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STUDENT VERSION
STACKED COFFEE FILTERS FALLING

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Abstract: Data on free falling 2, 4, 6, and 8 stacked coffee filters is offered for analysis. Students first form a model using a resistance term proportional to velocity, velocity squared, or velocity to some general power. Parameters need to be estimated and models compared.

SCENARIO DESCRIPTION

In [2] data on several sets of stacked coffee filters falling is presented. The stacks contain 2, 4, 6, and 8 coffee filters. This is part of a larger set of data and videos offered by the Doane College (Crete NB USA), Department of Physics [1]. We enclose the data with additional information in the Excel file 3-17-S-Excel-StackedCoffeeFiltersFalling-StudentVersion.xls. farthest.

1. Draw a free body diagram of the stack of coffee filters in free fall.
2. From your diagram using Newton's Second Law of Motion, which says that the mass times the acceleration of that mass is equal to the sum of the external forces acting on that mass, to construct several differential equations of the form $my''(t) =$ _____. Hint: Consider various resistance terms due to the medium (air).
3. Solve the differential equations.
4. Using the data for the situations (one at a time) offered in 3-17-S-Excel-StackedCoffeeFiltersFalling-StudentVersion.xls estimate the parameters in your model. Consider the mass of one coffee filter as m and absorb it into the constant for resistance, but note how many filters for each data set, e.g., in first data set the mass of the stack of coffee filters is $2m$ while in the second data set the mass of the stacked coffee filters is $4m$.
5. Compare your models to the data and to each other.

REFERENCES

[1] Doane College Physics Department. 2009. *Gravity and Air Resistance.* http://physics.doane.edu/physicsvideolibrary/default.html.

[2] Doane College Physics Department. 2009. *Filter Data.* http://physics.doane.edu/physicsvideolibrary/spreadsheets/ht Accessed 31 March 2016.