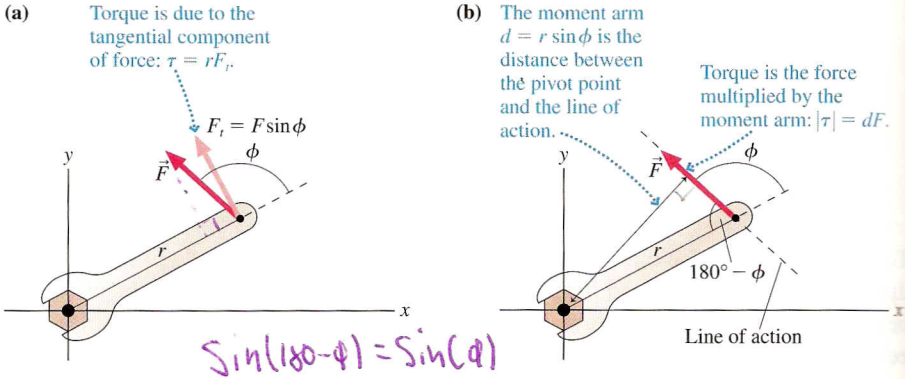
Interpreting Torque

Torque can be interpreted from two perspectives. First, FIGURE 12.21a shows that the quantity $F\sin\phi$ is the tangential force component F_t. Consequently, the torque is

$$\tau = rF_t \tag{12.21}$$

In other words, torque is the product of r with the force component F_t that is *perpendicular* to the radial line. This interpretation makes sense because the radial component of $\vec{F}$ points straight at the pivot point and cannot exert a torque.

FIGURE 12.21 Two useful interpretations of the torque.



Alternatively, FIGURE 12.21b shows that $d = r\sin\phi$ is the distance from the pivot to the **line of action,** the line along which force $\vec{F}$ acts. Thus the torque can also be written

$$|\tau| = dF \tag{12.22}$$

The distance d from the pivot to the line of action is called the **moment arm** (or the *lever arm*), so we can say that the torque is the product of the force and the moment arm. This second perspective on torque is widely used in applications.

NOTE ▶ Equation 12.22 gives only $|\tau|$, the magnitude of the torque; the sign has to be supplied by observing the direction in which the torque acts. ◀