

Часть 1

Олимпиада: **Физика, 9 класс (1 часть)**

Шифр: **21205929**

ID профиля: **824260**

Вариант 1

Задача 1

Тестовик

Физика, 9 кл.

По закону сохранения энергии:

$$\frac{m v_0^2}{2} = mg H_{\max}$$

v_0 - начальная скорость мяча
 m - масса первого мяча

$$v_0 = \sqrt{2g H_{\max}}$$

H_{\max} - максимальная высота 1 мяча

$$H_{\max} = v_0 \tau - \frac{g \tau^2}{2} + \frac{g \tau^2}{2} = v_0 \tau = \sqrt{2g H_{\max}} \tau$$

$$H_{\max}^2 = 2g H_{\max} \tau^2$$

H - высота столкновения

$$H_{\max} = 2g \tau^2 \quad H = H_{\max} - \frac{g \tau^2}{2} = 2g \tau^2 - \frac{g \tau^2}{2} = \frac{3g \tau^2}{2}$$

L - отношение путей, пройденных мячами до столкновения

$$L = \frac{H}{H_{\max} - H} = \frac{\frac{3g \tau^2}{2}}{2g \tau^2 - \frac{3g \tau^2}{2}} = \frac{\frac{3}{2}}{2 - \frac{3}{2}} = 3$$

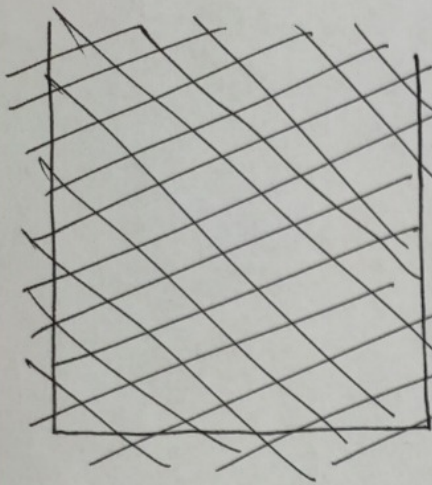
Ответ: 1) $H_{\max} = 2g \tau^2$; 2) $H = \frac{3}{2} g \tau^2$; 3) $L = 3$

1

Задача 2

Тестовик

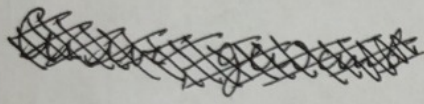
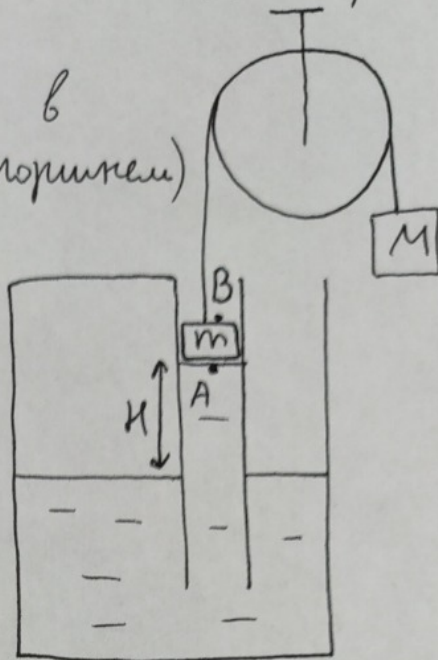
Физика, 9 кл.



P_A - давление в
точке А (под поршнем)

$$P_A = P_0 - \rho g H = 99 \text{ кПа}$$

$$P_0 S + mg = T + P_A S$$



$$P_0 S + mg = T + P_0 S - \rho g H S$$

$$T = mg + \rho g H S = Mg$$

$$M = m + \rho H S = 130 \text{ г}$$

M - масса груза

h - расстояние от поверхности воды в сосуде до
нижнего края поршня после добавления груза

Δm - масса ~~гру~~ груза

$$P_0 S + (m + \Delta m)g = T + (P_0 + \rho g h) S$$

$$P_0 S + mg + \Delta m g = Mg + P_0 S + \rho g h S$$

$$m + \Delta m = M + \rho h S$$

$$h = \frac{m + \Delta m - M}{\rho S} = 5 \text{ см}$$

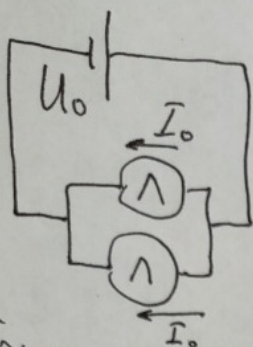
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Ответ: 1) $P_A = 99 \text{ кПа}$; 2) $M = 130 \text{ г}$; 3) $h = 5 \text{ см}$

Задача 3

Чистовик

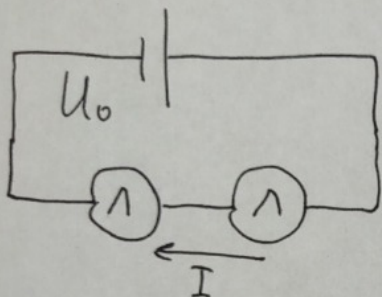
Физика, 9 кл.



$$P_1 = U_0 I_0$$

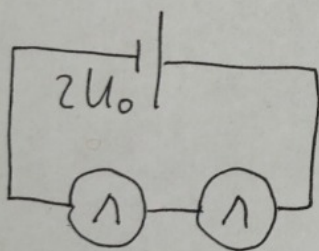
$$I_0 = \frac{P_1}{U_0} = 1,67 \text{ A}$$

По симметрии схемы в обоих лампочках течет такой ток.



$$P_2 = \frac{U_0}{2} I$$

$$I = \frac{2P_2}{U_0} = 1,1 \text{ A}$$



На каждой лампе напряжение $U_0 \Rightarrow$ мощность на каждой лампе $P_1 = 20 \text{ Вт}$

Ответ: 1) $I_0 = 1,67 \text{ A}$; 2) $I = 1,1 \text{ A}$; 3) $P_1 = 20 \text{ Вт}$

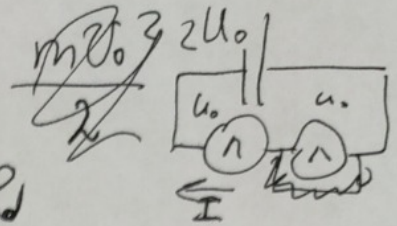
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Терновик $U_0 = IR$

Физика, 9 кл.

$$H_{\max} = \frac{gt_0^2}{2}$$

$$\frac{mU_0^2}{2} = mgH_{\max}$$



$$H_{\max} = U_0 t - \frac{gt^2}{2} + \frac{gt^2}{2} = U_0 t \quad P = I^2 R$$

$$U_0 = \sqrt{2gH_{\max}} \quad \left[H = H_{\max} - \frac{gt^2}{2} = \frac{3}{2} gt^2 \right]$$

$$H_{\max} = \sqrt{2gH_{\max}} t$$

$$\frac{H_{\max} - H}{H} = \frac{2gt^2 - \frac{3}{2}gt^2}{\frac{1}{2}gt^2}$$

$$H_{\max}^2 = 2gH_{\max} t^2$$

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

$$H_{\max} = 2gt^2$$

$$P_{\text{н}} = P_0 - \rho g H$$

$$P = \frac{F}{S}$$

$$P_0 S + mg = P_n S + T$$

$$P_0 S + mg$$

$$P_0 S + mg = P_0 S - \rho g H S + T$$

$$P_0 S + (m + \Delta m)g =$$

$$mg + \rho g H S = T = Mg$$

$$= T + (P_0 - \rho g h) S$$

$$P_0 S + (m + \Delta m)g = Mg + P_0 S - \rho g h S$$

$$M = m + \rho h S$$

$$m + \Delta m = M - \rho h S$$

Часть 2

Олимпиада: **Физика, 9 класс (2 часть)**

Шифр: **21205929**

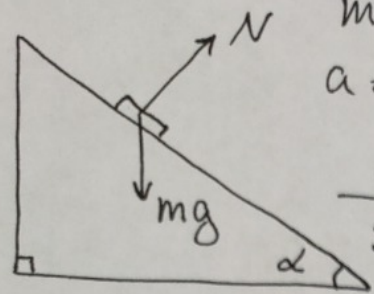
ID профиля: **824260**

Вариант 1

Задача 4

Турбовик

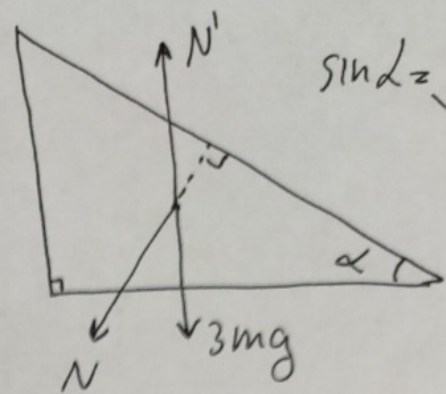
Физика, 9 кл.



$$mg \sin \alpha = ma$$

$$a = g \sin \alpha$$

$$\frac{H}{\sin \alpha} = \frac{a t_0^2}{2}$$



$$\sin \alpha = \sqrt{1 - \cos^2 \alpha}$$

$$t_0 = \sqrt{\frac{2H}{g \sin^2 \alpha}} = \sqrt{\frac{2H}{g(1 - \cos^2 \alpha)}}$$

$$N \sin \alpha = 3m A$$

$$mg \cos \alpha - N = m A \sin \alpha$$

$$N = \frac{3m A}{\sin \alpha}$$

$$mg \cos \alpha - \frac{3m A}{\sin \alpha} = m A \sin \alpha$$

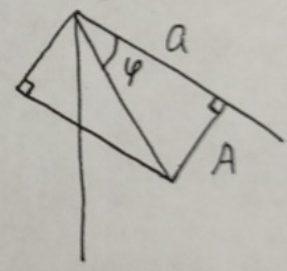
$$g \cos \alpha = A \left(\frac{3}{\sin \alpha} + \sin \alpha \right)$$

A - ускорение кинка

$$A = \frac{g \cos \alpha}{\frac{3}{\sin \alpha} + \sin \alpha}$$

$$a_0 = \sqrt{A^2 + a^2}$$

$$\tan \varphi = \frac{A}{a}$$



$$\frac{H}{\cos(90 - \alpha - \varphi)} = \frac{a_0 T^2}{2}$$

$$T = \sqrt{\frac{2H}{a_0 \cos(90 - \alpha - \varphi)}}$$

1

Ответ: 1) $t_0 = \sqrt{\frac{2H}{g(1 - \cos^2 \alpha)}}$; 2) $A = \frac{g \cos \alpha}{\frac{3}{\sin \alpha} + \sin \alpha}$;

3) $T = \sqrt{\frac{2H}{a_0 \cos(90 - \alpha - \varphi)}}$

Задача 5

Зистовик

Физика, 9 кл.

~~V = \pi R^2 H~~ $V = \pi R^2 H$ T - время затопления

$V = vTS$ банка

$$\pi R^3 = TS \sqrt{\frac{gH}{2}} \quad T = \frac{\pi}{5} \sqrt{\frac{2H^5}{g}}$$

$$v \cos \alpha t = H \quad t = \frac{H}{v \cos \alpha}$$

$$v \sin \alpha t - \frac{gt^2}{2} = -H$$

$$v \sin \alpha \frac{H}{v \cos \alpha} - \frac{g \frac{H^2}{v^2 \cos^2 \alpha}}{2} = -H$$

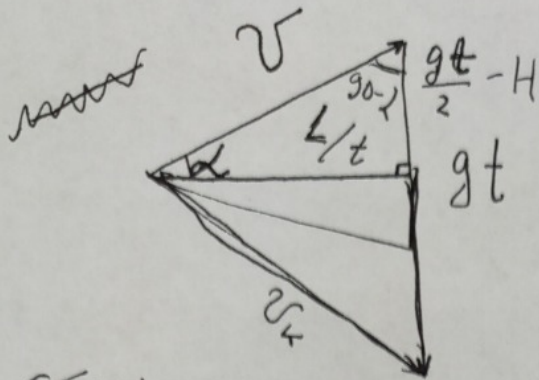
$$\frac{gH}{2v^2 \cos^2 \alpha} - \operatorname{tg} \alpha = 1$$

$$1 + \operatorname{tg} \alpha = \frac{gH}{2 \frac{gH}{2} \cos^2 \alpha} = \frac{1}{\cos^2 \alpha} = 1 + \operatorname{tg}^2 \alpha$$

$$\operatorname{tg}^2 \alpha = \operatorname{tg} \alpha \quad \operatorname{tg} \alpha = 1 \quad \alpha = 45^\circ$$

2

Ответ: 1) $T = \frac{\pi}{5} \sqrt{\frac{2H^5}{g}}$; 2) $\alpha = 45^\circ$



~~cos alpha~~

$$\operatorname{tg} \alpha = \frac{\frac{gt}{2} - H}{L/t} = \frac{gt^2 - 2Ht}{2L}$$

$$\cos \alpha = \frac{L}{vt}$$

$$t = \frac{L}{v \cos \alpha}$$

$$y^2(1+x^2) - xy - 1 = 0$$

$$y = \frac{x + \sqrt{5x^2 + 4}}{2 + 2x^2}$$

$$(2y(1+x^2) - x)^2 = 5x^2 + 4$$

$$4y^2(1+x^2)^2 - 4xy(1+x^2) + x^2 = 5x^2 + 4$$

$$4y^2(1+2x^2+x^4) - 4xy - 4x^3y + x^2 = 5x^2 + 4$$

$$y^2(1+2x^2+x^4) - xy - x^3y = x^2 + 1$$

$$y^2(1+x^2)^2 - xy(1+x^2) = (x^2 + 1)$$

$$y^2(1+x^2) - xy = 1$$

Терновик

Пушкина, 9 кн.

$$v \cos \alpha t = L$$

$$t = \frac{L}{v \cos \alpha} \quad y = \frac{x + \sqrt{x^2 + 4}}{2 + 2x^2}$$

$$v \sin \alpha t - \frac{gt^2}{2} = -H$$

$y' = 0$

$$v \sin \alpha \frac{L}{v \cos \alpha} - g \frac{L^2}{v^2 \cos^2 \alpha} = -H$$

$$L^2 y' = \left(\frac{x}{2+2x^2} \right)' + \left(\frac{\sqrt{x^2+4}}{2+2x^2} \right)'$$

$$a' = \frac{1}{2} \left(\frac{x}{1+x^2} \right)'$$

$$\frac{gL^2}{2v^2 \cos^2 \alpha} - L \operatorname{tg} \alpha - H = 0$$

$$D = \operatorname{tg}^2 \alpha + 4 \cdot \frac{g}{2v^2 \cos^2 \alpha} \cdot H = \operatorname{tg}^2 \alpha + \frac{2gH}{v^2 \cos^2 \alpha} =$$

$$= \operatorname{tg}^2 \alpha \left(1 + \frac{2gH}{v^2} \right) + \frac{2gH}{v^2}$$

$(3x)^2 = 10x$

$$5x^2 = 10x$$

$$L = \frac{\operatorname{tg} \alpha \pm \sqrt{D}}{g}$$

$$\frac{gn^2 H}{2v^2 \cos^2 \alpha} - n \operatorname{tg} \alpha - H = 0$$

$$n^2(1 + \operatorname{tg}^2 \alpha) - n \operatorname{tg} \alpha - 1 = 0$$

$$\frac{gn^2 H}{2v^2 \cos^2 \alpha} = n \operatorname{tg} \alpha + 1$$

$$D = \operatorname{tg}^2 \alpha + 4(1 + \operatorname{tg}^2 \alpha) =$$

$$= n^2(1 + \operatorname{tg}^2 \alpha) = n \operatorname{tg} \alpha + 1$$

$$= 5 \operatorname{tg}^2 \alpha + 4$$

$$n = \frac{\operatorname{tg} \alpha + \sqrt{5 \operatorname{tg}^2 \alpha + 4}}{2 + 2 \operatorname{tg}^2 \alpha} = \frac{2 + \sqrt{5 \cdot 2 + 4}}{2 + 2 \cdot 2} = \frac{5 + \sqrt{14}}{6}$$

Терновик

Физика, 9 кл.

$$3H = v_0 \cos \alpha t$$

$$t = \frac{3H}{v_0 \cos \alpha}$$

$$v_0 \sin \alpha t - \frac{gt^2}{2} = H$$

$$v_0 \sin \alpha \frac{3H}{v_0 \cos \alpha} - \frac{g \frac{9H^2}{v_0^2 \cos^2 \alpha}}{2} = H$$

$$3H \operatorname{tg} \alpha - \frac{9gH^2}{2v_0^2 \cos^2 \alpha} = H$$

$$1 = \frac{9gH}{2v_0^2 \cos^2 \alpha} - 3 \operatorname{tg} \alpha =$$

$$= \frac{9gH}{2 \frac{gH}{g} \cos^2 \alpha} - 3 \operatorname{tg} \alpha = \frac{9}{\cos^2 \alpha} - 3 \operatorname{tg} \alpha$$

$$1 + 3 \operatorname{tg} \alpha = n^2 (1 + \operatorname{tg}^2 \alpha)$$

$$9 \operatorname{tg}^2 \alpha - 3 \operatorname{tg} \alpha + 8 = 0$$

$$\overset{n^2}{9} x^2 - \overset{n}{3} x + 8 = 0$$

$$5n^2 = 4n^4$$

$$5 = 4n^2 \quad n = \pm \frac{\sqrt{5}}{2}$$

$$D = n^2 - 4n^2 \cdot 8$$

$$D = n^2 - 4 \cdot n^2 \cdot (n^2 - 1) = 5n^2 - 4n^4 = 0$$

Черновик

Физика, 9 кл.

$$V = \pi H^2 H = \pi H^3 = \pi T^2 S^2 \frac{gH}{2} = TS \sqrt{\frac{gH}{2}}$$

$$L = v_0 \cos \alpha t$$

$$\pi^2 H^6 = T^2 S^2 \frac{gH}{2}$$

$$v_0 \cos \alpha t = H$$

$$0 = v_0 \sin \alpha t + \frac{gt^2}{2}$$

$$2\pi^2 H^5 = T^2 S^2 g$$

$$v_0 \sin \alpha t - \frac{gt^2}{2} = -H$$

$$\frac{gt}{2} = v_0 \sin \alpha$$

$$T = \frac{\pi}{5} \sqrt{\frac{2H^5}{g}}$$

$$t = \frac{H}{v_0 \cos \alpha}$$

$$v_0 \sin \alpha t - \frac{gt^2}{2} = -v_0 \cos \alpha t$$

$$v_0 \sin \alpha \frac{H}{v_0 \cos \alpha} - \frac{g \frac{H^2}{v_0^2 \cos^2 \alpha}}{2} = -H$$

$$\frac{gH}{2v_0^2 \cos^2 \alpha} = -H$$

$$\frac{gt}{2} - v_0 \sin \alpha = v_0 \cos \alpha$$

$$\frac{gH}{2v_0 \cos \alpha} = v_0 (\cos \alpha + \sin \alpha)$$

$$\frac{gH}{2v_0^2 \cos^2 \alpha} - \text{Atg} \alpha = \dots$$

$$H = v_0 \cos \alpha t$$

$$t = \frac{2v_0 \sin \alpha}{g}$$

$$L = \frac{v_0^2 \sin^2 \alpha}{g} = \frac{v_0^2}{g}$$

$$gH$$

$$\frac{gH}{2v_0^2 \cos^2 \alpha}$$

$$= 1 + \text{tg}^2 \alpha$$

$$= \frac{gH}{2 \frac{gH}{2} \cos^2 \alpha} = \dots$$

$$= 1 + \text{tg}^2 \alpha$$

$$\text{tg}^2 \alpha = \text{tg}^2 \alpha$$

$$\text{tg} \alpha = 1$$

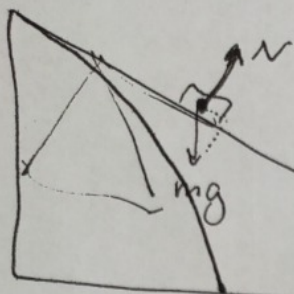
$$\alpha = 45^\circ$$

$$\frac{1}{m^2} \sqrt{\frac{m}{5} \frac{m}{c^2}} = m^2 c^2 \quad m^2 c^2$$

$$\frac{gH}{2g} = \frac{H}{2}$$

Черновик

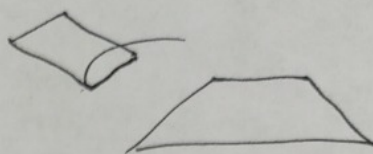
Физика, 9 кл.



$$mg \sin \alpha = ma$$

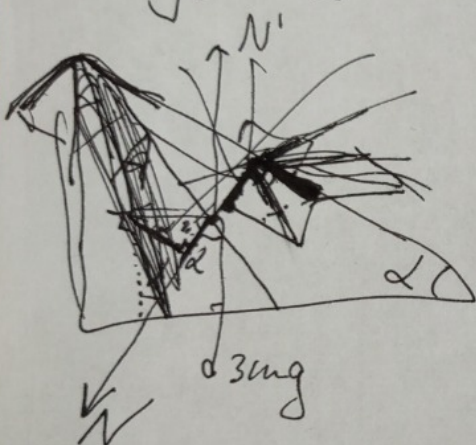
$$a = g \sin \alpha = 6 \text{ м/с}^2$$

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



$$t = \sqrt{\frac{2H}{g \sin^2 \alpha}}$$

$$N - mg \cos \alpha = -A \sin \alpha m$$



$$N \sin \alpha = 3mg$$

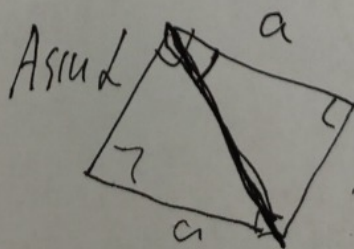
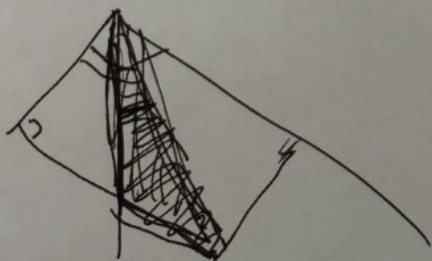
$$\frac{3mg}{\sin \alpha} - mg \cos \alpha = -mA \sin \alpha$$

$$g \cos \alpha - \frac{3A}{\sin \alpha} = A \sin \alpha$$

$$g \cos \alpha = A \left(\frac{3}{\sin \alpha} + \sin \alpha \right)$$

$$A = \frac{g \cos \alpha}{\frac{3}{\sin \alpha} + \sin \alpha}$$

$$= \frac{10 \cdot \frac{4}{5}}{\frac{3}{\frac{3}{5}} + \frac{3}{5}} = \frac{8}{5 + \frac{3}{5}} = \frac{40}{25+3} = \frac{40}{28}$$



$$\frac{2}{\frac{9}{25}} = 10$$