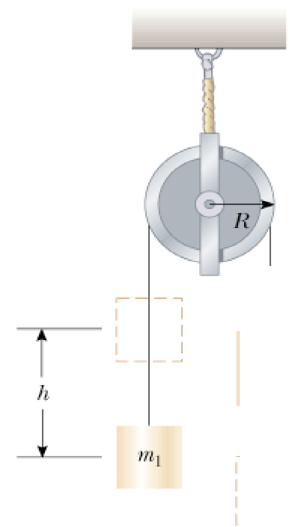
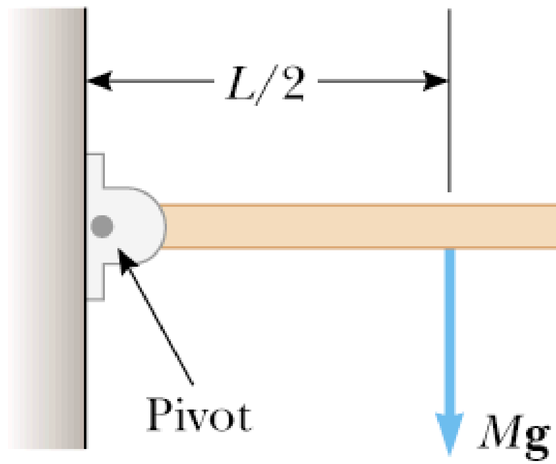
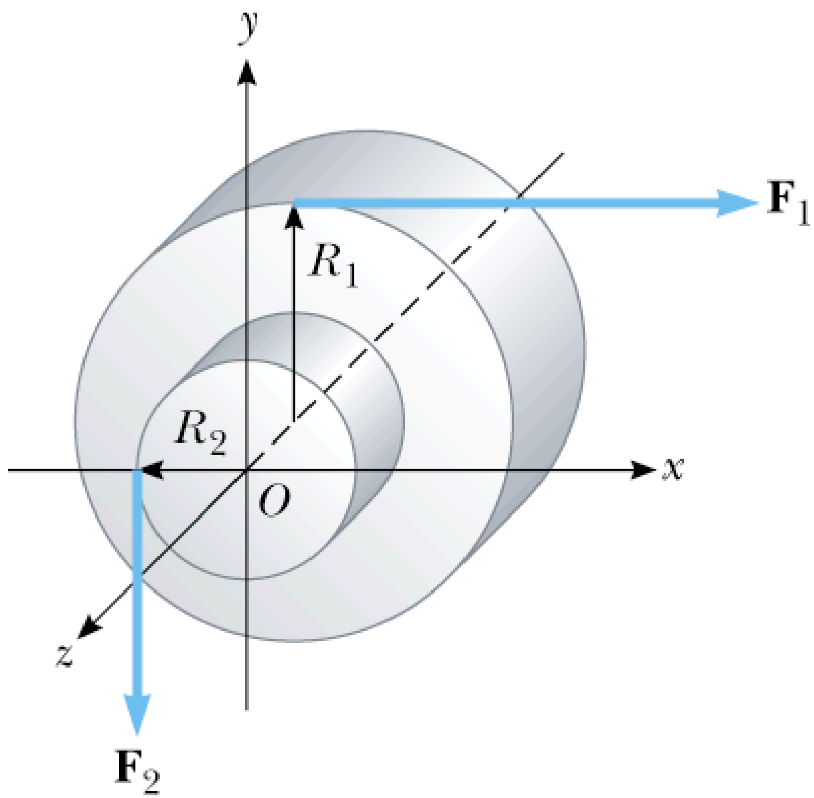
A dentist's drill starts from rest. After 3.20 s of constant angular acceleration, it turns at a rate of 2.51×10^4 rev/min. (a) Find the drill's angular acceleration. (b) Determine the angle (in radians) through which the drill rotates during this period.



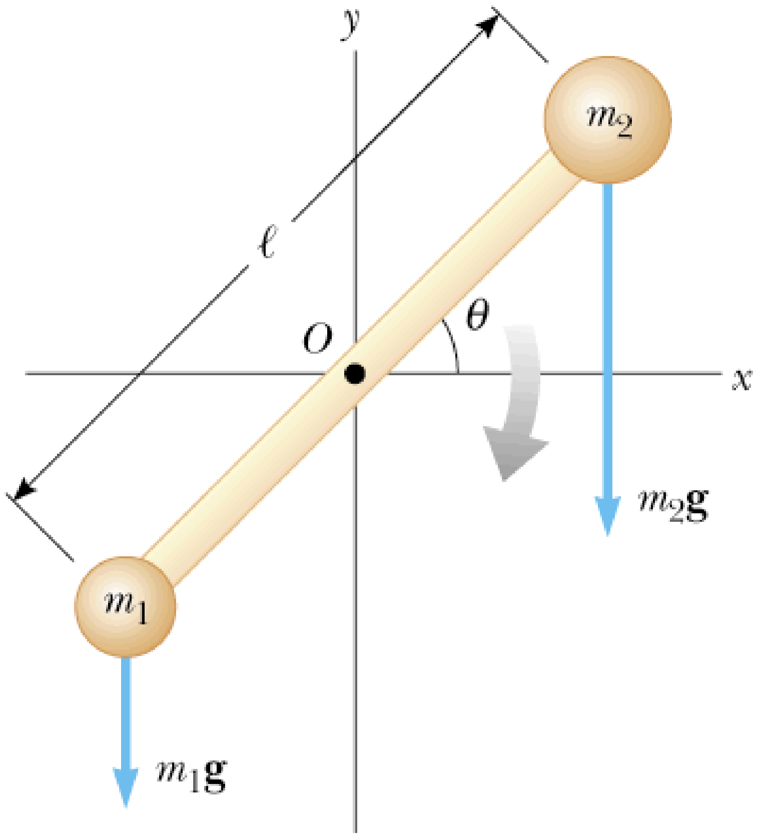
What is the angular acceleration of a wheel of radius R and mass M (and moment of inertial I) where the wheel has a block of mass m_1 attached to it which produces the torque.



A uniform rod of length L and Mass M is attached at one end to a frictionless pivot. If the rod is released from rest from the horizontal position, what is the initial angular acceleration of the rod, and the initial linear acceleration of its right end?



A one-piece cylinder is shaped as shown below. The cylinder is free to rotate about the central axis. A rope wrapped around the drum (of radius R_1) exerts a force F_1, while a rope wrapped around the hub (of radius R_2) exerts a force F_2. What is the net Torque on the cylinder about the axis of rotation, if R_1 =1m, R_2 =0.5m, F_1 =5N, and F_2 =15N?



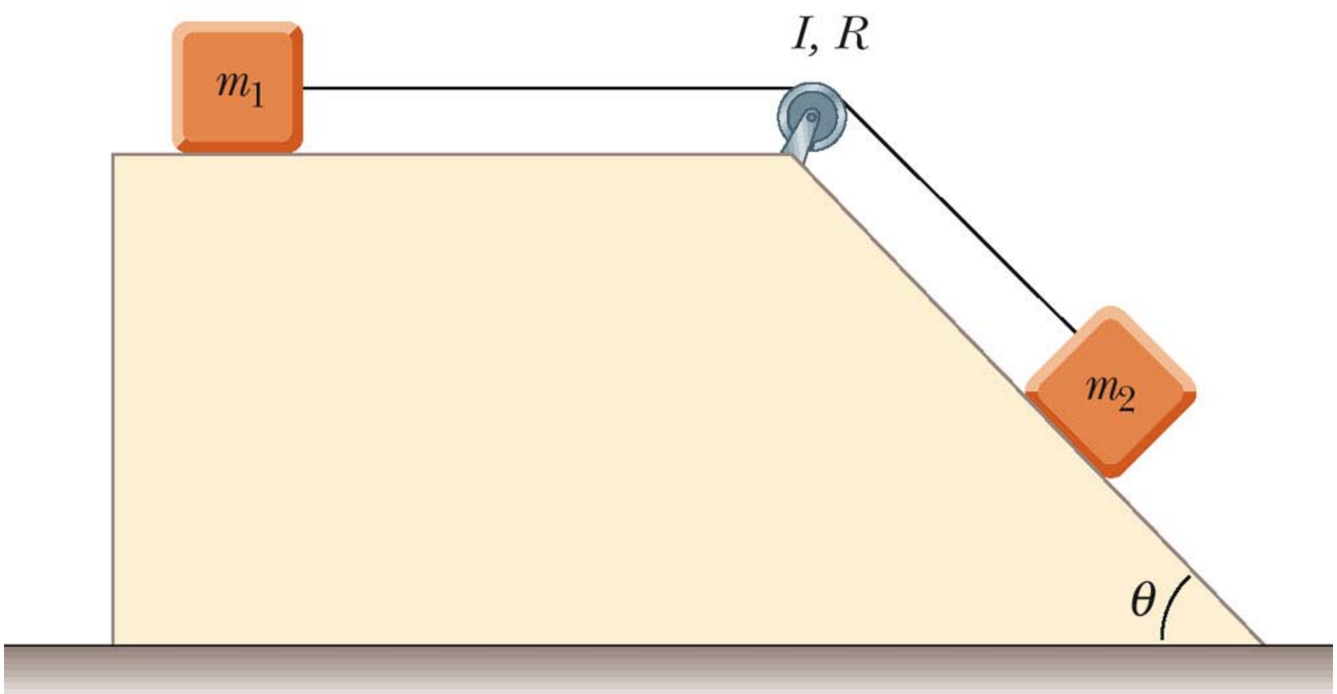
Consider a rigid rod of length *l* and mass *M* that rotates about its center with angular speed ω. What is the angular momentum of the system?

A student sits on a freely rotating stool holding two weights, each of which has a mass of 3.0kg. When the student's arms are fully extended horizontally, the weights are 1.0m from the axis of rotation and the system rotates with an angular speed of 0.75 rad/s. The moment of inertia of the student and the stool is 3.0 kgm^2 and is assumed to be constant. The student pulls the weights inward horizontally to a position 0.30m from the rotation axis.

a. What is the new angular speed?
b. What are the initial and final kinetic energies of the student?
c. If your answers to part b are not the same number, what happened in the system in order for there to be an increase or decrease in the angular velocity?

The pumpkin on the Nott revisited! Suppose that the Nott Memorial is topped with an approximately hemispherical dome of radius R. Somehow an individual has balanced a spherical pumpkin at the top to the dome at an angle of $\theta_i = 0^o$ with the vertical. Suppose that a gust of wind starts the pumpkin rolling from rest. It loses contact with the dome when the line from the center of the hemispherical dome to the pumpkin makes a certain angle with respect to the vertical. At what angle does this happen? How does this angle compare to 48.2^o?

A block of mass m_1 = 2kg and a block of mass m_2 = 6kg are connected by a massless string over a pulley in the shape of a solid disk having a radius R = 0.25m and a mass M = 10kg. These blocks are allowed to move on a fixed wedge of angle $\theta = 30^o$. The coefficient of kinetic friction is 0.36 for both blocks. What is the acceleration of the blocks and what are the tensions in the string on both sides of the pulley?



When a bumblebee of mass $m = 0.25g$, begins feeding at a suitable flower for nectar, it hovers above the flower as shown below by beating its wings very rapidly. The wings are required to provide sideways stability as well as the lifting force necessary to overcome the force of gravity. The wings are designed so that during the downstroke the wings push down on the air and the reaction force of the air creates lift that makes the bumblebee hover. On the upstroke the force is negligibly small.

a. What is the net lifting force due to the wings of the bumblebee?
b. Given that $d = r\theta$, what is the work done by the wings of the hovering bumblebee during a downstoke assuming that the wing has a length of 1cm? (Hint θ needs to be in *radians* and *1 radian* $= 57.3^{o}$)
c. During the upstroke the gravitational force causes the bumblebee to fall through a height $h = 0.1mm$ and this takes a time Dt. The downstoke then returns the bumblebee to its original height. What is the frequency of the wingbeats?
d. The downstroke returns the bumblebee back to its original height. How much energy does the downstroke need to produce to accomplish this raising?