

An object is launched at 40 m/s at 40 degrees from the horizontal. It lands on a platform 10 meter below the height it started from. What is delta x? (distance traveled horizontally)

Solution:

Δx – horizontal range of the object;

$V = 40 \frac{\text{m}}{\text{s}}$ – initial speed of the object;

$\alpha = 40^\circ$ – the angle between the velocity and the horizontal;

$h = 10\text{m}$ – initial height

Equation of the motion for the object, directed at angle α : (t – time of the flight)

$V_x = V \cos \alpha$; $V_y = V \sin \alpha$;

$x: \Delta x = V_x t = Vt \cos \alpha$ (1)

$y: -h = Vt \sin \alpha - \frac{gt^2}{2}$

$gt^2 - 2Vt \sin \alpha - 2h = 0$

$9.8t^2 - 80t \sin 40^\circ - 20 = 0$

Roots of a quadratic equation:

$$t_1 = 5.6\text{s} \quad t_2 = -0.36$$

The time of the flight can be only positive: $t = 5.6\text{s}$ (2)

(2)in(1):

$\Delta x = Vt \cos \alpha = 40 \frac{\text{m}}{\text{s}} \cdot 5.6\text{s} \cdot \cos 40^\circ = 172\text{m}$

Answer: distance traveled horizontally is equal to 172m.

