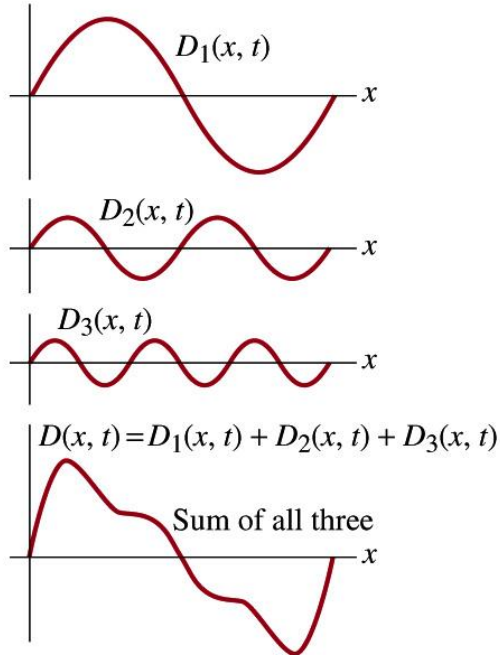
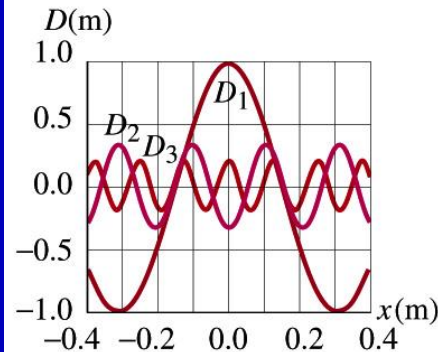


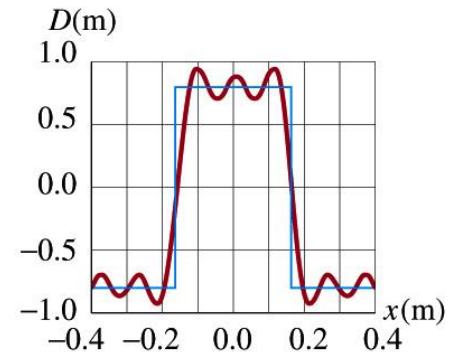
Superposition of Waves



- Fourier's Theorem:
Any complex periodic wave
is the superposition of many
sinusoidal waves



(a)



(b)

Reflection in 1-d

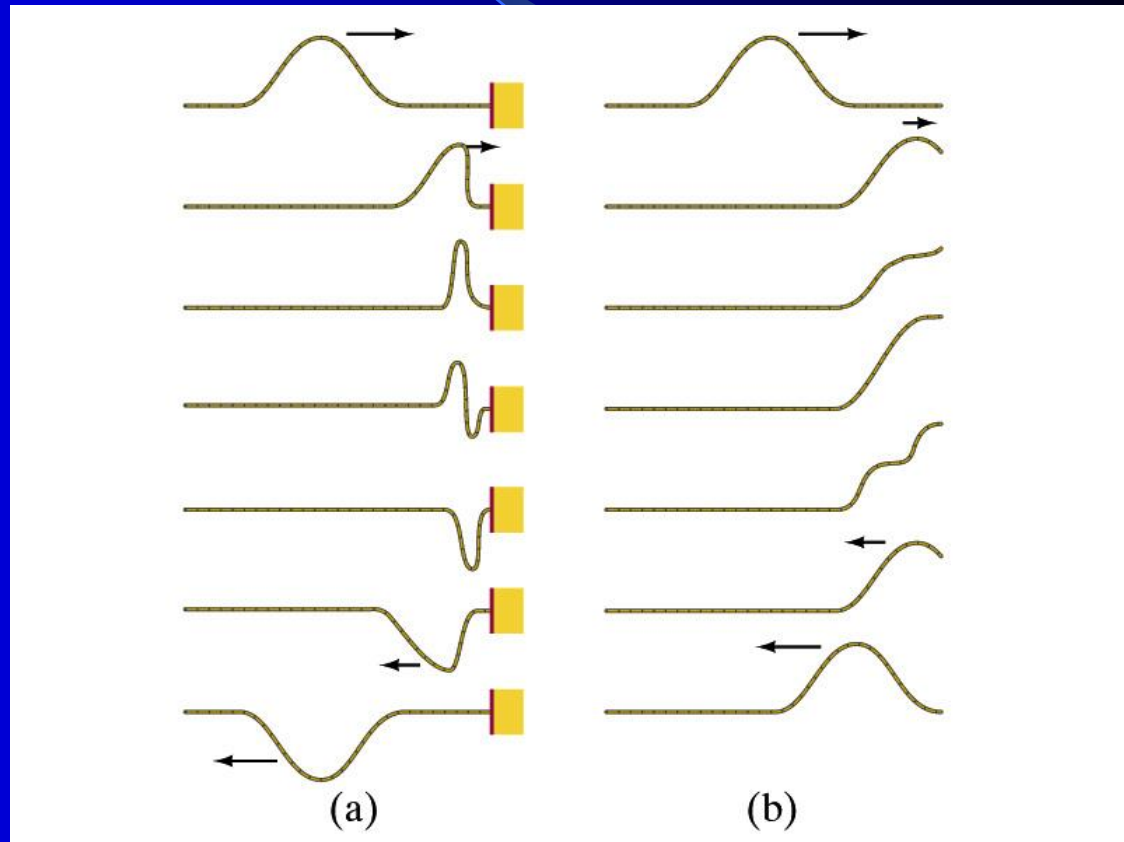
- Two Cases:

- 1) Fixed End (a)

Pulse returns inverted

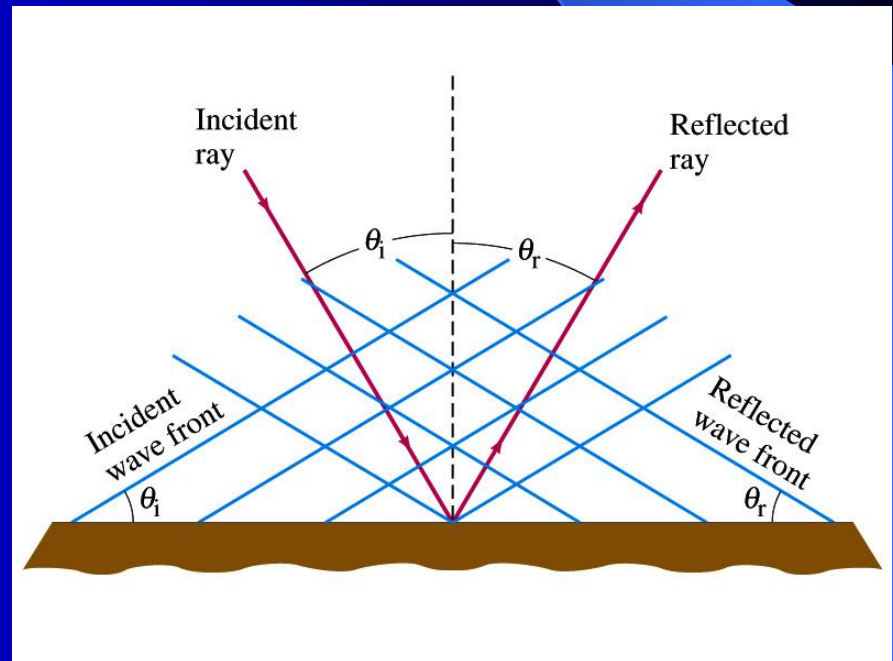
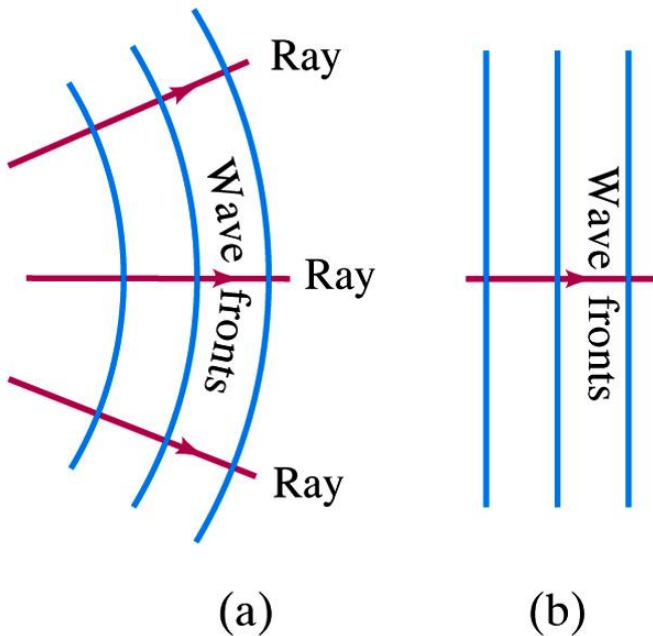
- 2) Free End (b)

Pulse returns right side up



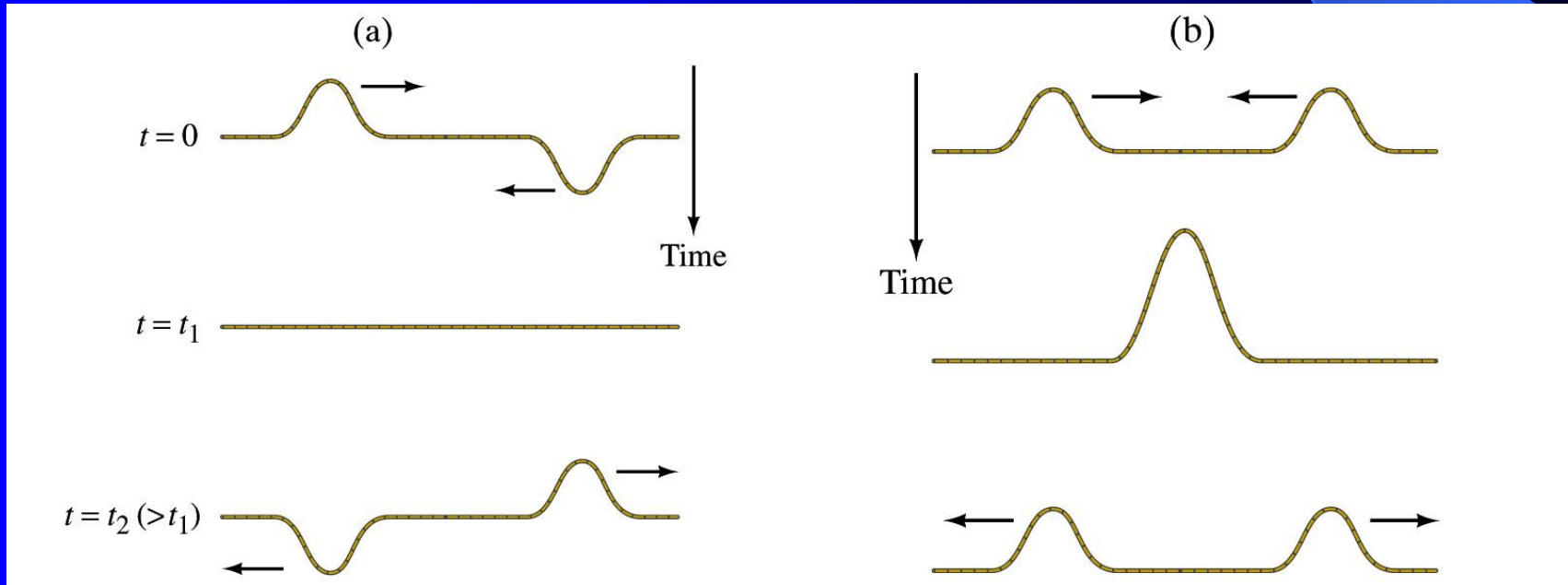
Reflection in 2-d or 3-d

- Wave Fronts
 - Close-by: circular
 - Far-away: plane
- Reflection
 - $\theta_i = \theta_r$



Interference

- Two waves passing through the same region of space at the same time
- Destructive vs Constructive



Interference

- In phase

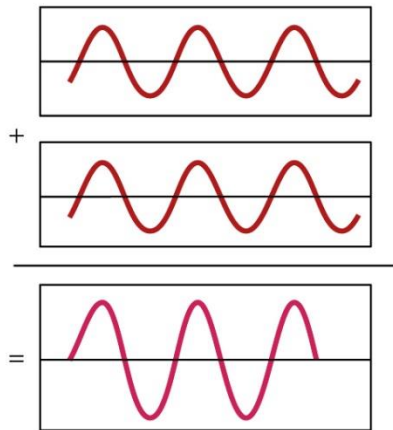
Out of Phase

Random Phase

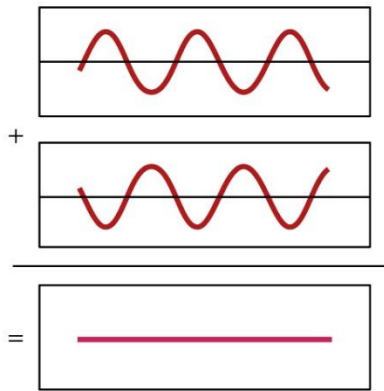
- Constructive

Destructive

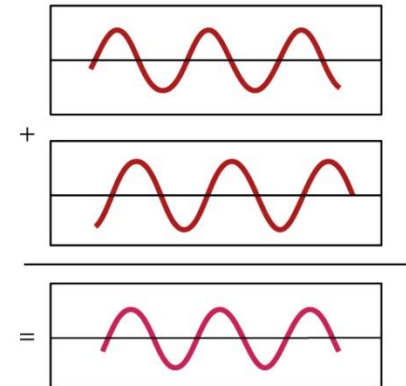
Partially Destr



(a)



(b)



(c)

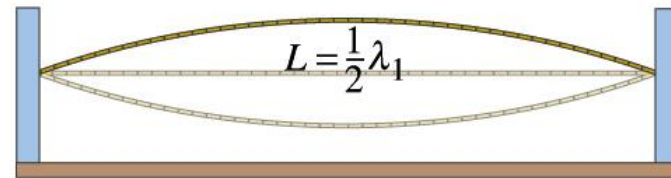
Standing Waves

$$L = \frac{n\lambda_n}{2}, n = 1, 2, 3, \dots$$

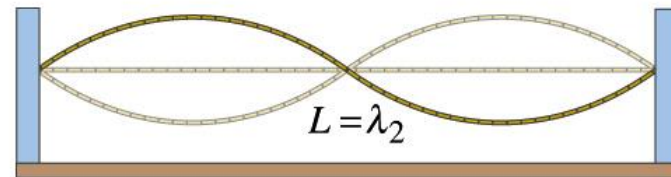
$$\lambda_n = \frac{2L}{n}, n = 1, 2, 3, \dots$$

$$f_n = \frac{v}{\lambda_n} = \frac{nv}{2L} = nf_1$$

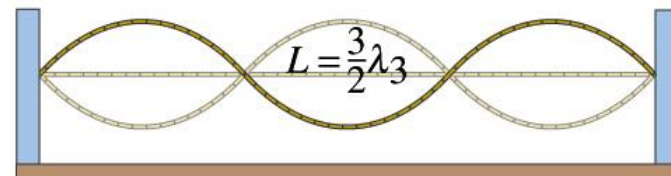
$$f_1 = \frac{v}{\lambda_1} = \frac{v}{2L}$$



Fundamental or first harmonic, f_1



First overtone or second harmonic, $f_2 = 2f_1$



Second overtone or third harmonic, $f_3 = 3f_1$

(b)