Часть 1

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

Шифр: **21201563**

ID профиля: **305427**

Вариант 6

Физика 11кл

Чистовик

Физика 11кл

Чистовик

№1

Дано:

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

m

$2m$

H

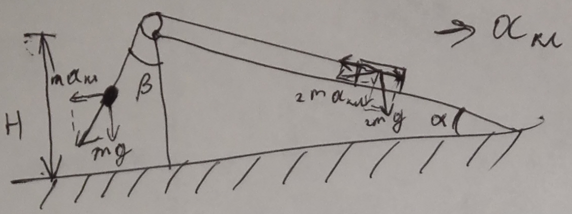
$\cos\beta = 12/13$

~~$\sin\beta$~~

1) $a_{кл}$ - ?

2) $a_{бр}$ - ?

3) t - ?



1) $\frac{a_{кл}}{g} = tg\,\beta = \frac{5}{12}$

$a_{кл} = \frac{5}{12} g$ [1]

2) $2ma_{бр} = F_{ТШ} - F_{ТБР}$ по II зак Ньютона

где $F_{ТШ}$ – сила, с которой тянет шарик

$F_{ТБР}$ – сила, с которой тянет брусок

$F_{ТБР} = 2mg\sin\alpha - 2ma_{кл}\cos\alpha = 2m\left(\frac{3}{5}g - \frac{4}{5}a_{кл}\right)$ [2]

$F_{ТШ} = mg\cos\beta + ma_{кл}\sin\beta = m\left(\frac{12}{13}g + \frac{5}{13}a_{кл}\right)$ [3]

подставим [2] и [3] в [1]:

$2ma_{бр} = m\left(\frac{12}{13}g + \frac{5}{13}a_{кл} - \frac{6}{5}g + \frac{8}{5}a_{кл}\right)$

$a_{бр} = \frac{129a_{кл} - 18g}{130} = \frac{53{,}75g - 18g}{130} = \frac{11}{40}g$

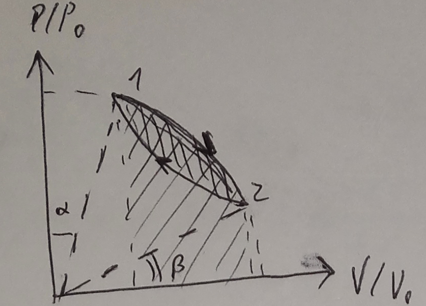
3) $\frac{H}{\cos\beta} = \frac{a_{бр}t^2}{2}$ ур-е РУД

$t^2 = \frac{2H}{\cos\beta\, a_{бр}} = \frac{2H}{\frac{12}{13}\cdot\frac{11}{40}g}$ $t = \sqrt{\frac{260H}{33g}}$

Ответ: $a_{кл} = \frac{5}{12}g$; $a_{бр} = \frac{11}{40}g$; $t = \sqrt{\frac{260H}{33g}}$

1

Чистовик



№2

Дано:

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

$i = 5$

2-1 – адиабата

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

$\beta = 15^\circ$

---

1) $\frac{T_1}{T_2}$ – ?

2) γ при $C = 0$ – ?

3) $\frac{A_{12}}{A_{цикла}}$ – ?

$PV = \nu RT$ – ур-е Менделеева-Клапейрона

1) $P_1 = r\cos\alpha P_0$ $V_1 = r \sin\alpha V_0$, где r – радиус дуги 1-2

$P_2 = r\sin\beta P_0$ $V_2 = r\cos\beta V_0$

$$\frac{P_1V_1}{P_2V_2} = \frac{r^2 P_0V_0 \cos\alpha\sin\alpha}{r^2P_0V_0\sin\beta\cos\beta} = \frac{T_1}{T_2}$$

$$\frac{T_1}{T_2} = \frac{\cos\alpha\sin\alpha}{\sin\beta\cos\beta} = \frac{\frac{1}{2}\sin2\alpha}{\frac{1}{2}\sin2\beta} = \frac{\frac{1}{2}\cdot\frac{\sqrt2}{2}}{\frac{1}{2}\cdot\frac{1}{2}} = \sqrt2$$

2) $C = 0$ при ~~изоте~~ $dT = 0 \Rightarrow C = 0$ в точке касания дуги 1-2 и изотермы, ~~эта~~ точка будет удовл усл $P = V \Rightarrow$

$$\Rightarrow \operatorname{tg}\gamma = \frac{P/P_0}{V/V_0} = \frac{V_0}{P_0}$$

3) $$A_{12} = \frac{\left(\frac{\pi r^2}{360}\cdot 135 - r^2\sin\alpha\cos\alpha\right) - \left(\frac{\pi r^2}{360}\cdot 30 - r^2\sin\beta\cos\beta\right)}{2}$$

$$A_{12} = \frac{r^2}{2}\left(\frac{\pi}{24} + \frac{1}{2}\sin2\beta - \frac{1}{2}\sin2\alpha\right) = \frac{r^2}{2}\left(\frac{\pi}{24} + \frac{1-\sqrt2}{4}\right)$$

$$A_{цикла} = A_{12} - \frac{5}{2}\nu R\Delta T = A_{12} + \frac{5}{2}\nu RT_1\left(\frac{\sin2\beta}{\sin2\alpha} - 1\right) = A_{12} + \frac{5}{2}P_1V_1\left(\frac{1}{\sqrt2} - 1\right) = A_{12} + \frac{5}{4}r^2P_0V_0\left(\frac{1}{\sqrt2} - 1\right)$$

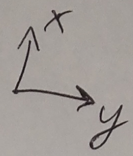
$$\frac{A_{12}}{A_{цикла}} = \frac{\frac{r^2}{2}\left(\frac{\pi}{4} - \frac{1-\sqrt2}{4}\right)P_0V_0}{P_0V_0\frac{r^2}{2}\left(\frac{\pi}{4} - \frac{1-\sqrt2}{4}\right) + \frac{5}{2}\frac{r^2}{2}P_0V_0\left(\frac{1}{\sqrt2} - 1\right)} = \frac{\frac{\pi}{4} - \frac{1-\sqrt2}{4}\,P_0V_0}{P_0V_0\frac{\pi}{4} - \frac{1-\sqrt2}{4} + \frac{5}{2}P_0V_0\left(\frac{1}{\sqrt2} - 1\right)}$$

Ответ: $\frac{T_1}{T_2} = \sqrt2$ γ при $(C = 0) = \operatorname{arctg}\frac{V_0}{P_0}$ $\frac{A_{12}}{A_{цикла}} = \frac{\frac{\pi}{4} - \frac{1-\sqrt2}{4}}{\frac{\pi}{4} - \frac{1-\sqrt2}{4} + \frac{5}{2}\left(\frac{1}{\sqrt2} - 1\right)}$

$$\frac{A_{12}}{A_{цикла}} = \frac{\frac{\pi}{4} - \frac{1-\sqrt2}{4}}{\frac{\pi}{4} - \frac{1-\sqrt2}{4} + \frac{5}{2}\left(\frac{1}{\sqrt2} - 1\right)}$$

Физика 11 кл

Черновик



№1

Дано:

$\cos\alpha = 4/5$

$\sin\alpha = 3/5$

m

$2m$

H

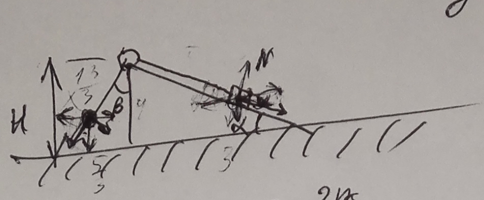
$\cos\beta = 12/13$

$\sin\beta = 5/13$

1) $a_{кл}$ - ?

2) $a_{бр/кл}$

3) t - ?



$\cancel{N = 2mg\cos\alpha + 2m a_{кл}\sin\alpha = 2m\left(\frac{4}{5}g + \frac{3}{5}a_{кл}\right)}$

1) $F_{T_{бр}} = 2mg\sin\alpha - 2ma_{кл}\cos\alpha = 2m\left(\frac{3}{5}g - \frac{4}{5}a_{кл}\right)$

$F_{T_{ш}} = mg\cos\beta + ma_{кл}\sin\beta = m\left(\frac{12}{13}g + \frac{5}{13}a_{кл}\right)$

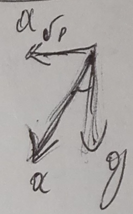
$2m\left(\frac{3}{5}g - \frac{4}{5}a_{кл}\right) = m\left(\frac{12}{13}g - \frac{5}{13}a_{кл}\right)$

$\frac{6}{5}g - \frac{8}{5}a_{кл} = \frac{12}{13}g - \frac{5}{13}a_{кл}$

$\frac{8}{5}a_{кл} - \frac{5}{13}a_{кл} = \frac{6}{5}g - \frac{12}{13}g$

$\frac{104-25}{65}a_{кл} = \frac{78-60}{65}g$

$a_{кл} = \frac{18}{79}g$



1) $\frac{a_{кл}}{g} = \operatorname{tg}\beta = \frac{5}{12}$

$a_{кл} = \frac{5}{12}g$

2) $2m a_{бр/кл} = F_{T_ш} - F_{T_{бр}} = m\left(\frac{12}{13}g + \frac{5}{13}a_{кл} - \frac{6}{5}g + \frac{8}{5}a_{кл}\right)$

$a_{бр/кл} = \dfrac{\frac{60-78}{65}g + \frac{25+104}{65}a_{кл}}{2} = \frac{129a_{кл} - 18g}{130} =$

$= \frac{53{,}75g - 18g}{130} = \frac{\frac{143}{4}g}{130} = \frac{143}{520}g = \cancel{0{,}275g}\ \frac{11}{40}g$

3) $\frac{H}{\cos\beta} = \frac{a_{бр/кл}t^2}{2}$ $\qquad t^2 = \frac{2H}{\cos\beta\, a_{бр/кл}} = \frac{2H}{\frac{12}{13}\cdot\frac{11}{40}g} =$

$t = \sqrt{\frac{260H}{33g}}$

1

21201563 (U305427 M1264025)

Физика 11 кл

Черновик

№2

Дано:

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

$i = 5$

2-1-адиабата

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

$\beta = \cancel{15}\,{,}^\circ$

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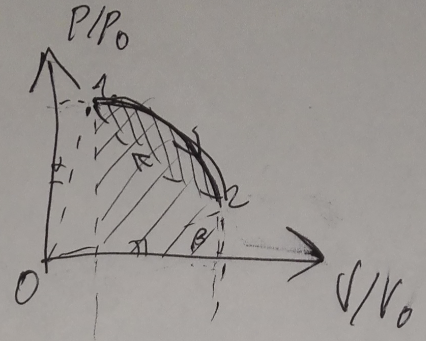
1) $\frac{T_1}{T_2}$ - ?

2) γ при $C=0$

3) $\frac{A_{12}}{A_{цикла}}$ -?



$PV = \nu RT$

1) $P_1 = r\cos\alpha \quad V_1 = r\sin\alpha$

$P_2 = r\sin\beta \quad V_2 = r\cos\beta$

$\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2} = \frac{r^2 \sin\alpha\cos\alpha}{r^2\sin\beta\cos\beta} = \frac{\sin\alpha\cos\alpha}{\sin\beta\cos\beta} = \cancel{0{,}259 \cdot 0{,}966}$

$= \frac{\cancel{0{,}2502}}{\cancel{0{,}2502}} \quad \cancel{0{,}383 \cdot 0{,}924} \quad \frac{\cancel{0{,}3538}}{\cancel{0{,}2502}} \quad \frac{\frac{1}{2}\sin\frac{\alpha}{2}}{\frac{1}{2}\sin\frac{\beta}{2}} = \frac{\sin\frac{\alpha}{2}}{\sin\frac{\beta}{2}}$

2) $C=0$ при изотермич процессе $\Rightarrow$

$\Rightarrow$ в участке 12 $C=0$ в точке касания графика 12 с изотермой, ~~то~~ то есть в точке T_{max}

$T = \frac{PV}{\nu R}$, график 1 2 можно описать $V^2 + P^2 = r^2$ или $\cancel{V^2 = r^2 - P^2}$ $P = \sqrt{r^2 - V^2}$

$T = \frac{\sqrt{r^2 - V^2}\,V}{\nu R} = \frac{\sqrt{r^2V^2 - V^4}}{\nu R}$ найдем произв $T' = \frac{1}{\nu R}$

т.к графики изотерм симм относ прямой $P=V \Rightarrow \cancel{\gamma = 45^\circ}$

$tg\,\gamma = \frac{P/P_0}{V/V_0} = \frac{V_0}{P_0}$

3) $A_{12} = -\left(\frac{\pi r^2}{360}\cdot \overset{30}{\cancel{22{,}5}} - r^2\sin\beta\cos\beta\right) + \left(\frac{\pi r^2}{360}\cdot 45 - r^2 \sin\alpha\cos\alpha\right)$

$A_{12} = r^2\left(\frac{\pi}{360}\cdot 15 - \sin\alpha\cos\alpha + \sin\beta\cos\beta\right) =$

$\Delta T = T_1 - T_2 = -\frac{T_1 \sin\frac{\beta}{2}}{\sin\frac{\alpha}{2}} + T_1$

$= r^2\left(\frac{\pi}{24} + \frac{1}{2}\sin\frac{\beta}{2} - \frac{1}{2}\sin\frac{\alpha}{2}\right)$

$A_{цикла} = A_{12} - \frac{5}{2}\nu R\,\Delta T = A_{12} + \frac{5}{2}\nu R\,T_1\left(\frac{\sin\frac{\beta}{2}}{\sin\frac{\alpha}{2}} - 1\right)$

2

Физика 11кл

Черновик

$$A_{цикла} = A_{12} + \frac{5}{2} p_1 V_1 \left(\frac{\sin\frac{\beta}{2}}{\sin\frac{\alpha}{2}} - 1 \right) = A_{12} \cancel{A} \frac{5}{2} r^2 \sin\alpha\cos\alpha \left(1 - \frac{\sin\frac{\beta}{2}}{\sin\frac{\alpha}{2}}\right)$$

$$\frac{A_{12}}{A_{цикла}} = \frac{r^2\left(\frac{\pi}{24} + \frac{1}{2}\sin\frac{\beta}{2} - \frac{1}{2}\sin\frac{\alpha}{2}\right)}{r^2\left(\frac{\pi}{24} + \frac{1}{2}\sin\frac{\beta}{2} - \frac{1}{2}\sin\frac{\alpha}{2}\right) - \frac{5}{2} r^2 \sin\alpha\cos\alpha\left(1 - \frac{\sin\beta\cos\beta}{\sin\alpha\cos\alpha}\right)} =$$

$$= \frac{\frac{\pi}{24} + \cancel{\frac{1}{2}\sin\frac{\beta}{2}}^{\sin\beta\cos\beta} - \cancel{\frac{1}{2}\sin\frac{\alpha}{2}}^{\sin\alpha\cos\alpha}}{\frac{\pi}{24} + \sin\beta\cos\beta - \sin\alpha\cos\alpha - \frac{5}{2}\sin\alpha\cos\alpha + \frac{5}{2}\sin\beta\cos\beta} = \frac{\frac{\pi}{24} + \sin\beta\cos\beta - \sin\alpha\cos\alpha}{\frac{\pi}{24} + 2\sin\beta\cos\beta - 2\sin\alpha\cos\alpha}$$

$$= \frac{\frac{\pi}{24} + \sin\beta\cos\beta - \sin\alpha\cos\alpha}{\frac{\pi}{24} + 3{,}5\sin\beta\cos\beta - 3{,}5\sin\alpha\cos\alpha}$$

Часть 2

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

Шифр: **21201563**

ID профиля: **305427**

Вариант 6

№3 Черновик

Дано:

$\frac{D_{уд}}{D_{т}} = \frac{7}{3}$

$d_т = 0,25$ м

$f = 0,025$ м

1) x - ?

$D_{уд}$ - ?

2) $D_{0,5}$ - ?

1) $\cancel{D_{уд} = \frac{1}{F} = \frac{1}{f} - D_{гл}}$

$\cancel{D_{уд} = \frac{1}{F} - D_{гл}}$

опт. сила ид. гл:

$D_{ид} = \frac{1}{0,25} + \frac{1}{0,025} = \cancel{\frac{10}{25}}\ \frac{100}{25} + \frac{1000}{25} = \frac{1100}{25} = 44\ Dптр$

$\cancel{D_{уд} + D_{ид} = \frac{1}{0,025}} =$

$D_т + D_{гл} = D_{ид}$

$D_{уд} + D_{гл} = 40\ Dптр$

$D_{уд} = 40 - D_{гл}$

$D_т = 44 - D_{гл}$

$\frac{40 - D_{гл}}{44 - D_{гл}} = \frac{7}{3}$

$\overset{120}{\cancel{280}} - 3D_{гл} = 308 - 7D_{гл}$

$4D_{гл} = 188$

$D_{гл} = 47$

$47 = \frac{1}{x} + \frac{1}{0,025}$

$x = \frac{1}{7}$ м

$\cancel{D_{уд}}$ $D_{уд} = -7\ Dптр$

2) $D_{0,5} + D_{гл} = \cancel{2+40}\ 42$

$D_{0,5} = -5\ Dптр$

21201563 (U305427 M1264026)

№3 Черновик

Чистовик

№3

Дано:

$\frac{D_{уд}^{н}}{D_т} = \frac{7}{3}$

$d_т = 0{,}25$ м

$f = 0{,}025$ м

~~$f = 0{,}025$ м~~

1) x - ? $D_{уд}$ - ?

2) $D_{0,5}$ - ?

~~от~~ Оптическая сила идеального зрения для чтения при $d = 0{,}25$ м и при $d \to \infty$:

$D_{0,25} = \frac{1}{0{,}25} + \frac{1}{0{,}025} = 44$ Дптр

$D_\infty = \frac{1}{0{,}025} = 40$ Дптр

~~$D_т + D_{гл} = D_{0,25}$~~

$\begin{cases} D_т + D_{гл} = D_{0,25} \\ D_{уд} + D_{гл} = D_\infty \end{cases}$

$D_{гл}$ - зрение человека из условия

$\begin{cases} D_{уд} = 40 - D_{гл} \\ D_т = 44 - D_{гл} \end{cases}$

$\frac{40 - D_{гл}}{44 - D_{гл}} = \frac{7}{3}$

$D_{гл} = 47$

1) $D_{гл} = \frac{1}{x} + \frac{1}{0{,}025}$

$D_{уд} = 40 - D_{гл}$

$x = \frac{1}{7}$ м $\quad D_{уд} = -7$ Дптр

2) $D_{0,5} + D_{гл} = \frac{1}{0{,}5} + \frac{1}{0{,}025}$

$D_{0,5} = -5$ Дптр

Ответ: $x = \frac{1}{7}$ м $\quad D_{уд} = -7$ Дптр $\quad D_{0,5} = -5$ Дптр

3

21201563 (U305427 M1264026)

N2

~~Черновик~~

Чистовик

Дано:

m

d, $b = d/4$

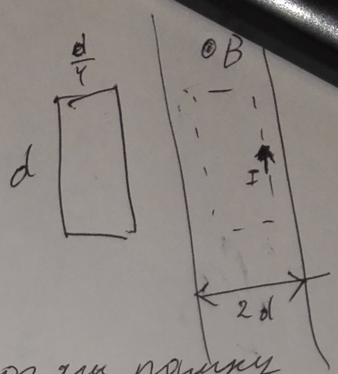
ϑ_0 $H = 2d$

R, B

$a - ?$

$V_1 - ?$

$V_2 - ?$



$F_A = BIL$

$I = \frac{\varepsilon}{R}$ $\quad \varepsilon = \cancel{BS}\ \cancel{BL} \frac{B\Delta S}{\Delta t}$

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

$F_A = \frac{B^2 \frac{dS}{dt} d}{R}$ - сила, тормозящ рамку на момент вход прав части

$a = \frac{B^2 S' d}{mR}$ $\quad S' = dx' = d(V_0 - at)$

~~$F_A = 0$ пока контур не вошел целиком~~ на него F_A не действ т.к. ~~ценьнетральна~~

$F_A = BIL$

$I = \frac{\varepsilon}{R}$ $\quad F_A = \frac{B\varepsilon L}{R} = \frac{B^2 S' L}{R}$ $\quad \varepsilon = \frac{\Phi'}{\cancel{\Delta t}} = \frac{B \cancel{\Delta S}}{\cancel{\Delta t}} S'$

$a = \frac{B^2 d^2 (V_0 - at) d}{mR}$ $\quad a = \frac{B^2 d^2 V_0 - B^2 d^2 a \Delta t}{R}$

$a + \frac{B^2 d^2 a \Delta t}{R} = \frac{B^2 d^2 V_0}{R}$ $\quad a = \frac{B^2 d^2 V_0}{R} \left(\frac{1}{1 + \frac{B^2 d^2 \Delta t}{R}}\right)$

2

N2

~~Черновик~~

Чистовик

Дано:

$F_A = BIL \sin\alpha$

m

d, l

v_0

R

a - ?

V_1 -

V_2 - ?

$= 44$ Днтр

~~Черновик~~ I

Чистовик

№31

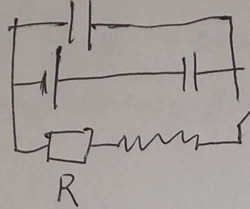
Найти:

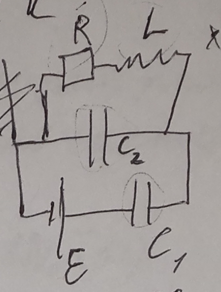
$C_1 = C$ $C_2 = 3C$

I - ?

Q - ?

U_R при I_2 - ?





$$I = \frac{\varepsilon}{R}$$

$$R_{12} = R + X_L$$

$$\frac{1}{R_{123}} = \frac{1}{R + X_L} + \frac{1}{X_C}$$

$$\frac{1}{R_{123}} = \frac{X_{C_2} + R + X_L}{X_{C_2}(R + X_L)}$$

$$R_{\Sigma} = R_{123} + X_{C_1}$$

$$R = \frac{X_{C_2}(R + X_L)}{X_{C_2} + R + X_L} + X_{C_1}$$

$$X_C = \frac{1}{\omega C}$$

$$X_L = \omega L$$

$$I = \frac{\varepsilon}{\frac{R + \omega L}{\omega C_2\left(\frac{1}{\omega C_2} + R + \omega L\right)} + \frac{1}{\omega C_1}}$$

$$I = \frac{\varepsilon}{\frac{R + \omega L}{3\omega C\left(\frac{1}{3\omega C} + R + \omega L\right)} + \frac{1}{\omega C}} = \frac{\varepsilon \cdot 3\omega C\left(\frac{1}{3\omega C} + R + \omega L\right)}{R + \omega L + \frac{1}{\omega C} + 3R + 3\omega L} =$$

$$= \frac{\varepsilon + 3\varepsilon\omega C R + 3\varepsilon\omega^2 L C}{4R + 4\omega L + \frac{1}{\omega C}} = \omega C \varepsilon \frac{\frac{\varepsilon}{\omega C} + 3\varepsilon R + 3\varepsilon\omega L}{\frac{1}{\omega C} + 4R + 4\omega L}$$

1