Laboratory #2
Air friction & Vectors

Part A: That Air Just Took My Arm Off, Bubba

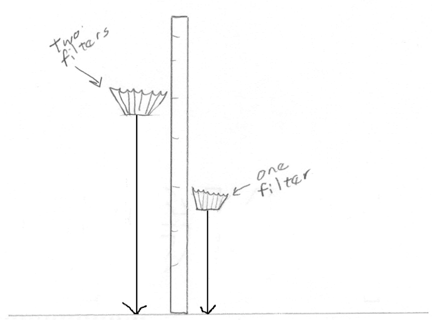
Concepts
Basic Algebra; Proportional; Terminal Velocity; Air Friction; Free fall; Equilibrium

Introduction
If you have ever stuck your hand out the window of a moving car you know that air resistance depends on how fast you are going. At 25 mph there is not much force against your hand, but at 70 mph you have to really work to keep your hand from getting thrown against the doorframe. This means that the force of air friction is dependent on velocity.

In this experiment we will find the power of velocity (e.g., v^x , where x = 1,2,3 · · ·) that is proportional to the force of air friction. You are going to do this by simultaneously dropping coffee filters from various heights. If it is done right, they will hit the ground at exactly the same time.

Procedure

- Read all the steps in the procedure before doing anything
- Ask your instructor to step you through the logic of the experiment.
- Fill in the chart provided using the information you obtained from your instructor
- Compare 1 coffee filter to 2 coffee filters. Place them at their respective heights for a given power.
- Drop them simultaneously
- Try this combination for all the powers. If both hit the ground at the same time, the power is correct.
- After you find the correct power, test that power with other combinations of filters (say 1 & 3 or 2 & 4 or whatever you like).



Part B: Dune Buggy Drag Race

Concepts

Vectors; Velocity; Speed; Vector Components

Introduction

Vector? Sounds like a military secret mission that I shouldn't and don't want to know anything about.

Vectors aren't really that bad. They are something that every physics student needs to know about and understand. Vectors are nothing more than arrows. When you notice an arrow in flight you have to know what direction it points and how fast the arrow is moving. If the arrow is pointed at you, and is moving fast enough to hit you, you better get out of the way! This lab will deal with the two parts that add up to make a vector, called components. You will also learn the difference between a vector and a scalar.

Procedure

- Lay out a large piece of paper on the floor or tabletop.
- Use a meter stick and magic marker to make a vertical line along the left edge of the paper (leave a 1"-2" margin).
- Use the meter stick and magic marker to make a horizontal line along the bottom of the paper (leave a 1"-2" margin). Insure that horizontal is perpendicular to vertical.
- These two lines will be the vertical and horizontal axes of a large graph.
- Turn on your dune buggy, start it at the origin (the place where the two axes cross) and send it across the paper at some angle. Be sure to time it from the origin until it goes off the paper.
- Mark the place where the dune buggy finished.
- Using your meter stick make a straight line from where your dune buggy started to where it finished.
- Make the line an arrow by putting an arrow at the finish end of the line. Label it "Vector 1"
- Turn your dune buggy on again and repeat the previous 4 steps for the second run on the same piece of paper at a different angle. Use a different color marker for the second arrow and label it "Vector 2".
- From the tip of the first arrow, draw a line (with the same color as the arrow) to the horizontal axis (insure that it is parallel to the vertical axis). Put an arrow on the end of the line so it ends at the same place as Vector 1. Label the new arrow "Vertical Component of Vector 1".
- From the tip of the first arrow, draw a line (with the same color as the arrow) to the vertical axis (ensure that it is parallel to the horizontal axis). Put an arrow on the end of the line so it ends at the same place as Vector 1. Label it "Horizontal Component of Vector 1"
- Repeat the last two steps for Vector 2
- Fill in Table II.

Lab Reporting Sheet
Laboratory #2

Name:____________________

Date:____________________

Part A. That Air Just Took My Arm Off, Bubba

# of Coffee Filters	Height (if ? =1)	Height (if ? =2)	Height (if ? =3)	Height (if ? =4)
1				
2				
3				
4				
5				

- **What power of velocity is proportional to the force of air friction?**

- **If it takes 5 N of force for you to hold your hand steady when you stick it out the window at 25 mph, how much force does it take to hold your hand steady at 50 mph? At 75 mph?**

- **Why is it good to have a parachute when jumping out of an airplane (other than preventing sudden pantswetting)? Use at least 2 new vocabulary words in answering this question.**

Part B: Dune Buggy Drag Race

Vector	Time	Distance Traveled	Distance Squared	Angle from Horizontal	Horizontal Distance Traveled	Horizontal Distance Squared	Vertical Distance Traveled	Vertical Distance Squared
Vector 1								
Vector 2								

- **Write (in your own words) the difference between a scalar and a vector (if you are unsure, ask your instructor).**

- **Speed is a scalar quantity. What was the speed of the first dune buggy run? The 2nd?**

- **Velocity is a vector. What was the velocity of the first dune buggy run? The 2nd?**

- **What was the horizontal component of velocity of the first run? The vertical component of velocity of the first run?**

- **What happens when you add the square of the horizontal to the square of the vertical components for each run (What do the numbers add up to)? Show it with your numbers. Why is this so?**