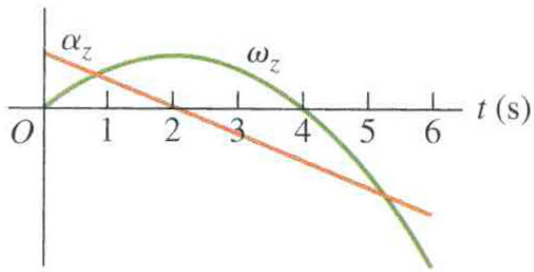
# Rotational Kinematics
## Concept Questions

**Question 1** The figure shows a graph of $\omega_z$ and $\alpha_z$ versus time for a particular rotating body.



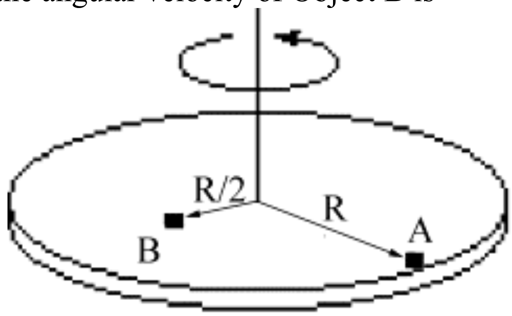

During which time intervals is the rotation slowing down?

1. 0 < t < 2 s
2. 2 s < t < 4 s
3. 4 s < t < 6 s
4. None of the intervals.
5. Two of the intervals.
6. Three of the intervals.

**Answer 2. During the interval from** 2 s < t < 4 s, the magnitude of the angular speed is decreasing so the rotation is slowing down. For all other intervals the magnitude of the angular speed is increasing hence the rotation is increasing. Note that at t= 4 s. The angular velocity reverses direction and so the rotation speeding up in the opposite direction.

**Question** 2

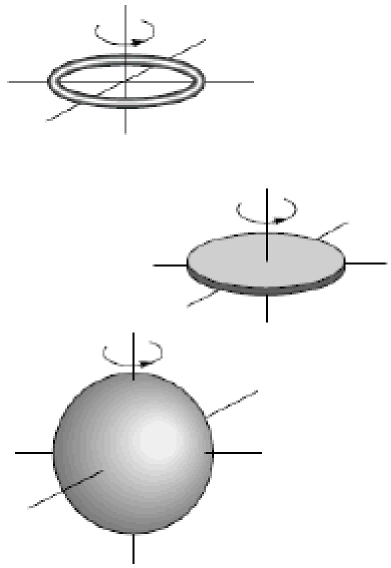
Object A sits at the outer edge (rim) of a merry-go-round, and object B sits halfway between the rim and the axis of rotation. The merry-go-round makes a complete revolution once every thirty seconds. The magnitude of the angular velocity of Object B is




1. half the angular speed of Object A .
2. the same as the angular speed of Object A .
3. twice the angular speed of Object A .
4. impossible to determine

**Answer: 2**. All points in a rigid body rotate with the same angular velocity.

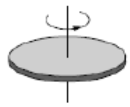
**Question 3** Which has the smallest I about its center?

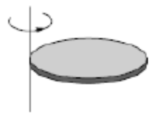


1. Ring (mass $m$, radius $R$)
2. Disc (mass $m$, radius $R$)
3. Sphere (mass $m$, radius $R$)
4. All have the same I.

**Answer 3.** The mass of the sphere is on average closer to an axis of rotation passing through its center then in the case of the ring or the disc so the moment of inertia of the sphere about an axis passing through its center is smallest.

**Question 4** Which gives the largest I for the disc?

1) 

2) 

3) 

4) All have the same I.

**Answer 2.** The mass of the ring is furthest on average from an axis passing perpendicular to the plane of the disc and passing through a point on the edge of the disc.

**Question 5 Rotational Kinetic Energy** A disk with mass $m$ and radius $R$ is spinning with angular speed $\omega$ about an axis that passes through the rim of the disk perpendicular to its plane. The moment of inertia about cm is $I_{cm} = (1/2)mR^2$. Its total kinetic energy is:

1. $(1/4)mR^2\omega^2$

2. $(1/2)mR^2\omega^2$

3. $(3/4)mR^2\omega^2$

4. $(1/4)mR\omega^2$

5. $(1/2)mR\omega^2$

6. $(1/4)mR\omega$

**Answer 3.** The parallel axis theorem states the moment of inertia about an axis passing perpendicular to the plane of the disc and passing through a point on the edge of the disc is equal to $I_{edge} = I_{cm} + mR^2$. The moment of inertia about an axis passing perpendicular to the plane of the disc and passing through the center of mass of the disc is equal to $I_{cm} = (1/2)mR^2$. Therefore $I_{edge} = (3/2)mR^2$. The kinetic energy is then $K = (1/2)I_{edge}\omega^2 = (3/4)mR^2\omega^2$.