

Some useful relations:

$\omega_0 = \text{orig value of } \omega$
 $\theta_0 = \dots \dots \dots \theta$ (F2)

if α is constant ... $\omega = \omega_0 + \alpha t$

[NOTE SIMILARITY to
EQN'S FOR LINEAR ACCLN]

$$\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2$$

$$\omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$$

if α is not constant, more general expressions needed

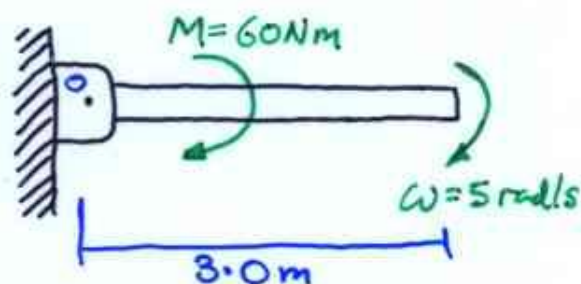
$$\alpha = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}; \quad \omega = \frac{d\theta}{dt}; \quad \alpha d\theta = \omega d\omega$$



AN EXAMPLE: Moment $M = 60 \text{ Nm}$

20.0 kg slender rod rotates in vertical plane. $\omega = 5 \text{ rad s}^{-1}$

FIND α & components of forces @ O



3 UNKNOWN'S O_N, O_t, α
EQUATIONS...

$$\sum F_N = m a_N$$

$$O_N = m r_G \omega^2 = (20)(1.5)(5)^2 = \underline{750 \text{ N}}$$

$$\sum F_t = m a_t$$

$$-O_t + mg = m \alpha r_G \quad (1)$$

$$\sum M_G = I_G \alpha \Rightarrow O_t r_G + M = I_G \alpha \quad (2)$$

$$-O_t(1.5) - 60 = -\left[\frac{1}{12}(20)(3)^2\right]\alpha$$

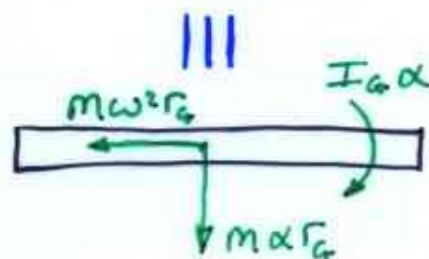
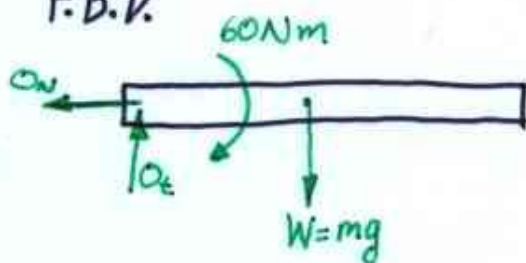
be careful with signs.

SOLVE BETWEEN (1) & (2)

$$\Rightarrow \underline{O_t = 19.05 \text{ N}}$$

$$\underline{\alpha = 5.905 \text{ rad s}^{-2}}$$

F.B.D.



note: $I_G = \frac{1}{12} m l^2$

for rod

