MOMENT OF INERTIA

● Remember: Motion problems do **NOT** depend on Mass, but Energy (eg. K = ½ **m** v^2) and Force (ΣF = **m**a) problems do.

- Mass is the ***amount of resistance*** to LINEAR acceleration, which we call (linear) ______________:

● In ROTATION, the ***amount of resistance*** to ANGULAR acceleration depends on mass AND _____________________.

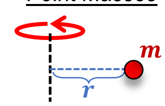
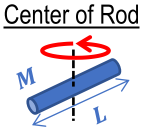
- This combination is called _______________________ (___), and it's the rotational equivalent of __________!

- You can think of it as (rotational) _____________.

● There are two types of objects:

Point Masses	**Rigid Bodies/Shapes**
(_______)	(_______)
I = _______, where **r** = ____________________	I is found by Table Lookup ⟶ General Form: I = **[fraction] mR^2** (R = Radius)

EXAMPLE: A system is made of two point masses (M_{LEFT} = 3 kg, M_{RIGHT} = 4 kg) at the ends of a 2-m long massless rod, as shown. Calculate the moment of inertia of the system if it spins about a perpendicular axis through the center of the rod.

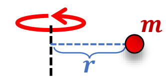
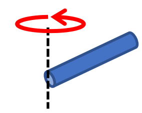
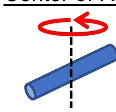
Common Moments of Inertia	
Point Masses 	$I = mr^2$
Center of Rod 	$I = \frac{1}{12}ML^2$

● The moment of inertia of a system of objects is the sum of each moment of inertia of the objects that make it up.

I_{sys} = ________________

<u>PRACTICE: MOMENT OF INERTIA / SIMPLE SYSTEM</u>

<u>PRACTICE</u>: A system is made of two small masses (M_{LEFT} = 3 kg, M_{RIGHT} = 4 kg) attached to the ends of a 5 kg, 2-m long thin rod, as shown. Calculate the moment of inertia of the system if it spins about a perpendicular axis through the mass on the left.

Common Moments of Inertia	
<u>Point Masses</u> 	$I = mr^2$
<u>End of Rod</u> 	$I = \frac{1}{3}mL^2$
<u>Center of Rod</u> 	$I = \frac{1}{12}mL^2$

<u>EXAMPLE: MOMENT OF INERTIA / EARTH</u>

<u>EXAMPLE</u>: The Earth has mass and radius 5.97 x 10^{24} kg and 6.37 x 10^6 m. The radial distance between the Earth and the Sun is 1.50 x 10^{11} m. Calculate the Moment of Inertia of the Earth as it spins around:

(a) itself -- treat the Earth as a solid sphere (solid spheres have moment of inertia given by 2/5 mR^2);

(b) the Sun -- treat the Earth as a point mass.

PRACTICE: MOMENT OF INERTIA / FIND MASS

PRACTICE**:** A solid disc 4 m in diameter has a moment of inertia equal to 30 kg m^2 about an axis through the disc, perpendicular to its face. The disc spins at a constant 120 RPM. Calculate the mass of the disc**.**

EXAMPLE: MOMENT OF INERTIA / WITH DENSITY

EXAMPLE**:** A planet is nearly spherical with nearly continuous mass distribution, with 8×10^7 m in radius and 10,000 kg/m^3 in density. If the planet rotates around itself, calculate its moment of inertia around its central axis **(**Note**:** V_{SPHERE} **=** $4/3\ \pi R^3$**).**