Air Resistance

As you work through the steps in the lab procedure, record your experimental values and the results on this worksheet. Use the exact values you record for your data to make later calculations.

Data and Calculations

Enter your mass values for the filters.

Fill in the tables below according to the instructions.

Table 1

Small Filters							
# Filters	**Time**					**Avg. Speed (m/s)**	**Force of Air (N)**
	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**	**Avg.**		
1							
2							
3							

Table 2

Large Filters							
# Filters	**Time**					**Avg. Speed (m/s)**	**Force of Air (N)**
	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**	**Avg.**		
1							
2							
3							

What n values does the power-law fit produce?

Results

Compare your results to equations 1 and 2.

$$|\mathbf{F}_{\text{air}}| = bv \qquad \text{equation 1}$$
$$|\mathbf{F}_{\text{air}}| = cv^2 \qquad \text{equation 2}$$

Which one seems to be a better fit for modeling the air resistance of the falling filter? Was there a significant difference between the different filter sizes?

Questions

The full equation for the model of air resistance that uses v^2 is

$$F_{\text{air}} = \frac{1}{2} C_d \rho A v^2,$$

where C_d is a drag coefficient, ρ is the density of air, and A is the cross-sectional area of the leading surface. How does this equation match up with your data? Fill in the following table, using one set of terminal speed and force of air data from each filter type. You will need to determine the relevant area for the filter, and look up data for the density of air. The drag coefficient for a circular leading surface is approximately 0.47 (the ruffles make the shape more complicated, but this can be used as an approximation).

Table 3

Filter Size	**# Filters**	**Terminal Speed (m/s)**	**Force of Air (N)**	C_d	ρ **(kg/m^3)**	**Area (m^2)**	**Calculated Drag Force (N)**	**% Diff. Between Force Measurements**
Small				0.47				
Large				0.47				

Judging by the percent difference between your measured force of air resistance and your calculated value using this method, how would you say this model fits your data? Is the fit better for the large or small filter? Why might that be? What sources might contribute to the difference you encountered?

Excel® Spreadsheet

Turn in the Excel® spreadsheet containing your data, calculations, and graphs here. The file name must end in ".xls". (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)