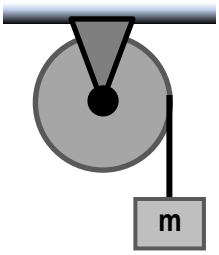
ROTATIONAL DYNAMICS WITH TWO MOTIONS



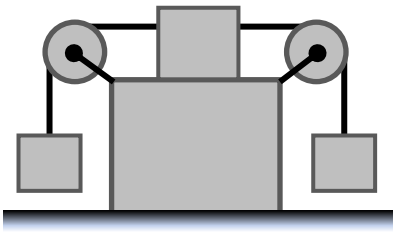
● In problems where Torque causes Angular Acceleration, we use _____.

- But in some problems, the system has both rotational AND linear motion.
- We write _____ for each ___ AND _____ for each ___.
- You'll end up with ___ AND ___, so we'll replace ___ with ___:

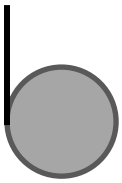
- The SIGNS for ____ & ____ as well as ____ & ____ must be consistent.

EXAMPLE: For each of the following, you want to solve for acceleration. **(a)** Determine which equations you'd start with. **(b)** Sketch a diagram for each object showing forces and torques acting on it, with the proper signs **(+ / –).**

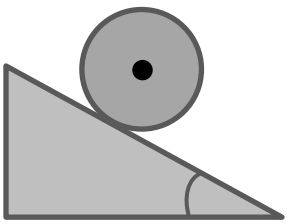
(i) Three blocks and two pulleys on a desk:



(ii) A simple yo-yo:



(iii) A cylinder rolling downhill:

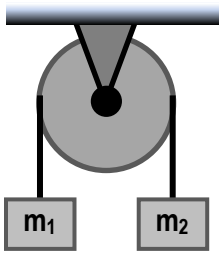


EXAMPLE: ACCELERATION OF BLOCK ON A PULLEY

EXAMPLE**:** A block of mass m is attached to a long, light rope that is wrapped several times around a pulley, as shown above. The pulley has mass M, radius R, can be modeled as a solid cylinder, and is free to rotate about a fixed, frictionless axis perpendicular to itself and through its center. When the block is released from rest, it begins to fall, causing the pulley to unwind without slipping. Derive an expression for the**: (a)** acceleration of the block**; (b)** angular acceleration of the pulley**.**

PRACTICE: TWO BLOCKS ON A PULLEY (ATWOOD'S MACHINE)

PRACTICE**:** Two blocks of masses $\mathbf{m_1}$ and $\mathbf{m_2}$ are both attached to a long, light rope that is wrapped several times around a pulley, as shown below. The pulley has mass M and radius R, can be modeled as a solid cylinder, and is free to rotate about a fixed, frictionless axis perpendicular to itself and through its center. When the block is released from rest, it begins to fall, causing the pulley to unwind without slipping. Derive an expression for the angular acceleration of the pulley**.**



PRACTICE: ACCELERATION OF A YO-YO

PRACTICE**:** When you release a simple 100-g yo-yo from rest, it falls and rolls, unwinding the light string around its cylindrical shaft, which is 2 cm in radius. If the yo-yo can be modeled after a solid disc, calculate its linear acceleration.