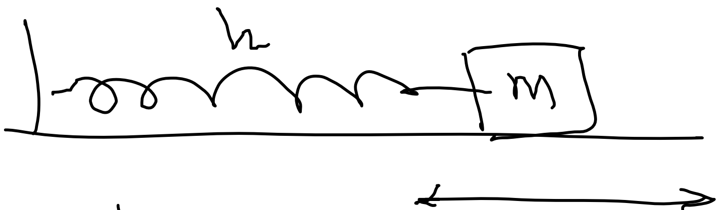
Phys 2110-4 11/21/11

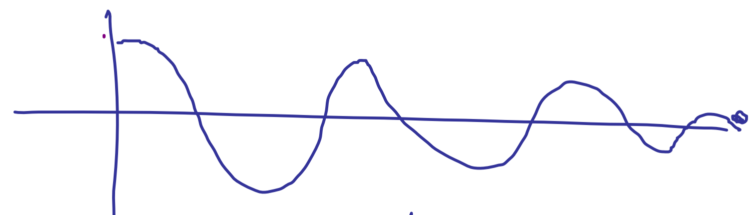
Note Title 11/21/2011

Old business! Oscillations:

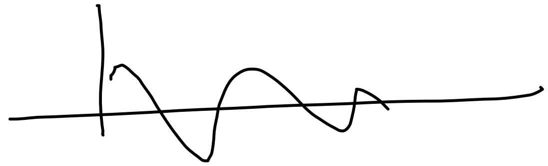


$\omega = \sqrt{\frac{k}{m}}$

13.6 Damped Oscillations



Motion dies off



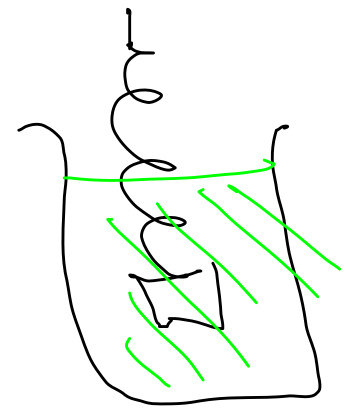
Chap 13.6

Friction ?

Suppose friction force is prop to the velocity.

(Mass moving thru fluid

b is constant



$$\Longrightarrow \quad f_{k,x} = -b v_x$$

Mass on a spring

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

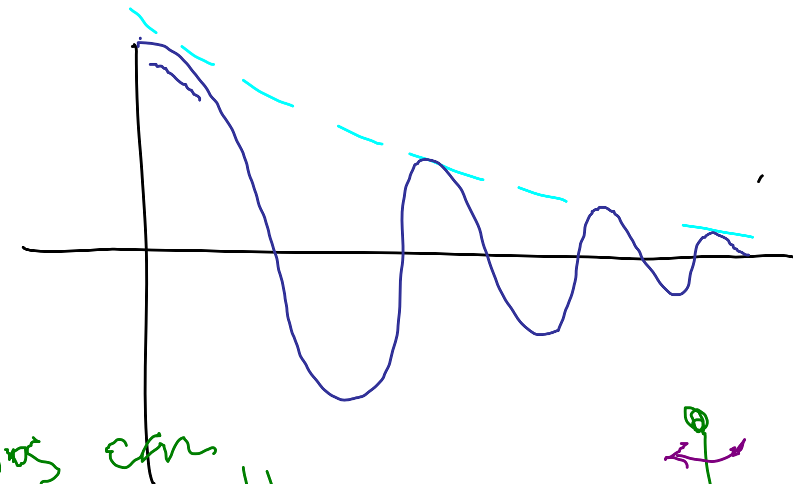
Harder DE to solve ...

Sol'n is ...

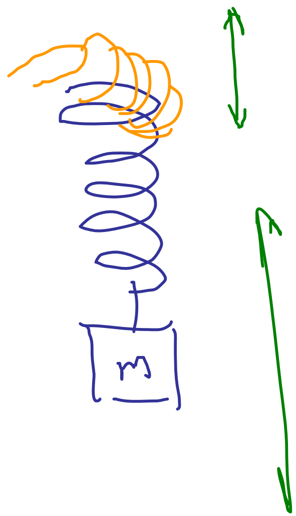
Get

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

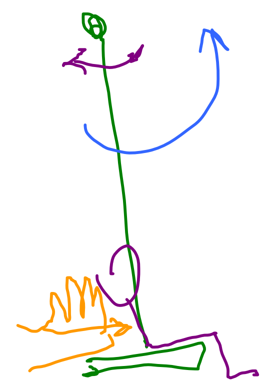
Damped harmonic motion.



Also



Oscillations can very big with motion of hand in sync w/ natural freq of spring.



Driven oscillations

$F(t) = F_0 \cos(\omega t)$

w/ fric:

$\omega_0 = \sqrt{k/m}$

$$m\frac{d^2x}{dt^2} = -kx - b\frac{dx}{dt} + F_0\cos(\omega_d t)$$

ω_d = driving ang freq.

Interest to plot A vs ω_d

Resonance curve.

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Analog in electric circuits
Next semester

Chap 14 Wave Motion

Wave is a traveling disturbance which transports energy but not matter.

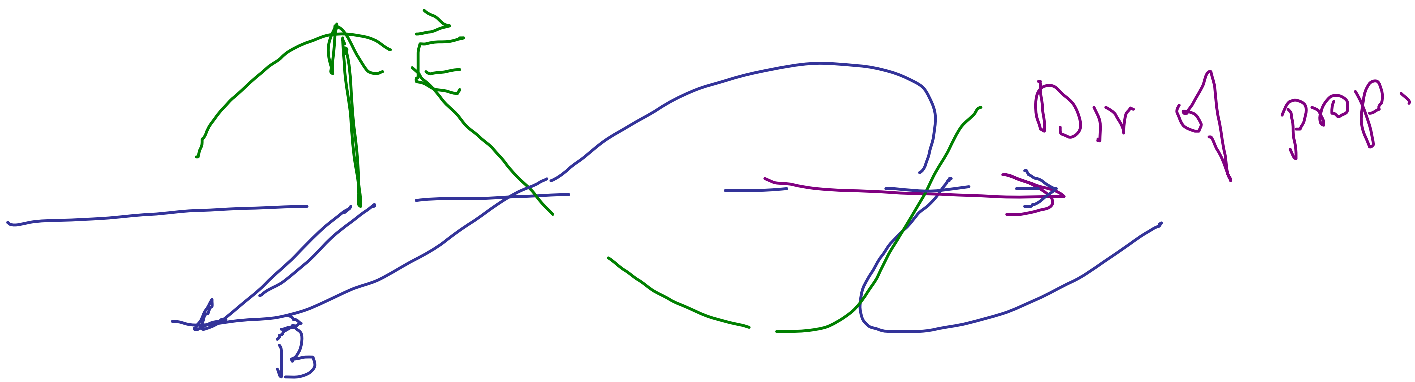
Two types

Transverse wave : Disturb. is perp to dir. motion.

Longitudinal wave : Disturb is parallel to dir of motion (Slinky)

Important kind of wave

Electromagnetic wave



Maxwell 19th Century : Ether aether

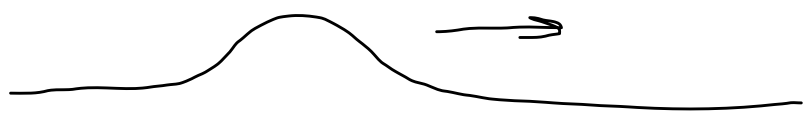
No medium $\Rightarrow$ Relativity 1905

Because no medium

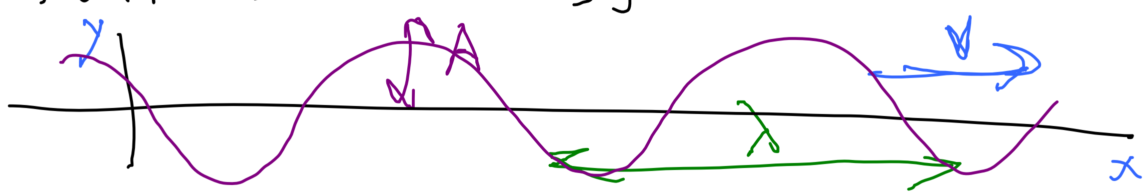
This semester: Waves in a mechanical medium.

Travel at $v = c = 2.998 \times 10^{8} \frac{m}{s}$

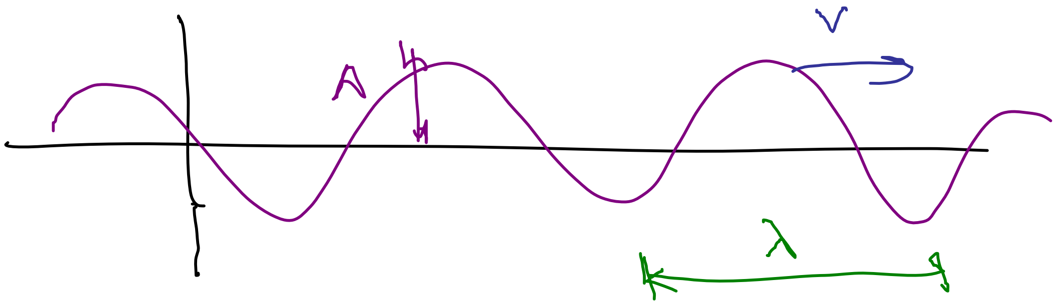
Pulse



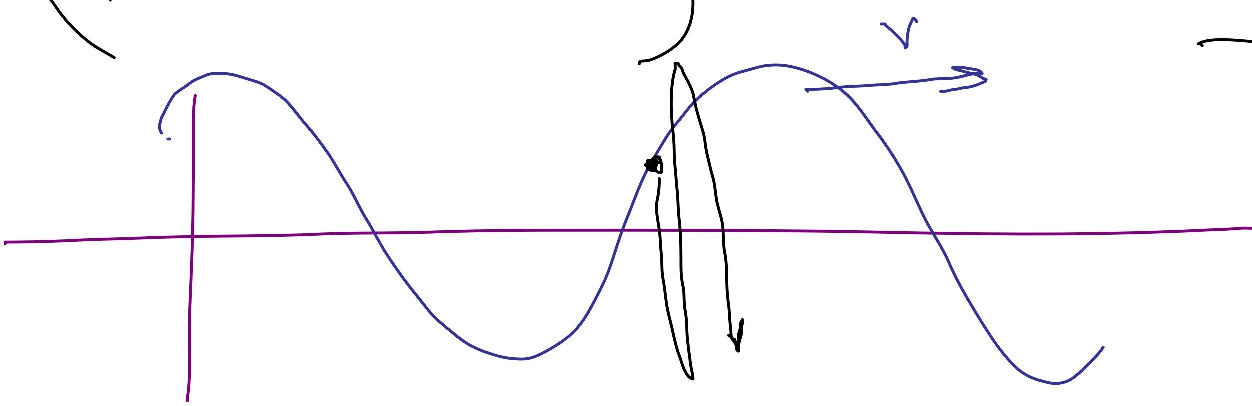
Periodic Waves, Harmonic Waves

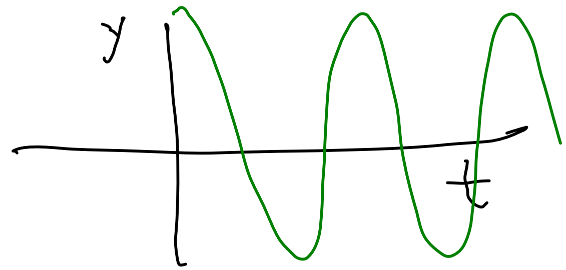


Infinite repeating funct.

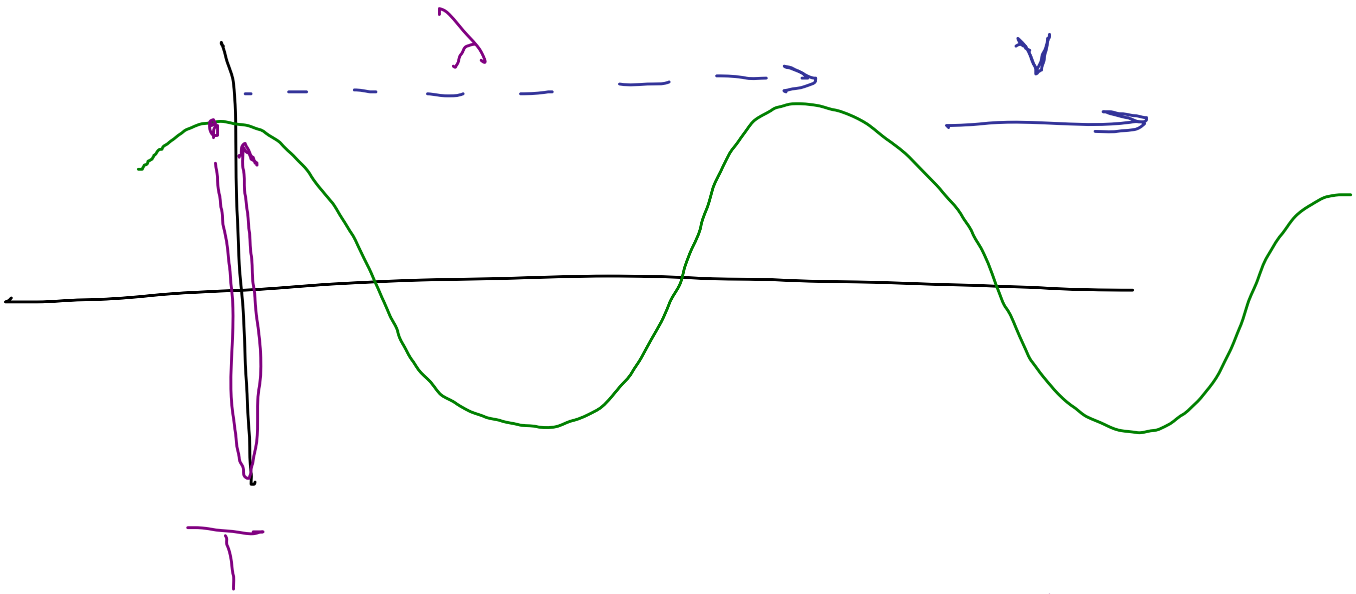


Specializing to sinusoidal wave.
(Harmonic Waves)





f = frequency
of motion
of one bit
of string



$$T = \frac{1}{f}$$

$$v = \frac{\lambda}{T} = \lambda \frac{1}{T} = \lambda f$$

$$\boxed{\lambda f = v}$$

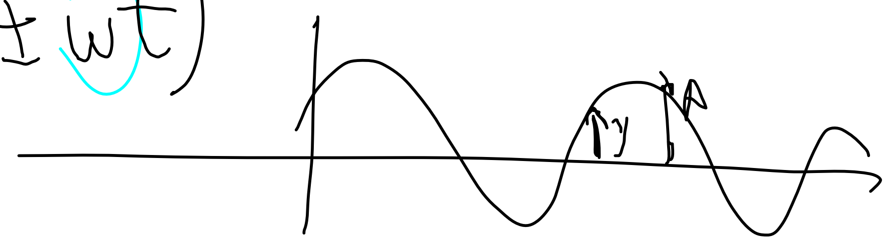
Mathematical form of wave

Wiggly in space

Wiggly in time

$\cos(\qquad)$

$$y(x,t) = A\cos(kx \pm \omega t)$$



ω = ang freq. of wave

$= 2\pi f = 2\pi/T$

$k\lambda = 2\pi$ $\quad k = \frac{2\pi}{\lambda}$

If x incr's by λ

$k(x) \to k(x+\lambda) = kx + 2\pi$

$k = \frac{2\pi}{\lambda}$ wave number

Watch out! Often $\nu = 1/\lambda$???

$$A\cos(kx \pm \omega t)$$

$\pm$? Gives dir of travel of wave