Answer on Question 68882, Physics, Mechanics | Relativity

Question:

A fisherman casts his bait toward the river at an angle of 25° above the horizontal. The bait and hook reach a maximum height of $2.9\,m$. What was the initial velocity with which the bait was cast? Assume that the fishing line exerts no appreciable drag force on the bait and hook.

Solution:

Let's first find the vertical component of the initial velocity of the bait from the kinematic equation:

$$v_y^2 = v_{0y}^2 + 2gh,$$

here, v_{0y} is the vertical component of the initial velocity of the bait, $v_y = 0$ is the final velocity of the bait at the maximum height, h is the maximum height reached by the bait, $g = -9.8\ m/s^2$ is the acceleration due to gravity (since we take the upwards as the positive direction, the acceleration due to gravity will be with sign minus).

Then, we get:

$$0 = v_{0y}^2 + 2gh,$$

$$v_{0y} = \sqrt{-2gh} = \sqrt{-2 \cdot \left(-9.8\ \frac{m}{s^2}\right) \cdot 2.9\ m} = 7.54\ \frac{m}{s}.$$

From the other hand, we can write the formula for the vertical component of the initial velocity of the bait as follows:

$$v_{0y} = v_0 sin\theta,$$

here, v_0 is the initial velocity of the bait, θ is the angle above the horizontal.

Then, from this formula we can find v_0:

$$v_0 = \frac{v_{0y}}{sin\theta} = \frac{7.54\ \frac{m}{s}}{sin25^{\circ}} = 17.84\ \frac{m}{s}.$$

Answer:

$v_0 = 17.84\ \frac{m}{s}.$