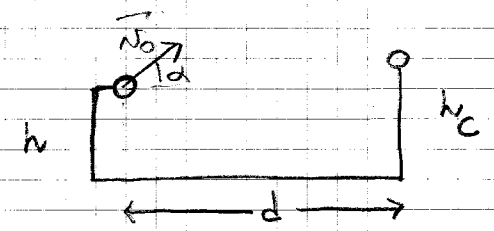
Soluzioni

1)



$h = 2\ m$
$h_c = 3.05\ m$
$d = 10\ m$
$\alpha = 40°$

$$\begin{cases} x(t) = v_0 \cos\alpha\ t \\ y(t) = h + v_0 \sin\alpha\ t - \frac{1}{2} g t^2 \end{cases}$$

$\exists\ t$ tale che $\quad d = v_0 \cos\alpha\ t$

$$h_c = h + v_0 \sin\alpha\ t - \frac{1}{2} g t^2$$

$$\Rightarrow \quad t = \frac{d}{v_0 \cos\alpha} \qquad h_c = h + \cancel{v_0} \sin\alpha \frac{d}{\cancel{v_0}\cos\alpha} - \frac{1}{2} g \frac{d^2}{v_0^2 \cos^2\alpha}$$

$$(h_c - h) = d\,tg\alpha - \frac{g d^2}{2 v_0^2 \cos^2\alpha}$$

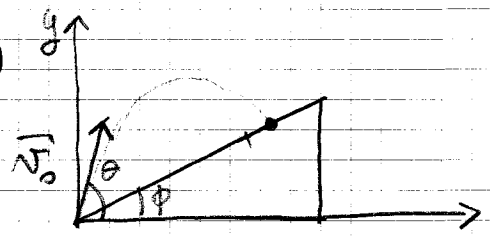
$$\frac{g d^2}{2 v_0^2 \cos^2\alpha} = d\,tg\alpha + h - h_c$$

$$\frac{2 v_0^2 \cos^2\alpha}{g d^2} = \frac{1}{d\,tg\alpha + h - h_c}$$

$$v_0^2 = \left(\frac{g d^2}{d\,tg\alpha + h - h_c} \right) \frac{1}{2\cos^2\alpha}$$

$$v_0 = \frac{d}{\cos\alpha} \sqrt{\frac{g}{2(d\,tg\alpha + h - h_c)}} = 10.67\ m/s$$

3)



(a) $x(t) = v_0 \cos\theta \; t$

$y(t) = v_0 \sin\theta \; t - \frac{1}{2} g t^2$

$\exists\, t$ tale che $\frac{y}{x} = \operatorname{tg}\phi \Rightarrow$

$$\frac{v_0 \sin\theta \; t - \frac{1}{2} g t^2}{v_0 \cos\theta \; t} = \operatorname{tg}\phi$$

$$\operatorname{tg}\theta - \frac{g t}{2 v_0 \cos\theta} = \operatorname{tg}\phi \qquad \operatorname{tg}\alpha - \operatorname{tg}\beta = \frac{\sin(\alpha-\beta)}{\cos\alpha \cos\beta}$$

$$t = (\operatorname{tg}\theta - \operatorname{tg}\phi) \frac{2 v_0 \cos\theta}{g} = \frac{2 v_0 \cancel{\cos\theta}}{g} \frac{\sin(\theta-\phi)}{\cancel{\cos\theta}\cos\phi}$$

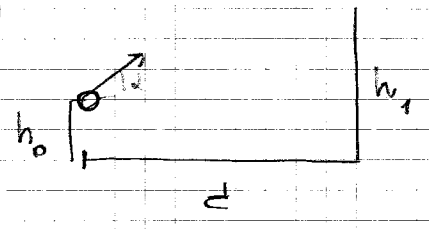
$$\Rightarrow t = 2 v_0 \frac{\sin(\theta-\phi)}{g \cos\phi}$$

$$d^2 = x^2 + y^2 = x^2 + x^2 \operatorname{tg}^2\phi = \frac{x^2}{\cos^2\phi} \Rightarrow$$

$$d^2 = v_0^2 \cos^2\theta \; \frac{4 v_0^2 \sin^2(\theta-\phi)}{g^2 \cos^2\phi} \; \frac{1}{\cos^2\phi}$$

$$d = \frac{2 v_0^2 \cos\theta \sin(\theta-\phi)}{g \cos^2\phi} =$$

4)



$h_0 = 1\ m$
$h_1 = 21\ m$
$d = 130\ m$
$\alpha = 25°$

(a) $x(t) = v_0 t \cos\alpha$

$y(t) = h_0 + v_0 t \sin\alpha - \frac{1}{2} g t^2$

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

$h_1 = h_0 + v_0 \sin\alpha \frac{d}{v_0 \cos\alpha} - \frac{1}{2} g \frac{d^2}{v_0^2 \cos^2\alpha}$

$-h_1 + h_0 + d\,tg\alpha = \frac{1}{2} \frac{g d^2}{v_0^2 \cos^2\alpha}$

$\frac{2 v_0^2 \cos^2\alpha}{g d^2} = \frac{1}{h_0 - h_1 + d\,tg\alpha}$

$v_0 = \sqrt{\frac{g d^2}{2\cos^2\alpha (h_0 - h_1 + d\,tg\alpha)}} = 41.68\ m/s$

(b) $t = \frac{d}{v_0 \cos\alpha} = 3.81\ s$

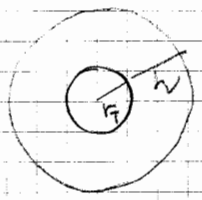
(c) $v_x = v_0 \cos\alpha = 34.14\ m/s$

$v_y = v_0 \sin\alpha - g \frac{d}{v_0 \cos\alpha} = -13.47\ m/s$

$\Rightarrow \vec{v} = (34.14\,\hat{i} - 13.5\,\hat{j})\ m/s$

$v = 36.70\ m/s = \sqrt{v_x^2 + v_y^2}$

7)



$r_T = 6400\ km = 6.4 \times 10^6\ m$

$h = 200\ km = 2 \times 10^5\ m$

$T = 88.2\ m = 5292\ sec$

(a) $a_\perp = \frac{v^2}{R} = \omega^2 R$

$\omega = \frac{2\pi}{T} \Rightarrow a_\perp = \frac{4\pi^2}{T^2}(r_T + h) = 9.30\ m/s^2$

(b) $v = \omega R = \frac{2\pi}{T}(r_T + h) = 7836\ m/s = \frac{7836}{1000}\ \frac{km}{s}$

$= 7.84\ \frac{km}{s} = 7.84\ \frac{km}{1\,h} \cdot 3600\ sec$

$= 28210\ km/h$!