PHYSICS **NAME: ________________________**

VIRTUAL LAB ACTIVITY
PROJECTILE MOTION

OBJECTIVE:

To use computer simulations to investigate the effect of initial velocity, launch angle and air resistance on an object experiencing projectile motion.

PART I. PROJECTILE MOTION

A) INITIAL VELOCITY
- Check the box titled "Show Trails".
- Set the angle to **45**˚
- Set the Velocity to 10 m/s
- Click FIRE
- Complete the data on the table.
- Repeat the procedure for the different velocities.

Initial Velocity (m/s)	Range (m)	Maximum Height (m)	Final Velocity (m/s)	Total Time (s)
10				
20				
30				
40				
50				

1. Which variable(s) varied with the initial velocity?

2. Which variable(s) remained the same?

B. LAUNCH ANGLE
- Refresh the page
- Set the Velocity to 50 m/s
- Set the angle to 10˚
- Click FIRE
- Complete the data on the table.
- Repeat the procedure for the different launch angles.

Launch Angle	Range (m)	Maximum Height (m)	Final Velocity (m/s)	Total Time (s)
10˚				
30˚				
45˚				
60˚				
80˚				

1. Which angle had the maximum range?

2. Which angle had the maximum height?

3. Compare the maximum range obtained for these pairs of launch angles.
10° and 80° 30° and 60°

What pattern is observed for these angles and their maximum ranges?

4. A projectile is launched at an initial speed of 50 m/s with a horizontal angle of 76°. Use the simulation to answer these questions:
a. What is its range?

b. Give another angle that will produce the same range.
Does the simulation verify your prediction?

c. What is the sum of the two angles that produce this range?

PART II. HOLE-IN-ONE

1. Use the **TRIALS** and **NO AIR** options.
2. Set the Green on the Position and the Launch Angle and **LAUNCH**.
3. Record the **Velocity** to hit **HOLE-IN-ONE.**
4. Repeat steps 1-3 using the **AIR** option.

LAUNCH ANGLE: 30°

Position (m)	Velocity (m/s) NO AIR	Velocity (m/s) AIR
200		
400		

LAUNCH ANGLE: 45°

Position (m)	Velocity (m/s) NO AIR	Velocity (m/s) AIR
200		
400		

1. On **PART I.** you found that the maximum range was achieved by a ________ launch angle.

How does the range achieved compare when there is air resistance?

2. How did you have to modify the velocities when air resistance was present?

PART III. GRAPHICAL ANALYSIS OF MOTION

- Select the PROJECTILE MOTION simulation from the left-side menu
- Set the initial velocity to 10 m/s
- Play the simulation and answer the questions.

Position-Time Graphs

1. Sketch the Position-Time graphs for the horizontal and vertical components of motion.

2. Explain why the graphs are different.

3. What conclusion about the displacement of the object can you draw from the horizontal component graph?

4. What conclusion about the displacement of the object can you draw from the vertical component graph?

Velocity-Time Graphs

1. Sketch the Velocity-Time graphs for the horizontal and vertical components of motion.

2. Explain why the graphs are different.

3. What conclusion about the velocity of the object can you draw from the horizontal component graph?

4. What conclusion about the velocity of the object can you draw from the vertical component graph?

5. Describe the motion of the object depicted in the vertical-component graph. Include observations about the direction of motion.

PART IV. PROBLEM

Show all your work: data, equations, etc.

1. A stone is thrown horizontally at a speed of 5.0 m/s from the top of a cliff 78.4 m high.

a) How long does it take the stone to reach the bottom of the cliff?

b) How far from the base of the cliff does the stone strike the ground?

c) What are the horizontal and vertical components of the velocity of the stone as it hits the ground?

d) What is the final speed of the stone as it hits the ground?

2. How would the answers to a), b) and c) change

a) If the stone were thrown with twice the horizontal speed, (EXPLAIN)

b) the stone were thrown with the same speed but the cliff were twice as high? (EXPLAIN)