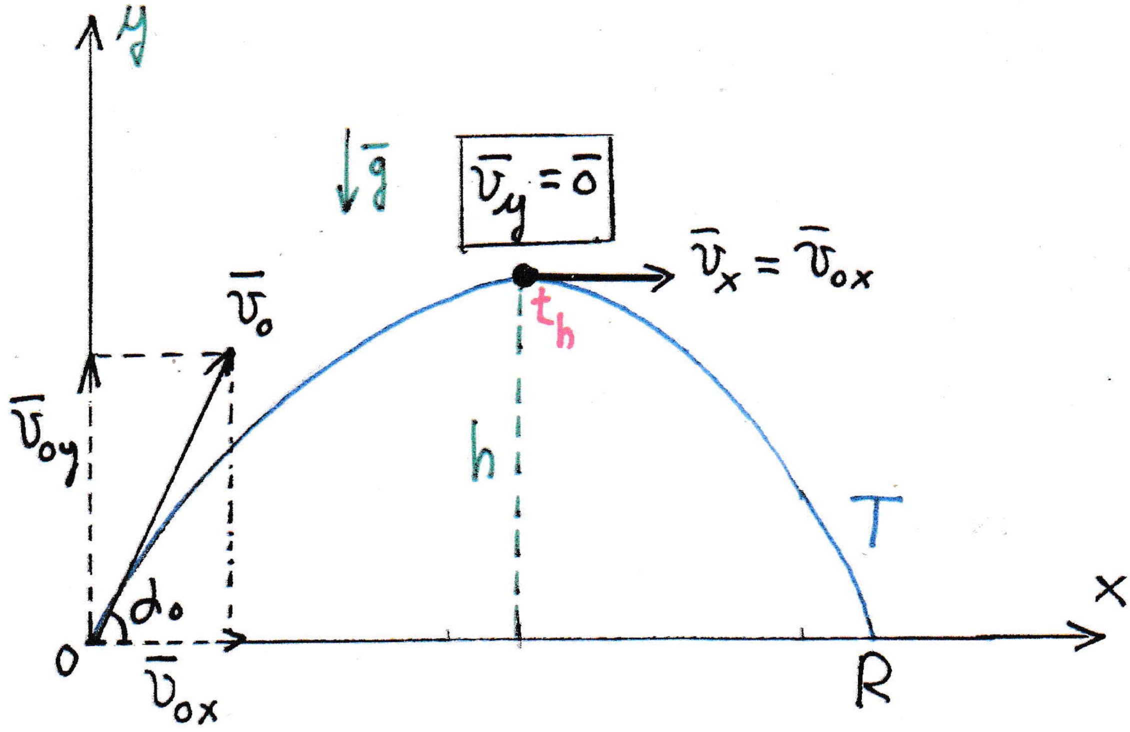
JOHDA <u>VINON HEITTOLIIKKEEN</u>
NOUSUAJAN t_h, LENTOAJAN T, LAKIKORKEUDEN h JA KANTAMAN R LAUSEKKEET.



NOUSUAIKA $\boxed{t_h = \frac{v_{oy}}{g}}$

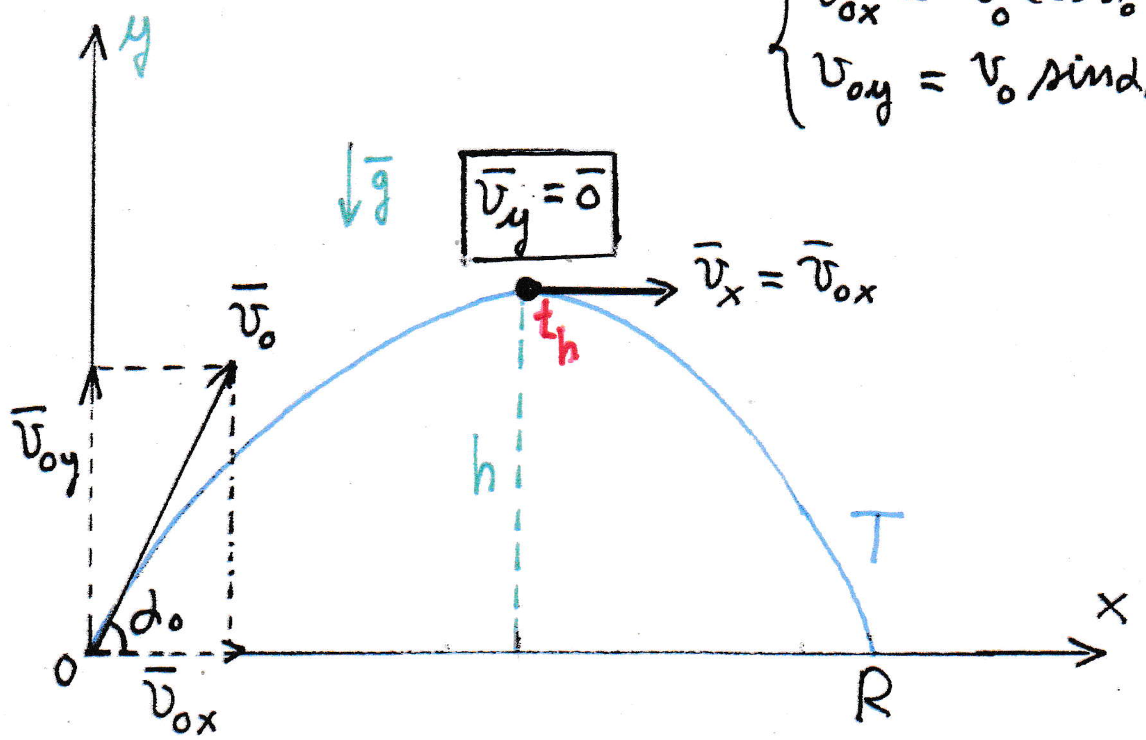
LENTOAIKA $\boxed{T = \frac{2v_{oy}}{g}}$

LAKIKORKEUS $\boxed{h = \frac{v_{oy}^2}{2g}}$

KANTAMA $\boxed{R = \frac{2v_{ox}v_{oy}}{g}}$

RATKAISU

$$\begin{cases} v_{0x} = v_0 \cos\alpha_0 \\ v_{0y} = v_0 \sin\alpha_0 \end{cases}$$



LAKIPISTE: $v_y = 0$ $\qquad a = -g$

$v_y = v_{0y} - g t_h = 0$ $\qquad (v = v_0 + at)$

NOUSUAIKA $t_h = \dfrac{v_{0y}}{g}$

LENTOAIKA $T = 2t_h = \dfrac{2v_{0y}}{g}$

LAKIKORKEUS $h = v_{0y} t - \frac{1}{2} g t^2$
$(y = v_0 t + \frac{1}{2} a t^2)$

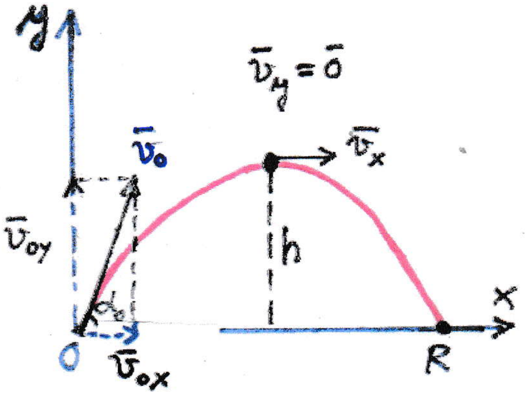
SIJ. $t_h = \dfrac{v_{0y}}{g}$

$$h = v_{0y} \cdot \frac{v_{0y}}{g} - \frac{1}{2} g \left(\frac{v_{0y}}{g}\right)^2$$

$$h = \frac{v_{0y}^2}{2g}$$

KANTAMA $R = v_{0x} \cdot T = \dfrac{2 v_{0x} v_{0y}}{g}$
$(s = vt)$

TOISIN:



$$\begin{cases} v_{0x} = v_0 \cos\alpha_0 \\ v_{0y} = v_0 \sin\alpha_0 \end{cases}$$

$$\begin{cases} x = v_0 \cos\alpha_0 \cdot t \\ y = v_0 \sin\alpha_0 \cdot t - \frac{1}{2}gt^2 \end{cases}$$

a) NOUSUAIKA $t_h = ?$

LAKIPISTE: $v_y = 0$ $\qquad v_y = v_0 \sin\alpha_0 - gt = 0$

$$t = \frac{v_0 \sin\alpha_0}{g} = t_h \qquad (1)$$

b) LENTOAIKA $T = 2 \cdot t_h = \frac{2 v_0 \sin\alpha_0}{g}$ $\qquad (2)$

SYMMETRIAN PERUSTEELLA

c) LAKIKORKEUS $h = ?$

SIJ. NOUSUAIKA t_h (1) PAIKAN Y-KOORDINAATIN YHTÄLÖÖN

$$y = v_0 \sin\alpha_0 \cdot t - \frac{1}{2} g t^2$$

$$y = v_0 \sin\alpha_0 \cdot \frac{v_0 \sin\alpha_0}{g} - \frac{1}{2} g \cdot \left(\frac{v_0 \sin\alpha_0}{g}\right)^2$$

$$y = {}^{2)}\frac{v_0^2 \sin^2\alpha_0}{g} - \frac{v_0^2 \sin^2\alpha_0}{2g} = \frac{v_0^2 \sin^2\alpha_0}{2g} = h$$

d) KANTAMA $R = ?$

SIJ. LENTOAIKA T (2) PAIKAN X-KOORDINAATIN YHTÄLÖÖN $\quad x = v_0 \cos\alpha_0 \cdot t = v_0 \cos\alpha_0 \cdot \frac{2 v_0 \sin\alpha_0}{g}$

$$x = \frac{2 v_0^2 \sin\alpha_0 \cos\alpha_0}{g} = \frac{v_0^2 \sin 2\alpha_0}{g} = R$$

(Käytetty: 2sinx·cosx = sin2x).