Unit 2 major HW **(Due Nov 9)** 100 points

2D Kinematics Lab

Brooklyn Tech *Randy J. Asher, Principal*

29 Fort Greene Place · Brooklyn, New York · 11217 · Telephone: (718) 804-6400 · Fax: (718) 260 – 9245 · www.bths.edu

A snow ball is thrown. A ball is hit. A bullet is fired. What affects the projectile's trajectory (path) and range (how far it travels horizontally)? Consider variables, such as these:

launch speed || launch angle || projectile mass || projectile size || height from which the projectile was fired ||

height of intended target || air resistance

Materials need: Paper || Pencil || Calculator || Computer with access to the internet

Background knowledge from previous labs, demos, and bookwork

Measured quantities in physics can be grouped into two categories called scalars and vectors.

A vector can be broken into two perpendicular components.

Kinematics equations should be understood by now.

Procedure

Simulation: Go to "www.bari-science-lab.com" and clink on **Brooklyn Tech** and click on Homework and then click on Kinematics 2D Simulation (Projectile Motion).

1. Note the choices in the left hand column. Scroll down to and open "Index".
2. Scroll down to and open "Projectile Motion".
3. Record the original parameter settings (angle, initial speed, . . . ,including the fact that air resistance is "turned off")

4. Investigate this simulation until you have answers to the questions listed above. As is always the case in a scientific investigation, change only one variable at a time to see how it affects the projectile. Record what you learned.

Reset the simulation to the original parameters before you answer each of the following questions (Use simulation to answer all 18 questions):

1. Fire the cannon. What do the black (+) signs on the projectile's path show you?

2. If you cut the projectile's velocity in half, will the projectile's range also be cut in half? Why or why not?

3. What is the best launch angle for maximum range?

4. If you cut the launch angle in half, will the range also be cut in half? Why or why not?

5. Are there two different launch angles that will allow you to hit the red target?

6. How do the three pieces of information across the top of the screen differ in time from the information in the box down the right hand side?

7. Fire the cannon horizontally. How high above the ground is the cannon ball before launch?

8. Use kinematics equations, a calculator and the simulation to find how high the cannon ball will rise when fired straight up. Show your work.

9. Fire the cannon straight up. Use the tape measure supplied, currently at the bottom of the screen, to determine the height of the ball's trajectory above the ground.

10. Is the calculated height from the kinematics equations the same as the height of the launched cannon ball from the computer simulation? Why or why not?

Return data in right box to original parameters.

11. Remember there is still no air resistance. If a larger cannon ball were fired, should that have an effect on the trajectory's height or range? Does it?

12.If air resistance were turned on for the larger ball, should that have an effect on the trajectory's height or range? Does it? Why?

13.In the absence of air resistance, if a more massive cannon ball were fired at the same velocity, should that have an effect on the trajectory's height or range? Does it? Why?

14.If air resistance were turned on for the more massive ball, should that have an effect on the trajectory's height or range? Does it? Why?

15. The cannon can be raised. If the cannon were fired from an elevated position, what would be the best angle to achieve maximum range? Is it the same as the previous maximum range angle?

16. Change cannon parameters until the cannon ball hits the target. If the red target were elevated above the ground, like a basket ball hoop, which cannon parameters could you increase or decrease in order to make a "basket"? Use the simulation to see if you are correct.

17. Move the cannon to the left side of the screen. Move the cannon half way up the screen. Don't erase the screen for the following shots. Fire the cannon horizontally. Fire the cannon several more times with progressively lower muzzle velocities. What physics principle can be learned from the black (+'s) on the multiple trajectories?

18. What new physics was learned and will be remembered from this exploration? Remember to say it well but say it briefly !