Rotational Dynamics

Solve the following problems

1. (Walker, p. 303, # 46) The moment of inertia of a 0.98-kg bicycle wheel rotating about its center is $0.13\ \text{kg} \cdot \text{m}^2$. What is the radius of this wheel, assuming the weight of the spokes can be ignored?

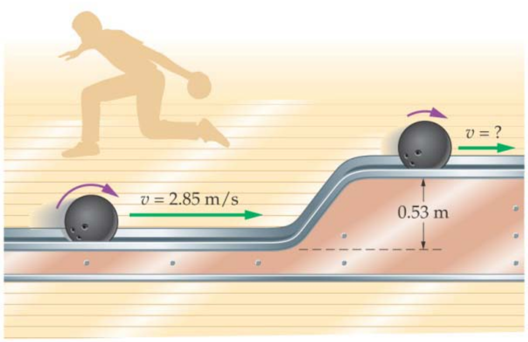
2. (Walker, p. 303, #48) An electric fan spinning with an angular speed of 13 rad/s has a kinetic energy of 4.6 J. What is the moment of inertia of the fan?

3. (Walker, p. 303, #50) 12-g CD with a radius of 6.0 cm rotates with an angular speed of 34 rad/s. **(a)** What is its kinetic energy? **(b)** What angular speed must the CD have if its kinetic energy is to be doubled?

4. (Walker, p. 303, #54) A lawn mower has a flat, rod-shaped steel blade that rotates about its center. The mass of the blade is 0.58 kg and its length is 0.56 m. **(a)** What is the rotational energy of the blade at its operating angular speed of 3500 rpm? **(b)** If all of the rotational kinetic energy of the blade could be converted to gravitational potential energy, to what height would the blade rise?

5. (Walker, p. 344, #39) A 2.85-kg bucket is attached to a disk-shaped pulley of radius 0.121 m and mass 0.742 kg. If the bucket is allowed to fall, **(a)** what is its linear acceleration? **(b)** What is the angular acceleration of the pulley? **(c)** How far does the bucket drop in 1.50 s?

6. (Walker, p. 303, #60) 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 (**Figure 10–24**). 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



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7. (Walker, p. 344, #41) A child exerts a tangential 40.0-N force on the rim of a disk-shaped merry-go-round with a radius of 2.40 m. If the merry-go-round starts at rest and acquires an angular speed of 0.0870 rev/s in 3.50 s, what is its mass?

8. (Walker, p. 344, #46) Calculate the angular momentum of the Earth about its own axis, due to its daily rotation. Assume that the Earth is a uniform sphere.

9. (Walker, p. 344, #47) A 0.015-kg record with a radius of 15 cm rotates with an angular speed of 33 1/3 rpm. Find the angular momentum of the record.

10. (Walker, p. 344, #48) In the previous problem, a 1.1-g fly lands on the rim of the record. What is the fly's angular momentum?

11. (Walker, p. 344, #55) As an ice skater begins a spin, his angular speed is 3.17 rad/s. After pulling in his arms, his angular speed increases to 5.46 rad/s. Find the ratio of the skater's final moment of inertia to his initial moment of inertia.

12. (Walker, p. 344, #61) A student sits at rest on a piano stool that can rotate without friction. The moment of inertia of the student-stool system is $4.1\ \text{kg} \cdot \text{m}^2$. A second student tosses a 1.5-kg mass with a speed of 2.7 m/s to the student on the stool, who catches it at a distance of 0.40 m from the axis of rotation. What is the resulting angular speed of the student and the stool?

13. (Walker, p. 344, #64) A student on a piano stool rotates freely with an angular speed of 2.95 rev/s. The student holds a 1.25-kg mass in each outstretched arm, 0.759 m from the axis of rotation. The combined moment of inertia of the student and the stool, ignoring the two masses, is $5.43\ \text{kg} \cdot \text{m}^2$, a value that remains constant. **(a)** As the student pulls his arms inward, his angular speed increases to 3.54 rev/s. How far are the masses from the axis of rotation at this time, considering the masses to be points? **(b)** Calculate the initial and final kinetic energy of the system.

14. (Walker, p. 344, #66) How much work must be done to accelerate a baton from rest to an angular speed of 7.4 rad/s about its center. Consider the baton to be a uniform rod of length 0.53 m and mass 0.44 kg.

15. (Walker, p. 344, #67) Turning a doorknob through 1/4 of a revolution requires 0.14 J of work. What is the torque required to turn the doorknob?

16. (Walker, p. 344, #68) A person exerts a tangential force of 36.1 N on the rim of a disk-shaped merry-go-round of radius 2.74 m and mass 167 kg. If the merry-go-round starts at rest, what is its angular speed after the person has rotated it through an angle of 32.5°?

17. (Walker, p. 344, #69) To prepare homemade ice cream a crank must be turned with a torque of 3.95Nm How much work is required for each complete turn of the crank?