Physics 210	Unquiz 05	Name___________

A particle of mass m at one instant in time is traveling with a velocity $\vec{v}=0\hat{x}+v_t\hat{y}$ and is located at $\vec{r}=R\hat{x}+0\hat{y}$ and is attached to a massless bar hinged at x=0, which you may assume here to be the pivot and axis.

(a) Determine the angular momentum vector $\vec{L}$.

(b) Suppose a torque $\vec{\Gamma}=-\tau\hat{z}$ was applied for a time t. What is the final angular momentum?

(c) If the final angular momentum was given by $\vec{L}_f=-mv_tR\hat{z}$, what is the angular impulse required? **Note:** I'll use this symbol to represent angular impulse: ${}_{\phi}\vec{J}=\vec{\Gamma}\Delta t$ if $\vec{\Gamma}=\overrightarrow{constant}$. There is no commonly used symbol to denote angular impulse and various choices I have seen are H and K, neither of which I find acceptable. Angular impulse is not the most used topic in physics.

(d) Suppose that the torque that produced this angular impulse was supplied for t=1 s. How large was the required torque if m=1 kg, v_t=1 m/s, and R=1 m.

(e) Draw a sequence of pictures showing this situation for :.

(e-a) Show x,y,z, $v_{t,}$ R, L_i

(e-c) Show x,y,z, $v_{t,}$ R, $L_{i,}$ F, Γ, ΔL, v_t final

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A particle of mass m at one instant in time is traveling with a velocity $\vec{v}=0\hat{x}+v_t\hat{y}$ and is located at $\vec{r}=R\hat{x}+0\hat{y}$.

(a) Determine the angular momentum vector $\vec{L}$.

$$\vec{L}=\vec{r}\ x\ \vec{p}=mv_tR(\hat{x}\ x\ \hat{y})=mv_tR\hat{z}$$

(b) Suppose a torque $\vec{\Gamma}=-\tau\hat{z}$ was applied for a time t. What is the final angular momentum?

$$\vec{F}=m\vec{a}=\frac{\Delta\vec{P}}{\Delta t}:\vec{\Gamma}=\vec{R}\ x\ \vec{F}=\vec{R}\ x\ \frac{\Delta\vec{P}}{\Delta t}=\frac{\Delta\left[\vec{R}\ x\ \vec{p}\right]}{\Delta t}=\frac{\Delta\vec{L}}{\Delta t}\ \text{if}\ \vec{R}=\overrightarrow{\text{constant}};\ \text{so}$$

$$\vec{\Gamma}=\frac{\Delta\vec{L}}{\Delta t}\Rightarrow\vec{\Gamma}\Delta t=\Delta\vec{L}\Rightarrow-\tau t\hat{z}=\vec{L}_f-\vec{L}_i\Rightarrow\vec{L}_f=\vec{L}_i-\tau t\hat{z}=(mv_tR-\tau t)\hat{z}$$

(c) If the final angular momentum was given by $\vec{L}_f=-mv_tR\hat{z}$, what is the angular impulse required? **Note:** I'll use this symbol to represent angular impulse: ${}_\phi\vec{J}=\vec{\Gamma}\Delta t$ if $\vec{\Gamma}=\overrightarrow{\text{constant}}$ .There is no commonly used symbol to denote angular impulse and various choices I have seen are H and K, neither of which I find acceptable. Angular impulse is not the most used topic in physics.

$${}_\phi\vec{J}=\Delta L=\vec{L}_f-\vec{L}_i=-mv_tR\hat{z}-mv_tR\hat{z}=-2mv_tR\hat{z}$$

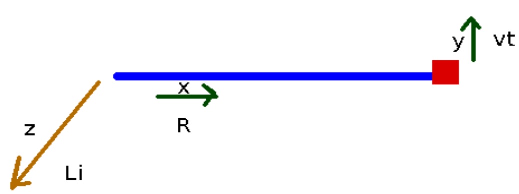
(d) Suppose that the torque that produced this angular impulse was supplied for t=1 s. How large was the required torque if m=1 kg, v_t=1 m/s, and R=1 m.

$${}_\phi\vec{J}=\vec{\Gamma}\Delta t\Rightarrow\vec{\Gamma}=\frac{{}_\phi\vec{J}}{\Delta t}=\frac{\Delta\vec{L}}{\Delta t}=\frac{-2mv_tR\hat{z}}{\Delta t}=\frac{-2\,kg\frac{m^2}{s}}{1s}\hat{z}=-2\,kg\frac{m^2}{s^2}\hat{z}$$

$$\text{note}\ \ [J_\phi]=Nms=(\text{energy}\,x\,\text{time})=kg\frac{m^2}{s}$$

(e) Draw a sequence of pictures showing this situation for :.

(e-a) Show x,y,z, $v_{t,}$ R, L_i



(e-c) Show x,y,z, $v_{t,}$ R, $L_{i,}$ F, Γ, ΔL, v_t final