 Phys 2426 2014-11-05

Oscillations

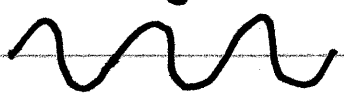
- Occur in place, single entity involved
- Always repeating in time

f, T are important

- Can have any amplitude

Waves

- Formed from collective oscillations of many bits.
- There is always some direction to the wave – propagation direction.
- There is a direction to the oscillations.
  - Transverse
  - Longitudinal
- Can be pulsed or repeating.
- If repeating, there is also repetition in space.
  Wavelength λ is length of 1 oscillation.



This wave is 3 wavelengths long.

Speed of the wave

$$v = \frac{\text{dist}}{\text{time}} = \frac{\lambda}{T} = f\lambda$$

Wave Examples

- String vibrations
- Spring oscillations
- Sound - pressure waves in a fluid.
- Light/radio - E and B oscillations.
- Surface waves - e.g. water waves

(e.g. - for example
i.e. - "that is"
n.b. - note well)

- Electrical waves

String Waves

speed depends on F_T = tension
m/L = mass density

$$v = \sqrt{F_T/\mu}$$ Not dependent on A, f

All waves on the given string have the same speed.

$v_{sound} \approx 340\ m/s$ $v_{light} = c = 3 \times 10^8\ m/s$

Ex: How much time does it take light to go 1 mile?

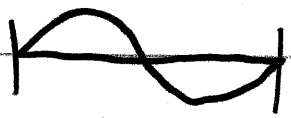
$d = 1609\ m$ $\qquad t = \frac{1609\ m}{3\times10^8\ m/s} \approx 5.4\ \mu s$

For a string clamped on both ends, $2 \cdot L$ is an important distance.

For a string clamped on one end, $4 \cdot L$ is important.

Standing waves occur when the time it takes the wave to travel the above distance is $i \cdot T$.
Equivalently: $i \cdot \lambda = 2 \cdot L$ or $4 \cdot L$

$\lambda = 2L$



$\lambda = [illegible]L$

$\lambda = \frac{2L}{3}$

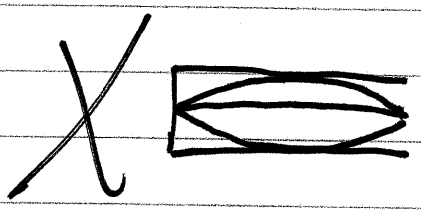
In general $\qquad \lambda = \frac{2L}{i}$ $\qquad i$ = any integer

i = # oscillating sections

④

Standing waves w/ "Different Ends"

$L = \frac{\lambda}{4}$ $\lambda = 4L$



$L = \frac{\lambda}{2}$ Doesn't work.

$L = \frac{3}{4}\lambda$ $\lambda = \frac{4L}{3}$

$\lambda = \frac{4L}{5}$

$\lambda = \frac{4L}{i}$ i = odd integers