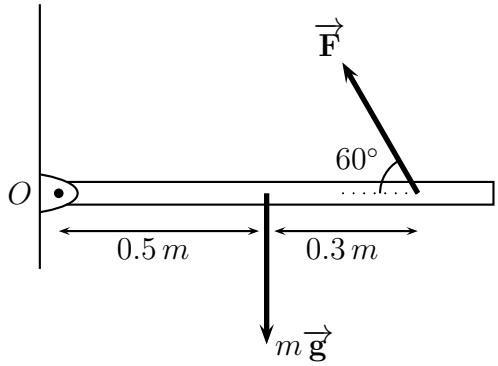
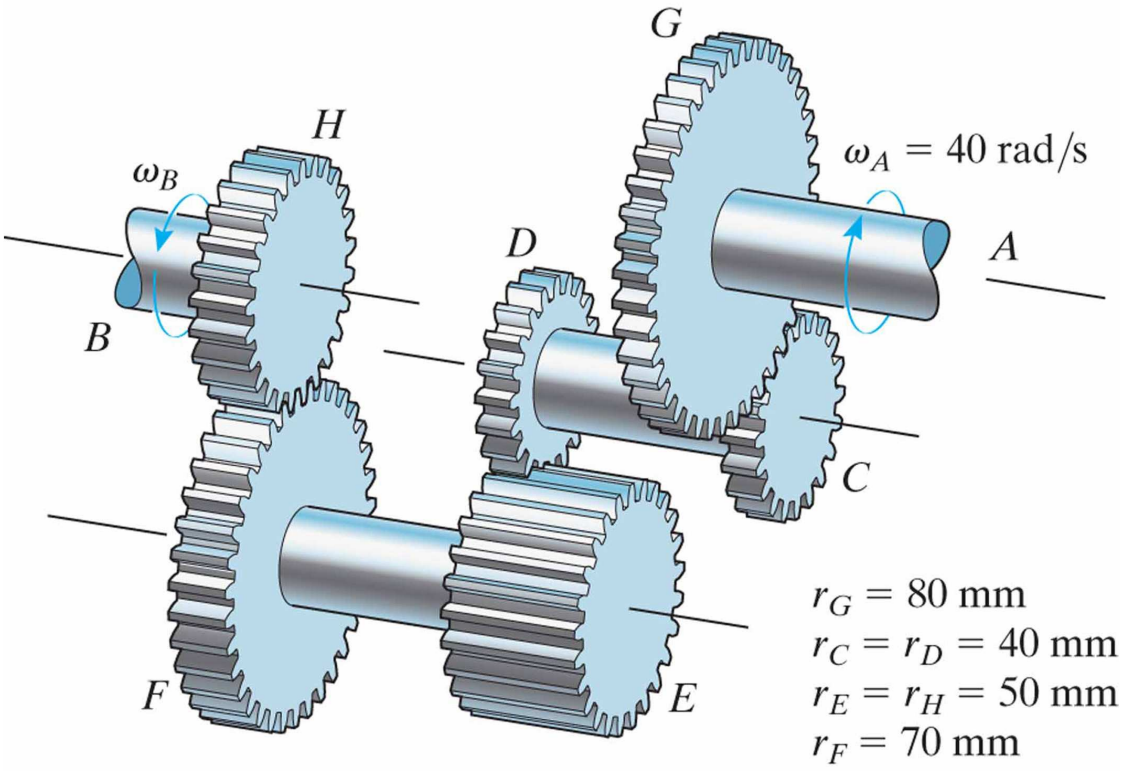
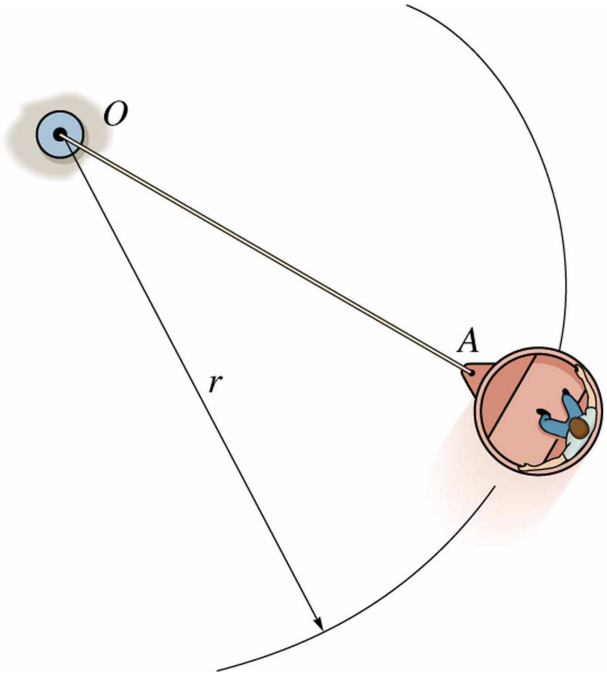
1. A uniform $6.3\,kg$, $1\,m$ long slender rod is attached to a vertical wall and can pivot about the point O shown below. The rod is being held horizontal by an applied force $\overrightarrow{\mathbf{F}}$. What is the magnitude of the force $\overrightarrow{\mathbf{F}}$ shown above if the rod does not rotate? What are the directions of the torque exerted by $\overrightarrow{\mathbf{F}}$ and the torque exerted by gravity?



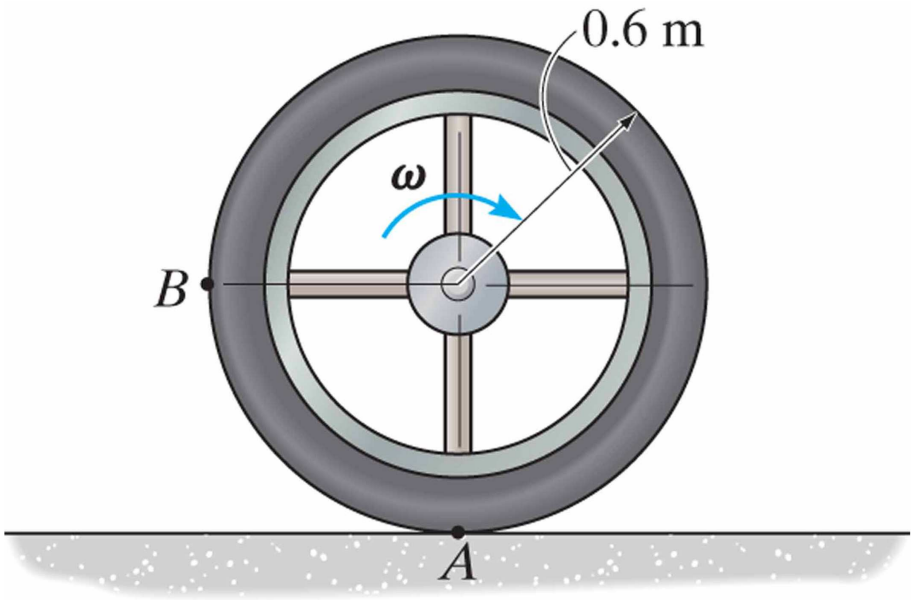
2. The reverse gear of a car is made possible through a clever arrangement of gears and axles as schematically shown below. If the radius of each gear is as given in the figure and the car's engine rotates gear A with $\omega_A = 40\, rad/s$, what is the angular *velocity* of the the "drive shaft", B?



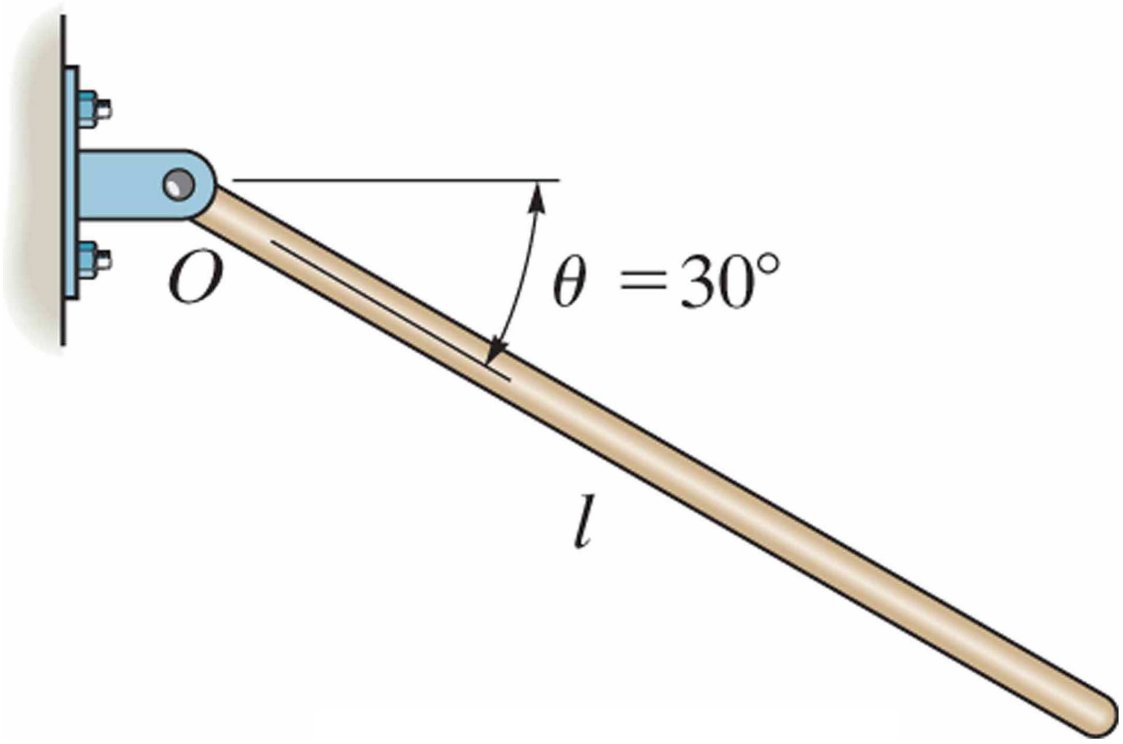
3. An amusement park ride has a car, initial speed $6\,m/s$ and distance $r = 4\,m$, traveling in a horizontal circular path. If the distance r is slowly decreased (so the car always goes around in a circle) to $1.5\,m$, how fast will the car be going? Ignore friction.



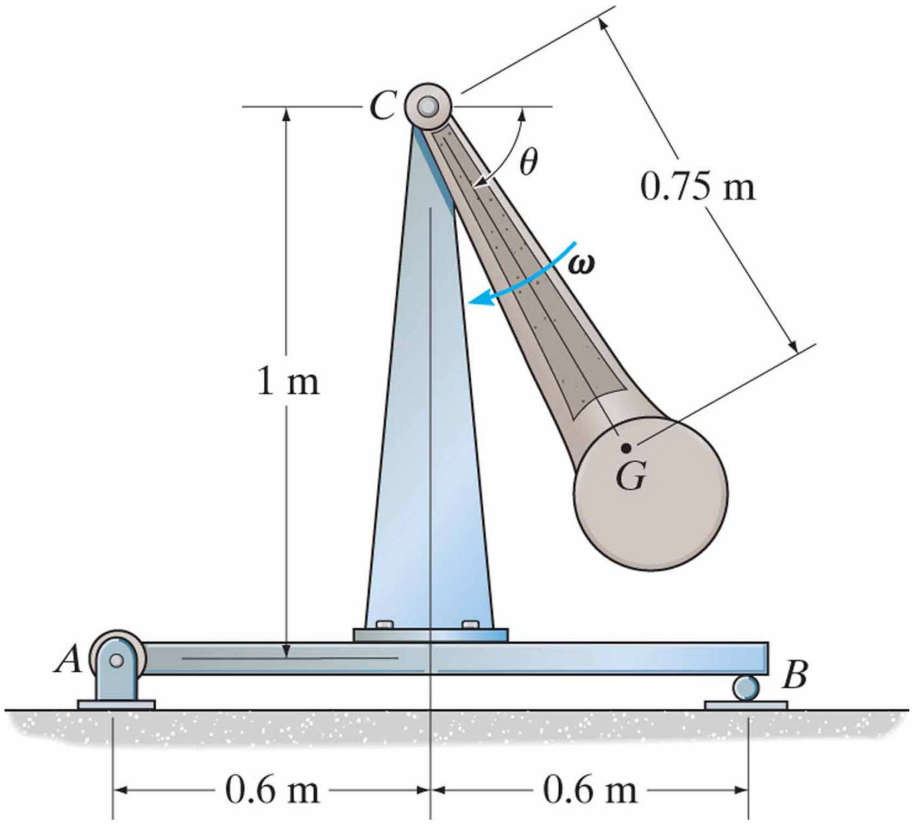
4. The 9-kg wheel shown below, when its center is given an initial speed of 4.3 m/s, rolls without slipping up a hill to a height of 6 m. What is the wheel's moment of inertia?



5. The $l = 2.5\text{-}m$ long stick has, at the instant shown, angular speed $\omega = 3\,rad/s$ and angular velocity $\alpha = 5\,rad/s^2$ both in the clockwise sense. What is the magnitude and direction of the angular velocity, the angular acceleration, the linear velocity, and the linear acceleration of the point at a distance $2\,m$ from O?

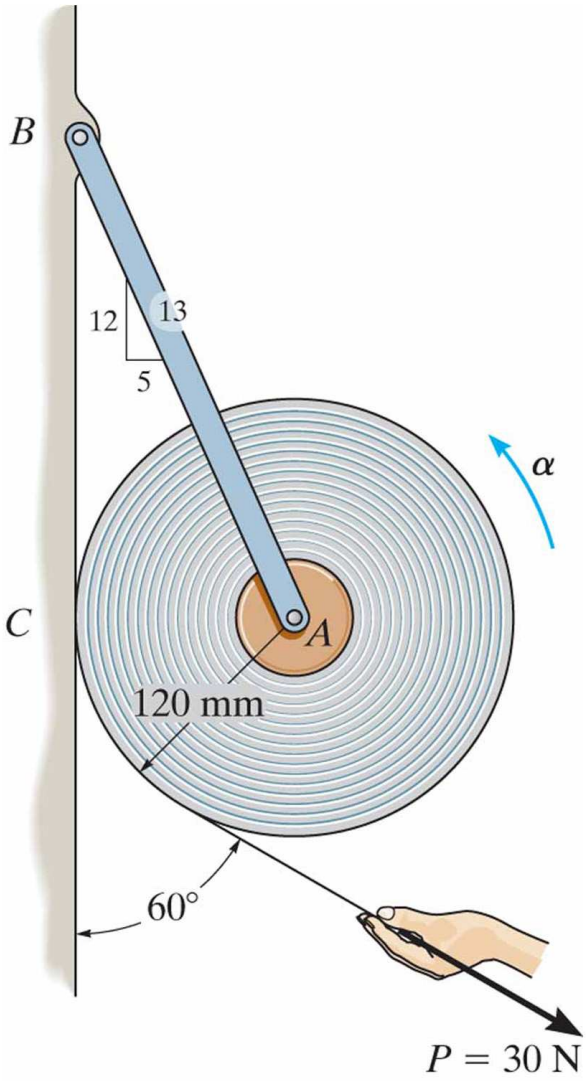


6. The 12-kg "physical-pendulum" with moment of inertia $5.5\,kg \cdot m^2$ and center of mass at G is released from rest at $\theta = 65°$. How fast will it be going when it swings through the vertical ($\theta = 90°$)?



7. What is the angular acceleration of the physical pendulum the instant it is released from rest at $\theta = 65°$?

8. If the roll of paper towels shown below has mass $25\,kg$ and the coefficient of kinetic friction between the wall and paper towels is $\mu_k = 0.3$, what is the force exerted by the support rod and the angular acceleration of the roll. Treat the roll as a solid cylinder, and therefore has moment of inertia, $I = \frac{1}{2}MR^2$.



9. Find the torque exerted by the $25\,N$ and $20\,N$ forces shown. If the torques remain constant and the 3-kg mass has an initial speed of $3.4\,m/s$, how fast will it be going after $0.25\,s$? Assume the mass continues on its 2-m circle.