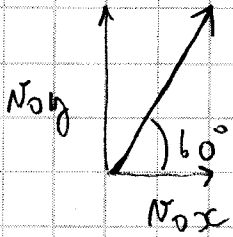


Lançamento Balístico

Exemplo 1:

$$v_0 = 15 \text{ m/s}$$



$$a) \quad v_{0x} = 15 \cdot \cos 60^\circ \Rightarrow v_{0x} = 7,5 \text{ m/s}$$

$$v_{0y} = 15 \cdot \sin 60^\circ \Rightarrow v_{0y} = 13 \text{ m/s}$$

$$b) \quad x = v_{0x} \cdot t \Rightarrow x = 7,5 \cdot t$$

$$h = v_{0y} \cdot t - \frac{g t^2}{2} \Rightarrow h = 13 \cdot t - \frac{9,8 t^2}{2}$$

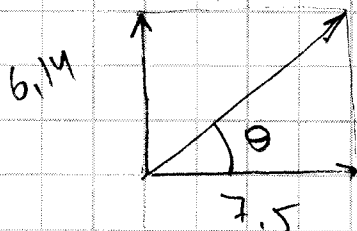
$$h = 13t - 4,9 t^2$$

$$c) \quad v_x = v_{0x} \Rightarrow v_x = 7,5 \text{ m/s}$$

$$v_y = v_{0y} - g t \Rightarrow v_y = 13 - 9,8 t$$

$$d) \quad p/ \quad t = 0,7 \text{ s} \Rightarrow \left\{ \begin{array}{l} x = 7,5 \cdot 0,7 \Rightarrow x = 5,25 \text{ m} \\ h = 13t - 4,9 \cdot 0,7^2 \Rightarrow h = 6,7 \text{ m} \end{array} \right.$$

$$v_x = 7,5 \text{ m/s} \quad ; \quad v_y = 13 - 9,8 \cdot 0,7 \Rightarrow v_y = 6,14 \text{ m/s}$$



$$v_{(0,7)} = \sqrt{6,14^2 + 7,5^2} = 9,7 \text{ m/s}$$

$$\theta = \arctan \frac{6,14}{7,5} \Rightarrow \theta = 39,3^\circ$$
$$\vec{v} = 9,7 \text{ m/s}; \theta = 39,3^\circ$$

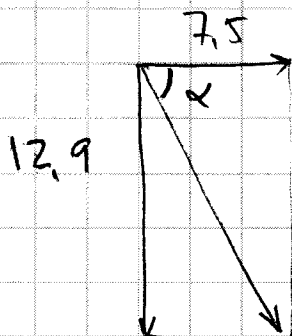
$$e) \quad p/ \quad t = 2,4 \text{ s} \Rightarrow x = 7,5 \times 2,4 \Rightarrow x = 18,0 \text{ m}$$

$$h = 13 \times 2,4 - 4,9 \times 2,4^2 \Rightarrow h = 3,0 \text{ m}$$

Exemplo ① cont.

e) $v_x = 7,5 \text{ m/s}$; $v_y = 13 - 9,8 \cdot 2,4$

$$v_y = -10,5 \text{ m/s}$$



$$v(2,4) = \sqrt{7,5^2 + (-10,5)^2} = 12,9 \text{ m/s}$$

$$\alpha = \arctan \frac{12,9}{7,5} \Rightarrow \alpha = 59,8^\circ$$

$$\vec{v} = 12,9 \text{ m/s}; \theta = 59,8^\circ$$

f) $v_y = v_{0y} - gt$

$$0 = 13 - 9,8 \cdot t \Rightarrow t = \frac{-13}{-9,8} \Rightarrow t = 1,3 \text{ s}$$

g) $v_y^2 = v_{0y}^2 - 2gh$

$$0^2 = 13^2 - 2 \cdot 9,8 \cdot h \Rightarrow h = \frac{-169}{-19,6} \Rightarrow h = 8,6 \text{ m}$$

ou

$$h = 13t - 4,9t^2 \Rightarrow h = 13 \times 1,3 - 4,9 \times 1,3^2 \Rightarrow h = 8,6 \text{ m}$$

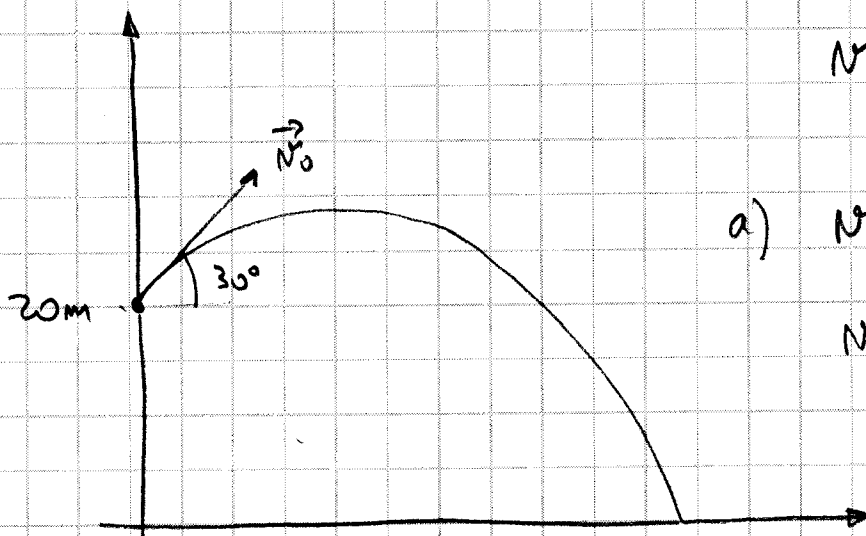
h) $t_t = 2 \times t_{\text{subida}} \Rightarrow t_t = 2 \times 1,3 \Rightarrow t = 2,6 \text{ s}$

i) $x = 7,5 t \Rightarrow x = 7,5 \times 2,6 \Rightarrow x = 19,5 \text{ m}$

j) $h = 13t - 4,9t^2$; $x = 7,5 t \Rightarrow t = \frac{x}{7,5}$

$$h = 13 \cdot \frac{x}{7,5} - 4,9 \left(\frac{x}{7,5} \right)^2 \Rightarrow h = 1,73x - 8,711 \cdot 10^{-2} x^2$$

Exemplo (2)



$$v_0 = 20 \text{ m/s}$$

a) $v_{0x} = 20 \cdot \cos 30^\circ$

$$v_{0x} = 17,2 \text{ m/s}$$

$$v_{0x} = v_x$$

$$x = v_{0x} \cdot t \Rightarrow \boxed{x = 17,2 t}$$

$$v_{0y} = v_0 \cdot \sin 30^\circ \Rightarrow v_{0y} = 20 \times \sin 30^\circ$$

$$v_{0y} = 10 \text{ m/s}$$

$$h = h_0 + v_{0y}t - \frac{g t^2}{2}$$

$$h = 20 + 10t - \frac{10 t^2}{2} \Rightarrow \boxed{h = 20 + 10t - 5 t^2}$$

b) $v_y = v_{0y} - gt$

$$\boxed{v_y = 10 - 10t}$$

c) $0 = 10 - 10t \Rightarrow \boxed{t = 1,0 \text{ s}}$

d) $h_{\text{máx}} = 20 + 10 \cdot 1,0 - \frac{10 \cdot 1,0^2}{2} \Rightarrow \boxed{h_{\text{máx}} = 25 \text{ m}}$

e) $0 = 20 + 10t - 5t^2$ (Buscara)

$$\boxed{t' = 3,24 \text{ s}}$$

$$t'' = -1,23 \text{ s (não convém)}$$