15.7 Angular Impulse & Momentum

- Newton's 2nd Law $$\vec{F}_{\text{net}} = \frac{d}{dt} m\vec{v}$$
- written in terms of impulse-momentum

$$\int_i^f \vec{F}_{\text{net}}\, dt = \int_i^f d(m\vec{v}) = m\vec{v}_f - m\vec{v}_i$$

- Newton's 2nd Law for rotation $$\sum \vec{M}_O = \frac{d}{dt} \vec{H}_O$$
- written in terms of impulse-momentum

$$\int_i^f \sum \vec{M}_O\, dt = \int_i^f d\vec{H}_O = \vec{H}_{Of} - \vec{H}_{Oi}$$

15.7 Angular Impulse & Momentum

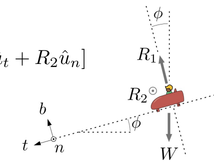
- Can often use the scalar version (if you're interested in only one component):

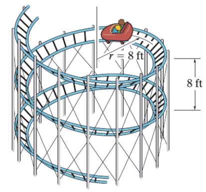
$$\sum M_z = \frac{d}{dt} H_z$$

- Be careful about using only the relevant component of force.

$$\begin{aligned} \vec{M} &= -r\hat{u}_n \times \vec{F}_{\text{net}} \\ &= -r\hat{u}_n \times [(W \sin\phi)\hat{u}_t + R_2\hat{u}_n] \\ &= (rW \sin\phi)\hat{u}_b \end{aligned}$$

$$M_z = rW \sin\phi \cos\phi$$





What force components contribute to M_z ?

15.7 Angular Impulse & Momentum

- If there is no external force, momentum is conserved

if $\vec{F}_{\text{net}} = \vec{0}$

then $m\vec{v}_f = m\vec{v}_i$

- If there is no external moment about O, angular momentum about O is conserved

if $\sum \vec{M}_O = \vec{0}$

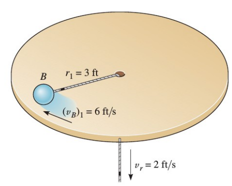
then $\vec{H}_{Of} = \vec{H}_{Oi}$

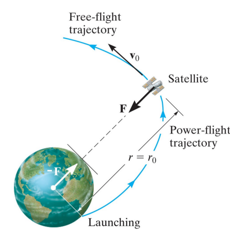
(note "momentum" here refers to the total momentum of whole system)

15.7 Angular Impulse & Momentum

- Central forces create no moments, so angular momentum is constant.

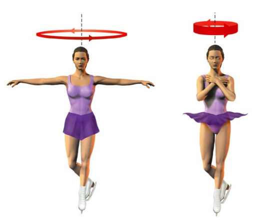
$$\vec{H}_{Of} = \vec{H}_{Oi}$$





15.7 Angular Impulse & Momentum

Conservation of angular momentum $\vec{H}_{Of} = \vec{H}_{Oi}$



https://www.youtube.com/watch?v=RtWbpyjJqrU