Experimental design 1 (Solutions)

Full Name, Period, AP/Honors: Instructor-All

1 Stuff, and Things

1. Measure 25 m intervals with the tape measure and mark them with the red tape. Place a student at each marker.
2. Put the tires on the car.
3. Have the car accelerate to some velocity between 5 and 30 $\frac{\text{m}}{\text{s}}$ before reaching the first mark. Then set the cruise control.
4. When the car reaches a mark, the student next to that mark begins timing on their stopwatch.
5. When the car reaches the last red mark (and last student), all other students stop timing and record their times. The driver slams on the breaks here.
6. Provided that no skidding occurred, use the tape measure to measure the distance from the last red tape to the car's final position. Call this distance D.
7. Have each student calculate the velocity of the car before slamming on the breaks using $v = \frac{\Delta x_i}{t_i}$ where Δx_i is the distance from their mark to the last mark, and t_i is their measured time. These velocities should match.
8. Using energy conservation and the fact that no other forces are important to stopping the car

   $$W = FD = \Delta E$$

   so $mg\mu_s D = \frac{1}{2}mv^2$,which gives

   $$\mu_s = \frac{v^2}{2gD}$$

9. Repeat the experiment several times with different velocity values within the range.
10. Linearize the equation and plot $y = v^2$ against $x = 2gd$. The slope will be μ_s