

Friction

Friction is a force like any other, and it affects motion. Friction acts on materials that are in contact with each other, and it always acts in a direction opposite to the direction of motion.

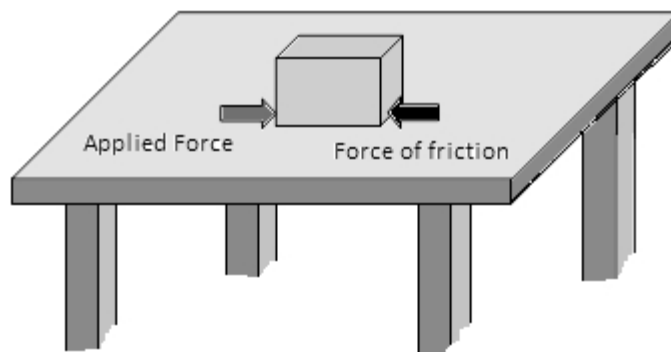
When two solid objects come into contact, the friction is mainly due to irregularities in the two surfaces. When one object slides against another, it must overcome these irregularities, and that requires force.

The amount of friction that acts between two surfaces depends on two things: the type of materials in contact, and how hard they are pressing against each other. For example, rubber on concrete produces more friction than rubber on ice. That's why the city streets are so much more hazardous in winter than they are in summer.

Friction is not restricted to solids sliding across other solids. Friction also occurs in liquids and gases, both of which are called **fluids**. Fluid friction occurs as an object pushes aside the fluid it is moving through. If you've ever tried running while waist deep in water, then you have experienced this sort of friction. The friction of liquids is considerable, even at low speeds.

Air resistance, which is the friction acting on something moving through the air, is a very common form of fluid friction. You usually don't notice air resistance when walking or jogging, but you certainly notice it at the higher speeds that occur when riding a bicycle or downhill skiing.

When friction is present, an object may move with a constant velocity even when an outside force is applied to it. In such a case, the friction force just balances the applied force. The net force is then zero, so there is no acceleration. For example, in the diagram below the box moves with a constant velocity when the applied force just balances the force of friction.



A diagram showing all the forces acting on an object is called a **free-body diagram**.

Example

If the applied force in the diagram above is 50 N and the force of friction is 20 N, determine the acceleration of the box. The mass of the box is 10 kg.

Worksheet

1. What is the cause of friction, and in what direction does it act with respect to the motion of a sliding object?
2. If the force of friction acting on a sliding crate is 100 N, how much force must be applied to maintain a constant velocity? What will be the net force acting on the crate? What will be the acceleration?
3. You push with 20 N on a 10 kg block and there is a 10 N force of friction. How fast will the block accelerate?
4. Suppose that you exert 400 N horizontally on a 50 kg crate on a factory floor, when friction between the crate and the floor is 200 N. What is the acceleration of the crate?