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Topic: Friction
Code: HF60622

Air resistance is a form of friction

Another type of friction, the retarding force produced by air resistance, is important in the analysis of motion. Whenever an object moves through a fluid medium, such as air or water, the fluid provides a resistance to the object's motion.

For example, the force of air resistance, $\mathbf{F_R}$, on a moving car acts in the direction opposite the direction of the car's motion. At low speeds, the magnitude of $\mathbf{F_R}$ is roughly proportional to the car's speed. At higher speeds, $\mathbf{F_R}$ is roughly proportional to the square of the car's speed. When the magnitude of $\mathbf{F_R}$ equals the magnitude of the force moving the car forward, the net force is zero and the car moves at a constant speed.

A similar situation occurs when an object falls through air. As a free-falling body accelerates, its velocity increases. As the velocity increases, the resistance of the air to the object's motion also constantly increases. When the upward force of air resistance balances the downward gravitational force, the net force on the object is zero and the object continues to move downward with a constant maximum speed, called the *terminal speed*.

Why it Matters

Driving and Friction

Accelerating a car seems simple to the driver. It is just a matter of pressing on a pedal or turning a wheel. But what are the forces involved?

A car moves because as its wheels turn, they push back against the road. It is actually the reaction force of the road pushing on the car that causes the car to accelerate. Without the friction between the tires and the road, the wheels would not be able to exert this force and the car would not experience a reaction force. Thus, acceleration requires this friction. Water and snow provide less friction and therefore reduce the amount of control the driver has over the direction and speed of the car.

As a car moves slowly over an area of water on the road, the water is squeezed out from under the tires. If the car moves too quickly, there is not enough time for the weight of the car to squeeze the water out from under the tires. The water trapped between the tires and the road will lift the tires and car off the road, a phenomenon called *hydroplaning*. When this situation occurs, there is very little friction between the tires and the water, and the car becomes difficult to control. To prevent hydroplaning, rain tires, such as the ones shown above, keep water from accumulating between the tire and the road. Deep channels down the center of the tire provide a place for the water to accumulate, and curved grooves in the tread channel the water outward.

Because snow moves even less easily than water, snow tires have several deep grooves in their tread, enabling the tire to cut through the snow and make contact with the pavement. These deep grooves push against the snow and, like the paddle blades of a riverboat, use the snow's inertia to provide resistance.