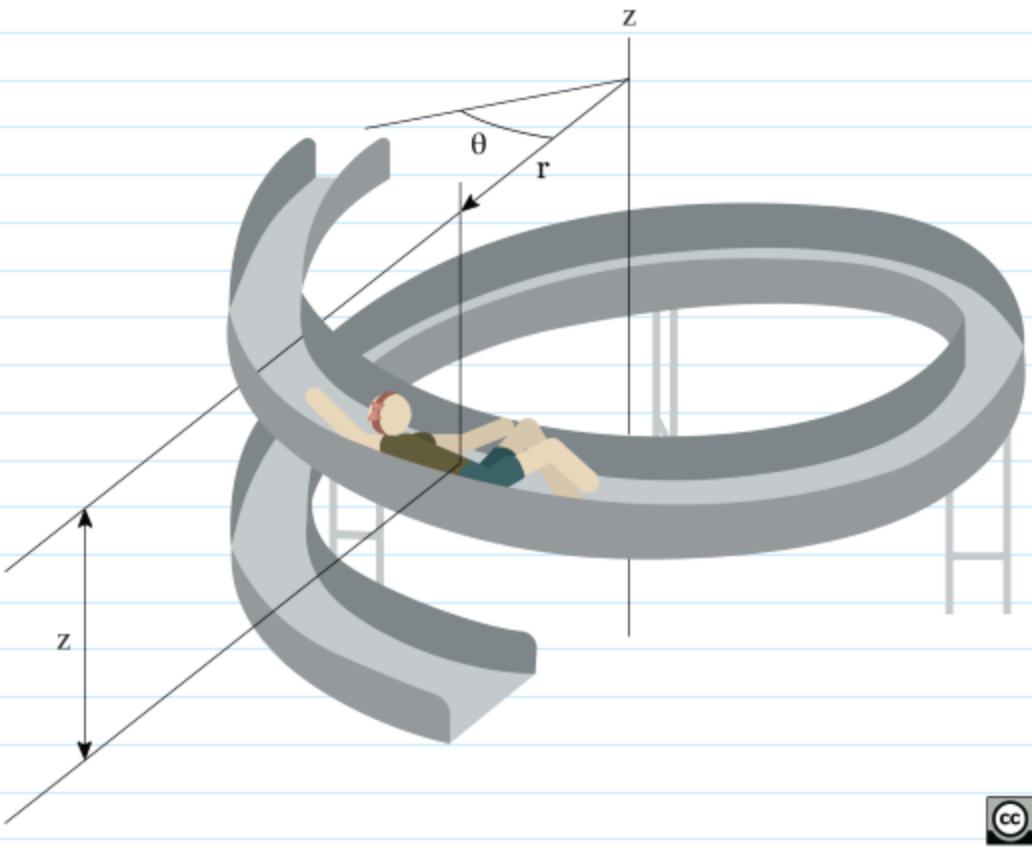
21-P-FA-GD-009



You decide to go down the slide at your old elementary school. The old slide is a spiral of constant radius r_3 and you descend at a constant velocity.

Your position, as you descend the slide is given by $\theta = A_3 t$ and $z = -B_3 t$, where t is time elapsed in seconds.

You have a mass of m_3 and your butt will be sore, at the bottom of the slide, if the force on you exceeds F_3.

What are the components of force F_r, F_θ, F_z the slide exerts on you t_3 seconds after you begin sliding?

Will you be sore afterwards?

(Assume $g = 9.81\ m/s^2$).

$r = r_s \quad \theta = At \quad z = -Bt$

$\dot{r} = 0 \quad \dot{\theta} = A \quad \dot{z} = -B$

$\ddot{r} = 0 \quad \ddot{\theta} = 0 \quad \ddot{z} = 0$

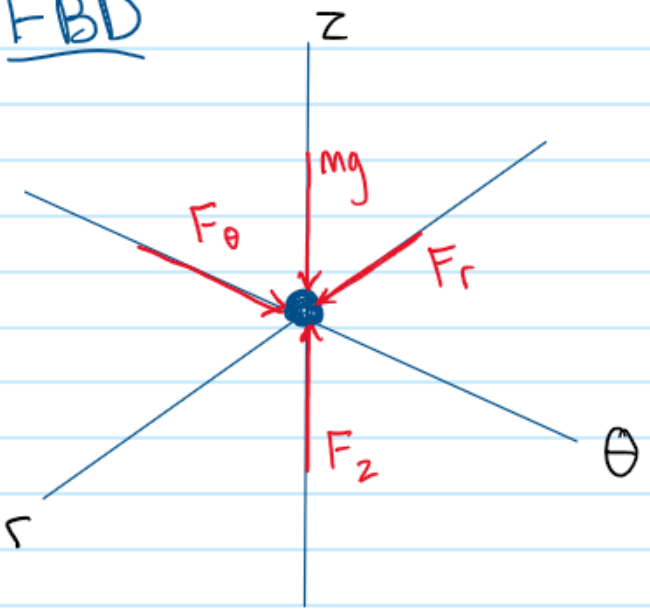
$$\begin{cases} a_r = \ddot{r} - r\dot{\theta}^2 \\ a_\theta = r\ddot{\theta} + 2\dot{r}\dot{\theta} \\ a_z = \ddot{z} \end{cases}$$

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

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

$a_z = \cancel{\ddot{z}}^{0} = 0$

FBD



Force Equilibrium

$\Sigma F_r = ma_r = F_r \quad F_r = -mrA^2$

$\Sigma F_\theta = m\cancel{a_\theta}^{0} = F_\theta \quad F_\theta = 0$

$\Sigma F_z = m\cancel{a_z}^{0} = F_z - mg \quad F_z = mg$

$$F_{tot} = \sqrt{F_r^2 + F_\theta^2 + F_z^2}$$

if $F_{tot} > F_s$, you will be sore.