Часть 1

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

Шифр: **21202473**

ID профиля: **870623**

Вариант 7

Физика 11 класс

Чистовик

Вар 11-07.

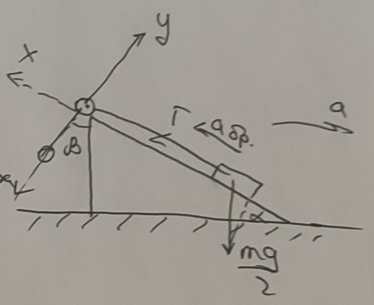
№1

$\cos\alpha = 5/13$

$\cos\beta = 3/5$

1) $a = a_{др.} = a_{шара}$

$\sin\alpha = \sqrt{1 - \frac{25}{169}} = \frac{12}{13}$



$$\begin{cases} x: T - \frac{mg}{2}\sin\alpha = \frac{ma}{2} \\ y: T - mg\cos\beta = -ma \end{cases}$$

$T = \frac{ma}{2} + \frac{mg}{2}\sin\alpha$

$\frac{ma}{2} + \frac{mg}{2}\sin\alpha - mg\cos\beta = -ma$

$a + g\sin\alpha - 2g\cos\beta = -2a$

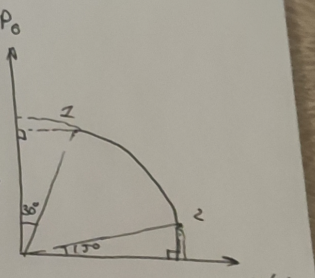
$2g\cos\beta - g\sin\alpha = 3a$

$a = \frac{2g\cos\beta - g\sin\alpha}{3} = \frac{20\cdot\frac{3}{5} - 10\cdot\frac{12}{13}}{3} = \frac{12 - 9{,}23}{3} = 0{,}92\ м/с^2$

(1)

1) Условие

Пусть R – радиус окружности



в т.1: $P_1/P_0 = R\cos 30° \Leftrightarrow P_1 = RP_0\cos 30°$

$V_1/V_0 = R\sin 30° \Leftrightarrow V_1 = RV_0\sin 30°$

в т.2 $P_2/P_0 = R\sin 15° \Leftrightarrow P_2 = RP_0\sin 15°$

$V_2/V_0 = R\cos 15° \Leftrightarrow RV_0\cos 15°$

$$\begin{cases} P_1V_1 = \nu RT_1 \\ P_2V_2 = \nu RT_2 \end{cases} \Leftrightarrow \begin{cases} RP_0\cos 30° \cdot RV_0\sin 30° = \nu RT_1 \\ RP_0\sin 15° \cdot RV_0\cos 15° = \nu RT_2 \end{cases}$$

$$T_1 = \frac{R^2P_0V_0\cos 30°\sin 30°}{\nu R}$$

$$T_2 = \frac{R^2P_0V_0\sin 15°\cos 15°}{\nu R}$$

$$\frac{T_1 - T_2}{T_2} = \frac{\frac{R^2P_0V_0}{\nu R}(\cos 30°\sin 30° - \sin 15°\cos 15°)}{\frac{R^2P_0V_0}{\nu R}(\cos 15°\cdot\sin 15°)} =$$

$$= \frac{\cos 30°\sin 30° - \sin 15°\cos 15°}{\cos 15°\sin 15°} = \frac{\sin 30°\cos 30° - \frac{\sin 30°}{2}}{\frac{\sin 30°}{2}} =$$

$$= \frac{\frac{\sqrt{3}}{2}\cdot\frac{1}{2} - \frac{1}{4}}{\frac{1}{4}} = \frac{\frac{\sqrt{3}-1}{4}}{\frac{1}{4}} = \sqrt{3} - 1$$

(2)

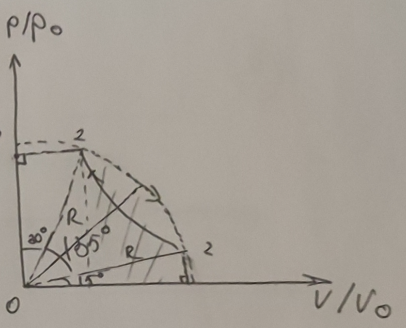
Иванов Иван Ученица 11 класса

черновик

$\nu 2$

$i = 3$

Пусть R - радиус окружности



в т. 1.: $P_1/P_0 = R\cos 30°$

$V_1/V_0 = R\sin 30°$

в т. 2: $P_2/P_0 = R\sin 15°$

$V_2/V_0 = R\cos 15°$

$P_2 = R\sin 15° \cdot P_0$

$V_2 = R\cos 15° V_0$

$$\begin{cases} P_1V_1 = \nu RT_1 \\ P_2V_2 = \nu RT_2 \end{cases} \Leftrightarrow \begin{cases} R\cos 30° P_0 \cdot R\sin 30° V_0 = \nu RT_1 \\ R\sin 15° P_0 \cdot R\cos 15° V_0 = \nu RT_2 \end{cases}$$

$$T_1 = \frac{R^2 P_0 V_0 \sin 30° \cdot \cos 30°}{\nu R}$$

$$T_2 = \frac{R^2 P_0 V_0 \cos 15° \sin 15°}{\nu R}$$

$$\frac{T_1 - T_2}{T_2} = \frac{\frac{R^2 P_0 V_0}{\nu R}(\sin 30° \cos 30° - \cos 15° \sin 15°)}{\frac{R^2 P_0 V_0}{\nu R}(\cos 15° \sin 15°)} =$$

$$= \frac{\sin 30° \cos 30° - \cos 15° \sin 15°}{\cos 15° \sin 15°} = \frac{\frac{\sin 30°}{2}\cos 30° - \frac{\sin 30°}{2}}{\frac{\sin 30°}{2}} =$$

$$= \frac{\frac{\sqrt{3}}{2} \cdot \frac{1}{2} - \frac{1}{4}}{\frac{1}{4}} = \frac{\frac{\sqrt{3}-1}{4}}{\frac{1}{4}} = \sqrt{3} - 1$$

2) $Q = 0$ в адиабатном процессе.

(4)

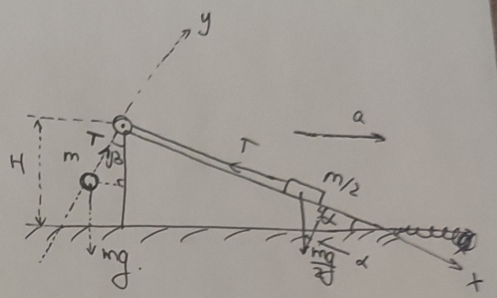
Черновик Физика 11 класс

№1

$\cos\alpha = 5/13$

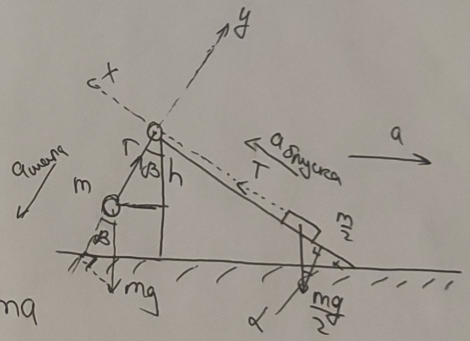
$\cos\beta = 3/5$

m; $m/2$



1) $a_{\text{шарика}} = -a_{\text{бруска}} = a_{x\ \text{шарика}}$

$$\begin{cases} \frac{mg}{2}\sin\alpha - T = \frac{ma}{2} \\ mg - T\cos\beta = ma \end{cases}$$



$\sin\alpha = \sqrt{1 - \frac{25}{169}} = \sqrt{\frac{144}{169}} = \frac{12}{13}$

$$\begin{cases} x: T - \frac{mg}{2}\sin\alpha = \frac{ma}{2} \\ y: T - mg\cos\beta = -ma \end{cases}$$

$$\begin{cases} T = \frac{ma}{2} + \frac{mg}{2}\sin\alpha \\ \frac{ma}{2} + \frac{mg}{2}\sin\alpha - mg\cos\beta = -ma \end{cases}$$

(1)

$a + g\sin\alpha - 2g\cos\beta = -2a$

$g\sin\alpha - 2g\cos\beta = -3a$

$2g\cos\beta - g\sin\alpha = 3a$

$a = \frac{2g\cos\alpha - g\sin\alpha}{3} = \frac{20\cdot\frac{3}{5} - 10\cdot\frac{12}{13}}{3} = \frac{12 - 9{,}23}{3} =$

$= \frac{2{,}77}{3} = 0{,}92\ \text{м/с}^2$

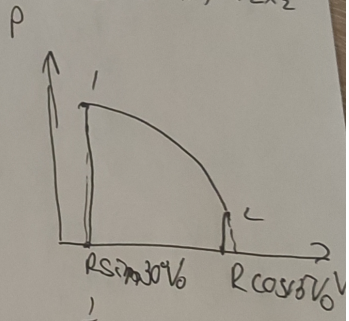
Черновик

③

$(1-x^2)^{\frac{1}{2}} \in$

$\in x(1-x^4)^{\frac{3}{2}} =$

$= 1 \cdot (1-x^4)^{\frac{3}{2}} \cdot 2x^{\frac{3}{2}}$



3) ~~Дел~~ ~~$p/p_0^2 + V/V_0^2 = R^2$~~

~~$p/p_0 = \sqrt{R^2 - V/V_0^2}$~~

$A = \int_{R\sin 30°}^{R\cos 15° V_0} \sqrt{R^2 - V/V_0^2} = \int (R^2 - V/V_0)^{\frac{1}{2}} =$

$= \frac{2}{3}(V/V_0)\sqrt{R^2 - V/V_0^2}$

$p^2 + V^2 = R^2$

$p = (R^2 - V^2)^{\frac{1}{2}}$

$A = \int_{R\sin 30° V_0}^{R\cos 15° V_0} (R^2 - V^2)^{\frac{1}{2}} =$

$((R^2 - V^2)^{\frac{3}{2}})' =$

$= -\frac{3}{8} \cdot V\sqrt{R^2 - V^2} =$

$= -3V\sqrt{R^2 - V^2} + 4\sqrt{R}$

$(R^2 - V^2)^3 =$

$(x = V)$

$\sqrt{R^2 - V^2} =$

$p^2 = R^2 - V^2$

$\frac{1}{3}p^3 = R^2 V - \frac{1}{3}V^3$

$p^3 = 3R^2 V - V^3$

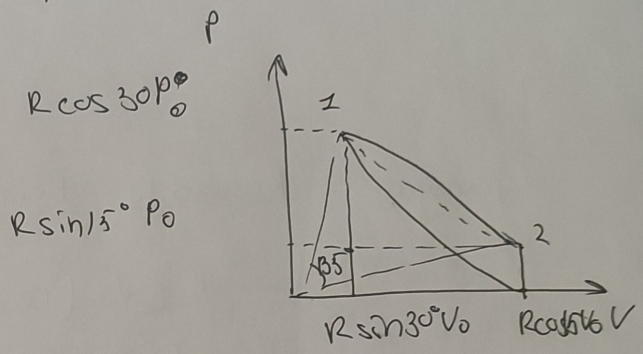
$U = \frac{3}{2}P_2V_2 - \frac{3}{2}P_1V_1 =$

$= \frac{3}{2}(R\sin 15° P_0 R\cos 15° V_0 -$

$- R\cos 30° P_0 R\sin 30° V_0) =$

$= \frac{3}{2}R^2 P_0 V_0 (\sin 15° \cos 15° - \cos 30° \sin 30°)$

Черновик



$A = \frac{1}{2} R\cos 30 P_0 \cdot (R\cos 15 V_0 - R\sin 30° V_0) =$

$= \frac{1}{2} R^2 P_0 V_0 (\cos 15 - \sin 30°)$

$S_{\text{кругового}} = \frac{135}{360} \cdot \pi R^2 - \frac{1}{2} R^2 \sin 135°$

$S_{\text{треугольника}} = \frac{R\cos 30 P_0 + R\sin 15 P_0}{2} \cdot (R\cos 15 V_0 - R\sin 30 V_0) - \frac{1}{2} R^2 P_0 V_0 (\cos 15 - \sin 30°$

$= \frac{1}{2} R^2 P_0 V_0 ((\cos 30 + \sin 15)(\cos 15 - \sin 30°) - (\cos 15$

$= \frac{1}{2} R^2 P_0 V_0 ((\cos 15 - \sin 30) + (\cos 30 + \sin 15 - 1)$

$\eta = \frac{\frac{1}{2} R^2 P_0 V_0 (\cos 15 - \sin 30°) + \left(\frac{135}{360} \pi R^2 - \frac{1}{2} R^2 \sin 135°\right)}{}$

(2)

Часть 2

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

Шифр: **21202473**

ID профиля: **870623**

Вариант 7

$$m v_0^2 = m v_1^2 + \frac{2B^2 d^3 v}{5R}$$ Перемещение.

$$m v_1^2 = m v_0^2 - \frac{2B^2 d^3 v}{5R}$$

$$v_1^2 = v_0^2 - \frac{2B^2 d^3 v}{5Rm}$$

$$v_1 = \sqrt{v_0^2 - \frac{2B^2 d^3 v}{5Rm}}$$

3) $$\frac{m v_1^2}{2} = \frac{m v_2^2}{2} + BId \cdot H$$

$$m v_1^2 = m v_2^2 + \frac{2B^2 d^2 v}{R} \cdot \frac{d}{5}$$

$$m\left(v_0^2 - \frac{2B^2 d^3 v}{5Rm}\right) = m v_2^2 + \frac{2B^2 d^3 v}{5R}$$

$$v_0^2 - \frac{2B^2 d^3 v}{5Rm} = v_2^2 + \frac{2B^2 d^3 v}{5Rm}$$

$$v_2^2 = v_0^2 - \frac{4B^2 d^3 v}{5Rm}$$

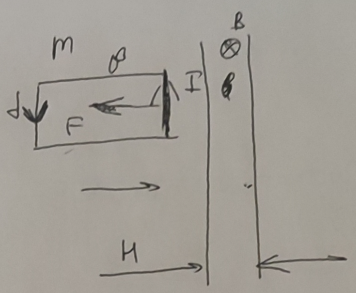
$$v_2 = \sqrt{v_0^2 - \frac{4B^2 d^3 v}{5Rm}}$$

№4 Черновик

m; R

$\Phi = Bdl$

$H = d/5$



1) $Bd V_0 = ma$

$a = \frac{Bd V_0}{m}$

2) $\frac{mV_0^2}{2} = \frac{mV_1^2}{2}$ + Алюминий проводник

$\frac{mV_0^2}{2} = \frac{mV_1^2}{2} +$

1) $\mathcal{E} = \frac{B \cdot \Delta S}{\Delta t} = Bd V$

$I = \frac{\mathcal{E}}{R} = \frac{Bd V}{R}$

$BIdt \cdot \cos\alpha = ma$

$a_2 = \frac{BId \cos 90^\circ}{m} = \frac{B \cdot Bd V dt}{Rm} =$

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

2) $\frac{mV_0^2}{2} = \frac{mV_1^2}{2} + BId \cdot H$ 2

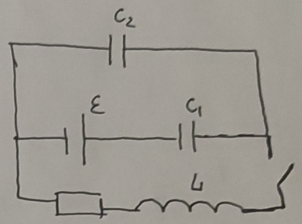
$mV_0^2 = mV_1^2 + \frac{2B^2 d^2 V}{R} \cdot \frac{d}{5}$

Физика 11 класс

Числовик
Вар. 11-07

№3

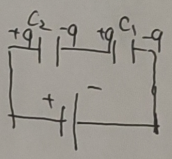
$C_1 = C$; $C_2 = 4C$



1) $\frac{1}{C_0} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{1}{C} + \frac{1}{4C} =$

$= \frac{4+1}{4C} = \frac{5}{4C} \Rightarrow C_0 = \frac{4}{5}C$

$q = C_0 \cdot \mathcal{E} = \frac{4}{5}C\mathcal{E}$



После замыкания ключа $U_{C_1} = \frac{q}{C_1} = \frac{\frac{4}{5}C\mathcal{E}}{C} =$

$= \frac{4}{5}\mathcal{E}$

Ток в нач. момент времени равен 0 $\Rightarrow$

$U_R = I \cdot R = 0.$

$U_{катушки} = \mathcal{E} - U_R - U_{C_1} = \mathcal{E} - \frac{4}{5}\mathcal{E} = \frac{1}{5}\mathcal{E}.$

$U_{кат} = L \cdot \frac{\Delta I}{\Delta t}$

$\frac{\Delta I}{\Delta t} = \frac{U_{кат}}{L} = \frac{\frac{1}{5}\mathcal{E}}{L} = \frac{\mathcal{E}}{5L}$

2) $W_{в\ цепи} = W_{конденсаторов} = \frac{q^2}{2C} + \frac{q^2}{8C} =$

$= \frac{5q^2}{8C} = \frac{5 \cdot \left(\frac{16}{25}C^2\mathcal{E}^2\right)}{8C} = \frac{5 \cdot 16 \cdot C^2\mathcal{E}^2}{5 \cdot 25 \cdot 8C} = \frac{2C\mathcal{E}^2}{5}$

Ответ: 1) $\frac{\mathcal{E}}{5L}$ 2) $\frac{2}{5}C\mathcal{E}^2$

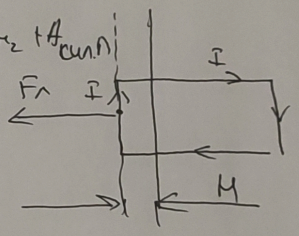
(1)

Чистовик

№4

3) Когда вышла правая сторона рамки и левая не вошла, силы, действующие на верхнюю и нижнюю рамку компенсируют друг друга. Ускорения по горизонтальной составляющей нет.

Когда вошла левая сторона рамки:



По З.С.Э: $E_{кин_1} = E_{кин_2} + A_{сил}$

$\frac{mv_1^2}{2} = \frac{mv_2^2}{2} + BIJ \cdot H$

$mv_1^2 = mv_2^2 + \frac{2B^2J^2v}{R} \cdot \frac{d}{5}$

$m\left(v_0^2 - \frac{2B^2J^3v}{5Rm}\right) = mv_2^2 + \frac{2B^2J^3v}{5R}$

$v_0^2 - \frac{2B^2J^3v}{5Rm} = v_2^2 + \frac{2B^2J^3v}{5Rm}$

$v_2^2 = v_0^2 - \frac{4B^2J^3v}{5Rm}$

$v_2 = \sqrt{v_0^2 - \frac{4B^2J^3v}{5Rm}}$

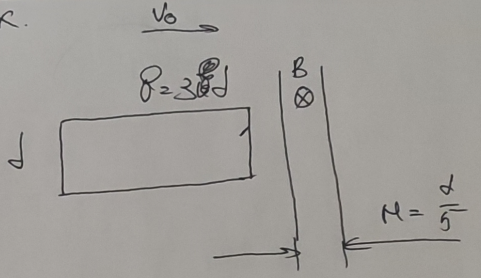
Ответ: 1) $\frac{B^2J^2v}{Rm}$ 2) $\sqrt{v_0^2 - \frac{2B^2J^3v}{5Rm}}$

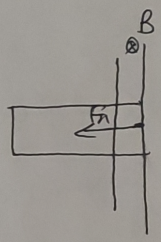
3) $v_2 = \sqrt{v_0^2 - \frac{4B^2J^3v}{5Rm}}$

(3)

№24

R, m, V_0, d, B





1) $\mathcal{E} = \frac{B \cdot \Delta S}{\Delta t} = B \cdot d V$

$I = \frac{\mathcal{E}}{R} = \frac{B d V}{R}$

$F_A = ma$

$BId\cos\alpha = ma$

$a = \frac{BId\cos\alpha}{m} = \frac{B \cdot B d V d \cos 90}{Rm} = \frac{B^2 d^2 V}{Rm}$

2) По З.С.Э.

$E_{кин0} = E_{кин1} + A_{сил тр.}$

$\frac{mV_0^2}{2} = \frac{mV_1^2}{2} + BId\cos\alpha \cdot H$

$mV_0^2 = mV_1^2 + \frac{2B^2 d^2 V}{R} \cdot \frac{d}{5}$

$V_0^2 = V_1^2 + \frac{2B^2 d^3 V}{5Rm}$

$V_1 = \sqrt{V_0^2 - \frac{2B^2 d^3 V}{5Rm}}$

(2)

Числовик

№5

Пусть D_1 – оптическая сила очков для дали; D_2 – для близи

$\frac{D_1}{D_2} = 3$

$\begin{cases} D_1 = \frac{1}{\infty} - \frac{1}{d} \\ D_2 = \frac{1}{0{,}25} - \frac{1}{d} \end{cases}$

$\frac{D_1}{D_2} = \frac{\frac{1}{\infty} - \frac{1}{d}}{\frac{1}{0{,}25} - \frac{1}{d}}$

$3 = \frac{-\frac{1}{d}}{4 - \frac{1}{d}}$

$12 - 3\frac{1}{d} = -\frac{1}{d}$

$12 = 2\frac{1}{d}$

$6 = \frac{1}{d}$

$d = \frac{1}{6}$ м

$\frac{1}{x} = \frac{1}{0{,}25} - \frac{1}{d} = \frac{1}{0{,}25} - \frac{1}{\frac{1}{6}} = 2 - 6 = 4$

$x = -0{,}25$ м

$D_1 = -\frac{1}{d} = -\frac{1}{\frac{1}{6}} = -6$ дптр.

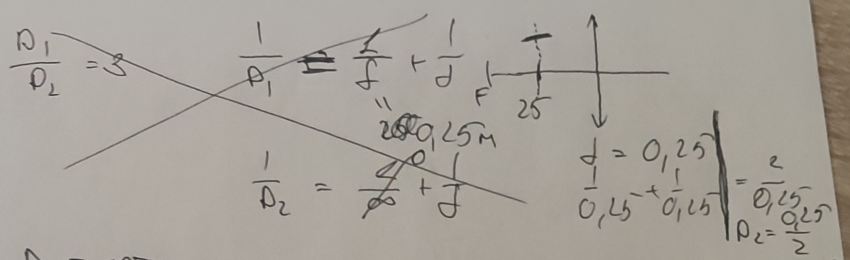
2) $D = \frac{1}{0{,}5} - \frac{1}{\frac{1}{6}} = 2 - 6 = -4$ дптр.

Ответ: 1) 0,25 м ; –6 дптр 2) –4 дптр.

4

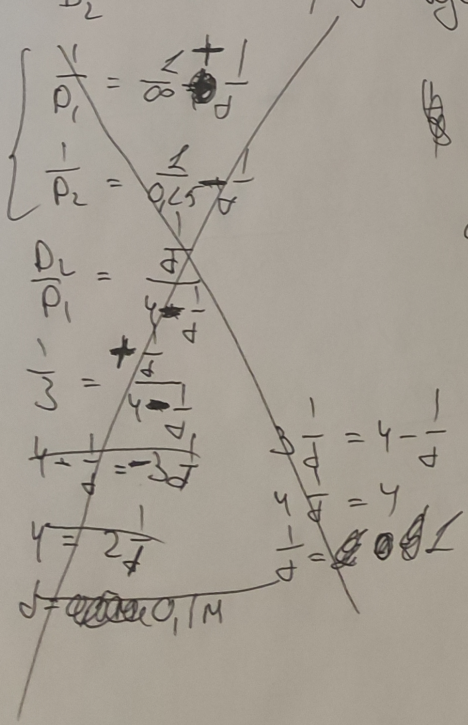
№5

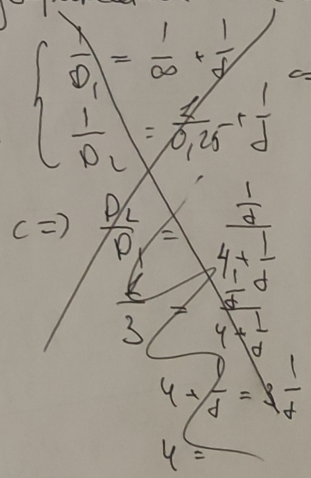
Черновик



D_1 – оптическая сила двояковогнутой линзы для $F_1 = 0{,}25$ м; D_2 – для плоской

$\frac{D_1}{D_2} = 3$; d – расстояние между линзами





4

Черновик

$$\begin{cases} D_1 = \frac{1}{\infty} + \frac{1}{d} \\ D_2 = \frac{1}{0{,}25} + \frac{1}{d} \end{cases}$$

$$D_1 = -\frac{1}{d} = -6$$

$$\frac{D_1}{D_2} = \frac{-\frac{1}{d}}{4 + \frac{1}{d}}$$

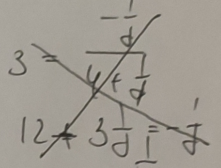
$$3 = \frac{-\frac{1}{d}}{4 + \frac{1}{d}}$$

$$12 + 3\frac{1}{d} = -\frac{1}{d}$$

$$12 = -2\frac{1}{d}$$

$$-6 = \frac{1}{d}$$

$$d = -\frac{1}{6}\ м$$



$$3 = \frac{-\frac{1}{d}}{4 + \frac{1}{d}}$$

$$12 + 3\frac{1}{d} = -\frac{1}{d}$$

$$3 = \frac{\frac{1}{d}}{4 - \frac{1}{d}}$$

$$12 - 3\frac{1}{d} = +\frac{1}{d}$$

$$12 = 4\frac{1}{d}$$

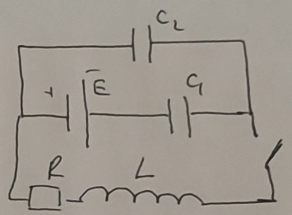
$$\frac{1}{d} = \frac{1}{3} \quad d = 3$$

21 $D = \frac{1}{0{,}5} + \frac{1}{-6} =$ 2 − 6 = −4

Черновик

№3

$C_1 = C$, $C_2 = 4C$

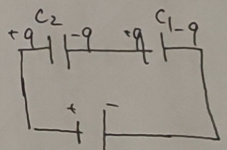


2) Пусть ~~I – так теч.~~

~~R L~~

~~W =~~

$W_{в\ цепи} = W_{конденсаторов}$ = 2)



$= \frac{q^2}{2C} + \frac{q^2}{8C} =$

$= \frac{4q^2+q^2}{8C} = \frac{5q^2}{8C} =$

$= \frac{5 \cdot \left(\frac{16}{25}C\mathcal{E}^2\right)}{8C} =$

$= \frac{2C\mathcal{E}^2}{5}$

$\frac{1}{C_0} = \frac{1}{C_1} + \frac{1}{4C} = \frac{5}{4C}$

$C_0 = \frac{4}{5}C$

$q = C_0 \cdot \mathcal{E} = \frac{4}{5}C\mathcal{E}$

$U_{кат} = \mathcal{E} - \frac{q}{C} = \mathcal{E} - \frac{4}{5}\mathcal{E} =$

$= \frac{1}{5}\mathcal{E}$

$\left|\frac{1}{5}\mathcal{E}\right| = |I \cdot r|$

$\Delta I = \frac{\mathcal{E}}{5r}$

3)

1