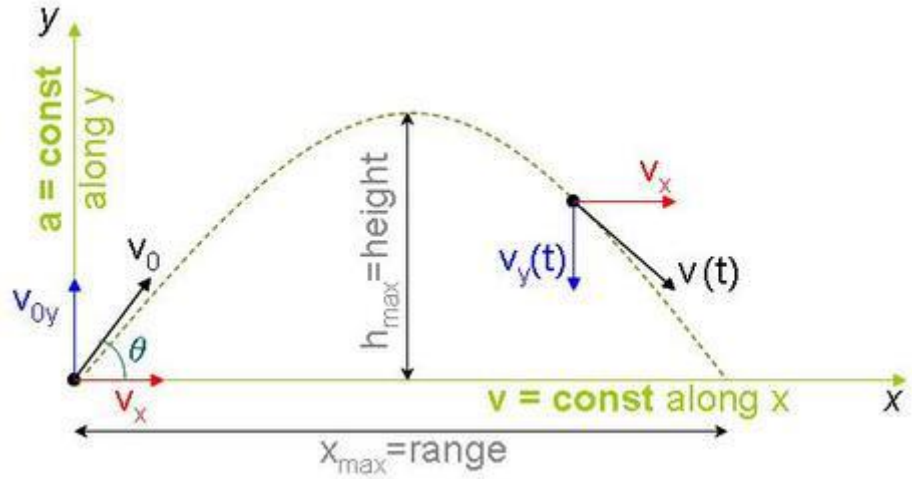
Answer on Question #43480, Physics, Mechanics | Kinematics | Dynamics

A player kicks a soccer ball towards the goalkeeper, but at an angle of 37 degree to the horizontal and with an initial speed of 14.7m/s. The goalkeeper stands 26 m from the kicker. Where will the ball land relative to the goalkeeper?

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

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

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

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

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

where v_0 is the initial velocity.

$$R = \frac{v_0^2 \sin 2\theta}{g} = \frac{14.7^2 \sin(2 \cdot 37°)}{9.81} = 21.17 \approx 21.2 \text{ m}$$

Thus, the ball land front of the goalkeeper on distance

$$d = 26 - 21.2 = 4.8 \text{ m}$$

Answer: $d = 4.8$ m.