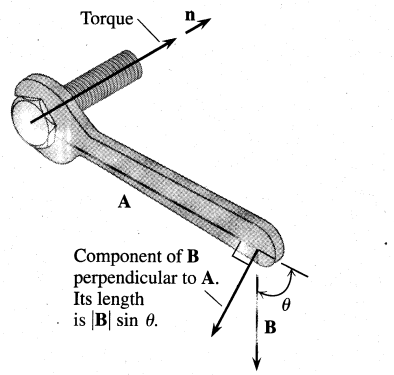
Cross Products



The torque vector describes the tendency of the force **B** to drive the bolt forward.

When we turn a bolt by applying a force to a wrench (see Fig.), the torque we produce acts along the axis of the bolt to drive the bolt forward. The magnitude of the torque depends on how far out on the wrench the force is applied and on how much of the force is perpendicular to the wrench at that point. The number we use to measure the torque's magnitude is the product of the length of the lever arm A and the scalar component of B perpendicular to A. In the notation of Fig.,

$$\text{Magnitude of the torque vector} = |\mathbf{A}||\mathbf{B}|\sin q$$

If we let n be a unit vector along the axis of the bolt in the direction of the torque, then the complete description of the torque vector is

$$\text{Torque vector} = \mathbf{n}|\mathbf{A}||\mathbf{B}|\sin q\ .$$

In mathematics, we call $\mathbf{n}|\mathbf{A}||\mathbf{B}|\sin q$ the vector product of **A** and **B**.

Vector products are widely used to describe the effects of forces in studies of electricity, magnetism, fluid mechanics, and planetary motion. This section presents the mathematical properties of vector products that account for their use in these fields.