Answer on Question #43390 – Physics – Other

Question.

A shot putter throws the shot (mass=7.3 kg) with an initial speed of 14.4 m/s at a 34.0 degree angle to the horizontal. Calculate the horizontal distance traveled by the shot if it leaves the athlete's hand at a height of 2.1 m above the ground.

Given:

$m = 7.3\ kg$

$v_0 = 14.4\ \frac{m}{s}$

$\theta = 34°$

$h = 2.1\ m$

Find:

$L = ?$

Solution.

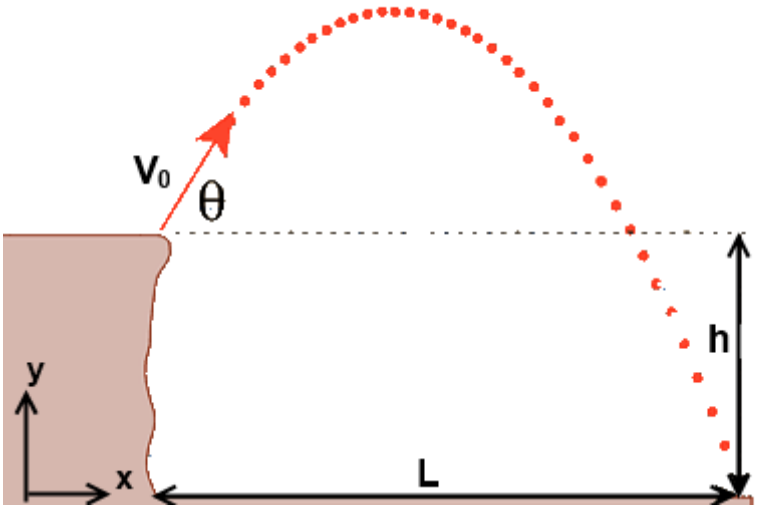

Fig.1. The trajectory of motion in our case.

The horizontal velocity is:

$$v_x = v_0 \cos\theta$$

The vertical velocity is:

$$v_y = v_0 \sin\theta$$

We can find the time of travel, if we consider the vertical motion. By definition the displacement is:

$$y = y_0 + vt + \frac{at^2}{2}$$

For the vertical motion in our case:

$$y_0 = h$$

$$v = v_y = v_0 \sin\theta$$

$$a = -g = -9.8\ \frac{m}{s^2}$$

So, the time of travel is at $y = 0$, therefore:

$$-\frac{g}{2}t^2 + v_0 \sin\theta\, t + h = 0$$

Let solve this quadratic equation:

$$t = \frac{-v_0 \sin\theta \pm \sqrt{v_0^2 \sin^2\theta + 2gh}}{-g}$$

Calculate:

$$t = \frac{-14.4 \cdot 0.56 - \sqrt{(14.4 \cdot 0.56)^2 + 2 \cdot 9.8 \cdot 2.1}}{-9.8} = \frac{-8.05 - \sqrt{105.96}}{-9.8} = \frac{-8.05 - 10.29}{-9.8} =$$
$$= 1.87\ s$$

We selected the sign "-", because other answer is negative.

From the horizontal motion we know, that the horizontal distance traveled is:

$$L = v_x t = v_0 t \cos\theta$$

So,

$$L = 14.4 \cdot 1.87 \cdot 0.829 = 22.32\ m$$

Answer.

$L = 22.32\ m$