

Technology Idea: Acceleration Due to Gravity

Background:

All objects on Earth are subject to its gravitational field. Because of that gravitational field, when objects free fall they accelerate. Measuring that acceleration in free fall can be sometimes difficult.

In this lab, an accurate measure of the acceleration due to gravity can be determined by using a "picket fence" - a clear plastic strip with equally spaced bands that is very thin and should present minimal resistance due to air friction. By dropping this picket fence through a photogate, intervals of time between bands can be detected and used to calculate the acceleration due to gravity.

The Question:

What is the acceleration due to gravity?

Variables:

This experiment involves these variables: acceleration due to gravity, velocity, time. Identify and state the manipulated, responding, and controlled variables in this investigation.

Materials:

- photogate
- photogate port
- USB links
- picket fence
- lab stand
- computer and DataStudio software

Procedure:

Step 1:

Attach the photogate to the lab stand. Connect the USB link (or equivalent) to your computer and then plug the photogate port into the USB link. Then plug the photogate into port 1 of the photogate port.

Step 2:

Your DataStudio software will ask you to define the interval spaces between bands on your picket fence. If you are using a large Pasco picket fence (model ME-9377A) the band separations are 0.03 m. However, you can construct your own simple picket fence with clear plastic and black electrician's tape. Whatever the band separation on your picket fence, ensure that the appropriate measurement is entered in the DataStudio software.

Step 3:

Configure the DataStudio software to display a graph of velocity versus time, and a table for acceleration.

Step 4:

Hold the picket fence vertically above the photogate.

Press "start" in the DataStudio software, then drop the picket fence through the photogate. Press "stop".

Step 5:

Complete the analyzing and interpreting steps below, then repeat the whole process starting with procedure step 4. Continue to repeat until you have done a total of 4 trials and you are confident you have accurate results.

Analyze:

1. Apply a linear fit to the velocity-time graph. The resulting slope value is the measured acceleration of the picket fence. Record this value as the acceleration of the picket fence.
2. Select your table display of acceleration and click the statistics button. A statistic for "Mean" will appear at the bottom of the table. Record this mean value as the acceleration of the picket fence.

Conclude and Apply:

3. How does the slope value from your velocity-time compare to the accepted value for the acceleration of a free falling object on Earth (9.81 m/s^2)? Calculate the percentage difference between your experimental value and the accepted value for the acceleration of a free falling object.
4. How does the value from your acceleration table compare to the accepted value for the acceleration of a free falling object on Earth (9.81 m/s^2)? Calculate the percentage difference between your experimental value and the accepted value for the acceleration of a free falling object.
5. Was there a great percentage difference for the acceleration values in any of the trials? Account for any differences between the measured and accepted values of acceleration for free fall.
6. On several occasions NASA has performed classroom physics experiments on the space shuttle. Imagine this particular experiment being performed on the space shuttle.

Would the space shuttle results of this experiment be similar to your Earth-based experiment? Explain why you think the results would be the same or different.