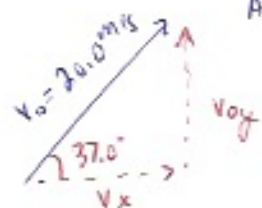


Full Projectile – Additional Practice:

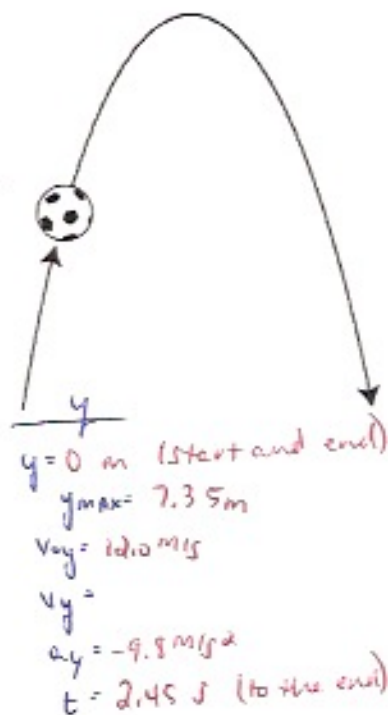
A soccer ball is kicked with an initial velocity of 20.0 m/s at an angle of 37.0°. Find the following information:

- What are the x- and y- components of the initial velocity?
- What is the maximum height reached by the soccer ball?
- What is the 'hang time' or time spent in the air?
- What is the horizontal range of the soccer ball?



$$\begin{aligned} \text{A)} \quad v_x &= \cos(37.0^\circ) \cdot 20.0 \\ v_x &= 16.0 \text{ m/s} \\ v_{0y} &= \sin(37.0^\circ) \cdot 20.0 \\ v_{0y} &= 12.0 \text{ m/s} \end{aligned}$$

$$\begin{aligned} \text{X} \\ x &= \\ v_x &= 16.0 \text{ m/s} \\ t &= 2.45 \text{ s} \\ &\text{(to the end)} \end{aligned}$$



B.) Max Height

$$\begin{aligned} y_{\text{max}} &= ? \\ v_{0y} &= 12.0 \text{ m/s} \\ v_y &= 0 \text{ m/s} \\ a_y &= -9.8 \text{ m/s}^2 \end{aligned}$$

v_y -velocity will be 0 m/s here

$$\begin{aligned} v_y^2 &= v_{0y}^2 + 2a_y \cdot y_{\text{max}} \\ (0)^2 &= (12.0)^2 + 2(-9.8)y_{\text{max}} \\ 0 &= 144 - 19.6 y_{\text{max}} \\ -144 &= -19.6 y_{\text{max}} \end{aligned}$$

$$y_{\text{max}} = 7.35 \text{ m}$$

C.) Hang time \rightarrow time when $y = 0 \text{ m}$ again

$$\begin{aligned} t &= ? \\ y &= 0 \text{ m} \\ v_{0y} &= 12.0 \text{ m/s} \\ a_y &= -9.8 \text{ m/s}^2 \end{aligned}$$

$$\begin{aligned} y &= v_{0y}t + \frac{1}{2}a_y t^2 \\ 0 &= 12 \cdot t + \frac{1}{2}(-9.8)t^2 \\ 0 &= 12 \cdot t - 4.9 t^2 \end{aligned}$$

two solutions

$$0 = (12 - 4.9t)t$$

$$t = 0 \text{ s}$$

$$12 - 4.9t = 0$$

$$-4.9t = -12$$

$$t = \frac{-12}{-4.9}$$

$$t = 2.45 \text{ s}$$

D.) Range (x)

$$x = v_x t$$

$$x = (16.0)(2.45)$$

$$x = 39.2 \text{ m}$$