

SECTION

FRICTION IS A FORCE THAT OPPOSES MOTION.

3.2 Challenge and Extension**BIG IDEA** Newton's laws apply to all forces.**KEY CONCEPT** Friction is a force that opposes motion.

Friction Imagine pushing on a heavy object. If you push just a little, the object does not move because of friction. You can find out how much you must exert on the object before it starts to move. As you start to push, a frictional force is produced that balances your push and prevents the object from moving. If you increase your push, the force of friction increases as well. However, the force of static friction has a limit to how large it can get. If you push harder than the maximum possible frictional force, the object will start to move. This maximum force is called the force of static friction.

To calculate the force of static friction on an object on a flat surface, you multiply a certain number that depends on the types of surfaces, called the coefficient of static friction, by the reaction force of the surface on the object. (On a flat surface, this force is equal to the object's weight.) The resulting force is how much you will have to push the object before the object will move.

Listed below are some coefficients of static friction for common surfaces.

| Surfaces | Coefficient of Static Friction |
|------------------------|--------------------------------|
| Wood on wood | 0.4 |
| Ice on ice | 0.1 |
| Steel on steel | 0.7 |
| Rubber on dry concrete | 1.0 |

- How much force would you have to apply to begin pushing a wood block with a weight of 150 N if it was sitting on a plain wood floor? Show your work.

- How much force would you have to apply to begin moving an 800 N ice sculpture sitting on an ice surface? Show your work.

- You have two objects of equal mass. One is made of steel and rests on a steel surface. The other is made of wood and rests on a wood surface. If a force of 40 N just moves the wooden object, how much force would you need to just move the steel object?

