Webreview - 8.2 Torque and Rotation Practice Test

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. A 0.30-m-radius automobile tire rotates how many rad after starting from rest and accelerating at a constant 2.0 rad/s^2 over a 5.0-s interval?
a. 12.5 rad
b. 25 rad
c. 2.0 rad
d. 0.50 rad
e. 0.25 rad

____ 2. A fan blade, initially at rest, rotates with a constant acceleration of 0.025 rad/s^2. What is its angular speed at the instant it goes through an angular displacement of 4.2 rad?
a. 0.025 rad/s
b. 0.11 rad/s
c. 0.46 rad/s
d. 1.2 rad/s
e. 1.4 rad/s

____ 3. A ventilation fan has blades 0.25 m in radius rotating at 20 rpm. What is the tangential speed of each blade tip?
a. 0.02 m/s
b. 0.52 m/s
c. 5.0 m/s
d. 20 m/s
e. 23 m/s

____ 4. What centripetal force does an 80-kg passenger experience when seated 12 m from the center of a Ferris wheel whose angular speed is 0.50 rad/s?
a. 484 N
b. 720 N
c. 914 N
d. 240 N
e. 180 N

____ 5. At what angle (relative to the horizontal) should a curve 52 m in radius be banked if no friction is required to prevent the car from slipping when traveling at 12 m/s? (g = 9.8 m/s^2)
a. 28°
b. 32°
c. 16°
d. 10°
e. 8.2°

____ 6. Consider a point on a bicycle tire that is momentarily in contact with the ground as the bicycle rolls across the ground with constant speed. The direction for the acceleration for this point at that moment is:
   a. upward.
   b. down toward the ground.
   c. forward.
   d. at that moment the acceleration is zero.
   e. none of the above.

____ 7. If a planet has a radius 20% greater than that of the Earth but has the same mass as the Earth, what is the acceleration due to gravity at its surface?
   a. 14 m/s^2
   b. 12 m/s^2
   c. 8.2 m/s^2
   d. 6.8 m/s^2
   e. 5.3 m/s^2

____ 8. An object when orbiting the Earth at a height of three Earth radii from the center of the Earth has a weight of 1.00 N. What is the object's mass? (g at the surface of the Earth is 9.8 m/s^2)
   a. 0.102 kg
   b. 0.306 kg
   c. 0.92 kg
   d. 1.0 kg
   e. 1.4 kg

____ 9. A satellite is in a circular orbit about the Earth at a distance of one Earth radius above the surface. What is the speed of the satellite? (The radius of the Earth is 6.4×10^6 m, and $G = 6.67 \times 10^{-11}$ N · m^2/kg^2.)
   a. 2 800 m/s
   b. 4 200 m/s
   c. 5 600 m/s
   d. 16 800 m/s
   e. 19 500 m/s

____ 10. A 3.0-m rod is pivoted about its left end. A force of 6.0 N is applied perpendicular to the rod at a distance of 1.2 m from the pivot causing a ccw torque, and a force of 5.2 N is applied at the end of the rod 3.0 m from the pivot. The 5.2 N is at an angle of 30^o to the rod and causes a cw torque. What is the net torque about the pivot?
   a. 15 N□m
   b. 0 N□m
   c. -6.3 N□m
   d. -0.6 N□m
   e. 6.3 N□m

____ 11. A rod of length L is pivoted about its left end and has a force F applied perpendicular to the other end. The force F is now removed and another force F' is applied at the midpoint of the rod. If F' is at an angle of 30° with respect to the rod, what is its magnitude if the resulting torque is the same as when F was applied?
a. F
b. 2F
c. 3F
d. 4F
e. 5F

____ 12. A disk has a moment of inertia of 3.0×10^{-4} kg·m^2 and rotates with an angular speed of 3.5 rad/sec. What net torque must be applied to bring it to rest within 3 s?
a. 4.5×10^{-3} N·m
b. 7.5×10^{-4} N·m
c. 3.5×10^{-4} N·m
d. 5.0×10^{-4} N·m
e. 2.5×10^{-4} N·m

____ 13. A bowling ball has a mass of 7.0 kg, a moment of inertia of 2.8×10^{-2} kg·m^2 and a radius of 0.10 m. If it rolls down the lane without slipping at a linear speed of 4.0 m/s, what is its angular speed?
a. 0.80 rad/s
b. 10 rad/s
c. 0.050 rad/s
d. 40 rad/s
e. 4 rad/s

____ 14. A solid cylinder ($I = MR^2/2$) has a string wrapped around it many times. When I release the cylinder, holding on to the string, the cylinder falls and spins as the string unwinds. What is the downward acceleration of the cylinder as it falls?
a. 0
b. 4.9 m/s^2
c. 6.5 m/s^2
d. 9.8 m/s^2
e. 11 m/s^2

____ 15. Two hoops or rings ($I = MR^2$) are centered, lying on a turntable. The smaller ring has radius = 0.050 m; the larger has radius = 0.10 m. Both have a mass of 3.0 kg. What is the total moment of inertia as the turntable spins? Ignore the mass of the turntable.
a. 0.030 kg·m^2
b. 0.007 5 kg·m^2
c. 0.038 kg·m^2
d. 0.075 kg·m^2
e. 0.045 kg·m^2

____ 16. An object consists of a rod (of length 3.0 m and negligible moment of inertia) to which four small 2.0-kg masses are attached, one at each end and one at each point on the rod 1.0 m from each end. (The masses are one meter apart.) The moment of inertia of this object about an axis perpendicular to the rod and through one of the inner masses:
a. is 72 kg·m^2.
b. is 12 kg·m^2.
c. is 6 kg·m^2.
d. is 4 kg·m^2.
e. cannot be uniquely determined until it is stated which inner mass the axis goes through.

____ 17. A ventilation fan with a moment of inertia of 0.034 kg·m^2 has a net torque of 0.11 N·m applied to it. If it starts from rest, what kinetic energy will it have 8.0 s later?
a. 31 J
b. 17 J
c. 11 J
d. 6.6 J
e. 5.4 J

____ 18. A bowling ball has a mass of 7.0 kg, a moment of inertia of 2.8×10^{-2} kg·m^2 and a radius of 0.10 m. If it rolls down the lane without slipping at a linear speed of 4.0 m/s, what is its total kinetic energy?
a. 45 J
b. 32 J
c. 11 J
d. 78 J
e. 85 J

____ 19. A solid sphere of mass 4.0 kg and radius 0.12 m starts from rest at the top of a ramp inclined 15°, and rolls to the bottom. The upper end of the ramp is 1.2 m higher than the lower end. What is the linear speed of the sphere when it reaches the bottom of the ramp? (Note: $I = 0.4MR^2$ for a solid sphere and $g = 9.8$ m/s^2)
a. 4.7 m/s
b. 4.1 m/s
c. 3.4 m/s
d. 2.4 m/s
e. 1.8 m/s

____ 20. A solid cylinder of mass 3.0 kg and radius 0.2 m starts from rest at the top of a ramp, inclined 15°, and rolls to the bottom without slipping. (For a cylinder $I = 0.5MR^2$) The upper end of the ramp is 1.2 m higher than the lower end. Find the linear speed of the cylinder when it reaches the bottom of the ramp. ($g = 9.8$ m/s^2)
a. 4.7 m/s
b. 4.3 m/s
c. 4.0 m/s
d. 2.4 m/s
e. 2.2 m/s

____ 21. A solid sphere with mass, M, and radius, R, rolls along a level surface without slipping with a linear speed, v. What is the ratio of rotational to linear kinetic energy? (For a solid sphere, $I = 0.4\ MR^2$).
a. 1/4
b. 1/2
c. 1/1
d. 2/5
e. 3/5

____ 22. A cylinder ($I = MR^2/2$) is rolling along the ground at 7.0 m/s. It comes to a hill and starts going up. Assuming no losses to friction, how high does it get before it stops?
a. 1.2 m
b. 3.7 m
c. 4.2 m
d. 5.9 m
e. 6.4 m

____ 23. A meter stick is hinged at its lower end and allowed to fall from a vertical position. If its moment of inertia is $ML^2/3$, with what angular speed does it hit the table?
a. 5.42 rad/s
b. 2.71 rad/s
c. 1.22 rad/s
d. 7.67 rad/s
e. 4.83 rad/s

____ 24. Consider the use of the terms "rotation" and "revolution". In physics:
a. the words are used interchangeably.
b. the words are used interchangeably but "rotation" is the preferred word.
c. the words have different meaning.
d. "rotation" is the correct word and "revolution" should not be used.
e. the words are used interchangeably but "revolution" is the preferred word.

____ 25. A solid disk of radius R rolls down an incline in time T. The center of the disk is removed up to a radius of R/2. The remaining portion of the disk with its center gone is again rolled down the same incline. The time it takes is:
a. T.
b. more than T.
c. less than T.
d. requires more information than given in the problem to figure out.
e. T/2.

____ 26. An ice skater spins at 2.5 rev/s when his arms are extended. He draws his arms in and spins at 6.0 rev/s. By what factor does his moment of inertia change in the process?
a. 2.4
b. 1.0
c. 0.42
d. 0.12
e. 0.10

____ 27. A figure skater on ice with arms extended, spins at a rate of 2.5 rev/s. After he draws his arms in, he spins at 6.0 rev/s. By what factor does the skater's kinetic energy change when he draws his arms in?
a. 2.4
b. 1.0
c. 0.42
d. 0.12
e. 0.10

____ 28. A turntable has a moment of inertia of 3.00×10^{-2} kg·m^2 and spins freely on a frictionless bearing at 25.0 rev/min. A 0.300-kg ball of putty is dropped vertically onto the turntable and sticks at a point 0.100 m from the center. What is the new rate of rotation of the system?
a. 40.8 rev/min
b. 22.7 rev/min
c. 33.3 rev/min
d. 27.2 rev/min
e. 20.5 rev/min

____ 29. A turntable has a moment of inertia of 3.0×10^{-2} kg·m^2 and spins freely on a frictionless bearing at 25 rev/min. A 0.30-kg ball of putty is dropped vertically on the turntable and sticks at a point 0.10 m from the center. By what factor does the kinetic energy of the system change after the putty is dropped onto the turntable?
a. 0.91
b. 1.0
c. 0.82
d. 1.5
e. 0.76

____ 30. A tetherball is attached to a pole with a 2.0-m rope. It is circling at 0.20 rev/s. As the rope wraps around the pole it shortens. How long is the rope when the ball is moving at 5.0 m/s?
a. 1.8 m
b. 1.5 m
c. 1.2 m
d. 1.0 m
e. 0.82 m

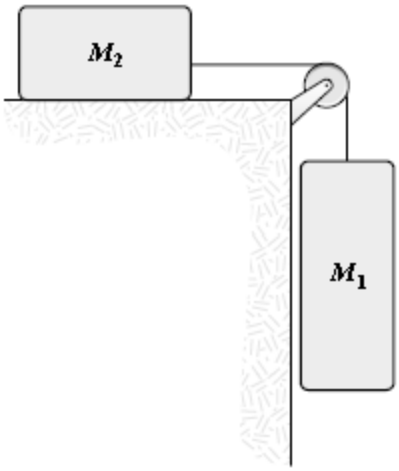
____ 31. An object with mass m and moment of inertia I is spinning with an angular momentum L. Its kinetic energy is:
a. 0.5 I^2/L.
b. 0.5 L^2/I.
c. 0.5 L^2/m.
d. 0.5 I^2/m.
e. 0.5 I^2/ L^2.

____ 32. An object of mass m and moment of inertia I has rotational kinetic energy K_R. Its angular momentum is:
a. 0.5 I/m.
b. $(2\ IK_R)^{1/2}$.
c. $(2\ mK_R)^{1/2}$.
d. $2\ K_R/I$.
e. not given above.

____ 33. A disk (radius = 8.0 cm) that rotates about a fixed axis starts from rest and accelerates at a constant rate to an angular velocity of 4.0 rad/s in 2.0 s. What is the magnitude of the total linear acceleration of a point on the rim of the disk at the instant when the angular velocity of the disk is 1.5 rad/s?

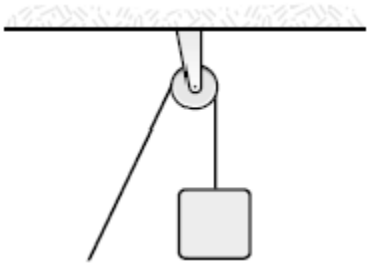
a. 24 cm/s^2
b. 16 cm/s^2
c. 18 cm/s^2
d. 34 cm/s^2
e. 44 cm/s^2

____ 34. A mass (M_1 = 5.0 kg) is connected by a light cord to a mass (M_2 = 4.0 kg) which slides on a smooth surface, as shown in the figure. The pulley (radius = 0.20 m) rotates about a frictionless axle. The acceleration of M_2 is 3.5 m/s^2. What is the moment of inertia of the pulley?



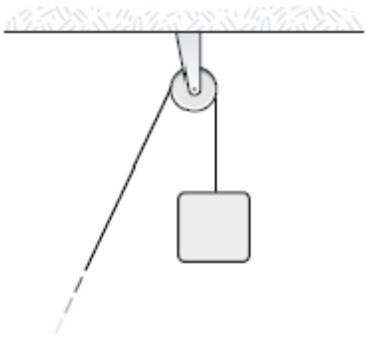
a. 0.29 kg·m^2
b. 0.42 kg·m^2
c. 0.20 kg·m^2
d. 0.62 kg·m^2
e. 0.60 kg·m^2

____ 35. A wheel (radius = 0.20 m) is mounted on a frictionless, horizontal axis. A light cord wrapped around the wheel supports a 0.50-kg object, as shown in the figure. When released from rest the object falls with a downward acceleration of 5.0 m/s^2. What is the moment of inertia of the wheel?



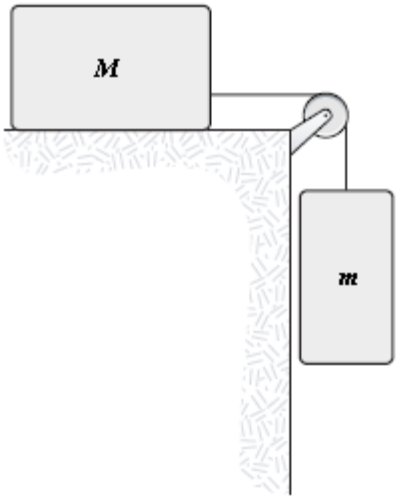
a. 0.023 kg·m^2
b. 0.027 kg·m^2
c. 0.016 kg·m^2
d. 0.019 kg·m^2
e. 0.032 kg·m^2

____ 36. A wheel (radius = 0.25 m) is mounted on a frictionless, horizontal axis. The moment of inertia of the wheel about the axis is 0.040 kg·m^2. A light cord wrapped around the wheel supports a 0.50-kg object as shown in the figure. The object is released from rest. What is the magnitude of the acceleration of the 0.50-kg object?



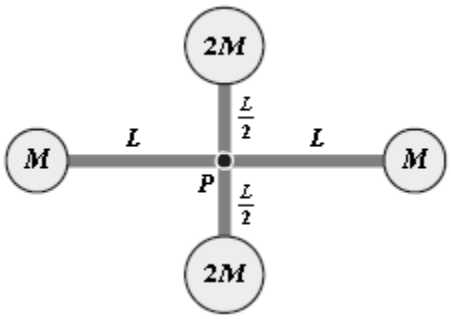
a. 3.0 m/s^2
b. 3.4 m/s^2
c. 4.3 m/s^2
d. 3.8 m/s^2
e. 2.7 m/s^2

____ 37. A mass m = 4.0 kg is connected, as shown, by a light cord to a mass M = 6.0 kg, which slides on a smooth horizontal surface. The pulley rotates about a frictionless axle and has a radius R = 0.12 m and a moment of inertia I = 0.090 kg·m^2. The cord does not slip on the pulley. What is the magnitude of the acceleration of m?



a. 2.4 m/s^2
b. 2.8 m/s^2
c. 3.2 m/s^2
d. 4.2 m/s^2
e. 1.7 m/s^2

____ 38. The rigid object shown is rotated about an axis perpendicular to the paper and through point P. The total kinetic energy of the object as it rotates is equal to 1.4 J. If M = 1.3 kg and L = 0.50 m, what is the angular velocity of the object? Neglect the mass of the connecting rods and treat the masses as particles.



a. 1.3 rad/s
b. 1.5 rad/s
c. 1.7 rad/s
d. 1.2 rad/s
e. 2.1 rad/s

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Answer Section

MULTIPLE CHOICE

1. B
2. C
3. B
4. D
5. C
6. A
7. D
8. C
9. C
10. D
11. D
12. C
13. D
14. C
15. C
16. B
17. C
18. D
19. B
20. C
21. D
22. B
23. A
24. C
25. B
26. C
27. A
28. B
29. A
30. D
31. B
32. B
33. A
34. C
35. D
36. C
37. A
38. C