Survey of Physics

Lab 3: Acceleration Due to Gravity

Name:_____

partner name(s):_____

Theory:

We say an object is in free fall when the only force acting on it is the earth's gravitational force. No other forces can be acting; in particular, air resistance must be either absent or so small as to be ignored. When the object in free fall is near the surface of the earth, the gravitational force on it is nearly constant. As a result, an object in free fall accelerates downward at a constant rate. This acceleration is usually represented with the symbol *g*.

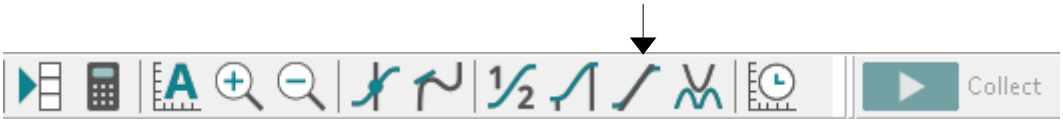
Equipment:

balls
Vernier Motion Detector mounted to ceiling
Computer with Logger Pro open
Picket fence
photogate

Procedure:

Part A: Ball drop with motion sensor

1. The motion sensor in the ceiling should be connected to the computer. Open Logger Pro on the laptop.
2. Use a ladder to get closer to the motion sensor attached to the ceiling. Place a ball roughly 6 inches or more below the sensor.
3. One person will hit the triangular play button on Logger Pro. You will then hear a clicking noise coming from the sensor. The other person will then drop the ball.
4. Logger Pro will automatically record the position and time data of the ball. A velocity vs. time graph will appear on the screen.
5. The slope of the velocity vs. time graph is the acceleration of the ball. Select (click) the velocity graph, then click the "Linear Fit" button on the toolbar (see figure).



You will need to move the brackets on the velocity graph to select only the data for the free-fall. The box should report the slope. Record this slope in the table below.

6. Carry out this experiment three times. Find the average value of g for all three slopes. Include units with your answer.

Slope of each velocity vs. time graph	**Average Slope = *g***

7. Calculate the percent error in your value from the expected value of $g_{true} = 9.8$ m/s^2.

percent error $= \frac{g_{meas} - g_{true}}{g_{true}} \times 100\%$ = _____

Part B: Photogate

In this experiment, you will have the advantage of using a very precise timer connected to the calculator and a Photogate. The Photogate has a beam of infrared light that travels from one side to the other. It can detect whenever this beam is blocked. You will drop a piece of clear plastic with evenly spaced black bars on it, called a Picket Fence. As the Picket Fence passes through the Photogate, the Logger Pro interface will measure the time from the leading edge of one bar blocking the beam until the leading edge of the next bar blocks the beam. This timing continues as all eight bars pass through the Photogate. From these measured times, the program will calculate the velocities and accelerations for this motion and graphs will be plotted.

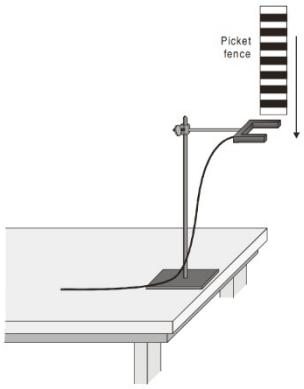


Figure 1

1. Now collect your free fall data. To do this, select the play button from the main screen.
2. Drop it through the Photogate, releasing it from your grasp completely before it enters the Photogate. Be careful when releasing the Picket Fence. It must not touch the sides of the Photogate as it falls and it needs to remain vertical.
3. The slope of the velocity vs. time graph is the acceleration of the ball. Measure the slope as described in the previous section. Carry out this experiment three times.

Slope of each velocity vs. time graph	**Average Slope = *g***

Find the average value of g for all three slopes.

Calculate the percent error in your value from the expected value.

percent error $= \frac{g_{meas} - g_{true}}{g_{true}} \times 100\%$ = _____