

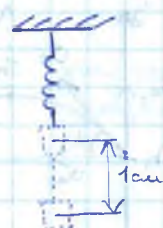
Задача 1

Дано:

$$\Delta X = 1 \text{ см} = 1 \cdot 10^{-2} \text{ м}$$

$T = ?$

$F_{\text{уп.}}$   
 $F_{\text{грав.}}$



$$T = 2\pi \sqrt{\frac{m}{k}}$$

В состоянии равновесия  $mg = kx \Rightarrow k = \frac{mg}{x}$

$$T = 2\pi \sqrt{\frac{m}{\frac{mg}{x}}} = 2\pi \sqrt{\frac{x}{g}} =$$

$$= 2 \cdot 3,14 \sqrt{\frac{1 \cdot 10^{-2}}{10}} = 6,28 \sqrt{\frac{0,01}{10}} \approx 0,2 \text{ с}$$



# Задача 2.

Дано:

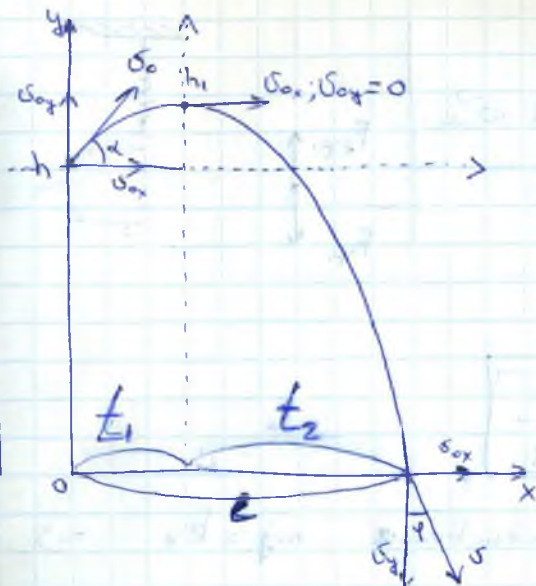
h

$U_0$

$\alpha$

$U, \varphi$

$t_{\max}$  от d



$$U_{0x} = U_0 \cos \alpha$$

$$U_{0y} = U_0 \sin \alpha$$

$$S = S_0 + U_0 t + \frac{at^2}{2}$$

$$\begin{aligned} l &= 0 + U_0 \cos \alpha t + \frac{at^2}{2} & x \\ 0 &= h + U_0 \sin \alpha t + \frac{gt^2}{2} & y \end{aligned}$$

$$l = U_0 \cos \alpha t$$

$$\text{В точке } h=0 \Rightarrow h_1 = 0 + U_0 \sin \alpha t + \frac{gt^2}{2}$$

$$l = U_0 \cos \alpha t$$

$$\frac{gt^2}{2} = h + U_0 \sin \alpha t \quad \Rightarrow \quad gt^2 = 2h + 2U_0 \sin \alpha t$$

$$\Rightarrow gt = 2h + 2U_0 \sin \alpha \Rightarrow t = \frac{2h + 2U_0 \sin \alpha}{g}$$

$$l = U_0 \cos \alpha \frac{2h + 2U_0 \sin \alpha}{g} = \frac{2h U_0 \cos \alpha + 2U_0^2 \sin \alpha \cos \alpha}{g} = \frac{2h U_0 \cos \alpha + U_0^2 \sin 2\alpha}{g}$$

$$l_x = \frac{U_0^2 \sin 2\alpha}{g}$$

- формула определения расстояния без первоначальной высоты.

$$\Rightarrow (\sin 2\alpha)_{\max} = 1 \Rightarrow l_{\max}$$

$$2\alpha = 90^\circ \Rightarrow \alpha = 45^\circ - \text{наилучший угол выстрела.}$$

$$U = U_0 + at$$

$$0 = U_0 \sin \alpha - gt \Rightarrow gt = U_0 \sin \alpha \Rightarrow$$

$$\Rightarrow t = \frac{U_0 \sin \alpha}{g} \quad \text{время подъема, равное времени падения до уровня } h$$

$$\text{Т.к. в точке } h_1, U_{0y} = 0 \text{ то } h_1 = \frac{gt^2}{2} + h$$

$$h_1 = \frac{g \left( \frac{U_0 \sin \alpha}{g} \right)^2}{2} + h = \frac{g U_0^2 \sin^2 \alpha}{2g^2} + h = \frac{U_0^2 \sin^2 \alpha}{2g} + h$$

$$h_1 = h + \frac{U_0^2 \sin^2 \alpha}{2g} - \text{высота подъема пули}$$

$$U_y = U_{0y} + gt \Rightarrow gt$$



$$0 = h_1 + 0 - \frac{gt^2}{2} \quad - \text{проекция пути из } h_1$$

$$\frac{gt^2}{2} = h_1 \Rightarrow gt^2 = 2h_1 \Rightarrow$$

$$\Rightarrow t = \sqrt{\frac{2h_1}{g}} \quad - \text{время падения из } h_1$$

$$v_y = g \sqrt{\frac{2h_1}{g}} = \sqrt{\frac{g^2 2h_1}{g}} = \sqrt{g 2h_1}$$

$$v = \sqrt{v_{ox}^2 + v_y^2} = \sqrt{v_0 \cos^2 \alpha + g 2h_1} \quad - \text{скорость в точке падения}$$

$$\tan \alpha = \frac{v_y}{v_{ox}} = \frac{\sqrt{g 2h_1}}{v_0 \cos \alpha} \quad - \text{угол падения}$$

$$\begin{cases} x = v_0 \cos \alpha t \\ y = h + v_0 \sin \alpha t - \frac{gt^2}{2} \end{cases} \quad 0 \leq t_1 \leq t_1$$

$$\begin{cases} x = v_0 \cos \alpha t \\ y = h_1 - \frac{gt^2}{2} \end{cases} \quad t_1 \leq t \leq t_2$$

Задача 3.

$$m = 2 \text{ кг}$$

$$a = 4 \text{ м/с}^2$$

$$t = 10 \text{ с}$$

A.?



$$F_2 = mg \quad F_1 = ma \quad v_0 = 0$$

$$\vec{F}_1 = -\vec{F}_2 = -mg$$

$$F = F_1 + F_2 = 2 \cdot 10 + 2 \cdot 4 = 28 \text{ Н}$$

$$S = S_0 + v_0 t + \frac{at^2}{2}$$

$$S = 0 + 0t + \frac{4 \cdot 10^2}{2} = 200 \text{ м}$$

$$A = F \cdot \Delta S$$

$$A = 28 \cdot 200 = 5600 \text{ Дж} = 5,6 \text{ кДж}$$

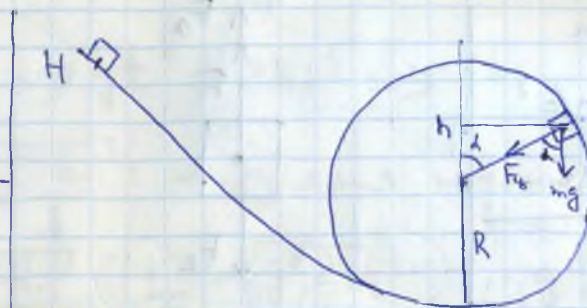


3agaza 4

Dano:

$$H = 2R$$

$h = ?$



$$F_b = \frac{mv^2}{R} = mg \cos \alpha$$

$$mgH = \frac{mv^2}{2} + mgh \Rightarrow$$

$$\Rightarrow \cancel{mg} 2R = \cancel{\frac{mv^2}{2}} + \cancel{m} gh \Rightarrow g 2R = \frac{v^2}{2} + gh \Rightarrow$$

$$\Rightarrow 4gR = v^2 + 2gh$$

$$h = R + R \cos \alpha \Rightarrow \cos \alpha = \frac{h-R}{R}$$

$$\frac{\cancel{mv^2}}{\cancel{R}} = \frac{\cancel{mg}(h-R)}{\cancel{R}} \Rightarrow v^2 = g(h-R)$$

$$4gR = g(h-R) + 2gh \Rightarrow$$

$$\Rightarrow 4gR = gh - gR + 2gh \Rightarrow$$

$$\Rightarrow \cancel{5gR} = \cancel{gh} + \cancel{2g} 3gh \Rightarrow 5R = 3h \Rightarrow$$

$$\Rightarrow h = \frac{5R}{3}$$



### 3agaza 5

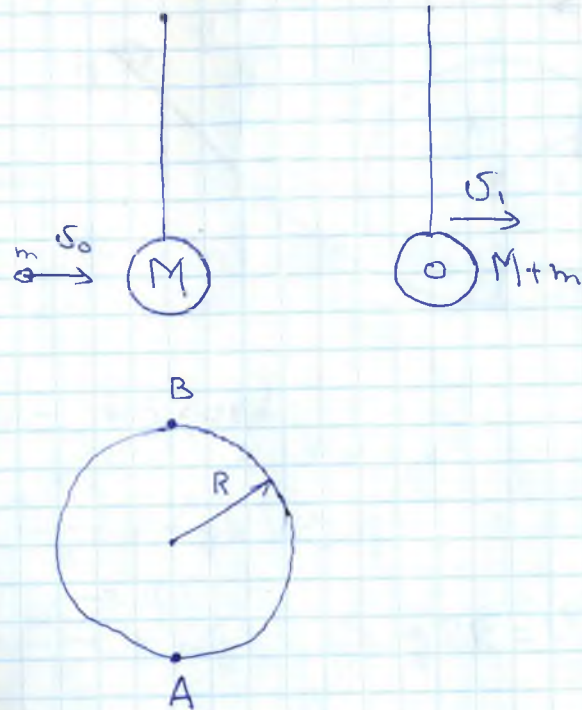
Dano:

$M$

$m$

$L$

$U_0 = ?$



$$E_{KA} = E_{NB}$$

$$E_{KA} = \frac{(m+M)U_1^2}{2}$$

$$E_{NB} = (m+M)gh$$

$$\frac{(m+M)U_1^2}{2} = (m+M)gh \Rightarrow$$

$$\Rightarrow (m+M)U_1^2 = 2(m+M)gh \Rightarrow$$

$$\Rightarrow U_1^2 = \frac{2(m+M)gh}{(m+M)}$$

$$h = 2R = 2L \Rightarrow U_1^2 = 4gL \Rightarrow U_1 = \sqrt{4gL}$$

$$U_0 m = (M+m)U_1$$

$$U_0 = \frac{(m+M)\sqrt{4gL}}{m} = \frac{2(m+M)\sqrt{gL}}{m}$$



# Soal 6.

Dik:  $\gamma = 1,4$

$$V_1 = 0,1 \text{ m}^3$$

$$V_2 = 0,3 \text{ m}^3$$

$$P_2 = 2 \cdot 10^5 \text{ Pa}$$

$$PV = \text{const}$$

$$a) U = \frac{f}{2} \gamma RT$$

$$\gamma = \frac{f+2}{f} \Rightarrow f = \frac{2}{\gamma-1} = \frac{2}{1,4-1} = 5$$

$$U = \frac{f}{2} \gamma \cdot 8,31 \cdot \text{const}$$

$$\gamma = \frac{m}{M} = \text{const}$$

$$U_1 = U_2 \quad \Delta U = 0$$

$$b) A = PV \Rightarrow 0$$

$$b) Q = \Delta U + A = 0$$

$$a) PV = \frac{m}{M} RT \Rightarrow U = \frac{f}{2} PV = \frac{5}{2} \cdot \text{const}$$

# Soal 7.

Dik:  $\eta = \frac{T_1 - T_2}{T_1} = \frac{A}{Q_1} \Rightarrow$

$$Q_1 = 4,38 \text{ kJ} = 4,38 \cdot 10^3 \text{ J}$$

$$A = 2,4 \text{ kJ} = 2,4 \cdot 10^3 \text{ J}$$

$$T_2 = 273 \text{ K}$$

$$T_1 = ?$$

$$\eta = \frac{T_1 - T_2}{T_1} = \frac{A}{Q_1} \Rightarrow$$

$$\Rightarrow (T_1 - T_2) \cdot Q_1 = A \cdot T_1 \Rightarrow$$

$$\Rightarrow T_1 Q_1 - T_2 Q_1 = A \cdot T_1 \Rightarrow$$

$$\Rightarrow T_1 Q_1 - A \cdot T_1 = T_2 Q_1 \Rightarrow$$

$$\Rightarrow T_1 (Q_1 - A) = T_2 Q_1 \Rightarrow T_1 = \frac{T_2 Q_1}{Q_1 - A} \Rightarrow$$

$$\Rightarrow \frac{273 \cdot 4,38 \cdot 10^3}{4,38 \cdot 10^3 - 2,4 \cdot 10^3} = \frac{273 \cdot 4,38 \cdot 10^3}{1,98 \cdot 10^3} = 604 \text{ K}$$



Задача 10

Дано:

$$P_1 = 500 \text{ Н}$$

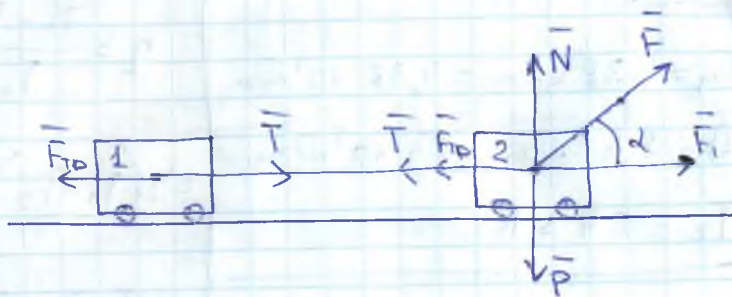
$$P_2 = 500 \text{ Н}$$

$$a = 0,9 \text{ м/с}^2$$

$$\alpha = 45^\circ$$

$$\mu = 0,3$$

$$T = ?$$



$$\bar{F}_1 = \bar{F} \cdot \cos \alpha$$

$$N = P = mg$$

$$F = ma$$

$$F_{fr} = \mu \cdot N$$

$$\sum \bar{F} = 2ma$$

$$\bar{F} + \bar{F}_{fr} + \bar{T} + \bar{T} + \bar{F}_{fr} = ma + ma$$

$$F \cos \alpha - F_{fr} - \cancel{T} + \cancel{T} - F_{fr} = 2ma$$

$$F \cos \alpha - 2F_{fr} = 2ma$$

$$F \cos \alpha = 2ma + 2F_{fr} \quad \text{II закон ньютона}$$

$$F \cos \alpha - F_{fr} - T = ma \quad \text{II закон ньютона}$$

$$T = F \cos \alpha - F_{fr} - ma = \cancel{F \cos \alpha} + \cancel{F_{fr}} - \cancel{ma} = ma + F_{fr} = \frac{P}{g} a + \mu \cdot N = \frac{P}{g} a + \mu \cdot mg =$$

$$= \frac{P}{g} a + \mu \frac{P}{g} g = \frac{500}{10} \cdot 0,9 + 0,3 \cdot 500 = 195 \text{ Н}$$