Halliday/Resnick/Walker
Fundamentals of Physics 8th edition

Classroom Response System Questions

Chapter 11 Rolling, Torque, and Angular Momentum

Interactive Lecture Questions
11.2.1. The wheels of a bicycle have a radius of $r$ meters. The bicycle is traveling along a level road at a constant speed $v$ m/s. Which one of the following expressions may be used to determine the angular speed, in rev/min, of the wheels?

a) $\frac{v}{r}$

b) $\frac{\pi v}{30r}$

c) $\frac{30v}{\pi r}$

d) $\frac{30v}{2\pi r}$

e) $\frac{60v}{\pi r}$
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11.2.2. Josh is painting yellow stripes on a road using a paint roller. To roll the paint roller along the road, Josh applies a force of 15 N at an angle of 45° with respect to the road. The mass of the roller is 2.5 kg; and its radius is 4.0 cm. Ignoring the mass of the handle of the roller, what is the magnitude of the tangential acceleration of the roller?

a) 4.2 m/s²

b) 6.0 m/s²

c) 15 m/s²

d) 110 m/s²

e) 150 m/s²
11.2.2. Josh is painting yellow stripes on a road using a paint roller. To roll the paint roller along the road, Josh applies a force of 15 N at an angle of $45^\circ$ with respect to the road. The mass of the roller is 2.5 kg; and its radius is 4.0 cm. Ignoring the mass of the handle of the roller, what is the magnitude of the tangential acceleration of the roller?

a) 4.2 m/s²

b) 6.0 m/s²
c) 15 m/s²
d) 110 m/s²
e) 150 m/s²
11.2.2. Which one of the following statements concerning a wheel undergoing rolling motion is true?

a) The angular acceleration of the wheel must be zero m/s².

b) The tangential velocity is the same for all points on the wheel.

c) The linear velocity for all points on the rim of the wheel is non-zero.

d) The tangential velocity is the same for all points on the rim of the wheel.

e) There is no slipping at the point where the wheel touches the surface on which it is rolling.
11.2.2. Which one of the following statements concerning a wheel undergoing rolling motion is true?

a) The angular acceleration of the wheel must be zero m/s\(^2\).

b) The tangential velocity is the same for all points on the wheel.

c) The linear velocity for all points on the rim of the wheel is non-zero.

d) The tangential velocity is the same for all points on the rim of the wheel.

e) There is no slipping at the point where the wheel touches the surface on which it is rolling.
11.2.3. A circular hoop rolls without slipping on a flat horizontal surface. Which one of the following is necessarily true?

a) All points on the rim of the hoop have the same speed.

b) All points on the rim of the hoop have the same velocity.

c) Every point on the rim of the wheel has a different velocity.

d) All points on the rim of the hoop have acceleration vectors that are tangent to the hoop.

e) All points on the rim of the hoop have acceleration vectors that point toward the center of the hoop.
11.2.3. A circular hoop rolls without slipping on a flat horizontal surface. Which one of the following is necessarily true?

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c) Every point on the rim of the wheel has a different velocity.

d) All points on the rim of the hoop have acceleration vectors that are tangent to the hoop.

e) All points on the rim of the hoop have acceleration vectors that point toward the center of the hoop.
11.2.4. A bicycle wheel of radius 0.70 m is turning at an angular speed of 6.3 rad/s as it rolls on a horizontal surface without slipping. What is the linear speed of the wheel?

a) 1.4 m/s
b) 28 m/s
c) 0.11 m/s
d) 4.4 m/s
e) 9.1 m/s
11.2.4. A bicycle wheel of radius 0.70 m is turning at an angular speed of 6.3 rad/s as it rolls on a horizontal surface without slipping. What is the *linear speed* of the wheel?

a) 1.4 m/s  
b) 28 m/s  
c) 0.11 m/s  
d) 4.4 m/s  
e) 9.1 m/s
11.3.1. A bowling ball is rolling without slipping at constant speed toward the pins on a lane. What percentage of the ball’s total kinetic energy is translational kinetic energy?

a) 50 %

b) 71 %

c) 46 %

d) 29 %

e) 33 %
11.3.1. A bowling ball is rolling without slipping at constant speed toward the pins on a lane. What percentage of the ball’s total kinetic energy is translational kinetic energy?

a) 50 %

b) 71 %

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d) 29 %

e) 33 %
11.3.2. A hollow cylinder is rotating about an axis that passes through the center of both ends. The radius of the cylinder is \( r \). At what angular speed \( \omega \) must the cylinder rotate to have the same total kinetic energy that it would have if it were moving horizontally with a speed \( v \) without rotation?

a) \( \omega = \frac{v^2}{2r} \)

b) \( \omega = \frac{v}{r} \sqrt{2} \)

c) \( \omega = \frac{v}{r} \)

d) \( \omega = \frac{v}{2r} \)

e) \( \omega = \frac{v^2}{r^2} \)
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a) \( \omega = \frac{v^2}{2r} \)

b) \( \omega = \frac{v}{\sqrt{2}} \)

c) \( \omega = \frac{v}{r} \)

d) \( \omega = \frac{v}{2r} \)

e) \( \omega = \frac{v^2}{r^2} \)
11.3.3. Two solid cylinders are rotating about an axis that passes through the center of both ends of each cylinder. Cylinder A has three times the mass and twice the radius of cylinder B, but they have the same rotational kinetic energy. What is the ratio of the angular velocities, $\omega_A / \omega_B$, for these two cylinders?

a) 0.25  
b) 0.50  
c) 1.0  
d) 2.0  
e) 4.0
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a) 0.25

b) 0.50

c) 1.0

d) 2.0

e) 4.0
11.3.4. A 1.0-kg wheel in the form of a solid disk rolls along a horizontal surface with a speed of 6.0 m/s. What is the total kinetic energy of the wheel?

a) 9.0 J

b) 18 J

c) 27 J

d) 36 J

e) 54 J
11.3.4. A 1.0-kg wheel in the form of a solid disk rolls along a horizontal surface with a speed of 6.0 m/s. What is the total kinetic energy of the wheel?

a) 9.0 J
b) 18 J
c) 27 J
d) 36 J
e) 54 J
11.4.1. A hollow cylinder of mass $M$ and radius $R$ rolls down an inclined plane. A block of mass $M$ slides down an identical inclined plane. Complete the following statement: If both objects are released at the same time,

da) the cylinder will reach the bottom first.

db) the block will reach the bottom first.

cy) the block will reach the bottom with the greater kinetic energy.

d) the cylinder will reach the bottom with the greater kinetic energy.

e) both the block and the cylinder will reach the bottom at the same time.
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a) the cylinder will reach the bottom first.

b) the block will reach the bottom first.

c) the block will reach the bottom with the greater kinetic energy.

d) the cylinder will reach the bottom with the greater kinetic energy.

e) both the block and the cylinder will reach the bottom at the same time.
11.4.2. Consider the following three objects, each of the same mass and radius:
(1) a solid sphere     (2) a solid disk     (3) a hoop
All three are released from rest at the top of an inclined plane. The three objects proceed down the incline undergoing rolling motion without slipping. In which order do the objects reach the bottom of the incline?

a) 3, 1, 2
b) 2, 3, 1
c) 1, 2, 3
d) 3, 2, 1
e) All three reach the bottom at the same time.
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a) 3, 1, 2

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e) All three reach the bottom at the same time.
11.5.1. The drawing shows a yo-yo in contact with a tabletop. A string is wrapped around the central axle. How will the yo-yo behave if you pull on the string with the force shown?

a) The yo-yo will roll to the left.

b) The yo-yo will roll to the right.

c) The yo-yo will spin in place, but not roll.

d) The yo-yo will not roll, but it will move to the left.

e) The yo-yo will not roll, but it will move to the right.
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e) The yo-yo will not roll, but it will move to the right.
11.6.1. The position vector of a particle is directed along the positive $y$ axis. What is the direction of the net force acting on the particle if the net torque is directed along the negative $x$ direction?

a) negative $x$ direction

b) positive $x$ direction

c) negative $y$ direction

d) positive $z$ direction

e) negative $z$ direction
11.6.1. The position vector of a particle is directed along the positive $y$ axis. What is the direction of the net force acting on the particle if the net torque is directed along the negative $x$ direction?

a) negative $x$ direction

b) positive $x$ direction

c) negative $y$ direction

d) positive $z$ direction

e) negative $z$ direction
11.6.2. The position vector of a particle is directed along the positive $y$ axis. What is the direction of the net torque acting on the particle if the net force is directed along the negative $x$ direction?

a) negative $x$ direction

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a) negative $x$ direction

b) positive $x$ direction

c) negative $y$ direction

d) positive $z$ direction

e) negative $z$ direction
11.7.1. The second hand on a clock completes one revolution each minute. What is the direction of the angular momentum of the second hand as it passes the “12” at the top of the clock?

a) toward the “12”

b) toward the “3”

c) toward the “6”

d) outward from the face of the clock

e) into the face of the clock
11.7.1. The second hand on a clock completes one revolution each minute. What is the direction of the angular momentum of the second hand as it passes the “12” at the top of the clock?

a) toward the “12”

b) toward the “3”

c) toward the “6”

d) outward from the face of the clock

e) into the face of the clock
11.7.2. What is the direction of the Earth’s orbital angular momentum as it spins about its axis?

a) north

b) south

c) east

d) west

e) radially inward
11.7.2. What is the direction of the Earth’s orbital angular momentum as it spins about its axis?

a) north
b) south
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11.7.3. While excavating the tomb of Tutankhamun (d. 1325 BC), archeologists found a sling made of linen. The sling could hold a stone in a pouch, which could then be whirled in a horizontal circle. The stone could then be thrown for hunting or used in battle. Imagine the sling held a 0.050-kg stone; and it was whirled at a radius of 1.2 m with an angular speed of 2.0 rev/s. What was the angular momentum of the stone under these circumstances?

a) 0.14 kg · m²/s
b) 0.90 kg · m²/s
c) 1.2 kg · m²/s
d) 2.4 kg · m²/s
e) 3.6 kg · m²/s
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a) 0.14 kg \cdot m^2/s

b) 0.90 kg \cdot m^2/s

c) 1.2 kg \cdot m^2/s

d) 2.4 kg \cdot m^2/s

e) 3.6 kg \cdot m^2/s
11.7.4. A particle is moving in a straight line at a constant velocity with respect to a point P. Which one of the following statements is true, if the angular momentum of the particle is zero $\text{kg} \cdot \text{m/s}^2$?

a) The particle cannot be traveling at constant velocity.

b) The particle has passed through the point P.

c) The particle cannot pass through the point P.

d) The path of the particle must pass through point P.
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11.11.1. A star is rotating about an axis that passes through its center. When the star “dies,” the balance between the inward pressure due to the force of gravity and the outward pressure from nuclear processes is no longer present and the star collapses inward and its radius decreases with time. Which one of the following choices best describes what happens as the star collapses?

a) The angular velocity of the star remains constant.

b) The angular momentum of the star remains constant.

c) The angular velocity of the star decreases.

d) The angular momentum of the star decreases.

e) Both angular momentum and angular velocity increase.
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11.11.2. A solid sphere of radius $R$ rotates about an axis that is tangent to the sphere with an angular speed $\omega$. Under the action of internal forces, the radius of the sphere increases to $2R$. What is the final angular speed of the sphere?

a) $\omega/4$

b) $\omega/2$

c) $\omega$

d) $2\omega$

e) $4\omega$
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e) $4\omega$
11.11.3. Joe has volunteered to help out in his physics class by sitting on a stool that easily rotates. As Joe holds the dumbbells out as shown, the professor temporarily applies a sufficient torque that causes him to rotate slowly. Then, Joe brings the dumbbells close to his body and he rotates faster. Why does his speed increase?

a) By bringing the dumbbells inward, Joe exerts a torque on the stool.

b) By bringing the dumbbells inward, Joe decreases the moment of inertia.

c) By bringing the dumbbells inward, Joe increases the angular momentum.

d) By bringing the dumbbells inward, Joe increases the moment of inertia.

e) By bringing the dumbbells inward, Joe decreases the angular momentum.
11.11.3. Joe has volunteered to help out in his physics class by sitting on a stool that easily rotates. As Joe holds the dumbbells out as shown, the professor temporarily applies a sufficient torque that causes him to rotate slowly. Then, Joe brings the dumbbells close to his body and he rotates faster. Why does his speed increase?

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d) By bringing the dumbbells inward, Joe increases the moment of inertia.

e) By bringing the dumbbells inward, Joe decreases the angular momentum.
11.11.4. Joe has volunteered to help out in his physics class by sitting on a stool that easily rotates. Joe holds the dumbbells out as shown as the stool rotates. Then, Joe drops both dumbbells. How does the rotational speed of stool change, if at all?

a) The rotational speed increases.

b) The rotational speed decreases, but Joe continues to rotate.

c) The rotational speed remains the same.

d) The rotational speed quickly decreases to zero rad/s.
11.11.4. Joe has volunteered to help out in his physics class by sitting on a stool that easily rotates. Joe holds the dumbbells out as shown as the stool rotates. Then, Joe drops both dumbbells. How does the rotational speed of stool change, if at all?

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11.11.5. Joe has volunteered to help out in his physics class by sitting on a stool that easily rotates. Joe holds the dumbbells out as shown as the stool rotates. Then, Joe drops both dumbbells. How does the angular momentum of Joe and the stool change, if at all?

a) The angular momentum increases.

b) The angular momentum decreases, but it remains greater than zero kg $\cdot$ m$^2$/s.

c) The angular momentum remains the same.

d) The angular momentum quickly decreases to zero kg $\cdot$ m$^2$/s.
11.11.5. Joe has volunteered to help out in his physics class by sitting on a stool that easily rotates. Joe holds the dumbbells out as shown as the stool rotates. Then, Joe drops both dumbbells. How does the angular momentum of Joe and the stool change, if at all?

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c) The angular momentum remains the same.

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11.11.6. Joe has volunteered to help out in his physics class by sitting on a stool that easily rotates. Joe holds the dumbbells out as shown as the stool rotates. Then, Joe drops both dumbbells. Then, the angular momentum of Joe and the stool change, but the angular velocity does not change. Which of the following choice offers the best explanation?

a) The force exerted by the dumbbells acts in opposite direction to the torque.

b) Angular momentum is conserved, when no external forces are acting.

c) Even though the angular momentum decreases, the moment of inertia also decreases.

d) The decrease in the angular momentum is balanced by an increase in the moment of inertia.

e) The angular velocity must increase when the dumbbells are dropped.
11.11.6. Joe has volunteered to help out in his physics class by sitting on a stool that easily rotates. Joe holds the dumbbells out as shown as the stool rotates. Then, Joe drops both dumbbells. Then, the angular momentum of Joe and the stool change, but the angular velocity does not change. Which of the following choice offers the best explanation?

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d) The decrease in the angular momentum is balanced by an increase in the moment of inertia.

e) The angular velocity must increase when the dumbbells are dropped.
11.11.7. Sarah has volunteered to help out in her physics class by sitting on a stool that easily rotates. The drawing below shows the view from above her head. She holds the dumbbells out as shown as the stool rotates. Then, she drops both dumbbells. Which one of the four trajectories illustrated best represents the motion of the dumbbells after they are dropped?

[Diagram showing different trajectories for dropped dumbbells, labeled as a, b, c, and d.]
11.11.7. Sarah has volunteered to help out in her physics class by sitting on a stool that easily rotates. The drawing below shows the view from above her head. She holds the dumbbells out as shown as the stool rotates. Then, she drops both dumbbells. Which one of the four trajectories illustrated best represents the motion of the dumbbells after they are dropped?
11.11.8. Two ice skaters are holding hands and spinning around their combined center of mass, represented by the small black dot in Frame 1, with an angular momentum $L$. When the skaters are at the position shown in Frame 2, they release hands and move in opposite directions as shown in Frame 3. What is the angular momentum of the skaters in Frame 3?

a) zero kg $\cdot$ m$^2$/s

b) a value that is greater than zero kg $\cdot$ m$^2$/s, but less than $L$

c) a value less than $L$ and decreasing as they move further apart

d) a value that is greater than $L$

e) $L$
11.11.8. Two ice skaters are holding hands and spinning around their combined center of mass, represented by the small black dot in Frame 1, with an angular momentum $L$. When the skaters are at the position shown in Frame 2, they release hands and move in opposite directions as shown in Frame 3. What is the angular momentum of the skaters in Frame 3?

a) zero kg $\cdot$ m$^2$/s

b) a value that is greater than zero kg $\cdot$ m$^2$/s, but less than $L$

c) a value less than $L$ and decreasing as they move further apart

d) a value that is greater than $L$

e) $L$
11.12.1. The precession of a gyroscope is an example of which of the following principles?

a) conservation of rotational energy

b) conservation of angular momentum

c) conservation of linear momentum

d) conservation of total mechanical energy

e) conservation of torque
11.12.1. The precession of a gyroscope is an example of which of the following principles?

a) conservation of rotational energy

b) conservation of angular momentum

c) conservation of linear momentum

d) conservation of total mechanical energy

e) conservation of torque