

ROTATIONAL MOTION—PART 1 (rotational kinematics and Newton's Laws)

1.) A rigid object is rotating in a counter clockwise sense around a fixed axis. The object rotates through an angle that is greater than 180° but less than 360° . Which of the following could represent the initial and final angular positions of this object?

- a. -2 radians, 1 radian
- b. 1 radian, 4 radians
- c. 0 radians, 5 radians
- d. 2 radians, 3 radians

2.) Suppose that the following changes in angular position occur in a 1 second time interval. Which change represents the lowest average angular speed?

- a. -2 radians, 1 radian
- b. 1 radian, 4 radians
- c. 0 radians, 5 radians
- d. 2 radians, 3 radians

3.) A rigid object is rotating with an angular speed $\omega > 0$. The angular velocity vector and the angular acceleration vector are anti-parallel. The angular speed of the rigid object is:

- a. clockwise and increasing.
- b. clockwise and decreasing.
- c. counterclockwise and increasing.
- d. counterclockwise and decreasing.

4.) Consider the following pairs of angular positions for the rigid object. Assuming that the object starts from rest at the initial angular position, that it moves counterclockwise with constant angular acceleration, and that it arrives at its final angular position with the same speed in all four cases, for which choice is the angular acceleration the highest?

- a. -2 radians, 1 radian
- b. 1 radian, 4 radians
- c. 0 radians, 5 radians
- d. 2 radians, 3 radians

5.) Billy and Teo are riding on a merry-go-round. Billy rides on a horse at the outer rim of the circular platform, one-and-a-half times as far from the center as Teo, who rides on an inner horse. When the merry-go-round is rotating at a constant angular speed, Billy's *angular* speed is:

- a. $3/2$ that of Teo's.
- b. the same as Teo's.
- c. $2/3$ that of Teo's.
- d. impossible to determine.

6.) Billy and Teo are riding on a merry-go-round. Billy rides on a horse at the outer rim of the circular platform, one-and-a-half times as far from the center as Teo, who rides on an inner horse. When the merry-go-round is rotating at a constant angular speed, Billy's *tangential* speed is:

- a. $3/2$ that of Teo's.
- b. the same as Teo's.
- c. $2/3$ that of Teo's.
- d. impossible to determine

7. A hoop and a solid disk both have the same radius and mass and negligible thickness. Assume that they are both rotating with the same constant angular speed. Which has the higher rotational kinetic energy?

- a. the hoop
- b. the disk
- c. They both have the same rotational kinetic energy.
- d. impossible to determine

8. Which of the following screwdrivers would likely be the most effective to loosen a stubborn screw? Assume the size of the driver head is the same in each case.

- a. one with a handle that is 8 cm long and 2 cm wide
- b. one with a handle that is 12 cm long and 2 cm wide
- c. one with a handle that is 8 cm long and 4 cm wide
- d. They would all loosen the screw just as effectively.

9. With which wrench would you have the best success in loosening a bolt? Assume that the socket part of the wrench is the same size in each case.

- a. one in which the handle is 10 cm long and 2 cm wide
- b. one in which the handle is 12 cm long and 2 cm wide
- c. one in which the handle is 10 cm long and 4cm wide
- d. They would all loosen the bolt just as effectively.

10. Your electric drill has been on for a period of time and you turn it off. The time interval for the rotating bit to come to rest due to frictional torque is Δt . You replace the bit with a smaller one that results in a smaller moment of inertia of the entire rotating mechanism of the drill by a factor of $2/3$. When this smaller bit is rotated at the same angular speed as the first and the drill is turned off, the frictional torque remains the same as that for the previous situation. The time for this second bit to come to rest is

- a. $\frac{4}{9}\Delta t$
- b. $\frac{2}{3}\Delta t$
- c. $\frac{3}{2}\Delta t$
- d. $\frac{9}{4}\Delta t$

11. A ball rolls without slipping down incline A, starting from rest. At the same time, a box starts from rest and slides down incline B, which is identical to incline A except it is frictionless. Which has a larger translational speed at the bottom of the ramp?

- a. They have the same translational speed at the bottom of the ramp.
- b. the ball
- c. the box
- d. It is impossible to determine.

12. Complete the following sentence: "The moment of inertia of an object

- a. depends on the rotational speed of the object."
- b. will be greater for a larger-massed object than for a smaller-massed object."
- c. is not a function of the object's mass."
- d. is a function of the axis about which the object is spun."

13. If you see an object rotating, is there necessarily a net nonzero torque acting on it?

- a. Yes.
- b. Only if it is rotating with a constant angular speed.
- c. No, a net nonzero torque would not cause an object to rotate.
- d. Only if the object's angular speed changes.

Solutions: c, d, d, d, b, a, a, c, b, b, c, d, d