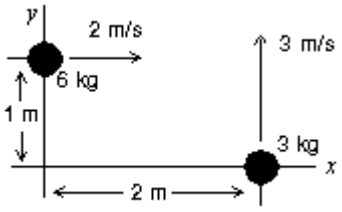
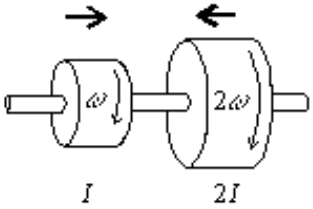
Chapter 11 (Rolling, Torque & Angular Momentum)

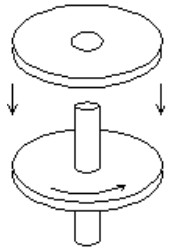
1- A 2.0-kg block is located on the x-axis 3.0 m from the origin and is acted upon by a force **F** = 8.0**i** N. Find the net torque acting on the block relative to the origin. (A: 0.0 N.m)

2- Force **F** = (2.0**i** –3.0**j**) N, acts on a mass located at **r** = (0.50**i** +2.0**j**) m. Find the resulting torque (in N.m) about the origin. (A: –5.5 **k**)

3- Two objects are moving in the x,y plane as shown. The magnitude of their total angular momentum (about the origin O) is (in kg.m^2/s): (A: 6 kg.m^2/s)



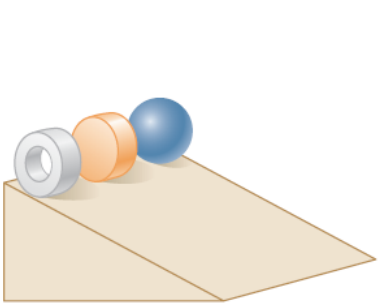


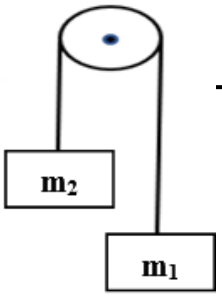


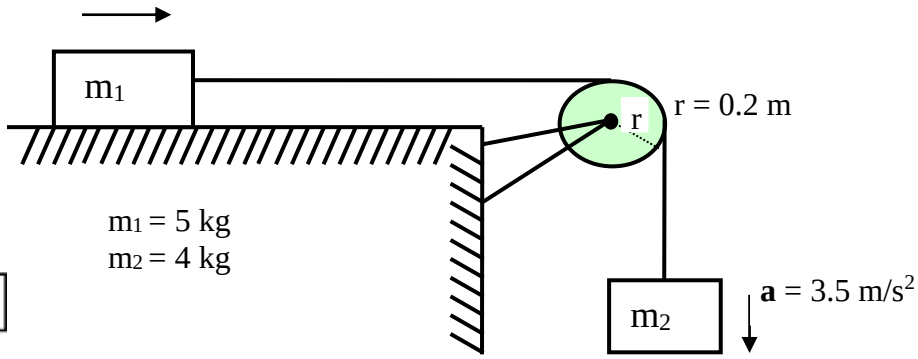
4- Two disks are mounted on low-friction bearings on a common shaft. The first disc has rotational inertia I and is spinning with angular velocity *w*. The second disc has rotational inertia 2I and is spinning in the same direction as the first disc with angular velocity 2*w* as shown. The two disks are slowly forced toward each other along the shaft until they couple and have a final common angular velocity of: (A: 5*w*/3)

5- A wheel, mounted on a vertical shaft of negligible rotational inertia, is rotating at 500 rpm. Another identical (but not rotating) wheel is suddenly dropped onto the same shaft as shown. The resultant combination of the two wheels and shaft will rotate at: (A: 250 rpm)

6- Three objects (with mass *M*, radius *R* and moment of inertia *I*) of uniform density: a solid sphere, a solid cylinder (disk), and a thin cylindrical shell (hoop) are placed at the top of an inclined plane (with height *h*), as shown in the figure. Each object is released from rest and allowed to roll down the incline without slipping. Find the center of the mass' speed (v_{com}) at the bottom of the incline and determine the order in which the objects reach the bottom of the incline, ranking them from first to last. (A: $v_{com} = [(2gh)/(1 + (I_{com}/MR^2))]^{½}$, the sphere (largest *a*) arrives first, then the disk, and the hoop last).







7- Two masses, m_1 and m_2, are connected by a massless string that passes over a pulley of radius ***R*** and moment of inertia ***I***, as illustrated in the figure. Determine the magnitude of the system linear acceleration. (A: $a = [(m_2-m_1)g]/[m_2+m_1+I/R^2]$)

8- A mass (m_1 = 5.0 kg) which slides on a frictionless surface is connected by a light cord to a mass (m_2 = 4.0 kg), as shown in Figure 7. The pulley (radius = 0.20 m) rotates about a frictionless axle. The acceleration of m_2 is 3.5 m/s^2. What is the rotational inertia of the pulley? (A: 0.088 kg.m^2)

9- An object of mass m=100 g and velocity =Vo is fired onto one end of a uniform thin rod (L=0.4 m, M = 1.0 kg) initially at rest. The rod can rotate freely about an axis through its center (O). The object sticks to the rod after collision. The angular velocity of the system (rod + object) is 10 rad/s immediately after the collision. Calculate Vo. (A: 8.7 m/s)

10- A 2.5 kg block travels around a 0.50 m radius circle with an angular velocity of 12 rad/s. Find the magnitude of the angular momentum of the block about the center of the circle. (A: 7.5 $kg.m^2/s$)

11- A solid ball, whose radius R is 10 cm and whose mass M is 8.5 kg, rolls smoothly from rest down a 25 deg inclined plane whose length L is 5.0 m. What is the speed of the center of mass of the ball when it reaches the bottom of the inclined plane? (A: 5.4 m/s)

Summary of Chapter 11 topics

1- Understanding the Rolling, Forces and Kinetic Energy of Rolling.
2- Understanding the Torque and Angular moment, Newton's 2nd Law in Angular form.
3- Understanding the Rigid Body and Conservation of Angular Momentum.