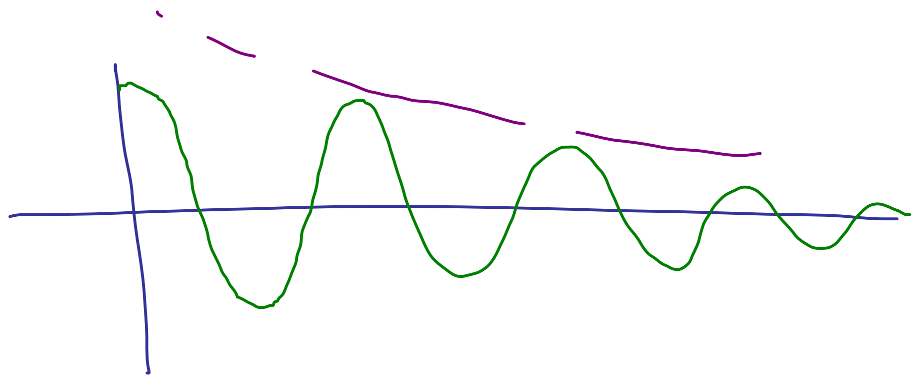
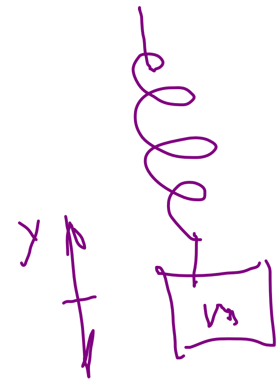
Phys 2110-5   11/21/12

Oscillations:

Damped oscillations

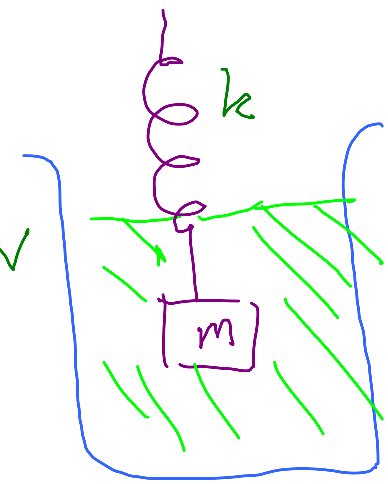
$$y(t) = A e^{-bt/2m} \cos(\omega t + \phi)$$





friction

$$f_{fric} = -bv$$



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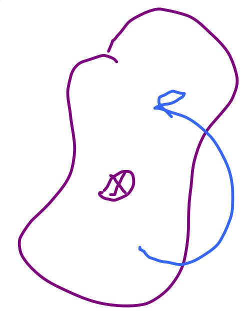
Waves Ch 14

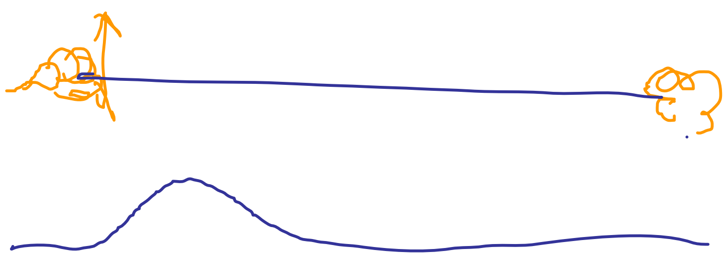
Different type of motion

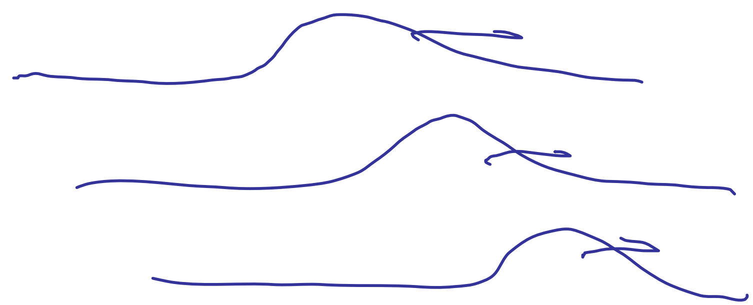


Elastic medium, disturbance

(could travel)

Examples: String, Air, Water





Waves

Small motion of medium

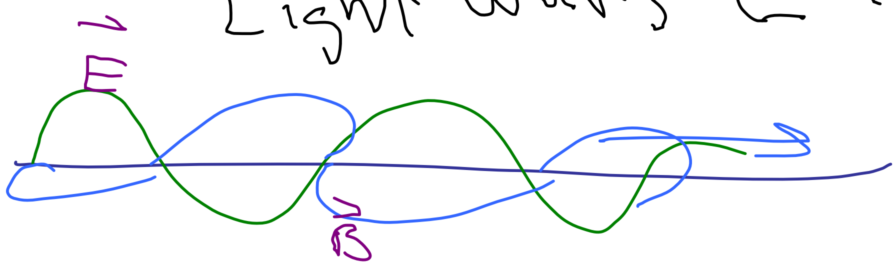
Big motion of disturbance

Transverse: small motion is $\perp$ to motion of disturbance

Longitudinal: Small motion is $\parallel$ to motion of disturbance.

Very important wave:

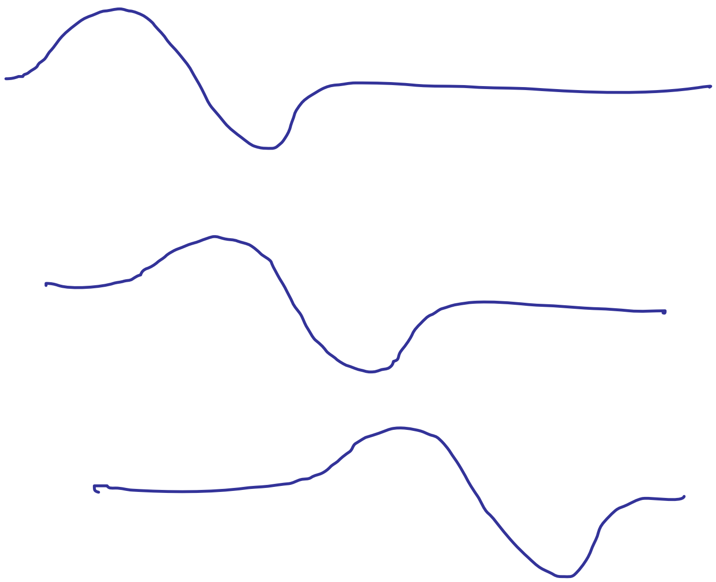
Light wave, EM waves



Mechanical waves

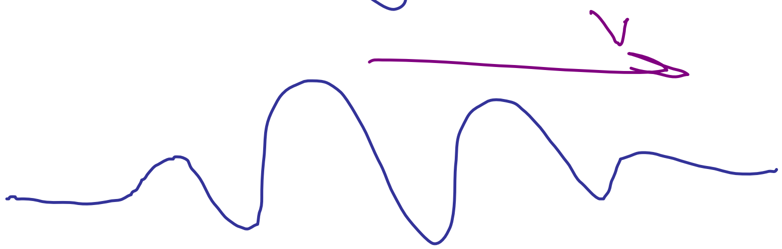
EM waves

Assumption : Regardless of shape of wave, speed is same.



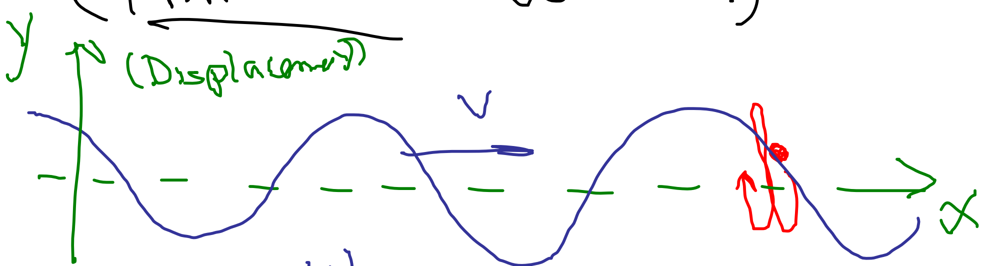
Wave keeps same shape.

Generally waves can have any shape



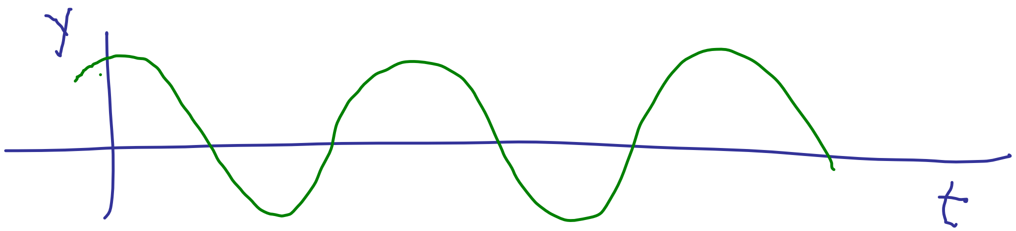
Easier to analyze repeating wave

(Harmonic wave)

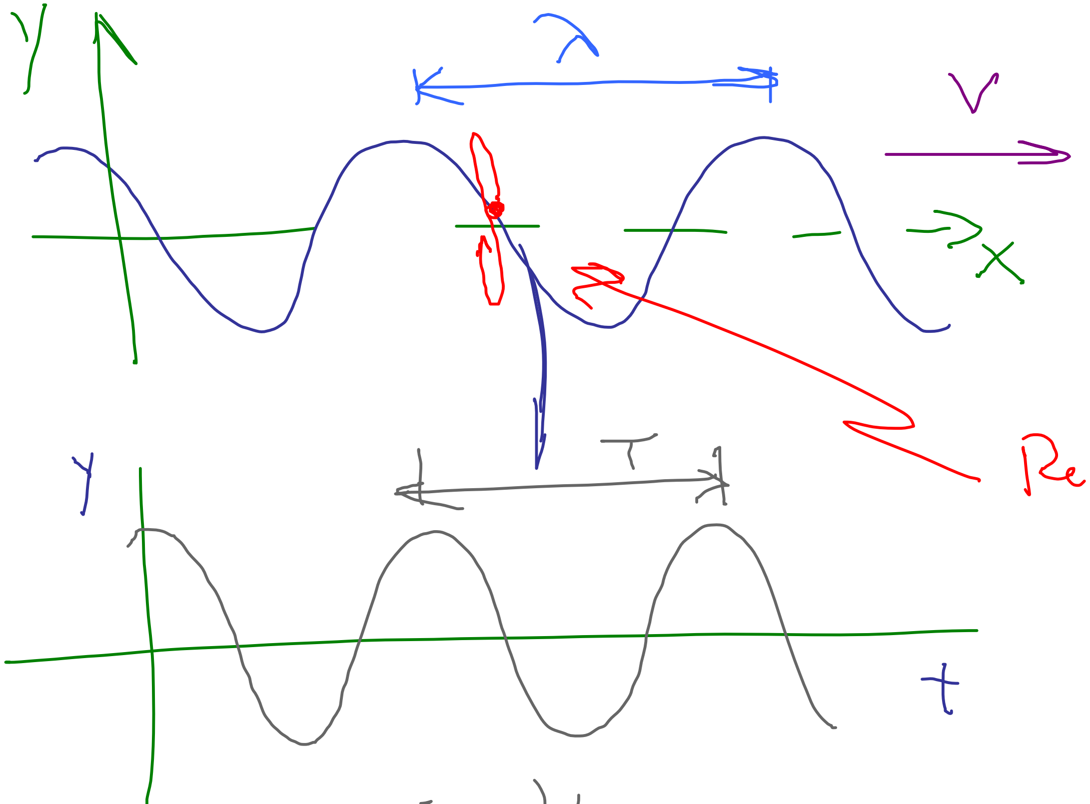


snap shot

one bit



motion in time.



λ = wavelength (m)

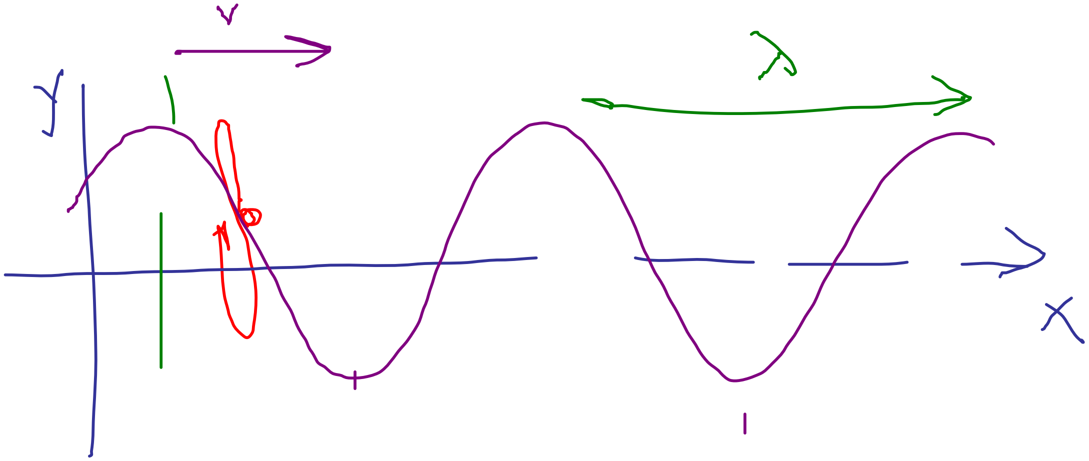
Repeat position in time T

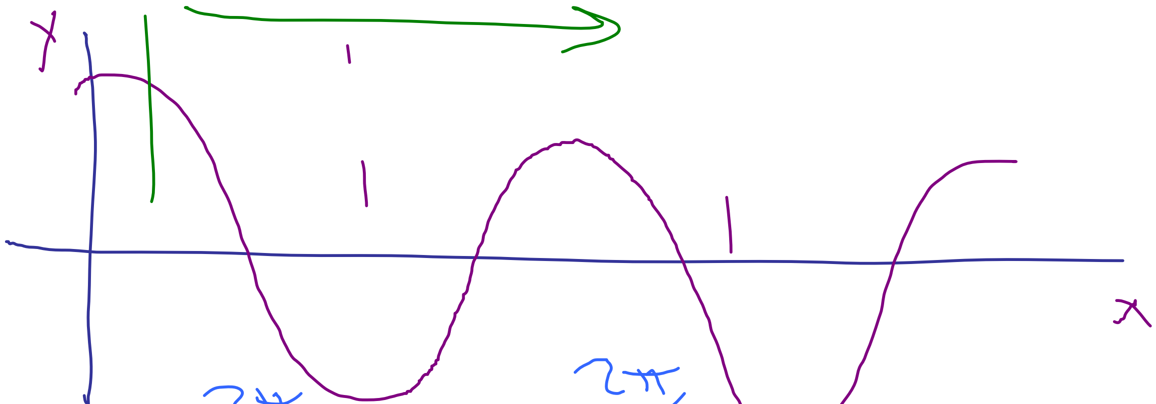
$T = 1/f \qquad \omega = 2\pi f$

$= 2\pi / T$

$T = 1/f$

Definition $\quad k = \dfrac{2\pi}{\lambda}$ $\quad$ wave number





Wave trav'd by one λ.

Speed v.

Time T

$$vT = \lambda$$

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

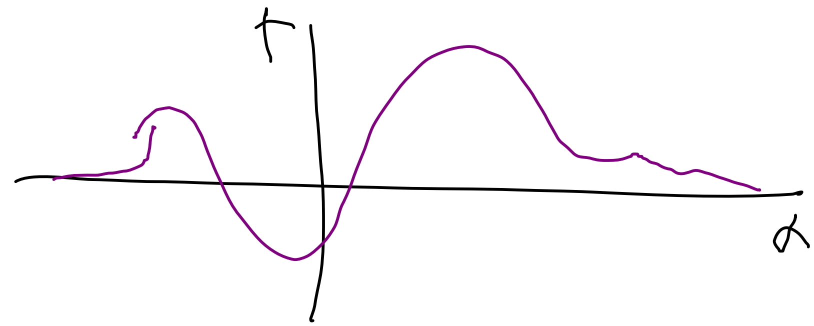
$$\boxed{\lambda f = v}$$

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

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

$$f = \frac{\omega}{2\pi} \qquad \frac{2\pi}{k}\frac{\omega}{2\pi} = \boxed{v = \frac{\omega}{k}}$$

Some math:



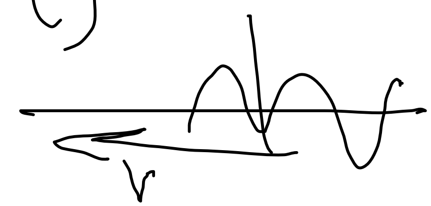
Traveling wave (v)

keep same shape $f(x)$

If shape travels at speed v (to right)

$\Longrightarrow$ $f(x-vt)$

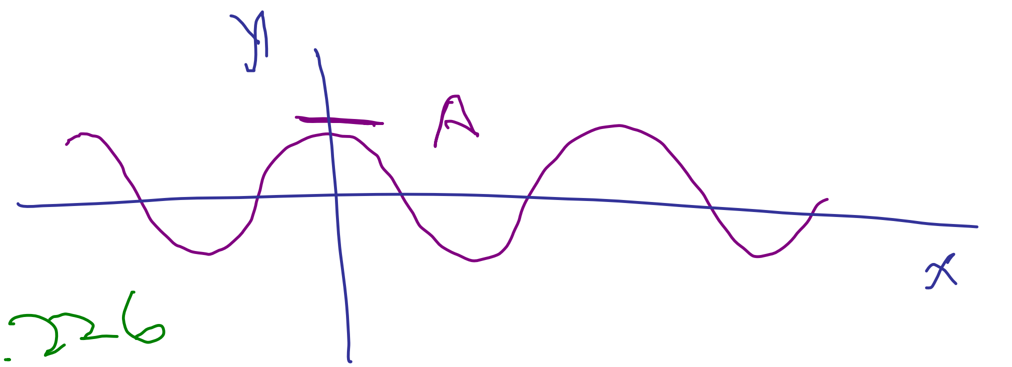
If shape moves to left, $f(x+vt)$



Waves is always $f(x \mp vt)$ right / left

Note: Harmonic

$$x - vt = x - \frac{\omega}{k}t = \frac{1}{k}(kx - \omega t)$$



$$y = A\sin(x+\phi)$$

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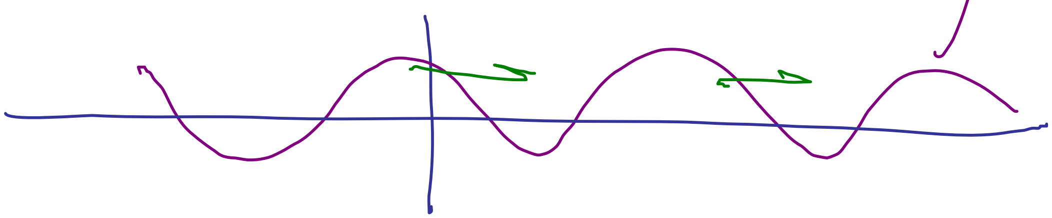
$$y(x,t) = A\sin(kx - \omega t + \phi)$$

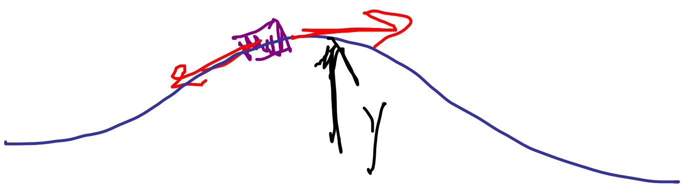
wave function.

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



Wave Equation

How do waves arise from physics



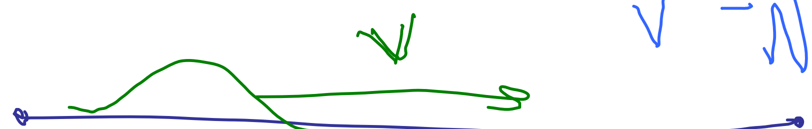
Depends on x, t

Shows

$$\boxed{\frac{\partial^2 y}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 y}{\partial t^2}}$$

$$f(x \mp vt)$$

Waves on string



Tension F

$\mu = \frac{\text{mass}}{\text{Length}}$

$$v = \sqrt{\frac{F}{\mu}}$$