- Last Lecture
  - Everything you need to know about dynamics of rotation
- Today
  - Pendulums and Kinetic Energy of rotation
- Important Concepts
  - Equations for angular motion are mostly identical to those for linear motion with the names of the variables changed.
  - Kinetic energy of rotation adds a new term to the same energy equation, it does not add a new equation.
  - Kinetic energy can be simply written as a linear term and a rotational term

Important Reminders

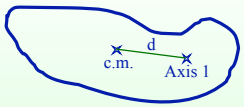
- Contact your tutor about session scheduling
- Mastering Physics due tomorrow at 10pm.
- Pset due this Friday at 11am.

Pendulums

- Simple pendulum: Small mass at the end of a string
  - Period is $T = 2\pi\sqrt{l/g}$ where l is the length from the pivot to the center of the object.
- Physical pendulum: More complex object rotating about any pivot
  - Period is $T = 2\pi\sqrt{I/Mgl}$ where l is the distance from the pivot to the center of mass of the object, M is the total mass, and I is the moment of inertia around the pivot.

Parallel Axis Theorum

- Very simple way to find moment of inertia for a large number of strange axis locations.



- $I_1 = I_{c.m.} + Md^2$ where M is the total mass.

Kinetic Energy with Rotation

- Adds a new term not a new equation!
- Rotation around any fixed pivot: $KE = \frac{1}{2} I_{pivot} \omega^2$
- Moving and rotating: $KE = \frac{1}{2} I_{CM} \omega^2 + \frac{1}{2} M_{Tot} v_{CM}^2$

Everything you need to know for Linear & Rotational Dynamics

- $\Sigma \vec{F} = M\vec{a}$
- $\Sigma \vec{\tau} = I\vec{\alpha}$
  - This is true for ***any fixed*** axis and for an axis through the center of mass, even if the object moves or accelerates.
- Rolling ***without*** slipping: $v = R\omega \quad a = R\alpha \quad f \neq \mu N$
  - Friction does NOT do work!
- Rolling ***with*** slipping: $v \neq R\omega \quad a \neq R\alpha \quad f = \mu N$
  - Friction does work, usually negative.
  - Rarely solvable without using force and torque equations!