Lab – Coffee Filter Air Resistance Name _____
AP Physics C

Purpose: To experimentally verify that the air drag on a falling coffee filter matches a theoretical prediction.

Procedure:

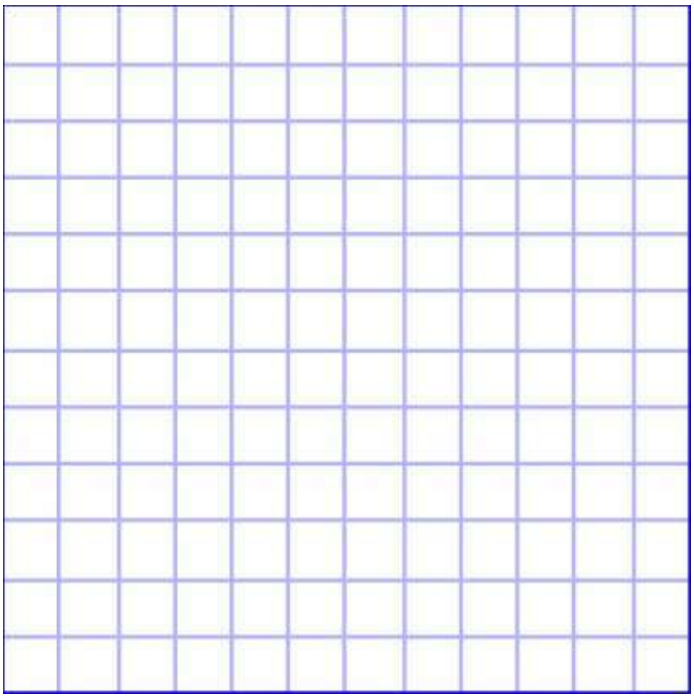
1) Determine the density of the air in the room. This will require an internet search.
2) Measure the cross-sectional area of your coffee filters. Note that this is **not the same** as the area you would measure if you flattened the filter.
3) Obtain the mass of one coffee filter. We will assume all the coffee filters have the same mass.
4) Use your ipad to determine the terminal velocity of the falling coffee filters.

Data Table

# of filters	Air Density (kg/m^3)	Cross Sectional Area (m^2)	Mass of filters (kg)	Terminal velocity (m/s)	v^2
1					
2					
3					
4					
5					

It will be assumed that the air resistance for the coffee filters is proportional to the square of the velocity. Mathematically, $F_{drag} = bv^2$. This is why a column is included for this in your data table.

If something is falling at a constant velocity, this means that the sum of the forces on it is zero. Therefore, the force of air resistance on the object is equal to the force of gravity. For our purposes, since $\Sigma F=0$, $bv^2-mg=0$, or $bv^2=mg$. Using this relationship, plot a graph whose slope may be used to calculate the value of b on the next page.



Using the graph at right, calculate a value for b_{exp}. Remember to indicate units!

b_{exp} = _____ [ ]

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Discussion of Theory:

Theory says that the drag on an object falling through the air is given by the equation

$$F_{drag} = \frac{1}{2}\rho A C v^2$$

where:
ρ = density of the air [kg/m^3]
A = cross sectional area of the object [m^2]
C = "drag coefficient", a unitless constant which depends on the shape (for our shape, C = 1)

In this case, b_{exp} *should equal* $b_{theo} = \frac{1}{2}\rho A C$, within a small experimental error. Your next task is to verify whether your experiment matches the theory.

Analysis:

1. Using the value you calculated based on your graph as your experimental value for b_{exp}, determine a percent error between the experimental value and the theoretical value for b_{theo}, which is based on the above equation.

% Error = _____