Physics 113 - December 3, 2013

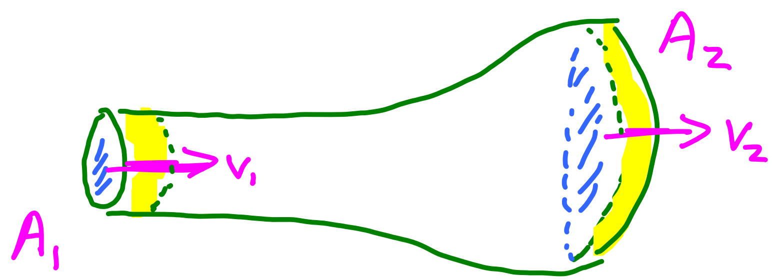
- Q+A session today 5:30 Hoyt
- Sent email to class this morning w/ Answers to many questions of potential interest to all
  → others ?

Final Exam Thurs. Dec 19, 7:15 pm, Hubbell

Got Right Hand ?

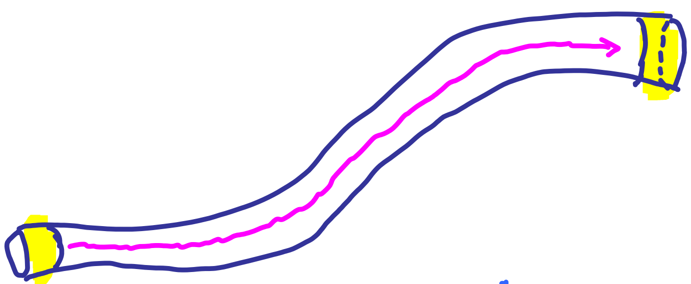
Last Time

Fluid Dynamics



Eqn of Continuity

$$\boxed{A_1 V_1 = A_2 V_2}$$

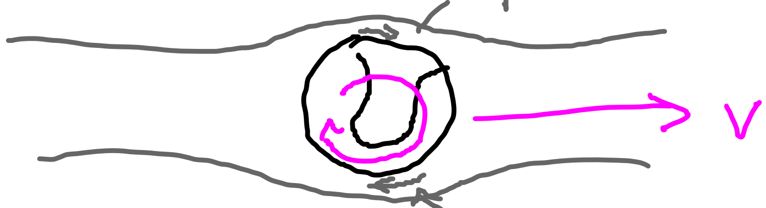


Energy conservation

Bernoulli's Equation

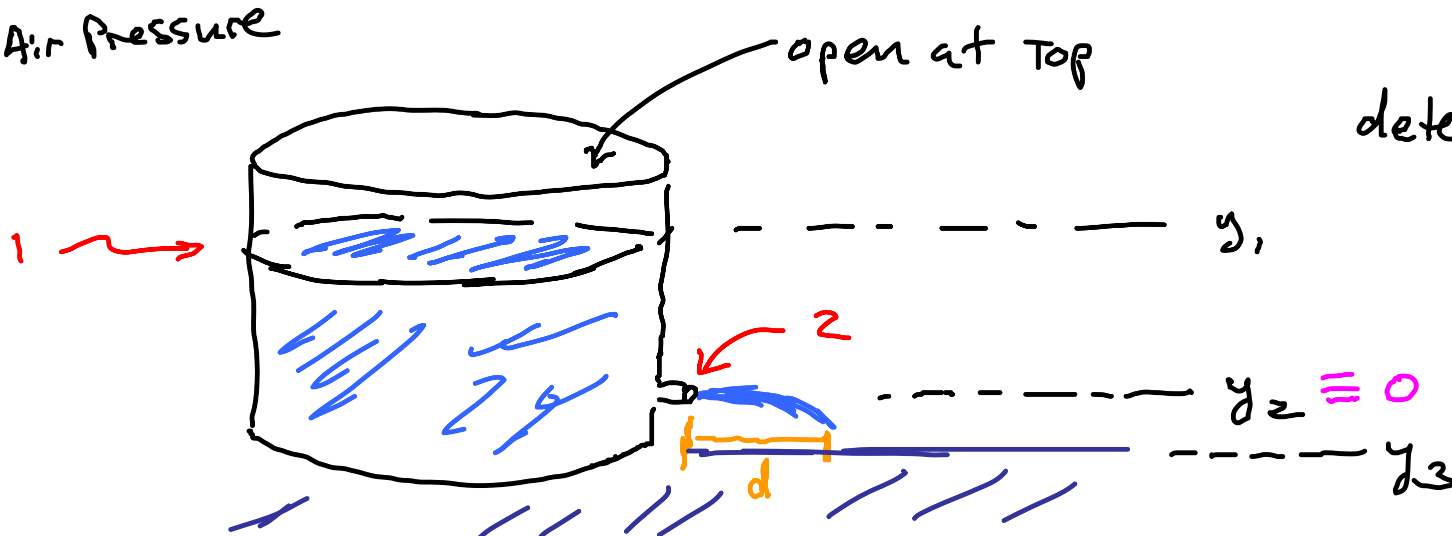
$$\boxed{P + \frac{1}{2}\rho v^2 + \rho g h \sim \text{CONSTANT}}$$

V_T slows a little



V_B is a bit bigger than V

$$P_T + \frac{1}{2}\rho V_T^2 = P_B + \frac{1}{2}\rho V_B^2$$



determine d

$v_1 \sim 0$ "large vat"

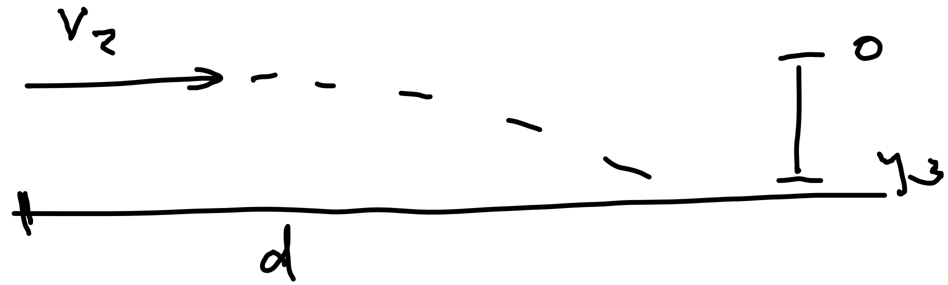
$$\cancel{P_1} + \tfrac{1}{2}\rho \cancel{v_1^2} + \rho g y_1 = \cancel{P_2} + \tfrac{1}{2}\rho V_2^2 + \rho g \cancel{y_2}^{\,0}$$

Assume $P_1 \sim P_2 \equiv P_{ATM}$

$$\rho g y_1 - \tfrac{1}{2}\rho V_2^2$$

$$V_2 = \sqrt{2 g y_1}$$

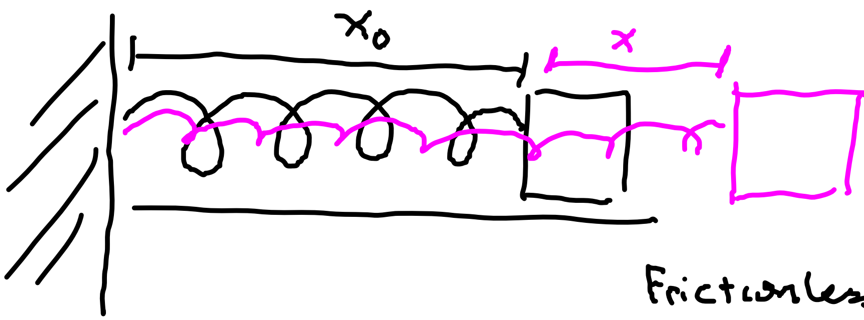
$$= \sqrt{2 g h}$$



v2
0
y3
d

Simple harmonic motion SHM

$$\vec{F}_x = -k(\vec{x} - \vec{x}_0)$$



Frictionless floor

$$|F| = kx$$

$$x_0 = 0$$

$$F = -kx$$

$$ma = -kx$$

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

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

2ND order ordinary differential equation

→ equation of motion for SHM

hypothesize $x = A\cos(\omega t + \varphi)$ is a soln

CONSTANT Amplitude

Angular frequency

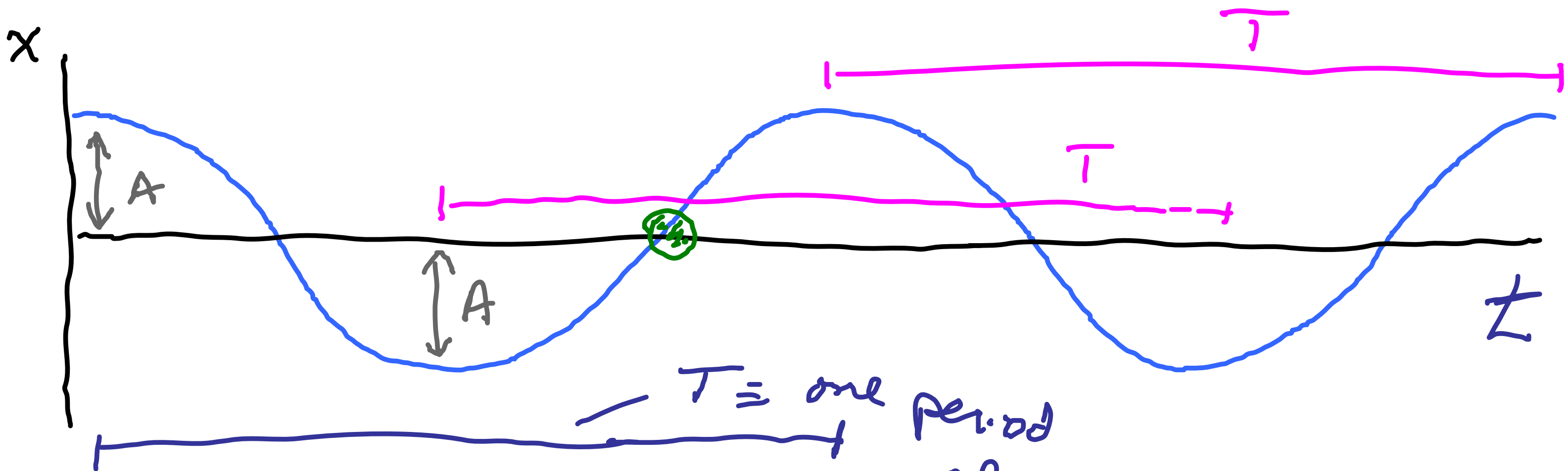
initial phase

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

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

$$\frac{d^2x}{dt^2} + \frac{k}{M}x = 0 \rightsquigarrow A\omega^2\cos(\omega t + \varphi) - \frac{k}{m}A\cos(\omega t + \varphi) = 0$$

True if $\omega^2 = k/M$ $\quad \omega = \pm\sqrt{k/M}$



$T \equiv$ one period of Motion

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

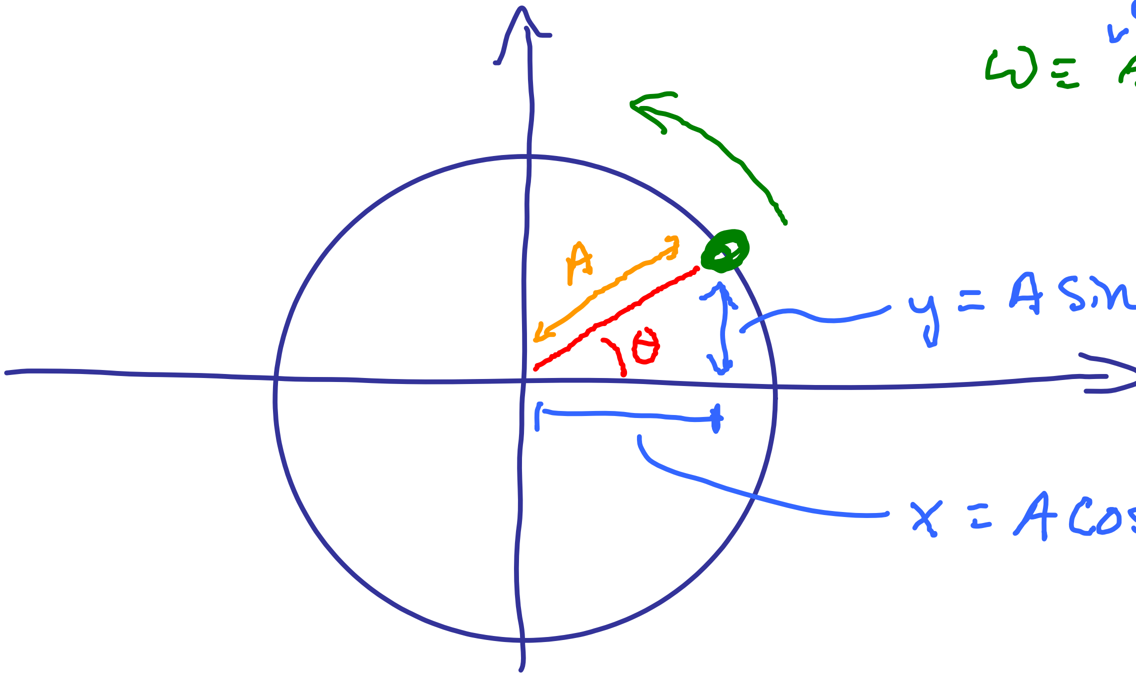
$$\omega = \frac{2\pi}{T}$$

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

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

ω = Angular frequency (constant)

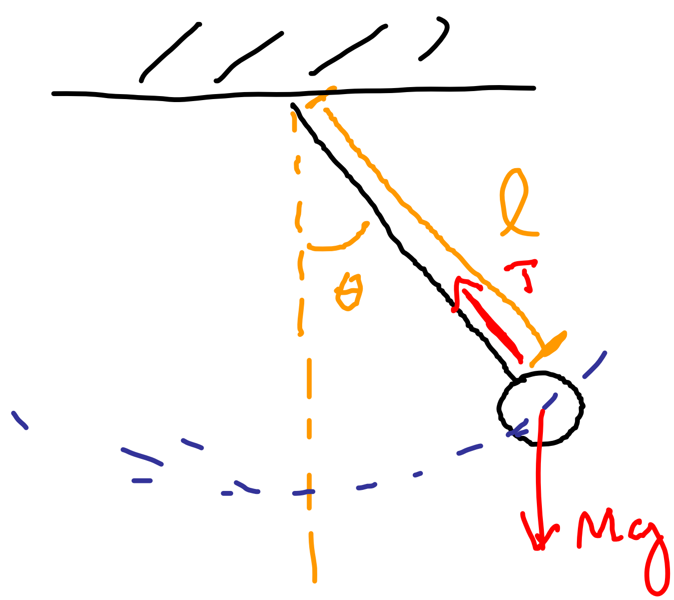
$\theta = \omega t$

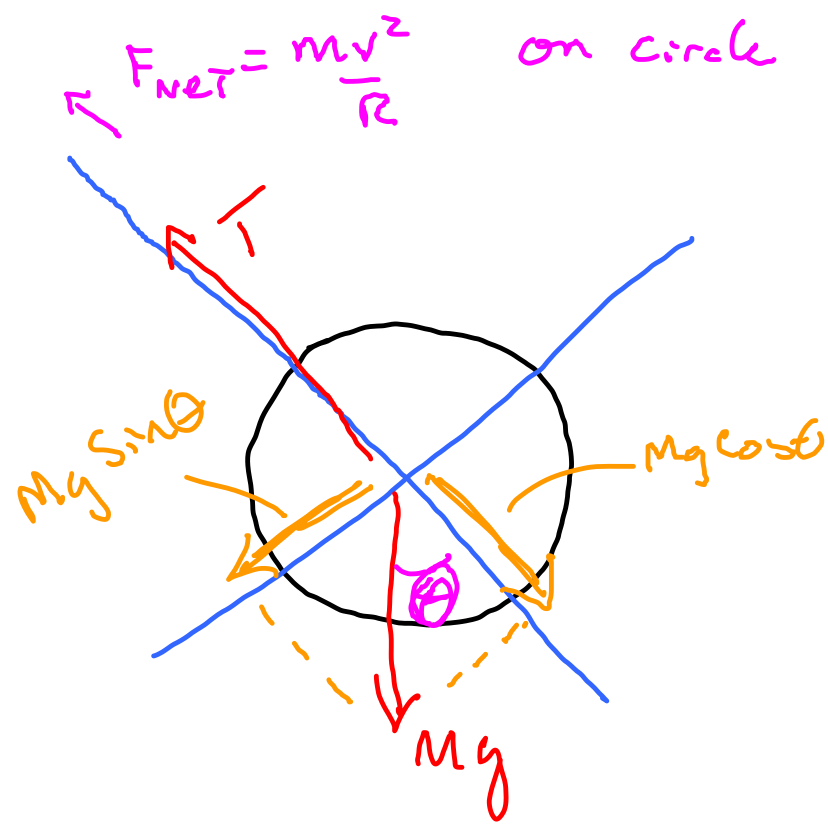


$y = A \sin\theta = A \sin\omega t$

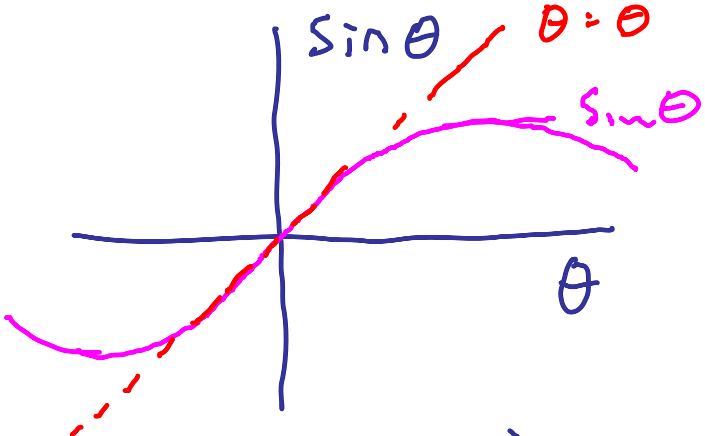
$x = A \cos\theta = A \cos\omega t$

Simple Pendulum



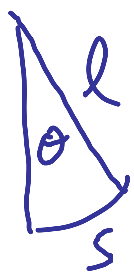


look at $F_\perp = ma_\perp = -mg\sin\theta$



$\sin\theta \approx \theta$ for small θ

$ma_\perp = -mg\sin\theta$



$s = l\theta$

$\theta = s/l$

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

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

where $\omega^2 = g/l$