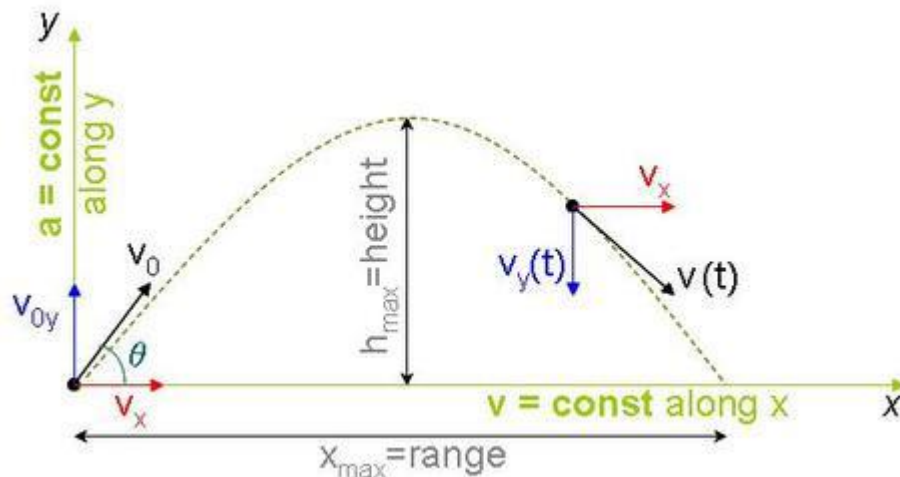


Answer on Question #43406, Physics, Mechanics | Kinematics | Dynamics

A rabbit leaps into the air at an angle of 30 degrees and lands back on the ground 8.00m away in a time of 1.50s. What is the maximum height the rabbit has reached?

Solution:



Projectile motion is a form of motion in which an object or particle (called a projectile) is thrown near the earth's surface, and it moves along a curved path under the action of gravity only.

In projectile motion, the horizontal motion and the vertical motion are independent of each other; that is, neither motion affects the other.

The horizontal component of the velocity of the object remains unchanged throughout the motion. The vertical component of the velocity increases linearly, because the acceleration due to gravity is constant ($g=9.81 \text{ m/s}^2$).

Equations related to trajectory motion are given by

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

$$\text{Vertical distance, } y = y_0 + v_{0y}t - \frac{1}{2}gt^2$$

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

$$\text{Maximum height reached, } H = \frac{v_0^2 \sin^2 \theta}{2g}$$

where v_0 is the initial velocity.

From third equation we have the initial velocity

$$v_0 = \sqrt{\frac{Rg}{\sin 2\theta}} = \sqrt{\frac{8.0 \cdot 9.81}{\sin 60^\circ}} = 9.52 \text{ m/s}$$

From fourth equation

$$H = \frac{v_0^2 \sin^2 \theta}{2g} = \frac{9.52^2 \sin^2 30^\circ}{2 \cdot 9.81} = 1.555 \approx 1.6 \text{ m}$$

Answer: $H = 1.6 \text{ m}$.