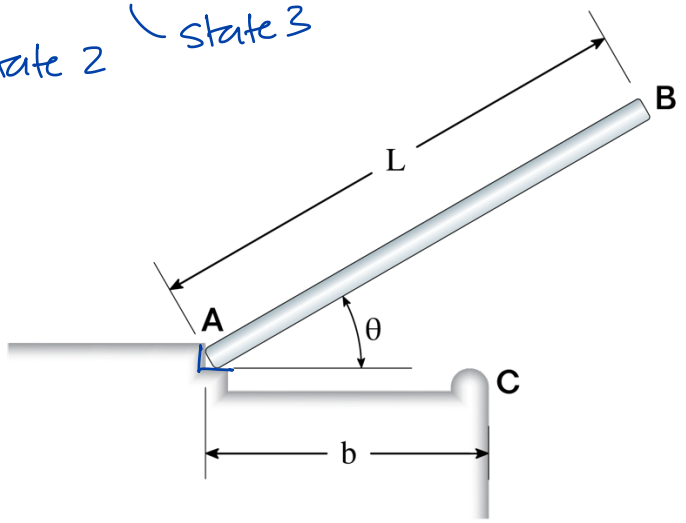
state 1

The rod AB (length L = 2 m, mass 15 kg) falls from rest from an initial angle of θ = 30 degrees. It impacts the corner C (b = 1.3 m). Determine the angular velocity, $\vec{\omega}$, and the velocity of the rod's centre of gravity, $\vec{v_G}$, just after impact.

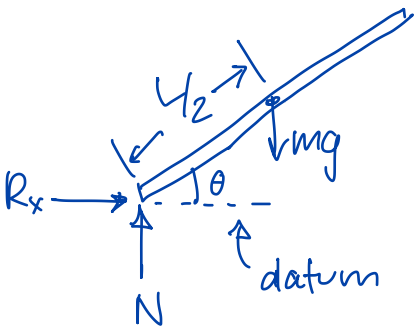
state 2 state 3



state 1 from rest

$\vec{V}_{G1} = 0$

$\vec{\omega}_1 = 0$



$T_1 = 0$

$V_1 = mg\frac{L}{2}\sin\theta$

conservation of energy 1→2

$T_1^{0} + V_1 = T_2 + V_2^{0}$

$mg\frac{L}{2}\sin\theta = \frac{1}{3}mL^2\omega_2^2$

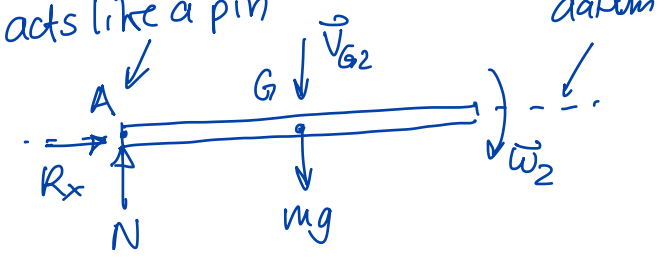
$g\sin\theta = \frac{1}{3}L\omega_2^2$

$\Rightarrow \omega_2^2 = \frac{3g}{L}\sin\theta \Rightarrow \omega_2 = \sqrt{\frac{3g}{L}\sin\theta} = \sqrt{\frac{3(9.81)\sin 30}{2}}$

$= 2.71$ rad/s

state 2 just before impact

acts like a pin



$V_2 = 0$

$T_2 = \frac{1}{2}I_A\omega_2^2$

$= \frac{1}{2}\left(\frac{1}{3}mL^2\right)\omega_2^2$

$= \frac{1}{6}mL^2\omega_2^2$

$$= 1.17 \text{ m/s}$$

$$\boxed{\vec{v}_{G_3} = 1.17 \text{ m/s}\,\hat{j}}$$