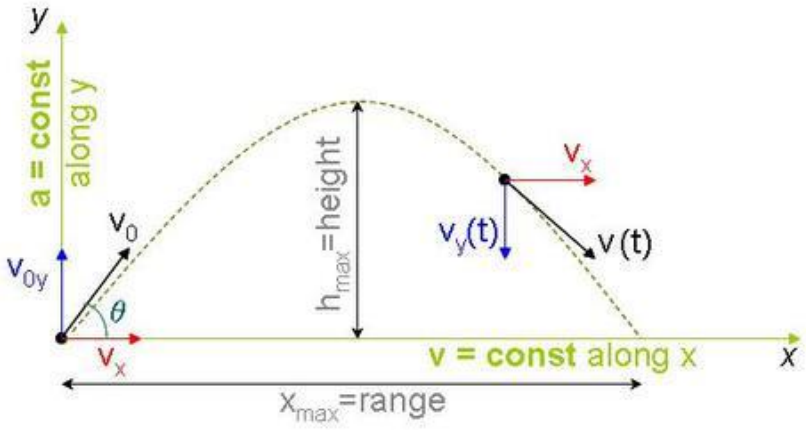
Answer on Question #48401, Physics, Mechanics | Kinematics | Dynamics

A batsman hits a ball at a velocity of 17.5 m/s angled at tan−1 (3/4) above the horizontal, the ball initially being 60 cm above level ground. The ball is caught by a fielder standing 28 m from the batsman. Find the time taken for the ball to reach the fielder and the height above ground at which he takes the catch.

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 m/s^2).

Equations related to trajectory motion are given by

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

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

where $v_0 = 17.5 \text{ m/s}$ is the initial velocity.

$$\theta = \tan^{-1}\left(\frac{3}{4}\right) = 36.87°$$

$$v_x = v_0 \cos\theta$$

$$v_{0y} = v_0 \sin\theta$$

$$y_0 = 0.6 \text{ m}$$

$$x = 28 \text{ m}$$

From first equation

$$28 = 17.5 * \cos 36.87° \, t$$

Thus,

$$t = \frac{28}{17.5 * \cos 36.87°} = \mathbf{2 \text{ s}}$$

$$y = 0.6 + 17.5 * \sin 36.87° * 2 - \frac{1}{2} * 9.81 * 4 = \mathbf{1.98 \text{ m}}$$