Answer on Question 63297, Physics, Mechanics, Relativity

Question:

A softball is tossed into the air at an angle of 56.9 degrees with the vertical (that would be 33.1 degrees with the horizontal). The initial velocity is 19.5 m/s. What is the maximum height of the softball?

Solution:

Let's take the upwards as the positive direction. Then, we can find the maximum height of the softball from the kinematic equation:

$$v_f^2 = v_i^2 + 2ah_{max},$$

here, v_f is the final velocity of the softball at the maximum height, v_i is the initial velocity of the softball, $a = -g = -9.8\ m/s^2$ is the acceleration of gravity, h_{max} is the maximum height.

Let's write the kinematic equation in projection on the axis y:

$$v_{fy}^2 = v_{iy}^2 - 2gh_{max}.$$

At the maximum height $v_{fy} = 0\ m/s$, so we get:

$$h_{max} = \frac{-v_{iy}^2}{-2g} = \frac{v_{iy}^2}{2g}.$$

The projection of the initial velocity of the softball on the axis y can be found as follows:

$$v_{iy} = v_i cos\theta,$$

here, $\theta = 56.9^\circ$ is the angle with the vertical.

Substituting v_{iy} into the equation for the maximum height we get:

$$h_{max} = \frac{(v_i cos\theta)^2}{2g}.$$

Finally, we can calculate the maximum height of the softball:

$$h_{max} = \frac{(v_i cos\theta)^2}{2g} = \frac{\left(19.5\ \frac{m}{s} \cdot cos56.9^{\circ}\right)^2}{2 \cdot 9.8\ \frac{m}{s^2}} = 5.78\ m.$$

Answer:

$h_{max} = 5.78\ m.$