

2. A small missile is fired with a velocity of 300. m/s at an angle of 30.0 degrees from the ground. The missile returns to the level ground. (Neglect air resistance).

A) Determine the initial horizontal and initial vertical components of the velocity.

$$v_{ix} = v_i \cos \theta = (300 \text{ m/s}) \cos 30^\circ = 260 \text{ m/s}$$

$$v_{iy} = v_i \sin \theta = (300 \text{ m/s}) \sin 30^\circ = 150 \text{ m/s}$$

B) Determine the maximum height of the missile above the ground.

$$v_{fy}^2 = v_{iy}^2 + 2a_y d_y$$

$$d_y = \frac{v_{fy}^2 - v_{iy}^2}{2a_y} = \frac{-(150 \text{ m/s})^2}{2(-9.81 \text{ m/s}^2)} = 1150 \text{ m}$$

C) Determine the horizontal range of the missile.

$$d_x = v_{ix} t_{\text{TOTAL}} = (260 \text{ m/s})(30.6 \text{ s}) = 7960 \text{ m}$$

$$t_{\text{up}} = \frac{v_{fy} - v_{iy}}{a_y} = \frac{-150 \text{ m/s}}{-9.81 \text{ m/s}^2} = 15.3 \text{ s}$$

$$t_{\text{TOTAL}} = 2t_{\text{up}} = 30.6 \text{ s}$$

3. Payton Mellon throws a football with a velocity of 60.0 m/s at 25.0 degrees.

A. Calculate the time it takes to reach the maximum height.

$$t_{\text{up}} = \frac{v_{fy} - v_{iy}}{a_y} = \frac{-25.4 \text{ m/s}}{-9.81 \text{ m/s}^2} = 2.58 \text{ s}$$

B. How long is the ball in the air for? (total time in the air).

$$t_{\text{TOTAL}} = 2t_{\text{up}} = 2(2.58 \text{ s}) = 5.17 \text{ s}$$

C. Calculate the horizontal distance (range) it traveled during the entire flight.

$$d_x = v_{ix} t_{\text{TOTAL}} = (54.4 \text{ m/s})(5.17 \text{ s}) = 281 \text{ m}$$

D. Calculate the maximum height of the football.

$$d_y = \frac{v_{fy}^2 - v_{iy}^2}{2a_y} = \frac{-(25.4 \text{ m/s})^2}{2(-9.81 \text{ m/s}^2)} = 32.8 \text{ m}$$

E. What would happen to **each** of the following if he threw it at the same speed, but at an angle of 70°? (Increase, decrease, or remain the same)

A)  $v_{ix}$ : ↓  
 $v_{ix} = v_i \cos \theta$   
 ↑θ, ↓cosθ

B)  $v_{iy}$ : ↑  
 $v_{iy} = v_i \sin \theta$   
 ↑θ, ↑sinθ

C) maximum height  
 ↑  
 (Fired @ GREATER θ)

D) total flight time  
 ↑  
 REACHES HIGHER HEIGHT

E) Range  
 ↓  
 DOESN'T TRAVEL AS FAST HORIZONTALLY