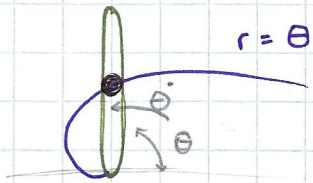
ZO-P-FA-AF-005

E.M Cylindrical Components: Beginner

Q: The arm is rotating along the described path with an angular velocity of $\dot{\theta} = A$ rad/s and $\ddot{\theta} = 0$ rad/s^2. Determine magnitude of the force exerted on the M kg ball when θ = theta?

A:

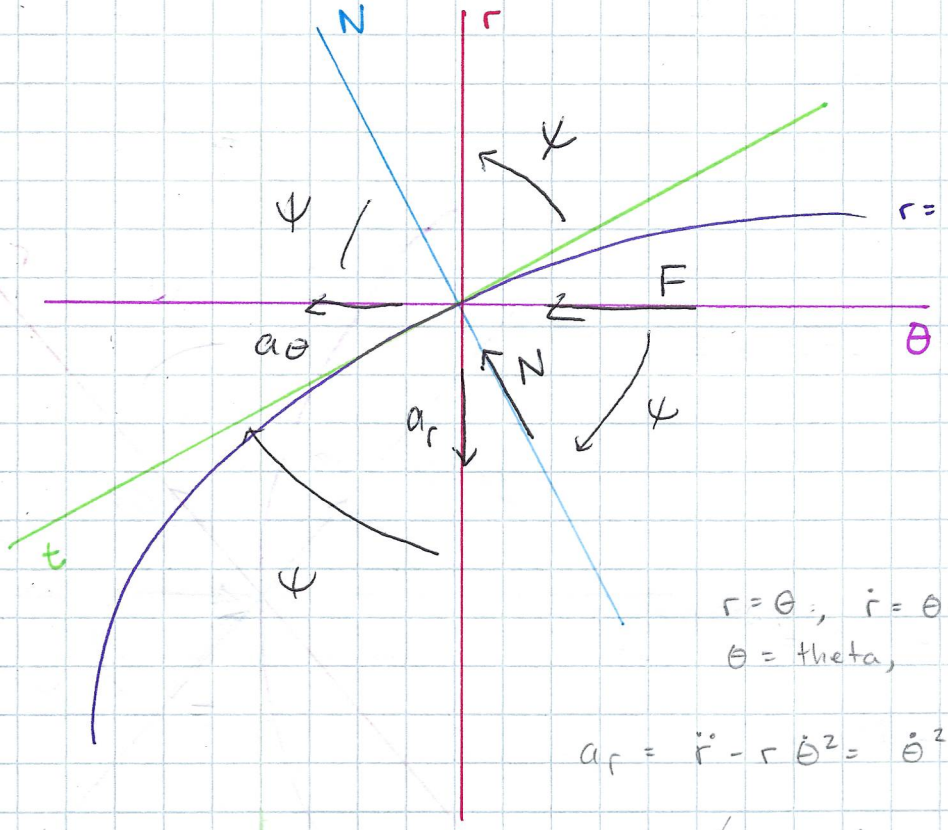


$r = \theta$ = theta

$dr/d\theta = \dot{\theta} = A$

$$\overset{+}{\leftarrow} \sum F_\theta = M a_\theta$$

$$= F + N\cos(\psi)$$



$$+\uparrow \sum F_r = M a_r$$

$$= N\sin(\psi) = M a_r$$

$$\tan\psi = \frac{r}{dr/d\theta} = \frac{\theta}{\dot{\theta}}$$

$$\psi = \tan^{-1}\left(\theta/\dot{\theta}\right)$$

$r = \theta$, $\dot{r} = \theta\cdot\dot{\theta}$, $\ddot{r} = \dot{\theta}\cdot\dot{\theta} + \theta\cdot\ddot{\theta}$ ($\ddot{\theta} = 0$)

θ = theta, $\dot{\theta} = A$, $\ddot{\theta} = 0$

$$a_r = \ddot{r} - r\dot{\theta}^2 = \dot{\theta}^2 - r\dot{\theta}^2 = \dot{\theta}^2(1 - r)$$

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

$$N = \frac{M a_r}{\sin(\psi)}$$

$$F = M a_\theta - N\cos(\psi)$$

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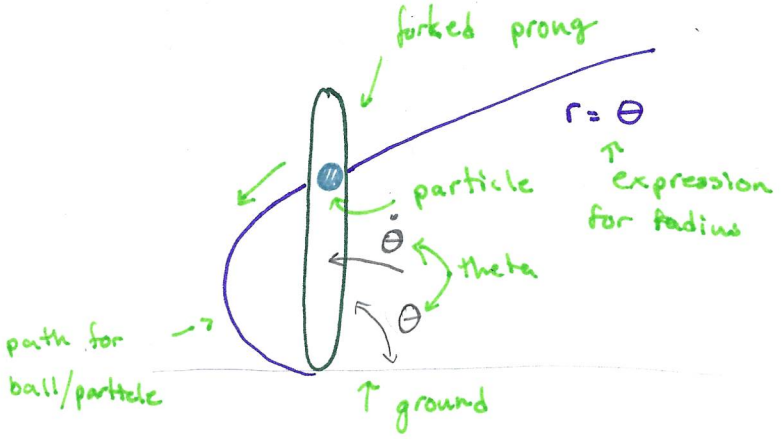
this is for labelling



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