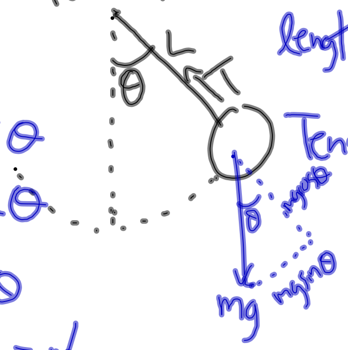
Pendulums

$v = \frac{d}{t}$



length L

$d = S = r\theta$

$s = L\theta$

Tension T

$T = mg\cos\theta$

$-mg\sin\theta = ma$

$T = 2\pi\sqrt{\frac{L}{g}}$

$a = -g\sin\theta$

$a = \frac{d^2 s}{dt^2} = L\frac{d^2\theta}{dt^2} = -g\sin\theta$

$\frac{d^2\theta}{dt^2} = -\frac{g}{L}\sin\theta \approx -\frac{g}{L}\theta$ for small θ

$T = 2\pi\sqrt{\frac{L}{g}}$ $\quad \alpha = -\frac{g}{L}\theta$

$\frac{g}{L} = \frac{4\pi^2}{T^2} = \omega^2$ $\quad = -\omega^2\theta$

$\omega = \sqrt{\frac{g}{L}}$ $\quad T = \frac{2\pi}{\omega}$ $\quad f = \frac{\omega}{2\pi}$

For small θ

Eq. $\theta = \theta_0 \cos(\omega t + \delta)$

For Larger θ

$$T = T_0\left[1 + \frac{1}{2^2}\sin^2\frac{1}{2}\theta_0 + \frac{1}{2^2}\left(\frac{3}{4}\right)^2\sin^4\frac{1}{2}\theta_0 + \cdots\right]$$

$T = 2\pi\sqrt{\frac{I}{MgD}}$

I = moment of Inertia
M = mass
g = gravity
D = dist. to pivot pt. from c.m.

Physical Pendulum

- Can't neglect mass of rope
i.e. not a point mass bob