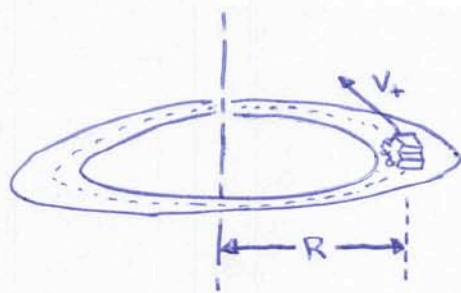
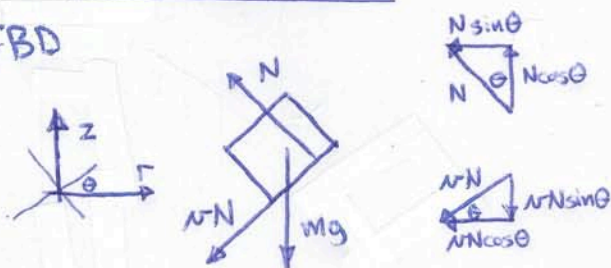


Banked Turn



Determine V_{max}

FBD



Newton's 2nd Law

$$\sum F_r = m a_r = -N \cos \theta - N \sin \theta \quad (1)$$

$$\sum F_z = m a_z^0 = N \cos \theta - N \sin \theta - mg \quad (2)$$

Uniform circular motion

$$a_r = -\omega^2 R = -\frac{v^2}{R} \quad (3)$$

solve for N in (2)

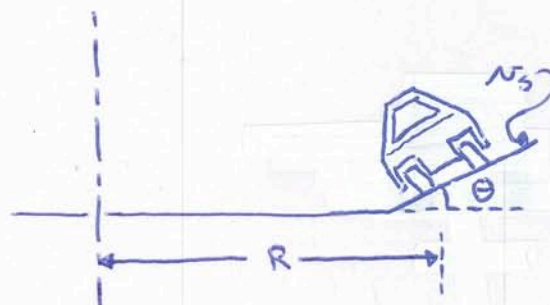
$$N = \frac{mg}{\cos \theta - \mu \sin \theta} \quad (2a)$$

sub (2a) and (3) into (1)

$$m \left[-\frac{v^2}{R} \right] = - \left[\frac{mg}{\cos \theta - \mu \sin \theta} \right] [N \cos \theta + \sin \theta]$$

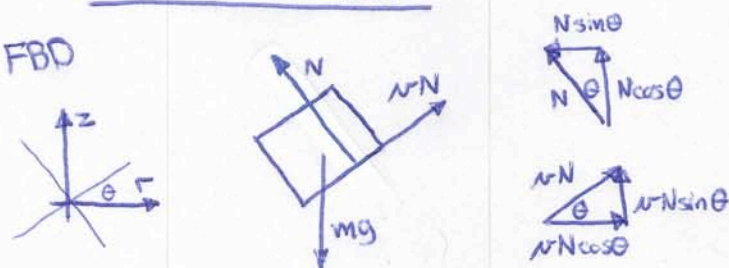
$$v^2 = Rg \frac{(\mu \cos \theta + \sin \theta)}{(\cos \theta - \mu \sin \theta)}$$

$$V_{max} = \sqrt{Rg \frac{(\sin \theta + \mu \cos \theta)}{(\cos \theta - \mu \sin \theta)}}$$



Determine V_{min}

FBD



Newton's 2nd Law

$$\sum F_r = m a_r = N \cos \theta - N \sin \theta \quad (1)$$

$$\sum F_z = m a_z^0 = N \cos \theta + N \sin \theta - mg \quad (2)$$

Uniform circular motion

$$a_r = -\omega^2 R = -\frac{v^2}{R} \quad (3)$$

solve for N in (2)

$$N = \frac{mg}{\cos \theta + \mu \sin \theta} \quad (2a)$$

sub (2a) and (3) into (1)

$$m \left[-\frac{v^2}{R} \right] = \left[\frac{mg}{\cos \theta + \mu \sin \theta} \right] [N \cos \theta - \sin \theta]$$

$$v^2 = Rg \frac{(\sin \theta - \mu \cos \theta)}{(\cos \theta + \mu \sin \theta)}$$

$$V_{min} = \sqrt{Rg \frac{(\sin \theta - \mu \cos \theta)}{(\cos \theta + \mu \sin \theta)}}$$