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UNIT 12 PRACTICE PROBLEMS AP PHYSICS

12.1 DESCRIBING ANGULAR MOTION

CHECKING CONCEPTS

1. You observe the wheels of a car as it moves past you from right to left. Do the wheels have a positive or a negative angular velocity? Explain.
2. Is the angular speed of the hour hand of a clock greater than, less than, or equal to the angular speed of the minute hand? Explain.

SOLVING PROBLEMS

3. Through how many radians does the minute hand of a clock rotate in 15 min.?
4. Find the angular speed of the Earth as it orbits about the Sun. Give your answer in radians per second (rad/s).
5. A bicycle wheel with a radius of 0.31 m rotates with an angular speed of 21 rad/s about its axle, which is at rest. What is the linear speed of a point on the rim of the wheel?
6. A propeller on a ship has an initial angular velocity of 5.1 rad/s and an angular acceleration of 1.6 rad/s2. What is the angular velocity of the propeller after 3.0 s?
7. The angular speed of a propeller on a boat increases with constant acceleration from 12 rad/s to 26 rad/s in 2.5 revolutions. What is the angular acceleration of the propeller?
8. The angular speed of a propeller on a boat increases with constant acceleration from 12 rad/s to 26 rad/s in 2.5 seconds. Through what angle did the propeller turn during this time?
9. The drill used by most dentists today is powered by a small air-turbine that can operate at angular speeds of 350,000 rpm. These drills, along with ultrasonic dental drills, are the fastest turbines in the world—far exceeding the angular speeds of jet engines. Suppose a drill starts at rest and comes up to operating speed in 2.1 s. **(a)** Find the angular acceleration produced by the drill, assuming it to be constant. **(b)** How many revolutions does the drill bit make as it comes up to speed?

12.2 ROLLING MOTION AND THE MOMENT OF INERTIA

CHECKING CONCEPTS

10. How will doubling the mass of an object affect its moment of inertia? Explain.
11. A hoop and a disk have the same mass and radius. In addition, they both spin about their centers with the same angular speed. Is the kinetic energy of the hoop greater than, less than, or equal to the kinetic energy of the disk? Explain.

SOLVING PROBLEMS

12. As a car travels along a road, the speed of the tops of its wheels is 46 m/s. What is the speed of the car and its occupants?

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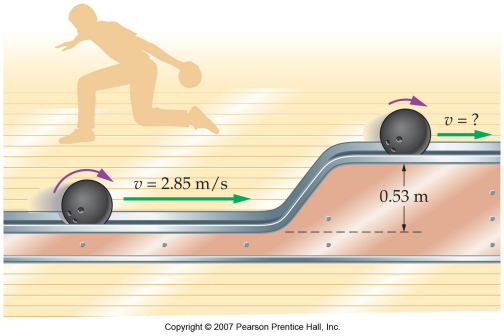
13. A basketball has a radius of 0.12 m and a mass of 0.57 kg. Assuming the ball to be a hollow sphere, what is its moment of inertia?
14. A chef spins a disk of pizza dough over her head, giving it an angular speed of 7.2 rad/s. If the moment of inertia of the pizza dough is 6.3×10^{-6} kg·m^2, what is its rotational kinetic energy? (Assume that the disk of dough is uniform.)
15. The moment of inertia of a ball is 1.6×10^{-8} kg·m^2. If the ball spins with an angular speed of 8.2 rad/s, what is its angular momentum?
16. A torque of 0.12 N·m is applied to an egg beater. **(a)** If the egg beater starts at rest, what is its angular momentum after 0.50 s? **(b)** If the moment of inertia of the egg beater is 2.5×10^{-3} kg·m^2, what is its angular speed after 0.50 s?
17. After you pick up a spare, your bowling ball rolls without slipping back toward the ball rack with a linear speed of 2.85 m/s (**See Figure**). To reach the rack, the ball rolls up a ramp that rises through a vertical distance of 0.53 m. **(a)** What is the linear speed of the ball when it reaches the top of the ramp? **(b)** If the radius of the ball were increased, would the speed found in part (a) increase, decrease, or stay the same? Explain.



12.3 TORQUE

CHECKING CONCEPTS

18. Explain how force and torque differ.
19. A classmate states that two forces of equal magnitude must produce equal torques. Is the classmate correct? Explain why or why not.

SOLVING PROBLEMS

20. A force of 5.5 N is applied to an object. The moment arm for the force is 0.84 m. What is the torque produced by the force?
21. A torque of 7.4 N·m is applied to a wheel with a moment of inertia of 0.092 kg·cm^2. What is the resulting angular acceleration?
22. A ceiling fan has an angular acceleration of 62 rad/s^2 when acted on by a torque of 8.3 N·m. What is the moment of inertia of the fan?
23. 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^2?

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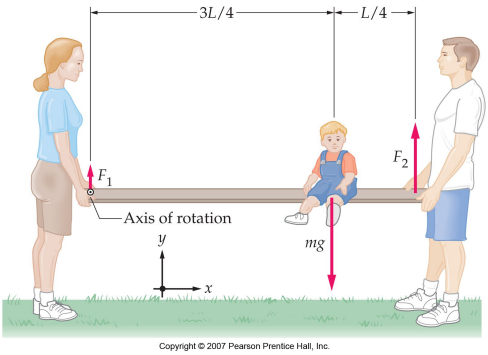
12.4 STATIC EQUILIBRIUM

CHECKING CONCEPTS

24. What can you say about a system that **(a)** has no linear acceleration and **(b)** has no angular acceleration.
25. Why does an object balance at its center of mass?

SOLVING PROBLEMS

26. If the two parents in the figure exert upward forces of 18 N on the left end of the plank and 71 N on the right end, **(a)** how much does the child weigh? **(b)** How far is the child from the left end of the plank? The plank has a length of 2.2 m.



27. Two students sit on either side of a teeter-totter that is 2.8 m in length. The teeter-totter balances when the student on the left side is 1.1 m from the center and the student on the right is 1.4 m from the center. The total mass of the two students is 84 kg. What is the mass of the student on the left side of the teeter-totter? (Assume that the teeter-totter itself pivots at the center and produces zero torque.)
28. A pivoted lamp pole is shown in **Figure 8-31**. The pole weighs 27 N, and the lamp weighs 64 N. Determine the tension in the rope supporting the lamp pole.

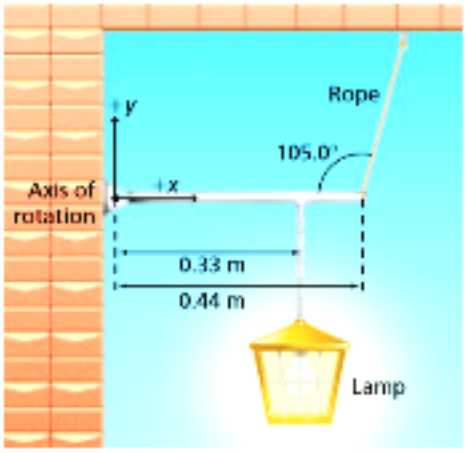


Figure 8-31