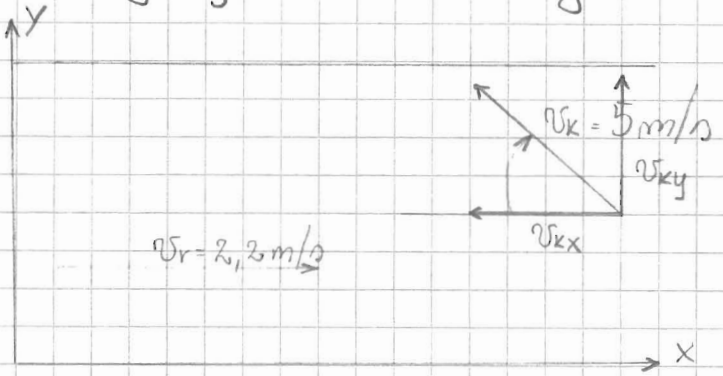
Fizika - Vaje

1) Kanuist želi prečkati reko, ki teče z 2,2 m/s. Veslo s hitrostjo 5 m/s glede na vodo pod kotom 70° proti rečnemu toku. S kolikšno hitrostjo in v kateri smeri se giblje naprem bregu



$\vec{v} = \vec{v}_k + \vec{v}_r$

$v_x = v_{kx} + v_{rx}$

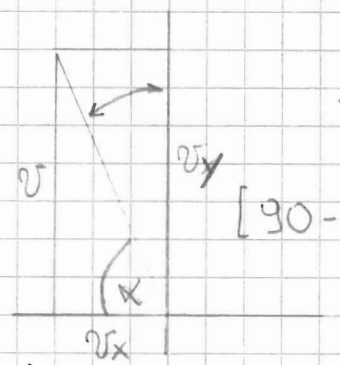
$v_x = 2,2\,m/s - 5\,m/s \cdot \cos 70°$

$v_y = v_{ky} + v_{ry}$

$v_y = 0 + 5\,m/s \cdot \sin 70°$

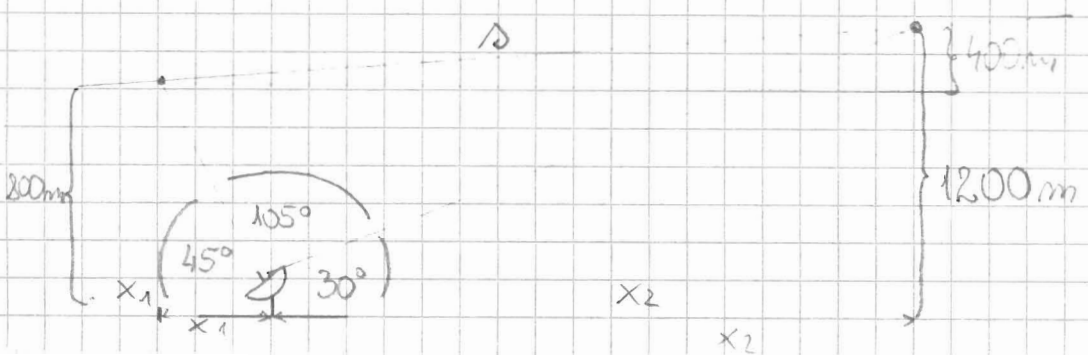
$v^2 = v_x^2 + v_y^2$

$v = \sqrt{v_x^2 + v_y^2} = \underline{\underline{4,72\,m/s}}$



$tg\,x = \frac{v_y}{v_x} = 80,5 \Rightarrow x = \underline{\underline{6°}}$

2) Radar zazna letalo, ki se enakomerno dviga. Zazna ga pod kotom 45° glede na horizont. Leti iz vzhoda proti zahodu na višini 800m. Radar mu sledi nadaljnjih 105° proti zahodu. Ob zadnjem sprejetem signalu je na višini 1200m. Kolikšno razdaljo je preletelo letalo v tem času?



$s^2 = \sqrt{400m^2 + x^2}$

(2)

$X = X_1 + X_2$ $\quad X_1 = 800m$ $\quad X_2 = 2080m$ $\quad X = 2300m$ $\quad X^2 = X_1^2 + X_2^2$

$36 km/h = 10 m/s$

3) Prvi odsek poti do mojega prepotujemo s hitrostjo 120 km/h, drugega pa s hitrostjo 80 km/h. Dolžina prvega odseka je 100 km, drugi pa 50 km. Kolikšna je povprečna hitrost? Koliko časa potujemo? Za koliko bi se zmanjšal čas, če bi na obeh odsekih vozili 10 km/h hitreje?

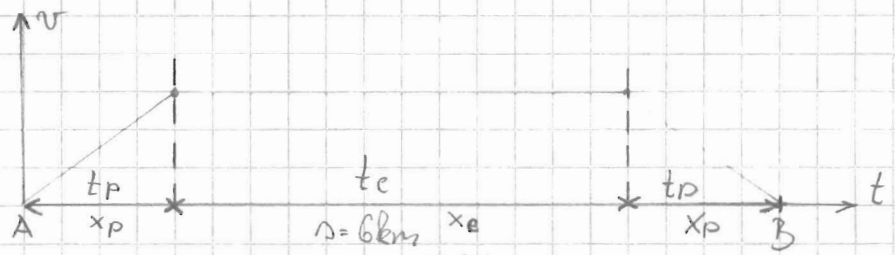
$$t = t_1 + t_2 = \frac{s_1}{v_1} + \frac{s_2}{v_2} = \frac{100\,km}{120\,km/h} + \frac{50\,km}{80\,km/h}$$

$$\underline{t = 1{,}458\,h = 1h\,27{,}5\,min}$$

$$\bar{v} = \frac{s_1 + s_2}{t} = \frac{150\,km}{1{,}458\,h} = \underline{103\,km/h}$$

$$t' = \frac{s_1}{v_1'} + \frac{s_2}{v_2'} = 1{,}326\,h = 1h\,19{,}5\,min$$

4) Kolikšen je najkrajši čas v katerem lahko vlak prevozi razdaljo 6 km med postajema, če je $v_{max} = 60 km/h$, pospešek oz. pojemek pa $0{,}5 m/s^2$



$s = 6 km$

$|a| = 0{,}5 m/s^2$

$v_{max} = 60 km/h$

$t = t_c + 2 \cdot t_p = 4{,}5 min$ (394 s)

$v = a \cdot t \Rightarrow t_p = \frac{60\,km\,s^2}{0{,}5\,m\,h}$

$x_c = 6km - 550m$

$s = x_p \cdot 2 + x_c$

$t_p^2 = \frac{16{,}6\,m\,s^2}{0{,}5\,m} = 33{,}2$

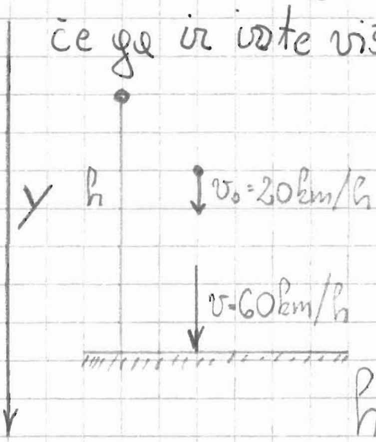
$\underline{x_c = 5450\,m}$

$x_p = \frac{a \cdot t_p^2}{2} = \frac{0{,}5 \cdot 33{,}3}{2}$

$t_c = \frac{s}{v} = \frac{5450}{60} = \underline{324\,s}$

$\underline{x_p = 270\,m}$

5) S kolikšne višine moremo spustiti kamen, da pade na tla s hitrostjo 60 km/h, kolikšna višina pa je potrebna za enako hitrost, če ga vržemo s hitrostjo 20 km/h, kolikšna pa je hitrost če ga iz iste višine vrgli navzgor?



↑ 20 km/h

$g = 9{,}81\ m/s^2$

$v = v_0 + g \cdot t$

1) $v = g \cdot t \Rightarrow 60\ km/h = 10\ m/s^2 \cdot t$

$t = \frac{16{,}6\ m/s}{10\ m/s^2} = \underline{\underline{1{,}7\ s}}$

$h = \frac{1}{2} \cdot g \cdot t^2 = \frac{1}{2} \cdot 10\ m/s^2 \cdot (1{,}7\ s)^2$

$\underline{\underline{h = 14{,}4\ m}}$

2) $v = v_0 + g \cdot t$

$v - v_0 = g \cdot t$

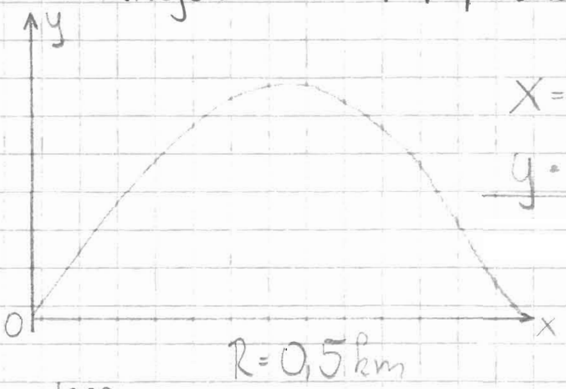
$40\ km/h = 10\ m/s^2 \cdot t$

$t = \frac{11{,}1\ m\ s^2}{10\ s\ m} = \underline{\underline{1{,}1\ s}}$

$h = \frac{1}{2} \cdot g \cdot t^2 = 5\ m/s^2 \cdot (1{,}21\ s)^2 = \underline{\underline{6\ m}}$

3) vtoku prej $v = 60\ km/h$

6) Piratska ladja stoji 0,5 km pred vhodom v pristanišče. Pod kolikšnim kotom morajo s topom iz pristanišča ustreliti proti ladji, da jo zadenejo. Hitrost topovske krogle je 300 km/h



$R = 0{,}5\ km$

$2 \sin\alpha \cdot \cos\alpha = \sin(2\alpha)$

$x = v_{0x} \cdot t$

$y = v_{0y} \cdot t - \frac{g \cdot t^2}{2}$

$v_{0x} = v_0 \cdot \cos\alpha$

$v_{0y} = v_0 \cdot \sin\alpha$

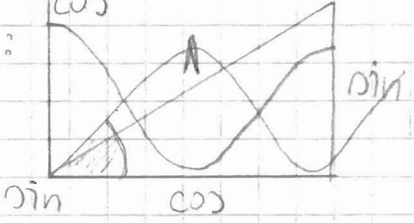
$R = v_0 \cdot \cos\alpha \cdot t$

$0 = v_0 \cdot \sin\alpha \cdot t - \frac{g \cdot t^2}{2} =$

$t \cdot \left(v_0 \cdot \sin\alpha - \frac{g \cdot t}{2}\right)$

na začetku 0 — 0 na koncu

trik:



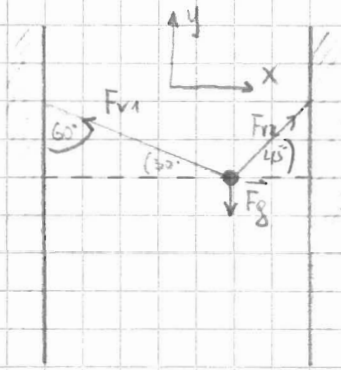
$v_0 \cdot \sin\alpha - \frac{g \cdot t}{2} = 0 \Rightarrow t = \frac{2 v_0 \cdot \sin\alpha}{g}$

$R = v_0 \cdot \cos\alpha \cdot \frac{2 v_0 \cdot \sin\alpha}{g} = \frac{v_0^2}{g} \cdot \sin 2\alpha \Rightarrow \sin 2\alpha = \frac{g \cdot R}{v_0^2}$

$\sin 2\alpha = \underline{0{,}72} \Rightarrow 2\alpha = 46^\circ \Rightarrow \underline{\alpha_1 = 23^\circ}$,

$2 \cdot \alpha_2 = 180 - 46^\circ = \frac{134^\circ}{2} = \underline{67^\circ}$

7) Med vzporedni steni dveh hiš napnemo vrv in manjo obesimo svetilko. Vrv oklepa kot 60° z levo steno in 45° z desno. Najmanj kolikšno notranjo silo mora zdržati vrv, če je masa svetilke 15 kg?



$\sum \vec{F} = 0$

x: $-F_{v2} \cdot \cos 30° + F_{v1} \cdot \cos 45° = 0$

y: $+F_{v2} \cdot \sin 30° + F_{v1} \cdot \sin 45° - F_g = 0$

$F_{v2} \cdot \cos 30° = F_{v1} \cdot \cos 45°$

$F_{v2} \cdot \frac{\sqrt{3}}{2} = F_{v1} \cdot \frac{\sqrt{2}}{2}$

$F_{v2} = F_{v1} \cdot \sqrt{\frac{2}{3}}$

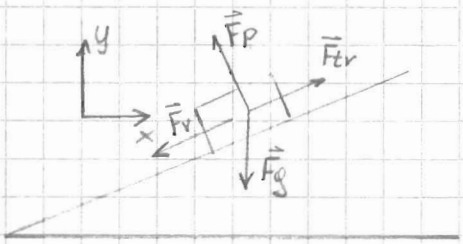
$F_{v1} \cdot \sqrt{\frac{2}{3}} \cdot \frac{1}{2} + F_{v1} \cdot \frac{\sqrt{2}}{2} - F_g = 0$

$F_{v1} = \frac{F_g}{\sqrt{\frac{2}{3}} \cdot \frac{1}{2} + \frac{\sqrt{2}}{2}} = \frac{150N}{\sqrt{\frac{2}{3}} \cdot \frac{1}{2} + \frac{\sqrt{2}}{2}}$

$F_{v1} = 134,5\,N$

$F_{v2} = F_{v1} \cdot \sqrt{\frac{2}{3}} = 134,5 \cdot \sqrt{\frac{2}{3}} = 110N$

8) Po gozdnem pobočju, ki je nagnjeno pod kotom 20° glede na horizontalo z enakomerno hitrostjo vlečemo telo z maso 800 kg $k_{tr} = 0,5$. S kolikšno silo vlečemo deblo a) po klancu navzgor? b) po klancu navzdol?

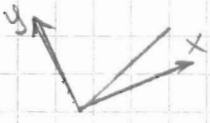


$\sum F = 0$

x: $-F_v \cdot \cos 20° + F_{tr} \cdot \cos 20° - F_p \cdot \sin 20° = 0$

y: $-F_g - F_v \cdot \sin 20° + F_{tr} \cdot \sin 20° + F_p \cdot \cos 20° = 0$

če peje:



x: $-F_v + F_{tr} - F_g \cdot \cos 70° = 0$

y: $F_p - F_g \cdot \sin 70° = 0$

$F_p = F_g \cdot \sin 70°$

$F_p = 752,0N$

$-F_v - F_g \cdot \cos 70 + F_{tr} = 0 \Rightarrow F_v = F_{tr} - F_g \cdot \cos 70°$

$F_v = 1000N$

$F_{tr} = k_{tr} \cdot F_p = 0,5 \cdot 752,0N = 376,0N$

za v klanec navzgor: $F_v = F_{tr} + F_g \cdot \cos 70° = 636,0N$

9) Na avtocesti, kjer je $v_{max} = 120\,km/h$, želijo narediti večji ovinek. Kolikšen je minimalni krivinski radij ovinka, če naj centripetalni pospešek vozil naj ne presega 30% g. Kolikšen bo na ovinku a_{cp} vozil, ki vozijo z $v = 150\,km/h$?

$$a_{cp} = \frac{v^2}{R} \Rightarrow R = \frac{v^2}{a_{cp}} = \frac{(33{,}3\,m/s)^2}{3\,m/s^2} = \underline{370\,m}$$

$$a_{cp}' = \frac{v_1^2}{R} = \frac{(150\,km/h)^2}{370} = \frac{(41{,}7\,m/s)^2}{370\,m} = \underline{4{,}7\,m/s^2}$$

$a_{cp} = 30\%\ g = 3\,m/s^2$

$a_{cp}'' = \frac{(220\,km/h)^2}{370\,m} \approx 10{,}1\,m/s^2$ - ga flikne iz ovinka

10) Ventilator se vrti enakomerno s frekvenco $10\,s^{-1} = 10\,Hz$. V nekem trenutku izključimo motor, da se vrti enakomerno pojemajoče. Kolikšen je kotni pojemek, če se ventilator po 250 vrtljajih vrti s kotno hitrostjo $15\,s^{-1}$. Po kolikšem času neha ventilator povsem ustavil?

$\omega_0 = 10\,s^{-1} = 10\,Hz = \frac{\omega_0}{2\pi}$

$\alpha = ?$

$N = 250$

$\omega_1 = 15\,s^{-1} = 2 \cdot \pi \cdot \nu_1$

$t_u = ?$

$$v = v_0 \cdot a \cdot t$$
$$x = x_0 + v_0 \cdot t + \frac{1}{2} a \cdot t^2$$
$$\downarrow\downarrow$$
$$\omega = \omega_0 + a \cdot t$$
$$\varphi = \varphi_0 + \omega_0 \cdot t + \frac{1}{2} a \cdot t^2$$

$\omega_0 = 2 \cdot \pi \cdot \nu_0 = 62{,}8\,s^{-1}$

$\omega_1 = \omega_0 - \alpha \cdot t$

$250 \cdot 2\pi - 0 + \omega_0 \cdot t - \frac{1}{2} \alpha \cdot t^2$

$\alpha = \frac{\omega_0 - \omega_1}{t} = \underline{1{,}2\,s^{-2}}$

$250 \cdot 2\pi - \omega_0 \cdot t = \frac{1}{2} \alpha \cdot t \cdot t$

$\alpha \cdot t = \omega_0 - \omega_1$

$250 \cdot 2\pi - \omega_0 \cdot t = \frac{1}{2}(\omega_0 - \omega_1) \cdot t$

$250 \cdot 2\pi = \frac{1}{2} t (\omega_0 - \omega_1) + \omega_0 \cdot t$

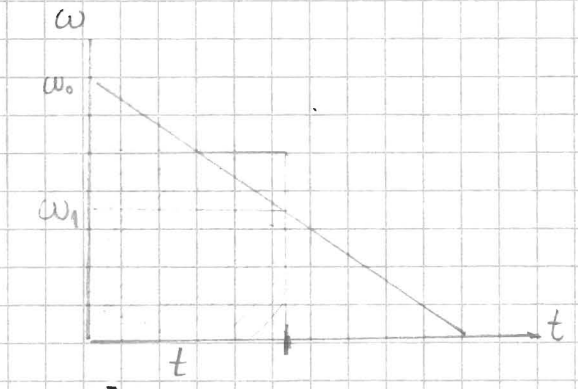
$500 \cdot \pi = \frac{1}{2}(\omega_0 + \omega_1) \cdot t$

$t = \frac{1000\pi}{\omega_0 + \omega_1} = \underline{40{,}4\,s}$

c) $\omega_2 = 0 = \omega_0 - \alpha \cdot t \Rightarrow t_u = \frac{\omega_0}{\alpha}$

$\underline{t_u = 52\,s}$

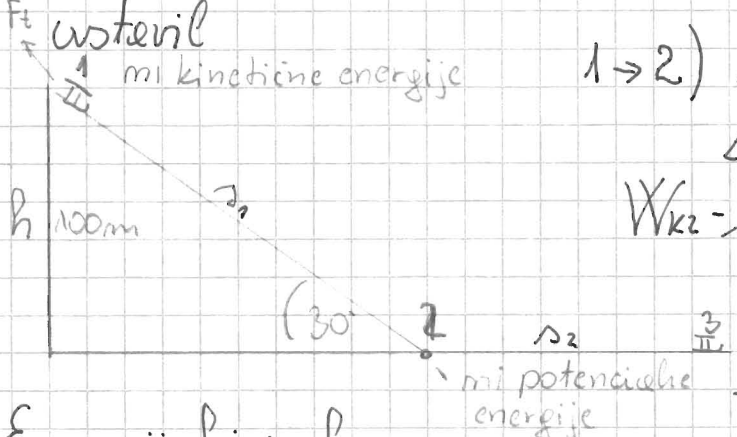
⑥



$\bar{\omega} = (\omega_1 + \omega_0) \cdot \frac{1}{2}$ $\quad x = \bar{v} \cdot t$ + pospešeno

$\varphi = \bar{\omega} \cdot t$

11) Študent se s sanmi spusti z vrha 100 metrov visoke vzpetine z naklonskim kotom 30°. k_tr med snegom in sanmi je 0,1. Ko je prispel do vznožja vzpetine se je odsenkal še naprej po ravni podlegi. Koliksno pot je v celoti presenkal preden se je ustavil



1 → 2) $\Delta W = A$

$\Delta W_k + \Delta W_p = A_t$ $\quad A = \vec{F} \cdot \vec{s}$

$W_{k2} - W_{k1} + W_{p2} - W_{p1} = A_t$

$\frac{m \cdot v_2^2}{2} - m \cdot g \cdot h = A_t$

$\frac{m \cdot v_2^2}{2} - m \cdot g \cdot h = \frac{-m \cdot g \cdot k_t \cdot h}{tg\,30°}$

$\frac{v_2^2}{2} = g \cdot h \left(1 - \frac{k_t}{tg\,30°}\right)$

$v_2 = \sqrt{2gh\left(1 - \frac{k_t}{tg\,30°}\right)} = \underline{\underline{40{,}6\ m/s}}$

Energijski zakon:

$F_t - F_p \cdot k_t = m \cdot g \cdot \cos 30° \cdot 0{,}1$

$h = s \cdot \sin 30° \Rightarrow s = \frac{h}{\sin 30°}$

$A_t = -m \cdot g \cdot \cos 30° \cdot k_t \cdot \frac{h}{\sin 30°}$

2 → 3) $\Delta W = A$ $\quad F_t' = m \cdot g \cdot k_t$

$W_{k3} - W_{k2} = A$

$-\frac{m \cdot v_2^2}{2} = -F_t \cdot s_2$

$s_2 = \frac{m \cdot v_2^2}{2 \cdot F_t} = \frac{m \cdot v_2^2}{2 \cdot m \cdot g \cdot k_t} = \underline{\underline{820\ m}}$