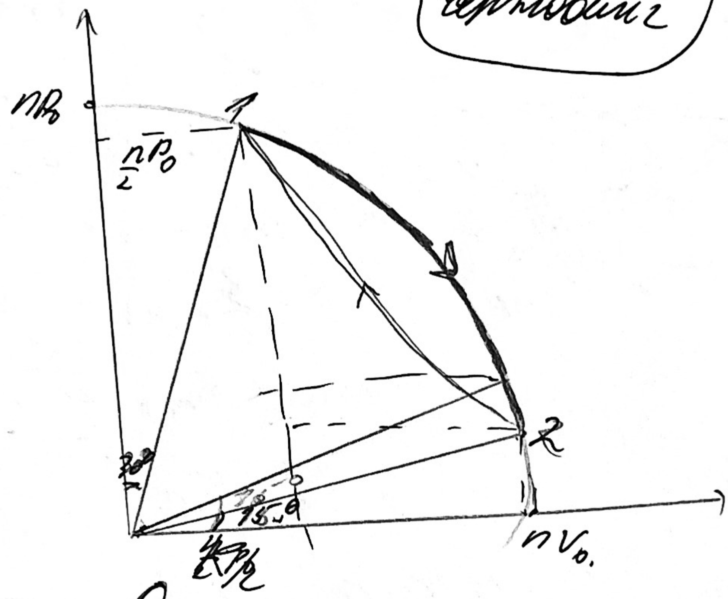
~~$\frac{4}{3}g - a_0 = \frac{65}{12}g - \frac{60}{39}g$~~

~~$a_0 = \frac{4}{3}g - \frac{65}{12}g + \frac{60}{39}g$~~

~~$\frac{4}{3}g - \frac{65}{1}$~~

2-1 $Q=0$.

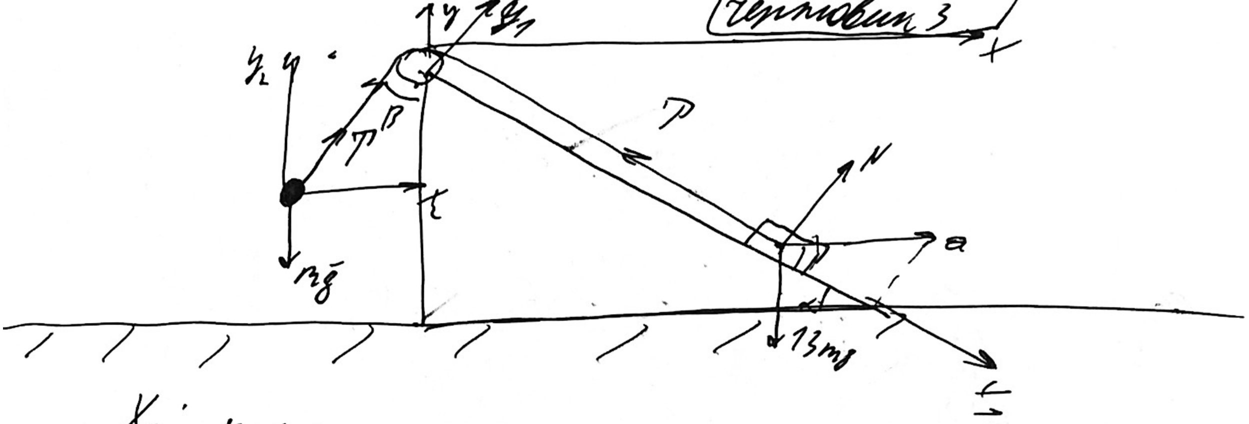
Черновик



$Q_{21} = 0$.

$A_{21} = -\Delta U_{21}$.

$\Delta U_{21} = -A_{21}$.



$X_1: m(a_u\cos\alpha - a_d) = 13mg\cdot\sin\alpha - T.$

$Y_1: \cancel{N = 13mg\cos\alpha}$

$\boxed{\cancel{N = 12mg.}}$

$X_2\ \ T\cdot\sin\beta = m(a_u - a_d\cdot\sin\beta)$

$Y_2!\ \ T\cdot\cos\beta - mg = -a_d\cdot\cos\beta\cdot m$

$$T = \frac{m(g - a_d\cos\beta)}{\cos\beta} = \frac{5m(g-\frac{4}{5}a_d)}{4}$$

$$\frac{3}{4}m(g-\frac{4}{5}a_d) = m(a_u - \frac{3}{5}a_d)$$

$$\frac{3}{4}g - \frac{3}{5}a_d = a_u - \frac{3}{5}a_d$$

$$\boxed{a_u = \frac{3}{4}g}$$

$$m(\frac{3}{4}\cdot\frac{12}{13}g - a_d) = 13mg - \frac{5}{4}m(g-\frac{4}{5}a_d)$$

$$\frac{9}{13}g - a_d = 13g - \frac{5}{4}g + a_d$$

$$\frac{9}{13}g - 13g + \frac{5}{4}g = 2a_d$$

$$\frac{36-676+65}{52}g = 2a_d$$

$2a_d \approx -11{,}06$ м/с^2

$a_d \approx -5{,}53$ м/с^2

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

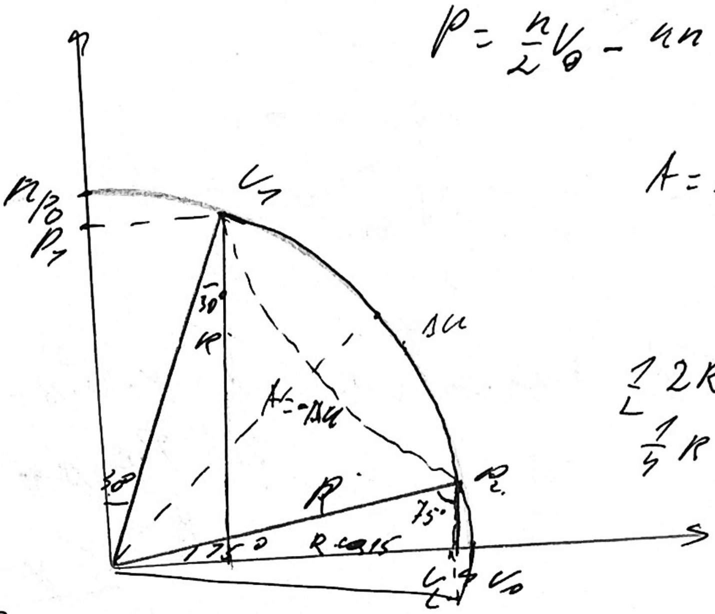
$$\frac{11}{\cos\beta} = \frac{5{,}53g\cdot t^2}{2}$$

$$t = \sqrt{\frac{8\cdot 11}{11{,}06g}}$$

(черновик 4)

$P = \frac{n}{2} V_0 - un$

$A = \Delta V \Delta P$



$\frac{1}{2} 2R \cos 15 \cdot R \sin 15° = \frac{1}{12}\pi R^2 - x.$

$\frac{1}{4} R^2 = \frac{1}{12}\pi R^2 - x.$

$x = R^2\left(\frac{\pi}{12} - \frac{1}{4}\right)$

$P_0 = V_0$

$\frac{P_1}{R} = \sin 30°.$

$P_1 = \frac{1}{2}R.$

$V_1 = \frac{\sqrt{3}}{2}R.$

$P_2 = 0{,}26R$

$V_2 = 0{,}97R.$

$P_1 V_1 = \nu R T_1$

$P_2 V_2 = \nu R T_2$

$\frac{0{,}5 \cdot 0{,}866}{0{,}26 \cdot 0{,}97} = \frac{T_1}{T_2}$

1) $1{,}72 = \frac{T_1}{T_2}$ =>

$A_{цикл} = \frac{1}{2}\pi R^2 - \frac{1}{6}\pi R^2 - x$

$\frac{2}{6}\pi R^2 - x = \frac{2}{6}\pi R^2 - \frac{\pi R^2}{12} - \frac{1}{4}R^2 =$

$= \frac{\pi R^2}{4} - \frac{1}{4}R^2 = \boxed{\frac{R^2}{4}(\pi - 1)}$

$A = -\Delta U$

$Q_н = A + \Delta U.$

$\Delta U = -A_{21}.$

$\frac{1}{12}\pi R^2$

$\frac{1}{12}\pi R^2 - \frac{1}{2} \cdot R \cdot R \sin$

$= R^2\left(\frac{1}{12}\pi - \frac{1}{4}\sin 60°\right)$

$\frac{1}{24}\pi R^2 - \frac{R^2}{2}\sin 15 \cos 75° =$

$= R^2\left(\frac{1}{24}\pi - \frac{1}{4}\right)$

Черновик 5

$Q=0.\quad A=-\Delta U$

$P_K V_K = P_i V_i \quad P_K = \frac{P_i V_i}{V_K}$

$P_K V_K \in$ Окр $\quad P_K^2+V_K^2=R^2$

$P_i V_i \in$ окр. $\quad P_i^2+V_i^2=R^2$

$P_K^2+V_K^2=P_i^2+V_i^2$

$\frac{P_i^2V_i^2+V_K^4}{V_K^2}=P_i^2+V_i^2$

$V_K^4-V_K^2(P_i^2+V_i^2)+P_i^2V_i^2=0.$

$D=(P_i^2+V_i^2)^2-4P_i^2V_i^2=(P_i^2-V_i^2)^2$

$V_K^2=\frac{P_i^2+V_i^2\pm(P_i^2-V_i^2)}{2}.$

$\left[\begin{array}{l} V_K=P_i \\ V_K=V_i \end{array}\right.$ $\quad V_K=\cos\alpha$

$P_i=\sin\alpha$

$T=$ const, если $V_K=P_i$

$V_K=V_i$

$\frac{P_K+P_K+\Delta P}{2}\cdot\Delta V=-\frac{3}{2}\cdot(\ldots)$

$(2P_K+\Delta P_K)(\Delta V_K)=3P_KV_K-(P_K+\Delta P)(V_K+\Delta V)$

$2P\Delta V+\Delta P\Delta V=3P_KV_K-3P_KV_K-3P\Delta V-3V\Delta P-3\Delta P\Delta V$

$5P\Delta V+3V\Delta P+4\Delta P\Delta V=0.$

$>0. \quad <0$

$(P\Delta V)^2=(V\Delta P)^2+(\Delta P\Delta V)^2$

$\sin\alpha=\frac{P\Delta V}{V\Delta P}=\frac{P}{\Delta P}$

Часть 2

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

Шифр: **21200242**

ID профиля: **804204**

Вариант 5

Шитовин (1) ВАР 11-05

№4

d

$b = 2d$

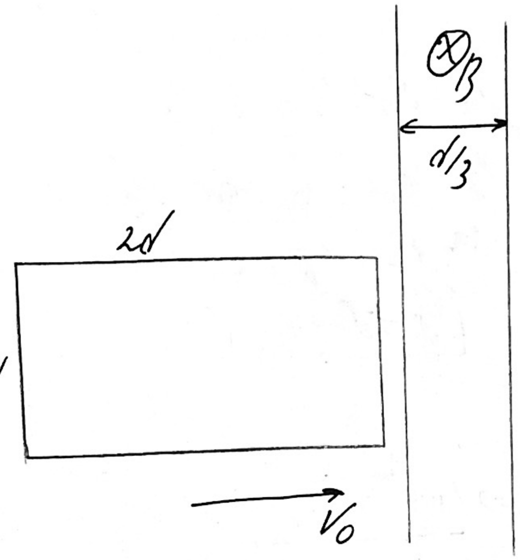
$H = \frac{d}{3}$

m, d, V_0, R, B

1) a_0 - ?

2) V_1 - ?

3) V_2 - ?



1) $\Phi = B \cdot S$.

$\varepsilon_i = -\Phi' = B \cdot S' = B \cdot d \cdot V_0$

$I = \frac{\varepsilon_i}{R} = \frac{B \cdot d \cdot V_0}{R}$

$F_A = \frac{B \cdot I \cdot l}{\cancel{2}}$, где $l = d$.

$F_A = m a_0$

$a_0 = \frac{F_A}{m} = \frac{B \cdot I d}{\cancel{2} m} = \frac{B^2 d^2 V_0}{\cancel{2} m R}$

2) З.С.Э.

$\frac{mV_1^2}{2} - \frac{mV_0^2}{2} = \int_{V_0}^{V_1} F(V) \cdot S$, где $S = d/3$

$\boxed{\text{Ответ: 1) } a_0 = \frac{B^2 d^2 V_0}{mR}}$

чистовик ②

№5

$d = 0{,}25$ м

$\frac{D_g}{D_б} = 2$

1) x – ?

D_g – ?

2) $d_2 = 0{,}5$ м

D_i – ?

1) $\begin{cases} D_г - D_б = \frac{1}{0{,}25} + \frac{1}{f} \\ D_г - D_g = \frac{1}{f} \end{cases} \Rightarrow D_г - D_б = 4 + D_г - D_g$

$D_g - D_б = 4$, где $D_g = 2D_б$

за $D_б = -4$ дптр

$\boxed{D_g = -8 \text{ дптр.}}$

$\begin{cases} D_г = \frac{1}{x} + \frac{1}{f} \\ \frac{1}{f} = D_г - D_g \end{cases} \Rightarrow \frac{1}{x} = 8 \Rightarrow \boxed{x = 12{,}5 \text{ см}}$

2) $\begin{cases} D_г + D_i = \frac{1}{0{,}5} + \frac{1}{f} \\ \frac{1}{f} = D_г - D_g \end{cases} \Rightarrow D_г - D_i = 2 + D_г - D_g \Rightarrow \boxed{D_i = -6 \text{ дптр}}$

Ответ: 1) $D_g = -8$ дптр

$x = 12{,}5$ см

2) $D_i = -6$ дптр.

Чистовик

№3

$C_1 = C$

$C_2 = 2C$

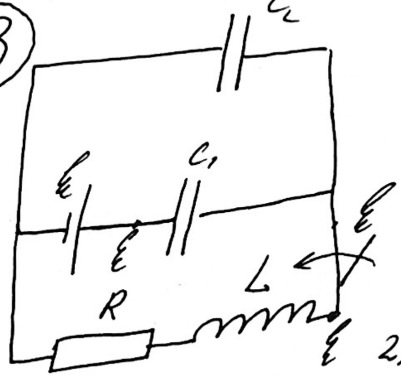
1) $\mathcal{I}'_L(0) - ?$

2) $Q - ?$

3) $\mathcal{I}_{C_1} = \mathcal{I}_0$

$\mathcal{I}_L - ?$

3



1) Сразу после замыкания ключ $U_{C_1} = 0 \Rightarrow U_L(0) = \mathcal{E}$

$U_L = L\,\mathcal{I}'_L \Rightarrow \boxed{\mathcal{I}'_L(0) = \frac{\mathcal{E}}{L}}$

2) Ток в цепи прекратится тогда когда C_1 зарядится до $U_{C_1} = \mathcal{E}$

$C = \frac{q}{U} \Rightarrow q_{C_1} = C \cdot \mathcal{E}$

$q_{C_2} = 2 \cdot C \cdot \frac{\mathcal{E}}{2} = q_{C_1}$.

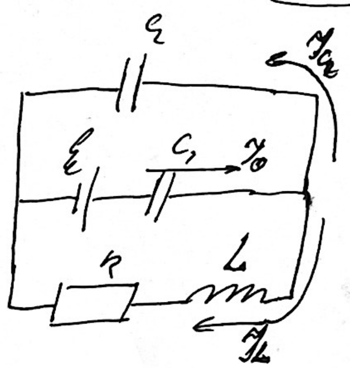
З.С.Э.:

$A_{ист} = Q + \Delta W$.

$\mathcal{E} \cdot C\mathcal{E} = Q + \frac{C\mathcal{E}^2}{2} + \frac{C\mathcal{E}^2}{4}$

$\boxed{Q = \frac{C\mathcal{E}^2}{4}}$

3)



$U_{C_2} = U_L + U_R$

$\mathcal{I}_0 = \mathcal{I}_{C_2} + \mathcal{I}_L$

Ответ: 1) $\frac{\mathcal{E}}{L} = \mathcal{I}'_L(0)$

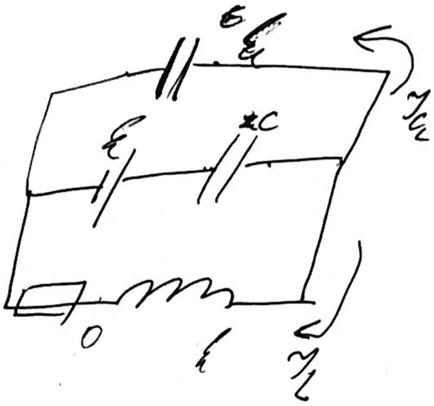
2) $Q = \frac{C\mathcal{E}^2}{4}$

черновик ①

$C_1 = C$

$C_2 = 2C$

$U_L = LY'$



$C = \frac{q}{U}$

$q = C \cdot U$

$q = \mathcal{E} \cdot C$

$\boxed{Y_0' = \frac{\mathcal{E}}{L}}$

2)

$2C = \frac{q}{U}$ $\quad 2C = \frac{\mathcal{E} C}{U}$

$U = \frac{\mathcal{E}}{2}$

$\mathcal{E}^2 \cdot C = Q + \frac{CU^2}{2} + \frac{2CU^2}{2}$

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

$\mathcal{E}^2 \cdot C = Q + \frac{C\mathcal{E}^2}{2} + \frac{C\mathcal{E}^2}{4}$

$\boxed{Q = \frac{\mathcal{E}^2 C}{4}}$

$Y_C = 2CU'$

$\mathcal{E} = U_L + Y_L \cdot R$

$Y_{C_1} = Y_0$

$U_1 + U_2 = \mathcal{E}$

$3U_2 = \mathcal{E}$

$U_2 = \frac{\mathcal{E}}{3}$

$U_L = LY_L'$

$Y_C = C \cdot U_C'$

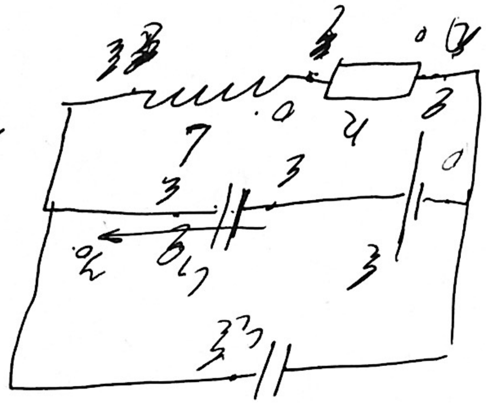
$\boxed{Y_L' = \frac{\mathcal{E}}{L}}$

$U_0' = U_{C0}'$

$C = \frac{q}{U}$

$U = \frac{q}{C}$

$U_{C_1} = \frac{\mathcal{E}}{2\mathcal{E}}$



2)

$C = \frac{q}{U}$

$C = \frac{q}{\mathcal{E}} \Rightarrow q = C\mathcal{E}$

$\mathcal{E} \cdot C = Q + \frac{C\mathcal{E}^2}{2} + \frac{C\mathcal{E}^2}{4}$

$Q = \frac{1}{4} C\mathcal{E}^2$

$\frac{1}{3}\mathcal{E} = Y_L \cdot R + \cancel{\mathcal{E}}$

$\boxed{Y_{L_0} = \frac{\mathcal{E}}{3R}}$

$Y_0 = Y_L + Y_{C_2}$

4) V_0 1) a - ?

d, $2d$.

B, R

$m = d/3$

$F_A = ma$

$$\boxed{a = \frac{B^2 d^2 V}{Rm}}$$

$\cancel{V = V_0 \cdot t}$

$$S = \frac{V^2 - V_0^2}{2a}$$

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

$$\sqrt{\frac{2}{3} d \cdot \frac{B^2 \cdot d^2 \cdot V_0}{Rm} + V_0^2}$$

$$\frac{2}{3} d a = V_4^2 - \frac{2}{3} d \cdot \frac{B^2 \cdot d^2 \cdot V_0}{Rm} - V_0^2 .$$

$$\sqrt{\frac{4}{3} \frac{d^3 B^2 V_0}{Rm^2} + V_0} = V_4$$

черновик

1)

$\Phi = B \cdot S$

$\Phi' = B \cdot S'$

$\mathcal{E}_i = \Phi' = B \cdot S'$

$I = \frac{\mathcal{E}_i}{R}$

$$F_A = \frac{B I l}{L} = \frac{B \cdot 2d \cdot \mathcal{E}_i}{R \cdot L} =$$

$$= \frac{B^2 \cdot d \cdot S'}{R} = \frac{B^2 \cdot d^2 \cdot V_0}{R}$$

$S' = d \cdot V$

$$\frac{2}{3} \frac{d \cdot B^2 \cdot d^2 \cdot V}{R} = V_1^2 - V_0^2$$

$$\frac{B^2 d^3}{3R} \cdot V^2 \Big|_{V_0}^{V_1}$$

$$\frac{B^2 d^3}{3R} (V_0 - V_1) = (V_1^2 - V_0^2)(V_0 + V_1)$$

$$V_1 = V_0 - \frac{B^2 d^3}{3R}$$

Церковник 3

$S = 25$ см

$d = 25$ см

$\cancel{-\frac{1}{25} + \frac{1}{F_2} = \frac{1}{25} + \frac{1}{F}}$

$\cancel{\frac{1}{25} - \frac{1}{F_2} + \frac{1}{F_8} = \frac{1}{F}}$

$\cancel{-\frac{1}{25} + \frac{1}{F_2} = \frac{1}{F_2} - \frac{1}{F_8} + \frac{1}{25}}$

$-\frac{2}{25} = \frac{1}{F_8} \Rightarrow F_8 = 25$ см

$F_d =$

$d = 25$ см

$\frac{1}{F_2} - \frac{1}{F_d} = \frac{1}{25} + \frac{1}{F}$

$\frac{1}{F_2} - \frac{1}{F_8} = \frac{1}{F}$

$-\frac{1}{F_d} + \frac{2}{F_2} = \frac{1}{25} + \frac{1}{F}$

$-\frac{1}{F_8} + \frac{1}{F_2} = \frac{1}{F}$

$\frac{1}{F_2} - \frac{1}{F_d} = \frac{1}{25} + \frac{1}{F_2} - \frac{1}{F_8}$

$-\frac{1}{25} = \frac{1}{F_2} = \frac{1}{25}$ $\quad -\frac{1}{F_d} + \frac{1}{F_8} = \frac{1}{25}$

$-\frac{1}{F_d} + \frac{1}{F_2} = \frac{1}{25} - \frac{1}{F_8} + \frac{1}{F_2}$

$F_8 = \frac{25}{2}$ см

$F_d = 25$ см

$\frac{1}{F_8} - \frac{1}{F_d} = \frac{1}{25}$ $\quad \frac{1}{F_8} = \frac{1}{F_d}$ $\quad -\frac{2}{25} = \frac{1}{F}$

$-\frac{1}{25} + \frac{1}{F_2} = \frac{1}{25} + \frac{1}{F}$

$\frac{1}{F_d} = \frac{1}{25}$

$F_d = 25$ см.

$F_0 = \frac{25}{2}$ см

$\frac{1}{F_2} = \frac{1}{F} + \frac{2}{25}$

$\frac{1}{x} + \frac{2}{25} = \frac{1}{x} + \frac{1}{F}$

$\boxed{D_8 = \frac{1}{0{,}125} = 8 \text{ дптр}}$

$\boxed{x = \frac{25}{2} \text{ см}}$

$D =$

$D + \frac{1}{F_2} = \frac{1}{0{,}5} + \frac{1}{F}$

черновик 4

$d = 25$ см

$\frac{D_g}{D_\delta} = 2.$

$D_2 + D_\delta = \frac{1}{d} + \frac{1}{f}$

$D_2 - D_g = \frac{1}{f}.$

$D_2 + D_\delta = 4 + D_2 - D_g.$

$D_g + D_\delta = 4.$

$D_g = 8.$

$D_\delta = 4.$

$D_2 = \frac{1}{f} + 8.$ $\frac{1}{f} = D_2 - 8.$

$D_2 = \frac{1}{x} + \frac{1}{f}.$

$D_2 = \frac{1}{x} + D_2 - 8.$

$\frac{1}{x} = 8. \Rightarrow \boxed{x = 12{,}5 \text{ см}}$

$\boxed{D_g = -8 \text{ дптр.}}$

$D_2 + D_y = 2 + \frac{1}{f}.$

$D_2 + D_y = 2 + D_2 - 8.$

$\boxed{D_y = -6 \text{ дптр}}$

$\frac{mV^2}{2} = F(S) \cdot S$

$\Delta E_k = \frac{8}{3}\left(\frac{B^2 d^2 V_1}{K} - \frac{B^2 d^2 V_0}{K}\right)$

$\frac{m}{2}(V_1^2 - V_0^2) = \frac{d^3 B^2}{3R}(V_1 - V_0)$

$\frac{m}{2}(V_1 + V_0) = \frac{d^3 B^2 2}{3R m}$

$V_1 = \frac{d^3 B^2}{3Rm} - V_0$

$V = \frac{B^2 \cdot d^2 \cdot (V_0 + V)}{2mR} = \frac{B^2 \cdot d^2}{2mR} V_0 - \frac{B^2 d^2 \cdot 0}{4mR3}$

const.

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

$V = \frac{B^2 \cdot d^2}{2mR}$

$V = \frac{B^2 d^2 V_0}{2mR} - \frac{B^2 d^2 \cdot 0}{6mR}$