

Objective

The goal of this exercise is to

- verify the theoretical prediction for the acceleration of a massive object experiencing a net force
- solidify your understanding of the relationship between acceleration, mass, and net force
- give you experience with the experimental apparatus, particularly the calibration of a force probe
- give you experience with graphing noisy data with error bars and finding best fit lines

Materials

- Vernier [Lab pro](#), [photogates](#), [range finder](#), and [force probe](#)
- Low-friction air track and carts
- Low-friction track and wheeled carts
- A variety of pulleys, clamps, and brass weights
- Ruler

Theoretical model

Newton's 2nd Law predicts an acceleration a due to a net force F_{net} acting on a mass m according to the formula $a = F_{\text{net}}/m$.

Procedure

- This laboratory requires a great deal of student responsibility and ingenuity. You are to *design* the experimental procedure on your own. You might find that your experiment doesn't work as intended – feel free to modify your design and start again until you have something you're happy with.
- Most sensitive measurement devices require calibration so that they read out the "right value" when asked to. We're going to have to calibrate the force probe in Logger Pro by going to Experiment -> Calibrate
 - You'll need to hang two known weights from the force probe to calibrate it. Enter their weight in Newtons when prompted.
 - Verify your calibration by hanging a third known weight.
 - Note that vertical calibrations take into account the weight of the "hook" that you use to hold the weights -- it won't be calibrated, then, for horizontal use since the "hook" is no longer pulling down. You have to use a pulley to calibrate horizontally.

Post-lab & writeup

- Attach this sheet as a cover sheet. Do not feel you need to duplicate the information in this cover sheet in your write-up.
- Attach the generic laboratory rubric and checklist ([grayscale .pdf](#)) as an appendix. Your instructor will refer to those when grading.
- A photo or careful sketch of your experimental apparatus can be very useful to the reader.