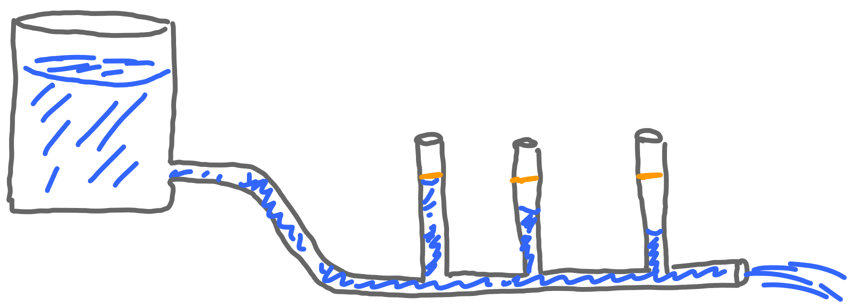
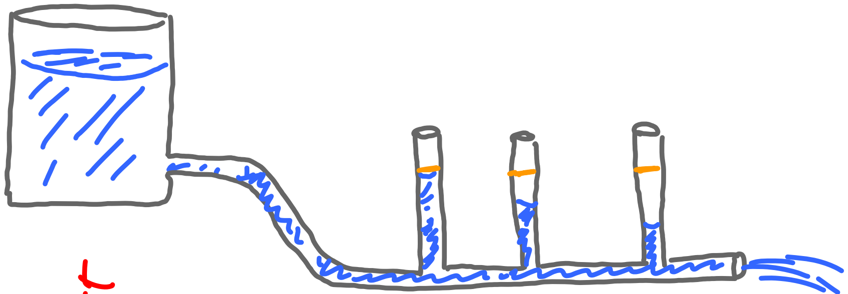
Physics 113 - November 29, 2012

- Exam 3 Next Tuesday Morning
- Q+A session TBD

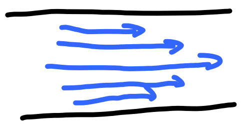
Confusion about Demo last time



$P + \frac{1}{2}\rho v^2 + \rho g h \sim$ constant (ideal fluid)



Bad choice of demo on my part
Sorry about that
... This demo illustrates the non-ideal, viscous nature of water



viscous flow

v unchanges
so friction affects p

Good Mistake on my part
.: but non-ideal fluids
not on Exams

$$|\Delta P| = k Q \eta \ell$$

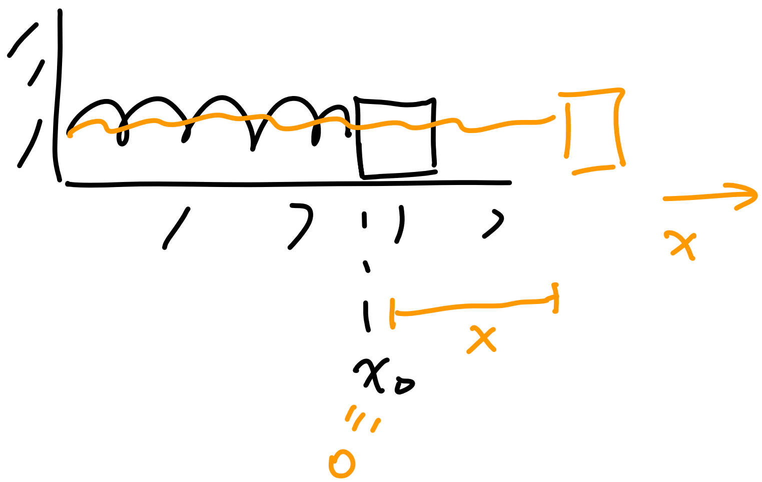
- k: constant depends on shape of pipe
- Q: volume flow rate
- η: coefficient of viscosity
- ℓ: length

Poiseuille's Law – for circular cross-section

$$|\Delta P| = \frac{8}{\pi r^4} Q \eta \ell$$

Small change in radius of artery causes large pressure drop
heart works much harder to maintain same flow rate

Simple Harmonic Motion



$$F = -kx$$

$$ma = -kx$$

$$m\frac{d^2x}{dt^2} = -kx$$

$$\frac{d^2x}{dt^2} + \frac{k}{m}x = 0$$

hypothesize

$$x = A\cos(\omega t + \phi)$$

Amplitude (A), angular frequency (ω), initial phase (ϕ)

$$\frac{dx}{dt} = A\omega \sin(\omega t + \phi)$$

$$\frac{d^2x}{dt^2} = -A\omega^2\cos(\omega t + \phi)$$

$$\frac{d^2x}{dt^2} + \frac{k}{m}x = 0$$

sub in

$$-A\omega^2\cos(\omega t + \phi) + \frac{k}{m}A\cos(\omega t + \phi) = 0$$

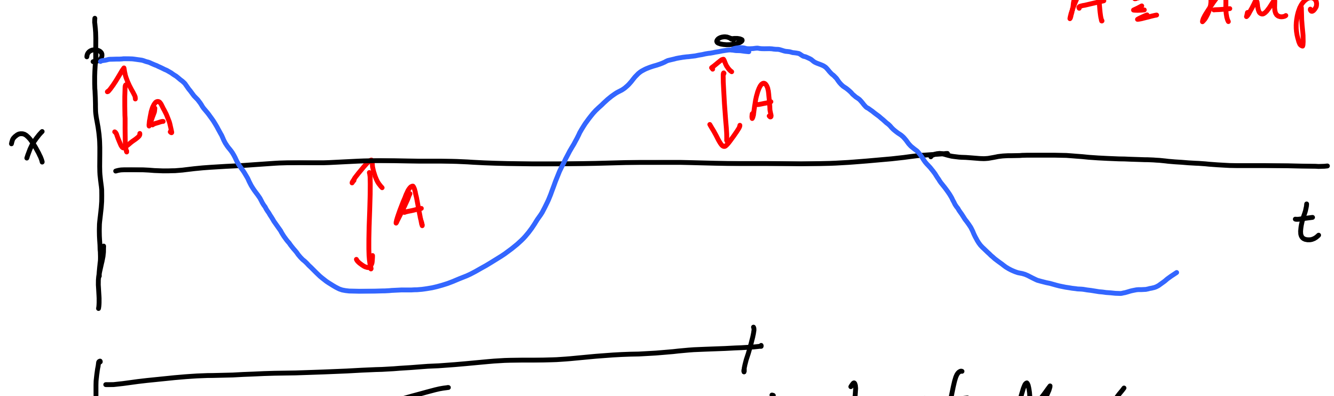
True if $\omega^2 = \frac{k}{m}$ $\quad \omega = \pm\sqrt{\frac{k}{m}}$

$$x = A\cos(\omega t + \phi)$$

$T \equiv$ period of motion

$$\omega \equiv \frac{2\pi}{T}$$

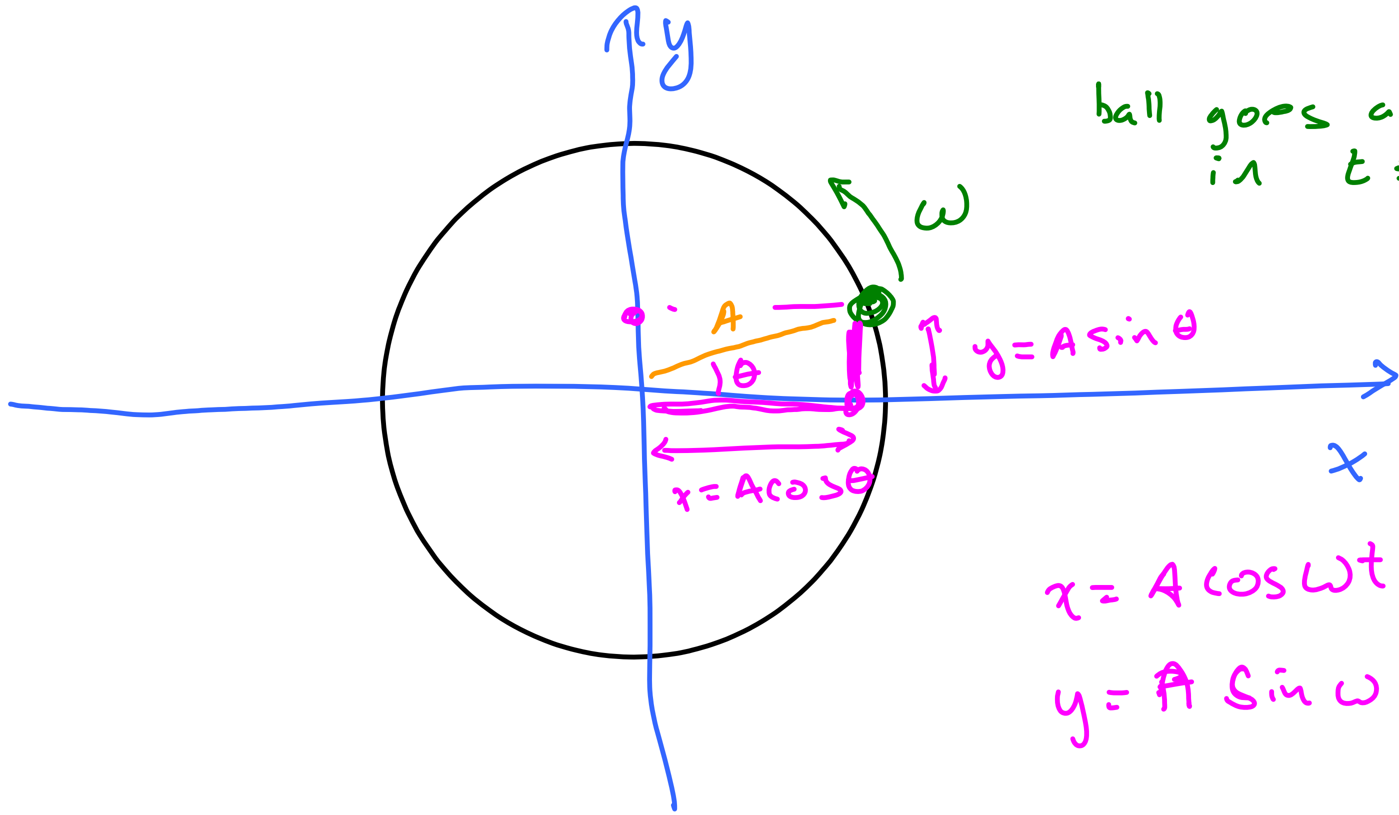
$A \equiv$ Amplitude of motion



$T \equiv$ one period of Motion

define $\frac{1}{T} \equiv$ frequency f

ω is also called frequency $\omega = \frac{2\pi}{T}$



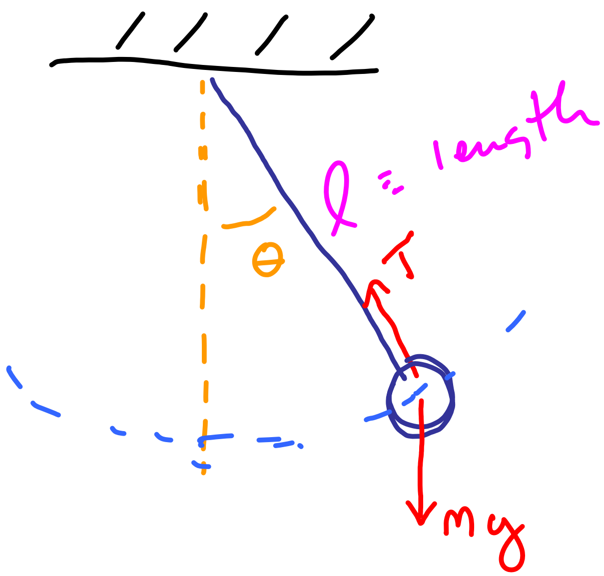
ball goes around circle in $t = T$

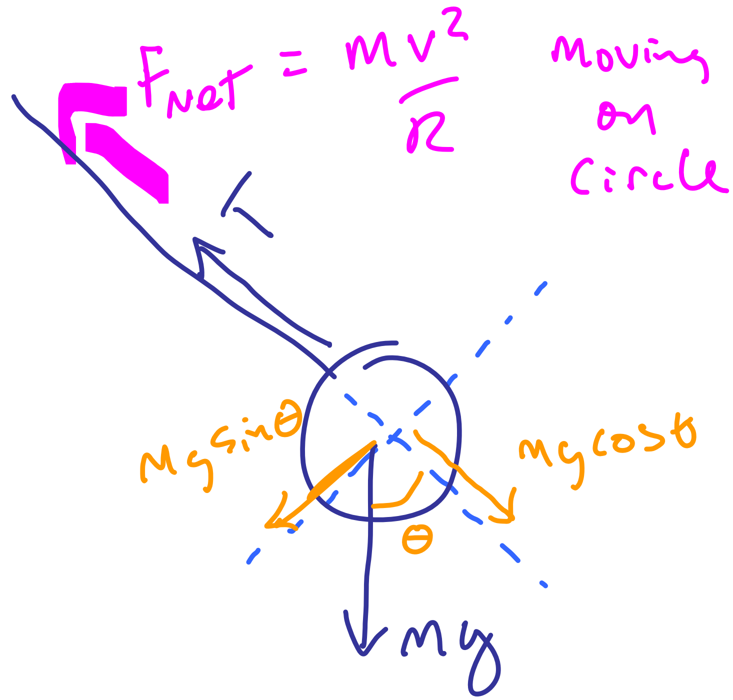
$\theta = \omega t$

$x = A\cos\omega t$

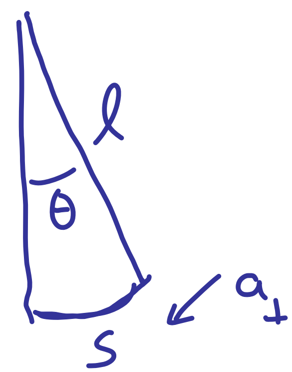
$y = A\sin\omega t$

Simple pendulum





Look at $F_\perp = ma_\perp = -mg\sin\theta$



$$s = l\theta$$

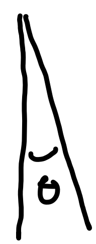
$$\theta = \frac{s}{l}$$

$$m\frac{d^2s}{dt} = -mg\sin\theta$$

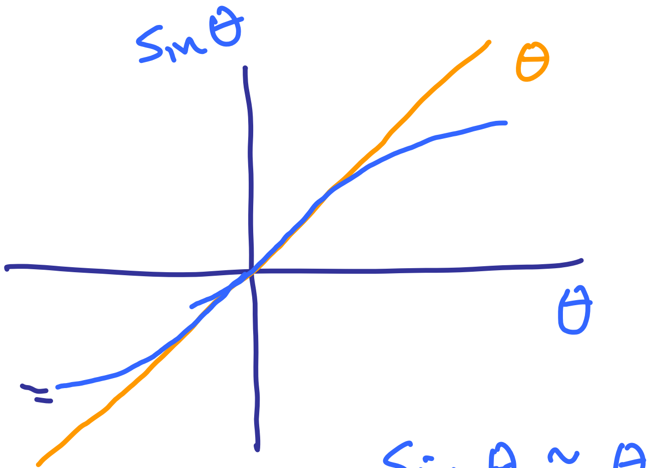
θ small

$$m\frac{d^2s}{dt^2} = -mg\theta$$

$$m\frac{d^2s}{dt^2} = -mg\,s/l$$



θ is small



$$\sin\theta \approx \theta$$

$$\frac{d^2 s}{dt^2} + \frac{g}{l} s = 0$$

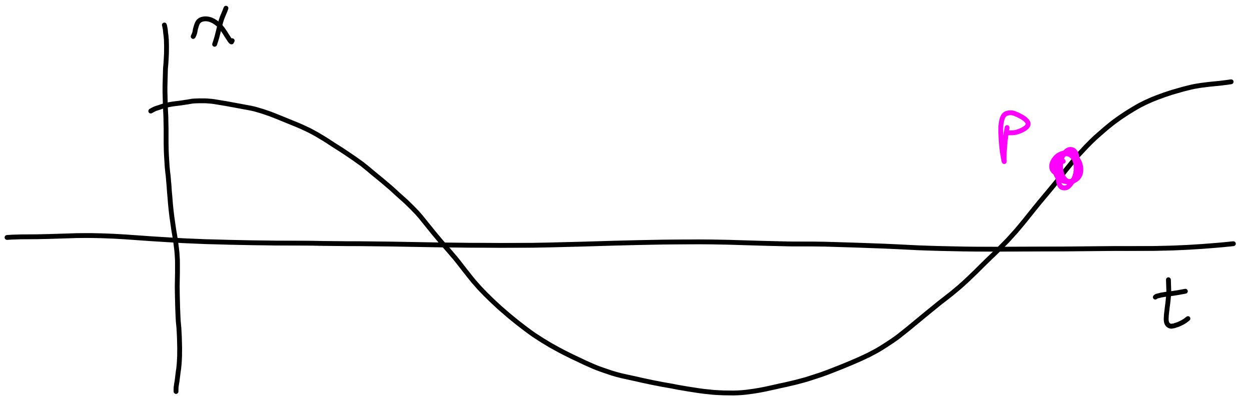
$\rightarrow$ SHM with

$$\omega^2 = \frac{g}{l}$$

$$\omega = \sqrt{g/l}$$

$$\frac{d^2 x}{dt^2} + \frac{k}{m} x = 0$$

$$\omega^2 = k/m$$



I pos. velocity, pos. Accel.

II + V, − a

III − V, − a

IV − V, + a

V 0 V but have a

VI 0 V 0 a

A simple pendulum has period T on Earth. What is the period of same pendulum if taken to the moon

$$\omega = \sqrt{g/l}$$

$$\omega = \frac{2\pi}{T}$$

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

$g_{moon} < g_{earth}$

I $T_E > T_M$

II $T_E < T_M$

III $T_E = T_M$