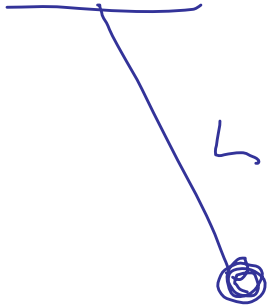
Phys 2110-4 4/17/13

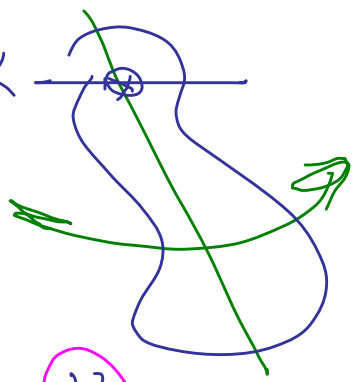
Note Title 4/17/2013

Oscillations

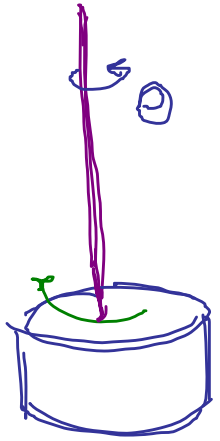


$T = 2\pi\sqrt{\frac{L}{g}}$

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



Torsional pendulum



Fiber gives a torque opp. θ.

units N·m / rad

$\tau = -K\theta$

$= I\alpha = I\frac{d^2\theta}{dt^2}$

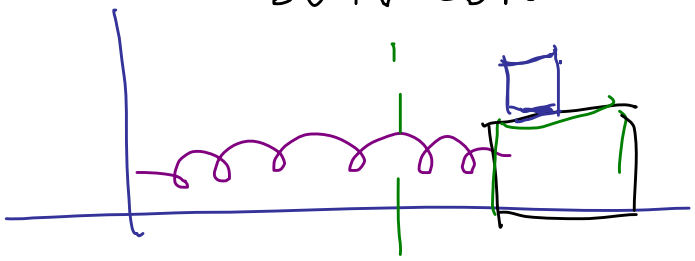
$\frac{d^2\theta}{dt^2} = -\frac{K}{I}\theta$

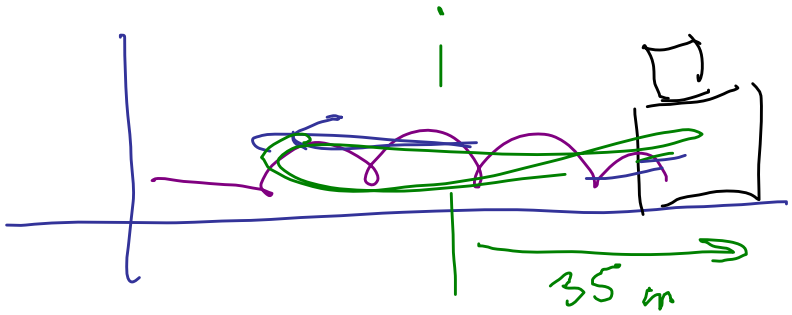
ω^2

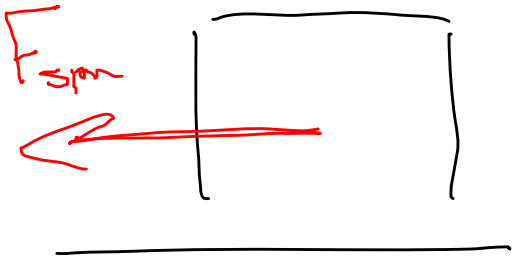
$\omega = \sqrt{\frac{K}{I}}$, f, T etc.

13.74 500 g block on a frictionless horiz surface is attached to a rather limp spring $k = 8.7 \frac{N}{m}$. A second block rests on first, & whole system executes SHM w/ period 1.8 s.

Amp is incr'd to 35 cm, upper block begins to slip. What is coeff of static fric between two blocks?







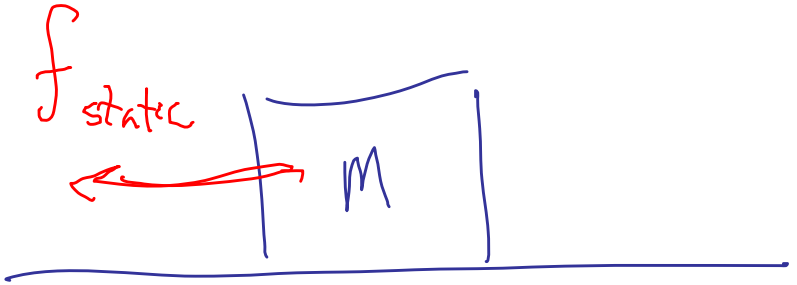
$$a_{max} = A\omega^2$$

$$= 4.26 \frac{m}{s^2}$$

$$A = 35\ cm$$

$$T = 1.8\ s$$

$$\omega = 3.49\ s^{-1}$$



$$f_{stat}^{max} = \mu_s n = \mu_s mg$$

$$= m a_{max}$$

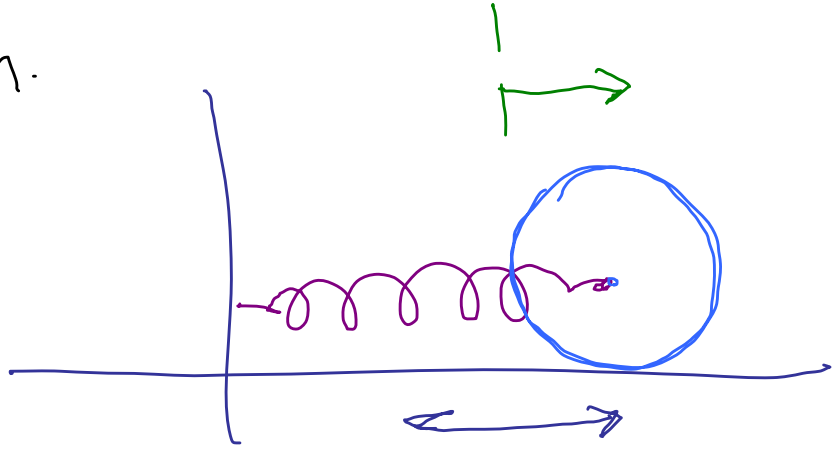
$$\omega = \sqrt{\frac{k}{m+m}}$$

$$m + m = \frac{k}{\omega^2} = 0.713\ kg$$

$$m = 0.214\ kg$$

$$\mu_s = \frac{a_{max}}{g} = \frac{4.26 \frac{m}{s^2}}{9.8 \frac{m}{s^2}} = 0.435$$

13.63 A solid cylinder mass M radius R mounted on axle thru center. Axle attached to spring, const k. Rolls back & forth. Find ang freq of motion.



Do it with energy!

Suppose spring is extd by x

Wheel is motion. KE:

$K_{tot} = K_{trans} + K_{rot}$ ($\frac{1}{2} I\omega^2$)

$= \frac{1}{2} M v^2 + \frac{1}{2}\left(\frac{1}{2} M R^2\right)\left(\frac{v}{R}\right)^2 = \frac{3}{2} M v^2$

$U_{spr} = \frac{1}{2} k x^2$

$$U = \frac{1}{2}kx^2 + \frac{3}{4}Mv^2$$

Take $\frac{d}{dt}$ of this Gives zero!

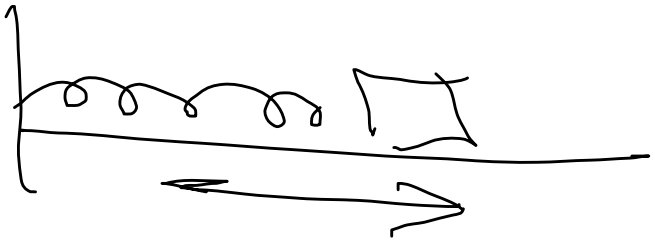
$$\frac{1}{2}k\,2x\frac{dx}{dt} + \frac{3}{4}M\,2v\frac{dv}{dt} = 0$$

$$kxv + \frac{3}{2}Mva = 0$$

$$\frac{d^2x}{dt^2} = a = -kx\left(\frac{2}{3M}\right) = -\frac{2k}{3M}x$$

$$\omega^2 \qquad \omega = \sqrt{\frac{2k}{3M}}$$

More on osc's



Damped osc's

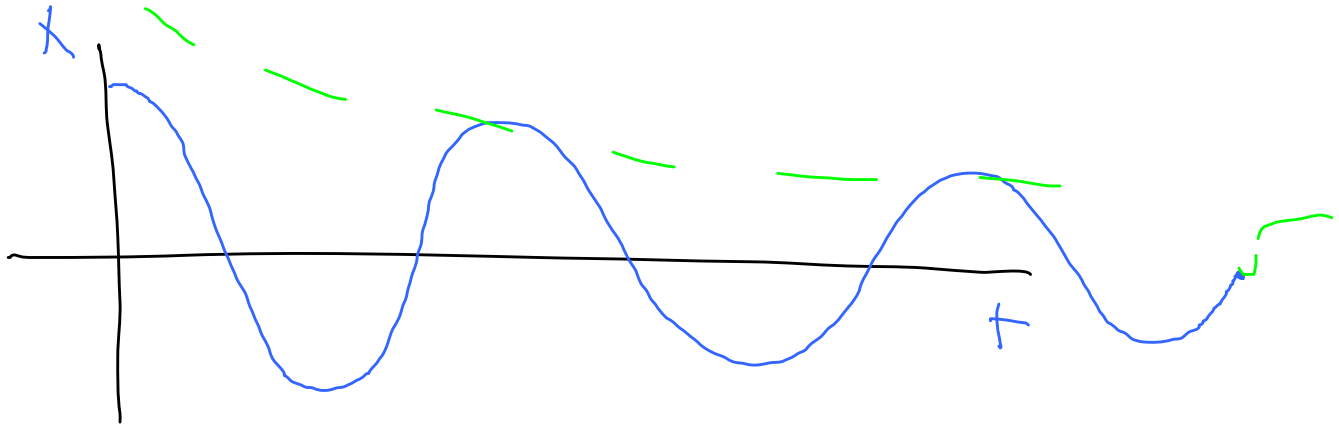
More often study vel.-dep friction

Approx $f_{kn} \propto -v$

Rel for mass moving thru fluid.

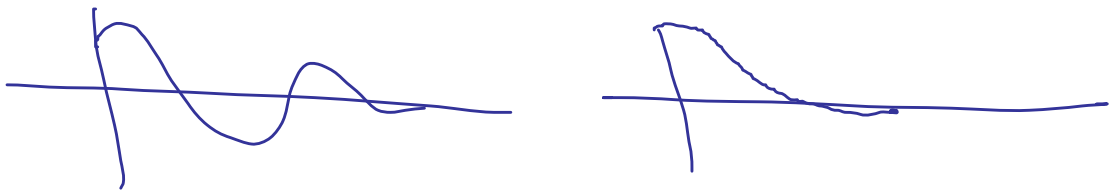
DE $\quad -kx - bv = ma$

$$m\frac{d^2x}{dt^2} + b\frac{dx}{dt} + kx = 0$$



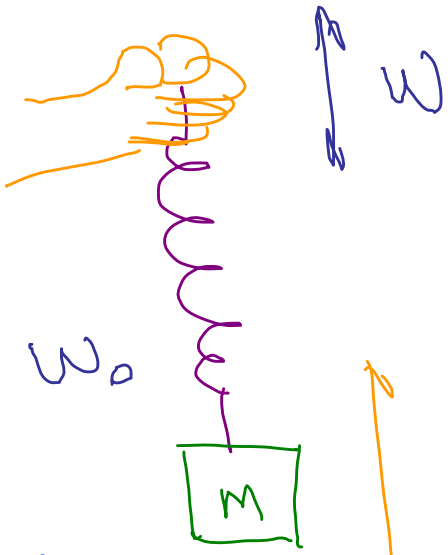
Damped Harmonic Osc.

$$x(t) = A e^{-bt/2m} \cos(\omega t + \phi)$$



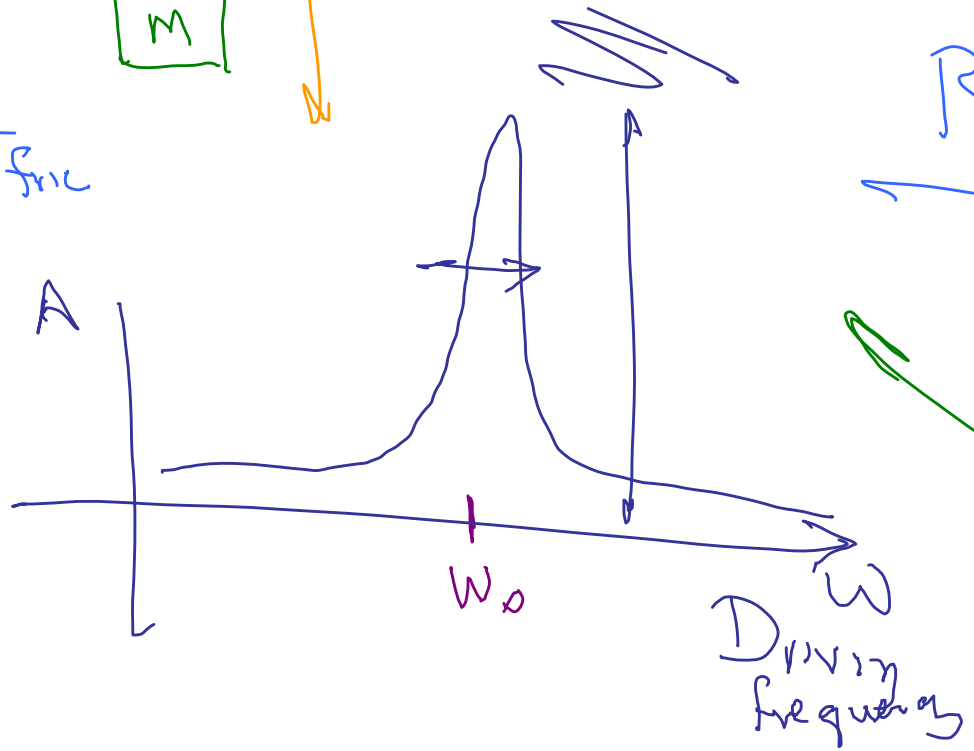
Driven oscillations

Apply ext force at some other freq.

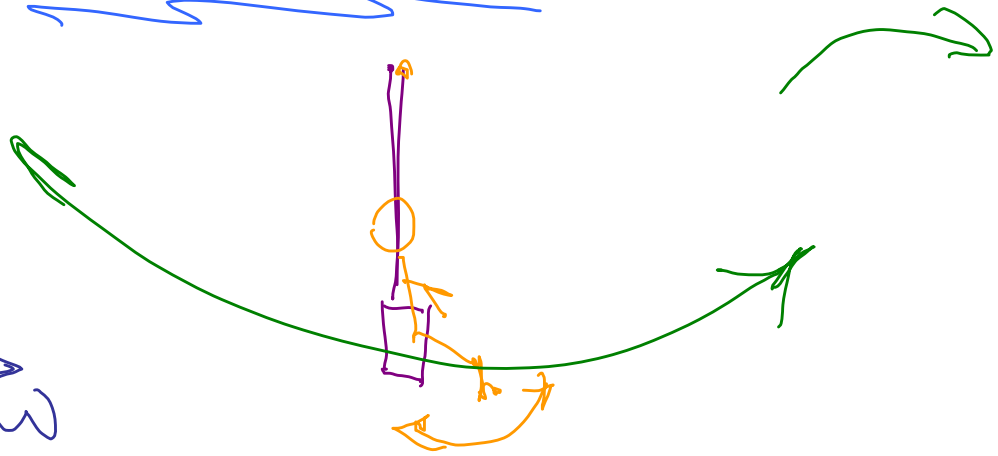


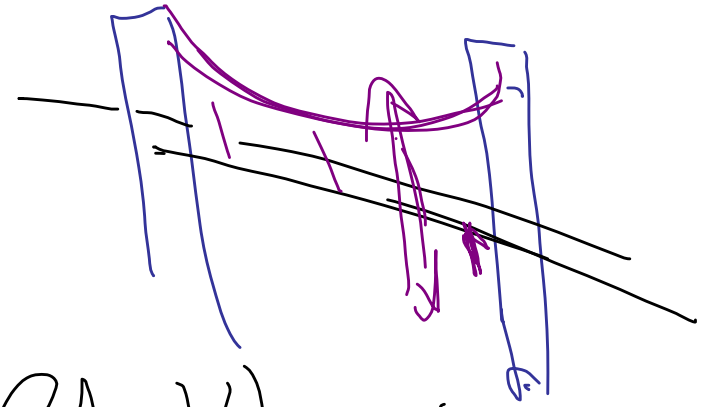
$w_0 = \sqrt{\frac{k}{m}}$

f_{fric}



Resonance



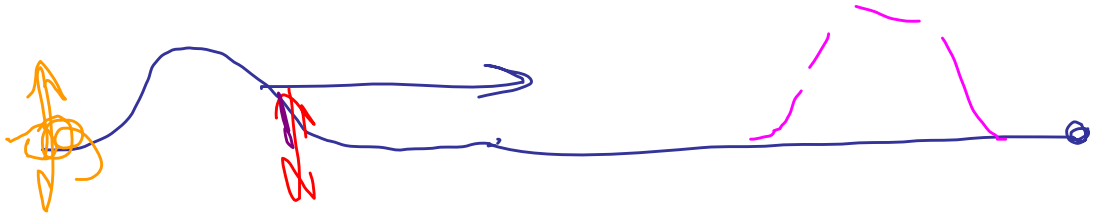


Ch 14 Waves

Deformable medium.

String
Water
Air.

Motion:



Disturbance travels two ways

Waves.