PHYSICS

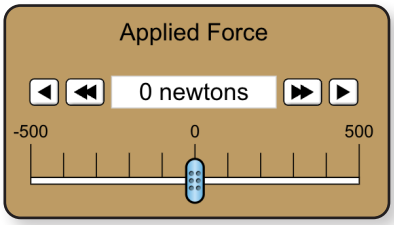
Physics Lab Instructions

Read and follow the steps to complete the investigation.

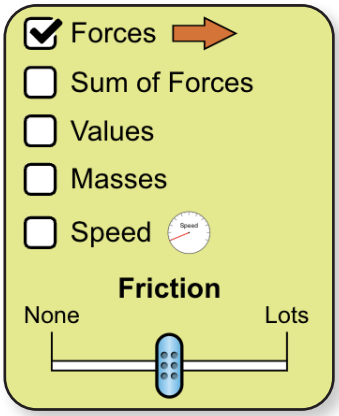
Coefficient of Friction Online Lab

Laboratory Instructions

Click the “Friction” mode of the simulation. On the screen, you will see a crate and a figure that can apply force to the crate.



The controller for the “Applied Force” is located below the track. The applied force is set to 0 newtons. To make the figure apply a force to the crate, use the arrows on the right side of the force reading. The double arrows add 50 N at a time, and the single arrow adds 1 N at a time.



The section toward the top right side of the simulation window has various labelled areas.

If “Values” is checked, the values for the forces and masses will be shown. If “Masses” is checked, the mass of each object will be shown; and if “Speed” is checked, the relative speed of the object will be shown.

There is also a slider to vary the friction with a default of medium friction. “Forces” should already be selected. For this activity select “Sum of Forces,” “Values,” “Masses,” and keep the friction slider at the default value of medium friction.

Make two data tables for recording information. Make one data table for the coefficient of static friction and one for the coefficient of kinetic friction. On each of these data tables, have places to record the mass, normal force, friction force, and coefficient of friction for four trials.

Follow these instructions to calculate the coefficient of static friction using the simulation.

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Coefficient of Static Friction, μs

The coefficient of static friction is calculated by using the static friction force. This is the force that must be overcome for the crate to begin moving.

1. To determine the static friction force, you will need to add force to the object until the object just starts to move. Use the crate, which has a mass of 50 kg, and click on the right-facing double arrow twice. This exerts a force of 100 N on the crate. If the crate has not started to move, click on the single arrow until the crate just barely starts to move. If you overshoot the movement, you can reset and start adding forces again.

2. The force at which the object barely starts to move is the static friction force.

3. Record the mass and friction force in your data table.

4. Calculate Fn (normal force) for the crate and record it in your data table.

5. Use the normal force and the static friction force to calculate the coefficient of static friction.

Follow these instructions to calculate the coefficient of kinetic friction using the simulation.

Coefficient of Static Friction, μk

The coefficient of kinetic friction is calculated by using the kinetic friction force. This is the force that must be applied for the crate to keep moving at a constant speed once it has started moving. **Important Note:** To make sure the crate is moving at a constant speed, the sum of the forces must equal zero.

1. To determine the kinetic friction force, you will repeat the procedures for static friction. Once the crate is moving, reduce the force applied using the left arrows until the crate starts moving at a constant speed (no acceleration). Once the crate is moving at a constant speed and the sum of the forces is zero, the friction force shown as the object is moving is the kinetic friction force.

2. Record the mass and friction force in your data table.

3. Calculate Fn (normal force) for the crate and record it in your data table.

4. Use the normal force and the kinetic friction force to calculate the coefficient of kinetic friction.

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Add another crate on top of the first one. Calculate the new normal force based on the new mass. Record the mass and the normal force of the two crates. Repeat the procedure of pushing on the crates until they just move. Find the static friction force and the sliding friction force and record them in your data table. Use the forces to calculate the coefficient of static and kinetic friction for the two crates.

Change the mass two more times by changing the objects. For each mass, record the mass and new normal forces in your data table. Find the friction forces for each and calculate and record the coefficients of static and kinetic friction.

Compare the coefficient of static friction and the coefficient of kinetic friction and determine how they compare to each other. As you write your lab report, answer the question “What is the relationship between the coefficients of static and kinetic friction?”