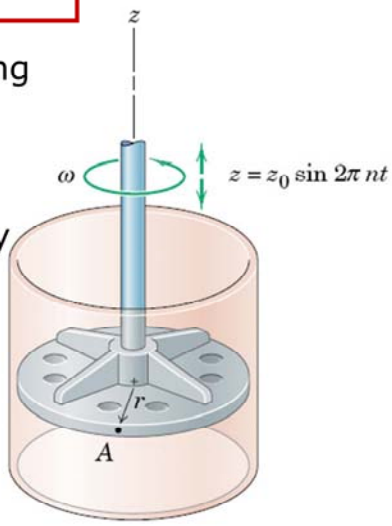
Cylindrical coordinates (r, θ, z): Exercise

$$\mathbf{a} = \left(\ddot{r} - r\dot{\theta}^2\right)\mathbf{e}_r + \left(r\ddot{\theta} + 2\dot{r}\dot{\theta}\right)\mathbf{e}_\theta + \ddot{z}\,\mathbf{k}$$

The rotating element of a mixing chamber has a periodic ***axial movement*** $z = z_0 \sin(2\pi nt)$ while rotating at the constant ***angular velocity*** ω. Frequency n is constant.

Determine the magnitude of the ***acceleration*** of point A on the rim of radius r.



See Notes Page view for solution.

2/176

$a_r = \ddot{r} - r\dot{\theta}^2 = 0 - r\omega^2$

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

$a_z = \frac{d^2}{dt^2}(z_0 \sin 2\pi nt) = -4n^2\pi^2 z_0 \sin 2\pi nt$

$a = \sqrt{(-r\omega^2)^2 + (-4n^2\pi^2 z_0 \sin 2\pi nt)^2}$

$a_{max} = \sqrt{r^2\omega^4 + 16n^4\pi^4 z_0^2}$