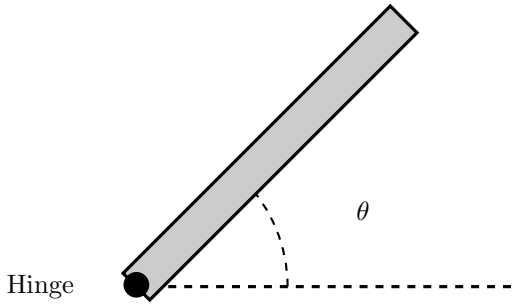
PHY 211 Recitation

April 22, 2020

1

A rod of mass $M = 5.0\,\text{kg}$ and length $1.0\,\text{m}$ is connected to a hinge that allows it to rotate about one end.



(a) If the rod is falling, is the angular acceleration constant? Try to answer without doing any math.

(b) Find the torque due to gravity and the angular acceleration in each of the following scenarios:

(i) The rod is horizontal ($\theta = 0$)

(ii) The rod is at an angle $\theta = 10°$ above the horizontal

(iii) The rod is at an angle $\theta = 45°$

(iv) The rod is exactly vertical ($\theta = 90°$)

2

A seesaw has a total length of 4 m, supported by a pivot at the midpoint. A child of mass $m_1 = 14\,\text{kg}$ sits on one end, a distance of $d_1 = 2\,\text{m}$ from the pivot. A second child of mass $m_2 = 30\,\text{kg}$ wants to sit somewhere on the other side, at a distance d_2 away from the center.

(a) Make a sketch of the seesaw if it is horizontal, showing all forces acting on it. Make sure the tail of each force vector begins where the force acts.

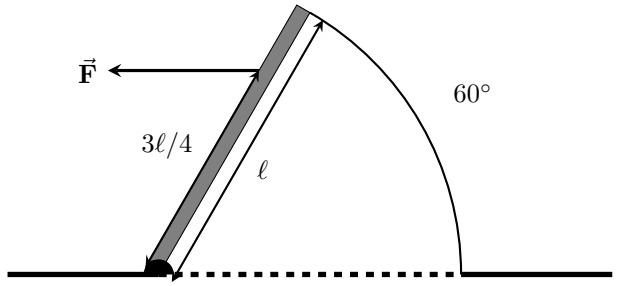
(b) Choose the pivot of the seesaw to analyze the torque. Write down the sum of the torques about this point, including the unknown distance d_2. What is the angular acceleration of the seesaw in terms of the variables (including the unknown d_2)?

(c) Solve for the distance d_2 if the seesaw is not accelerating.

(d) If the child is at the distance d_2 where the seesaw does not accelerate while horizontal, and someone comes and angles the seesaw by an angle θ, would its angular acceleration still be zero?

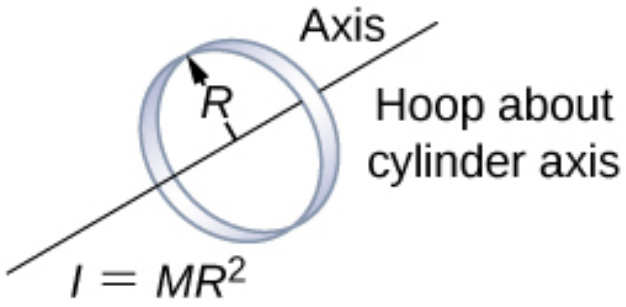
3

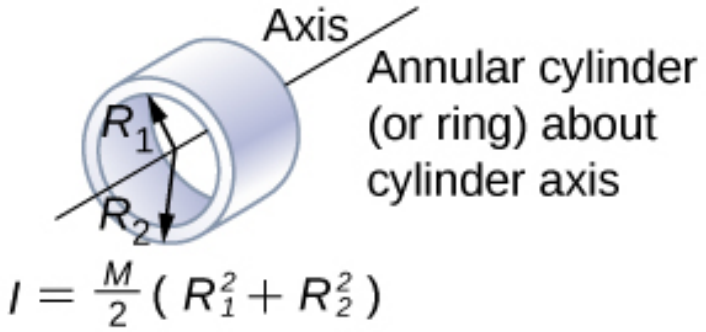
You are using a rope to hold open a trapdoor which is connected with a hinge to the floor. The door has a mass of 10 kg, a length $\ell = 1.0\,\text{m}$, and is currently at an angle of 60° with respect to the floor. You pull with a force parallel to the floor, $3\ell/4$ of the length away from the hinge.

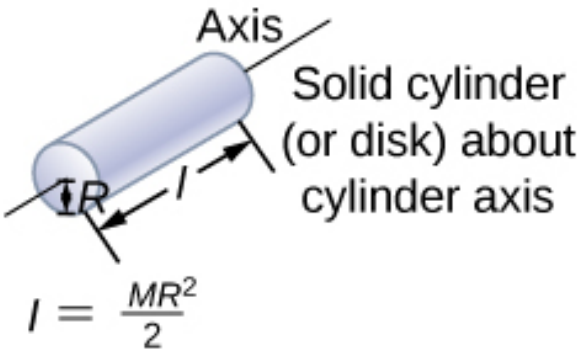


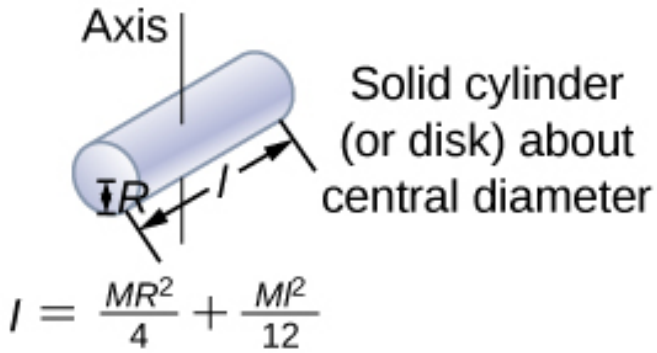
(a) With how much force should you pull to keep the trapdoor at rest?

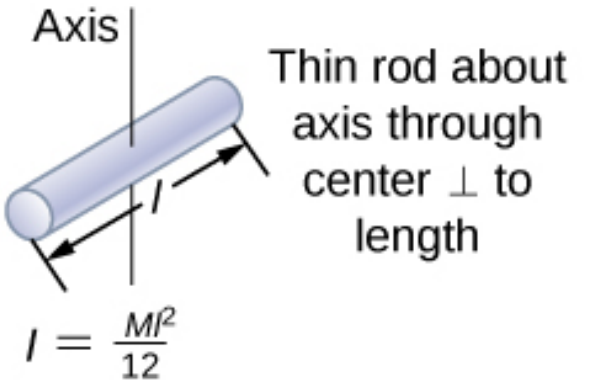
(b) If you then started to instead pull with a force of 40 N along the same direction, what will be the angular acceleration of the trapdoor? Be sure to specify if it is opening or closing.

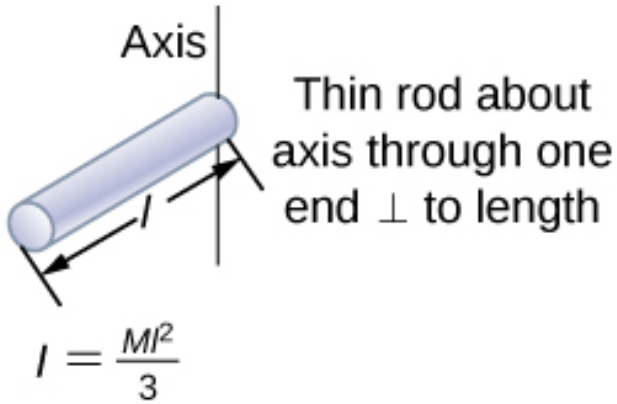

Axis
R
Hoop about
cylinder axis
$I = MR^2$

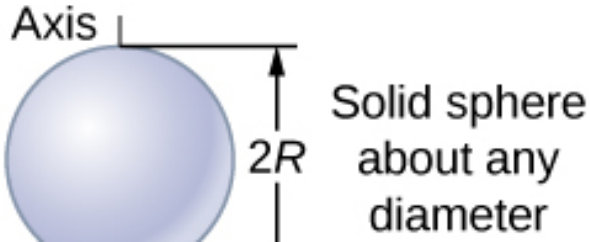

Axis
R_1
R_2
Annular cylinder
(or ring) about
cylinder axis
$I = \frac{M}{2}(R_1^2 + R_2^2)$


Axis
R
l
Solid cylinder
(or disk) about
cylinder axis
$I = \frac{MR^2}{2}$


Axis
R
l
Solid cylinder
(or disk) about
central diameter
$I = \frac{MR^2}{4} + \frac{Ml^2}{12}$


Axis
l
Thin rod about
axis through
center ⊥ to
length
$I = \frac{Ml^2}{12}$


Axis
l
Thin rod about
axis through one
end ⊥ to length
$I = \frac{Ml^2}{3}$


Axis
2R
Solid sphere
about any
diameter


Axis
2R
Thin
spherical shell
about any