

Due by midnight Sunday, June 21, 2020

Name _____

PHY 1100 Lab 3

Projectile motion

Open the following Hyperlink.

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

Click on the **Lab Option** at the bottom of the screen.

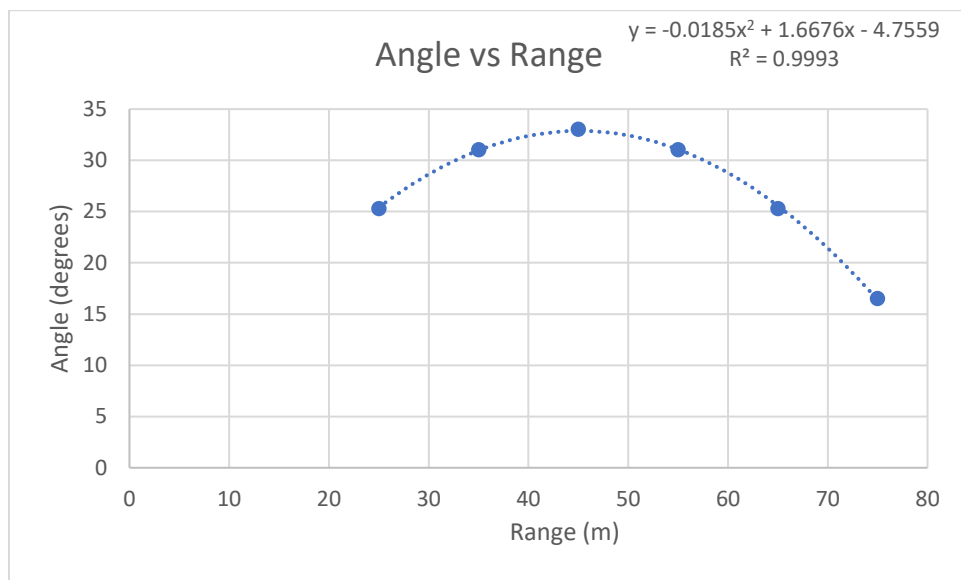
This simulation has a cannon that can be fired at different angles. Keep the initial velocity (located at the bottom of the screen) at 18 m/s for every angle. There are several objects that you can choose to fire from the cannon. Try them all if you wish, but use the same one when you are collecting data.

Procedure

1. Select the type of projectile you wish to use for collecting the data. Type of projectile used: _____
2. Set the cannon's angle to 25° by putting the cursor on it and pushing the tip of the cannon up or down.
3. There is a yellow square and a red square at the bottom of the page. Click on the yellow square to load the cannon and the red square to fire the cannon. Fire the cannon!
4. Grab with your cursor the blue rectangle with time, range, and height marked inside (at the top of the screen). Put the crosshairs on the little circle at the very top of the arc. When the crosshairs are in the right spot, the dot will glow green.. This will tell you the time for $\frac{1}{2}$ the trip, for $\frac{1}{2}$ the total range and the height of the projectile. Record the values in the data table below. Double the time for the time for the whole trip. Double the range for the total range.
5. Reset the angle for 35° , fire your shot, and again move the blue rectangle to the highest point to collect data. Repeat with the rest of the angles, filling in the data table.
6. Click on the air resistance button. Set the altitude to 1000 m (this is about the altitude of Springfield). Fire the cannon twice more: once at 35° and once at 45° . Put the data for these trials in the last row in the data table.

Angle	t (s) Time to go up or $\frac{1}{2}$ the trip	2t (s) Total time in the air or the whole trip	Range at highest point (m) or $\frac{1}{2}$ total range	Total range (m) or $2(\frac{1}{2}$ total range)	Height (m)
25°					
35°					
45°					
55°					
65°					
75°					
35° with air resistance					
45° with air resistance					

6. The following is a graph of typical data for this lab.



Questions

1. Write the equation for this graph and the R^2 value.

Equation _____

R^2 _____

2. What does the R^2 value tell you about the data? _____

3. What does the graph tell you about how the angle of a projectile is related to the horizontal distance or range? _____

4. Look at the highest point on the graph. At what angle should a projectile be fired to make it go as far and as high as possible? _____

6. Based on the one trial using air resistance, explain the effect of air resistance on a projectile. _____

7. You are able to increase or decrease the initial velocity of the projectile at the bottom of the screen. Try this with your projectile to see what effect this has on the range of the projectile. What did you find out? _____

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PHY 1100 Lab 4 Gravity and Orbits

Open the following Hyperlink.

https://phet.colorado.edu/sims/html/gravity-and-orbits/latest/gravity-and-orbits_en.html

This simulation allows one to change the mass of Earth, the mass of the sun, and change the velocity of a satellite orbiting Earth. The length of a vector is proportional to the measurement it represents. In other words, when the gravity vectors, which are in blue, get very long, it indicates a much stronger force of gravitational attraction. When the gravity vectors become shorter, it indicates a much weaker force of attraction. The velocity vector, shown in red, increases in length when the planet is moving around the star at a faster velocity, and when it becomes shorter, it is moving at a slower velocity.

Procedure

Part I A Planet Orbiting a Star

1. Click on To Scale. On the menu on the right, click on the topmost selection. This will give you information about a planet orbiting a star.
2. Click on Gravity Force, Velocity, Mass, Path and Grid.
3. At the bottom of the menu on the right, set the mass of the sun to 2.0 (which means our sun would have twice the mass it actually has). Set the Earth mass to 1.0 and keep it there while you collect all the data. Be sure the Earth Days icon is cleared at the bottom of the page, then click on the start icon. Let the earth go around the sun once and write down the number of Earth days it take for one orbit.
4. Change the mass of the sun to 1.5 and keep the mass of Earth at 1.0. Clear the Earth Days and begin again. Record the orbital period.
5. Repeat step 4 with the sun's mass at 0.50 and record the orbital period. If the Earth reaches escape velocity (flies out of orbit), indicate that instead of the orbital period.

Sun Mass	Earth Mass	Orbital Period (d) or Reached Escaped Velocity
2.0	1	
1.5	1	
1.0	1	365
0.5	1	

Questions

1. Is the orbit of Earth around the sun circular or an ellipse (oval shaped)? _____
 2. What direction are the two blue gravity vectors always pointing? _____
 3. The red velocity vector is always tangent to the orbital path. Where in its orbit did Earth speed up (longer velocity vector) and where in its orbit did it slow down? _____
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4. What happened to the orbital period when we increased the mass of the sun? _____
5. What happened to the gravitational force between Earth and the sun when the sun's mass was increased?

6. What happened to Earth when the sun's mass was only $\frac{1}{2}$ the actual mass? Why was this? _____

Part II. The Moon Orbiting Earth

1. On the menu on the right, click on the third choice in the topmost selection. This will give you information about a moon orbiting a planet.
2. Click on Gravity Force, Velocity, Mass, Path and Grid.
3. At the bottom of the menu on the right, set the mass of the planet to 2.0 (which means our earth would have twice the mass it actually has). Set the moon mass to 1.0 and keep it there while you collect all the data. Be sure the Earth Days icon is cleared at the bottom of the page, and click on the start icon. Let the moon go around the planet once and write down the number of Earth days it take for one orbit. If the moon reaches escape velocity, indicate that instead of the orbital period.
4. Change the mass of the planet to 1.5 and keep the mass of the moon at 1.0. Record the orbital period.
5. Repeat step 4 with the sun's mass at 0.50 and record the orbital period.

Planet Mass	Moon Mass	Orbital Period (d) or Reached Escaped Velocity
2.0	1	
1.5	1	
1.0	1	27
0.5	1	

Questions

1. How does the orbital period of the moon compare to Earth's orbit around the sun?
2. What happened to the orbital period when we increased the mass of the planet ? _____
3. What happened to the size of the orbit when the mass of the planet was increased? _____
4. What happened to the moon when the planet's mass was only $\frac{1}{2}$ the actual mass? Why was this? _____

Part III A Satellite Orbiting a Planet

On the menu on the right, click on the bottom choice in the topmost selection. This will give you information about a satellite orbiting Earth. Click on Gravity Force, Velocity, Mass, Path and Grid.

Questions

1. In this simulation, you can pause the action and then grab the arrowhead of the red velocity vector on the satellite and change its length, thereby changing the velocity of the satellite. Try making the velocity vector a little longer. This will make the satellite go faster. What happens to the orbital path of the satellite if it speeds up?

2. In this simulation, you can also move Earth away from the satellite. Try moving Earth a little at a time. What happens to the orbit of the satellite?
