1. For a wheel spinning with constant angular acceleration on an axis through its center, the ratio of the speed of a point on the rim to the speed of a point halfway between the center and the rim is:
A) 1
B) 2
C) $1 / 2$
D) 4
E) $1 / 4$
2. The acceleration of a point on a spinning wheel is increased by a factor of 4 if:
A) the angular velocity and the angular acceleration are each increased by a factor of 4
B) the angular velocity is increased by a factor of 4 and the angular acceleration is not changed
C) the angular velocity and the angular acceleration are each increased by a factor of 2
D) the angular velocity is increased by a factor of 2 and the angular acceleration is not changed
E) the angular velocity is increased by a factor of 2 and the angular acceleration is increased by a factor of 4
3. Three identical objects, each of mass $M$, are fastened to a massless rod of length $L$ as shown. The rotational inertia about one end of the rod of this array is:

A) $M L^{2 / 2}$
B) $M L^{2}$
C) $3 M L^{2 / 2}$
D) $5 M L^{2 / 4}$
E) $3 M L^{2}$
4. The rotational inertia of a disk about its axis is $0.70 \mathrm{~kg} \cdot \mathrm{~m}^{2}$. When a 2.0 kg weight is added to its rim, 0.40 m from the axis, the rotational inertia becomes:
A) $0.38 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
B) $0.54 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
C) $0.70 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
D) $0.86 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
E) $1.0 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
5. A solid uniform sphere of radius $R$ and mass $M$ has a rotational inertia about a diameter that is given by $(2 / 5) M R^{2}$. A light string of length $2 R$ is attached to the surface and used to suspend the sphere from the ceiling. Its rotational inertia about the point of attachment at the ceiling is:
A) $(2 / 5) M R^{2}$
B) $4 M R^{2}$
C) $(7 / 5) M R^{2}$
D) $(22 / 5) M R^{2}$
E) $(47 / 5) M R^{2}$
6. A cylinder is 0.10 m in radius and 0.20 in length. Its rotational inertia, about the cylinder axis on which it is mounted, is $0.020 \mathrm{~kg} \cdot \mathrm{~m}^{2}$. A string is wound around the cylinder and pulled with a force of 1.0 N . The angular acceleration of the cylinder is:
A) $2.5 \mathrm{rad} / \mathrm{s}^{2}$
B) $5.0 \mathrm{rad} / \mathrm{s}^{2}$
C) $10 \mathrm{rad} / \mathrm{s}^{2}$
D) $15 \mathrm{rad} / \mathrm{s}^{2}$
E) $20 \mathrm{rad} / \mathrm{s}^{2}$
7. A disk with a rotational inertia of $5.0 \mathrm{~kg} \cdot \mathrm{~m}^{2}$ and a radius of 0.25 m rotates on a frictionless fixed axis perpendicular to the disk and through its center. A force of 8.0 N is applied tangentially to the rim. If the disk starts at rest, then after it has turned through half a revolution its angular velocity is:
A) $0.57 \mathrm{rad} / \mathrm{s}$
B) $0.64 \mathrm{rad} / \mathrm{s}$
C) $0.80 \mathrm{rad} / \mathrm{s}$
D) $1.6 \mathrm{rad} / \mathrm{s}$
E) $3.2 \mathrm{rad} / \mathrm{s}$
8. A thin circular hoop of mass 1.0 kg and radius 2.0 m is rotating about an axis through its center and perpendicular to its plane. It is slowing down at the rate of $7.0 \mathrm{rad} / \mathrm{s}^{2}$. The net torque acting on it is:
A) $7.0 \mathrm{~N} \cdot \mathrm{~m}$
B) $14.0 \mathrm{~N} \cdot \mathrm{~m}$
C) $28.0 \mathrm{~N} \cdot \mathrm{~m}$
D) $44.0 \mathrm{~N} \cdot \mathrm{~m}$
E) none of these
9. A wheel initially has an angular velocity of $18 \mathrm{rad} / \mathrm{s}$ but it is slowing at a rate of 2.0 $\mathrm{rad} / \mathrm{s}^{2}$. The time it takes to stop is:
A) 3.0 s
B) 6.0 s
C) 9.0 s
D) 12 s
E) never stops
10. A child, riding on a large merry-go-round, travels a distance of 3000 m in a circle of diameter 40 m . The total angle in radians through which she revolves is:
A) 50
B) 75
C) 150
D) 314
E) none of these
11. A wheel of diameter 3.0 cm has a 4.0 m cord wrapped around its periphery. Starting from rest, the wheel is given a constant angular acceleration of $2 \mathrm{rad} / \mathrm{s}^{2}$. The cord will unwind in:
A) 0.82 s
B) 2.0 s
C) 8.0 s
D) 16 s
E) 130 s
12. A massless frame in the shape of a square with $2-\mathrm{m}$ sides has a $1-\mathrm{kg}$ ball at each corner. What is the moment of inertia of the four balls about an axis through the corner marked $O$ and perpendicular to the plane of the paper?

A) $4 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
B) $8 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
C) $10 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
D) $12 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
E) $16 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
13. A certain merry-go-round is accelerated uniformly from rest and attains an angular speed of $0.4 \mathrm{rad} / \mathrm{s}$ in the first 10 seconds. If the net applied torque is $2000 \mathrm{~N} \cdot \mathrm{~m}$, what is the moment of inertia of the merry-go-round?
A) $400 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
B) $800 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
C) $5000 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
D) $50000 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
E) This cannot be determined since the radius is not specified.
14. Three objects are attached to a massless rigid rod that has an axis of rotation as shown. Assuming all of the mass of each object is located at the point shown for each, calculate the moment of inertia of this system.

A) $1.3 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
B) $3.1 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
C) $5.3 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
D) $7.2 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
E) $9.1 \mathrm{~kg} \cdot \mathrm{~m}^{2}$
15. A $45-\mathrm{N}$ brick is suspended by a light string from a $2.0-\mathrm{kg}$ pulley. The brick is released from rest and falls to the floor below as the pulley rotates through 5.0 rad. The pulley may be considered a solid disk of radius 1.5 m . What is the angular speed of the pulley?

A) $7.3 \mathrm{rad} / \mathrm{s}$
B) $8.1 \mathrm{rad} / \mathrm{s}$
C) $9.4 \mathrm{rad} / \mathrm{s}$
D) $15 \mathrm{rad} / \mathrm{s}$
E) $19 \mathrm{rad} / \mathrm{s}$
16. A fan rotating with an initial angular velocity of $1000 \mathrm{rev} / \mathrm{min}$ is switched off. In 2 seconds, the angular velocity decreases to $200 \mathrm{rev} / \mathrm{min}$. Assuming the angular acceleration is constant, how many revolutions does the blade undergo during this time?
A) 10
B) 20
C) 100
D) 125
E) 1200
17. A wheel turns through an angle of 188 radians in 8.0 s ; and its angular speed at the end of the period is $40 \mathrm{rad} / \mathrm{s}$. If the angular acceleration is constant, what was the angular speed of the wheel at the beginning of the 8.0 s interval?
A) $4.8 \mathrm{rad} / \mathrm{s}$
B) $7.0 \mathrm{rad} / \mathrm{s}$
C) $9.1 \mathrm{rad} / \mathrm{s}$
D) $23.5 \mathrm{rad} / \mathrm{s}$
E) $32.5 \mathrm{rad} / \mathrm{s}$

Use the following to answer questions 19-20:
A bicycle wheel of radius 0.70 m is rolling without slipping on a horizontal surface with an angular speed of $2.0 \mathrm{rev} / \mathrm{s}$ when the cyclist begins to uniformly apply the brakes. The bicycle stops in 5.0 s .
18. Through how many revolutions did the wheel turn during the 5.0 seconds of braking?
A) 10 rev
B) 2.0 rev
C) 9.6 rev
D) 5.0 rev
E) 0.4 rev
19. How far did the bicycle travel during the 5.0 seconds of braking?
A) 1.8 m
B) 8.8 m
C) 22 m
D) 42 m
E) 44 m

## Answer Key

1. B
2. E
3. D
4. E
5. E
6. B
7. D
8. C
9. C
10. C
11. D
12. E
13. D
14. E
15. A
16. B
17. B
18. D
19. C
