FIZIKA

2020/2021

VAJE

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VAJE 1

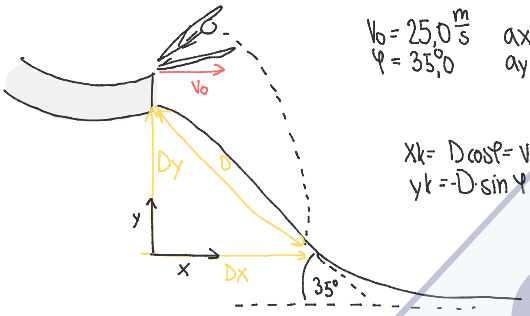
* signifikantna mesta

toliko mest, kolikor jih ima najmanj natančen podatek.

- vmesne rezultate NE zaokrožujemo s signifikantnimi mesti

naloga 1

skakalka odskoči v vodoravni smeri; klanec je pod kotom 35°. Kje skakalka pristane?



$v_0 = 25{,}0\ \frac{m}{s}$ $\quad a_x = 0$ $\quad x_k = v_{ox} \cdot t$

$\varphi = 35{,}0°$ $\quad a_y = -g$ $\quad y_k = v_{oy} \cdot t - \frac{gt^2}{2}$

$x_k = D\cos\varphi = v_{ox} \cdot t$

$y_k = -D\sin\varphi = -\frac{1}{2}gt^2$

$t = \frac{D\cos\varphi}{v_{ox}}$

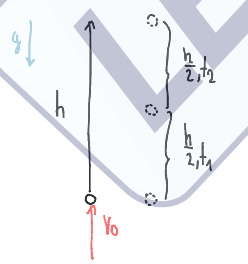
$D\sin\varphi = \frac{1}{2}g \cdot \frac{D^2\cos^2\varphi}{v_{ox}^2}$

$D = \frac{2\sin\varphi\, v_{ox}^2}{g\cos^2\varphi} = \frac{2\tan\varphi \cdot v_{ox}^2}{g\cos\varphi} = 109\,m$

$x_k = 89{,}3\,m$ $\quad y_k = -62{,}5\,m$

naloga 2

(4.) Predmet vržemo navpično navzgor. Kolikšno je razmerje med časom, ki ga potrebuje za prvo polovico poti in časom, ki ga potrebuje za drugo polovico poti?



uporabimo trik: gledamo prosti pad (komplementarni primer)

celotni čas potovanja $h = \frac{gt^2}{2}$

zgornji del poti $t = \sqrt{\frac{2h}{g}}$

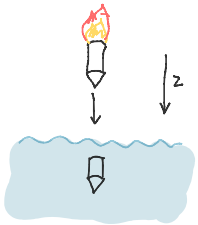
$\frac{h}{2} = \frac{gt^2}{2}$ $\quad h = gt^2$ $\quad t_2' = \sqrt{\frac{h}{g}}$

spodnji $t_s = t - t_2 = \sqrt{\frac{2h}{g}} - \sqrt{\frac{h}{g}} = \sqrt{\frac{2h}{g}}\left(1 - \frac{1}{\sqrt{2}}\right)$

$\frac{t_s}{t_2} = \frac{\sqrt{\frac{2h}{g}}\left(1 - \frac{1}{\sqrt{2}}\right)}{\sqrt{\frac{h}{g}}} = \frac{\sqrt{2}\left(1 - \frac{1}{\sqrt{2}}\right)}{1} = \sqrt{2} - 1 = 0{,}41$

naloga 3

Iz strelek zadane gladine vode s $v_0 = 233\ \frac{m}{s}$. Lego opisuje f. $z = A \cdot \ln\left(\frac{v_0 t}{A} + 1\right)$. Konstanta A znaša 0,1140m.
Zapiši časovno odvisnost njegove hitrosti. Časovna odvisnost pospeška? Čez koliko časa pade hitrost na 10% začetne hitrosti? Kako globoko je takrat?



$v = \frac{dz}{dt} = A \cdot \frac{1}{\frac{v_0 t}{A} + 1} \cdot \frac{v_0}{A}$ $\quad v(t) = \frac{A \cdot v_0}{v_0 t + A}$ $\quad a(t) = \frac{dv}{dt} = -\frac{v_0 t \cdot A \cdot v_0}{(v_0 t + A)^2} = -\frac{v(t)^2}{A}$

naloga 4

Avto zavira s pojemkom $a = -Bv^2$ pri čemer je $B = 6{,}12 \cdot 10^{-4}\ m^{-1}$. Koliko časa prej moramo prestaviti v prosti tek, da bomo mimo cestninske postaje peljali 60 km/h. Začetna hitrost je 120 km/h. Koliksno pot bo prevozil v tem času?

$$v = \int a\,dt = \int -Bv^2\,dt = -B \cdot v^2 \cdot t + C_1 \quad C_1 = v_0 \quad v(t) = -Bv^2 \cdot t + v_0 \qquad v(t_1) = 60\,\frac{km}{h} = 16{,}67\,\frac{m}{s}$$

$$t_1 = \frac{v(t_1) - v_0}{-B \cdot v^2} = \frac{v(t_1) - v_0}{-B(v_0 - v(t_1))^2} = \frac{1}{B(v_0 - v(t_1))} = 49{,}0\,s$$

asistentka:

$$B\int_0^t dt = -\int_{v_0}^{v_1} \frac{dv}{v^2} \qquad Bt = \frac{1}{v_1} - \frac{1}{v_0}$$

$t = 49{,}0\,s$

za pot:

$$\frac{1}{v} = B \cdot t + \frac{1}{v_0} \qquad v(t) = (B \cdot t + \frac{1}{v_0})^{-1} \qquad dx = v\,dt$$

$$v = \frac{dx}{dt}$$

$$\int_0^x dx = \int_0^t \frac{1}{B \cdot t + \frac{1}{v_0}}\,dt \qquad x = \frac{\left|\ln|B \cdot t + \frac{1}{v_0}|\right|}{\frac{B}{2} + \frac{t}{v_0}} = 1{,}13\,km$$

naloga 5

$v_1 = 50\ km/h$
$v_2 = 90\ km/h$
$P_0 = 10\ kW$

$P_0 = m \cdot a \cdot v \qquad t = ?$

$m = 1000\ kg$

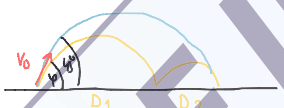
$$a = \frac{dv}{dt} \qquad P_0 = \frac{m \cdot dv}{dt} \cdot v \qquad P_0 \int_0^t dt = m \int_{v_1}^{v_2} v\,dv \qquad P_0 \cdot t = \frac{mv_2^2}{2} - \frac{mv_1^2}{2} = \frac{m}{2}(v_2^2 - v_1^2)$$

$$t = \frac{m(v_2^2 - v_1^2)}{2P_0}$$

naloga 6

žogica se odbija od tal. Odbija se pod istim kotom, kot je bila vržena, njena hitrost po odboju pa je enaka polovici hitrosti pred odbojem. Pot kakšnim kotom moramo vrči, da bo letela enako dolgo, kot če bi vrgli pod kotom 45° v zrak.

(ob drugem dotiku)



$v_{0x} = v_0 \cos\varphi$
$v_{0y} = v_0 \sin\varphi$

x: enakomerno $\qquad y: t_H = \frac{v_{0y}}{g}$

$$D = v_{0x} \cdot 2t_H = \frac{2v_{0x}v_{0y}}{g} = \frac{v_0^2 \cdot \sin 2\varphi}{g}$$

$D = D_1 + D_2$

$$\frac{v_0^2}{g} = \frac{v_0^2 \sin(2\varphi)}{g} + \frac{v_0^2}{4} \cdot \frac{\sin(2\varphi)}{g}$$

$$1 = \sin(2\varphi) + \frac{\sin(2\varphi)}{4}$$

$D = v_0^2 \cdot \frac{\sin(90°)}{g}$

$D_1 = v_0^2 \cdot \frac{\sin(2\varphi)}{g} \qquad D_2 = (\frac{v_0}{2})^2 \cdot \frac{\sin(2\varphi)}{g}$

$$\frac{4}{5} = \sin(2\varphi) \qquad 2\varphi = \arcsin(\frac{4}{5}) \qquad \varphi = \frac{\arcsin(\frac{4}{5})}{2} = 26{,}6°$$

Razmerje časov letenja za obe možnosti?