Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Conceptual

1. Two points, A and B, are on a disk that rotates about an axis. Point A is closer to the axis than point B. Which of the following is not true?
   A) Point B has the greater speed.
   B) Point A has the lesser centripetal acceleration.
   C) Points A and B have the same angular acceleration.
   D) Point B has the greater angular speed.
   E) Point A has the lesser tangential acceleration.
   Ans: D

Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Conceptual

2. Two points, A and B, are on a disk that rotates about an axis. Point A is three times as far from the axis as point B. If the speed of point B is v, then what is the speed of point A?
   A) v B) $3v$ C) $v/3$ D) $9v$ E) $v/9$
   Ans: B

Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Conceptual

3. Starting from rest, a disk rotates with constant angular acceleration. If it takes 10 rev to reach an angular velocity ω, then how many additional revolutions are required to reach an angular velocity 2ω?
   A) 10 rev B) 20 rev C) 30 rev D) 40 rev E) 50 rev
   Ans: C

4.

Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Conceptual

6. A wheel rotates through 6.0 rad in 2.0 s as it is uniformly brought to rest. The initial angular velocity of the wheel before braking began was
   A) 0.60 rad/s B) 0.90 rad/s C) 1.8 rad/s D) 6.0 rad/s E) 7.2 rad/s
   Ans: D

Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Numerical

7. You are whirling a stone on the end of a string in a horizontal circle of radius R = 0.65 m with a frequency of 4 rev/s when the string breaks. Just after the string breaks, the velocity of the stone is
A) straight down.
B) 32 m/s along a tangent to the circle.
C) 16 m/s along the radius away from the center.
D) 1.0 m/s along the radius toward the center.
E) none of these.
Ans: E

Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Conceptual

13. A point P is at a distance R from the axis of rotation of a rigid body. The linear speed, centripetal acceleration, and tangential acceleration of the point can be expressed as

	Linear speed	Centripetal acceleration	Tangential acceleration
A)	$R\omega$	$R\omega^2$	$R\alpha$
B)	$R\omega$	$R\alpha$	$R\omega^2$
C)	$R\omega^2$	$R\alpha$	$R\omega$
D)	$R\omega$	$R\omega^2$	$R\omega$
E)	$R\omega^2$	$R\alpha$	$R\omega^2$

Ans: A

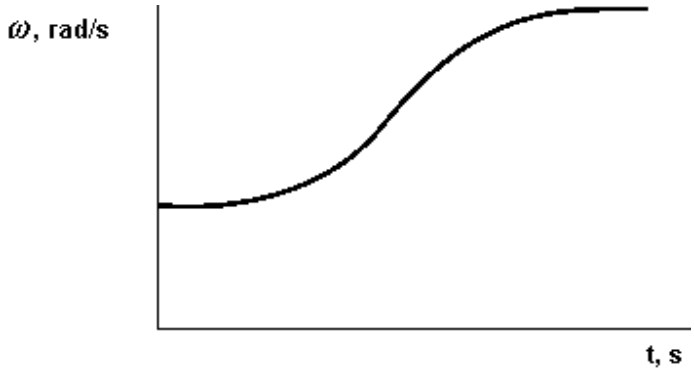
Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Conceptual

14. A body that moves with a constant speed in a circle
A) experiences no acceleration.
B) undergoes no change in velocity.
C) has no resultant force acting on it.
D) has no work done on it.
E) is described by all of these.
Ans: D

17.

Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Conceptual

18.



What physical quantity is represented by the slope of the curve shown on the graph?

A) displacement
B) angular acceleration
C) tangential acceleration
D) velocity
E) None of these is correct.

Ans: B

Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Numerical

19. You give an orbiting satellite a command to rotate through an angle given by

$$\theta = at + bt^2 - ct^4$$

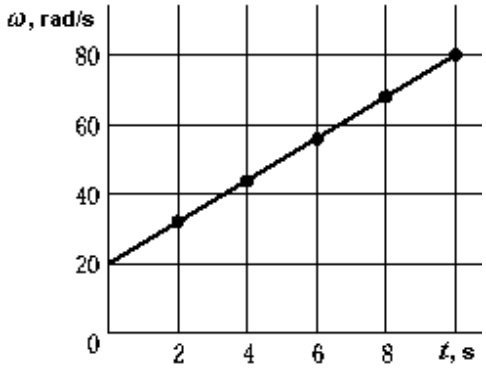
where *a, b,* and *c* are constants and θ is in radians if *t* is in seconds. What is the angular acceleration of this satellite at time *t*?

A) at B) $a + b - c$ C) -12 D) $2b - 12ct^2$ E) zero

Ans: D

Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Numerical

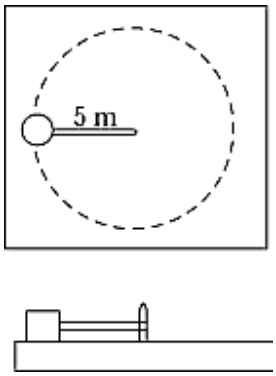
21.



The data used to construct the graph were taken from the tachometer of an airplane. The angular acceleration during the 10 s interval was
A) 3.0 rad/s^2 B) 6.0 rad/s^2 C) 8.0 rad/s^2 D) 20 rad/s^2 E) 38 rad/s^2
Ans: B

Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Conceptual
Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Numerical

25.



A 2.0-kg mass is attached to the end of a 5.0-m rope. The mass moves in a circular path on a horizontal frictionless surface. If the breaking strength of the rope is 40 N, the maximum translational speed with which you can swing the mass without breaking the rope is approximately
A) 3.2 m/s B) 4.0 m/s C) 10 m/s D) 20 m/s E) 0.20 km/s
Ans: C

Section: 9-1 Topic: Angular Velocity & Angular Acceleration
Type: Numerical

26.

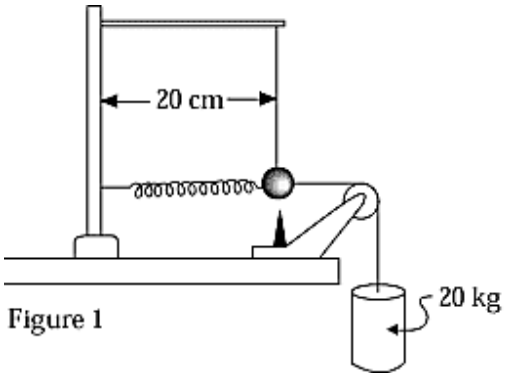


Figure 1

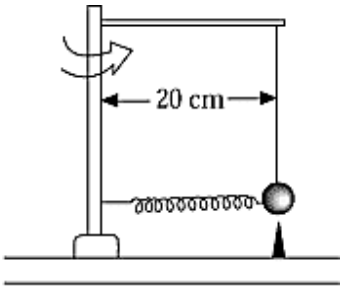


Figure 2

A 2-kg sphere attached to an axle by a spring is displaced from its rest position to a radius of 20 cm from the axle centerline by a standard mass of 20 kg, as in Figure 1. The same 2-kg sphere is also displaced 20 cm from the axle centerline, as in Figure 2, when the sphere is rotated at a speed of approximately
A) 4.4 m/s B) 9.8 m/s C) 14 m/s D) 98 m/s E) 0.44 km/s
Ans: A

Section: 9-1 Status: New to 5th edition
Topic: Angular Velocity & Angular Acceleration Type: Numerical

29. A 0.3-kg object is being whirled in a horizontal circle at the end of a 1.5 m long string. If the string breaks when the number of revolutions per minute, rpm = 200, then find the maximum tension in the string.
A) 2.0×10^2 N B) 59 N C) 7.0×10^5 N D) 9.0 N E) 88 N
Ans: A

Section: 9-1 Status: New to 5th edition
Topic: Angular Velocity & Angular Acceleration Type: Numerical

30. A wheel starting from rest has a constant angular acceleration. After 3.0 s the angular velocity of the wheel is 7.5 rad/s. This same angular acceleration continues for a further 7.0 s after which it drops suddenly to zero. In the first 20.0 s how many revolutions does the wheel make?
A) 20 B) 40 C) 60 D) 80 E) 100
Ans: C

Section: 9-1 Status: New to 5th edition
Topic: Angular Velocity & Angular Acceleration Type: Numerical

35. In a fast rotating atomic nucleus the rate of rotation is related to the energy of the emitted gamma-ray according to the relationship "$E_{\text{gamma}} = 2hf$," where h = Planck's constant, and f = rotational frequency. Find the period of rotation that corresponds to an energy of 0.75 MeV.
A) 1.2×10^{-14} s
B) 2.4×10^{-20} s
C) 8.5×10^{19} s
D) 1.7×10^{20} s
E) 1.2×10^{-20} s
Ans: E

Section: 9-2 Topic: Torque, Moment of Inertia, & Newton's...
Type: Numerical

36. A disk with a radius of 1.5 m whose moment of inertia is 34 kg · m^2 is caused to rotate by a force of 160 N tangent to the circumference. The angular acceleration of the disk is approximately
A) 0.14 rad/s^2 B) 0.23 rad/s^2 C) 4.4 rad/s^2 D) 7.1 rad/s^2 E) 23 rad/s^2
Ans: D

Section: 9-2 Topic: Torque, Moment of Inertia, & Newton's...
Type: Conceptual

38. A disk is free to rotate about an axis. A force applied at a distance d from the axis causes an angular acceleration α. What angular acceleration is produced if the same force is applied a distance $2d$ from the axis?
A) α B) 2α C) $\alpha/2$ D) 4α E) $\alpha/4$
Ans: B

Section: 9-2 Topic: Torque, Moment of Inertia, & Newton's...
Type: Conceptual

39. A bicycle wheel, a hollow sphere, and a solid sphere each have the same mass and radius. They each rotate about an axis through their centers. Which has the greatest moment of inertia and which has the least?
A) The wheel has the greatest; the solid sphere has the least.
B) The wheel has the greatest; the hollow sphere has the least.
C) The hollow sphere has the greatest; the solid sphere has the least.
D) The hollow sphere has the greatest; the wheel has the least.
E) The solid sphere has the greatest; the hollow sphere has the least.
Ans: A

Section: 9-2 Topic: Torque, Moment of Inertia, & Newton's...
Type: Numerical

45. A wheel slows from 20 rad/s to 12 rad/s in 5 s under the influence of a constant frictional torque. In these 5 s, the wheel turns through an angle of
A) 2.4 rad B) 43 rad C) 60 rad D) 80 rad E) 100 rad
Ans: D

Section: 9-2 Topic: Torque, Moment of Inertia, & Newton's...
Type: Numerical

46. A solid cylinder has a moment of inertia of 2 kg · m^2. It is at rest at time zero when a net torque given by

$$\tau = 6t^2 + 6 \quad \text{(SI units)}$$

is applied. After 2 s, the angular velocity of the cylinder will be
A) 3.0 rad/s B) 12 rad/s C) 14 rad/s D) 24 rad/s E) 28 rad/s
Ans: C

Section: 9-2 Topic: Torque, Moment of Inertia, & Newton's...
Type: Numerical

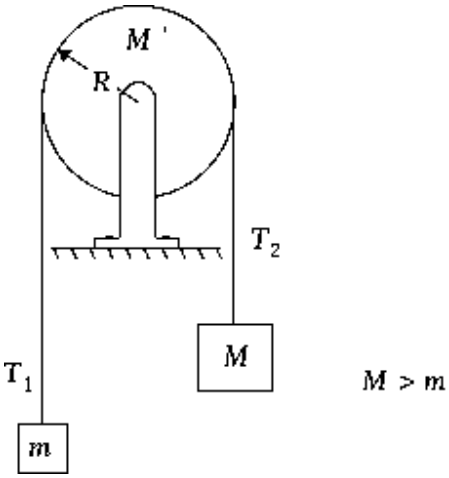
48. A solid disk ($I = \frac{1}{2}MR^2$) that is 10 cm in diameter has a mass of 4 kg. The force applied at the outer surface required to produce an angular acceleration of 6 rad/s^2 about an axis through the center of the disk is
A) 0.24 kN B) 0.12 kN C) 0.30 N D) 0.60 N E) 1.2 N
Ans: D

Section: 9-3 Topic: Calculating the Moment of Inertia Type: Numerical

53. The moment of inertia of a slim rod about a transverse axis through one end is $mL^2/3$, where m is the mass of the rod and L is its length. The moment of inertia of a 0.24-kg meterstick about a transverse axis through its center is
A) 0.14 kg · m^2
B) 20 kg · m^2
C) 0.020 kg · m^2
D) 80 kg · m^2
E) 4.5 kg · m^2
Ans: C

Section: 9-4 Topic: Applications of Newton's Second Law...
Type: Conceptual

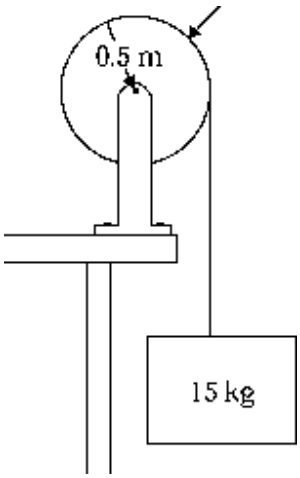
66.



Two masses M and m ($M > m$) are hung over a disk ($I_{disk} = \frac{1}{2} MR^2$) and are released so that they accelerate. If T_1 is the tension in the cord on the left and T_2 is the tension in the cord on the right, then
A) $T_1 = T_2$ B) $T_2 > T_1$ C) $T_2 < T_1$ D) $T_2 = Mg$ E) $T_2 = Mg/m$
Ans: B

Section: 9-4 Topic: Applications of Newton's Second Law... Type: Numerical

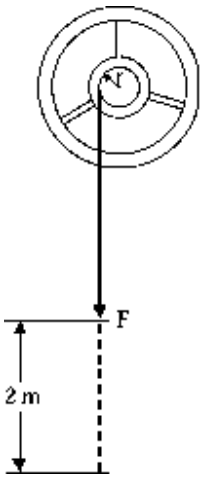
69.



The moment of inertia of the wheel in the figure is 0.50 kg · m^2, and the bearing is frictionless. The acceleration of the 15-kg mass is approximately
A) 9.8 m/s^2 B) 8.7 m/s^2 C) 74 m/s^2 D) 16 m/s^2 E) 0.53 m/s^2
Ans: B

Section: 9-4 Topic: Applications of Newton's Second Law... Type: Numerical

71.



In the figure, the rotational inertia of the wheel and axle about the center is 12.0 kg · m^2, the constant force *F* is 39.2 N, and the radius *r* is 0.800 m. The wheel starts from rest. When the force has acted through 2.00 m, the rotational velocity ω acquired by the wheel due to this force will be

A) 1.26 rad/s B) 3.33 rad/s C) 3.61 rad/s D) 6.24 rad/s E) 10.3 rad/s

Ans: C

Section: 9-5 Topic: Rotational Kinetic Energy Type: Numerical

79. A body of mass *m* is whirled at a constant angular velocity on the end of a string of length *R*. To double the kinetic energy of the body as it whirls while maintaining the angular velocity, the length of the string must be changed to

A) 2*R* B) $R\sqrt{2}$ C) *R*/2 D) 4*R* E) $R/\sqrt{2}$

Ans: B

Section: 9-5 Topic: Rotational Kinetic Energy Type: Numerical

81. A hoop of mass 50 kg rolls without slipping. If the center of mass of the hoop has a translational speed of 4.0 m/s, the total kinetic energy of the hoop is

A) 0.20 kJ B) 0.40 kJ C) 1.1 kJ D) 3.9 kJ E) None of these is correct.

Ans: E

Section: 9-6 Topic: Rolling Objects Type: Conceptual

84. Two solid balls (one large, the other small) and a cylinder roll down a hill. Which has the greatest speed at the bottom and which the least?
A) The large ball has the greatest; the small ball has the least.
B) The small ball has the greatest; the large ball has the least.
C) The cylinder has the greatest; the small ball has the least.
D) The cylinder has the greatest; both balls have the same lesser speed.
E) Both balls have the same greater speed; the cylinder has the least.
Ans: E

Section: 9-6 Topic: Rolling Objects Type: Conceptual

86. Starting from rest at the same time, a coin and a ring roll down an incline without slipping. Which reaches the bottom first?
A) The ring reaches the bottom first.
B) The coin reaches the bottom first.
C) They arrive at the bottom simultaneously.
D) The winner depends on the relative masses of the two.
E) The winner depends on the relative diameters of the two.
Ans: B

Section: 9-6 Topic: Rolling Objects Type: Conceptual

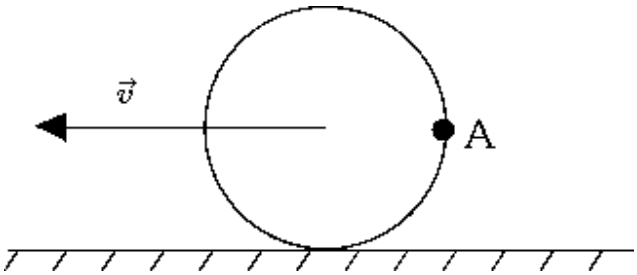
88. For a disk of mass M and radius R that is rolling without slipping, which is greater, its translational or its rotational kinetic energy?
A) Its translational kinetic energy is greater.
B) Its rotational kinetic energy is greater.
C) They are equal.
D) The answer depends on the radius.
E) The answer depends on the mass.
Ans: A

Section: 9-6 Topic: Rolling Objects Type: Conceptual

89. A wheel on a car is rolling without slipping along level ground. The speed of the car is 36 m/s. The wheel has an outer diameter of 50 cm. The speed of the top of the wheel is
A) 36 m/s B) 3.6 m/s C) 72 m/s D) 18 m/s E) 98 m/s
Ans: C

Section: 9-6 Topic: Rolling Objects Type: Numerical

90.



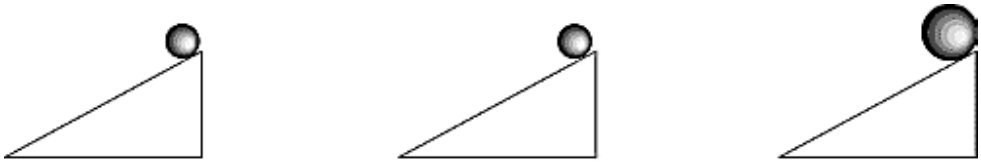
A bicycle is moving at a speed v = 12.6 m/s. A small stone is stuck to one of the tires. At the instant the stone is at point A in the figure, it comes free. The velocity of the stone (magnitude and direction) relative to the earth just after release is

A) 17.8 m/s at 45º above the horizontal, toward the front of the bicycle.
B) 12.6 m/s at 45º above the horizontal, away from the bicycle.
C) 12.6 m/s at 37º below the horizontal.
D) 12.6 m/s straight up.
E) 17.8 m/s at 45º above the horizontal, toward the back of the bicycle.

Ans: A

Section: 9-6 Topic: Rolling Objects Type: Conceptual

94.



Three solid, homogeneous spheres are on identical inclined planes. If there are no frictional losses, which of the following statements correctly relates the translational speeds at the bottoms of the inclined planes?

A) $v_A = v_B = v_C$
B) $v_A > v_B$; $v_A > v_C$
C) $v_A < v_C$; $v_B < v_C$
D) $v_A < v_B$; $v_B < v_C$
E) $v_A = v_B$; $v_B < v_C$

Ans: A

Section: 9-6 Topic: Rolling Objects Type: Numerical

96. The moment of inertia of a certain wheel about its axle is $\frac{3}{4}\ mR^2$. The translational speed of its axle after it starts from rest and rolls without slipping down an inclined plane 2.13 m high is

A) 9.75 m/s B) 8.53 m/s C) 7.31 m/s D) 6.10 m/s E) 4.88 m/s

Ans: E

Section: 9-6 Topic: Rolling Objects Type: Numerical

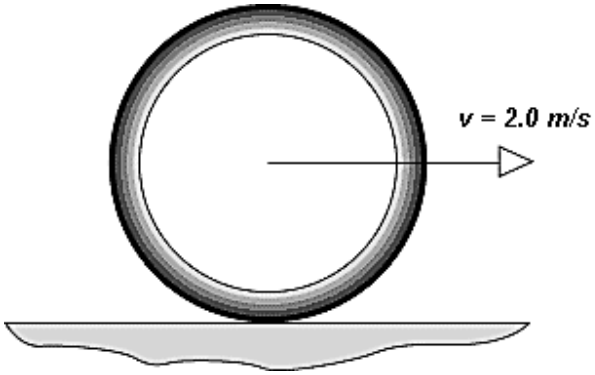
97. A uniform cylinder ($I = \frac{1}{2} mR^2$) of diameter 0.20 m and mass 12 kg rolls without slipping down a 37º inclined plane. The acceleration of the cylinder down the plane is approximately

A) 2.0 m/s^2 B) 3.9 m/s^2 C) 4.9 m/s^2 D) 5.8 m/s^2 E) 9.8 m/s^2

Ans: B

Section: 9-6 Topic: Rolling Objects Type: Numerical

102.



A 1.0-kg metal hoop with a radius of 0.5 m has a translational velocity of 2.0 m/s as it rolls without slipping. The angular momentum of this hoop about its center of mass is

A) 1.0 kg · m^2/s
B) 2.0 kg · m^2/s
C) 8.0 kg · m^2/s
D) 4.0 kg · m^2/s
E) 0.50 kg · m^2/s

Ans: A