LAB 7. FRICTION

Investigation

In this lab you will test the supposition that the force of friction between two objects follows the form $f_k = \mu_k N$ or $f_s \leq \mu_s N$, where N is the normal force between them and μ is a constant depending only on the materials.

Choose a question and plan to investigate it. What would constitute an experimental test of the model? The model leads to certain predictions about the motion of objects experiencing friction. If these predictions are at odds with reliable experimental results, the model may be wrong.

You can measure lengths and masses. You can find velocities and average accelerations using the motion sensor apparatus and Logger Pro software. How can you find friction? How can you determine if it follows or departs from our model?

Possible Questions

- Does the force of kinetic friction depend on the relative speed of the contacting surfaces?
- Is the force of friction directly proportional to the normal force, or does it follow a different dependency?
- Does the force of kinetic friction depend on the area of contact between the surfaces?
- Does the force of kinetic friction change over time?
- Does the model apply as well at different incline angles of the surface?
- Is the maximum force of static friction repeatable and consistent?

Design

When you decide what aspect of the model to test, plan how to take measurements. What is the best physical system to construct? What variables are in your experimental control? What can you measure? You want the model to predict the outcome of measurements you will take—then, you take the measurements and find if the predictions succeeded or failed.

Measurement

You want your measurements to be as accurate, precise, and reliable as possible. You know some of the quirks of the motion sensor. Depending on your experiment, you will need to measure other quantities, such as mass, tension, or incline angle. Plan to make these measurements as precise and trustworthy as possible.

Analysis and Interpretation

If your measurements don't exactly match predictions, is that because the measurements are in error, or because the model's predictions are wrong? To know, you will need an idea of how trustworthy your measurements are. What do you know about the reliability of your measurements? How can you maximize their reliability? How can you reap the most insight from your experiments?

Check-out

Your group needs to be checked by an instructor twice in this lab:

1. When you propose what question you will test, what process you will perform and what measurements you will take, to verify that your idea is reasonable and not repeated by too many other groups.
2. After you collect your data, to verify that you have data.

Lab Report

There will be one report per lab group. It will be short.

Abstract

Briefly describe the apparatus, the measurements, and what you did with the measurements.

Purpose

Why am I making you do this? What is its educational value?

Theory

What is the conventional model of friction? What is the model of the net force in the situation you studied? What experimental outcome does the conventional model of friction predict? What outcomes would indicate that the model is *not* correct?

Experimental

Explain the setup you used and the measurements you took to determine the force of friction under different circumstances. Explain steps you took to minimize measurement error.

Observations and Data

Your primary data should be recorded in your own records (paper, computer files). In your report, present the data in a form that is easy to visualize and understand, such as tables or graphs.

Analysis and Discussion

Compare your experimental findings to the predictions. What results did the $f = \mu N$ model predict for your experiment? Do your experiments show that the model accurately predicts the data? If so, what coefficients μ did you find for the surfaces you investigated?

Identify known or suspected errors in your measurements. Explain how these errors would affect your measured values.

Conclusion

Do your experiments suggest that our standard model of friction adequately predicts actual results, or do they call it into question? If the model of friction fails, in what way does the force of friction depart from the model?