

## Chapter 10 Problem 22 †

### Given

$$\tau = 35.0 \text{ N} \cdot \text{m}$$

$$r = 24.0 \text{ cm} = 0.24 \text{ m}$$

### Solution

a) Find the force needed when applied at right angles with the wrench shaft.

From the definition of the magnitude of torque,

$$\tau = rF \sin \theta \tag{1}$$

Solving for force gives

$$F = \frac{\tau}{r \sin \theta} = \frac{(35.0 \text{ N} \cdot \text{m})}{(0.24 \text{ m}) \sin(90^\circ)} = 146 \text{ N}$$

b) Find the force needed when applied at  $110^\circ$  with respect to the wrench shaft.

Using the definition of torque (equation 1) and solving for force gives

$$F = \frac{\tau}{r \sin \theta} = \frac{(35.0 \text{ N} \cdot \text{m})}{(0.24 \text{ m}) \sin(110^\circ)} = 155 \text{ N}$$

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†Problem from Essential University Physics, Wolfson