string has horizontal and vertical components. The vertical component is equal and opposite to the gravitational force. Thus, the horizontal component is the net force. This net force is directed toward the center of the circle, as shown in **Figure 4(b).** The net force that is directed toward the center of an object's circular path is called *centripetal force.* Newton's second law can be applied to find the magnitude of this force.

$$F_c = ma_c$$

The equation for centripetal acceleration can be combined with Newton's second law to obtain the following equation for centripetal force:

CENTRIPETAL FORCE

$$F_c = \frac{mv_t^2}{r}$$

$$\textbf{centripetal force} = \textbf{mass} \times \frac{\textbf{(tangential speed)}^2}{\textbf{radius of circular path}}$$

Centripetal force is simply the name given to the net force on an object in uniform circular motion. Any type of force or combination of forces can provide this net force. For example, friction between a race car's tires and a circular track is a centripetal force that keeps the car in a circular path. As another example, gravitational force is a centripetal force that keeps the moon in its orbit.

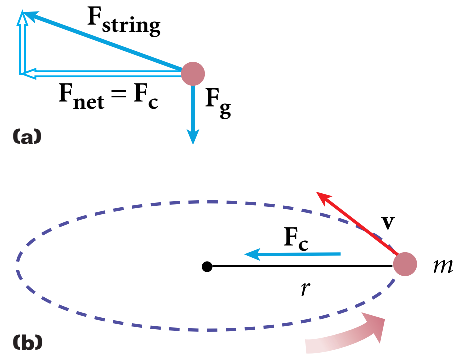

Figure 4
The net force on a ball whirled in a circle **(a)** is directed toward the center of the circle **(b).**

SAMPLE PROBLEM B

Centripetal Force

PROBLEM

A pilot is flying a small plane at 56.6 m/s in a circular path with a radius of 188.5 m. The centripetal force needed to maintain the plane's circular motion is 1.89×10^4 N. What is the plane's mass?

SOLUTION

Given: $v_t = 56.6$ m/s $\quad r = 188.5$ m $\quad F_c = 1.89 \times 10^4$ N

Unknown: $m = ?$

Use the equation for centripetal force. Rearrange to solve for *m*.

$$F_c = \frac{mv_t^2}{r}$$

$$m = \frac{F_c r}{v_t^2} = \frac{(1.89 \times 10^4 \text{ N})(188.5 \text{ m})}{(56.6 \text{ m/s})^2}$$

$$\boxed{m = 1110 \text{ kg}}$$