Часть 1

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

Шифр: **21202506**

ID профиля: **333901**

Вариант 6

Чистовик

Задача 2

Дано

$i=5$

$\alpha_1 = 22{,}5^\circ$

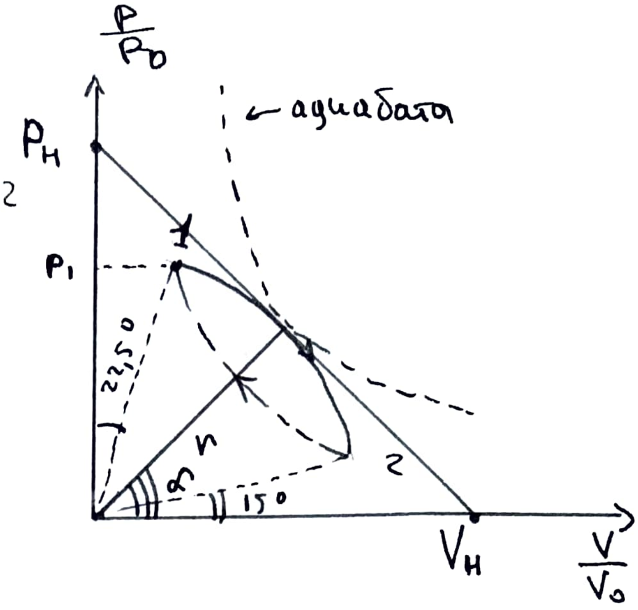
$\alpha_2 = 15^\circ$

Найти:

1) $\frac{T_1}{T_2}$

2) α при $C_\alpha = 0$

3) $\frac{A_{об}}{A_{12}}$



Решение

1) Введем радиус дуги 12 r

$p_1 = r\cos(22{,}5)$

$V_1 = r\sin(22{,}5)$

$p_2 = r\sin(15)$

$V_2 = r\cos(15)$

$p_1V_1 = \nu RT_1$

$p_2V_2 = \nu RT_2$

$$\frac{T_1}{T_2} = \frac{p_1V_1}{p_2V_2} = \frac{\cancel{r^2}\sin(22{,}5)\cos(22{,}5)}{\cancel{r^2}\sin(15)\cos(15)} =$$

$$= \frac{\cancel{\frac{1}{2}}\sin 45}{\cancel{\frac{1}{2}}\sin 30} = \frac{\sqrt{2}\cdot\cancel{2}}{\cancel{2}\cdot 1} = \sqrt{2}$$

2) Точка, где $C=0$ — это точка касания адиабаты прямая, проходящая через $p_н$ и $V_н$ — касательная в этой точке к дуге 12

Её ур-ие: $p = p_н - \frac{p_н}{V_н}V$, где $p_н = \frac{r}{\sin\alpha}$ $V_н = \frac{r}{\cos\alpha}$

Адиабата тоже касается этой прямой

Ур-ие адиабаты: $pV^\gamma = const$

$\gamma = \frac{0-C_p}{0-C_V} = \frac{\frac{7}{2}}{\frac{5}{2}} = \frac{7}{5}$ → для $i=2$ (ур-ие политропы)

продифференцируем $pV^\gamma = const$

$dpV^\gamma + p\cdot\gamma V^{\gamma-1}dV = 0 \quad |:V^{\gamma-1}$

$dpV + p\gamma dV = 0$

$\left(p = p_н - \frac{p_н}{V_н}V\right)'$

$dp = -\frac{p_н}{V_н}dV$ подставим dp

$-\frac{p_н}{V_н}VdV = -p\gamma dV$ подставим p

$\frac{p_н}{V_н}V\cancel{dV} = \left(p_н - \frac{p_н}{V_н}V\right)\gamma\cancel{dV}$

$\frac{V}{V_н} = \gamma\left(1-\frac{V}{V_н}\right)$

$\frac{V}{V_н}(1+\gamma) = \gamma \qquad V = \frac{\gamma V_н}{1+\gamma}$

Чистовик

Выразим V через α

$V = r\cos\alpha$

$$\cancel{r}\cos\alpha = \frac{\gamma}{1+\gamma}\cdot\frac{\cancel{r}}{\cos\alpha}$$

$$\cos\alpha = \sqrt{\frac{\gamma}{1+\gamma}} = \sqrt{\frac{7\cdot\cancel{5}}{\cancel{5}\cdot 12}} = \sqrt{\frac{7}{12}}$$

3) $$\frac{A_{об}}{A_{12}} = \frac{A_{12}+A_{21}}{A_{12}} = 1 + \frac{A_{21}}{A_{12}}$$

21 – адиабата, т.к $Q = 0$

$$A_{21} = -\Delta U_{21} = -\frac{5}{2}\nu R(T_1 - T_2) = -\frac{5}{2}(p_1V_1 - p_2V_2) =$$

$$= -\frac{5}{2}\left(\cancel{*}\ \frac{1}{2}r^2\sin 45 - \frac{1}{2}r^2\sin 30\right) = -\frac{5}{4}r^2(\sin 45 - \sin 30)$$

$A_{12} = S_{ABO} - S_{AOC} + S_{BOD}$

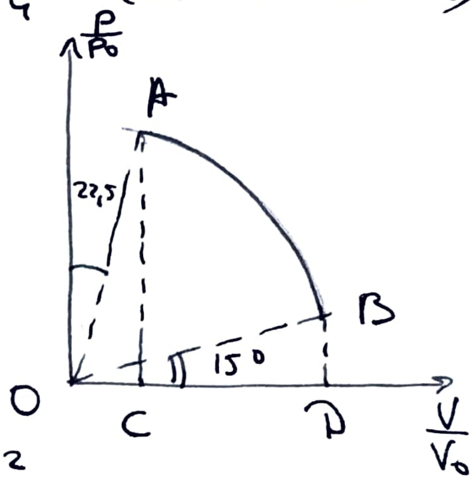
$$S_{ABO} = \pi r^2\cdot\frac{52{,}5}{360}$$

$$S_{AOC} = \frac{1}{2}\cdot AC\cdot OC = \frac{1}{2}r^2\sin(22{,}5)\cdot\cos(22{,}5) =$$

$$= \frac{1}{4}r^2\sin(45)$$

$$S_{BOD} = \frac{1}{2}BD\cdot OD = \frac{1}{2}\cdot r^2\cdot\sin 15\cdot\cos 15 =$$

$$= \frac{1}{4}r^2\sin 30$$



$$\frac{A_{об}}{A_{12}} = 1 - \frac{\frac{5}{\cancel{4}}\cancel{r^2}(\sin 45 - \sin 30)^{\approx 0{,}2}}{\frac{1}{\cancel{4}}\cancel{r^2}\left(\underbrace{\frac{\pi\cdot 210}{360}}_{\approx 1{,}83} - (\sin 45 - \sin 30)\right)} =$$

$$= 1 - \frac{5\cdot 0{,}2}{1{,}63} = 1 - 0{,}613 \approx 0{,}38$$

Отв:

$$\frac{T_1}{T_2} = \sqrt{2}$$

$$\cos\alpha = \sqrt{\frac{7}{12}}$$

$$\frac{A_{об}}{A_{12}} = 0{,}38$$

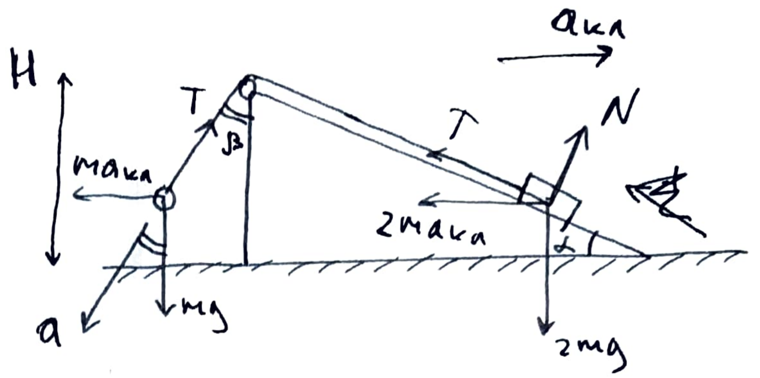
Дано: Задача 1 Чистовик.

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

H, $\cos\beta = \frac{12}{13}$

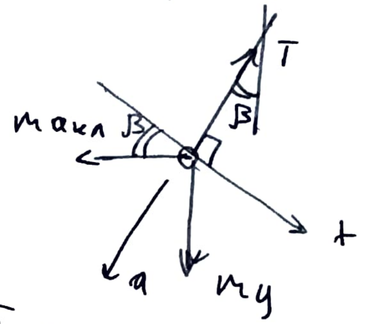
Найти:

$a_{кл}, a, T$



Решение

1) Перейдем в СО клина и рассмотрим шарик. Влево будет действовать сила $F = ma_{кл}$, т.к клин — НеИСО. $\beta = const \Rightarrow$ ускорение шарика в СО клина направлено по нити $\Rightarrow$ В проекции на ось $\perp$ T $\Sigma\vec{F} = 0$



$ma_{кл}\cos\beta = mg\sin\beta$

$a_{кл} = g\frac{\sin\beta}{\cos\beta} =$

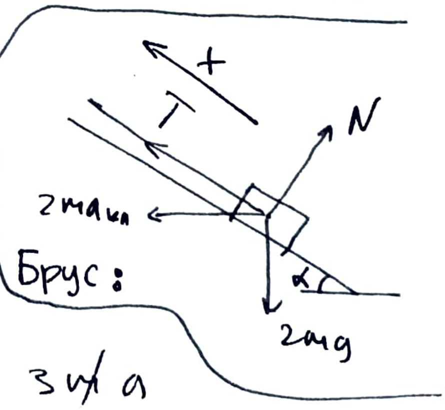
$= g\frac{\sqrt{1-\cos^2\beta}}{\cos\beta} = g\cdot\frac{5}{\cancel{13}\cdot 12}\cancel{13} = \frac{5}{12}g$

2) Распишем 2ЗН для шарика и бруска в СО клина

Брус: В проекции на ось, составляющей угол α с горизонтом

$T + 2ma_{кл}\cos\alpha - 2mg\sin\alpha = 2ma$

Шарик: В проекции на нить



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

$\cancel{m}(a_{кл}(\sin\beta + 2\cos\alpha) + g(\cos\beta - 2\sin\alpha)) = 3\cancel{m}a$

$a = \frac{1}{3}\left(\frac{5}{12}g\left(\frac{5}{13} + \frac{8}{5}\right) + g\left(\frac{12}{13} - \frac{6}{5}\right)\right) =$

$= \frac{g}{3}\left(\frac{\cancel{5}}{12}\cdot\frac{129}{13\cdot\cancel{5}} + \frac{60-78}{13\cdot 5}\right) =$

$= \frac{g}{3}\left(\frac{129}{12\cdot 13} - \frac{18}{13\cdot 5}\right) = \frac{g}{3}\cdot\frac{\cancel{645-216}\ 411}{5\cdot 12\cdot 13} = g\cdot\frac{137}{156\cdot 5}$

$a = \cancel{g\cdot 137}\ \frac{137}{5\cdot 156}g = \frac{137}{780}g$

Чистовик

3) Рассмотрим движение шара в проекции на нить

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

$$S = \frac{at^2}{2} = \frac{H}{\cos\beta}$$

$$t = \sqrt{\frac{2H}{\cos\beta \cdot a}} = \sqrt{\frac{2 \cdot H \cdot 13 \cdot 5 \cdot \cancel{156}\,13}{\cancel{12} \cdot 137 g}} =$$

$$= 13\sqrt{\frac{5 \cdot 2H}{137g}} = 13\sqrt{\frac{10H}{137g}}$$

Отв: $a_{кл} = \frac{5}{12} g$

$a = \cancel{\frac{137}{156} g}$ $\frac{137}{780} g$

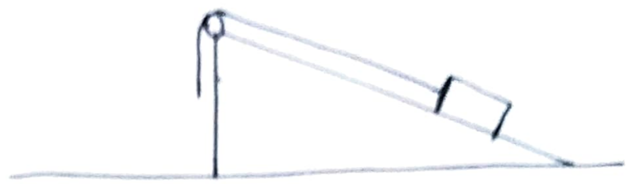
$t = 13\sqrt{\frac{10H}{137g}}$

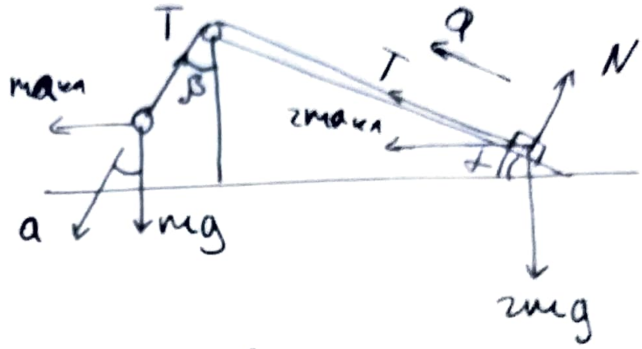
$tg\beta = \frac{a_{кл}}{g}$

$a_{кл} = g\,tg\beta =$

$= g\frac{\sin\beta}{\cos\beta} =$

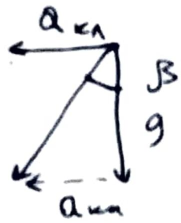
$= g\cdot\frac{5 \cdot 13}{13\cdot 12} = \frac{5}{12}g$





$H = \frac{gt^2}{2}$

$t = \sqrt{\frac{2H}{g}}$



F $\quad m(a_{кл}\sin\beta + g\cos\beta) - T = ma$

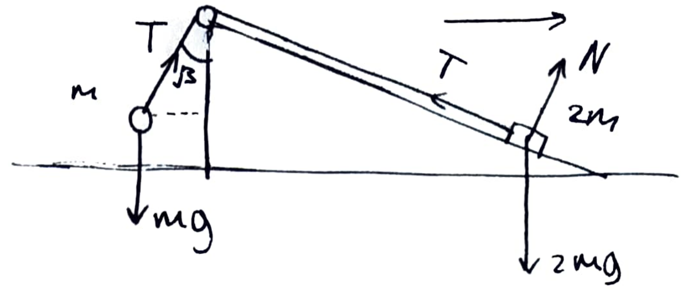
$T + 2ma_{кл}\cos\alpha - 2mg\sin\alpha = 2ma$

$\cancel{m}(a_{кл}\sin\beta + g\cos\beta) + 2\cancel{m}(a_{кл}\cos\alpha - g\sin\alpha) = 3\cancel{m}a$

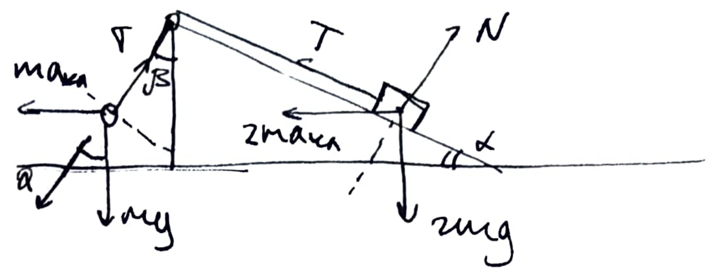
$a_{кл}(\sin\beta + 2\cos\alpha) + g(\cos\beta - 2\sin\alpha) = 3a$

$a = \frac{1}{3}\left(\frac{5}{12}g\left(\frac{5}{13} + \frac{8}{5}\right) + g\left(\frac{12}{13} - \frac{6}{5}\right)\right)$

$\cos\alpha = \frac{4}{5}$
$\sin\alpha = \frac{3}{5}$
$\cos\beta = \frac{12}{13}$
$\sin\beta = \frac{5}{13}$
$T\sin\beta = ma_к$



$T + 2ma_{кл}\cos\alpha - 2mg\sin\alpha = 2ma$



τ: $\cancel{m}g\sin\beta = \cancel{m}a_{кл}\cos\beta$

$$a_{кл} = \frac{g\sin\beta}{\cos\beta} =$$

$$= \cancel{\frac{g\cdot 3\cdot 5}{5\cdot 4}} \quad \frac{g\cdot 5\cdot 13}{13\cdot 12} = \frac{5}{12}g$$

τ: $ma_{кл}\sin\beta + mg\cos\beta - T = ma$

$T + 2ma_{кл}\cos\alpha - 2mg\sin\alpha = 2ma$

$\cancel{m}a_{кл}\sin\beta + \cancel{m}g\cos\beta + 2\cancel{m}a_{кл}\cos\alpha - 2\cancel{m}g\sin\alpha = 3\cancel{m}a$

$a_{кл}(\sin\beta + 2\cos\alpha) + g(\cos\beta - 2\sin\alpha) = 3a$

$$a = \frac{\frac{5}{12}g\left(\frac{5}{13} + \frac{8}{5}\right) + g\left(\frac{12}{13} - \frac{6}{5}\right)}{3} =$$

$$= \frac{g\left(\frac{\cancel{5}}{12}\cdot\frac{129}{\cancel{5}\cdot 13} - \frac{18}{65}\right)}{3} =$$

$$= \frac{g}{3}\left(\frac{129}{12\cdot 13} - \frac{18}{5\cdot 13}\right) = \frac{g(645 - 234)}{3\cdot 12\cdot 13} =$$

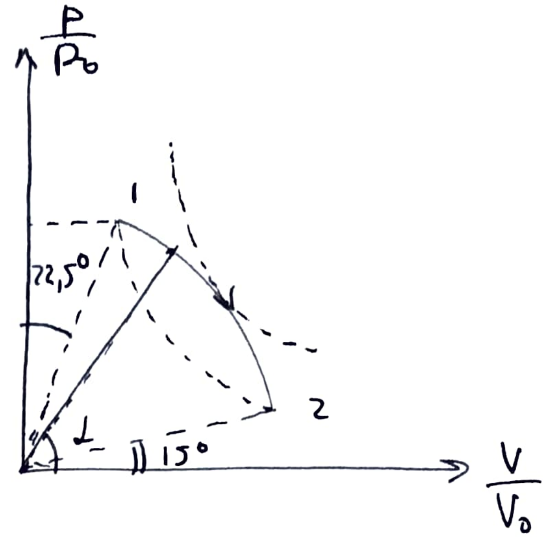
$$= g\frac{411}{3\cdot 12\cdot 13} = g\frac{137}{12\cdot 13} = \frac{137}{156}g$$

$$S = \frac{H}{\cos\beta} = \frac{13}{\cancel{12}_6}H = \frac{at^2}{\cancel{2}}$$

$$t = \sqrt{\frac{13H}{6a}} = \sqrt{\frac{13}{6}\frac{156}{137g}26} = 13\sqrt{\frac{2}{137g}}$$

$\mathcal{Q}$

21 – адиабата



$p_1 = R\cos\frac{45}{2}$

$V_1 = R\sin\frac{45}{2}$

$p_2 = R\sin 15$

$\cancel{R}\ V_2 = R\cos 15$

$p_1V_1 = \nu R T_1$

$p_2V_2 = \nu R T_2$

$$\frac{T_1}{T_2} = \frac{p_1V_1}{p_2V_2} = \frac{\cos\frac{45}{2}\cdot\sin\frac{45}{2}}{\sin 15\cdot\cos 15} = \frac{\cancel{\frac{1}{2}}\sin 45}{\cancel{\frac{1}{2}}\sin 30} = \frac{\sqrt{2}\ \cancel{2}}{\cancel{2}\cdot 1} = \sqrt{2}$$

$p = R\sin\alpha$

$V = R\cos\alpha$

$T = \cancel{pV/} \ \frac{pV}{\nu R} = \frac{R^2}{2\nu R}\sin 2\alpha$ –

$p\,dV + V\,dp = \nu R\,dT$ $\qquad \frac{dp}{p} + \frac{dV}{V} = \frac{dT}{T}$

$dQ = dA + dU$ $\qquad R = \frac{V}{\cos\alpha}$

$0 = dA + dU$ $\qquad p = V\,\mathrm{tg}\,\alpha$

$p\,dV = -\frac{5}{2}\nu R\,dT$ $\qquad dp = \frac{dV\cdot}{\cos^2\alpha}$

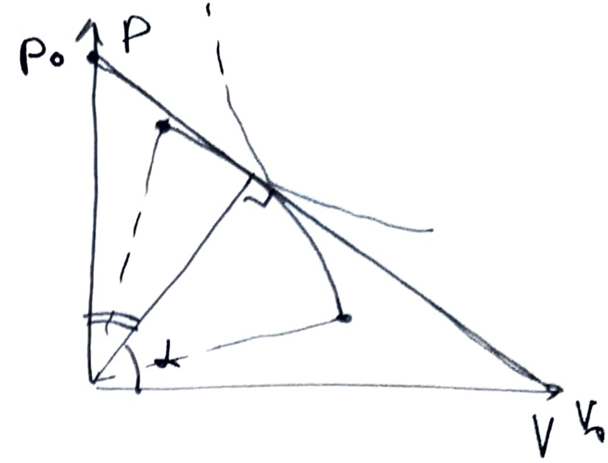
$p\,dp\cos^2\alpha = -\frac{5}{2}\cancel{\nu R}\ p\,dV + V\,dp$

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

$\frac{7}{\cancel{2}}p\,dV = -\frac{5}{\cancel{2}}V\,dp$

$7p\,dV = -5V\,dp$

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



$p = r\sin\alpha$
$V = r\cos\alpha$
$T = \frac{pV}{\nu R}$

$dQ = dA + dU =$

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

$\nu R\,dT = p\,dV + V\,dp$

$dQ = p\,dV + \frac{5}{2}p\,dV + \frac{5}{2}V\,dp = \frac{7}{2}p\,dV + \frac{5}{2}V\,dp =$

$=$

$\cancel{p=}\ \frac{p}{V} = tg\,\alpha$

$\frac{p\,dV - V\,dp}{V^2} = \frac{1}{\cos^2\alpha}$

$p\,dV - V\,dp = \frac{V_2}{\cos^2\alpha} \qquad p\,dV = \frac{V^2}{\cos^2\alpha} + V\,dp$

$dQ = \frac{7}{2}\left(\frac{V^2}{\cos^2\alpha} + V\,dp\right) + \frac{5}{2}V\,dp = \frac{7}{2}\frac{V^2}{\cos^2\alpha} + 6V\,dp =$

$= \frac{7}{2}\frac{r^2\cancel{\cos^2\alpha}}{\cancel{\cos^2\alpha}} + 6V\,dp = \frac{7}{2}r^2 + 6V\,dp$

$p_0 = \frac{r}{\sin\alpha} \qquad V_0 = \frac{r}{\cos\alpha}$

$p = p_0 - \alpha V = p_0 - \frac{p_0}{V_0}V$

$p = p_0 - \frac{p_0}{V_0}V \qquad pV^\gamma = const$

$dp = -\frac{p_0}{V_0}dV \qquad \cancel{pd}\ dp V^\gamma + \gamma p V^{\gamma-1} dV = 0$

$-\frac{p_0}{V_0}V^\gamma dV + p\cdot\gamma V^{\gamma-1} dV = 0 \ \Big|: V^{\gamma-1}$

$-\frac{p_0}{V_0}V\,d\cancel{V} + p\,\gamma\,\cancel{dV} = 0$

$+\frac{p_0}{V_0}V\,\cancel{dV} = \gamma\left(p_0 - \frac{p_0}{V_0}V\right)\cancel{dV} \qquad V = \frac{\gamma V_0}{1+\gamma}$

$\frac{\cancel{p_0}}{V_0}V = \cancel{\gamma\,(p_0}\ \gamma\cancel{p_0}\left(1 - \frac{V}{V_0}\right)$

$\frac{V}{V_0} = \gamma - \frac{\gamma}{V_0}V \qquad \frac{V}{V_0}(1+\gamma) = \gamma$

$pV^{\gamma} = c$

$\cancel{\theta} \quad \gamma = \frac{-\frac{7}{2}}{-\frac{5}{2}} = \frac{7}{5} \qquad \frac{7}{5} + 1 = \frac{12}{5}$

$V = \frac{\frac{7}{5} \cdot V_0 \cancel{\gamma}}{12} = \frac{7}{12} \cdot \frac{r}{\cos\alpha}$

$V = r\cos\alpha = \frac{7}{12} \cdot \frac{r}{\cos\alpha}$

$\cos^2\alpha = \frac{7}{12}$

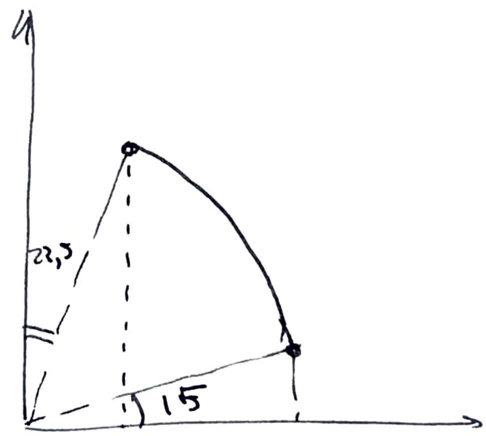
$\cos\alpha = \sqrt{\frac{7}{12}}$

3) $\eta \quad \frac{A_{об}}{A_{12}}$

$A_{об} = A_{12} + A_{21} = A_{12} + \frac{5}{2}\nu R(T_2 - T_1) =$

$= A_{12} - \frac{5}{2}\nu R(T_1 - T_2)$

$\frac{A_{об}}{A_{12}} = 1 - \frac{\frac{5}{2}\nu R(T_1 - T_2)}{A_{12}}$



$A_{12} = \frac{\pi r^2 \cdot 52{,}5}{360} - R \cdot \frac{1}{2} \cdot R\cos\frac{45}{2} \cdot$

$\cdot R \frac{\sin 45}{2}) + \frac{1}{2}R^2 \cdot \cos 15 \cdot \sin 15 =$

$= \pi r^2 \frac{52{,}5}{360} - \frac{1}{4}R^2 \sin 45 + \frac{1}{4}R^2 \sin 30$

$\frac{5}{2}\nu R(T_1 - T_2) = \frac{5}{2}(p_1V_1 - p_2V_2) = \frac{5}{4}r^2(\sin 45 - \sin 30)$

$\frac{A_{об}}{A_{12}} = 1 - \frac{\frac{5}{4}r^2(\sin 45 - \sin 30)}{\frac{r^2}{4}\left(\cancel{\frac{\pi \cdot 52{,}5}{360}} \, \pi \cdot \frac{210}{360} - (\sin 45 - \sin 30)\right)} =$

$= 1 - \frac{5(\sin 45 - \sin 30)^{\approx 0{,}2}}{1{,}83 - (\sin 45 - \sin 30)} = 1 - \frac{1}{1{,}62} \approx 0{,}4$

Часть 2

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

Шифр: **21202506**

ID профиля: **333901**

Вариант 6

Чистовик

Задача 4

Дано
m, d, v_0, R, B
$b = \frac{d}{4}$
Найти:
a
v_1
v_2

Решение

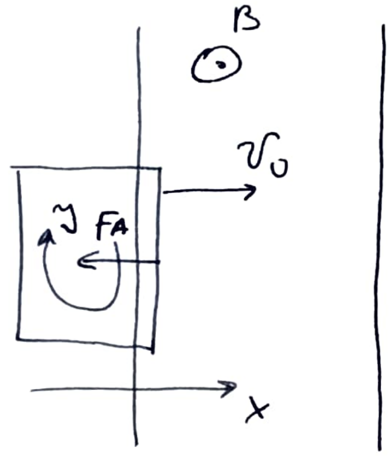
$$\mathcal{E}_i = -\frac{d\Phi}{dt}$$

$B = const$

$$\mathcal{E}_i = -B\frac{dS}{dt}$$

$$dS = d \cdot v \cdot dt$$

$$\mathcal{E}_i = -B d \cdot v$$



Сразу после вхождения скорость рамки еще v_0

$\mathcal{E}_i = -Bdv_0 \qquad |\mathcal{E}_i| = \mathcal{J}R$

$$\mathcal{J} = \frac{\mathcal{E}_i}{R} = \frac{Bdv_0}{R}$$

$\Phi\uparrow \Rightarrow \mathcal{J}$ направлен по часовой стрелке $\Rightarrow$ ~~сила~~ FA тормозит рамку

$-F_A = ma$

$$a = -\frac{F_A}{m} = -\frac{Bd\mathcal{J}}{m} = -\frac{B^2d^2v_0}{mR} \qquad |a| = \frac{B^2d^2v_0}{mR}$$

При полном вхождении ~~скор~~ рамки в поле и её дальнейшем движении $v = const$, т.к FA компенсируются, а потом исчезают, т.к $\frac{d\Phi}{dt} = 0 \Rightarrow \mathcal{E}_i = 0 \Rightarrow \mathcal{J} = 0 \Rightarrow F_A = 0$

$$F_A = Bd\mathcal{J} = \frac{B^2d^2v}{R}$$

v_1 – такая же, как и при полном входе рамки в поле

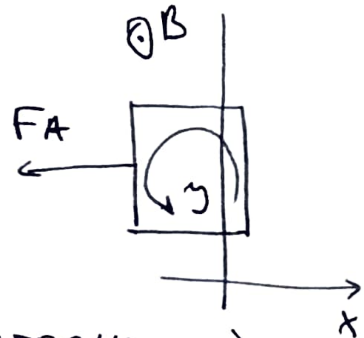
$-F_A = ma$

$$-\frac{B^2d^2}{R}v = ma$$

$$-\frac{B^2d^2}{mR}\frac{dx}{\cancel{dt}} = \frac{dv}{\cancel{dt}} \Rightarrow -\frac{B^2d^2\Delta x}{mR} = \Delta v$$

$$-\frac{B^2d^2 \cdot b}{mR} = v_1 - v_0$$

$$v_1 = v_0 - \frac{B^2d^3}{4mR}$$



При выходе рамки из поля $\Phi\downarrow \Rightarrow$
$\Rightarrow$ ток направлен против часовой стрелки $\Rightarrow$
$\Rightarrow$ FA опять тормозит рамку

Чистовик

$-F_A = ma$

$-\frac{B^2d^2}{R}v = ma$

$-\frac{B^2d^2}{R}\frac{dx}{\cancel{dt}} = m\frac{dv}{\cancel{dt}}$

$-\frac{B^2d^2}{R}\frac{d}{4} = m(v_2 - v_1)$

$v_2 = v_1 - \frac{B^2d^3}{4mR} = v_0 - \frac{B^2d^3}{2mR}$

Отв: $|a| = \frac{B^2d^2v_0}{mR}$

$v_1 = v_0 - \frac{B^2d^3}{4mR}$

$v_2 = v_0 - \frac{B^2d^3}{2mR}$

Чистовик

Задача 4

Дано

$C_1 = C$

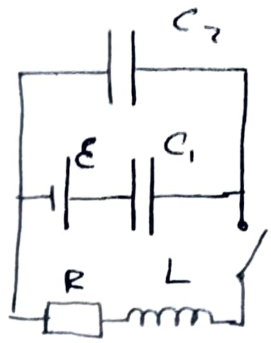
$C_2 = 3C$

$\mathcal{E}, R, L, I_0$

Найти: $\frac{dI}{dt}(0)$

Q, U_R

Решение



1) $U_{C_1}(0) = 0$

$I_L(0) = 0$ ⇒

т.к. магнитный поток сохраняется

$I_R(0) = 0$

$\mathcal{E} = L\frac{dI}{dt}$

$\frac{dI}{dt}(0) = \frac{\mathcal{E}}{L}$

2) заряд, при котором закрывается C_1 $q_1 = C\mathcal{E}$

$q_2 = 3C\mathcal{E}$, т.е. после замыкания ключа сначала закрывается конденсатор C_1, ~~который при~~ тем самым изолируя $\mathcal{E}$ ⇒ токи прекращают течь и устанавливается стационарный режим

$q_{ист} = q_1 = C\mathcal{E}$

~~$A_{ист} =$~~ ~~При~~ В этот момент $I_L = 0$, $U_{C_2} = 0$

$A_{ист} = Q + \Delta W$

$Q = A_{ист} - \Delta W = C\mathcal{E}^2 - \frac{C\mathcal{E}^2}{2} = \frac{C\mathcal{E}^2}{2}$

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

3) $\mathcal{E} \neq U_1 + U_2$

$\frac{\mathcal{E}}{t} = \frac{I_1}{C} + \frac{I_0}{3C} = \cancel{3(I_R - I_0) + I_0}$

$\frac{\mathcal{E}}{t} = \frac{I + I_0}{C} + \frac{I_0}{3C}$

$t = \frac{C\mathcal{E}}{I + \frac{4}{3}I_0}$

Отв: 1) $\frac{dI}{dt}(0) = \frac{\mathcal{E}}{L}$

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

3) $\cancel{\frac{I_0}{3}R}$ $U_R = \frac{I_0 R}{3}$

№ - 5

Чистовик

Дано

$d_1 = 25$ см

$d_2 = 50$ см

$\frac{D_2}{D_1} = \frac{7}{3}$

Найти

D_3, x, D_2

Решение

Человек близорукий => ему нужны очки с рассеивающими линзами

Без очков:

$$D_0 = \frac{1}{x} + \frac{1}{f}$$

С очками:

$$D_0 + D_1 = \frac{1}{d_1} + \frac{1}{f}$$

$$D_0 = \frac{1}{x} + \frac{1}{f}$$

$$D_1 = \frac{1}{d_1} - \frac{1}{x} = 4 - \frac{1}{x}$$

$$D_2 = \frac{7}{3} D_1 = \frac{7}{3}\left(4 - \frac{1}{x}\right)$$

$$D_3 + D_0 = \frac{1}{d_2} + \frac{1}{f}$$

$$D_0 = \frac{1}{x} + \frac{1}{f}$$

$$D_3 = \frac{1}{d_2} - \frac{1}{x} = 2 - \frac{1}{x}$$

Отв: $x = x$

$D_2 = \frac{7}{3}\left(4 - \frac{1}{x}\right)$

$D_3 = 2 - \frac{1}{x}$

4

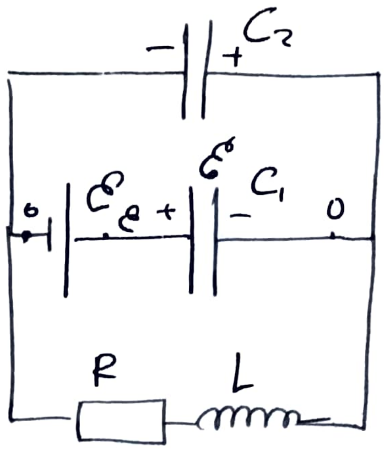
$\dot{J} = \frac{\mathcal{E}}{L}$

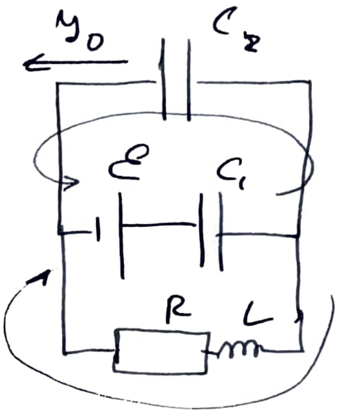
$q_{2\,\text{закр}} = 3C\mathcal{E}$

$q_{1\,\text{закр}} = C\mathcal{E}$

$\mathcal{E} = U_1 + U_2$

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





$L\frac{dJ}{dt} + JR = U_{C_2}$

$\frac{LdJ}{dt} + JR = \frac{q}{3C}$

$LdJ + dq_R R = \frac{dJ_2}{3C}$

$LJ + q_R R = \frac{J_0}{3C}$

$\frac{LdJ}{dt} + U_R = U_{C_2}$

$LJ \cancel{+U_R} = \frac{J_0}{3C} - Ut$

$\cancel{L\ddot{q}_R = \frac{J_0}{3C}}$

$q_R = q_1 - q_2$

$\mathcal{E} - U_1 = U_2$

$\mathcal{E} = \frac{q_1}{C} + \frac{q_2}{3C}$

$\cancel{q_R}\; 3q_1 + q_2 = 3C\mathcal{E}$

$q_2 = 3C\mathcal{E} - 3q_1$

$q_R = 4q_1 - 3C\mathcal{E}$

$$\frac{B^2d^2}{R}\frac{dx}{\cancel{dt}} = m\frac{dv}{\cancel{dt}}$$

$$\frac{B^2d^2}{R}\frac{d}{4} = m(v_2 - v_1)$$

$$v_2 = \frac{B^2d^3}{4Rm} + v_1 = \frac{B^2d^3}{2Rm} + v_0$$

Четко видит на нуле

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

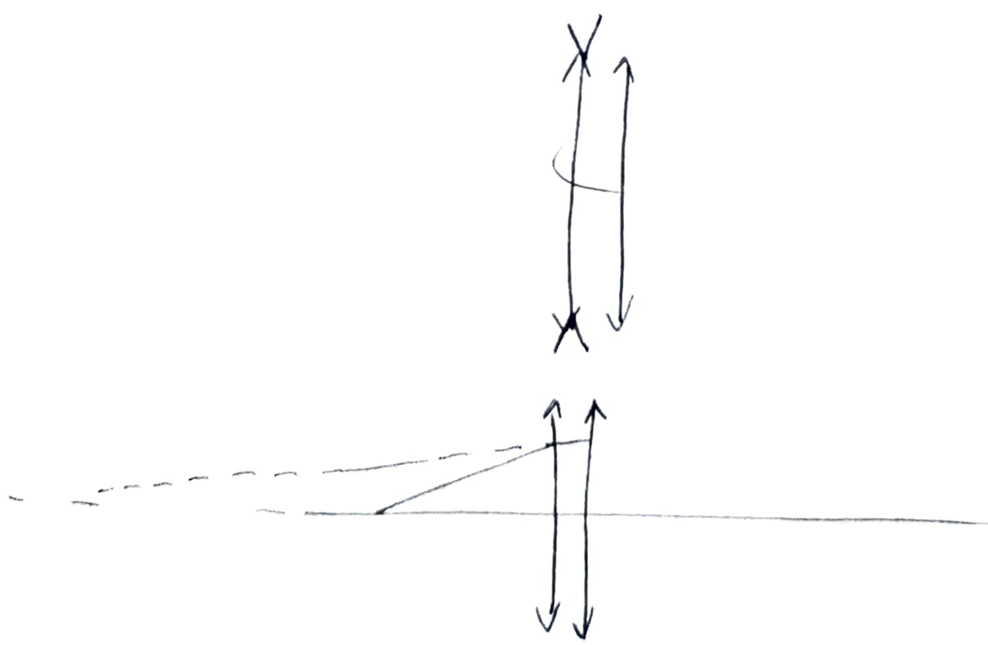
$$f = \frac{dF}{d-F} \qquad \frac{(d-\Delta d)F}{d-F-\Delta d} > \frac{dF}{d-F}$$

$$(d-\Delta d)(d-F) > d^2 - dF - \Delta d\, d$$

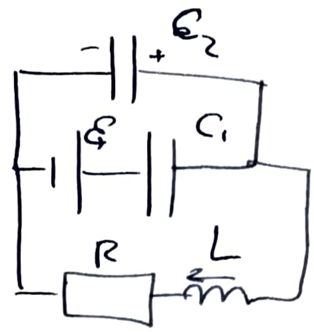
$$\cancel{d^2} - \cancel{\Delta d\, d} - \cancel{dF} + \Delta d F > \cancel{d^2} - \cancel{dF} - \cancel{\Delta d\, d}$$

Близорукость - когда перед сетчаткой

$$f = \frac{dF}{d-F}$$



$$\mathcal{E} = U_1 + L\frac{dI}{dt} + U_R$$



$\mathcal{E}_2$

$$L\frac{dI}{dt} + IR = U_2$$

$$L \circ I + U_R t = \cancel{t} \frac{I_0}{3C}$$

$$LI + IRt = \frac{I_0}{3C}$$

$$\mathcal{E}t = \frac{I + I_0}{C} + LI + U_R t$$

$$\frac{I_0}{3C} = LI + U_R t$$

$$\mathcal{E}t - \frac{I_0}{3C} = \frac{I + I_0}{C}$$

$$\mathcal{E}t = \frac{I}{C} + \frac{4}{3}\frac{I_0}{C}$$

$$t = \frac{1}{C\mathcal{E}}\left(I + \frac{4}{3}I_0\right)$$

$$LI + U_R t = \frac{I_0}{3C}$$

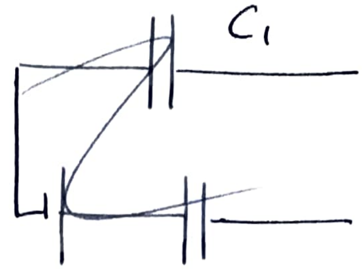
$$\frac{U_R}{C\mathcal{E}}\left(I + \frac{4}{3}I_0\right) + LI = \frac{I_0}{3C}$$

$$\frac{IR}{C\mathcal{E}}\left(I + \frac{4}{3}I_0\right) + LI = \frac{I_0}{3C} \quad \Big| \cdot C\mathcal{E}$$

$$I^2 R + \frac{4}{3}R I_0 I + C\mathcal{E}LI = \frac{I_0}{3}\mathcal{E}$$

$$I^2 R + I\left(C\mathcal{E}L + \frac{4}{3}RI_0\right) - \frac{I_0}{3}\mathcal{E} = 0$$

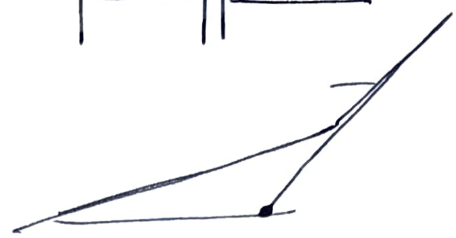
$$I = -C\mathcal{E}L + \frac{4}{3}RI_0 \pm$$



$D_1 \quad D_2$

$$\frac{1}{D_1} + \frac{1}{D_2} = \frac{1}{d} + \frac{1}{f}$$

D_2
$$\frac{1}{D_2} = \frac{1}{d^*} + \frac{1}{f}$$



D_1
$$\frac{1}{D_1} = \frac{1}{d} - \frac{1}{d^*}$$

$$D_1 = \frac{1}{0{,}25} - \frac{1}{d^*} = 4 - \frac{1}{d^*}$$

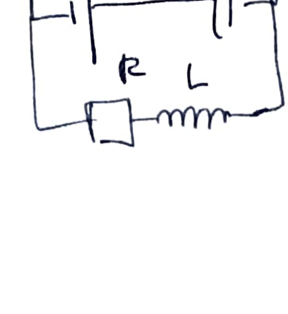
$$D_2 = \frac{1}{d_2} - \frac{1}{d^*} = \frac{7}{3} D_1$$

$$\frac{1}{d_2} - \frac{1}{d^*} = -k$$

$$D_3 = -\frac{7}{3} k$$

$$D_4 + D_2 = \frac{1}{0{,}5} +$$

$$D_4 = \frac{1}{0{,}5} - \frac{1}{d^*}$$



$$\mathcal{E} = U_1 + L\frac{dI}{dt} + \cancel{IR}\, U$$

$$\mathcal{E} = U_1 + U_2$$

$$\mathcal{E}t = \frac{I + I_0}{C} + \frac{I_0}{3C} =$$

$$t = \frac{1}{C\mathcal{E}}\left(I + \frac{4}{3}I_0\right)$$

$$\cancel{\mathcal{E}t} \quad \mathcal{E} = U_1 + L\frac{dI}{dt} + U_R$$

$$\mathcal{E}t = \frac{I + I_0}{C} -$$

$$\cancel{\mathcal{E}} \quad U_2 = \frac{L\,dI}{dt} + IR$$

$$\frac{\mathcal{E}}{t} = \frac{I + I_0}{C} + \frac{I_0}{3C}$$

$$t = \frac{\mathcal{E}}{\frac{1}{C}\left(I + \frac{4}{3}I_0\right)} = \frac{C\mathcal{E}}{I + \frac{4}{3}I_0}$$

$$U_R + L\frac{dI}{dt} = U_2$$

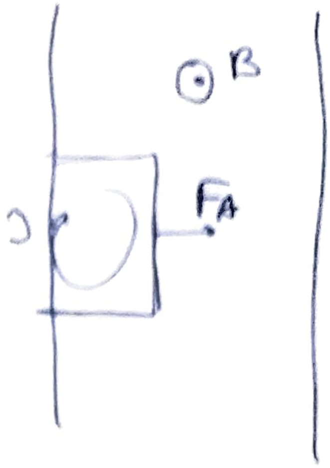
$$\mathcal{E}t =$$

$\mathcal{E} = U_1 + IR + 0$

$U_2 = \mathcal{E}$

$U_1 = \mathcal{E}$

$$\mathcal{E}_i = -\frac{d\Phi}{dt} =$$



$b = \frac{d}{4}$

v_0, R, B

$H = 2d$

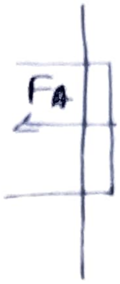
m

$$= -B\frac{dS}{dt}$$

$$dS = d \cdot v_0 dt$$

$$\mathcal{E}_i = B d v_0 = IR$$

$$I = \frac{B d v_0}{R}$$



$$F = BId = \frac{B^2 d^2}{R} v$$

$$F = ma$$

$$\boxed{a = \frac{F}{m} = \frac{B^2 d^2}{mR} v_0}$$

$$\cancel{v = -at} \quad v = v_0 - at$$

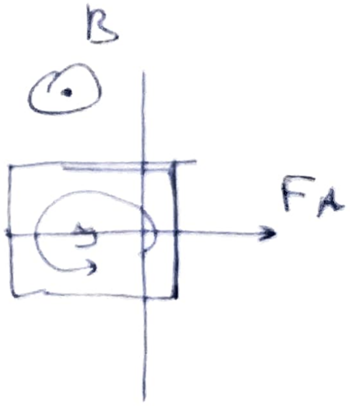
$$\cancel{\frac{B^2 d^2}{m}} \quad \frac{B^2 d^2}{R} v = ma$$

$$\frac{B^2 d^2}{R} \frac{dx}{\cancel{dt}} = m \frac{dv}{\cancel{dt}}$$

$$\frac{B^2 d^2}{R} b = m(v_1 - v_0)$$

$$m v_1 = \frac{B^2 d^2 b}{R} + m v_0$$

$$v_1 = \frac{B^2 d^3}{4mR} + v_0$$



$$\mathcal{E}_i = -\frac{d\Phi}{dt} = -B\frac{dS}{dt}$$

$$dS = d \cdot v\, dt$$

$$\mathcal{E}_i = -B d v = IR$$

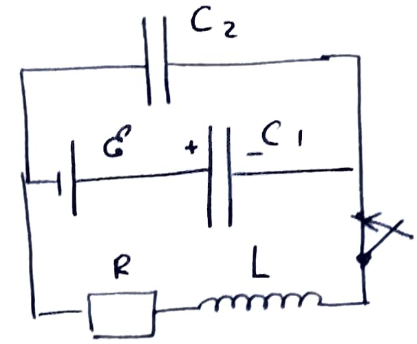
$$I = \frac{B d v}{R}$$

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

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

Черновик

$C_1 = C$
$C_2 = 3C$



$\mathcal{E} = \cancel{IR + L}\ L\frac{dI}{dt}$

$\frac{dI}{dt} = \frac{\mathcal{E}}{L}$

$U_2 = \mathcal{E}$

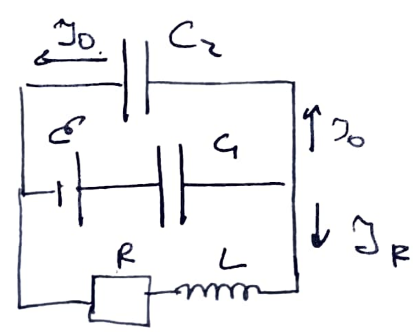
$\mathcal{E} = U_1 + IR + \frac{LdI}{dt}$

$U_1 = \mathcal{E}$

$q_{ист} = q_1 = C\mathcal{E}$

$A_{ист} = Q \cancel{+} W_1 + W_2$

$Q = C\mathcal{E}^2 - \frac{3C\mathcal{E}^2}{2} - \frac{C\mathcal{E}^2}{2} = -C\mathcal{E}^2$



$\mathcal{E} = U_1 + L\frac{dI}{dt} + I_R R =$

$= U_1 + U_R + \frac{LdI}{dt}$

$\mathcal{E} - U_1 - U_R = \frac{LdI}{dt}$

$(\mathcal{E} - U_1 - U_R)t = L\Delta I$

$\frac{I_0(\mathcal{E} - U_1 - U_R)}{C_2(\mathcal{E} - U_1)} = L\Delta I$

$\frac{I_0(\mathcal{E} - U_1)}{C_2(\mathcal{E} - U_1)} - \frac{I_0 I R}{}$

$\mathcal{E} - U_1 = \frac{q}{C_2}$

$(\mathcal{E} - U_1)t = \frac{\Delta I}{C_2}$

$t = \frac{I_0}{C_2(\mathcal{E} - U_1)}$