Answer on Question #40826, Physics, Mechanics

A projectile thrown at 45° just cross the top of pole whose foot is 6 m from point of projection. The projectile falls on the other side at a distance 3 m from foot of pole. Height of pole is?

(a) 1.5 m

(b) 2 m

(c) 2.5 m

(d) 3 m

Solution:

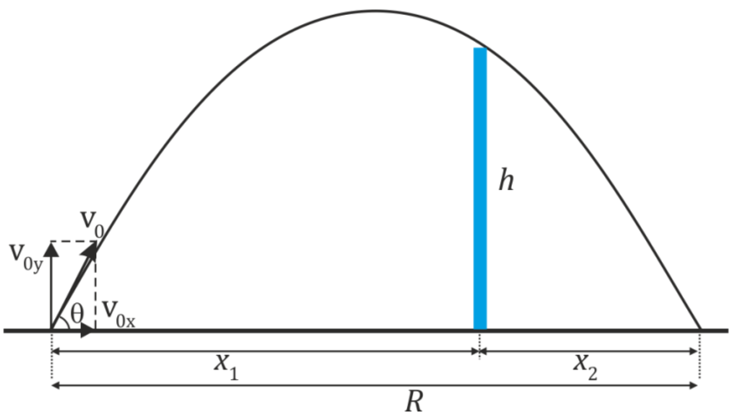
Given:

$x_1 = 6$ m,

$x_2 = 3$ m,

$\theta = 45°$

$h = ?$



Neglecting air resistance, the projectile is subject to a constant acceleration g=9.81 m/s^2, due to gravity, which is directed vertically downwards.

Equations related to trajectory motion (projectile motion) are given by

$$\text{Horizontal distance,} \quad x = v_{0x}t$$

$$\text{Vertical distance,} \quad y = v_{0y}t - \frac{1}{2}gt^2$$

$$\text{Horizontal range,} \quad R = \frac{v_0^2 \sin 2\theta}{g}$$

where v_0 is the initial velocity.

We have

$$R = 6 + 3 = 9 \text{ m}$$

Thus,

$$v_0 = \sqrt{\frac{Rg}{\sin 2\theta}} = \sqrt{\frac{9 \cdot 9.81}{1}} = 9.4 \text{ m/s}$$

Time to reach a pole is

$$t_1 = \frac{x_1}{v_{0x}} = \frac{x_1}{v_0 \cos\theta} = \frac{6}{9.4 \cdot \cos 45°} = 0.9027 \text{ s}$$

Vertical distance,

$$h = y = v_0 \sin\theta\, t_1 - \frac{1}{2} g {t_1}^2 = 9.4 \cdot \sin 45° \cdot 0.9027 - \frac{9.81 \cdot 0.9027^2}{2} = 2\ \mathrm{m}$$

Answer. (b) 2 m.