



$$\sum \vec{F} = m \vec{a}$$

$$-N\hat{r} + \cos\theta m g \hat{r} - \sin\theta m g \hat{\theta} = m \vec{a}$$

$$\hat{r} \quad \cos\theta m g - N = R \ddot{\theta} - R \dot{\theta}^2$$

$$\hat{\theta} \quad -\sin\theta m g = 2R \dot{\theta} \ddot{\theta} + R \ddot{\theta}$$

$$-m g \sin\theta = R \frac{d\ddot{\theta}}{d\theta} \dot{\theta} \rightarrow -\frac{m g}{R} \theta = \ddot{\theta}$$

$$-\frac{m g}{R} \theta d\theta = d\dot{\theta} \dot{\theta} \quad // \int$$

$$-\frac{m g}{R} \int \theta d\theta = \int \dot{\theta} d\dot{\theta}$$

$$-\frac{m g}{R} \frac{\theta^2}{2} \Big|_{\theta_0} = \frac{\dot{\theta}^2}{2} \Big|_{\dot{\theta}_0}$$

$$\left| -\frac{m g}{R} (\theta^2 - \theta_0^2) = \dot{\theta}^2 - \dot{\theta}_0^2 \right|$$

$$\omega = \sqrt{\frac{m g}{R}}$$

$$T = \frac{2\pi}{\omega} = 2\pi \sqrt{\frac{R}{m g}}$$

$$\theta(t) = A \cos\left(\sqrt{\frac{m g}{R}} t\right) + B \sin\left(\sqrt{\frac{m g}{R}} t\right)$$