Physics

Terminal Velocity

This Lab will assessed against the Data Collection, Processing and Conclusion assessment criteria

Introduction:

In the absence of air resistance objects fall with the same uniform rate of acceleration. In reality as the speed of a falling object increases air resistance increases also. This affects the motion. When the air resistance becomes equal to the weight of the object the net force on the body is zero and the object falls with a constant speed called the terminal velocity. In this experiment you will study the motion of falling objects (coffee filters) that reach terminal velocity rapidly. Your task is to establish a quantitative relationship between the terminal velocity and the mass of an object while keeping other important factors (like surface area) approximately constant.

Procedure:

The main instrument for studying the motion of the falling coffee filters is a motion detector, which is a sonic ranger connected to a logger pro. This instrument detects the position of an object as a function of time. It is from the slope of this graph that you should be able to obtain a measurement of terminal velocity.

Fix the motion detector at as high a position as possible (to the ceiling). Make sure there are no prominent objects underneath the motion detector that it may detect.

Hold the coffee filter with two hands about at a distance of 0.5 m below the motion detector (The detector cannot detect closer than 0.5 m) and release the filter moving your hands quickly to the side. With practice the filter should fall vertically downwards.

When the motion you obtain is not too erratic measure the terminal velocity of the filter from the slope of the position vs. time graph. Repeat the drop a few times and find an average value for the terminal velocity. Next drop two filters stacked together and repeat the measurements. Continue this procedure increasing the number of filters until you have enough data to plot a graph (at least six data points would be nice).

Plot a graph relating terminal velocity and number of filters dropped. Use a curve of best fit to establish a quantitative relationship between terminal velocity and the number of coffee filters dropped. State your conclusions.

Extension:

Drop a large bouncing ball and record the motion as it bounces. Plot graphs of position, velocity and acceleration. Can you use your data to get a good estimate of the acceleration due to gravity?