Question

An object is thrown upward at an angle of 37^0 with a velocity of 10 m/s from the top of a 20 m high building. Where, from the foot of the building, would it land?

Solution

v_0 = 10 m/s; α = 37^0; h_0 = 20 m; l - ?

$$OY:\ y = h_0 + v_0 \sin(\alpha)\, t - \frac{gt^2}{2};$$

$$OX: x = v_0 \cos(\alpha)\, t$$

When y = 0 it means that object is on surface of Earth.

$$y = 0 = h_0 + v_0 \sin(\alpha)\, t_f - \frac{gt_f^2}{2};$$

$$t_f = \frac{v_0 \sin(\alpha)}{g} \pm \frac{\sqrt{v_0^2 sin^2(\alpha) + 2gh_0}}{g};$$

We choose "+", because if we choose "-" : $t_f < 0$.

$$l = v_0 \cos(\alpha)\, t_f = v_0 \cos(\alpha)\, (\frac{v_0 \sin(\alpha)}{g} + \frac{\sqrt{v_0^2 sin^2(\alpha) + 2gh_0}}{g})$$

l ≈ 9*(0.6 + 2.1) m = **24.3 m**

Answer: l = 24.3 m.