

### Question #85283 – Physics - Classical Mechanics

A ball is tossed from an upper-story window of a building. The ball is given an initial velocity of 8 m/s at an angle of 20° below the horizontal. It strikes the ground 3.00 s later.

- How far horizontally from the base of the building does the ball strike the ground?
- Find the height from which the ball was thrown.
- How long does it take the ball to reach a point 10.0 m below the level of launching?

### Solution

From the equations of motion  $\ddot{\vec{r}} = \sum \vec{F}$  we obtain

$$\ddot{x} = 0, \quad \ddot{y} = g$$

Their solutions  $x(t) = C_1 + C_2 t$ ,  $y(t) = C_1 + C_2 t + \frac{1}{2} g t^2$

with initial conditions

$$y(0) = 0 = C_1, \quad \dot{y}(0) = v \cdot \sin(a) = C_2$$

$$x(0) = 0 = C_1, \quad \dot{x}(0) = v \cdot \cos(a) = C_2$$

have form

$$x(t) = v \cdot \cos(a)t, \quad y(t) = v \cdot \sin(a)t + \frac{1}{2} g t^2,$$

So

$$\text{a) } x(3[s]) = 8[m/s] \cdot \cos\left(\frac{\pi}{9}\right) \cdot 3[s] \approx 22.55[m]$$

$$\text{b) } y(3[s]) = h = 8[m/s] \cdot \sin\left(\frac{\pi}{9}\right) \cdot 3[s] + \frac{1}{2} 9.8[m/s^2] \cdot 9[s^2] \approx 52.3[m]$$

$$\text{c) } 10[m] = 8[m/s] \cdot \sin\left(\frac{\pi}{9}\right) \cdot t + \frac{1}{2} 9.8[m/s^2] \cdot t^2 \Rightarrow t = 1.18[s]$$

### Answer

a) 22.6m, b) 52.3 m, c) t=1.18 s.

Answer provided by <https://www.AssignmentExpert.com>