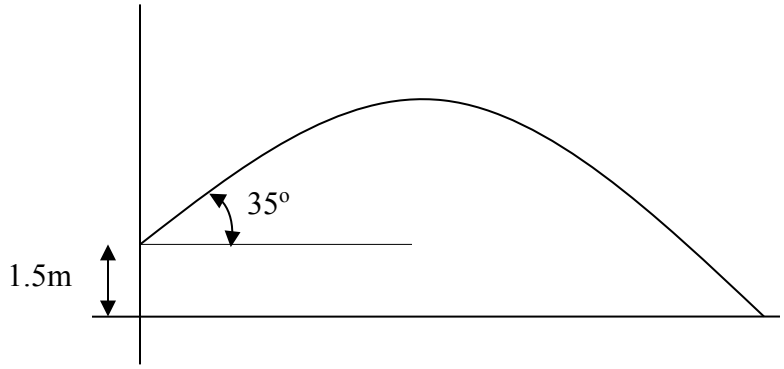
TOPIC

Engineering Mechanics (Statics and Dynamics) – Section VII – Question 10

QUESTION

A baseball player throws the ball in a projectile at an angle of 35^0 with an initial velocity of 110 km/h. If his hand is 1.5m above the ground, the distance in meters the ball will travel before it hits the ground most nearly is



(A) 2.093
(B) 89.46
(C) 91.54
(D) 111.8

HINT

If v is the velocity with which the ball is thrown, it has two components.

$$v_x = v\cos\theta$$

$$v_y = v\sin\theta$$

where

v_y= vertical component of velocity, m/s

v_x= horizontal component of velocity, m/s

θ = angle at which the ball is thrown, rad

The vertical distance, $s$covered by the ball in time t is given by

$$s = ut - \frac{1}{2}gt^2$$

SOLUTION

If v is the velocity with which the ball is thrown, it has two components.

$$v_x = v\cos\theta$$

$$v_y = v\sin\theta$$

where

v_y = vertical component of velocity, m/s

v_x = horizontal component of velocity, m/s

θ = angle at which the ball is thrown, rad

$v = 110\frac{\text{km}}{\text{hr}} \times \frac{1\text{hr}}{3600s} \times \frac{1000m}{1\text{km}}$

= 30.56 m/s

The vertical distance, $s$covered by the ball in time t is given by

$$s = ut - \frac{1}{2}gt^2$$

where

u = initial vertical velocity,

g = acceleration due to gravity, 9.81 m/s^2

$$-1.5 = (v\,sin\,\theta)t - \frac{1}{2}gt^2$$

$$-1.5 = 30.56(sin\,3\,5°)t - \frac{1}{2}(9.81)t^2$$

$$-1.5 = 17.528t - 4.905t^2$$

$$4.905t^2 - 17.528t - 1.5 = 0$$

$$t = \frac{17.528 \pm \sqrt{(-17.528)^2 - 4(4.905)(-1.5)}}{2(4.905)}$$

$$= \frac{17.528 \pm 18.348}{9.81}$$

$$= -0.083521,\ 3.6571s$$

So the acceptable value of $t = 3.6571s$. What is then the horizontal distance traveled by the ball before it touches the ground,

$$x = v_x t$$

$$= (v\,cos\,\theta)t$$

$$= (30.56 \times cos\,3\,5°)3.6571$$

= 91.54 m

ANSWER

(C)

CONTRIBUTOR

Autar Kaw