**Acceleration due to gravity, Projectile Motion, and Reaction Time**

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Kinematic Equations:

|  |  |  |  |
| --- | --- | --- | --- |
| 1. | 2. | 3. | 4. |
|  |  |  |  |



**A. Introduction:** The instructor will introduce Data Studio and PC Data collection.  **B. Acceleration due to gravity:**

Apparatus: PC, interface, photogate sensor (head, rod, and cable), stand, soft box, and picket fence.

1)               Assemble the photogate, plug it in to digital channel one on the Interface, and attach the rod to a lab stand so that the head is horizontal.

2)               Open DataStudio. Select “Open Activity”. In the Physics Labs folder select “P05 Free Fall”.

3)               Double click on the Position and Velocity graph in the Displays list on the left side of the screen. (Two graphs should appear, one of Position vs. Time and one of Velocity vs. Time).

4)               When you are ready, click on the Start button and holding the picket fence above the photogate, let it drop onto something soft on the ground.

5)               Click on the Stop button.

6)               If necessary, rescale the graph so that your data takes up most of the space.

7)        Distinguish the features of the plots (Position VS. Time and Velocity VS. Time) and explain it using the kinematic equations.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8)               On the plot of Velocity vs. Time, add the best fit line and determine the slope of this line, which is the acceleration due to gravity. (Select “linear” from the “Fit” menu to get the line).

9)        Measure the acceleration due to gravity two more times and complete the data table.

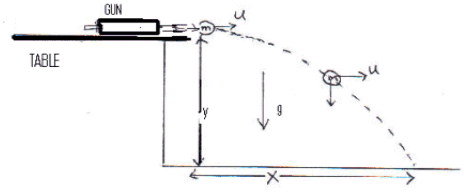
10)        Close DataStudio without saving.

|  |  |  |  |
| --- | --- | --- | --- |
| Trial | Acceleration due to gravity (m/s2) | | %Error |
| Measured | Accepted |
| 1 |  | 9.8 |  |
| 2 |  | 9.8 |  |
| 3 |  | 9.8 |  |

# C. The [Ballistic Pendulum](http://solomon.physics.sc.edu/~tedeschi/demo/demo20.html)

**Purpose:** To determine the initial velocity (u) of a projectile by measuring its range and vertical distance of fall.

**Apparatus**: Ballistic pendulum, meter stick, white paper, carbon paper, and scotch-tape.

**Theory:** Derive an expression for U in terms of X, Y, and g. 

Procedure:

1) Support the pendulum on the pawl and get the gun ready for firing.

2) The ball is fired horizontally to hit the floor. Fire the ball and determine approximately where it strikes the floor. Place a sheet of white paper on the floor so that the ball will hit it and secure the white paper to the floor with some tape. Place a carbon paper over the white paper. Fire the ball 4 more times.

3) Measure the average range X and the vertical distance of fall, Y as shown in the diagram and calculate the initial velocity of the projectile.

# D. Reaction Time Purpose: Determine the reaction time of you and your lab-partner, and investigate how it changes during subsequent trials.