Lab 3-3: Massing a car

By way of bathroom scales, stopwatches, and a tape measure, we are going to estimate the mass of a car using Newton's 2nd law.

First, 2 members of the class will accelerate the car from rest through a known distance on a flat piece of ground, while other members of the class measure time using stopwatches. The pushers will be pushing against bathroom scales and trying to keep as constant a force as they can throughout the acceleration. The distance through which the car is accelerated will need to be measured.

When the acceleration phase is over, the car will be allowed to coast to a stop, and the distance it travels while coasting will be measured. This can be used to estimate the force of friction which acts on the car as it rolls.

The data gathered will thus consist of:

Distance through which car is accelerated from rest	
Time for initial acceleration	
(≈avg) Forces exerted by pushers	
Distance through which car coasts to a stop	

Calculating the mass of the car from this data is not simple. First of all, the bathroom scales read in pounds, so these values will need to be converted into Newtons. Accelerations will need to be calculated for both parts of the experiment (pushing and coasting). You will need to set up correct Newton's 2nd law equations for both parts, which will first require having correct free-body diagrams. . Ultimately, our answer can be compared to the "curb weight" provided by the manufacturer. (note that this is not the same as the "gross vehicle weight" printed on the inside of the car door frame). The curb weight can (hopefully) be found at the manufacturer website or by doing a google search.

The report for this assignment should include:

- A data section listing all of the measurements made in this experiment. (You can use the other side of this sheet if you want).

- Carefully labeled free-body diagrams for both parts of the experiment (while the car is being pushed and while it is coasting).

- A neatly labeled sequence of all of the calculations that you made in arriving at a final mass for the car.

- A % error calculation between your experimental value for the car mass and the one given by the manufacturer

- A detailed conclusion in which you discuss how well our method ended up working and what you think might be the major sources of error in the experiment. Results in this experiment are typically off by a bit, so there will likely be some significant thinking/explaining to do here.