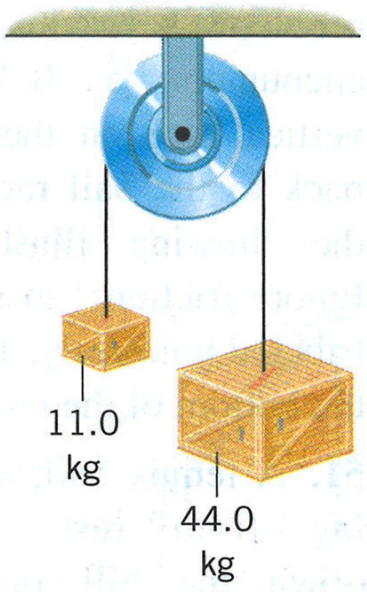
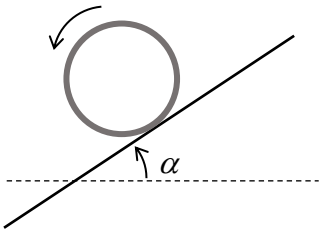
Name: _____

# Worksheet 19: Torque problems

1. By means of a rope whose mass is negligible, two blocks are suspended over a pulley, as the drawing shows. The pulley can be treated as a uniform cylindrical disk. The downward acceleration of the 44.0-kg block is observed to be exactly one-half the acceleration due to gravity. Noting that the tension in the rope is not the same on each side of the pulley, find the mass of the pulley.



2. A hollow ball with a mass of 0.570 kg and a radius of 0.108 m rolls without slipping down a surface that makes an angle of $\alpha$ below horizontal. The coefficient of friction between the ball and the surface is $\mu = 0.300$. What is the greatest slope angle $\alpha$ that will allow the ball to roll without slipping?



3. A solid bowling ball with a mass of 5.00 kg and a diameter of 21.6 cm is released onto a lane without spin at a speed of 2.50 m/s. The coefficient of kinetic friction between the ball and the lane is 0.250.

   a. What forces act on the bowling ball as it slides down the lane?

   b. What is the magnitude and direction of the force of kinetic friction on the bowling ball?

   c. What is the acceleration of the center of mass of the bowling ball?

   d. What is the moment of inertia of the bowling ball? Assume that it is a uniform solid sphere. (It probably isn't, but that is within specifications.)

   e. What is the torque on the bowling ball about its center of mass?

   f. What is the bowling ball's angular acceleration?

   g. What is the relationship between the velocity of the ball's center of mass and the ball's angular velocity when it rolls without slipping?

   h. How much time does it take for the ball to stop sliding and to begin rolling without slipping?

   i. What is the speed of the ball's center of mass when it begins to roll without slipping? What is the ball's corresponding angular speed?

4. A woman who weighs 500 N is leaning against a smooth vertical wall, as the drawing shows. Find:

   a. the force $F_N$ (directed perpendicular to the wall) exerted on her shoulders by the wall

   b. the horizontal component of the force exerted by her shoes on the ground

   c. the vertical component of the force exerted on her shoes by the ground.