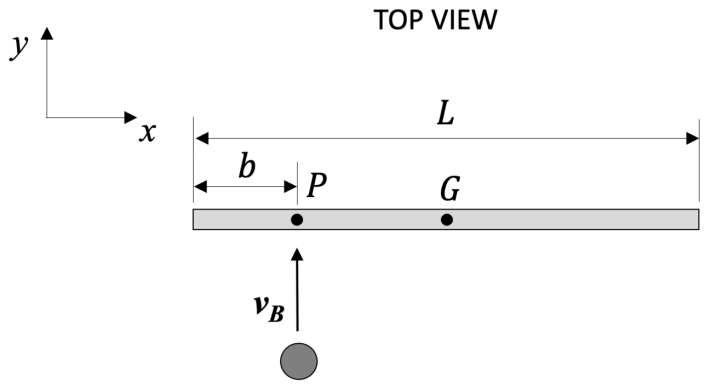
state 1 $\vec{v}_{B_1}$

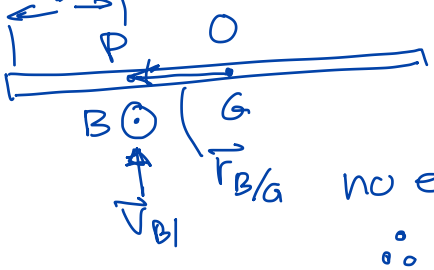
A rod (m_R = 5 kg, L = 3 m) rests on a frictionless surface. A ball (m_B = 1 kg) with an initial velocity $\vec{v}_B$ = 12 m/s in the direction shown impacts the rod at P. Find the rod's angular velocity, $\vec{\omega}_R$, and linear velocity of the centre of gravity, $\vec{v}_G$, immediately after impact if b = 1 m. Assume e = 0.6.

state 2



Find $\vec{\omega}_{R_2}$, $\vec{v}_{RG_2}$

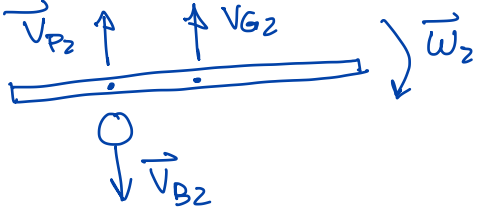
state 1 just before impact



$\vec{v}_{G_1} = 0$

$\vec{\omega}_{R_1} = 0$

state 2 just after impact



no external impulses

∴ cons. of momentum for system

$\vec{K}_G$: $\sum_{SYS} \vec{K}_G$ conserved

$$\sum_{SYS} \vec{K}_{G_1} = \vec{K}_{G1R}^{\,0} + \vec{K}_{G1B}$$

$$= I_B \vec{\omega}_{B_1}^{\,0} + \vec{r}_{B/G} \times m_B \vec{v}_{B1}$$

$$= \left(\frac{L}{2} - b\right)(-\hat{i}) \times m_B v_{B1} \hat{j}$$

$$= -m_B v_{B1} \left(\frac{L}{2} - b\right) \hat{k}$$

$$\sum_{SYS} \vec{K}_{G_2} = \vec{K}_{G2R} + \vec{K}_{G2B}$$

$$\vec{K}_{G2R} = I_{GR}(-\omega_2 \hat{k})$$

$$\vec{K}_{G2B} =$$