Часть 1

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

Шифр: **21200962**

ID профиля: **376477**

Вариант 5

ЧИСТОВИК

Задача 2.

Дано:

$i = 3$

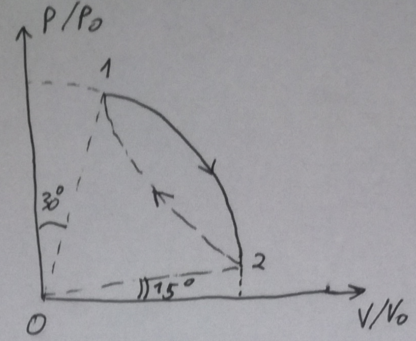
30°

15°

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

2) α - ?

3) $\frac{A_{121}}{A_{21}}$ - ?



Решение:

1) Так как сжатие газа характеризуется пренебрежимо малым теплообменом, то процесс 2-1 можно считать адиабатическим $\Rightarrow A_{21} = -\Delta U_{21}$

В точке 1 $P_1 = P_0 \cdot \cos 30^\circ = 0,87 P_0$

в точке 2 $P_2 = P_0 \cdot \cos(90^\circ - 15^\circ) = 0,26 P_0$

В точке 1 $V_1 = V_0 \cdot \sin 30^\circ = \frac{1}{2} V_0$

в точке 2 $V_2 = V_0 \cdot \cos 15^\circ = 0,97 V_0$

Тогда

$P_1 V_1 = \nu R T_1$

$P_2 V_2 = \nu R T_2$

$\Rightarrow \frac{T_1}{T_2} = \frac{P_1 V_1}{P_2 V_2} = \frac{0,87 P_0 \cdot \frac{1}{2} V_0}{0,26 P_0 \cdot 0,97 V_0} = \frac{0,435}{0,2522} = 1,72$

3) $A_{12} = \int\limits_{P_1}^{P_2} P^2 + V^2 dP = \frac{P_2^3}{3} + P_2 V_2^2 - \frac{P_1^3}{3} - P_1 V_1^2 = \frac{0,018}{3} + 0,245 - \frac{0,659}{3} - 0,218 =$

$= 0,251 - 438$

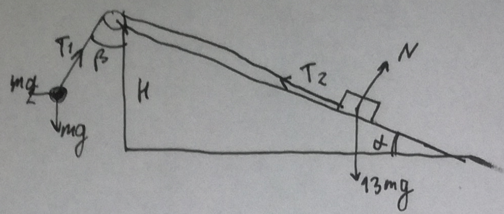
2) $C_V = \frac{3}{2} R$

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

Ответ: 1) $\frac{T_1}{T_2} = 1,72$

ЧИСТОВИК

Задача 1.



Дано:

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

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

$m_ш = m$

$m_б = 13m$

1) a - ? 2) $a_б$ - ? 3) t - ?

Решение:

1) $|T_1| = |T_2| \Rightarrow \frac{m(g - a_б \cdot \cos\beta)}{\cos\beta} \cdot \sin\beta = m(a - a_б \cdot \sin\beta)$, где $a_б$ - ускорение блока относительно клина

$a - a_б \cdot \sin\beta = (g - a_б \cdot \cos\beta) \cdot tg\beta$

$a - \cancel{a_б \cdot \sin\beta} = g \cdot tg\beta - \cancel{a_б \cdot \sin\beta}$

$a = g \cdot tg\beta \qquad tg\beta = \frac{\sin\beta}{\cos\beta} = \frac{\sqrt{1 - \frac{16}{25}}}{\frac{4}{5}} = \frac{\frac{3}{5}}{\frac{4}{5}} = \frac{3}{4}$

$a = g \cdot \frac{3}{4} = 10 \cdot \frac{3}{4} = 7{,}5\ м/с^2$

2) $|T_1| = |T_2|$

$\cancel{\cancel{m}(a - a_б \cdot \cos\beta) = 13\cancel{m}\, a_б}$

$\cancel{a - a_б \cdot \cos\beta = 13 a_б}$

$\cancel{a = 13 a_б - a_б \cdot \cos\beta}$

$\cancel{a = a_б (13 - \frac{4}{5})}$

$\cancel{a_б = \frac{a}{13 - \frac{4}{5}} = \frac{7{,}5}{13 - \frac{4}{5}} =}$

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

$\frac{mg}{\cos\beta} - m a_б = 13 m a_б$

$\frac{\cancel{m} g}{\cos\beta} = 14 \cancel{m} a_б$; $\frac{g}{\cos\beta} = 14 a_б$; $\frac{10}{\frac{4}{5}} = 14 a_б$; $a_б = \frac{12{,}5}{14} = 0{,}89\ м/с^2$

3) $S = \frac{H}{\cos\beta} = \frac{a_б \cdot t^2}{2}$

$t = \sqrt{\frac{2S}{a_б}} = \sqrt{\frac{2\frac{H}{\cos\beta}}{a_б}} = \sqrt{\frac{2H}{\cos\beta \cdot a_б}}$

Ответ: 1) $a = 7{,}5\ м/с^2$; 2) $a_б = 0{,}89\ м/с^2$ 3) $t = \sqrt{\frac{2H}{\cos\beta \cdot a_б}} = \sqrt{\frac{2H}{\cos\beta \cdot 0{,}89\ м/с^2}}$

1

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черновик

$$T = T \quad \frac{m(g - a_\delta \cdot \cos\beta)}{\cos\beta} \cdot \sin\beta = m(a - a_\delta \cdot \sin\beta)$$

$$m(g - a_\delta \cdot \cos\beta) \cdot tg\beta = m(a - a_\delta \cdot \sin\beta)$$

$$\cancel{m}(a - a_\delta \cdot \sin\beta) = 13 \cancel{m} a_\delta \qquad \frac{17,5}{12,2}$$

$$a - a_\delta \cdot \sin\beta = 13 a_\delta$$

$$\boxed{a - a_\delta \cdot \sin\beta = (g - a_\delta \cdot \cos\beta) tg\beta} \qquad a_\delta = 0,61475$$

$$\cancel{g\,tg\,a}$$

$$g \cdot \frac{\sin\beta}{\cos\beta} - a_\delta \cdot \sin\beta$$

$$g \cdot tg\beta = a = \frac{3}{4} g = 7,5 м/с^2$$

$$\cancel{g = tg}\beta$$

$$\frac{(g - a_\delta \cdot \cos\beta)}{\cos\beta} m \quad m\frac{g}{\cos\beta} - m a_\delta = 13 m a_\delta$$

$$\cancel{m}\frac{g}{\cos\beta} = 14 \cancel{m} a_\delta \qquad \frac{10}{\frac{4}{5}} = \frac{5}{4} \cdot 10 = 12,5$$

$$\frac{12,5}{14} = 0,892 = a_\delta$$

$H =$

$$S = \frac{H}{\cos\beta} = \qquad t = \sqrt{\frac{2H}{\cancel{\cos\beta \cdot a_\delta}}}$$

$$\frac{P^3}{3} + PV^2 \qquad C_V = \frac{i}{2} R$$

$$C_P = C_V + R = \frac{i}{2} \cdot R + R = R\left(\frac{i}{2} + 1\right) = \frac{i+2}{2} R$$

$$x^2 + y^2 = R^2$$

$$\int_{P_1}^{P_2} P^2 + V^2 \, dp = 2$$

$$\frac{P_2^3}{3} + P_2 V_2^2 - \frac{P_1^3}{3} - P_1 V_1^2$$

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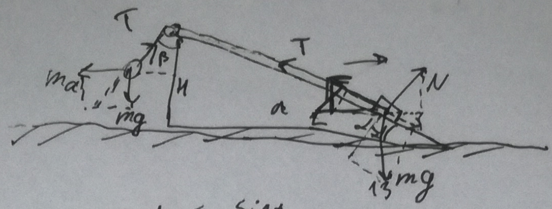
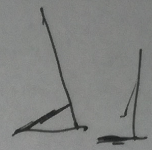
$m_ш = m$

$m_б = 13m$

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

Черновик.





$N = 13mg\cdot\cos\alpha$ $\quad mg\cdot\cancel{\cos\alpha}\cdot \cancel{tg\alpha}\cdot\frac{\sin\alpha}{\cos\alpha}$

$F_б = \cancel{13mg}\cdot\sin\alpha$ $\quad \cancel{13}mg\cdot\frac{5}{13} = 5mg$ $\quad \sin\alpha = \sqrt{1-\frac{144}{169}} = \sqrt{\frac{25}{169}} = \frac{5}{13}$

$Fб =$

$\cos\beta = \frac{4}{5}$ $\quad \sin\beta = \sqrt{1-\frac{16}{25}} = \sqrt{\frac{9}{25}} = \frac{3}{5}$

$tg\beta = \frac{\sin\beta}{\cos\beta} = \frac{\frac{3}{5}}{\frac{4}{5}} = \frac{3}{4} = \frac{ma}{mg} = \frac{a}{g} = \quad \frac{3}{4} = \frac{a}{g}$ $\quad a = \frac{3}{4}g = \frac{30}{4} = \frac{15}{2} =$

$= \boxed{7{,}5\,м/с^2}$

$a_{кл} = 7{,}5\,м/с^2$

$13g\cdot\cancel{\cos\alpha}\,\sin\alpha$

$5g - a\cdot\cos\alpha = g\cancel{\cos} + \cancel{\cos}(5g - a\cdot\cos\alpha)\cos\beta +$

$\frac{g\cdot}{\cos\beta}$

$a_1 = g\cdot\sin\alpha$

$a_2 = a\cdot\cos\alpha$

$a_1 = g\cdot\sin\alpha = 10\cdot\frac{5}{13} = \frac{50}{13}$ $\quad 3{,}85$

$g-$

$a_2 =$

$a_2 - a_1 = 7{,}5\cdot\cos\alpha - g\cdot\sin\alpha$

$6{,}92308$

$\boxed{a_б = 3{,}07692}$

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

$S = \frac{at^2}{2} = \frac{a_б\cdot t^2}{2}$ $\quad t^2 = \frac{S}{\frac{a}{2}} = \frac{2S}{a} =$

$t = \sqrt{\frac{2S}{a}} = \sqrt{\frac{2H}{\cos\beta\cdot a_б}}$

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Часть 2

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

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Вариант 5

ЧИСТОВИК

Задача 3.

Дано:

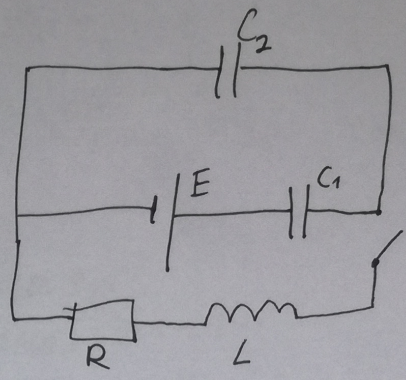
$C_1 = C$;

$C_2 = 2C$

1) V - ?

2) Q - ?

3) I_k - ?



Решения:

2) Через продолжительное время ток в цепи идти не будет, значит $E = U_{C_1} + U_{C_2}$; $U_{C_2} = 2U_{C_1}$, т.к. $2UC = 2UC$. $\Rightarrow$ $\boxed{U_{C_2} = \frac{1}{3}E \quad U_{C_1} = \frac{2}{3}E}$

$W_{C_1} = \frac{CU_{C_1}^2}{2}$; $W_{C_2} = \frac{2CU_{C_2}^2}{2} = CU_{C_2}^2$

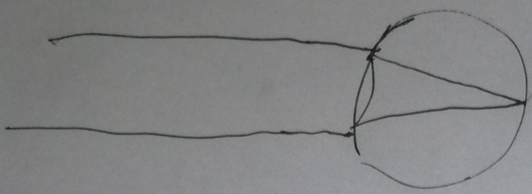
Вся теплота выделяется на резисторе; $\frac{C_2 U_{C_2}^2}{2} = \frac{LI^2}{2} = Q \Rightarrow$

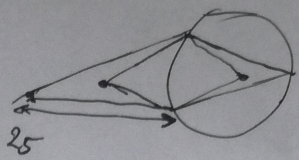
$\Rightarrow Q = CU_{C_2}^2 = W_{C_2} = \frac{C_2 U_{C_2}^2}{2} = \frac{\cancel{2}C \cdot \left(\frac{1}{3}E\right)^2}{\cancel{2}} = C \cdot \frac{1}{9}E^2 = \frac{CE^2}{9}$

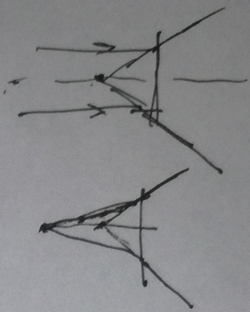
Ответ: 2) $Q = \frac{CE^2}{9}$

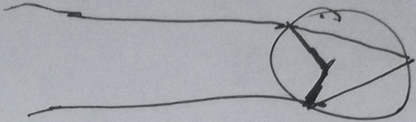
Черновик.

5.









25 см

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

25 $\quad \frac{1}{F} = \frac{1}{d} + \frac{1}{f}$

$D_2 = 2 D_1 = 0{,}08$ дптр

$D_1 = \frac{1}{25} + \frac{1}{x} \qquad \frac{1}{F_1} = \frac{1}{25} + \frac{1}{x}$

$S = V_0 t + \frac{at^2}{2}$

$\frac{d}{3t} = V_0 - \frac{at}{2}$

$D_2 = 0 + \frac{1}{x} \qquad \frac{1}{F_2} =$

$2D_1 = \frac{1}{x} = \frac{1}{12{,}5}$

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

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

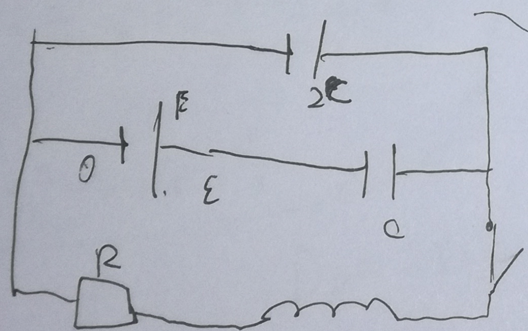
$\frac{d}{3} = V_0 \cdot t - \frac{a}{2} t^2$

$D_1 = \frac{1}{25} + \frac{1}{x} \qquad \frac{1}{2x} - \frac{1}{x} = \frac{1}{25}$

$\frac{1}{2x} \qquad \frac{1-2}{2x} = \frac{1}{25} \qquad -\frac{1}{2x} = \frac{1}{25}$

$-\frac{a}{2} t^2 + V_0 t - \frac{d}{3} = 0$

3.



$\frac{LI^2}{2} = \frac{CU^2}{2}$

$t = \frac{-V_0 \pm \sqrt{V_0^2 - \frac{2ad}{3}}}{-a}$

$V_0 \cdot t - \frac{at^2}{2} = \frac{d}{3}$

$t\left(V_0 - \frac{at}{2}\right) = \frac{d}{3}$

$-2x = 25$

$2x = -25$

$x = -12{,}5$ см

1. $d \cdot b = 2d^2 = S$

R

B

$H = \frac{d}{3} \qquad \mathcal{E} = \frac{\Delta \Phi}{\Delta t} \qquad \Delta \Phi = B \cdot \Delta S \cdot \cancel{\sin\alpha} \qquad \Delta S = d \cdot V_0 \cdot \Delta t$

$\mathcal{E} = \frac{B \cdot d \cdot V_0 \cdot \Delta t}{\Delta t} = B d V_0$

$F_a = IBL \cdot \cancel{\sin\alpha}$

$I = \frac{\mathcal{E}}{R} \qquad F_a = \frac{B d V_0}{R} \cdot B \cdot d = \frac{B^2 d^2 V_0}{R} \qquad a = \frac{B^2 d^2 V_0}{Rm}$

$\frac{d}{3} = V_0 \cdot \cancel{t} - \frac{at^2}{2} \qquad V_1 = V_0 - at$

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Черновик.

$V_1 = V_0 - at$

$\frac{d}{3} = \quad V_{cp} = \frac{V_0+V_1}{2}$

$V_{cp} \cdot t = \frac{d}{3} \quad \frac{V_0+V_1}{2} \cdot t = \frac{d}{3}$

$t = \frac{d}{3V_{cp}} = \quad \frac{2V_0 \cancel{+} at}{2} \cdot t = \frac{d}{3}$

$= \frac{2d}{3V_0 + 3V_1}$

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

$V_1 + a \cdot \frac{2}{3} \cdot \frac{d}{V_0+V_1}$

$(V_0+V_1)V_1 + a \cdot \frac{2d}{3} = V_0(V_0+V_1)$

$\cancel{V_0 V_1} + V_1^2 + a\frac{2}{3} = V_0^2 + \cancel{V_0 V_1}$

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

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

$V_2 = \sqrt{V_1 - \frac{2}{3}}$

$\frac{V_0+V_1}{2} \cdot t = \frac{d}{3}$

$t = \frac{\frac{d}{3}}{\frac{V_0+V_1}{2}} = \frac{\frac{2}{3}d}{V_0+V_1}$

$V_1 = V_0 - a \cdot t$

$V_1 = V_0 - a\left(\frac{\frac{2}{3}d}{V_0+V_1}\right)$

$V_1 + a\frac{\frac{2}{3}d}{V_0+V_1} = V_0 \quad | V_0+V_1$

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

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

$D_2 = \frac{D_1}{2}$

$\frac{D_1}{2} = \frac{1}{x} \quad D_1 = \frac{2}{x}$

$\frac{2}{x} - \frac{1}{x} = \frac{1}{25}$

$\frac{2-1}{x} = \frac{1}{25}$

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

$x = 25$

$\underline{1}$

$D_2 = 2D_1 =$

$D_2 = \frac{1}{x}$

$D_1 = \frac{1}{2x} = \frac{1}{25} + \frac{1}{x}$

$E = U_{c_1} + U_{c_2}$

$\frac{1}{2x} \cancel{-} \frac{1}{x} = \frac{1}{25}$

$\frac{1}{2x} - \frac{2}{2x} = \frac{1}{25}$

$-\frac{1}{2x} = \frac{1}{25}$

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

$\frac{1}{x} - \frac{2}{x} = \frac{2}{25}$

$-\frac{1}{x} = \frac{2}{25}$

$-\frac{1}{x} = 0{,}08$

$x = \frac{1}{0{,}08}$

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ЧИСТОВИК

Задача 4.

Дано:

$m; d; V_0; R; B.$

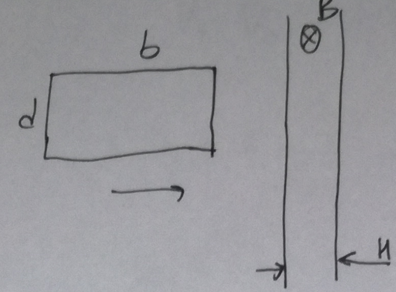
$H = d/3$

$b = 2d$

1) $a - ?$

2) $V_1 - ?$

3) $V_2 - ?$



$\cancel{a = \frac{V_0+V_1}{2S}}$

Решение:

1) $\mathcal{E} = -\frac{\Delta\Phi}{\Delta t}$ $\quad \Delta\Phi = B\cdot\Delta S$; $\Delta S = d\cdot V_0\cdot\Delta t \Rightarrow \Delta\Phi = B\cdot dV_0\cdot\Delta t \Rightarrow \mathcal{E} = -\frac{B\cdot d\cdot V_0\cdot\cancel{\Delta t}}{\cancel{\Delta t}} =$

$= -BdV_0$

$F_a = IBL\cdot\sin\alpha = IBL$; $I = \frac{\mathcal{E}}{R} = \frac{BdV_0}{R}$

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

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

2) $V_1 = V_0 - at$ (1)

$\frac{d}{3} = V_{cp}\cdot t = \frac{V_0+V_1}{2} \Rightarrow t = \frac{\frac{d}{3}}{\frac{V_0+V_1}{2}} = \frac{\frac{2}{3}d}{V_0+V_1}$ (2)

Подставляем в (1)

$V_1 = V_0 - a\left(\frac{\frac{2}{3}d}{V_0+V_1}\right)$; $V_1 + a\frac{\frac{2}{3}d}{V_0+V_1} = V_0 \quad \left|\cdot(V_0+V_1)\right.$;

$\cancel{V_0V_1} + V_1^2 + a\frac{2}{3}d = V_0^2 + \cancel{V_1\cdot V_0} \Rightarrow V_1 = \sqrt{V_0^2 - a\frac{2}{3}d} = \sqrt{V_0^2 - \frac{2B^2d^3V_0}{3Rm}}$

3) Скорость не менялась, пока стороны „d" не проходили через поле.

Тогда

$V_2 = V_1 - a't'$, где $a' = \frac{B^2d^2V_1}{Rm}$

Аналогично предыдущему пункту получаем: $V_2 = \sqrt{V_1^2 - a'\cdot\frac{2}{3}d}$

$$V_2 = \sqrt{V_1^2 - \frac{2B^2d^3V_1}{3Rm}} = \sqrt{V_1\left(V_1 - \frac{2B^2d^3}{3Rm}\right)}$$

Ответ: 1) $a = \frac{B^2d^2V_0}{Rm}$; 2) $V_1 = \sqrt{V_0^2 - \frac{2B^2d^3V_0}{3Rm}} = \sqrt{V_0\left(V_0 - \frac{2B^2d^3}{3Rm}\right)}$

3) $V_2 = \sqrt{V_1\left(V_1 - \frac{2B^2d^3}{3Rm}\right)}$

ЧИСТОВИК

Задача 5.

Дано:

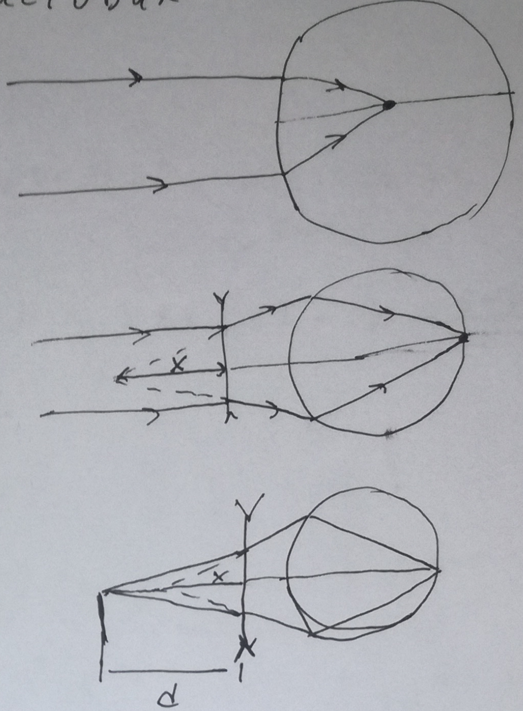
$d_1 = 25$ см $d_2 = 50$ см

$\frac{D_2}{D_1} = 2$

1) x - ?

D_2 - ?

2) D_3 - ?



Решение:

1) $D_1 = \frac{1}{25} + \frac{1}{x}$

$D_2 = \frac{1}{x} + 0$

$2D_1 = \frac{1}{x}$

$\cancel{D_1 =}$ $\frac{1}{2x} - \frac{1}{x} = \frac{1}{25} \Rightarrow \frac{1-2}{2x} = \frac{1}{25} \Rightarrow -\frac{1}{2x} = \frac{1}{25} \Rightarrow 2x = -25 \Rightarrow x = -12,5$ см

Значит мнимое изображение, находится слева от линзы => => линза рассеивающая

$|x| = 12,5$ см

$\frac{D_2}{100} = 2D_1 = \frac{1}{12,5} = 0,08 = 8$ дптр

2) $d_2 = 50$ см

$\frac{D_3}{100} = \cancel{\frac{1}{50}} \cancel{+ \frac{1}{x}} = \frac{1}{x} - \frac{1}{50} = \frac{1}{12,5} - \frac{1}{50} = 0,06 = 6$ дптр

Ответ: 1) $x = 12,5$ см ; 2) $D_3 = 0,06 \cdot 100$ см $= 6$ дптр

$D_2 = 0,08 \cdot 100$ см $= 8$ дптр

3