Chapter 11

4. Two vectors are given by \( \mathbf{A} = -3\mathbf{i} + 7\mathbf{j} - 4\mathbf{k} \) and \( \mathbf{B} = 6\mathbf{i} - 10\mathbf{j} + 9\mathbf{k} \). Evaluate the quantities (a) dot product of \( \mathbf{A} \) and \( \mathbf{B} \), that is, \( \cos^{-1}\left(\frac{\mathbf{A} \cdot \mathbf{B}}{||\mathbf{A}|| \cdot ||\mathbf{B}||}\right) \) and (b) \( \sin^{-1}\left(\frac{||\mathbf{A} \times \mathbf{B}||}{||\mathbf{A}|| \cdot ||\mathbf{B}||}\right) \). (c) Which give(s) the correct angle between the vectors?

12. A 1.5-kg particle moves in the xy plane with a velocity of \( \mathbf{v} = (4.20\mathbf{i} - 3.60\mathbf{j}) \) m/s. Determine the angular momentum of the particle about the origin when its position vector is \( \mathbf{r} = (1.50\mathbf{i} + 2.20\mathbf{j}) \) m.

45. Comet Halley moves about the Sun in an elliptical orbit, with its closest approach to the Sun being about 0.590 AU and its greatest distance 35.0 AU (1 AU – the Earth-Sun distance). The angular momentum of the comet about the Sun is constant, and the gravitational force exerted by the Sun has zero moment arm. The comet’s speed at closest approach is 54.0 km/s. What is its speed when it is farthest from the Sun?

31. A playground merry-go-round of radius \( R = 2.00 \text{ m} \) has a moment of inertia \( I = 250 \text{ kg} \cdot \text{m}^2 \) and is rotating at 10.0 rev/min about a frictionless, vertical axle. Facing the axle, a 25.0-kg child hops onto the merry-go-round and manages to sit down on the edge. What is the new angular speed of the merry-go-round?

Chapter 12

3. A carpenter’s square has the shape of an L as shown in the figure below. Locate its center of gravity.

9. Find the mass \( m \) of the counterweight needed to balance a truck with mass \( M = 1500 \text{ kg} \) on an incline of \( \theta = 45^\circ \) (figure below). Assume both pulleys are frictionless and massless.
27. A 200-kg load is hung on a wire of length 4.00 m, cross-sectional area $0.2000 \times 10^{-4}$ m$^2$, and Young’s modulus $8.00 \times 10^{10}$ N/m$^2$. What is its increase in length?