

Rotational Dynamics Conceptually

Questions

- How do the clockwise and counterclockwise torques compare in a balanced system? In other words, which is greater? Explain.
They are both equal
- What is the law of inertia for rotation?
 $I = \sum mr^2$
- On what two quantities does rotational inertia depend on?
Mass and radius
- What is the effect of adding a weight to the end of a baseball bat used for practice swings?
Increase the rotational Kinetic Energy
- Why is it easier to swing your legs back and forth when they are bent?
Less change in angular momentum
- How can a person vary his or her rotational inertia?
Change their length or width.
- What motion does the torque produced by Earth's gravity impart to a vertically spinning bicycle wheel supported at only one end of its axle?
Precession
- Distinguish between rotational speed and rotational velocity.
Scalar vs Vector
- Consider two rotating bicycle wheels, one filled with air, the other filled with water. Which would be more difficult to stop rotating? Explain.
Water, more mass.
- The most popular gyroscope around is a Frisbee-flying disk. What is one function, besides being a place for gripping and catching, of its somewhat thicker curved rim?
Brings the center of mass down from the center of the disk and adds the inertia to the outside walls to keep it spinning.
- When is angular momentum conserved?
ALWAYS
- If a skater who is spinning pulls her arms in so as to reduce her rotational inertia to half, by how much will her rate of spin increase?
By 4 times!
- About which axis of the human body is rotation the easiest? About which axis of the body is rotation the most difficult?
**Axis between feet and head.
Axis through our waist**
- Distinguish between linear and rotational speed.
Linear speed is the speed you are moving in a straight line while rotational speed is the speed something is spinning about an axis.
- If the rotational speed of a platform is doubled, how does the rotational speed anywhere on the platform change? How does the linear speed anywhere change? Explain.
It is doubled while the linear speed is reduced going towards the center and increase going outward from the center.

16. If the rotational speed on a platform is unchanged but your distance from the center is doubled, what happens to your rotational speed? What happens to your linear speed? Explain.
Rotational speed remains the same, linear speed doubles.
17. If you replace the regular tires on your car with tires of larger diameter, how will your speedometer reading change? Explain.
It will go down because it is based on revolutions.
18. Larry and Annie cycle at the same speed. The tires on Larry's bike are larger diameter than those on Annie's bike. Which, if either, has the greatest rotational speed? The greatest linear speed? Explain.
Both have the same rotational speed. The larger one has the greater linear speed.
19. Why do people with long legs generally walk with a slower stride than people with short legs?
Their legs have a greater moment of inertia
20. Explain why a solid disc will always beat a hoop if they are both rolled down an incline.

The moment of inertia of a hoop is its mass times its radius squared (mr^2). The moment of inertia of a disk is $\frac{1}{2}$ its mass times its radius squared ($\frac{1}{2}mr^2$). The linear velocity of a rolling disk is twice the linear velocity of a hoop of equal mass.

The hoop and disk have equal mass. Place them at the top of the inclined plane and release them simultaneously. The disk reaches the bottom in nearly $\frac{1}{2}$ the time it takes the hoop.

21. A basketball player wishes to balance a ball on his fingertip. Why is it easier to balance a spinning ball as opposed to a stationary one? Explain using the ideas in this lesson.
The ball has rotational inertia
22. What is the law of inertia for rotating systems in terms of angular momentum?
 $I=L/\omega$
23. What does it mean to say that angular momentum is conserved?
If one object spins faster, some other object has to start to spin slower.