Часть 1

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

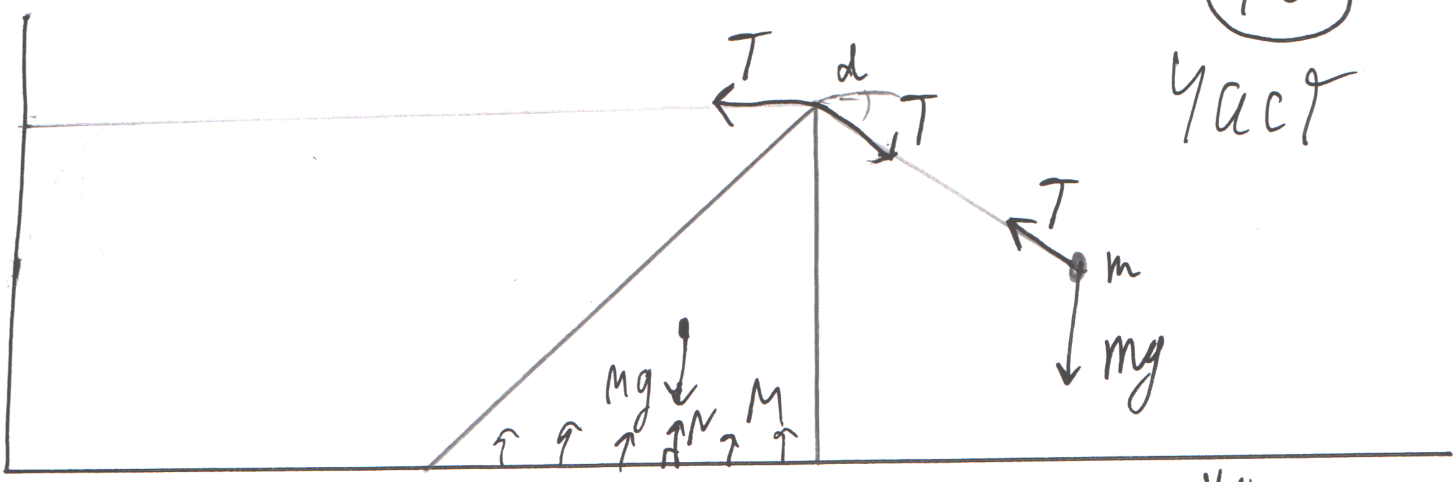
Шифр: **21201008**

ID профиля: **318547**

Вариант 3

(10)

Част



прод. реш. на стр. 4:

$$\frac{\partial L}{\partial l} = \frac{d}{dt}\frac{\partial L}{\partial \dot{l}}$$

ЧЕРН

$$m l(\dot{\alpha})^2 + m \sin\alpha\, \dot{l}\, \dot{\alpha} + mg\sin\alpha = \frac{d}{dt}\left[2m(1-\cos\alpha)(\dot{l})^2 + m l \sin\alpha\, \dot{\alpha} + M\dot{l}\right]$$

$\alpha = const \to \dot{\alpha} = \ddot{\alpha} = 0$

$$mg\sin\alpha = 2m(1-\cos\alpha)\ddot{l} + M\ddot{l}$$

$$mg\sin\alpha = 2m(1-\cos\alpha)\left[g\cos\alpha - (1-\sin\alpha)\frac{\dot{l}^2}{l}\right](2m(1-\cos\alpha)+M)$$

$$mg\sin\alpha = mg\cdot 2\cos\alpha(1-\cos\alpha) + \frac{M}{m}g\cos\alpha - \frac{\dot{l}^2}{l}(1-\sin\alpha)(2m(1-\cos\alpha)$$

Не успел

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9 Лист

$$\left[2(1-\cos\alpha)\frac{m}{M}+1\right](1-\cos\alpha) = (1+\tan^{-1}\alpha\,\tan\beta)\sin^2\alpha$$

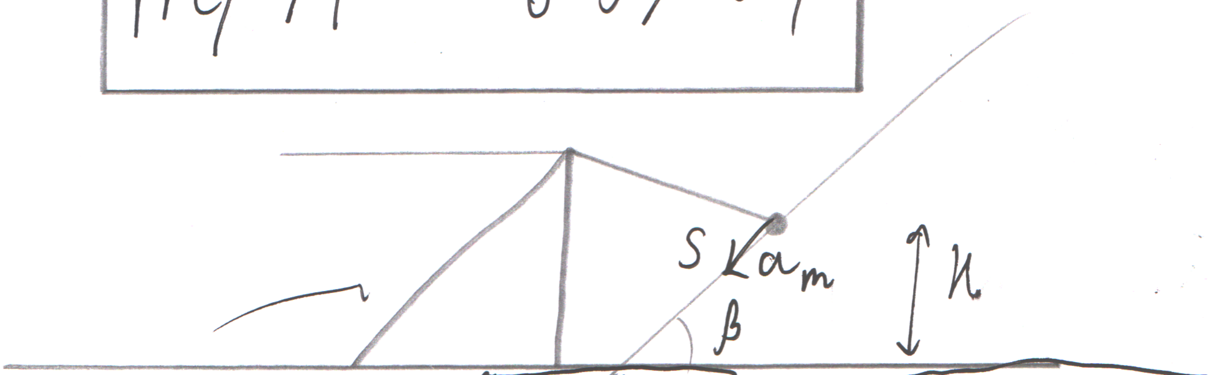
$$2(1-\cos\alpha)\frac{m}{M}+1 = (1+\tan^{-1}\alpha\,\tan\beta)\frac{(1-\cos\alpha)(1+\cos\alpha)}{1-\cos\alpha}$$

$$\frac{m}{M} = \frac{1}{2(1-\cos\alpha)}\left[(1+\tan^{-1}\alpha\,\tan\beta)(1+\cos\alpha)-1\right]$$

~~$\frac{m}{M} = 39/80$~~

$$\boxed{m/M = 65/64}$$

4)



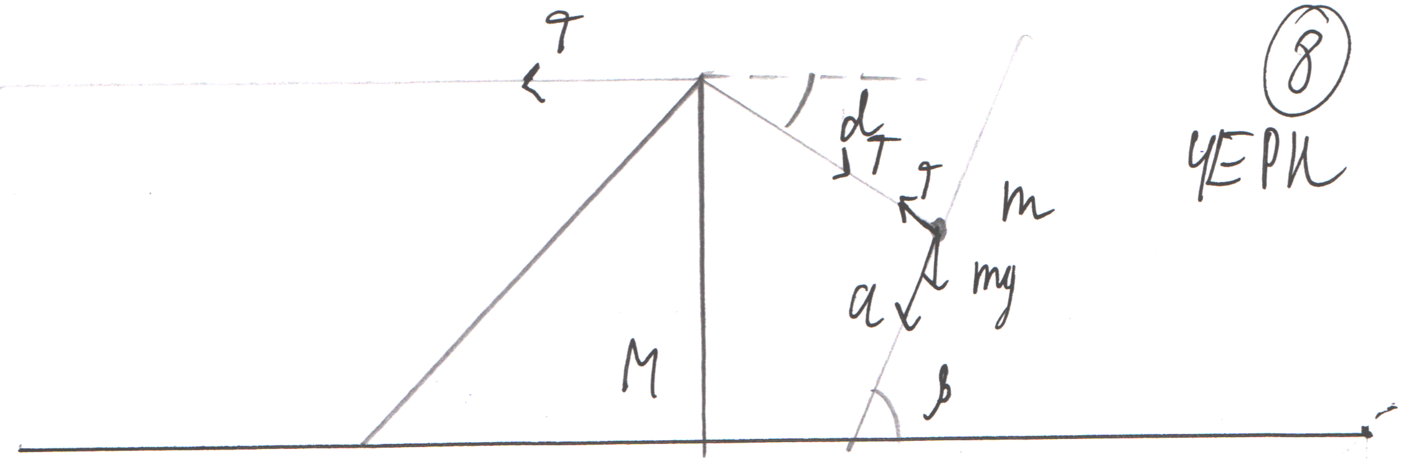
$$t=\sqrt{\frac{2S}{a_m}}=\sqrt{\frac{2H/\sin\beta}{2(1-\cos\alpha)a_M}}=\sqrt{\frac{1}{(1-\cos\alpha)\sin\beta}\,\frac{H}{a_M}}$$

$a_M = \frac{256}{623}g$ $\quad\sin\beta = \frac{3}{\sqrt{13}}$ $\quad 1-\cos\alpha = 8/13$

$$\boxed{t \approx 2.18\sqrt{\frac{H}{g}}}$$

(8)

ЧЕРН



$$(a_m)_y / (a_m)_x = \tan\beta = 3/2$$

$$\frac{T\sin\alpha - mg}{-T\cos\alpha} = \tan\beta$$

$$T\sin\alpha - mg = -T\cos\alpha\tan\beta$$

$$T(\sin\alpha + \cos\alpha\tan\beta) = mg$$

$$Ma_M = T(1-\cos\alpha)$$

$$\begin{cases} M\dfrac{\sin\alpha}{2(1-\cos\alpha)+M/m}g = T(1-\cos\alpha) \\ mg = T(\sin\alpha+\cos\alpha\tan\beta) \end{cases}$$

$$\frac{m}{M} = \frac{\sin\alpha+\cos\alpha\tan\beta}{(1-\cos\alpha)\Big/\dfrac{\sin\alpha}{2(1-\cos\alpha)+M/m}}$$

$$mg = (\sin\alpha+\cos\alpha\tan\beta)Mg\frac{\sin\alpha}{(2(1-\cos\alpha)+M/m)(1-\cos\alpha)}$$

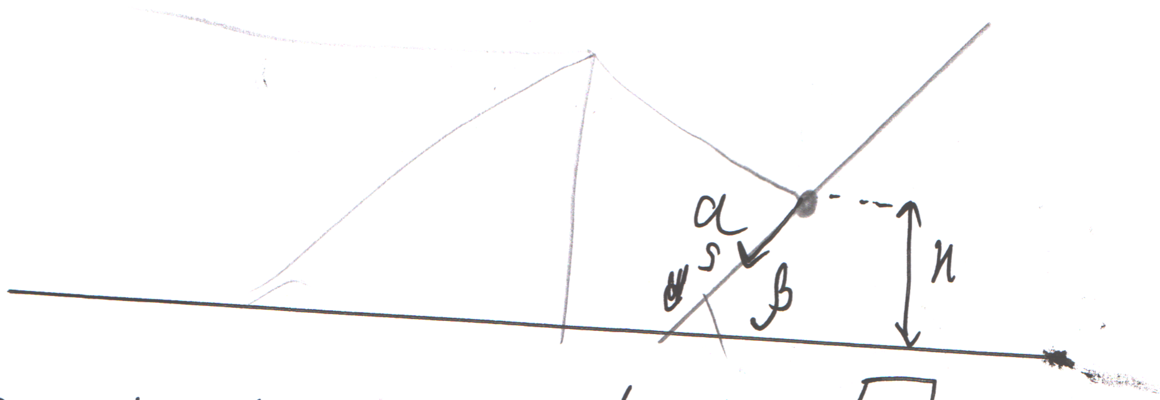
$$\frac{m}{M}\left(2(1-\cos\alpha)+\frac{M}{m}\right)(1-\cos\alpha) = (\sin\alpha+\cos\alpha\tan\beta)\sin\alpha$$

2)

(7) чист

$$a = \frac{\sin\alpha}{2(1-\cos\alpha) + M/m}\, g$$

4)



$$S = H/\sin\beta = H \Big/ \frac{\tan\beta}{\sqrt{1+\tan^2\beta}} = \frac{\sqrt{13}}{3} H$$

$$t = \sqrt{\frac{2S}{a}}$$

$$\left(\frac{d}{dt}\begin{pmatrix}x_m\\ y_m\end{pmatrix}\right)^2 = \left(-\dot{r}\begin{pmatrix}1-\cos\alpha\\ \sin\alpha\end{pmatrix}\right)^2 = \dot{r}^2\cdot\left[\sin^2\alpha + (1-\cos\alpha)^2\right] =$$

$$= 2(1-\cos\alpha)\,\dot{r}^2$$

6

$$\frac{d}{dt}\begin{pmatrix}x_M\\ y_M\end{pmatrix} = \frac{d}{dt}\begin{pmatrix}L-r\\ 0\end{pmatrix} = -\dot{r}$$

УИСТ

$$\left(\frac{d}{dt}\begin{pmatrix}x_M\\ y_M\end{pmatrix}\right)^2 = \dot{r}^2$$

$$E_k = \frac{m}{2}V_m^2 + \frac{M}{2}V_M^2 = \frac{m}{2}\cdot 2(1-\cos\alpha)\dot{r}^2 + \frac{M}{2}\dot{r}^2 =$$

$$= \left((1-\cos\alpha)m + \frac{M}{2}\right)\dot{r}^2$$

$$E_p = mg\cdot -r\sin\alpha = -mg\sin\alpha\, r$$

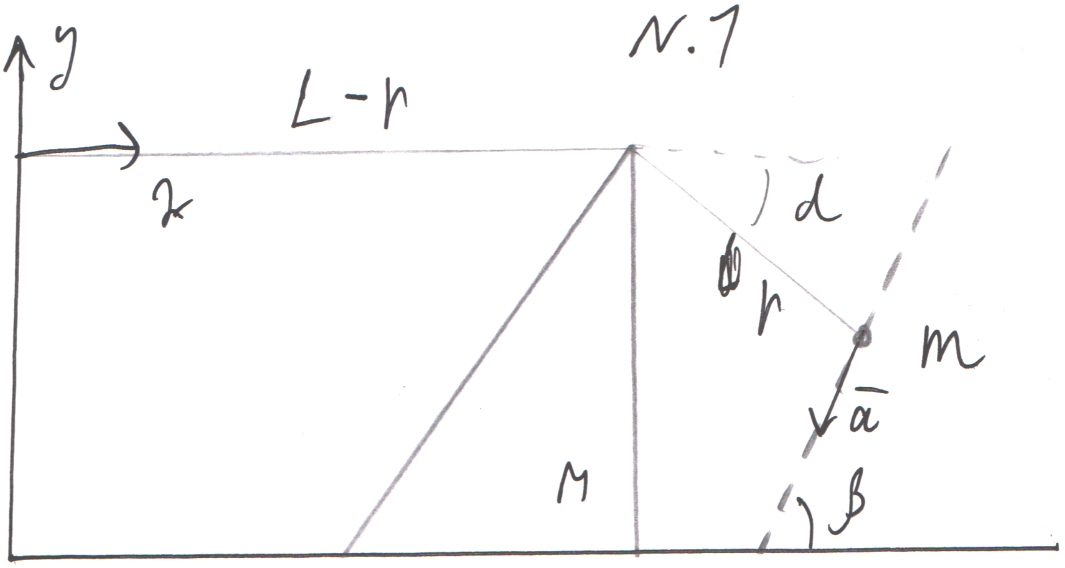
$$\mathcal{L} = \left[(1-\cos\alpha)m + \frac{M}{2}\right]\dot{r}^2 + mg\sin\alpha\, r$$

$$\frac{\partial\mathcal{L}}{\partial r} = \frac{d}{dt}\frac{\partial\mathcal{L}}{\partial\dot{r}}$$

$$mg\sin\alpha = 2\left[(1-\cos\alpha)m + \frac{M}{2}\right]\ddot{r}$$

$$\ddot{r} = g\frac{m\sin\alpha}{2(1-\cos\alpha)m + M} =$$

$$= \frac{\sin\alpha}{2(1-\cos\alpha) + M/m}\,g$$



Лист 5

$$\begin{cases} x_m = (L-r) + r\cos\alpha = L - (1-\cos\alpha) r \\ y_m = -r\sin\alpha \end{cases}$$

$$\frac{d^2}{dt^2}\begin{pmatrix} x_m \\ y_m \end{pmatrix} = \begin{pmatrix} -(1-\cos\alpha)\ddot{r} \\ -\sin\alpha\,\ddot{r} \end{pmatrix} = -\ddot{r}\cdot\begin{pmatrix} 1-\cos\alpha \\ \sin\alpha \end{pmatrix}$$

$$\tan\beta = \frac{\sin\alpha}{1-\cos\alpha} = \frac{\sqrt{1-\cos^2\alpha}}{\sqrt{(1-\cos\alpha)^2}} = \frac{\sqrt{(1-\cos\alpha)(1+\cos\alpha)}}{\sqrt{(1-\cos\alpha)(1-\cos\alpha)}}$$

$$\boxed{\tan\beta = \sqrt{\frac{1+\cos\alpha}{1-\cos\alpha}} = \frac{3}{2}}$$

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$$V^2 = (\cos^2\alpha - 2\cos\alpha + 1 + \sin^2\alpha)\left(\frac{dl}{dt}\right)^2 + l^2\left(\frac{d\alpha}{dt}\right)^2 +$$ (4)

$$+ 2l(-\sin\alpha\cos\alpha + \sin\alpha + \sin\alpha\cos\alpha)\frac{dl}{dt}\frac{d\alpha}{dt} =$$ ЧЕРК

$$= 2(1-\cos\alpha)\left(\frac{dl}{dt}\right)^2 + l^2\left(\frac{d\alpha}{dt}\right)^2 + 2l\sin\alpha\frac{dl}{dt}\frac{d\alpha}{dt}$$

$$L = E_k - E_p = \frac{m}{2}\left[2(1-\cos\alpha)(\dot{l})^2 + l^2(\dot{\alpha})^2 + 2l\sin\alpha\,\dot{l}\,\dot{\alpha}\right] +$$

$$+ \frac{M}{2}(\dot{l})^2 + mgl\sin\alpha$$

~~ЧЕРК~~

$$\frac{\partial L}{\partial \alpha} = \frac{d}{dt}\frac{\partial L}{\partial \dot{\alpha}}$$

$$\frac{m}{2}\left[2\sin\alpha(\dot{l})^2 + 2l\cos\alpha\,\dot{l}\,\dot{\alpha}\right] + mgl\cos\alpha = \frac{d}{dt}\left[ml^2\dot{\alpha}\right] + \frac{d}{dt}\left[ml\dot{l}\dot{\alpha}\right]$$

$$\alpha = const \rightarrow \dot{\alpha} = \ddot{\alpha} = 0$$

$$m\sin\alpha(\dot{l})^2 + mgl\cos\alpha = 0 \quad m((\dot{l})^2 + ml\ddot{l})$$

~~$\left(\frac{dl}{dt}\right)^2 + g\cot\alpha\, l = 0\left(\frac{dl}{dt}\right)^2$~~

$$gl\cos\alpha = (1-\sin\alpha)(\dot{l})^2 + l\ddot{l}$$

$$\ddot{l} = g\cos\alpha - (1-\sin\alpha)\frac{(dl/dt)^2}{l}$$

Прод. на стр. (10)

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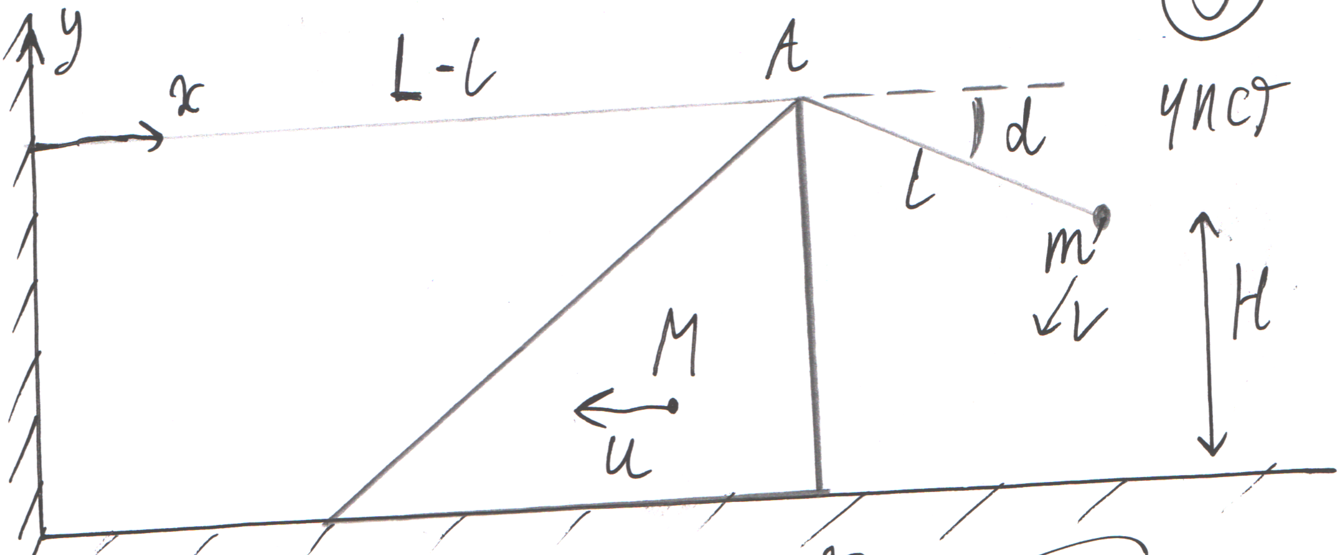
N.1

③ ЧИСТ



$$\begin{cases} E_k = \frac{M}{2}u^2 + \frac{m}{2}v^2 \\ E_p = -mgl\sin\alpha \end{cases}$$

$$u = \left|\frac{d}{dt}x_A\right| = \frac{dl}{dt}$$

$$v = \sqrt{\left(\frac{d}{dt}x_m\right)^2 + \left(\frac{d}{dt}y_m\right)^2} = \sqrt{\left(\frac{d}{dt}[x_A + l\cos\alpha]\right)^2 + \left(\frac{d}{dt}[y_A - l\sin\alpha]\right)^2}$$

$$v = \sqrt{\left(-\frac{dl}{dt} + \frac{dl}{dt}\cos\alpha - l\sin\alpha\frac{d\alpha}{dt}\right)^2 + \left(\frac{dl}{dt}\sin\alpha + l\cos\alpha\frac{d\alpha}{dt}\right)^2}$$

$$v^2 = \left((\cos\alpha - 1)\frac{dl}{dt} - l\sin\alpha\frac{d\alpha}{dt}\right)^2 + \left(\frac{dl}{dt}\sin\alpha + l\cos\alpha\frac{d\alpha}{dt}\right)^2$$

$$v^2 = \left[(\cos\alpha - 1)^2 + \sin^2\alpha\right]\left(\frac{dl}{dt}\right)^2 + l^2\left[\sin^2\alpha + \cos^2\alpha\right]\left(\frac{d\alpha}{dt}\right)^2 + 2l\left[-(\cos\alpha - 1)\sin\alpha + \sin\alpha\cos\alpha\right]\frac{dl}{dt}\frac{d\alpha}{dt}$$

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$$-\Delta A = \frac{3}{2} R\nu T_0 \left[(\theta_m^2 - 1^2) - (\theta_m - 1) \right] =$$

$$= \frac{3}{2} R\nu T_0 \left[\theta_m^2 - \theta_m \right]$$

(2)

$$-\Delta A = \min \rightarrow \frac{\partial}{\partial \theta_m} \Delta A = 0$$

$$2\theta_m - 1 = 0 \qquad \theta_m = \frac{1}{2}$$

$$\boxed{T_m = T_0 / 2}$$

3)

$$-\Delta A = \frac{3}{2} R\nu T_0 \left[\theta_m^2 - \theta_m \right] =$$

$$= \frac{3}{2} R\nu T_0 \left[\frac{1}{4} - \frac{1}{2} \right]$$

$$\Delta A = \frac{3}{2} R\nu T_0 \cdot \frac{1}{4} = \frac{3}{8} R\nu T_0$$

$$\boxed{\Delta A_m = \frac{3}{8} R\nu T_0}$$

N.2.

(1) часть

$$dQ = \nu C\, dT$$

$$C = 3R\frac{T}{T_0}$$

$$dQ = \nu \cdot 3R\frac{T}{T_0}dT = 3R\frac{\nu}{T_0}T\,dT = d\left[\frac{3}{2}\frac{R\nu}{T_0}T^2\right]$$

1) $$Q_1 = \int dQ = \frac{3}{2}\frac{\nu R}{T_0}T^2\Big|_{\frac{3}{5}T_0}^{T_0} = \frac{3}{2}\frac{\nu R}{T_0}T_0^2\left(1-\frac{9}{25}\right) =$$

$$= \frac{3}{2}\frac{\nu R}{T_0}T_0^2\cdot\frac{16}{25} = \frac{\cancel{32}\,24}{25}\nu R T_0$$

$$Q_1 = \frac{\cancel{32}\,24}{25}\nu R T_0$$

$$\boxed{Q_1 = \frac{24}{25}\nu R T_0}$$

2)
$$dQ = dU + dA$$

$$\Delta Q = \Delta U + \Delta A$$

$$\Delta Q = \Delta\left[\frac{3}{2}\frac{R\nu}{T_0}T^2\right]$$

$$\Delta U = \Delta\left[C_V T\right] = \frac{3}{2}R\nu\,\Delta T$$

$$-\Delta A = \Delta\left[\frac{3}{2}\frac{R\nu}{T_0}T^2\right] - \frac{3}{2}R\nu\Delta T$$

$$\theta \equiv T/T_0$$

$$-\Delta A = \frac{3}{2}R\nu T_0\left[\Delta[\theta^2] - \Delta\theta\right]$$

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Часть 2

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

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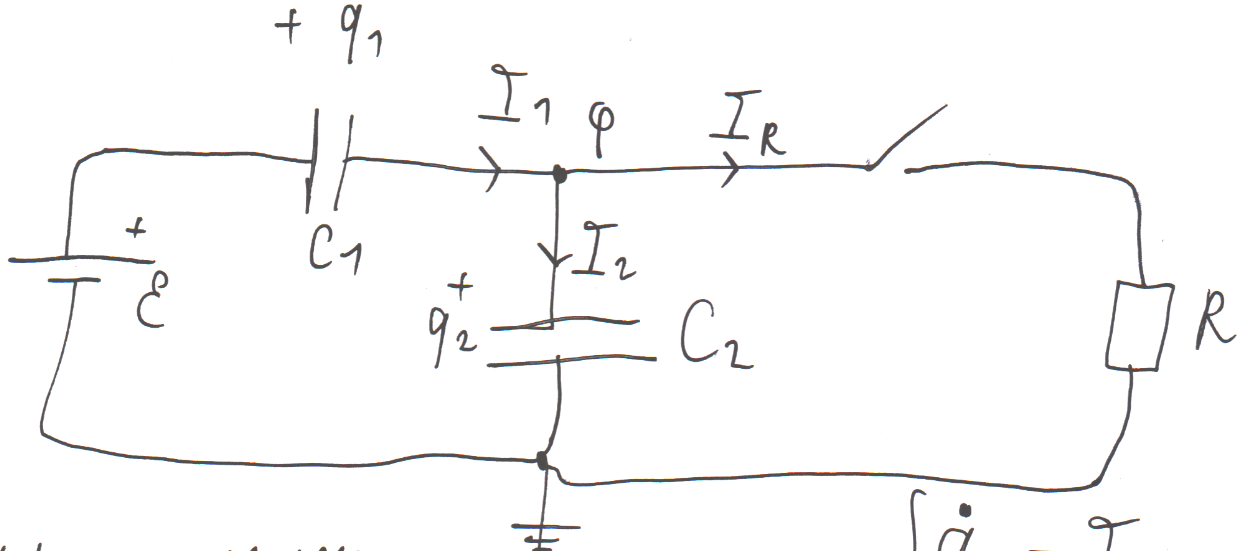
Вариант 3

N. 3

(1) лист



Ключ разомкнут:

$I_1 = I_2$ ✓ $I_R = 0$

$\dot{q}_1 = \dot{q}_2$ $\quad q_1(0) = q_2(0) = 0$

$q_1 = q_2$

$C_1(\mathcal{E} - \varphi) = C_2 \varphi$

$$\varphi = \mathcal{E} \frac{C_1}{C_1 + C_2}$$

$$\begin{cases} \dot{q}_1 = I_1 \\ \dot{q}_2 = I_2 \end{cases}$$

$$\begin{cases} q_2 = C_2 \varphi \\ q_1 = C_1(\mathcal{E} - \varphi) \end{cases}$$

$I_1 = I_2 + I_R$

$$q_1 = q_2 = \mathcal{E}\frac{C_1 C_2}{C_1 + C_2} = \frac{\mathcal{E}}{1/C_1 + 1/C_2}$$

Ключ замыкают:

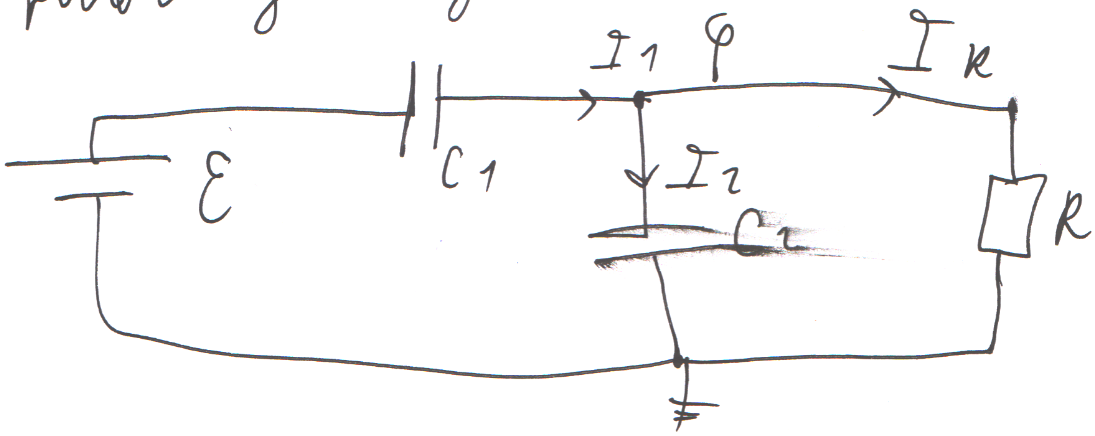
$R I_R = \varphi$

1)
$$\boxed{I_R = \frac{C_1}{C_1 + C_2} \frac{\mathcal{E}}{R}}$$

2)

Ключ замкнут:

② лист



$$\begin{cases} I_1 = I_2 = I_R = 0 \\ R I_R = \varphi \end{cases}$$

$$\varphi = 0$$

$$\begin{cases} q_2 = \varphi C_2 = 0 \\ q_1 = (\mathcal{E} - \varphi) C_1 = \mathcal{E} C_1 \end{cases}$$

$$\Delta A = \Delta Q + \Delta U$$

↑ работа источника

теплота

изм. внутренней энергии

$$dA = \mathcal{E}\, dq \rightarrow A = \mathcal{E}\,\Delta q_1 = \mathcal{E}\left(\mathcal{E}C_1 - \mathcal{E}\frac{C_1 C_2}{C_1 + C_2}\right)$$

$$\Delta U = U_1 - U_0 = \frac{q_1^2}{2C_1} + \frac{q_2^2}{2C_2} =$$

$$= \left(\frac{\mathcal{E}^2 C_1}{2} + 0\right) - \left(\frac{1}{C_1} + \frac{1}{C_2}\right) \cdot \frac{1}{2} \cdot \frac{\mathcal{E}^2}{(1/C_1 + 1/C_2)^2} =$$

$$= \frac{\mathcal{E}^2}{2}\left[C_1 - \frac{1}{1/C_1 + 1/C_2}\right]$$

$$\Delta U = \frac{\varepsilon^2}{2}\left[C_1 - \frac{C_1 C_2}{C_1 + C_2}\right] =$$

$$= \frac{\varepsilon^2}{2}\left[\frac{C_1^2 + C_1C_2 - C_1C_2}{C_1 + C_2}\right] = \frac{\varepsilon^2 C_1^2}{2(C_1 + C_2)}$$

$$\Delta Q = \Delta A - \Delta U = \frac{\varepsilon^2 C_1^2}{C_1 + C_2} - \frac{1}{2}\frac{\varepsilon^2 C_1^2}{C_1 + C_2} = \frac{1}{2}\frac{\varepsilon^2 C_1^2}{C_1 + C_2}$$

2)

$$\boxed{\Delta Q = \frac{1}{2}\frac{\varepsilon^2 C_1^2}{C_1 + C_2}}$$

3)

$$\begin{cases} \dot q_1 = I_1 \\ \dot q_2 = I_2 \\ q_1/C_1 + q_2/C_2 = \varepsilon \end{cases}$$

$$\dot q_1/C_1 + \dot q_2/C_2 = 0$$

$$I_1/C_1 + I_2/C_2 = 0$$

$$I_2 = -I_1\frac{C_2}{C_1}$$

4

лист

$I_1 = I_2 + I_R$

$I_R = I_1 - I_2 =$

$= I_1 \left(1 + \frac{C_2}{C_1}\right)$

$\varphi = R I_R = R I_1 \left(1 + \frac{C_2}{C_1}\right)$

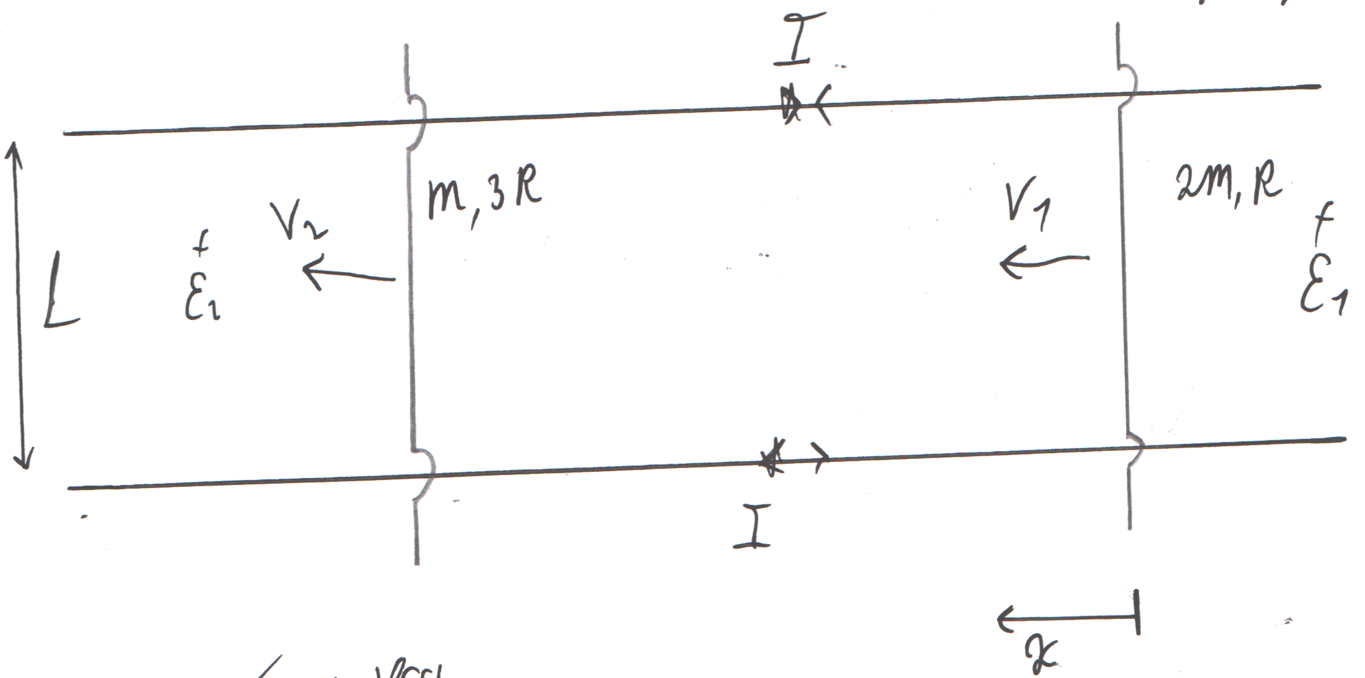
$I_1 = I_0$

↓

$$\boxed{\varphi = R I_0 \left(1 + \frac{C_2}{C_1}\right)}$$

N.4

⑤ лист



$-e(\bar{V}\times\bar{B}+\bar{E})=0$

$\bar{E}=-\bar{V}\times\bar{B}=\bar{B}\times\bar{V}$

$$\begin{cases}\mathcal{E}_1=BLV_1\\ \mathcal{E}_2=BLV_2\end{cases}$$

$$\mathcal{E}_1-\mathcal{E}_2=I(R_1+R_2)$$

$$BL(V_1-V_2)=(R_1+R_2)I$$

$$I=\frac{BL}{R_1+R_2}(V_1-V_2)$$

$$F=BIL$$

$$\begin{cases}m_1\frac{dV_1}{dt}=-BIL=-\frac{(BL)^2}{R_1+R_2}(V_1-V_2)\\ m_2\frac{dV_2}{dt}=+BIL=+\frac{(BL)^2}{R_1+R_2}(V_1-V_2)\end{cases}$$

$$\frac{d}{dt}\begin{pmatrix}V_1\\V_2\end{pmatrix}=\frac{(BL)^2}{R_1+R_2}\begin{pmatrix}-1/m_1 & 1/m_1\\ 1/m_2 & -1/m_2\end{pmatrix}\begin{pmatrix}V_1\\V_2\end{pmatrix}$$

⑥ чист

1) $$\left.\frac{dV_1}{dt}\right|_0 = \frac{-(BL)^2}{R_1+R_2}\left(V_1|_0 - V_2|_0\right) = -\frac{(BL)^2}{R_1+R_2}V_0 = -\frac{(BL)^2}{4R}V_0$$

$$a_1|_0 = \frac{(BL)^2}{4R}V_0$$

(против скорости)

$$\begin{pmatrix} W_1 & W_1 \\ W_2 & W_1 \end{pmatrix}$$

2) $$\frac{d}{dt}\begin{pmatrix} V_1 \\ V_2 \end{pmatrix} = \frac{(BL)^2}{R_1+R_2}\begin{pmatrix} -W_1 & W_1 \\ W_2 & -W_2 \end{pmatrix}\begin{pmatrix} V_1 \\ V_2 \end{pmatrix}$$

$W_1 = 1/m_1$ $\quad$ $W_2 = 1/m_2$

$$\frac{d\bar{V}}{dt} = A\bar{V}$$

S – собст. вектора A

Λ – собст. числа A

$$\bar{V}(t) = S e^{\Lambda t} S^{-1}\bar{V}(0) =$$

$$= (x_1 \;\; x_2) e^{\Lambda t} (x_1 \;\; x_2)^{-1}\bar{V}(0)$$

~~$\lambda_1\lambda_2 = W_1 W_2$~~

$$\begin{cases} \lambda_1\lambda_2 = \det A = 0 \\ \lambda_1 + \lambda_2 = \operatorname{tr} A = -W_1 - W_2 \end{cases}$$

$\downarrow$

$$\begin{cases} \lambda_1 = 0 \\ \lambda_2 = (-W_1 - W_2)\frac{(BL)^2}{R_1+R_2} \end{cases}$$

$$\Lambda = \begin{pmatrix} 0 & 0 \\ 0 & -W_1 - W_2 \end{pmatrix}$$

$\lambda_2 < 0$

$\downarrow$

$$\lim_{t\to\infty} e^{\Lambda t} = \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}$$

$$\lim_{t\to\infty}\bar{V}(t) = (x_1 \;\; x_2)\begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}(x_1 \;\; x_2)^{-1}\bar{V}(0) = (x_1 \;\; 0) S^{-1}\bar{V}(0)$$

$$\lim_{t\to\infty}\bar{V}(t) = C x_1 = \begin{pmatrix} V_\infty \\ V_\infty \end{pmatrix}$$

$A x_1 = \lambda_1 x_1$

$x_1 = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$

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$Ag=0$

$g=\begin{pmatrix}1\\1\end{pmatrix}$

$\frac{d}{dt}(g^T x) = \frac{dg^T}{dt}x + g^T\frac{dx}{dt} = g^T A x$

$$(m_1 \quad m_2)A = (m_1 \quad m_2)\frac{(BL)^2}{R_1+R_2}\begin{pmatrix}-1/m_1 & 1/m_1\\ 1/m_2 & -1/m_2\end{pmatrix} = (0 \quad 0)$$

$$g^T A = (0 \quad 0)$$

$$g^T = (m_1 \quad m_2)$$

$$\frac{d}{dt}(g^T x) = g^T\frac{dx}{dt} = (g^T A)x = 0$$

$$\downarrow$$

$$g^T x = \text{const}$$

$$m_1 V_1 + m_2 V_2 = \text{const}$$

$$m_1 V_\infty + m_2 V_\infty = m_1 V_0$$

$$\boxed{V_\infty = \frac{m_1}{m_1+m_2}V_0}$$

~~2) (альт. решение)~~

2) (альт. решение)

система инвариантна при переносе в направлении Ox. По теореме Нетер, импульс в направлении x сохраняется:

$$p_x = m_1 v_1 + m_2 v_2 = const$$

данный закон можно использовать вместо вывода данного на прошлой странице.

3) $S = S_0 - \int \frac{dS}{dt} dt$

$$\frac{dS}{dt} = v_2 - v_1 = (-1 \quad 1)\bar{v}$$

$$\int \frac{dS}{dt} dt = (-1 \quad 1)\int \bar{v}\, dt$$

$$\bar{v} = S e^{\Lambda t} S^{-1} \bar{v}(0)$$

~~$(-1 \quad 1)S = (-1 \quad 1)\begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix} = (0 \quad -2)$~~

~~$\int \frac{dS}{dt} dt =$~~

$$(-1 \quad 1)S = (-1 \quad 1)\begin{pmatrix} 1 & w_1 \\ 1 & w_2 \end{pmatrix} = (0 \quad w_2 - w_1)$$

$$\int \frac{dS}{dt} dt = (0 \quad w_2 - w_1)\int e^{\Lambda t} S^{-1} \bar{v}(0)\, dt =$$

$$= \int \begin{pmatrix} 0 & 0 \\ 0 & e^{\lambda_2 t} \end{pmatrix} (w_2 - w_1) S^{-1} \bar{v}(0)\, dt$$

9

чист

$$\left(\begin{array}{cc|c} 1 & W_1 & V_1 \\ 1 & W_2 & 0 \end{array}\right)$$

$$\left(\begin{array}{cc|c} 1 & W_1 & V_1 \\ 0 & W_2-W_1 & -V_1 \end{array}\right)$$

$$\left(\begin{array}{cc|c} 1 & W_1 & V_1 \\ 0 & 1 & -\frac{V_1}{W_2-W_1} \end{array}\right)$$

$$\left(\begin{array}{cc|c} 1 & 0 & V_1+\frac{V_1W_1}{W_2-W_1} \\ 0 & 1 & -\frac{V_1}{W_2-W_1} \end{array}\right)$$

$$S^{-1}\bar{V}(0) = \begin{pmatrix} V_0 W_2 \\ -V_0 \end{pmatrix} / (W_2-W_1)$$

$$S^{-1}\bar{V}(0) = \begin{pmatrix} V_0 \frac{W_2}{W_2-W_1} \\ V_0 \frac{-1}{W_2-W_1} \end{pmatrix}$$

$$\frac{A/C}{\frac{1}{KT}(M/A)} = \frac{A^3}{C \cdot M/KT} =$$

$$\frac{\theta T/A \cdot \theta T/A^2}{\frac{1}{KT}(M/A)^2} = \frac{\theta T}{M^2/KT} =$$

$$= \frac{M \cdot \theta M/C}{KT/KT} \cdot \frac{KT \cdot M/C}{M} =$$

$$= \frac{KT \cdot M/C}{KT \cdot M/C^2} = C$$

$$\int \frac{dS}{dt}dt = \int \begin{pmatrix} 0 & 0 \\ 0 & e^{\lambda_2 t} \end{pmatrix} \begin{pmatrix} W_2 \\ -1 \end{pmatrix} V_0\, dt =$$

$$= -V_0 \int e^{\lambda_2 t} dt$$

$$\int_0^{\infty} \frac{dS}{dt}dt = -\frac{V_0}{\lambda_2} = \frac{R_1+R_2}{W_1+W_2}(BL)^{-2} V_0$$

$$\boxed{S_\infty = S_0 - \frac{R_1+R_2}{\left(\frac{1}{m_1}+\frac{1}{m_2}\right)(BL)^2} V_0}$$

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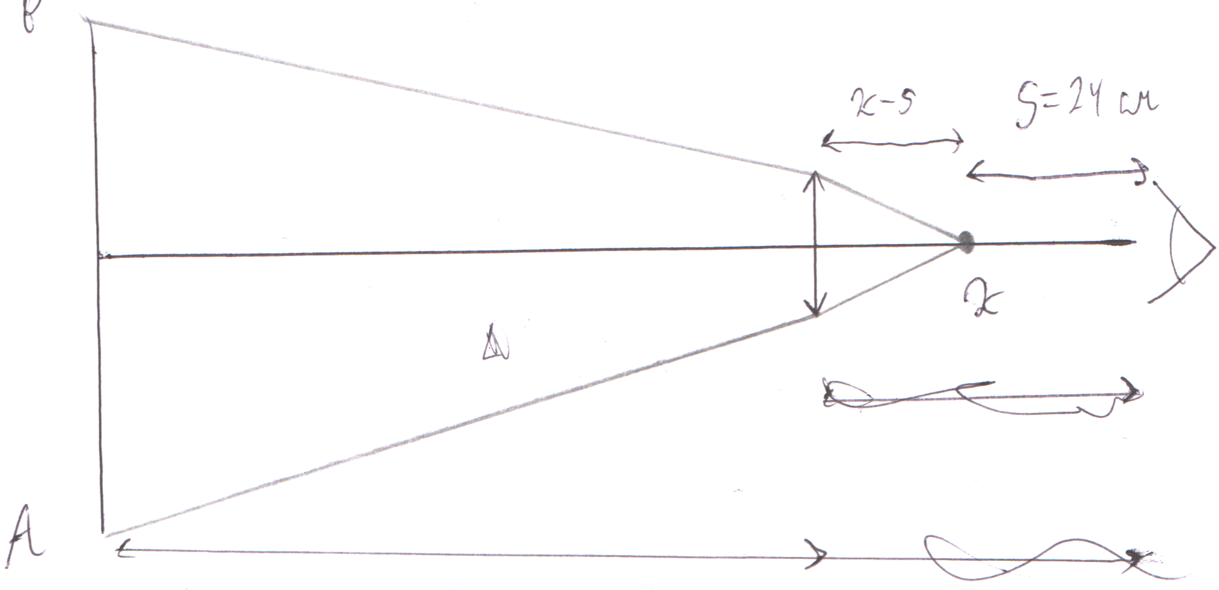
N.6

(10)

ЧЕРН



$$\frac{1}{F} = \frac{1}{L-x} + \frac{1}{x-s}$$

$$(L-x)(x-s)\frac{1}{F} = (x-s) + (L-x)$$

$$Lx - Ls + xs - x^2 = (L-s)F$$

$$x^2 - (L+s)x + Ls + (L-s)F = 0$$

$$x = \frac{(L+s) \pm \sqrt{(L+s)^2 - 4(Ls + (L-s)F)}}{2} =$$

$$= \frac{(L+s) \pm \sqrt{(L-s)^2 - 4(L-s)F}}{2} =$$

$$= \frac{(L+s) \pm \sqrt{(L-s)(L-s-4F)}}{2}$$

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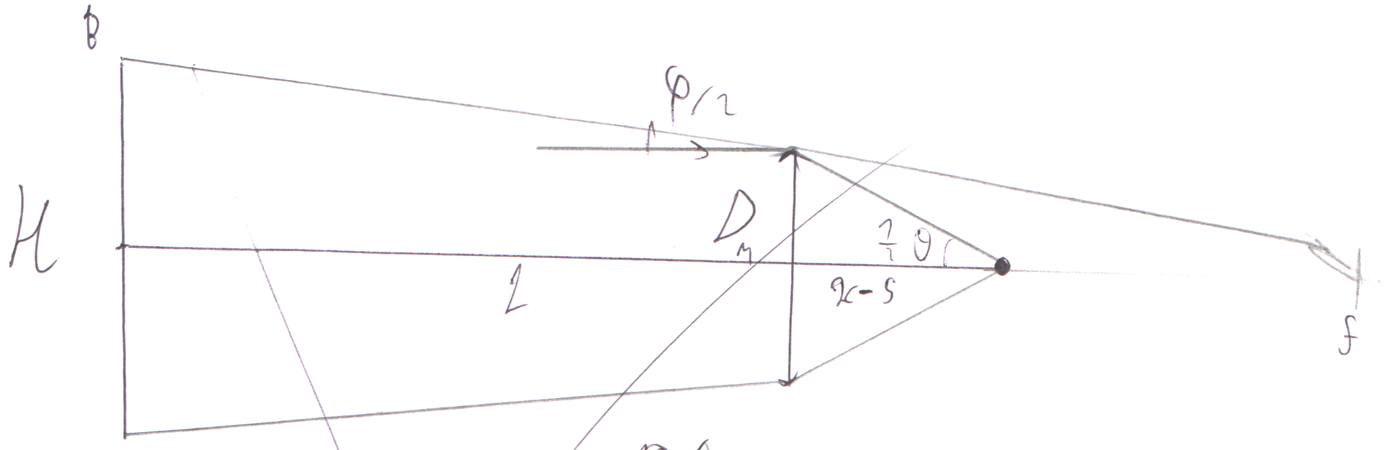
(11) чист

$$\frac{1}{F} = \frac{1}{L} + \frac{1}{x-S}$$

$$x - S = \frac{1}{1/F - 1/L}$$

$$\boxed{x = S + \frac{1}{1/F - 1/L} = 48\ \text{см}}$$

2)



$$\begin{cases} \frac{1}{2}(\theta - \varphi) = \frac{D_m/2}{F} \\ (x-S)\frac{\theta}{2} = \frac{D_m}{2} \\ L\frac{\varphi}{2} = \frac{H}{2} - \frac{D}{2} \end{cases}$$

$$\varphi = \frac{H - D_m}{L} \qquad \theta = \frac{D_m}{x-S}$$

$$\frac{D_m}{x-S} - \frac{H - D_m}{L} = \frac{D_m}{F}$$

$$D_m\left(\frac{1}{x-S} - \frac{1}{F} + \frac{1}{L}\right) = \frac{H}{L}$$

$$D_M = \frac{H/2}{\frac{1}{x-5}+\frac{1}{l}-\frac{1}{F}} =$$

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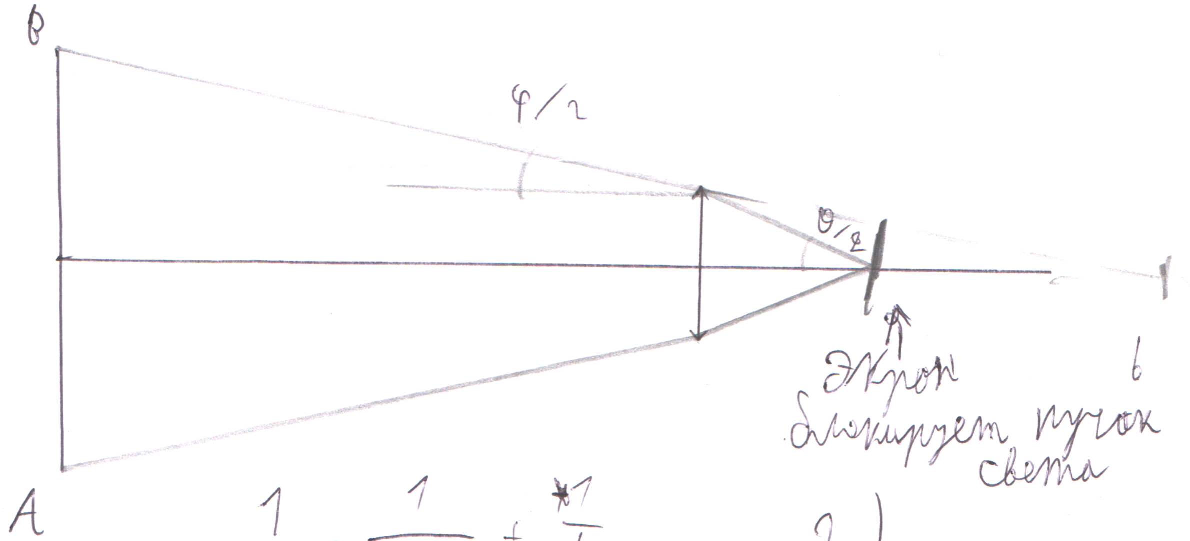
чист

2)



$$\frac{1}{F} = \frac{1}{x-5} + \frac{1}{b}$$

$$b = L$$

$$\varphi = \frac{D}{l}$$

$$\frac{H/2 - D/2}{\varphi/2} = l$$

$$H - D = D$$

3)

$$R = x - 5 = 24 \text{ см}$$

2)

$$D_m = H/2 = 4.5 \text{ см}$$