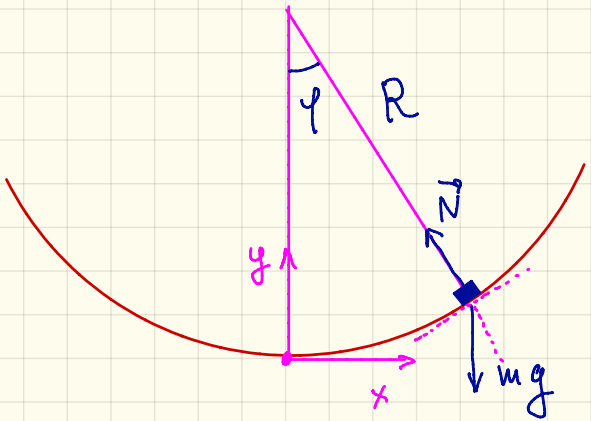

$r = \text{const} = R$

$F_\varphi = -mg \cdot \sin\varphi$

$a_\varphi = R\ddot{\varphi}$

$\ddot{\varphi} = -\frac{g}{R}\sin\varphi$

polar coord. are much easier!

For small φ, $\sin\varphi \approx \varphi$ $\quad \ddot{\varphi} = -\frac{g}{R}\varphi$ ← harmonic oscillations

$\varphi = \varphi_0 \cos\omega t$

$x = R\sin\varphi \approx R\varphi = R\varphi_0 \cos\omega t$

$y = R(1-\cos\varphi) \approx R\frac{\varphi^2}{2} = R\varphi_0^2 \frac{1}{2}\cos^2\omega t = \frac{R\varphi_0^2}{4} + \frac{R\varphi_0^2}{4}\cos 2\omega t$