

Type 2 Projectiles

The only difference between a type 1 and a type 2 projectile is that a type 2 is launched on an angle over level ground

The big challenge is to break the initial velocity into X and Y parts and remember which part to use!

Finding the time in the air remains the same using

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

Note: $d_y = 0$ at the end of the parabola!

Then use that time to find the range.

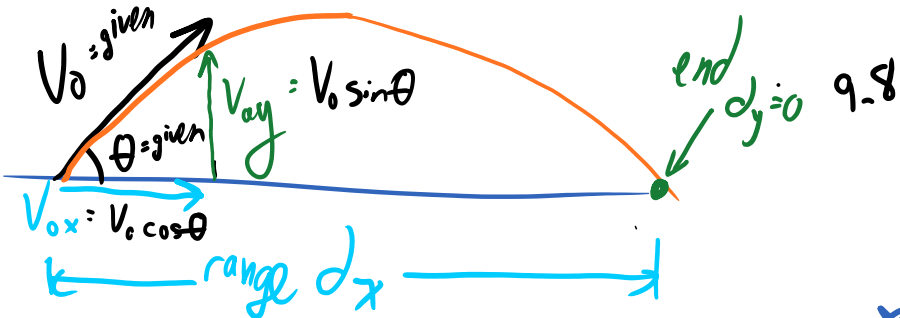
$$d_y = v_{oy}t + \frac{1}{2}a_y t^2$$

$$0 = 6t + \frac{1}{2}(-9.8)t^2$$

$$0 = 6t - 4.9t^2$$

$$4.9t^2 = 6t$$

$$t = \frac{6}{4.9} = 1.22s$$



① Find components V_0

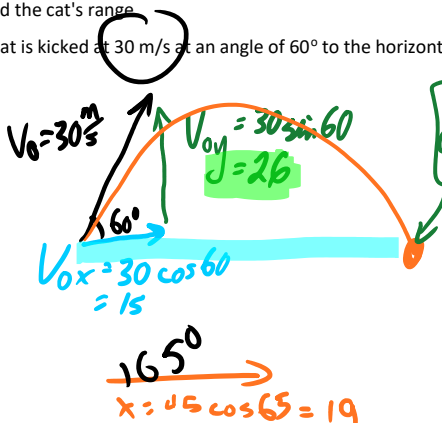
② Find t using $d_y = v_{oy}t + \frac{1}{2}a_y t^2$

③ find range

① Break vector into moments

Find the cat's range

A cat is kicked at 30 m/s at an angle of 60° to the horizontal, find the range



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

$$0 = 26t + \frac{1}{2}(-9.8)t^2$$

$$0 = 26t - 4.9t^2$$

$$4.9t^2 = 26t$$

$$t = \frac{26}{4.9} = 5.3s$$

$$d_x = v_{ox}t + \frac{1}{2}a_x t^2$$

$$d_x = 15(5.3)$$

$$= 79.5m$$

$$d_x = v_{ox}t + \frac{1}{2}a_x t^2$$

$$a_x = 0$$

$$t = 8.37$$

$$= 160m$$

What is its height at the high point?

$$d_y = ?$$

$$v_{fy} = 0$$

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

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

$$0 = 40.8^2 + 2(-9.8)d_y$$

$$0 = 1665 - 19.6d_y$$

$$19.6d_y = 1665$$

$$d_y = \frac{1665}{19.6} = 85m$$

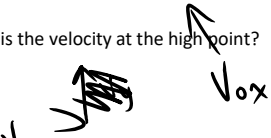
When does the golf ball hit its highest point?

What is the Y-velocity at the high point?

What is the X-velocity at the high point?

$$v_{fx} = v_{ox} + a_x t$$

What is the velocity at the high point?



At the high point the final velocity = v_{ox}

At the highest point the final velocity = V_{ox}



Determine the range of a cat kicked by an orangutan at 25 m/s at an angle of 72° above the horizon.

$V_0 = 25 \frac{m}{s}$
 $V_{oy} = 23.8$
 $V_{ox} = 7.73$
 72°

$d_y = v_{oy}t + \frac{1}{2}a_yt^2$
 $0 = 23.8t + \frac{1}{2}(-9.8)t^2$
 $0 = 23.8t - 4.9t^2$
 $4.9t^2 = 23.8t$
 $t = \frac{23.8}{4.9} = 4.85$

$d_x = v_{ox}t + \frac{1}{2}a_x t^2$
 $= 7.73(4.85)$
 $= 38 \text{ m}$

$v_{ox}t + \frac{1}{2}a_x t^2$
 $= 7.7(4.86)$
 $= 7.7 \text{ m}$

snake

You can find the high point.....

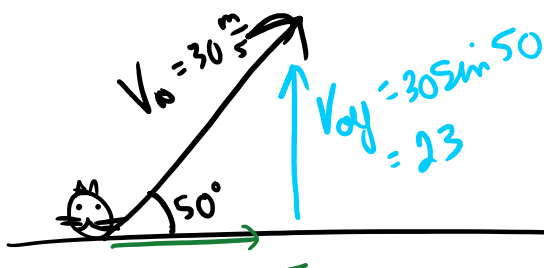
$v_{fy} = 0$
 $v_{oy} = 23.8$
 $a_y = -9.8$
 $d_y = ?$

$0 = 23.8^2 + 2(-9.8)d_y$
 $0 = 566.44 - 19.6d_y$
 $19.6d_y = \frac{566.44}{19.8} = 28.9 \text{ m}$

- 1) A cat is kicked on level ground with a velocity of 12 m/s at an angle of 50° to the horizon, what is its "hang time", range, & max height?

Hang time: 1.88s
 Range: 14.5 m
 Max height: 4.31 m

A cat was kicked, right in the face, and soared skyward at 30 m/s on an angle of 50° from the horizontal. Find its range and max height.



$t = ?$
 $d_y = 0$
 $a_y = -9.8$
 $v_{oy} = 23$

$d_y = v_{oy}t + \frac{1}{2}a_yt^2$
 $0 = 23t + \frac{1}{2}(-9.8)t^2$
 $0 = 23t - 4.9t^2$
 $4.9t^2 = 23t$
 $\frac{23}{4.9}$



$$V_{0x} = 30 \cos 50$$

$$30 \cos 50 = 19.3$$

$$v_{0y} = 23$$

$$4.9t = 23$$

$$t = 4.7 \text{ s}$$

$$d_x = ?$$

$$t = 4.7$$

$$V_{0x} = 19.3$$

$$a_x = 0$$

$$d_x = V_{0x}t + \frac{1}{2}a_x t^2$$

$$= (19.3)(4.7) = 90.5 \text{ m}$$

$$V_{fy} = 0$$

$$V_{0y} = 23$$

$$a_y = -9.8$$

$$d_y = ?$$

$$V_{fy}^2 = V_{0y}^2 + 2a_y d_y$$

$$0^2 = 23^2 + 2(-9.8)d_y$$

$$0 = 529 - 19.6d_y$$

$$19.6d_y = 529$$

$$\frac{529}{19.6} = d_y = 27 \text{ m}$$

$$d_y = 27 \text{ m}$$