Projectile Motion aka “Chunkuns Pumpkins Lab” Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

<https://www.youtube.com/watch?v=Vc2DAlKhIe0>

<https://phet.colorado.edu/sims/html/projectile-motion/latest/projectile-motion_en.html>

1. Calculate the time required for a cannonball to fall 10.0 m. Show equation, sub w/ units and answer w/ units
2. Click on the tab at the bottom of the screen labeled “Lab”. Raise the cannon to a height of 10 m, and set the canon angle to 00.

Make the following predictions **before** firing the cannon.

1. If the initial velocity increases then the time of flight will ( increase, decrease, remain the same).
2. If the initial velocity increases, while the height of the cannon remains the same, the distance travelled or horizontal range will ( increase, decrease, remain the same).

Complete the following data table using the tools provided.

|  |  |  |  |
| --- | --- | --- | --- |
| Initial Velocity(m/s) | Time(s) | Horizontal range (m) | Horizontal acceleration(m/s/s)\* |
| 0 |  |  |  |
| 5 |  |  |  |
| 10 |  |  |  |
| 15 |  |  |  |

\*If the range is equal to the product of the initial velocity and the time, then acceleration must equal 0.

3. Be honest, were both of your predictions correct? What does the y-component of the initial velocity for all 4 trials in your data table have in common? Draw a vector representing the initial velocity of a projectile fired horizontally.

1. As the initial velocity of a projectile fired horizontally increases, the x- component ( increase, decrease, remain the same).
2. As the initial velocity of a projectile fired horizontally increases, the y- component ( increase, decrease, remain the same).
3. True or False, When projectiles are fired horizontally, the y-component of the velocity depends on the initial velocity.
4. True or False, When projectiles are fired horizontally, the x-component of the velocity depends on the initial velocity.
5. True or False, When air resistance is ignored, the horizontal acceleration of a projectile is always equal to 0 m/s/s

4. If a projectile is fired horizontally (at an angle of 00 to the horizon) from a height of 50.0m, at an initial velocity of 40 m/s, how much time is required for the projectile to reach the ground? Show equation, sub w/ units and answer w/ units

1. Calculate the range of the projectile.

5. Using the simulation (and an initial velocity of 15 m/s determine the launch angle, when launched from a height of 0 m, is it possible to achieve maximum:

Range\_\_\_\_\_\_\_\_\_\_\_

Height\_\_\_\_\_\_\_\_\_\_\_

6. Launch at each of the given angles (while keeping everything else constant, and determine which other angle will achieve the same range.

100 \_\_\_\_\_\_\_\_\_\_\_

300 \_\_\_\_\_\_\_\_\_\_\_

500 \_\_\_\_\_\_\_\_\_\_\_

700 \_\_\_\_\_\_\_\_\_\_\_

Describe how the pair of angles that achieve equal ranges are related, in geometry terms.

7. Draw a sketch of the paths of all projectiles fired at an angle, when air resistance is ignored. What is this shape referred to on graphs?

8. A projectile is fired at a 400 to the horizon, at a height of 0.0m, with an initial velocity of 20 m/s.

1. Make a labeled diagram showing the angle, Vi , Vix , Viy
2. Calculate the horizontal component of the initial velocity (Vix). Show equation, sub w/ units and answer w/ units.
3. Calculate the vertical component of the initial velocity (Viy). Show equation, sub w/ units and answer w/ units.
4. Calculate the time of flight for the projectile. (Hint: Treat the problem as if the projectile is launched straight upwards, with the initial velocity of Viy and a final velocity that is equal in magnitude but opposite the direction of Viy . Show equation, sub w/ units and answer w/ units.
5. Calculate the maximum height of the projectile. (Remember, time to top is equal to ½ of the time of flight.) Show equation, sub w/ units and answer w/ units.

Continued

1. Calculate the range of the projectile. (Remember, when air resistance is ignored, there is no acceleration in the horizontal direction, so range is directly related to Vix. Show equation, sub w/ units and answer w/ units.

Check your work to a-e, using the simulation. Correct any errors.