Name _____

Moment of Inertia I, (units of $kg * m^2$) = object's resistance to changes in rotational motion (α)

Point mass: $I = mr^2$ Other extended objects: Look up I in the table

Generally: If object has more mass distributed closer to its axis of rotation, it will have a smaller I

If multiple objects share same axis of rotation, add their moments of inertia together

Linear Motion	Rotational Motion
m (mass):	I (Moment of Inertia)
a (acceleration)	α (angular acceleration)
F (Force)	τ (torque)
$F = ma$ (Newton's 2nd Law)	$\tau = I\alpha$
$F_{net} = 0 \Leftrightarrow a = 0$ (Newton's 1st Law)	$\tau_{net} = 0 \Leftrightarrow \alpha = 0$
$F_{net} \neq 0 \Leftrightarrow a \neq 0$ (Newton's 1st Law)	$\tau_{net} \neq 0 \Leftrightarrow \alpha \neq 0$

1. Two meter sticks are stood upright and then placed at a slight angle from the vertical and released. One is a normal meter stick (**A**) but the other one has a mass attached to the top end (**B**). Which ruler will hit the ground first? **A**, **B**, **C**: Both at same time

   Which one would hit the ground first if the meter stick with the mass is flipped around so that the mass is near the ground? **A**, **B**, **C**: Both at same time

2. Two rods have the same mass, radius, and length but the blue one has more mass distributed towards the center and the red one has its mass uniformly distributed. Which one would be easier to rotate? **A**: Blue, **B**: Red, **C**: Both same

3. Would it be easier to rotate a solid ball or a hollow one if they both have the same mass and radius? **A**: Solid, **B**: Hollow, **C**: Both same

4. What is the moment of inertia of a child with a mass of $22kg$ on a merrry-go-round a distance $1.2m$ from the center? (Hint: Treat the child as a point mass)

5. What is the moment of inertia of a solid disk rotating about its center, with a mass of $2kg$ and radius of $0.5m$?

   If a torque of $+5Nm$ is applied to the disk, what would be its angular acceleration?

   What would be the angular acceleration if a Force of $10N$ is applied perpendicular to its edge? **A**: 4x, **B**: 2x, **C**: same, **D** $\frac{1}{2}$, **E**: $\frac{1}{4}$

6. What is the moment of inertia of a ring or hoop with a mass of $2kg$ and radius of $0.5m$, rotating about its center?

   If a torque of $5Nm$ is applied to the disk, what would be its angular acceleration?

7. A rod has a mass of $5kg$, a length of $1.3m$ and is hinged on the left end as shown.

   (a) What is the torque due to the weight of the rod?

   (b) What is the moment of inertia of the rod?

   (c) What is the angular acceleration of the rod, just after it is released?

8. What is the moment of inertia of a windmill with three blades, each one $47m$ long with a mass of $5200kg$. Treat each blade as a thin rod.

9. To really make an entrance, you want to swing open a door such that it makes a quarter turn in $0.5s$. If the door has a mass of $12kg$ and the length of the door is $0.65m$, what minimum force do you need to apply?