Unit: Rotation

I. Coordinates: \( \theta = \frac{s}{R} \), \( \omega = \frac{v_t}{R} \), \( \alpha = \frac{a_t}{R} \)

II. Kinematics: *same form, new variables*

III. Energy:
   A. Moment of Inertia (rotational mass): \( I = \sum mr^2 \)
   B. Rotational Kinetic Energy: \( K = \frac{1}{2}I \omega^2 \)
   C. Rolling Bodies: *only the type of shape matters*

IV. Torque (rotational force): \( \tau = rF \sin \theta \)

V. Angular Momentum:
   A. \( L = rpsin\theta = I\omega \)
   B. \( \sum \tau \cdot t = \Delta L \)
   C. Conservation
You are trying to turn a rusty bolt. Which of the following would work the best?
You are riding an exercise bike. If a frictional force \( F \) is applied to the rim of the wheel, what force must you apply to the pedal in order to turn the wheel at a constant speed. (The gear radii are a one-to-one ratio.)
You push open a 20.0kg, 1.00m wide door with a force $F=100\text{N}$ at 0.500m from the hinge. Draw an extended force diagram for the door.

$I=(1/3)mL^2$
You push open a 20.0kg, 1.00m wide door with a force $F=100N$ at 0.500m from the hinge. What is the angular acceleration of the door?

$I=(1/3)mL^2$
The 2kg solid disk shown below is 50cm in diameter. The inner circle is 20cm in diameter. What is the angular acceleration of the disk?
The 10kg solid pulley shown below is 50cm in diameter. Draw appropriate force diagrams for each object.
The 10kg solid pulley shown below is 50cm in diameter. Is the tension in the string constant throughout?
The 10kg solid pulley shown below is 50cm in diameter. Write out the system of equations needed to solve for the acceleration. (Make sure you have as many equations as unknowns.)
The 10kg solid pulley shown below is 50cm in diameter. The blocks are released from rest. Determine their speed after they have traveled 20cm.
Two small masses sit on the ends of a very light pole that is 4m in length and fixed at the center. The pole is released from the horizontal position. What are the torques on each mass at the instant of release?
Two small masses sit on the ends of a very light pole that is 4m in length and fixed at the center. The pole is released from the horizontal position. What are the torques on each mass at the vertical position?
Two small masses sit on the ends of a very light pole that is 4m in length and fixed at the center. The pole is released from the horizontal position. What is the angular speed of the system when it is in the vertical position?
The spindle of the rotating disk below has a radius of 10cm. The axis it rotates around has a radius of 5cm and has noticeable friction. Draw an extended force diagram for the spindle.
The spindle of the rotating disk below has a radius of 10cm. The axis it rotates around has a radius of 5cm and has noticeable friction. If the hanging mass starts from rest and reaches a speed $v_f$ after falling 30cm, write a general expression for determining the magnitude of the frictional force.