Lecture 27, Nov 24, 2021

Parallel Axis Theorem

- The moment of inertia about some axis $I = I_{cm} + Md^2$ where d is the distance from this other axis and the centre of mass axis
  - This only works when the axis of I and I_{cm} are parallel
- As a consequence of this, $K = \frac{1}{2}I\omega^2 = \frac{1}{2}(I_{cm} + Md^2)\omega^2 = \frac{1}{2}I_{cm}\omega^2 + \frac{1}{2}Md^2\omega^2 = \frac{1}{2}I_{cm}\omega^2 + \frac{1}{2}Mv^2$
  - There is a component of kinetic energy from pure rotation about the centre of mass and another from the translational kinetic energy

Torque and Angular Momentum Change

- Change in angular speed requires a force that acts in the tangential direction: torque
- Since any applied force only speeds up an object in rotation if it acts in the tangential direction, torque is computed by $Fr\sin\phi$ where ϕ is the angle between the radius and force vectors
  - We can also look at the line of action and perpendicular lever arm $r_\perp$
  - We can also look at it as the vector cross product: $\vec{\tau} = \vec{r} \times \vec{F}$
    * The magnitude of this vector is the magnitude of torque, and it points in the direction of the axis of rotation