using the small ∡ appx $\sin\theta \approx \theta$,

$$\frac{d^2\theta}{dt^2} = -\omega^2\theta \quad \therefore \text{SHM!}$$

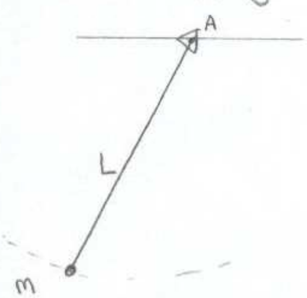
The solution is $\theta(t) = \theta_m \cos(\omega t + \phi)$

where $\omega = \sqrt{\frac{MgD}{I_A}}$. Since $T = \frac{2\pi}{\omega}$

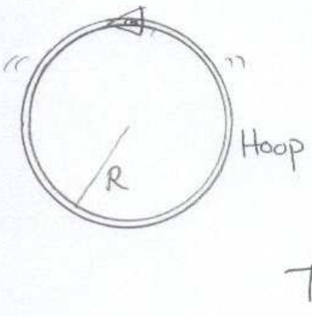
we find $$T = 2\pi\sqrt{\frac{I_A}{MgD}}$$ good to know!

Period of a Physical Pendulum

Let's apply this to a simple pendulum



$$T = 2\pi\sqrt{\frac{I_A}{MgD}} = 2\pi\sqrt{\frac{mL^2}{MgL}} = 2\pi\sqrt{\frac{L}{g}}$$:)



$T = ?$

$$T = 2\pi\sqrt{\frac{I_{cm} + Mh^2}{MgD}} = 2\pi\sqrt{\frac{MR^2 + MR^2}{MgR}}$$

$$T = 2\pi\sqrt{\frac{2MR^2}{MgR}} \Rightarrow T = 2\pi\sqrt{\frac{2R}{g}} = 2\pi\sqrt{\frac{d}{g}}$$

Solving for g: $g = \frac{4\pi^2 d}{T^2}$