**Union College Spring 2021**

**Physics 120 Lab 3: The Drag Force due to Air Resistance**

**The Experiment:** Work in groups of 3.

Time the fall of coffee filters to determine the terminal speed and force of air resistance for 4 different size packets. Note: the coffee filters should be handled carefully to avoid changing their cross-sectional area. To make the groups of filters, page through an edge gently.

**Analysis**:

The goal is to determine, empirically, how the force of air resistance depends on the velocity of the falling object. Since most laws of physics involve power laws, we start with the assumption that

*F* = (some numbers) x *v p*,

where *p* is the “power” index of the speed in the drag force of air resistance equation. The goal in this lab is to determine the value of *p*. A clever way to determine this power is to make a log-log plot, that is, plot log(*F*) on the y-axis and log(*v*) on the x-axis. Taking the log of both sides of the equation above, and applying some rules of logarithms we get:

log(*F*) = log[ (some numbers) x *v p*]

log(*F*) = log(some number) + log(*v p*)

**log(*F*) = log(some number) + *p* log(*v*).**

Note that this is the equation of a straight line: *y = mx + b*, where the slope (*m*) equals the power index (*p*) of the velocity. So, if the force of air resistance is indeed a power-law, the plot of log(*F*) vs. log(*v*) should be a straight line AND the slope of that straight line equals the power index of velocity.

Do the data fit a straight line within the uncertainties? If so, then your first conclusion is that the relationship between *F*air and *v* is indeed a power law. Then, fit a “linear” trendline (select “show equation on chart”), read the slope from the equation and set that equal to the *p*.

Do the following in Excel to perform a regression analysis to obtain *the uncertainty* in the slope:

-Under the “data” menu, select “data analysis.”

-Select the columns of data for the x axis and y axis data.

-In the new chart that appears, the slope, y-intercept, and their uncertainties are the four numbers in the lower left corner.