What is Angular Momentum?

Worksheet

Angular momentum is the rotational analogue of linear momentum: L = I, where I is the moment of inertia and is the angular velocity, measured in kgm/s.

@vec{L} = @vec{r} \times @vec{p} = I@omega

Questions

1. A wheel has I = 3 kgm and = 5 rad/s. What is L?

A) 8 kgm/s
B) 15 kgm/s
C) 1.67 kgm/s
D) 53 kgm/s

2. What is the SI unit of angular momentum?

A) N/m
B) kgm/s
C) kgm/s
D) rad/s

3. A skater spinning with arms out has a larger I than with arms in. If L is conserved, arms in means:

A) slower spin
B) faster spin
C) same spin
D) spin stops

4. Angular momentum is the rotational analogue of:

A) force
B) linear momentum
C) kinetic energy
D) torque

5. A flywheel has a moment of inertia of 2 kgm and spins at 10 rad/s. Find its angular momentum.

6. A figure skater has I = 4 kgm while spinning at = 3 rad/s. Find L.

7. The same skater pulls her arms in, dropping I from 6 kgm to 2 kgm while spinning at = 2 rad/s. If angular momentum is conserved, find her new angular velocity.

8. Define: What is angular momentum?

9. Define: What does angular momentum depend on?

10. Define: Is angular momentum conserved?

Answer Key

1. B) 15 kgm/s - L = I = 3 5 = 15 kgm/s.
2. B) kgm/s - Angular momentum has units of kgm/s (I in kgm, in rad/s).
3. B) faster spin - Smaller I with constant L means larger - faster spin.
4. B) linear momentum - Just as p = mv describes linear motion, L = I describes rotational motion.
5. L = I L = 2 10 L = 20 kgm/s
6. L = I L = 4 3 L = 12 kgm/s
7. L is conserved: L = I L = 6 2 = 12 kgm/s = L / I = 12 / 2 = 6 rad/s
8. The rotational equivalent of momentum: L = I, measured in kgm/s.
9. Moment of inertia (mass distribution) and angular velocity (spin rate).
10. Yes, in a closed system with no external torque - this explains the spinning skater effect.