Four-Sided Friction Block

P3-3608

INSTRUCTIONAL GUIDE

Contents

- 1 Friction Block
  - 4 surfaces: sandpaper, vinyl, paper, wood
- Post for slotted masses

Recommended for activities:

- Slotted Mass Set (P1-1073)
- Hooked Mass, Set of 9 (91-1000)
- Inclined Plane (P3-3541) or Table Clamp Pulley (P1-6115)
- Spring Scale (P1-1091) or Digital Newton Meter (01-7000)
- Timer and Photogates (P4-1450)

Background

The study of frictional forces is a basic requirement in meeting state and national standards for the physical sciences. The Friction Block allows elementary to secondary students meet the goals of these standards through well designed laboratory investigations. At the elementary level students are asked to focus on science relationships and to describe how one variable affects another. Here, the Friction Block allows the student to develop the relationship between the surface smoothness and the force of friction. At the secondary level, the Friction Block helps students discover such concepts as static and kinetic friction, coefficient of friction, and the equations for sliding friction.

Activities

Educational Objective: Use the **Friction Block** to develop the relationship between the force of friction and the normal force by defining the coefficient of friction.

Graphically Determine the Static Friction Coefficient

Objective: In this experiment you will construct a graph of the static friction force vs. normal force. The slope of this graph is the coefficient of friction.

General Idea: Force the block to move across a smooth and level plane at a constant speed and measure the forces of kinetic friction for one of the different-textured block surfaces. When pulling the block at a constant speed, the friction force is equal to and opposes the force you are pulling the block with. Students will repeat their measurements with additional mass on top of the block to increase both the normal force and the friction force. Create a data table of the amount of frictional force in one column and the combined weight of the block and its added masses in another column. **It is important, when using sensitive spring scales, to adjust the zero point when switching between vertical and horizontal measurements.** Adjust the spring scale for a vertical measurement of weight. Hang the Friction Block from the spring scale and record the block's weight (in Newtons) as the Normal Force (F_n).

1. Re-adjust the zero point of the spring scale for a horizontal force measurement. Rest the block on its sandpaper side and gently push or pull the block until it becomes unstuck and begins to slide. Carefully measure and record this spring scale force as the Force of Kinetic Friction (F_k).
2. Add extra mass to the top of the Friction Block and record the new total weight of the block and this added weight. Repeat step 1.
3. Repeat the process above until you have obtained five different weights and the corresponding frictional forces for each. Record each pair of measurements on the data table.
4. Construct a graph from the data table of the force of friction (F_k.) vs. force normal (F_n).
5. Calculate the slope of the best fit line through these data points. The slope of this line is equal to the value of the Coefficient of Kinetic Friction (μ_k.) $\mu_k = F_k/F_n$

Experimentally Determine the Dynamic Friction Coefficient

Objective: In this experiment you will determine the coefficient of friction dynamically using Newton's 2nd law.

Attach a pulley to a horizontal surface over which a hanging mass can be used to pull and accelerate the Friction Block. The force of friction one the Friction block acts in the opposite direction to the force produced by the weight of the hanging mass. After measuring the acceleration of the system of masses the force of friction can be calculated and combined with the force normal on the block (the weight of the Friction Block) to determine the coefficient of friction μ_k

1. Refer to the hanging mass as M_1 and the Friction Block as M_2. Record the mass of the hanging weight and calculate its weight (F_w) in Newtons.
2. Using a stopwatch or a pair of photogates, calculate the acceleration (a) of the Friction Block as it is pulled across the horizontal surface by the hanging weight.
3. According to Newton's 2nd law, $F_w - F_k = (M_1 + M_2)\, a$. Knowing F_w, M_1, M_2 and a, calculate the kinetic friction F_k.
4. Lastly, calculate the Coefficient of Kinetic Friction (μ_k.) Using the values F_k above and the value of the weight of the Friction Block as the force normal.

Related Products

Forces on Inclined Plane Demonstrator (P4-1420) This engaging piece of lab equipment makes the component theory of forces a tangible reality for every student.

Air Puck Physics Kit (P4-2155) Our exclusive Air Puck Physics Kit includes two pucks, inelastic collision kit, and puck launcher.

Car and Ramp Lab (P4-1405) Experiment with distance, time, velocity and acceleration, Newton's laws and simple machines. The 120cm ramp attaches to the Workshop Stand at angles up to 65°.