Questions

Chapter 11
Rolling, Torque, and Angular Momentum

11-1 Rolling as Translation and Rotation Combined
M2-032

A uniform wheel of radius 0.5 m rolls without slipping on a horizontal surface. Starting from rest, the wheel moves with constant angular acceleration 6.0 rad/s^2. The distance traveled by the center of mass of the wheel from t = 0 to t = 3 s is:

A) zero m
B) 27 m
C) 13.5 m
D) 18 m
E) none of other answers

Answer C

11-2 The Kinetic Energy of Rolling
M2-061

A thin hoop rolls without sliding along the floor. The ratio of its translational kinetic energy of the center of mass to its rotational kinetic energy about an axis through its center of mass is:

A) 3
B) 2
C) 1
D) 4
E) ½

Answer C

11-2 The Kinetic Energy of Rolling
M2-042

A hoop has a mass of 200 grams and a radius of 25 cm. It rolls without slipping along a level ground at 500 cm/s. Its total kinetic energy is :

A) 2 J
B) 25 J
C) 10 J
D) 5 J
E) 0 J

Answer D

11-2 The Kinetic Energy of Rolling
M2-041

A uniform solid sphere of radius 0.10 m rolls smoothly across a horizontal table at a speed 0.50 m/s with total kinetic energy 0.70 J. Find the mass of the sphere.

A) 5.0 kg
B) 8.0 kg
C) 2.0 kg
D) 1.0 kg
E) 4.0 kg

Answer E

11-3 The Forces of Rolling
M2-042

A 3.0 kg wheel, rolling smoothly on a horizontal surface, has a rotational inertia about its axis= $M R^2/2$, where M is its mass and R is its radius. A horizontal force is applied to the axle so that the center of mass has an acceleration of 2.0 m/s^2. The magnitude of the frictional force of the surface is :

A) 3.0 N
B) 6.0 N
C) 9.0 N
D) 12 N
E) 0 N

Answer A

11-4 The Yo-Yo
M2-062

A string is wrapped around a solid disk of mass *m*, radius *R*. The string is stretched in the vertical direction and the disk is released as shown in Fig. 8. Find the tension (*T*) in the string.

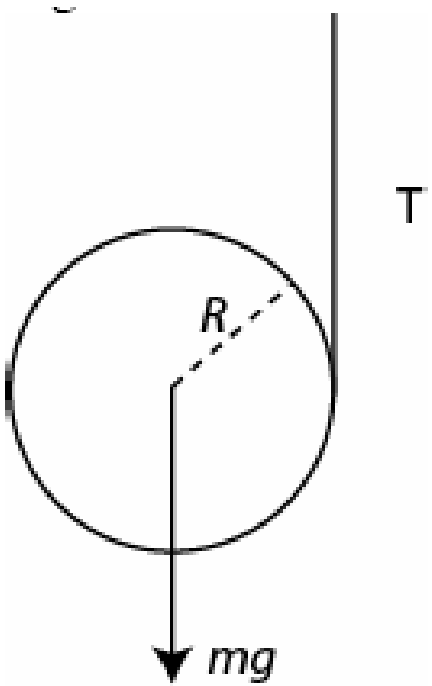
A) $\frac{2}{3}$ m g

B) $\frac{3}{2}$ m g

C) $\frac{2}{5}$ m g

D) $\frac{1}{3}$ m g

E) $\frac{3}{4}$ m g



Answer D

11-5 Torque Revisited
M2-061

What is the net torque about the origin on an object located at (0, -5.0, 5.0) m when forces $\mathbf{F}_1$ = (-3.0 **k**) N and $\mathbf{F}_2$ = (2.0 **j**) N act on the object?

A) (15 **i**) N m
B) (5.0 **i**) N m
C) (10 **j**) N m
D) (-3.0 **k** + 2.0 **j**) N m
E) Zero

Answer B

11-5 Torque Revisited
M2-041

A 2.0 kg particle is moving such that its position vector (r) relative to the origin is $\mathbf{r} = (-2.0\ t^2\ \mathbf{i} + 3.0\ \mathbf{j})$ m. What is the torque (about the origin) acting on the particle at t=2.0 s?

A) -24 **k** N.m
B) -36 **k** N.m
C) 24 **k** N.m
D) -48 **k** N.m
E) 0

Answer C

11-5 Torque Revisited
M2-032

A 2.0 kg stone is tied to a 0.50 m string and swung around a circle at a constant angular velocity of 12 rad/s. The net torque on the stone about the center of the circle is:

A) 0 N m
B) 6.0 N m
C) 12 N m
D) 72 N m
E) 140 N m

Answer A

11-5 Torque Revisited
M2-031

A particle located at the position vector **r** =(1.2 **i**+ 1.2 **j**) m has a force **F**=(150 **i**) N acting on it. The torque (in N.m) of the force about the origin is:

A) -180 **j**
B) 180 **k**
C) 180 **i**
D) 180 (**i** + **j**)
E) -180 **k**

Answer E

11-6 Angular Momentum
M2-061

A particle, held by a string whose other end is attached to a fixed point *C*, moves in a circle on a horizontal frictionless surface. If the string is cut, the angular momentum of the particle about the point *C*:

A) increases
B) changes direction but not magnitude
C) does not change
D) decreases
E) becomes zero

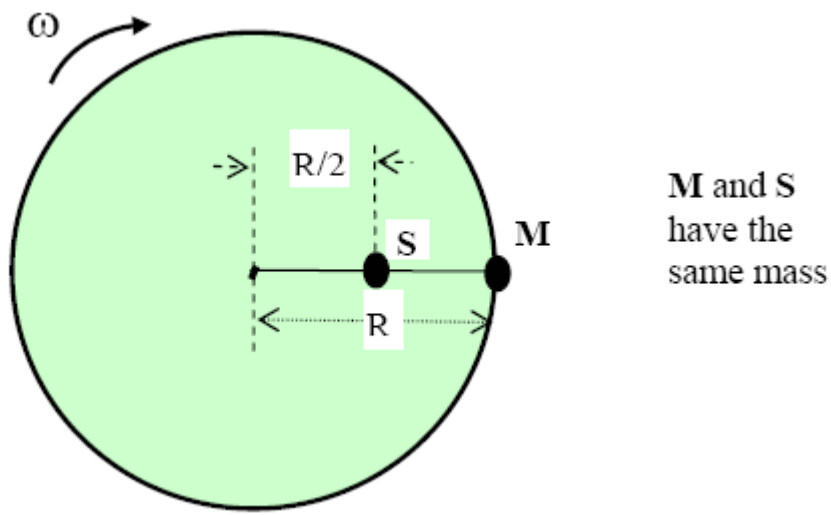
Answer C

11-6 Angular Momentum
M2-031

Mohammed (M) and Salim (S) (have the same mass) are riding on a merry-go-round rotating at a constant rate. Salem is half way in from the edge, as shown in Fig 7. The angular momenta of Salem and Mohammed about the axis of rotation are Ls and Lm respectively. Which of the following relations is correct?

A) Lm = 2 Ls
B) Lm = Ls
C) Lm = Ls/4
D) Lm = 4 Ls
E) Lm = Ls/2

FIGURE-7

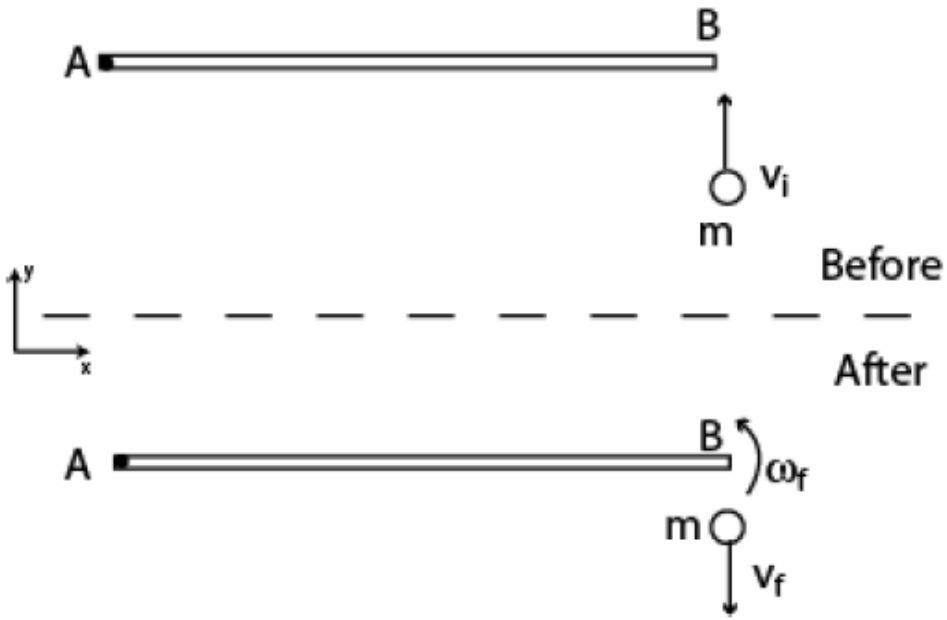


Answer D

11-10 Conservation of Angular Momentum
M2-062

Fig. 7 shows an overhead view of a thin rod of mass *M* (=*2.0 kg*) and length *L* = 2.0 *m* which can rotate horizontally about a vertical axis through the end *A*. A particle of mass *m* = 2.0 *kg* traveling horizontally with a velocity $\mathbf{v_i}$ = (10 **j**) m/s strikes the rod (which was initially at rest) at point *B*. The particle rebounds with a velocity $\mathbf{v_f}$ = (-6.0 **j**) m/s . Find the angular speed (ω_f) of the rod just after collision.

A) 24 *rad/s*
B) 2.0 *rad/s*
C) 10 *rad/s*
D) 50 *rad/s*
E) 30 *rad/s*

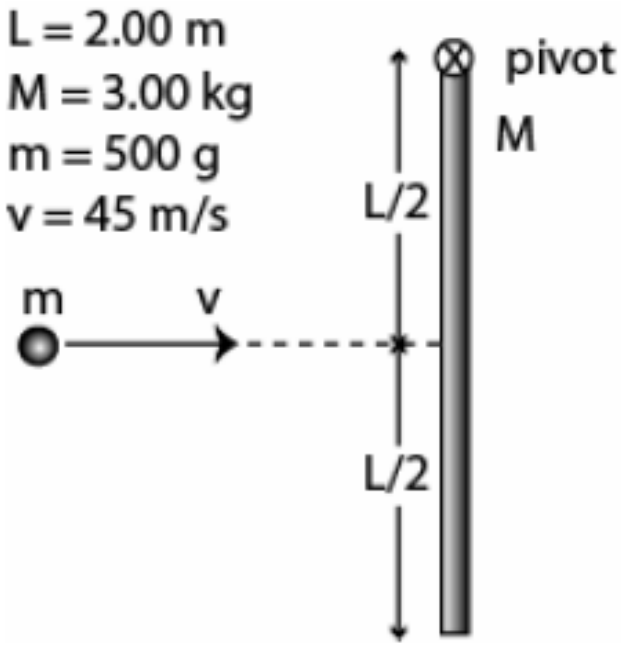


Answer A

11-10 Conservation of Angular Momentum
M2-061

A thin uniform rod of mass M = 3.0 kg and length L = 2.0 m is suspended vertically from a frictionless pivot at its upper end. An object of mass m = 500 g, traveling horizontally with a speed v = 45 m/s strikes the rod at its center of mass and sticks there (See Fig 6). What is the angular velocity of the system just after the collision?

A) 0.57 rad/s
B) 2.1 rad/s
C) 4.3 rad/s
D) 3.7 rad/s
E) 5.0 rad/s



Answer E

11-10 Conservation of Angular Momentum
M2-042

Fig 7 shows two disks mounted on bearings on a common axis . The first disk has rotational inertia I and is spinning with angular velocity ω. The second disk has rotational inertia 2I and is spinning in the same direction as the first disk with angular velocity 2ω. The two disks are slowly forced toward each other along the axis until they stick and have a final common angular velocity of:

A) ω
B) ω sqrt(3)
C) 5 ω/3
D) 3 ω
E) 2 ω

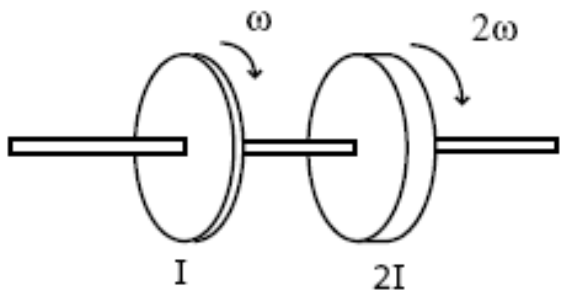


Figure 7

Answer C

11-10 Conservation of Angular Momentum
M2-041

A man, with his arms at his sides, is spinning on a light turntable that can rotate freely about a vertical frictionless axis. When he extends his arms:

A) his angular momentum will increase.
B) his angular velocity will decrease.
C) his angular velocity remains the same.
D) his rotational inertia decreases.
E) his rotational kinetic energy remains the same.

Answer B

11-10 Conservation of Angular Momentum
M2-032

A disk (rotational inertia = 2 I) rotates with angular velocity ω_o about a vertical, frictionless axle. A second disk (rotational inertia = I) and initially not rotating, drops onto the first disk (see Fig 5). The two disks stick together and rotate with an angular velocity ω. Find ω.

A) (2/3) ω_o
B) (1/2) ω_o
C) (3/4) ω_o
D) ω_o
E) 2 ω_o

.

Answer A

11-10 Conservation of Angular Momentum
M2-031

A star of radius R is spinning with an angular velocity ω. If it shrinks till its radius becomes R/2, find the ratio of the final angular momentum to its initial angular momentum.

A) 4
B) 2
C) 1
D) 1/2
E) 1/4

Answer C