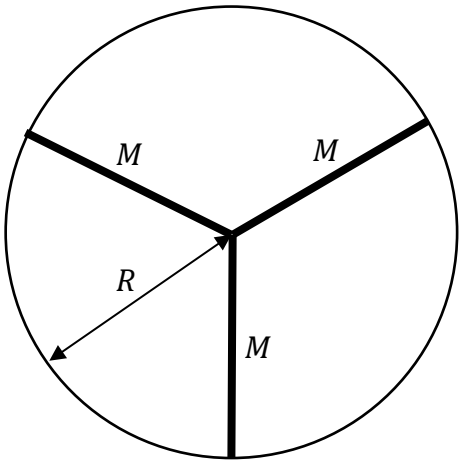
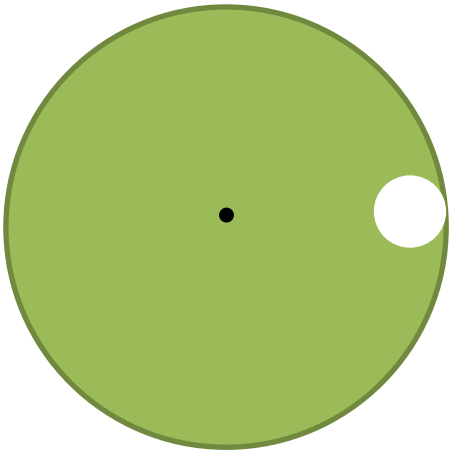
Problem 1.
A revolving door consists of three vertical, thin, homogeneous wings, each with mass $M$. The length of the wings is $R$. The revolving door is shown from above in the figure. The three wings are attached to each other and can rotate freely about a vertical rotation axis through the center of the revolving door.




The revolving door's moment of inertia with respect to the rotation axis is

A) $I = MR^2$
B) $I = \frac{1}{12}MR^2$
C) $I = \frac{1}{2}MR^2$
D) $I = \frac{1}{3}MR^2$
E) $I = 3MR^2$
F) $I = 2MR^2$
G) Do not know

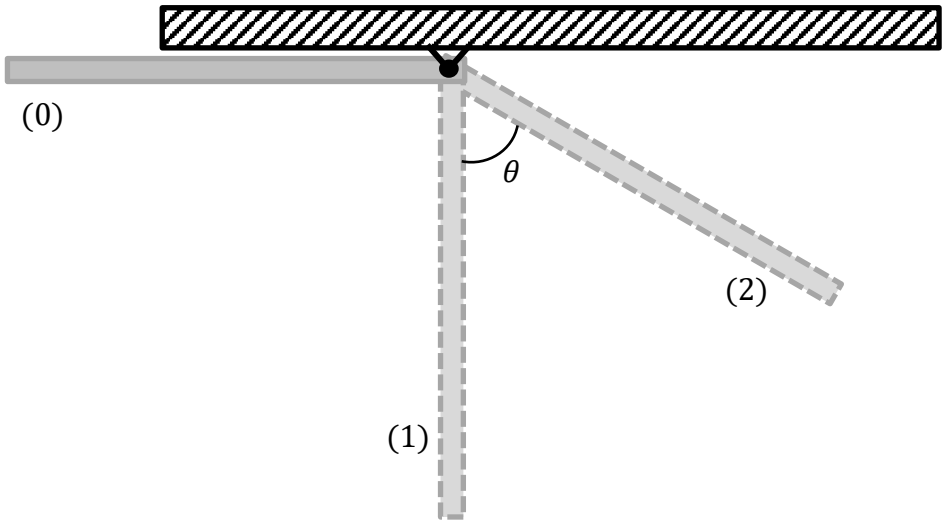
Problem 2.
A thin, homogeneous cylinder has mass $M$ and radius $6R$. A hole with radius $R$ is drilled into the right side of the cylinder.



What is the moment of inertia of the cylinder with the hole with respect to an axis perpendicular to the paper's plane and going through the center of the cylinder?

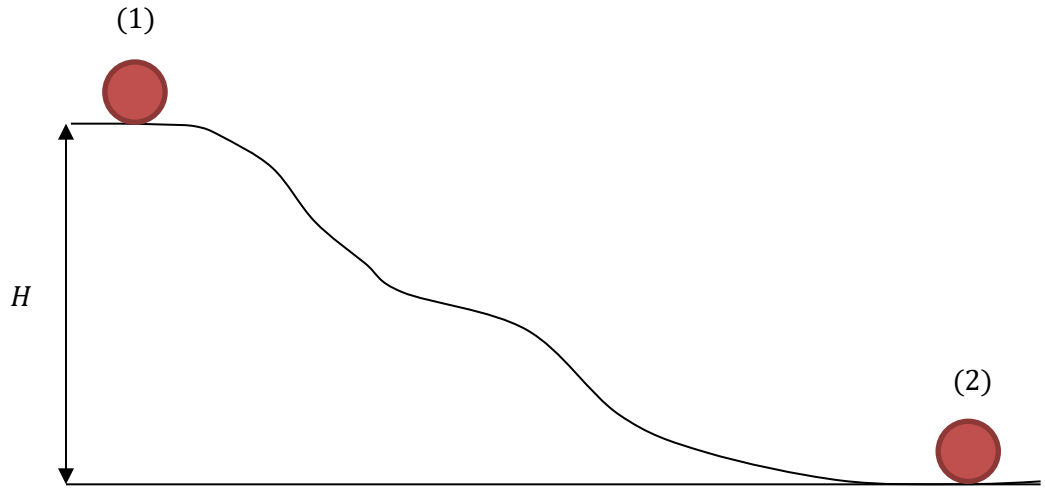
A) $I = \frac{1295}{72}MR^2$
B) $I = \frac{415}{24}MR^2$
C) $I = \frac{415}{24}MR^2$
D) $I = 18MR^2$
E) $I = 9MR^2$
F) Do not know

Problem 3.
A thin, homogeneous rod with mass $6M$ and length $2L$ can rotate freely about a horizontal rotation axis, which goes through one end of the rod. The rod is released from rest in a horizontal position (0). During its rotation, the rod is at vertical position (1) at one point in time, and sometime later, it is at an angle $\theta$ with the vertical (2).




a) Determine the angular velocity, $\omega_1$, when the rod is vertical (1).
b) Determine the speed of the center of mass, $v_{\text{cm}}$, of the rod when it is at $\theta$ to the vertical (2).

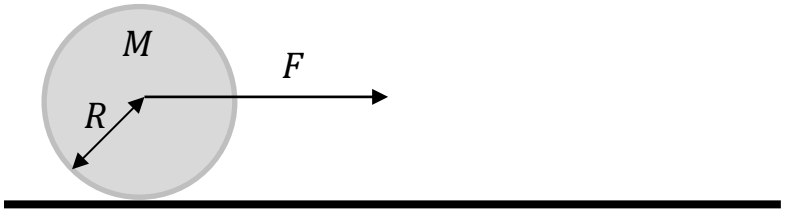
Problem 4.
A body, which looks circular from the side, starts from rest (1) and rolls down a slope to point (2). At position (2), the body's speed is determined to be between $4.40\ \mathrm{m/s}$ and $4.70\ \mathrm{m/s}$. The mass of the body is $M = 0.45\ \mathrm{kg}$ and its radius is $R = 0.37\ \mathrm{m}$. The difference in height between (1) and (2) is $H = 1.8\ \mathrm{m}$.




Which of the following shapes can the body have?

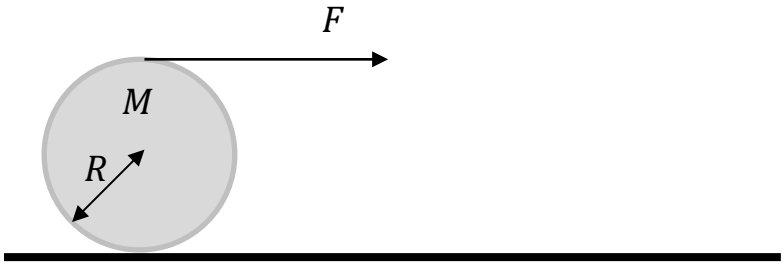
A) A thin ring
B) A thick ring with inner radius $R/2$
C) A cylinder
D) A solid sphere
E) A hollow, thin-walled sphere
F) Do not know

Problem 5.
A homogeneous cylinder with radius $R$ and mass $M$ is on a horizontal, rough surface. The cylinder is pulled by a constant, horizontal force $F$, acting on the cylinder's center of mass. The cylinder starts from rest and rolls on the substrate when the force is applied.



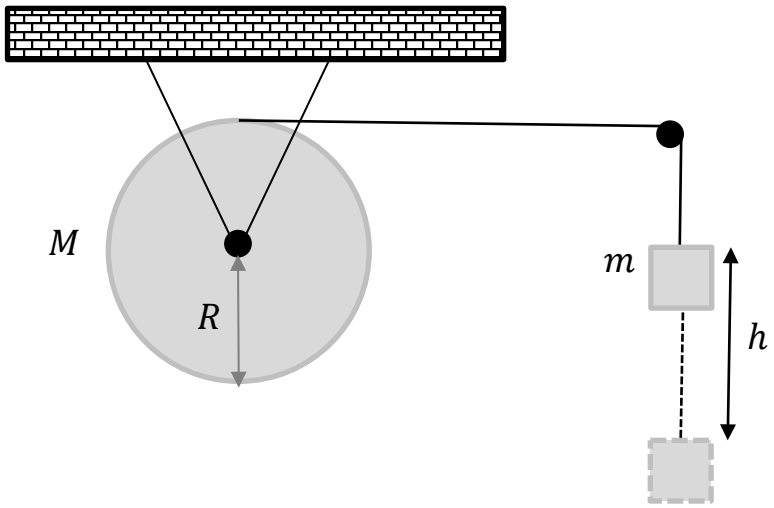

a) Determine the cylinder's angular velocity when its center of mass has been displaced by $L$.

The same constant force is now applied on the cylinder's vertex.




b) Determine the cylinder's angular velocity when its center of mass has been displaced by $L$.

Problem 6.
A homogeneous cylinder with radius $R$ and mass $M$ can rotate freely about a horizontal axis of rotation through its center. A rope is coiled around the cylinder, which does not move relative to the cylinder. A block with mass $m$ hangs from the other end of the rope. The rope passes over a nail (no friction). The system is released from rest.




a) Determine the angular velocity of the cylinder when the small block has moved a distance $h$.