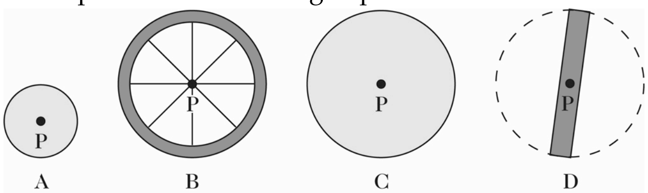
1) A car is traveling along a freeway at 65 mph. What is the linear speed, relative to the highway, of each of the following points on one of its tires?
(a) the highest point on the tire
(b) the lowest point on a tire
(c) the center of the tire

2) The figure shows scale drawings of four objects, each of the same mass and uniform thickness, with the mass distributed uniformly. Which one has the greatest moment of inertia when rotated about an axis perpendicular to the plane of the drawing at point P?



A) A
B) B
C) C
D) D
E) All are the same

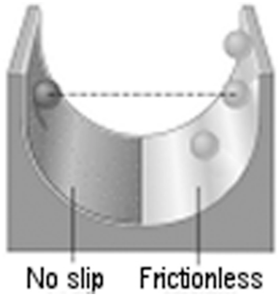
3) Consider a uniform hoop of radius R and mass M rolling without slipping. Which is larger, its translational kinetic energy or its rotational kinetic energy?
A) Rotational kinetic energy is larger.
B) Both are equal.
C) Translational kinetic energy is larger.
D) You need to know the speed of the hoop to tell.

4) Consider a solid uniform sphere of radius R and mass M rolling without slipping. Which form of its kinetic energy is larger, translational or rotational?
A) Both are equal.
B) Translational kinetic energy is larger.
C) Rotational kinetic energy is larger.
D) You need to know the speed of the sphere to tell.

5) A disk, a hoop, and a solid sphere are released at the same time at the top of an inclined plane. They are all uniform and roll without slipping. In what order do they reach the bottom?
A) sphere, hoop, disk
B) hoop, disk, sphere
C) hoop, sphere, disk
D) sphere, disk, hoop
E) disk, hoop, sphere

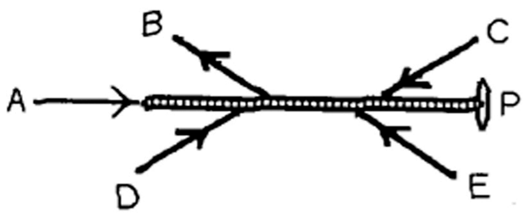
6) Suppose a uniform solid sphere of mass M and radius R rolls without slipping down an inclined plane starting from rest. The linear velocity of the sphere at the bottom of the incline depends on
A) the mass of the sphere.
B) the radius of the sphere.
C) both the mass and the radius of the sphere.
D) neither the mass nor the radius of the sphere.

7) A uniform ball is released from rest on a no–slip surface, as shown in the figure. After reaching its lowest point, the ball begins to rise again, this time on a frictionless surface. When the ball reaches its maximum height on the frictionless surface, it is



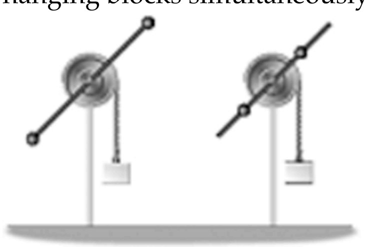
A) lower than when it was released.
B) at the same height from which it was released.
C) higher than when it was released.
D) It is impossible to tell without knowing the mass of the ball.
E) It is impossible to tell without knowing the radius of the ball.

8) Five forces act on a rod that is free to pivot at point P, as shown in the figure. Which of these forces is producing a counter–clockwise torque about point P? (There could be more than one correct choice.)



A) force A B) force B C) force C D) force D E) force E

9) The rotating systems shown in the figure differ only in that the two identical movable masses are positioned a distance r from the axis of rotation (left), or a distance $r/2$ from the axis of rotation (right). If you release the hanging blocks simultaneously from rest,



A) the block at the right lands first.
B) the block at the left lands first.
C) both blocks land at the same time.

10) A merry–go–round spins freely when Diego moves quickly to the center along a radius of the merry–go–round. As he does this, it is true to say that
A) the moment of inertia of the system increases and the angular speed decreases.
B) the moment of inertia of the system decreases and the angular speed decreases.
C) the moment of inertia of the system increases and the angular speed increases.
D) the moment of inertia of the system decreases and the angular speed remains the same.
E) the moment of inertia of the system decreases and the angular speed increases.

11) When is the angular momentum of a system constant?
A) Only when its total kinetic energy is constant.
B) Only when the linear momentum and the energy are constant.
C) Only when no net external torque acts on the system.
D) Only when no net external force acts on the system.
E) Only when the moment of inertia is constant.

12) As you are leaving a building, the door opens outward. If the hinges on the door are on your right, what is the direction of the angular velocity of the door as you open it?
A) forwards
B) to your left
C) up
D) down
E) to your right

13) When you ride a bicycle, in what direction is the angular velocity of the wheels?
A) to your left
B) forwards
C) up
D) to your right
E) backwards

14) The diameter of the Moon is 3.47×10^6 m, and it subtends an angle of 0.00904 rad when viewed from the surface of Earth. How far is the Moon from Earth?

15) What is the angular speed, in rad/s, of a flywheel turning at 813.0 rpm?

16) When a fan is turned off, its angular speed decreases from 10 rad/s to 6.3 rad/s in 5.0 s. What is the magnitude of the average angular acceleration of the fan?

17) A child is riding a merry-go-round that is turning at 7.18 rpm. If the child is standing 4.65 m from the center of the merry-go-round, how fast is the child moving?

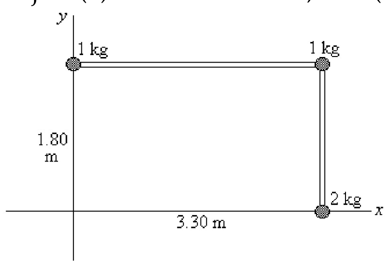
18) A scooter has wheels with a diameter of 120 mm. What is the angular speed of the wheels when the scooter is moving forward at 6.00 m/s?

19) A wheel accelerates with a constant angular acceleration of 4.5 rad/s^2 from an initial angular speed of 1.0 rad/s. (a) Through what angle does the wheel turn in the first 2.0 s, and (b) what is its angular speed at that time?

20) How long does it take for a rotating object to speed up from 15.0 rad/s to 33.3 rad/s if it has a uniform angular acceleration of 3.45 rad/s^2?

21) To drive a typical car at 40 mph on a level road for one hour requires about 3.2×10^7 J of energy. Suppose we tried to store this much energy in a spinning, solid, uniform, cylindrical flywheel. A large flywheel cannot be spun too fast or it will fracture. If we used a flywheel of diameter 1.2 m and mass 400 kg, what angular speed would be required to store 3.2×10^7 J?

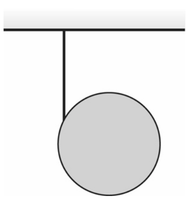
22) The L–shaped object shown in the figure consists of three small masses connected by extremely light rods. Assume that the masses shown are accurate to three significant figures. What is the moment of inertia of this object (a) about the x–axis, and (b) about the y–axis?



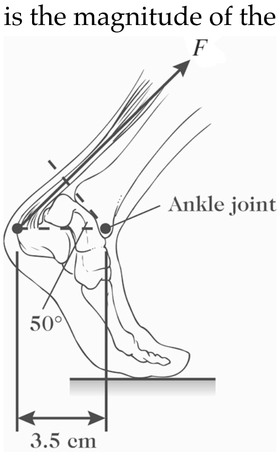
23) A small ball is tied to one end of a light 2.5–m wire, and the other end of the wire is hooked to the ceiling. A person pulls the ball to the side until the wire makes an angle of 35° with the plane of the ceiling and then gently releases it. What is the angular speed of the ball, in rad/s, as it swings through its lowest point?

24) A hoop with a mass of 2.75 kg is rolling without slipping along a horizontal surface with a speed of 4.5 m/s when it starts down a ramp that makes an angle of 25° below the horizontal. What is the forward speed of the hoop after it has rolled 3.0 m down as measured along the surface of the ramp?

25) A solid uniform 3.33–kg disk has thin string of negligible mass wrapped around its rim, with one end of the string tied to the ceiling, as shown in the figure. The disk is released from rest, and as it falls, it turns as the string unwraps. At the instant its center has fallen 2.25 m, (a) how fast is the center moving, and (b) how much rotational kinetic energy does the disk have?

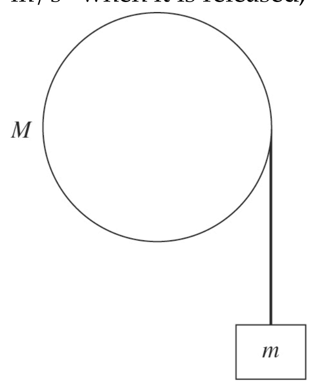


26) The figure shows a person's foot. In that figure, the Achilles tendon exerts a force of magnitude $F = 720$ N. What is the magnitude of the torque that this force produces about the ankle joint?



27) A mechanic is examining the wheel of a bicycle to adjust the brake. With the bicycle off the ground, he manually rotates the wheel until it reaches an angular speed of 12.0 rad/s and then allows it to coast to a stop. If the wheel has a moment of inertia of $0.100\ \text{kg} \cdot \text{m}^2$, and the wheel slows uniformly to a stop in 160 s, what is the magnitude of the retarding torque?

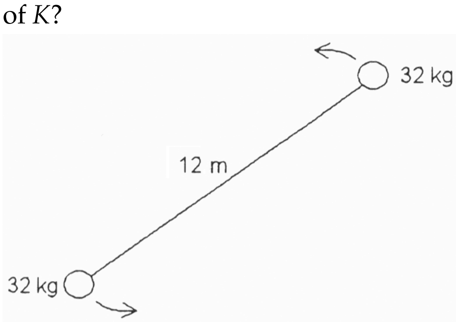
28) A cinder block of mass $m = 4.0$ kg is hung from a nylon string that is wrapped around a frictionless pulley having the shape of a cylindrical shell, as shown in the figure. If the cinder block accelerates downward at 4.90 m/s^2 when it is released, what is the mass M of the pulley?



29) A ballerina spins initially at 1.5 rev/s when her arms are extended. She then draws in her arms to her body and her moment of inertia becomes 0.88 kg • m^2, and her angular speed increases to 4.0 rev/s. What was her initial moment of inertia?

30) A 40.0-kg child running at 3.00 m/s suddenly jumps onto a stationary playground merry-go-round at a distance 1.50 m from the axis of rotation of the merry-go-round. The child is traveling tangential to the edge of the merry-go-round just before jumping on. The moment of inertia about its axis of rotation is 600 kg • m^2 and very little friction at its rotation axis. What is the angular speed of the merry-go-round just after the child has jumped onto it?

31) NASA puts a satellite into space that consists of two small 32-kg balls connected by a 12-m long light cable, as shown in the figure. The entire system is initially rotating at 4.0 rpm about an axis perpendicular to the cable at the center of mass. Motors in each mass reel out more cable so that the masses double their separation to 24 m.
(a) What is the final rotational speed (in rpm) of the balls?
(b) If the initial rotational kinetic energy of the system was K, what is the final rotational kinetic energy in terms of K?



Answer Key
Testname: HW_CH08_ROTATIONAL_DYNAMICS

1) (a) 130 mph (b) 0 mps (c) 65 mph
2) B
3) B
4) B
5) D
6) D
7) A
8) C
9) A
10) E
11) C
12) D
13) A
14) 3.84×10^8 m
15) 85.14 rad/s
16) 0.74 rad/s^2
17) 3.50 m/s
18) 955 rpm
19) (a) 11 rad (b) 10 rad/s
20) 5.30 s
21) 940 rad/s
22) (a) 6.48 kg • m^2 (b) 32.7 kg • m^2
23) 1.8 rad/s
24) 5.7 m/s
25) (a) 5.42 m/s (b) 24.5 J
26) 16 N • m
27) 0.00750 N • m
28) 8.0 kg
29) 2.3 kg • m^2
30) 0.261 rad/s
31) (a) 1.0 rpm (b) $K/4$