Off-the-wall 6: Two students get into an argument about air friction and how it affects the motion of a free falling body. One student thinks it is proportional to the body's velocity v, the other think it's proportional to the velocity squared.

a.) What would you have to do to write out a differential equation that would characterize the motion of a body in free fall?

b.) How would you determine the terminal velocity for that body?

c.) Assume you were given twenty coffee filters, a meter stick, a stop watch, a balance, a motion detector and a cell phone with video capabilities. Design an experiment that would allow you to deduce which of the two situations is the reality. Explain the set-up, explain what data you would take and explain how the data would allow you make your deduction.

d.) (Don't take a lot of time on this one—it's a weird one.) A third student inserts herself into the conversation right at the beginning and says she thinks the correct function can't be deduce by discussion but might be deduced another way. Her suggestion is to assume an air-friction force magnitude of $F = kv^N$. With that, she maintained that using a body whose mass could be varied (those coffee filters) and finding its terminal velocity for a

number of different masses would, with some clever manipulation, allow her to deduce both k and N. She points out that at terminal velocity, the force F exactly off-sets gravity, so it equals mg at that point, and she says that graphing the *natural log of F* versus the *natural log of v* would do the trick. She is then called away before explaining more. Kindly fill in the blanks. Explain how her procedure would help?