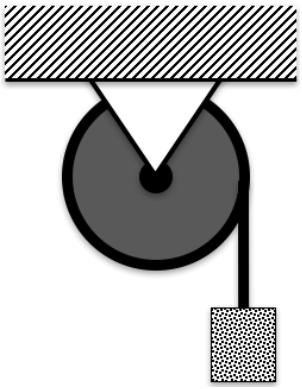
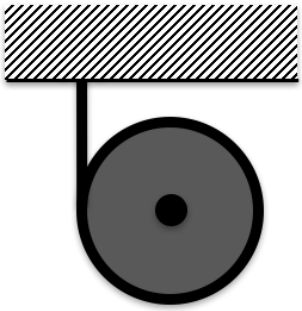
6.1 Rotating Systems:



At right, there is a falling mass with a string wrapped around a *massive* pulley. As the mass falls, the pulley turns. In understanding how to solve this problem, please consider and answer the following questions:

Example 1:
The system at right is released from rest:

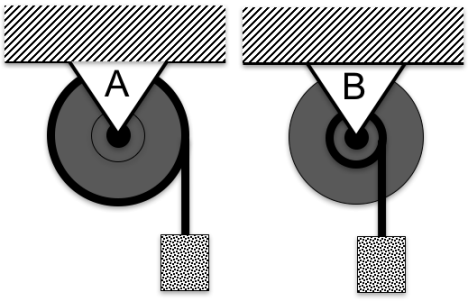
a) Is the downward acceleration of the falling mass <, =, or > g? How do you know?
b) Is the tension in the string <, =, > the force of gravity on the hanging mass? How do you know?
c) Let the hanging mass drop 1 m, and watch through an energy lens. Please identify the energy transition happening. Which of the objects lose energy, and which of the objects gain energy? What forms of energy?
d) In order to solve this question, it is crucial to know the relationship between the speed of the falling mass and the rotational velocity of the pulley. How does this relationship involve the radius of the wheel? Please check this with units to see if you have it.



At right, a string is wrapped around the circumference of a wheel. With the string anchored to the ceiling, the wheel is allowed to fall as it unwraps. Although this is only one object, we can treat it as a system because it is both falling and rotating.

Example 2:
The wheel at right unwraps like a "yo-yo".

a) What energy did it start with?
b) What *energies* does it gain as it falls?
c) What is the relationship between the vertical and rotational velocities?



Example 3:
Consider two identical massive wheels with a smaller diameter inner pulley free to rotate with identical hanging masses on a string. In A, the string is wrapped around the outer rim, and in B the string is wrapped around the smaller attached pulley. The systems are let go at the same time until the masses hit the floor below.

a) In which case is the hanging mass moving the fastest when it hits the ground? Or is it the same? Use a lens to support your answer.
b) In which model is the tension in the string the highest or are they the same? Explain.
c) Which mass took the longest time to fall to the ground or are the times the same? Explain.