20.1: Introduction to Friction

Friction is a resistive force between two solid bodies in contact that inhibits the motion of the objects. We're all familiar with friction in everyday life: if you try to slide an object across the floor, it does not continue in a straight line at constant speed, as might be expected from Newton's first law of motion. Instead, the object's speed decreases until it comes to a stop. The reason is given by Newton's first law: there must be an external force present-the frictional force.

Friction is caused by the interaction of the surfaces of two objects rubbing against each other. For example, as an object is sliding across the floor, the top layer of atoms in the floor are constantly making and breaking chemical bonds with the bottom layer of atoms in the object. This interaction of the atomic layers causes the object's kinetic energy to be converted to heat bit by bit, so both the object and the floor become hotter as the object slows down. (We'll learn about kinetic energy in Chapter 26.)

Here are a few facts about friction:

- Friction is a force that always acts opposite the direction of motion of the object.
- Experimentally, we find that the frictional force f is proportional to the normal force n : $f = \mu n$, where μ is called the coefficient of friction.
- Traditionally physicists describe three types of frictional force: static friction, kinetic friction, and rolling friction. Static friction is at work when the object is stationary; kinetic friction is at work when the object is in motion; and rolling friction applies to rolling bodies. But under carefully controlled conditions, experiments show that the two tend to become indistinguishable.
- No one has yet been able to derive the relation $f = \mu n$ from first principles. It's an example of an empirical law: something that has been found to be at least approximately true under many conditions.