



Use tool to examine the trajectory.



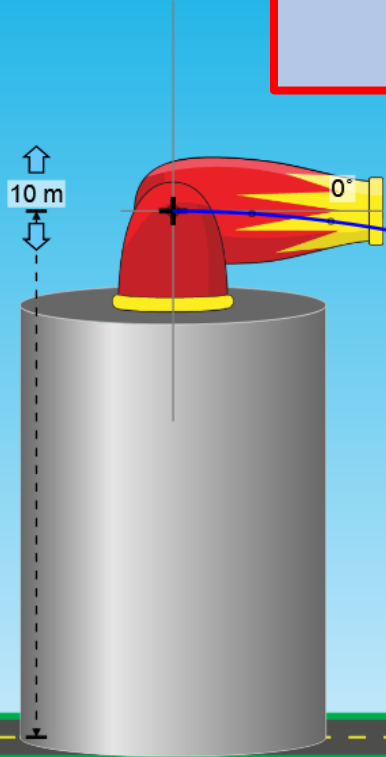
Pumpkin

Mass: 5 kg  
Diameter: 0.37 m

Air Resistance

Drag Coefficient: 0.60

10 m



Time 0.5 s  
Range 7.5 m  
Height 8.77 m

Velocity Vectors

Total  
 Components

Acceleration Vectors

Show velocity!



15.0 m

Initial Speed 15 m/s



Normal



Start with "Intro"

Using the default settings on “Intro” (click orange reset button), cannon fired horizontally with velocity 15 m/s from height of 10 meters:

1. View the velocity components – which one is constant? which one is changing?
2. Use the tool to examine the trajectory. How much does the projectile move forward every tenth of a second? How far has it moved forward in one second? How is this related to its initial velocity – magnitude *and* direction?

Starting with the default settings on “Lab” (click orange reset button), adjust cannon to fire with velocity 30 m/s,  $60^\circ$  from height of zero:

3. Use the tool to examine the trajectory. How much does the projectile move forward every tenth of a second? How far has it moved forward in one second? How is this related to its initial velocity – magnitude *and* direction? Calculate the  $x$ -component of the initial velocity and compare!
4. Without changing the initial speed, adjust the launch angle. What angle results in the greatest range?
5. Click on the erase button and try launching at the same speed with two complimentary angles (angles that add up to 90 degrees, like  $32^\circ$  and  $58^\circ$ . Repeat with different pairs of complimentary angles – what do you observe about the range? How does this make sense?
6. Click and drag to change the initial height of the cannon to 15 meters. Repeat the previous two questions – are the results the same for maximum range and complimentary angles if the projectile lands at a different elevation? Why or why not?

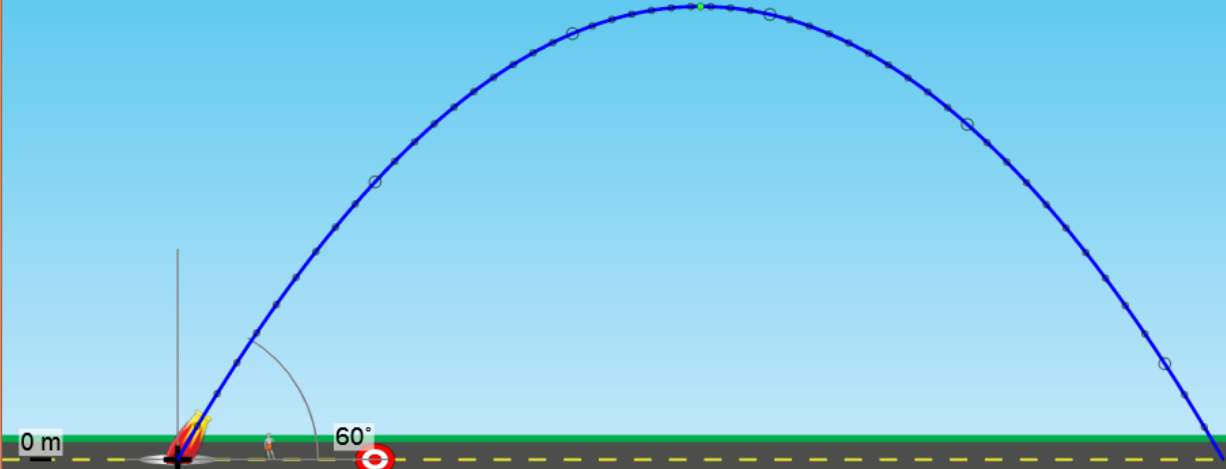


Zoom in/out

Time	-
Range	-
Height	-

**Initial Values**

Height: 0 m  
 Angle: 60°  
 Speed: 30 m/s



Cannonball

Mass: 17.60 kg

1 31

Diameter: 0.18 m

0.1 1

Gravity: 9.81 m/s<sup>2</sup>

Air Resistance

Altitude: 0 m

Drag Coefficient: 0.47

Initial Speed: 30 m/s

◀ [Slider] ▶

Normal
  Slow

