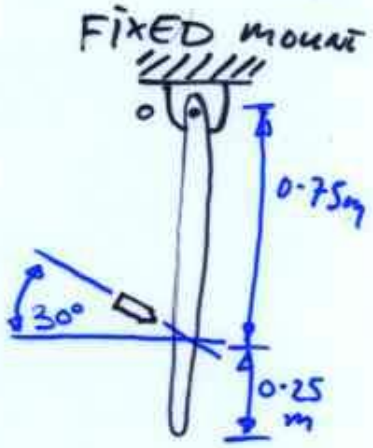
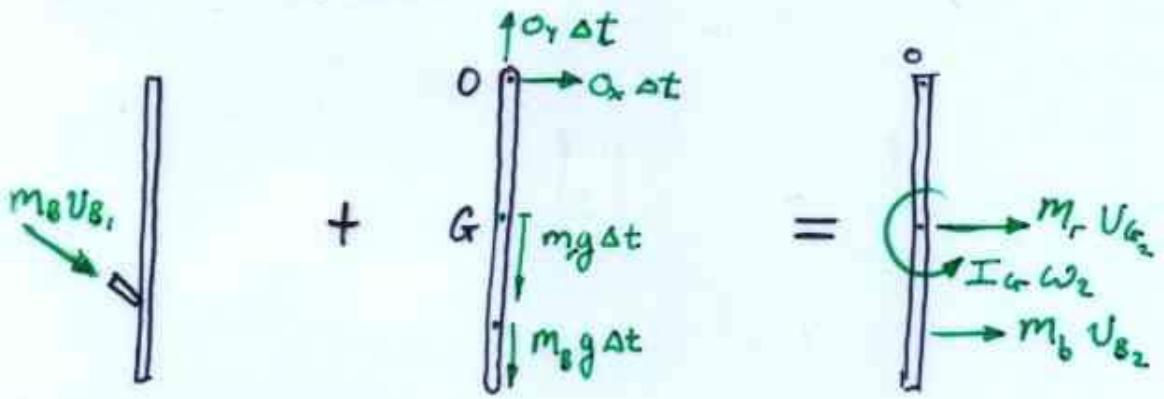
BULLET, $v_B = 400$ m/s embeds in 5kg SLENDER ROD AS SHOWN find ω of ROD just after BULLET EMBEDS. (Mass of Bullet = 4g)



ANALYSE BULLET & ROD AS A SINGLE SYSTEM



From this we see that there is no angular impulse about O

$$\sum (H_O)_1 = \sum (H_O)_2$$

$$\circlearrowleft + \quad m_B v_{B_1} \cos(30°)(0.75) = m_B v_{B_2}(0.75m) + \left[m_R v_{G_2}(0.5m) + I_G \omega_2 \right]$$

I_O

but note $v_{B_2} = 0.75\omega_2$, $v_{G_2} = 0.5\omega_2$, $I_G = \frac{1}{12} m l^2$ — Kinematics

solve & get $\omega_2 = 0.62$ rad/s

Approximation useful... neglect bullet on R.H.S.

$$(m_B)(v_{B_1})(\cos 30°)(0.75) \approx I_O \omega_2 = \tfrac{1}{3} m l^2 \omega^2$$

$$\Rightarrow \omega_2 \approx \frac{(0.004)(400)(0.866)(0.75)}{\frac{1}{3}(5)(1.0)^2} = 0.624$$