(1) Phys 1402 Lec 22 2015-11-10

Oscillations: $f = 1/T$ $\omega = 2\pi f$

Waves: v depends on wave

Sinusoidal Wave $v = f\lambda$

Waves don't have to be oscillating

Travelling Wave $y = f(x - vt)$

f() gives shape - can be anything

$x - vt$ makes wave move

x	t	x - vt
0	0	0
5.0	1.0	0
10.0	2.0	0

if $v = 5\ m/s$

$x - vt$ makes the same part of f() travel down the x-axis.

What if the wave is going to the left?

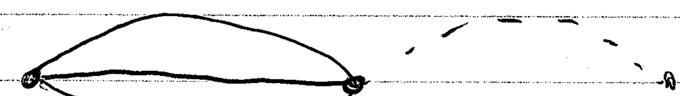
Option 1: Use $x + vt$ w/ $v = |\vec{v}|$

Option 2: Keep $x - vt$ w/ $v = -|\vec{v}|$

Standing Waves - formed from oscillating travelling waves in a cavity.

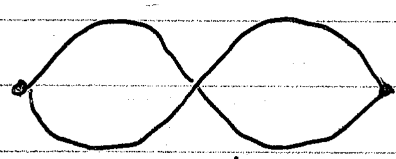
Waves on a string $v = \sqrt{F_T/\mu}$

With the string clamped at both ends, it can look like



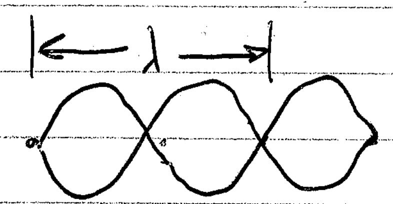
Fundamental

$\lambda = 2L$ $f_0 = \frac{v}{\lambda} = \frac{v}{2L}$



Second Harmonic

$\lambda = L$ $f = \frac{v}{L} = 2f_0$



Third Harmonic

$f = \frac{3v}{2L} = 3f_0$

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

Any f that is $f_0 n$ is a standing wave.

$\lambda = \frac{2L}{n}$ n = any integer

(3)

A guitar string is mis-tuned and produces a fundamental of 222 Hz. It should be 220 Hz. By what fraction should the tension be adjusted to fix it?

$f_{new} = \underline{0.991}\ f_{old}$ $\qquad \frac{220}{222} = 0.991$

f decreases by 0.9 %

$f_2 = 0.991\ f_1$

As we tune the string what changes?

F_T, not L, not μ

$v = \sqrt{F_T/\mu}$ $\qquad \lambda = 2L$ ← no change

$v = f\lambda$

$v_2 = f_2 \lambda = 0.991 (f_1 \lambda)$ ← v_1

$v_2 = 0.991\ v_1$

v decreases by 0.9%

$F_T = \mu v^2$

$F_{T2} = \mu v_2^2 = \mu (0.991\ v_1)^2$

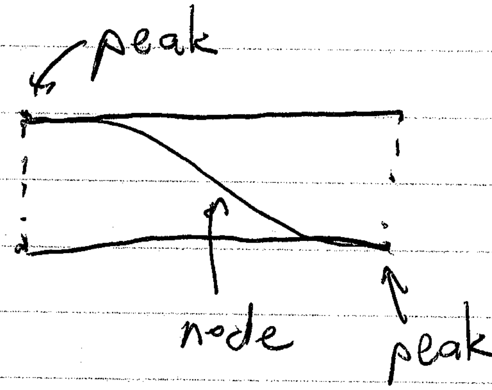
$1 - 0.982 = 0.018$

$= 0.982 (\mu v_1^2)$ ← F_{T1}

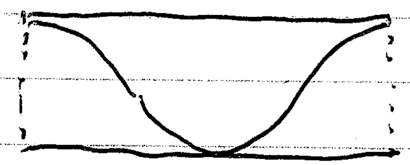
$F_T \downarrow 1.8\%$

Sound waves in a cavity

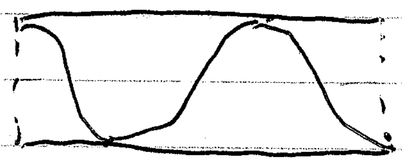
Dan Russell Longitudinal Standing Waves.



$\lambda = 2L$



$\lambda = L$



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

Open end = peak of displacement

Two open ends - pattern is the same as waves on a string.

If one end is closed, pattern is different.

$\lambda = \frac{4L}{n} \qquad f = \frac{v}{\lambda} = \frac{nv}{4L} = nf_0 \qquad n = \text{odd}$