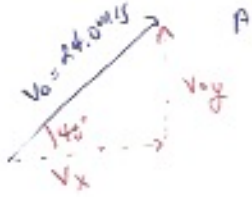
Physics: Kinematics in Two-Dimensions
Class Examples

Full Projectile:

Example 2:
The Human Cannonball in the Ringling Bros. and Barnum & Bailey Circus, was fired out of a cannon with an initial velocity (v_o) of 24.0 m/s at an angle of 40.0° with respect to the ground.

A. Find the x- and y-components of the initial velocity
B. After the cannon firing, how long was he in the air?
C. With the initial velocity described above, where would the safety net need to be placed in order to catch him at the end of his flight?

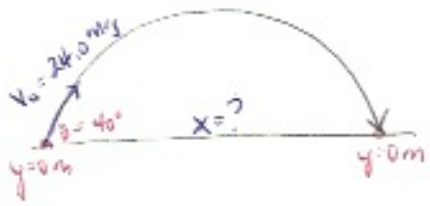


A) $v_x = \cos(40.0°) \cdot 24.0$

$v_x = 18.4$ m/s

$v_{oy} = \sin(40.0°) \cdot 24.0$

$v_{oy} = 15.4$ m/s



C) $x = v_x \cdot t$

$x = (18.4)(3.14)$

$x = 57.8$ m

x

$x =$

$v_x = 18.4$ m/s

$t = 3.14$ s

y

$y = 0$ m (start + end)

$v_{oy} = 15.4$ m/s

$v_y =$

$a_y = -9.8$ m/s²

$t = 3.14$ s

B) $t = ?$

$y = 0$ m

$v_{oy} = 15.4$ m/s

$a_y = -9.8$ m/s²

$y = v_{oy}t + \frac{1}{2}a_y t^2$

$0 = 15.4 \cdot t + \frac{1}{2}(-9.8)t^2$

$0 = (15.4 - 4.9t)t$

$t = 0$ s

$15.4 - 4.9t = 0$

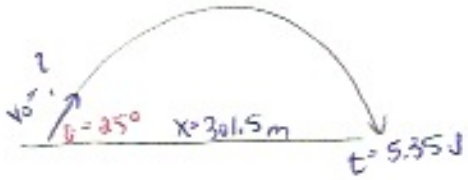
$-4.9t = -15.4$

$t = \frac{-15.4}{-4.9}$

$t = 3.14$ s

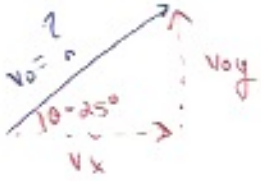
Example 3:
A golfer hits a golf ball, giving the ball an initial velocity (v_o) at an angle of 25.0°. The ball flies through the air for 5.35 s before landing a horizontal distance of 301.5 m away from the tee.

A. What was the initial velocity (v_o)?
B. What is the maximum height the ball reaches?



$v_x = \cos(25°) \cdot v_o$

$v_{oy} = \sin(25°) \cdot v_o$



A) $v_o = ?$

we can use either

$v_x = \cos(25°) \cdot v_o$ ← Now use $v_x = 56.4$ m/s here

or

$v_{oy} = \sin(25°) \cdot v_o$

Find v_x first

$x = v_x \cdot t$

$301.5 = v_x \cdot 5.35$

$v_x = \frac{301.5}{5.35}$

$v_x = 56.4$ m/s

$v_x = \cos(25°) \cdot v_o$

$56.4 = \cos(25°) \cdot v_o$

$v_o = \frac{56.4}{\cos(25°)}$

$v_o = 62.2$ m/s

x

$x = 301.5$ m

$v_x =$

$t = 5.35$ s

y

$y = 0$ m (start and end)

$v_{oy} =$

$v_y =$

$a_y = -9.8$ m/s²

$t = 5.35$ s

B.) Max height?

$y_{MAX} = ?$

$a_y = -9.8\ m/s^2$

$V_{oy} = \sin(25°) \cdot 62.2$

$V_{oy} = 26.3\ m/s$

$V_y = 0\ m/s$

$V_y^2 = V_{oy}^2 + 2a_y \cdot y$

$(0)^2 = (26.3)^2 + 2(-9.8) \cdot y$

$0 = 691.69 - 19.6y$

$-691.69 = -19.6y$

$y = \frac{-691.69}{-19.6}$

$y = 35.3m$