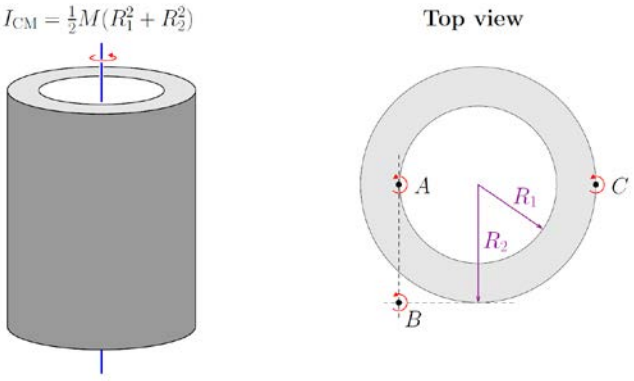
ROTATION OF RIGID BODIES, MOMENTS OF INERTIA

1. **Computer Disk:** A computer disk is turned on starting from rest and has constant angular acceleration. If it took time τ for the drive to make its *second* complete revolution.
   (a) how long did it take to make the first complete revolution?
   (b) what is its angular acceleration, in rad/s^2?

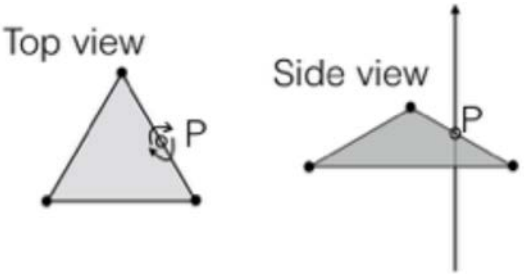
2. **Power Plant**: It has been argued that power plants should make use of off-peak hours to generate mechanical energy and store it until it is needed during peak load times. One suggestion has been to store the energy in large flywheels spinning on nearly frictionless ball bearings. Consider a flywheel made of iron (density 7800 kg/m^3) in the shape of a 10.0 cm thick uniform disk.
   (a) What would the diameter of such a disk need to be if it is to store 10.0 megajoules of kinetic energy when spinning at 90.0 rpm about an axis perpendicular to the disk at its center?
   (b) What would be the centripetal acceleration of a point on its rim when spinning at this rate?

3. **Mass on a Disk**: A uniform, solid disk with mass m and Radius R is pivoted about a horizontal axis through its center. A small object of the same mass m is glued to the rim of the disk. If the disk is released from rest with the small object at the end of a horizontal radius, find the angular speed when the small object is directly below the axis.

4. **Cylinder:** Consider the thin-walled hollow cylinder shown below which has a moment of inertia about its center of mass $I_{CM} = \frac{1}{2}M(R_1^2 + R_2^2)$. On the right side of the figure, three different axes of rotation are shown, all parallel to the axis through the center-of-mass shown on the left: A is on the inner radius, B is to the left of center by R_1 and below the center by R_2, and C is on the outer surface of the cylinder. Find moment of inertia corresponding to each of the axes of rotation.



5. **Triangle**. What is the moment of inertia of a system of three identical point particles with masses m located at the vertices of an equilateral triangle with sides $2\sqrt{3}l$ for the rotation axis perpendicular to the plane of the triangle and passing through the middle of one of the sides.



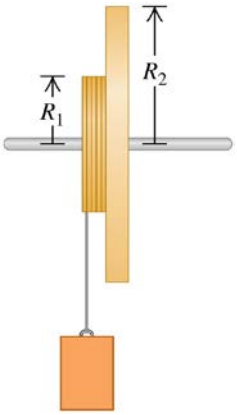
6. **Two Masses on a Rod**: A slender rod length is L and has mass M. A small m_1 sphere is welded to one end of the rod, and a small m_2 sphere is welded to the other end. The rod, pivoting about a stationary, frictionless axis at its center, is held horizontal and released from rest. What is the linear speed of the m_2 sphere as it passes through its lowest point?

7. **Rusty Wheel**: A thin, light wire is wrapped around the rim of a wheel. The wheel rotates about a stationary horizontal axle that passes through the center of the wheel. The wheel has radius R and moment of inertia for rotation about the axle of I. A small block with mass m is suspended from the free end of the wire. When the system is released from rest, the block descends with constant acceleration. The bearings in the wheel at the axle are rusty, so friction there does $-W$ of work as the block descends H. What is the magnitude of the angular velocity of the wheel after the block has descended H?

8. **Rotating Cylinder**: A thin, light wire is wrapped around the rim of a solid cylinder, with a small block suspended from the free end of the wire. The block, with a mass of 12.0 kg, is released from rest and falls, causing the uniform 10.0 kg cylinder of diameter 30.0 cm to turn about a frictionless axle through its center. How far will the mass have to descend to give the cylinder 480 J of kinetic energy?

9. **Slowing down**: Suppose a roulette wheel is spinning at 1 rev/s
   (a) How long will it take for the wheel to come to rest if it experiences an angular acceleration of -0.02 rad/s^2?
   (b) How many rotations will it complete in that time?

10. **Two Metal Disks**: Two metal disks, one with radius R_1 and mass M_1 and the other with radius R_2 and mass M_2, are welded together and mounted on a frictionless axis through their common center (see figure).



   (a) What is the total moment of inertia of the two disks?
   (b) A light string is wrapped around the edge of the smaller disk, and a m block is suspended form the free end of the string. If the block is released from rest at a distance L above the floor, what is its speed just before it strikes the floor?
   (c) Repeat part (b), this time with the string wrapped around the edge of the larger disk. In which case is the final speed of the block greater? Explain.