Answer on Question 80887, Physics, Other

Question:

An arrow is shot with a velocity of 40 m/s at an angle of 40 degrees. What is the maximum height attained? What is the horizontal range?

Solution:

a) Let's first find the vertical component of the arrow's velocity:

$$v_{0y} = v_0 sin\theta = 40\ \frac{m}{s} \cdot sin40^\circ = 25.7\ \frac{m}{s}.$$

Then, we can find the time that the arrow needs to reach the maximum height from the kinematic equation:

$$v_y = v_{0y} - gt_{rise},$$

here, $v_y = 0$ is the velocity of the arrow at the maximum height, v_{0y} is the vertical component of the arrow's velocity, $g = 9.8\ m/s^2$ is the acceleration due to gravity and t_{rise} is the time that the arrow needs to reach the maximum height.

Then, we get:

$$t_{rise} = \frac{v_{0y}}{g} = \frac{25.7\ \frac{m}{s}}{9.8\ \frac{m}{s^2}} = 2.62\ s.$$

Finally, we can find the maximum height attained from the kinematic equation:

$$y_{max} = v_{0y}t_{rise} - \frac{1}{2}gt_{rise}^2 = 25.7\ \frac{m}{s} \cdot 2.62\ s - \frac{1}{2} \cdot 9.8\ \frac{m}{s^2} \cdot (2.62\ s)^2 = 33.7\ m.$$

b) We can find the horizontal range from the formula:

$$R = \frac{v_0^2 sin2\theta}{g} = \frac{\left(40\ \frac{m}{s}\right)^2 \cdot sin2 \cdot 40^\circ}{9.8\ \frac{m}{s^2}} = 160.7\ m.$$

Answer:

a) $y_{max} = 33.7\ m.$

b) $R = 160.7\ m.$