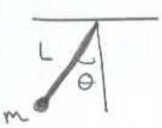
previously: $\dfrac{d^2x}{dt^2} = -\omega^2 x$ SHM 

Now:



$\dfrac{d^2\theta}{dt^2} = -\omega^2 \sin\theta$, $\therefore$ The pendulum is NOT a SHO & the motion is NOT SHM.

Actually, for this pendulum,

$$T = 2\pi\sqrt{\frac{L}{g}}\left(1 + \frac{\theta_0^2}{16} + \frac{11}{3072}\theta_0^4 + \ldots\right)$$

* T is <ins>NOT</ins> independent of Amplitude θ_0.

$\therefore$ Let's force the motion into being SHM by using a small initial amplitude θ_0.

Recall the Taylor Series for $\sin\theta$:

$$\sin\theta = \theta - \frac{\theta^3}{3!} + \frac{\theta^5}{5!} - \frac{\theta^7}{7!} + \ldots$$

We'll use the small angle approximation that:

for small angles $\sin\theta \approx \theta$ $\left(\text{for } \theta \ll 1\,\text{rad}^{\approx 57^\circ}\right)$. why?

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* Aside $\tan\theta \approx \theta$ too. $\left(\tan\theta = \dfrac{\sin\theta}{\cos\theta} = \dfrac{\theta - \frac{\theta^3}{3!} + \ldots}{1 - \frac{\theta^2}{2!} +}\right)$