Angular momentum Problems

1. A 34 kg child runs with a speed of 2.80 m/s tangential to the rim of a stationary merry go round. The merry go round has a radius of 2.31 m and a mass of 191 kg. When the child jumps on the merry go round, the entire system begins to rotate. What is the angular speed of the system after the child jumps on? What is the angular momentum of the system after the child jumps on? What is the change in kinetic energy of the child/merry go round system during the collision?
2. What initial speed does the child have if it takes her 22.5 s to make one complete revolution after she jumps on the merry go round?
3. An object consisting of three masses joined by light rods making an L shape. The masses are situated as follows: 1.2 kg located at the origin, 9.0 kg located on the y axis at (0,1.0) and a 2.5 kg mass located at the point (2.0,0). If the object is to be rotated so that it has an angular acceleration of 1.20 Rad/s2, what torque must be applied if it is rotated about the x-axis? The y-axis, or the z axis (through the origin but up out of the page?
4. Calculate the angular momentum of the earth about its own axis due to its daily rotation. (Assume the earth is a uniform sphere)
5. A disc shaped merry go round of radius 2.63 m and mass of 155 kg rotates freely with an angular speed of 0.0641 rev/s. A 59.4 kg person running tangential to the rim of the merry go round at 3.41 m/s jumps onto the rim and holds on. Before jumping onto the merry go round, the person was moving the same direction as the merry go round was spinning. What is the final angular speed of the marry go round?
6. A 2.0 kg block hangs from a massless cord from a pulley with a mass of 1.375 kg and a radius R of 0.040 m. When the block is released, it fall and the cord does not slip. Find the angular acceleration of the pulley and the tension in the cord as the block falls.
7. A solid disc rotates in the horizontal plane at an angular velocity of 0.067 rad/s with respect to an axis perpendicular to the disc at its center. The moment of inertia of the disc is 0.10 kg●m2 From above, sand is dropped straight down on the disc , so that a thin uniform ring of sand is formed at a distance of 0.40 m from the axis. The sand in the ring has a mass of 0.50 kg. After all the sand is in place, what is the angular velocity of the disc?
8. A thin walled cylinder of mass 1.5 kg and radius 0.15 m sits on a ramp so that its center of mass is 0.50 m above where its center of mass will be when it rolls off the ramp onto the level surface below. Determine the final translational velocity of the cylinder when it leaves the ramp as well as the angular velocity of a particle on the edge of the cylinder.
9. Two discs are rotating about the same fixed axis. Disc A has a moment of inertia of 3.4 kg●m2 and an angular velocity of +7.2 rad/s. Disc B is rotating with an angular velocity of – 9.8 rad/s. The two discs are linked together without the aid of any external torques, so that they rotate as a single unit with an angular velocity of – 2.4 rad/s. the axis of rotation for this unit is the same as that for the separate discs. What is the moment of inertia of disc B?
10. A man stands on a turntable with a 5.0 kg mass in each hand outstretched. He is set into rotation about a vertical axis, making one revolution every 2.0 s. The moment of inertia of the man without the dumb bells is 6.0 kg●m2, and the dumb bells are initially 1.0 m from the axis of rotation and they are at 0.20 m from the axis at the end. Find the new angular velocity of the man after he lowers his hands.
11. A door 1.0 m with a mass of 15 kg wide is hinged at one side so that it is free to rotate about a vertical axis. A bullet with a mass of 10.0 g and a speed of 400 m/s is fired into the door, perpendicular to the plane of the door, and embeds itself exactly in the center of the door. Find the angular velocity of the door just after the impact. Is kinetic energy conserved?
12. A small disc of mass M1= 50.0 g is connected to a larger disc of mass M2 = 200.0 g such that they have the same common axis of rotation. The small disc has a radius of 10.0 cm and the larger disc has a radius of 30.0 cm. A mass of 35.0 g is connected to a string that is wrapped around the small disc such that it would cause the disc to rotate counter clockwise if it were released. There is a smaller mass of 25.0 g suspended from the larger disc such that it would cause the disc to rotate clockwise if it were released. (An Atwood’s machine with two different radii.) Find the moment of inertia of each disc, the moment of inertia of the combined discs, the net torque acting on the discs, the angular acceleration of the discs, the angular velocity of the discs at 4.00 s, the kinetic energy of the discs at 4.00 s and the angular momentum of the discs at 4.00 s.
13. One end of a string is wrapped around a pulley and the other end is attached to the ceiling so that the pulley is 3.00 m above the floor. The mass of the pulley is 200.0 g and it has a radius of 10.0 cm. The pulley is released from rest and allowed to fall. Find the initial total energy of the system and, the velocity of the pulley just before it hits the floor.
14. Same problem as above, but use Newton’s second law for rotational motion to find angular acceleration of the cylinder and the tension in the string.



1. A thin uniform rod of mass M1 = 0.500 kg and length 0.80 m is initially at rest on a frictionless horizontal surface. The moment of inertia of the rod about its center of mass is 1/12 (M1L2). As shown in figure 1, the rod is struck at point P by a mass m2 = 0.250 kg whose initial velocity v is perpendicular to the rod and equal to 3.0 m/s. After the collision, m2 has a velocity of – 1.5 m/s as shown in figure II.

Determine the velocity of the center of mass of the rod after the collision.

Determine the angular velocity of the rod about its center of mass after the collision.