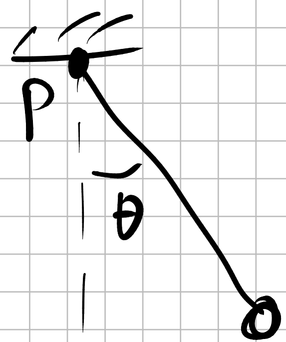
Pendulums

$$\omega = \sqrt{\frac{Lmg}{I_p}}$$



for simple pendulum

$$\omega = \sqrt{\frac{g}{L}}$$

angular frequency

not velocity

$$\ddot{x} = -\omega^2 x$$

$$\ddot{\theta} = -\omega^2 \theta \implies \theta(t) = \underbrace{A}_{\theta_A} \cdot \cos(\omega t + \varphi)$$

$$\dot{\theta} = \frac{d}{dt}\theta = \frac{d}{dt}\left(\theta_A \cos(\omega t + \varphi)\right)$$

$$= -\theta_A \cdot \omega \sin(\omega t + \varphi)$$

angular velocity

$$= -\Omega_A \sin(\omega t + \varphi) = \Omega(t)$$

$$\ddot{\theta} = \alpha = \ddot{\theta} = \dot{\Omega} = -\omega\,\Omega_A \cos(\omega t+\varphi)$$

$$= -\omega^2 \theta_A \cos(\omega t+\varphi)$$

↑ angular acceleration

sample problem :

at $t = 0$ → $\begin{cases} \theta_0 = \theta(t=0) \\ \Omega_0 = \Omega(t=0) \end{cases}$

$\theta_A \cos(\omega t+\varphi)$

↑ given ω

$$\theta_0 = \theta_A \cos(\omega \cancelto{0}{t} + \varphi) =$$

$$= \theta_A \cos(\varphi)$$

$$\Omega_0 = -\theta_A \omega \sin(\omega \cancelto{0}{t} + \varphi)$$

$$= -\theta_A \omega \sin(\varphi)$$

$$\frac{2\omega\Gamma_0}{\theta_0} = -\omega \frac{\sin\varphi}{\cos\varphi} = -\omega \tan(\varphi) \Rightarrow \varphi$$

$$(\theta_0 \omega)^2 + 2\Gamma_0^2 = (\theta_A \omega \cos(\dots))^2$$

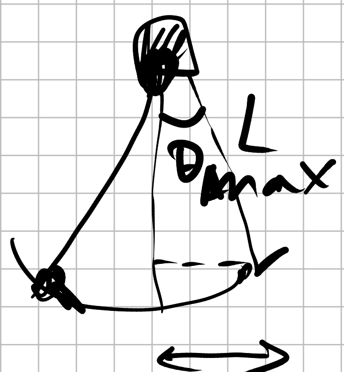
$$+ (\theta_A \omega \sin(\dots))^2 =$$

$$= (\theta_A \omega)^2 \underbrace{(\cos^2(\sim) + \sin^2(\sim))}_{1}$$

$$\theta_A = \sqrt{\theta_0^2 + \left(\frac{2\Gamma_0}{\omega}\right)^2}$$

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

People



$$d = L \cdot \sin\theta_{max}$$

$$v = \frac{2d}{T/2} \sim \frac{d}{T}$$

$$v \sim \frac{L \cdot}{\sqrt{L/g}} \sin\theta_{max}$$

$$v \sim \sqrt{Lg}$$