Lab 6-3: **Terminal Speed**

Purpose: To determine the relationship between the force of air resistance (*drag force*) and speed for an object moving through the air.

Discussion: To simplify problem-solving and focus on key ideas, we almost always ignore air resistance in this class. However, in this lab we will try to find the mathematical relationship between the force of air resistance (*drag force*) and the speed of an object through the air. We will drop coffee filters from a large height (stairwell). The large height is important because we are assuming that the coffee filters reach terminal speed pretty quickly so that the speed of the coffee filters as they fall is relatively constant. In this way, we can assume that the weight of the coffee filters is equal to the drag force.

Materials: 35 coffee filters stopwatch tape measure

Procedure:

1. Measure and record the drop height and the mass of 10 coffee filters.
2. Holding 1 coffee filter so that the flat part is on the bottom, release it from rest and record the time it takes the coffee filter to fall to the floor.
3. Repeat above, each time adding coffee filters so that they stack together, and always holding the flat part down. Fill in the chart below. (We are thus keeping the shape and surface area more or less constant, while changing the weight of the dropped object.)

Data:

Distance Fallen: _____ m Mass of 10 Coffee Filters: _____ kg

Coffee Filters (#)	Time to Fall (s)	*Weight of Coffee Filters (N)*	*Average Speed (m/s)*
1			
2			
3			
4			
5			
7			

Coffee Filters (#)	Time to Fall (s)	*Weight of Coffee Filters (N)*	*Average Speed (m/s)*
10			
15			
20			
25			
30			
35			

Calculations:

1. Calculate the average speed of each coffee filter as it fell and the weight of each set of coffee filters. Record your results in the data table above.

2. Graph Force vs Speed for your results. Linearize your results to find the equation that relates force and speed.

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Conclusions:

1. What is meant by the term *terminal speed*?

2. How reasonable is it to say that the average speed of the coffee filters is equal to the terminal speed of the coffee filters? Explain.

3. Why would this lab NOT have worked if we just dropped the coffee filters off the lab benches?

4. Why can we say that the weight of the coffee filters is equal to the force of air resistance on the coffee filters?

5. What is the relationship between the speed of the coffee filters and the force of air resistance on them?

6. Imagine dropping a ball from a large height. Sketch 1) speed vs. time, 2) acceleration vs. time, and 3) height vs. time. (Keep everything positive and qualitatively make the sketches.)