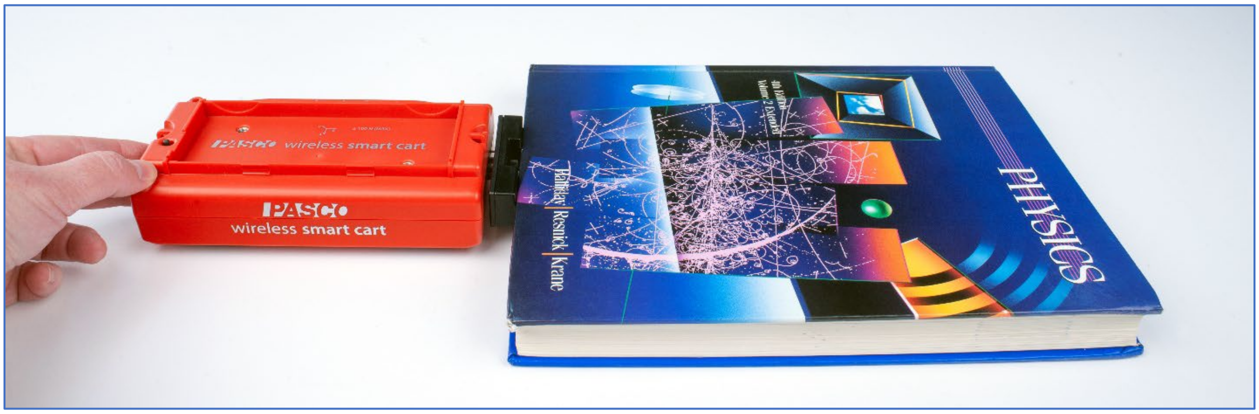
Static and Kinetic Friction

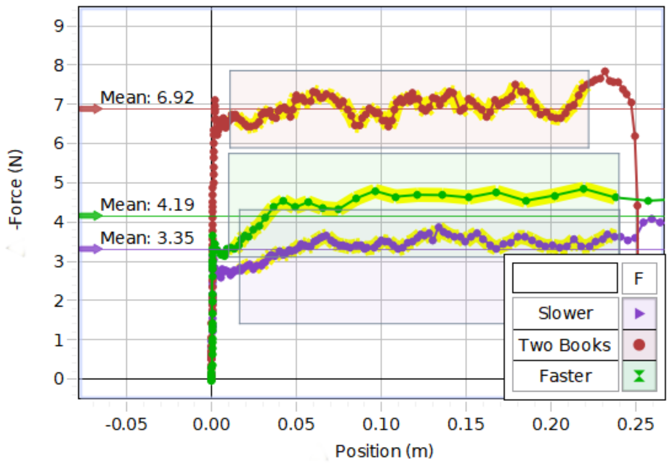


1. Take your Smart Cart out of the box.
2. Turn it on and open your choice of software: SPARKvue or Capstone.
3. Wirelessly connect to the Smart Cart.
4. Make a graph of Force vs. Position.
5. Make sure the Smart Cart Force sensor (with the magnetic bumper on it) is not touching anything and then zero the Force sensor in the software.
6. Set the cart bumper against the book. Start recording. Very slowly push the cart until the book breaks loose and then push it steadily across the table. Stop recording.
7. Take another run, pushing it at a faster speed once it breaks loose.
8. Add a second book on top of the first book and repeat.

Analysis

1. For each run, record the maximum force before the book moved. This is an indication of the static friction. If you can find the mass of the book, you can calculate the static coefficient of friction for the book on the table.
2. For each run, record the average force while the book was moving. This is an indication of the kinetic friction. If you can find the mass of the book, you can calculate the kinetic coefficient of friction for the book on the table.
3. What effect does speed have on the kinetic friction?
4. What changes when the extra book is added? Do the coefficients of static and kinetic friction change?

Sample Data



The average kinetic friction for two books is 6.92 N.

The average kinetic friction for one book going slower vs. faster was 3.35 N compared to 4.19 N. This indicates that the speed does influence the kinetic friction slightly.

Mass of First Book = 1.56 kg
Mass of Second Book = 1.58 kg

For one book:
$\mu_s = F/mg = 3.09N/(1.56)(9.8) = 0.2$

$\mu_k = F/mg = 3.17N/(1.56)(9.8) = 0.2$

For two books:
$\mu_s = F/mg = 7.11\ N/(1.56+1.58)(9.8) = 0.2$

$\mu_k = F/mg = 6.59N/(1.56+1.58)(9.8) = 0.2$