HW_10_Angular_Momentum_Ch_11

Problems: 19, 25, 29, 37, 42, 47, 53, 55, 58, 65, 73, Total = 11

19. What is the angular velocity of a 75.0-cm-diameter tire on an automobile traveling at 90.0 km/h?

25. A rigid body with a cylindrical cross-section is released from the top of a 30° incline. It rolls 10.0 m to the bottom in 2.60 s. Find the moment of inertia of the body in terms of its mass *m* and radius *r*.

29. A 40.0-kg solid cylinder is rolling across a horizontal surface at a speed of 6.0 m/s. How much work is required to stop it?

37. A particle of mass 5.0 kg has position vector $\vec{\mathbf{r}} = (2.0\,\hat{\mathbf{i}} - 3.0\,\hat{\mathbf{j}})\text{m}$ at a particular instant of time when its velocity is $\vec{\mathbf{v}} = (3.0\,\hat{\mathbf{i}})\text{m/s}$ with respect to the origin. (a) What is the angular momentum of the particle? (b) If a force $\vec{\mathbf{F}} = 5.0\,\hat{\mathbf{j}}\ \text{N}$ acts on the particle at this instant, what is the torque about the origin?

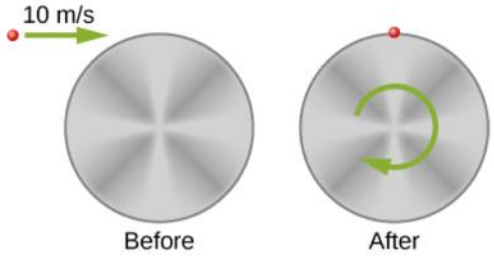
42. At a particular instant, a 1.0-kg particle's position is $\vec{\mathbf{r}} = (2.0\,\hat{\mathbf{i}} - 4.0\,\hat{\mathbf{j}} + 6.0\,\hat{\mathbf{k}})\text{m}$, its velocity is $\vec{\mathbf{v}} = (-1.0\,\hat{\mathbf{i}} + 4.0\,\hat{\mathbf{j}} + 1.0\,\hat{\mathbf{k}})\text{m/s}$, and the force on it is $\vec{\mathbf{F}} = (10.0\,\hat{\mathbf{i}} + 15.0\,\hat{\mathbf{j}})\text{N}$. (a) What is the angular momentum of the particle about the origin? (b) What is the torque on the particle about the origin? (c) What is the time rate of change of the particle's angular momentum at this instant?

47. A propeller consists of two blades each 3.0 m in length and mass 120 kg each. The propeller can be approximated by a single rod rotating about its center of mass. The propeller starts from rest and rotates up to 1200 rpm in 30 seconds at a constant rate. (a) What is the angular momentum of the propeller at $t = 10\,\text{s}; t = 20\,\text{s}$? (b) What is the torque on the propeller?

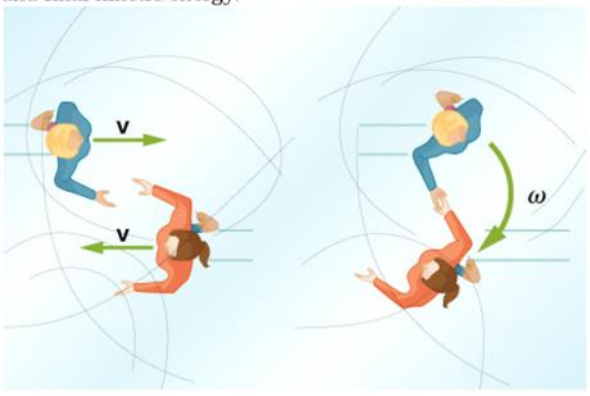
53. The Sun's mass is $2.0 \times 10^{30}\,\text{kg}$, its radius is $7.0 \times 10^{5}\ \text{km}$, and it has a rotational period of approximately 28 days. If the Sun should collapse into a white dwarf of radius $3.5 \times 10^{3}\ \text{km}$, what would its period be if no mass were ejected and a sphere of uniform density can model the Sun both before and after?

55. A diver off the high board imparts an initial rotation with his body fully extended before going into a tuck and executing three back somersaults before hitting the water. If his moment of inertia before the tuck is $16.9\,\text{kg}\cdot\text{m}^2$ and after the tuck during the somersaults is $4.2\,\text{kg}\cdot\text{m}^2$, what rotation rate must he impart to his body directly off the board and before the tuck if he takes 1.4 s to execute the somersaults before hitting the water?

58. Shown below is a small particle of mass 20 g that is moving at a speed of 10.0 m/s when it collides and sticks to the edge of a uniform solid cylinder. The cylinder is free to rotate about its axis through its center and is perpendicular to the page. The cylinder has a mass of 0.5 kg and a radius of 10 cm, and is initially at rest. (a) What is the angular velocity of the system after the collision? (b) How much kinetic energy is lost in the collision?



65. Twin skaters approach one another as shown below and lock hands. (a) Calculate their final angular velocity, given each had an initial speed of 2.50 m/s relative to the ice. Each has a mass of 70.0 kg, and each has a center of mass located 0.800 m from their locked hands. You may approximate their moments of inertia to be that of point masses at this radius. (b) Compare the initial kinetic energy and final kinetic energy.



(a) (b)

73. A space station consists of a giant rotating hollow cylinder of mass 10^6 kg including people on the station and a radius of 100.00 m. It is rotating in space at 3.30 rev/min in order to produce artificial gravity. If 100 people of an average mass of 65.00 kg spacewalk to an awaiting spaceship, what is the new rotation rate when all the people are off the station?