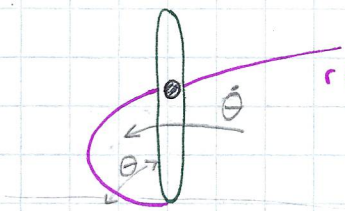
20-P-FA-AF-005

E.o.M Cylindrical Components : Beginner

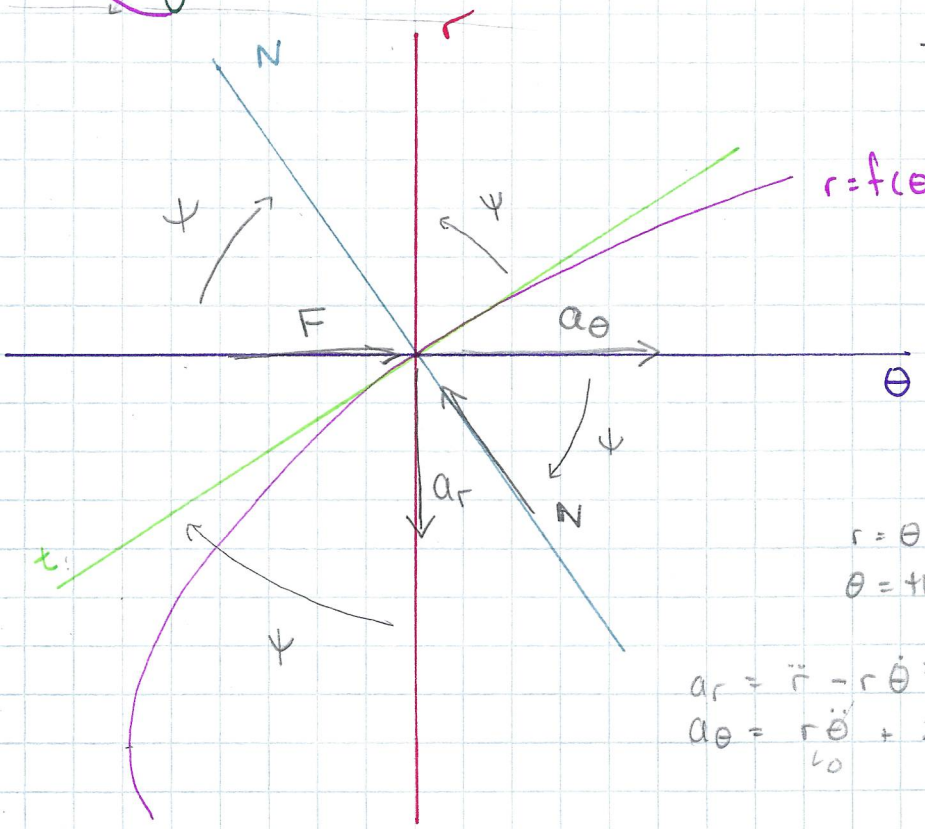
Q: The arm is rotating along the described path with an angular velocity of $\dot{\theta} = A$ rad/s and $\ddot{\theta} = 0$ rad/s^2. Determine magnitude of the force exerted on the M kg ball when θ = theta?

A:



$r = \theta$ = theta

$dr/d\theta = 1$



$\xrightarrow{+} F_\theta = Ma_\theta$

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

$+\uparrow F_r = Ma_r$

$= N\sin(\psi)$

$\tan\psi = r/dr/d\theta = \theta/1$

$\psi = \tan^{-1}(\theta)$

$r = \theta$, $\dot{r} = \theta \cdot \dot{\theta}$, $\ddot{r} = \dot{\theta}^2 + \theta \cdot \ddot{\theta}$ ($\ddot{\theta} = 0$)

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

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

$a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta} = 2\theta\dot{\theta}^2$ ($r\ddot{\theta} = 0$)

$$N = \frac{Ma_r}{\sin(\psi)}, \quad F = Ma_\theta - N\cos(\psi)$$