

### 12.1 DESCRIBING ANGULAR MOTION

1. The following angles are given in degrees. Convert them to radians:  $45^\circ$ ,  $180^\circ$ .
2. The following angles are given in radians. Convert them to degrees:  $0.70 \text{ rad}$ ,  $5\pi \text{ rad}$ .
3. A CD at  $22.0 \text{ rad/s}$ . What is the angular speed in revolutions per minute (rpm)?
4. A ceiling fan rotates at the rate of  $45^\circ$  every  $0.75 \text{ s}$ . What is the angular speed of the fan in radians per second?
5. How much time does it take for a spinning baseball with an angular speed of  $38 \text{ rad/s}$  to rotate through  $15^\circ$ ?
6. The hour hand on a certain clock is  $8.2 \text{ cm}$  long. Find the tangential speed of the tip of this hand during normal operation.
7. The wheels of a car speed up from  $5.2 \text{ rad/s}$  to  $7.9 \text{ rad/s}$  in  $1.3 \text{ s}$ . What is the angular acceleration of the wheels?
8. A bicycle wheel with a radius of  $0.31 \text{ m}$  rotates with an angular speed of  $21 \text{ rad/s}$  about its axle, which is at rest. What is the linear speed of a point on the rim of the wheel?
9. A propeller on a ship has an initial angular velocity of  $5.1 \text{ rad/s}$  and an angular acceleration of  $1.6 \text{ rad/s}^2$ . What is the angular velocity of the propeller after  $3.0 \text{ s}$ ?

### 12.2 ROLLING MOTION AND THE MOMENT OF INERTIA

10. As a car travels along a road, the speed of the tops of its wheels is  $46 \text{ m/s}$ . What is the speed of the car and its occupants?
11. A soccer ball, which has a circumference of  $70.0 \text{ cm}$ , rolls  $14.0 \text{ m}$  in  $3.35 \text{ s}$ . What is the average angular speed of the ball during this time?
12. A basketball has a radius of  $0.12 \text{ m}$  and a mass of  $0.57 \text{ kg}$ . Assuming the ball to be a hollow sphere, what is its moment of inertia?
13. An electric fan spinning with an angular speed of  $13 \text{ rad/s}$  has a kinetic energy of  $4.6 \text{ J}$ . What is the moment of inertia of the fan?
14. A chef spins a disk of pizza dough over her head, giving it an angular speed of  $7.2 \text{ rad/s}$ . If the moment of inertia of the pizza dough is  $6.3 \times 10^{-6} \text{ kg}\cdot\text{m}^2$ , what is its rotational kinetic energy? (Assume that the disk of dough is uniform.)
15. The moment of inertia of a ball is  $1.6 \times 10^{-8} \text{ kg}\cdot\text{m}^2$ . If the ball spins with an angular speed of  $8.2 \text{ rad/s}$ , what is its angular momentum?

### 12.3 TORQUE

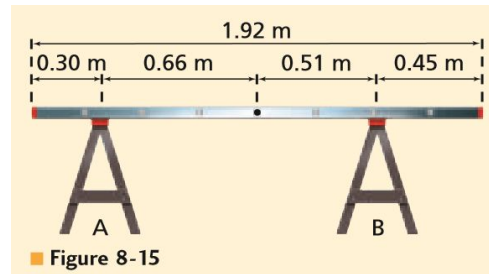
16. A force of  $5.5 \text{ N}$  is applied to an object. The moment arm for the force is  $0.84 \text{ m}$ . What is the torque produced by the force?
17. A force of  $8.8 \text{ N}$  pushes on the rim of a wheel of radius  $0.41 \text{ m}$ . **(a)** What is the maximum torque the force can produce? **(b)** If the direction of the force is at an angle of  $22^\circ$  relative to the radial direction, then what is the resulting torque on the wheel?

18. To tighten a spark plug, it is recommended that a torque of 15 N·m be applied. If a mechanic tightens the spark plug with a wrench that is 25 cm long, what is the force necessary to create the desired torque?
19. A torque of 7.4 N·m is applied to a wheel with a moment of inertia of 0.092 kg·m<sup>2</sup>. What is the resulting angular acceleration?
20. A ceiling fan has an angular acceleration of 62 rad/s<sup>2</sup> when acted on by a torque of 8.3 N·m. What is the moment of inertia of the fan?
21. A torque of 0.97 N·m is applied to a bicycle wheel of radius 35 cm and mass 0.75 kg. Treating the wheel as a hoop, find its angular acceleration.
22. What torque is required to give a disk of mass 6.1 kg and radius 0.58 m an angular acceleration of 17 rad/s<sup>2</sup>?

**12.4 STATIC EQUILIBRIUM**

23. A lightweight plastic rod has a mass of 1.0 kg attached to one end and a mass of 1.5 kg attached to the other end. The rod has a length of 0.80 m. How far from the 1.0 kg mass should a string be attached to balance the rod?
24. A 0.34 kg meter stick balances at its center. If a student ID lanyard is suspended from one end of the stick the balance point moves 9.5 cm toward that end. What is the mass of the lanyard?
25. A lightweight wooden stick has a length of 0.90 m. A 0.75 kg weight is attached to the left end of the stick and an unknown mass  $m$  is attached to the right end of the stick. When it is suspended from a string it balances at a point 25 cm from its left end. **(a)** Is the mass  $m$  greater than, less than, or equal to 0.75 kg? Explain. **(b)** Determine the mass  $m$ .

26. A 7.3-kg ladder, 1.92 m long, rests on two sawhorses, as shown in **Figure 8-15**. Sawhorse A, on the left, is located 0.30 m from the end, and sawhorse B, on the right, is located 0.45 m from the other end. What force does each sawhorse exert on the ladder?



27. A banner is suspended from a horizontal, pivoted pole, as shown in **Figure 8-30**. The pole is 2.10 m long and weighs 175 N. The banner, which weighs 105 N, is suspended 1.80 m from the pivot point or axis of rotation. What is the tension in the cable supporting the pole?

