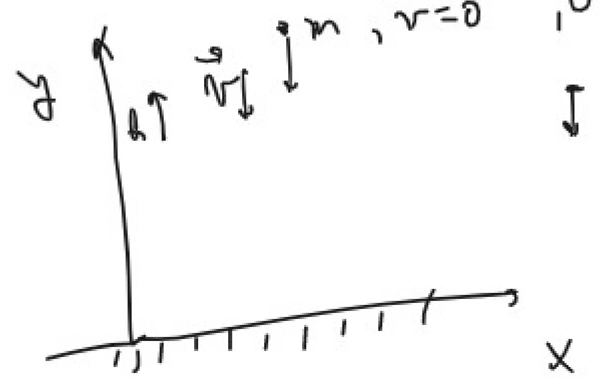
slobodan pad : $v(t)$, $h(t)$



$\downarrow \vec{g} = \vec{a}$

$\boxed{g = 9{,}81}$ = const

$$\boxed{\vec{a} = \frac{d\vec{v}(t)}{dt}} = \vec{g}$$

$$-g = -\frac{dv}{dt}$$

$v=0$, $v(t) = v(t)$, $t \in [0, t]$

$$\boxed{v(t) = gt}$$

$$t = \frac{v(t)}{g}$$

$$\frac{d\vec{h}}{dt} = \vec{v}$$

$$\boxed{\frac{dh}{dt} = -v}$$

$$\int_{h(0)}^{h(t)} dh = -\int_{v_0=0}^{v(t)} v\,dt$$

$$h(t) - h(0) = -\int_0^t g t\,dt =$$

$$\boxed{h(t) = -\frac{1}{2} g t^2 + h(0)}$$

$v(h)$

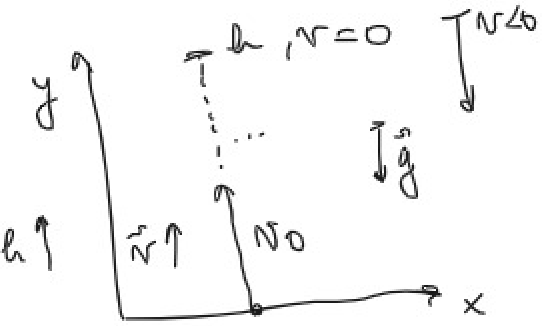
$$-g\int_0^t t\,dt = -g\left.\frac{t^2}{2}\right|_0^t = -\frac{1}{2} g (t^2 - 0^2)$$

$$= -\frac{1}{2} g t^2$$

Ojlerova metoda

$$\vec{r}(t+\Delta t) \approx \vec{r}(t) + \vec{v}(t) * dt$$
$$\vec{v}(t+\Delta t) \approx \vec{v}(t) + \vec{a}(t) * dt$$

Hitac naviše



$$dv = -g\,dt$$

$$\int_{v_0}^{v(t)} dv = -g \int_0^t dt$$

$$v(t) - v_0 = -gt$$

$$\boxed{v(t) = -gt + v_0}$$

$$dh = v\,dt$$

$$\int_0^h dh = \int_0^t (-gt + v_0)\,dt$$

$$\boxed{h(t) = -\frac{1}{2} g t^2 + v_0 t}$$

$$v(\tau) = 0 = -g\tau + v_0$$

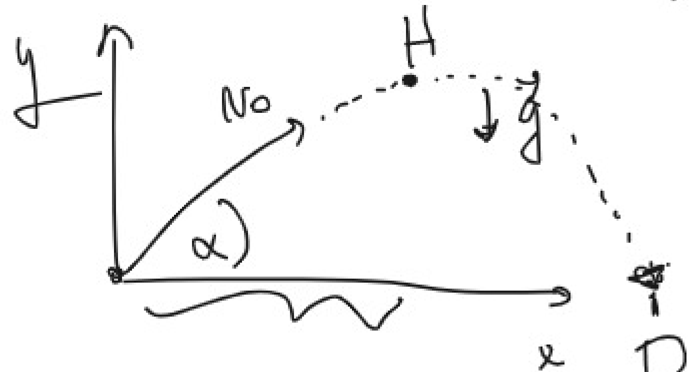
$$g\tau = v_0$$

$$\tau = \frac{v_0}{g}$$

$$h(\tau) = -\frac{1}{2} \cancel{g} \frac{v_0^2}{g^{\cancel{2}}} + \frac{v_0^2}{g} = \frac{v_0^2}{2g}$$

$\uparrow\downarrow$ $v(max) = v_0$

Kosi hitac



x: y:

$a_x = 0$

$a_y = -g$

$D = x(t_{TOT})$

$$\begin{cases} v_0^{(x)} = v_0 \cos\alpha \\ v_0^{(y)} = v_0 \sin\alpha \end{cases}$$

$$|\vec{v}| = \sqrt{v_x^2 + v_y^2}$$

x:

$a_x = 0$

$$\frac{dv_x}{dt} = 0 \qquad \boxed{v_x(t) = v_0 \cos\alpha}$$

$$\frac{dx}{dt} = v_x(t) = v_0 \cos\alpha$$

$x(t=0) = 0$

$$\boxed{x(t) = v_0 \cos\alpha \cdot t}$$

y:

$v_y(t) = -gt + v_0 \sin\alpha$

Za [illegible]

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

—

za padanji

$$v_y(t) = gt$$

$$y(t) = -\frac{1}{2}gt^2 + H$$

H: $v_y(t) = -gt + v_0 \sin\alpha = 0$

$\hookrightarrow t = \tau$

$\tau \to y(t)$

$$\boxed{\tau = \frac{v_0 \sin\alpha}{g}}$$

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

* kod padanja: $y(t) = 0$

$$\boxed{\tau = \frac{v_0 \sin\alpha}{g}}$$

ukupno vreme $\boxed{\tau_{TOT} = \frac{2v_0 \sin\alpha}{g}}$

$$V_{max} = V_0 \sin\alpha$$

domet

$$D = v_0 \cos\alpha \cdot \frac{2v_0 \sin\alpha}{g}$$

miro

domet

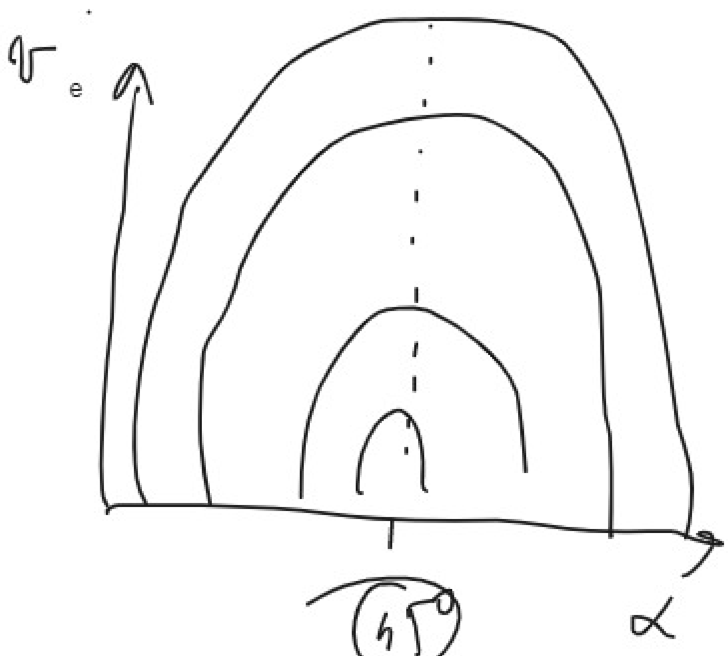
$$D = v_0 \cos\alpha \cdot \frac{2 v_0 \sin\alpha}{g}$$

$$\boxed{D = \frac{v_0^2 \sin(2\alpha)}{g}}$$

MAKSIMALNI DOMET $\alpha = ?$

$$\sin(2\alpha) = 1$$

$$2\alpha = \frac{\pi}{2} \Rightarrow \boxed{\alpha = \frac{\pi}{4}}$$



miro

$\alpha = 45^\circ$, $D = D_{max}$

Ojlerova

$$\vec r(t+\Delta t) = \vec r(t) + \vec v(t)\Delta t$$

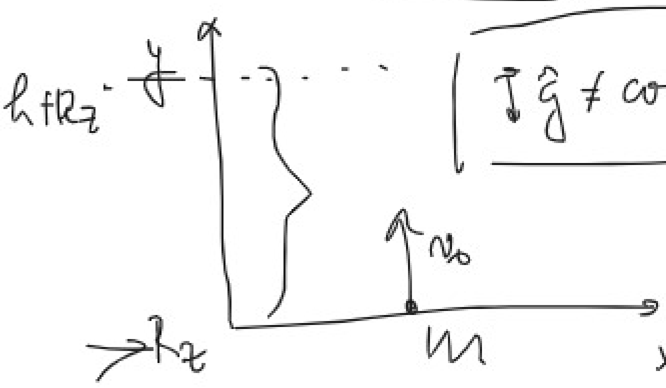
$$\vec v(t+\Delta t) = \vec v(t) + \vec a(t)\Delta t$$

Ojler-Kromerova metoda

$$\vec v(t+\Delta t) = \vec v(t) + \vec a(t)\Delta t$$

$$\vec r(t+\Delta t) = \vec r(t) + \underbrace{\vec v(t+\Delta t)}_{\vec v(t)}\Delta t$$

$$F = -\gamma \frac{mM}{y^2}$$



$$\vec g \neq const$$

$$\vec g = -\gamma \frac{M}{y^2}\vec e_y$$

$$\vec v_0 = v_0 \vec e_y$$

$$\vec a = \frac{d\vec v}{dt} , \quad \vec v = \frac{d\vec r}{dt}$$

$$\vec a(\vec r)$$

$$\vec a = \frac{d\vec v}{dt} = \frac{d\vec v}{d\vec r}\underbrace{\frac{d\vec r}{dt}}_{\vec v} = \vec v \frac{d\vec v}{d\vec r}$$

$$\boxed{\vec{a} \cdot d\vec{r} = \vec{v} \cdot d\vec{v}}$$

$$\boxed{g\,dy = v\,dv}$$

$v(r)$, h_{max}

$y(t)$

$$\int_{\to R_Z}^{\to R_Z + y} g\,dy = -\int_{\to v_0}^{\to v} v\,dv$$

R_Z - połpromień Ziemi