

section 1 Forces

What You'll Learn

- how force and motion are related
- what friction is between objects

● Before You Read

When you hit a baseball with a bat, you apply a force that moves another object. Think of three more examples from sports in which force is used to move something. Write your examples on the lines below.

Study Coach

Create a Quiz As you are reading this section, write five questions that could be used on a quiz. Be sure to include the answers.

● Read to Learn

What is force?

A **force** is a push or a pull. When you kick a soccer ball, it is obvious that you have applied force to it. Sometimes, though, a force is not as obvious. For example, do you feel the force of gravity acting on your body? There are many forces that you exert every day. Every time you sit, stand, stretch, bend, push, or pull, you exert a force on another object.

How does force change motion?

Think about a tennis player hitting a ball. What happens to the motion of the ball when the racket hits it? The force of the racket hitting the ball makes the ball stop. Then the force makes the ball move in a different direction.

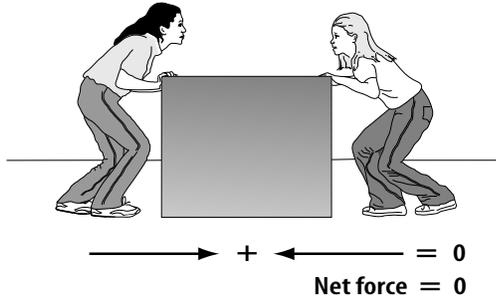
What are balanced forces?

Not all forces change velocity. Suppose two students are pushing on opposite sides of a box. As shown in the figure, if both students are pushing with an equal force, the box does not move. When two or more forces act on an object at the same time, the forces combine. This is called a **net force**. When two students are pushing with the same force, but in opposite directions, the two forces cancel each other. The net force on the box is zero. Forces on an object that are equal in size and opposite in direction are called balanced forces.

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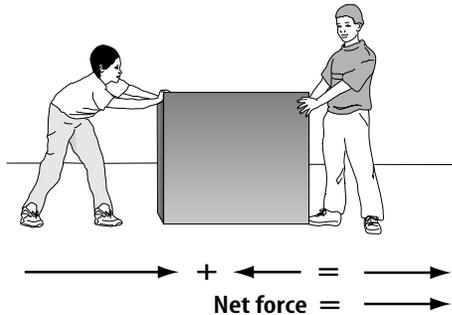
A Find Main Idea As you read, use quarter or half sheets of paper to help you identify the main ideas about forces and friction.



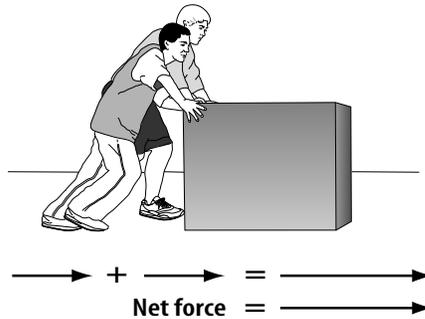


What is the result of unbalanced forces?

Not all forces in opposite directions balance each other. Think about two students pushing on the opposite sides of a box. What happens if one student pushes harder than the other as in the picture? The forces are not balanced, and the box will move in the direction of the larger force. The student who is pushing harder will move the box in the direction of the force. The net force that moves the box is the difference between the two forces.



Suppose both students push on the same side of the box as in the second figure. The students are both exerting force in the same direction. Again the forces are unbalanced. The forces combine, or add together, because they are exerted in the same direction. Again, net force is equal to both forces added together.



Friction

Suppose you give a skateboard a push with your hand. If the net force on the skateboard is zero, it will continue to move with a constant speed. Does it move with constant speed after it leaves your hand? No, the skateboard slows down and stops. There must be a net force acting on it. So, what force is acting? The force that brings the skateboard to a stop is friction.

Friction is the force that opposes the sliding motion of two surfaces that are touching each other. The amount of friction between two surfaces depends on two things. The first is the kind of surfaces that are touching. And the second is the amount of force that is pressing the surfaces together.

Picture This

- Describe** Why are the forces in the figure said to be balanced?

Reading Check

- Define** What is the net force?

Think it Over

- Infer** Which would have more friction, a car traveling down a street or a toy remote-control car traveling on the same street? Why?

What causes friction?

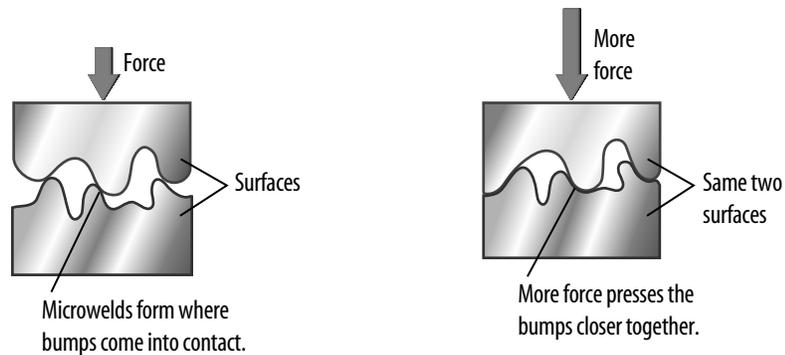
Something that seems very smooth, like polished metal, may actually be rough. You can see the dips and bumps on the surface when you look at it under a microscope. If two surfaces are pushed tightly together, welding, or sticking, happens where the bumps touch each other. These places are called microwelds. *Micro-* means “very small.” Friction is caused by the microwelds that form where the surfaces are in contact.

What makes things stick together?

The greater the force pushing two surfaces together, the stronger the microwelds will be. More of the surface bumps will be touching each other. You can see microwelds in the figure below. To move one surface over another, a force must be applied to break these microwelds.

Picture This

4. **Observe** Do surfaces touch more when there is less force or greater force?



✓ Reading Check

5. **Complete** the sentence:
The force that keeps two surfaces at rest from sliding over each other is
