SAN DIEGO MESA COLLEGE
PHYSICS 124A LAB REPORT

TITLE: Projectile Motion

Name__________________________
Date __________**Time**____________
Partners ________________________
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Objective: To study and predict the course of the motion of a projectile.

Theory:

Projectile motion in two dimensions can be predicted by treating the motion as two **independent** motions; the horizontal (**x**) component of the motion and the vertical (**y**) component of the motion.

When air resistance is ignored the horizontal motion is one of constant velocity equal to the x-component of the initial velocity. Thus,

$$v_x = v_0 \qquad x = v_{0x}t$$

The vertical component is the motion of a free falling body with acceleration due to gravity, denoted by g. (9.8m/s^2)

With the positive y direction pointing up,

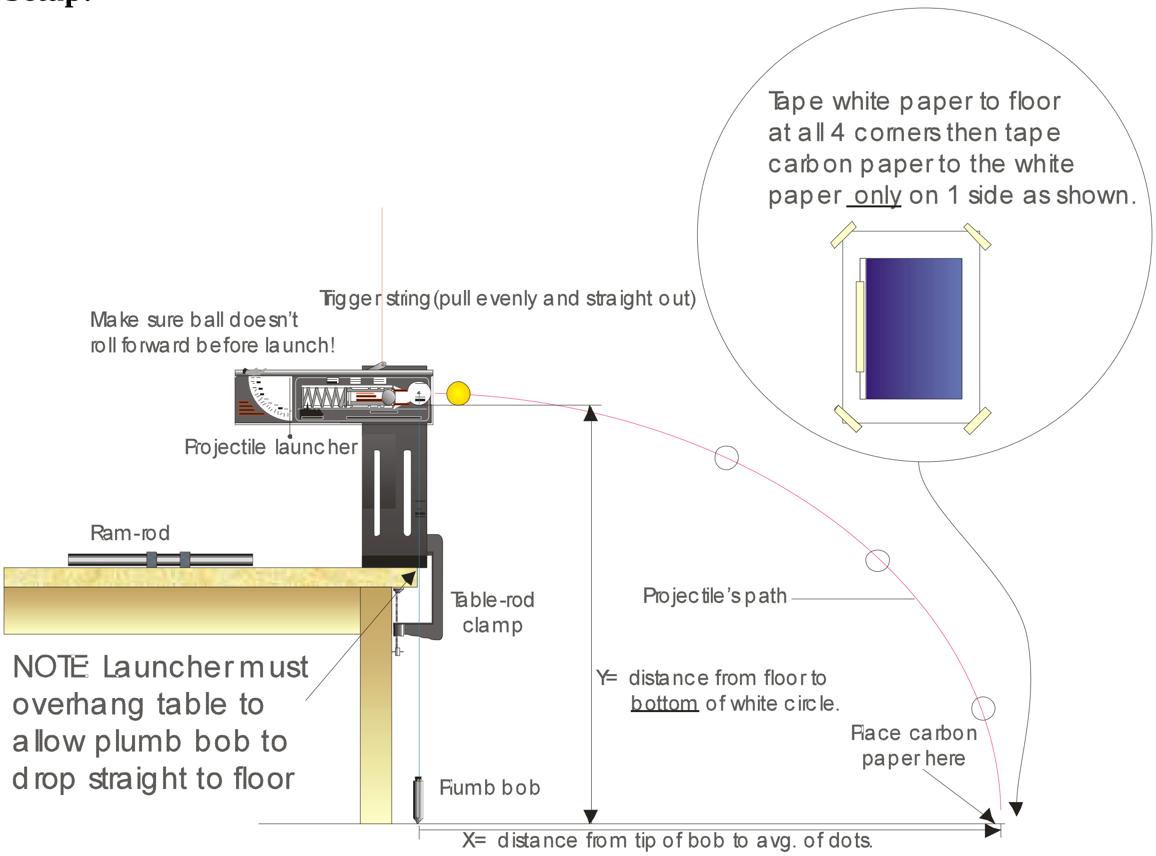
$$a_y = -g$$

$$v_y = v_{0y} + a_y t \qquad y = v_{0y}t + \frac{1}{2}a_y t^2$$

Equipment:
- Projectile Launcher
- Nylon Ball (Projectile)
- Plunger
- Plumb bob
- Carbon Paper
- Blank Sheet of Paper
- 12” Ruler
- Meter Stick
- 2.0m Meter Stick
- Hoop Ring and Stand
- Safety Glasses

PART I: Finding the initial speed of the projectile.

Setup:



Procedure:

Set the launcher so it will fire horizontally. (Angle = 0^0)

Hold the end of the string attached to the plumb bob next to the ⊕ on the side of the launcher. Let the plumb bob hang straight down, make sure the string isn't bending around the clamps or the table. The clamp on the launcher side of the base must be removed then replaced after you make the mark.

Lift the plumb bob so that is just barely above the floor. Place a piece of masking tape on the floor and mark on the tape where the point of the plumb bob would touch the tape. This is your x = 0.0m mark.

Measure the distance from the floor to the bottom of the **circle** surrounding the ⊕ on the launcher. This is your value for height (y). Record it in meters on your table.

Put the ball in the launcher and use the plunger to push the ball back to the medium setting (2 clicks). Make sure that the projectile remains seated against the plunger of the launcher and doesn't roll forward in the tube.

Make sure nothing is in the way of the launcher. Have one partner stand about 5 or 6 feet away from the launcher to spot where the ball lands.

Pull the long string on top of the launcher at a 90^o angle to the launcher to fire the projectile. If you yank hard or pull at angles other than about 90^o, then the launcher itself may move enough to alter your results in an erroneous way. Please don't hit your lab partner.

Tape the blank piece of paper to the floor about where your ball landed and place the carbon paper on top of it carbon side down.(see fig 2)

Fire the projectile about 8 to 10 times. All of the dots should be "grouped" within two inches of each other. If not, find out what might be going wrong, fix it and get 8-10 points that are within 5cm of each other.

Analysis:

Measure the distance from the x = 0.0m mark to each of the 10 marks in your cluster. Take an average of the distances by adding up all the distances and dividing by the number of marks. This is your value for x.
Using the equations in the theory section appropriate to this situation to do your calculations.
Calculate t from the y motion, and v_{ox} from t and the x motion.

Y Motion	X Motion
y = ___________	x = ___________
a_y = -9.8 m/s^2	t = ___________
v_{oy} = 0.0 m/s	
t = ___________	v_{ox} = _________ = v_o
CALCULATION OF t:	CALCULATION OF V_{ox}:

Initial speed of projectile: _____________

Initial velocity of projectile: _____________

PART II: Before firing the launcher, first calculate where the projectile will reach its highest point when launched at an angle.

Analysis:
The new initial velocity can be replaced by its horizontal and vertical components (v_{ox} and v_{oy}). The components are found by projecting the velocity vector on to the x and y axes to get the x direction value and y value direction respectively:

$v_{ox} = v_o \cos(\theta)$ $v_{oy} = v_o \sin(\theta)$

Y Motion

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

v_{oy} = ________________

at the highest point: v_{fy} = ________________

CALCULATION OF $t_{\text{to highest point}}$ and $y_{\text{highest point}}$:

$t_{\text{to highest point}}$ = ________________

$y_{\text{highest point}}$ = ________________

X Motion

v_{ox} = ________________

t = ________________

CALCULATION OF Δx:

Δx = ____________________

The projectile will reach its highest point in the trajectory __________meters measured horizontally from a point directly above the launch point.
The projectile will reach its highest point in the trajectory __________meters measured vertical from the launch point.

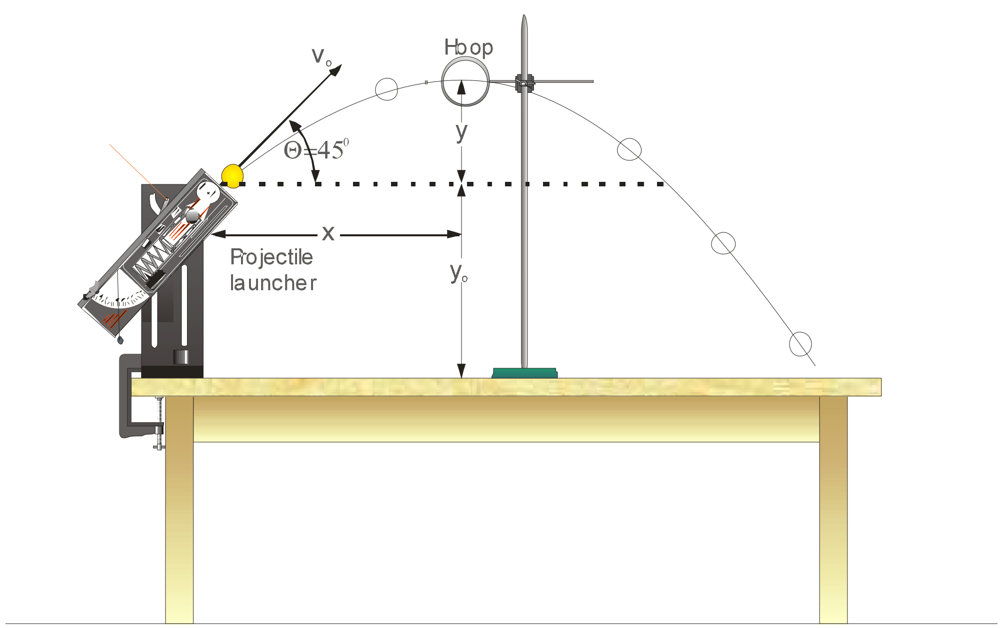
Procedure:

Unclamp the launcher, turn it to fire across the table (the opposite direction of what it was).

Firmly re-clamp the launcher. This doesn't mean tighten it down until nobody else can turn the screw… just firmly will do.
Place the hoop ring and stand on top of the table with the hoop in front of the launcher.
Adjust the launcher so that it fires at a 45^o angle.

Calculate the maximum height, and the x distance to the point of maximum height.
Set the center of the hoop at your **calculated** distance "x" away from the launcher **<u>and</u>** at your **calculated** max. height.

Using the medium setting, fire the launcher and (**hopefully**) it will go through the center of hoop. Did the ball go through the ring? If not… recalculate!



PART III: Before firing the launcher, first calculate where the projectile will hit the floor when launched at the same angle as in **PART II (45^0)**

<u>Y Motion</u>
$a_y = -9.8\ m/s^2$

v_{oy} = ____________________

$y_{\text{down to the floor}}$ = __________________

CALCULATIONS:

$t_{\text{to the floor}}$ = __________________

<u>X Motion</u>

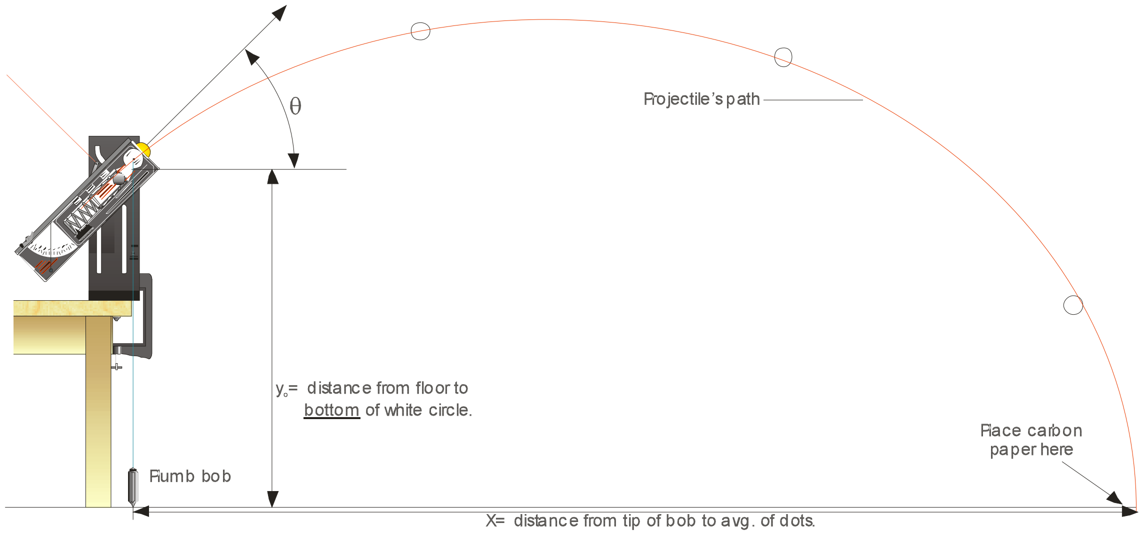
v_{ox} = __________________

t = __________________

CALCULATIONS:

Δx = __________________

Now fire the gun and mark where it lands.
Repeat five times and record the average below.



The average of the actual (measured) distances to the points of impact is:

Calculate the percent difference:

$$\%\,Difference = \frac{\left|X_{meas} - X_{pred}\right|}{X_{meas}} * 100$$

Percent Difference = ______________________ %

Conclusion and Summary of Results:
Write a brief conclusion, including a brief discussion of the physics involved in this experiment, including possible sources of error, and indicate whether your results give support or validate the purpose of the lab exercise.