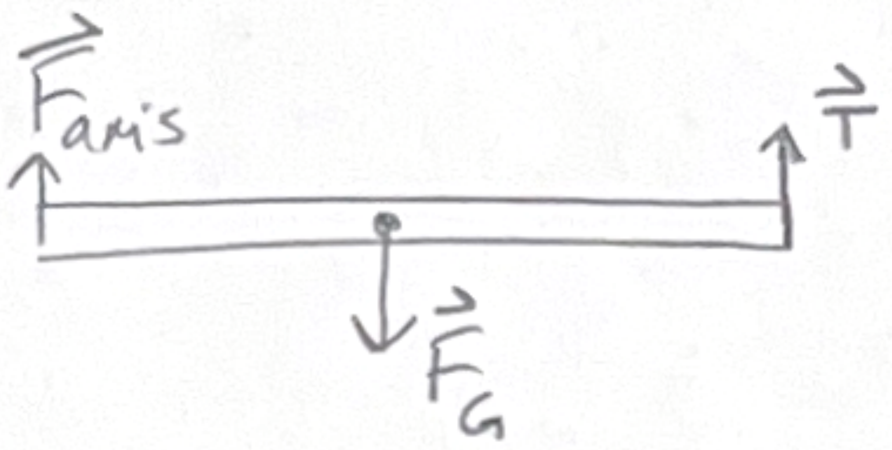
Analysis Problem 4

a)



by symmetry, $F_{axis} = T$

So, $\Sigma F_y = 0$

$F_{axis} + T - \cancel{m}g = 0$

$F_{axis} + F_{axis} = Mg$

$$\boxed{F_{axis} = \frac{Mg}{2}}$$

b) Find α

$\alpha = \dfrac{\Sigma \tau}{I}$

$\alpha = \dfrac{(Mg)\left(\frac{l}{2}\right)}{\frac{Ml^2}{3}}$

$$\boxed{\alpha = \frac{3g}{2l}}$$

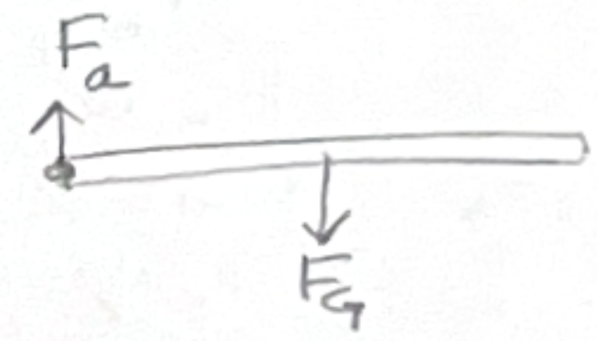
c) $a_t = \alpha r$, where r is a point at the center of the rod

$a_t = \left(\dfrac{3g}{2l}\right)\left(\dfrac{l}{2}\right)$

$$\boxed{a_t = \frac{3}{4}g}$$

d) The translational form of N2L applies to particles and to the center of mass of a rigid body.

So, here we appy N2L to relate the forces on the object to the translational motion of the center of mass, a_{cm}:



$a_{cm} = \dfrac{\Sigma F}{m}$

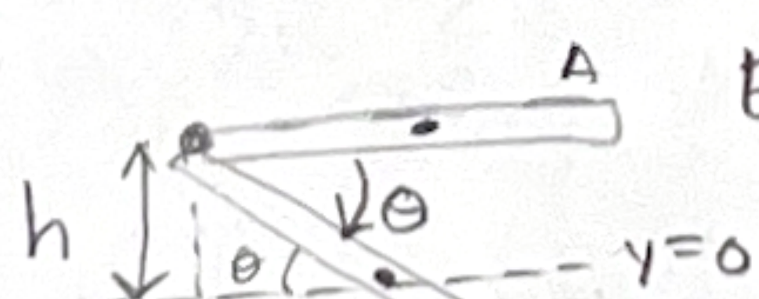
from part (c) $\left(\dfrac{3}{4}g\right) = \dfrac{Mg - F_a}{M}$

$\frac{3}{4}Mg - Mg = -F_a$

$-\frac{1}{4}Mg = -F_a$

$$\boxed{\frac{1}{4}Mg = F_a}$$

e) Apply energy conservation



$E_A = E_B$ b/c no transfers

$h = \frac{L}{2}\sin\theta$

$U_{GA} = K_B$

$Mg\left(\frac{l}{2}\sin\theta\right) = \frac{1}{2}I\omega_B^2$

$\dfrac{Mgl\sin\theta}{\frac{Ml^2}{3}} = \omega_B^2$

$$\boxed{\sqrt{\frac{3g\sin\theta}{l}} = \omega_B}$$