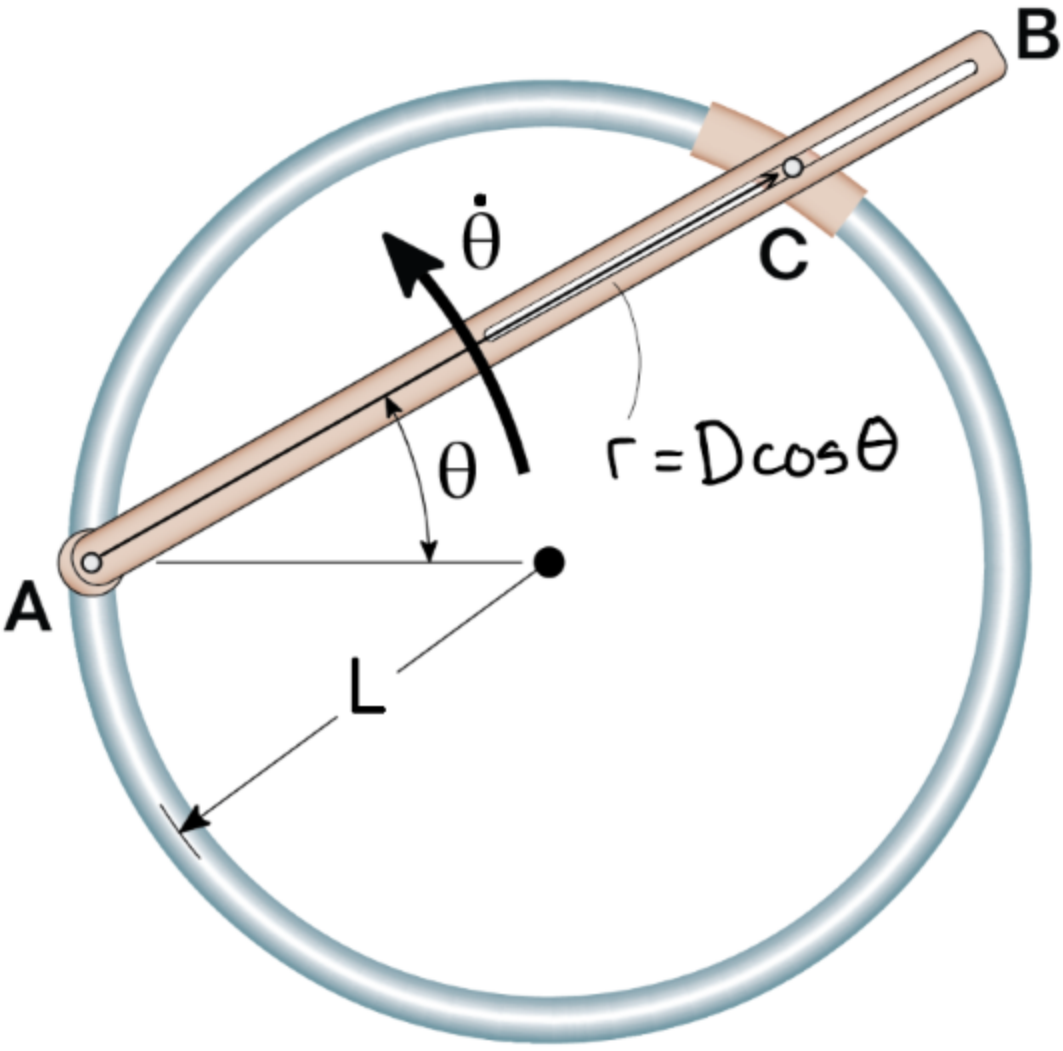
21-P-FA-GD-016



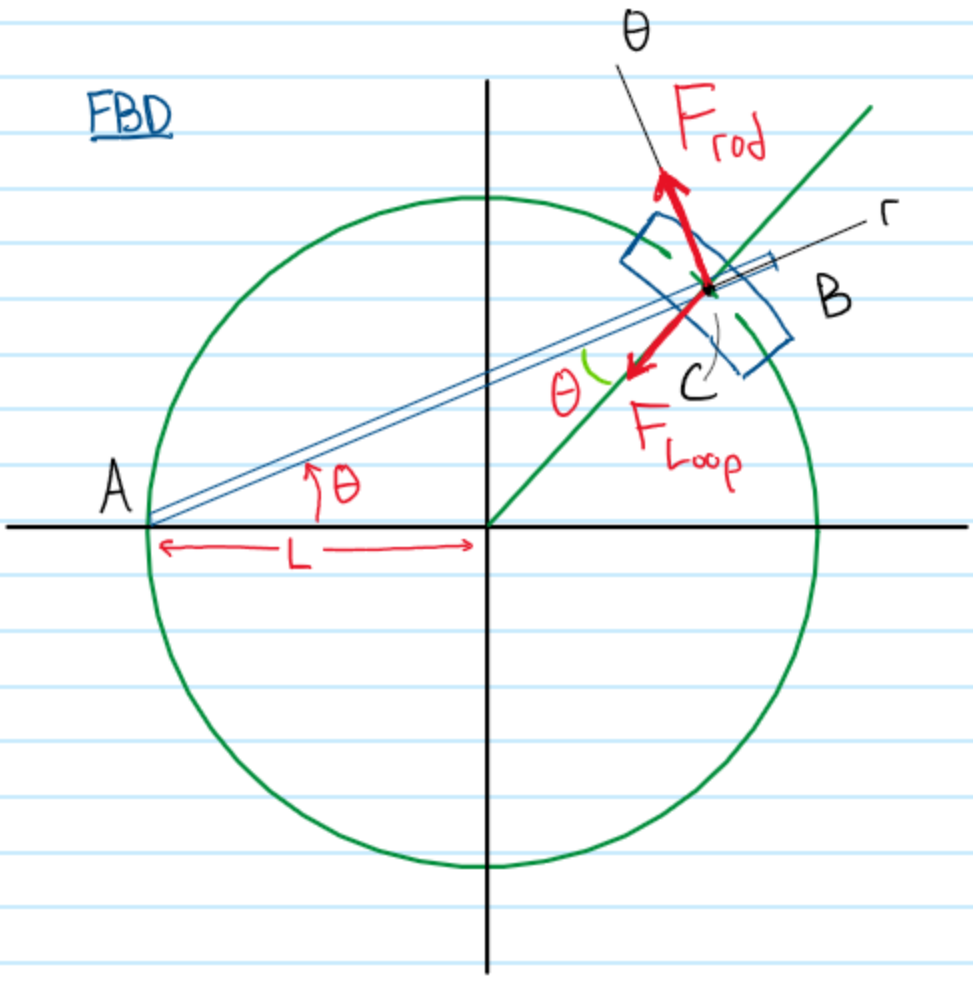
The rod AB rotates at a constant angular velocity $\dot{\theta} = \dot{\theta}_0$. The collar C slides along the circular loop of radius L, modelled by $r = D\cos\theta$ m and is pinned inside the slot in bar AB. If the collar has a mass m_0, what are the forces exerted on the collar by the circular loop and the slotted-rod AB when $\theta = \theta_0$?

(Neglect the force of gravity)

given $\theta, \dot{\theta}, m, D, L$

find F_{rod}, F_{Loop}

FBD



$r = D\cos\theta$

$\dot{r} = -D\dot{\theta}\sin\theta$

$\ddot{r} = -D\ddot{\theta}\sin\theta - D\dot{\theta}^2\cos\theta$

$\Theta = \theta$

$\dot{\Theta} = \dot{\theta}$

$\ddot{\Theta} = 0$

$a_r = \ddot{r} - r\dot{\theta}^2$

$a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta}$

Force Equilibrium

$\Sigma F_r = m a_r = -F_{Loop}\cos\phi$

$\Sigma F_\theta = m a_\theta = F_{rod} - F_{Loop}\sin\phi$

$F_{Loop} = \dfrac{m a_r}{-\cos\phi}$

$F_{rod} = m a_\theta + F_{Loop}\sin\theta = m a_\theta - m a_r \tan\theta$