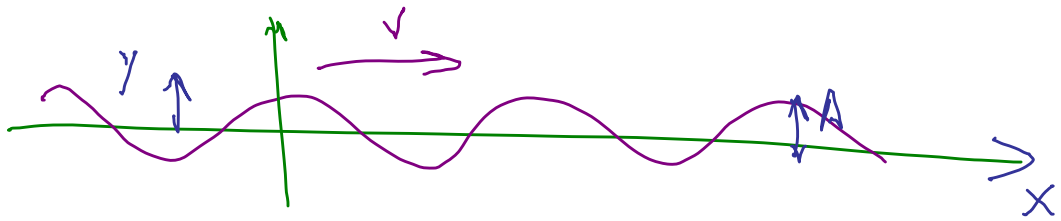
Phys 2110-4 11/28/11

Note Title 11/28/2011

Waves



Harmonic waves

λ, f

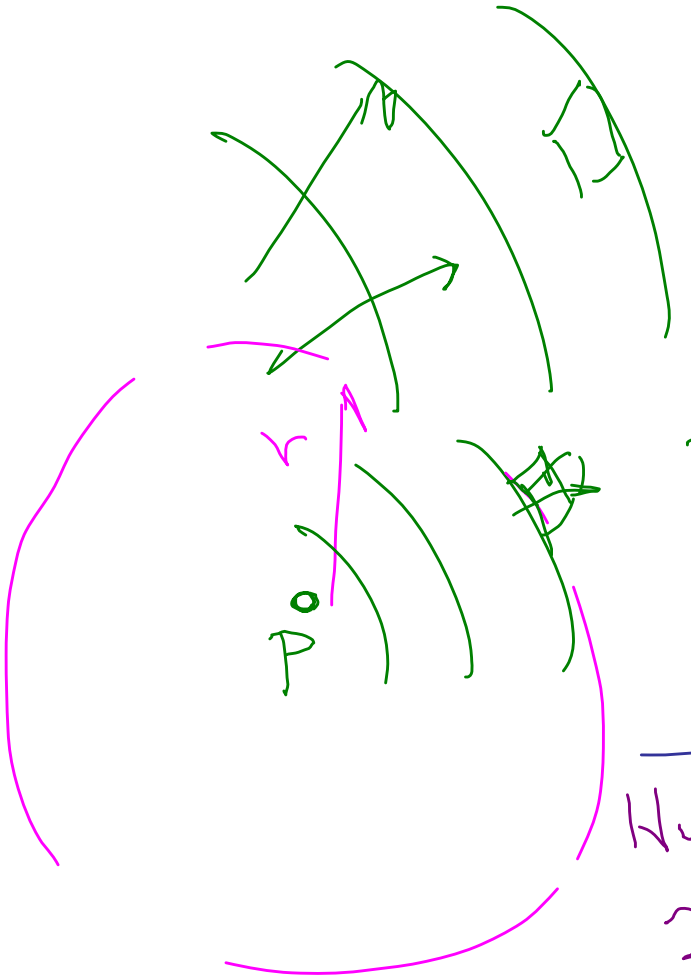
$\omega = 2\pi f \quad k = 2\pi/\lambda \quad \lambda f = v$

$T = 1/f$ etc.

$y(x,t) = A\cos(kx \mp \omega t + \delta)$

String $v = \sqrt{F/\mu}$

$\bar{P} = \frac{1}{2}\mu\omega^2 A^2 v$ power



$$\frac{\text{Energy}}{\text{Area} \cdot \text{Time}} = \text{Intensity}$$

$$I = \frac{P}{4\pi r^2}$$

Sound waves

$$\lambda f = v$$

$v \uparrow 340 \frac{m}{s}$

Human hearing:

20 Hz – 20,000 Hz

Middle C ~ 261 Hz

Loudness

Human hearing extends over ~12 orders of mag in Watt/m^2

Threshold of hearing $10^{-12}\ \frac{W}{m^2} = I_0$

Upper limit : $1\ W/m^2$

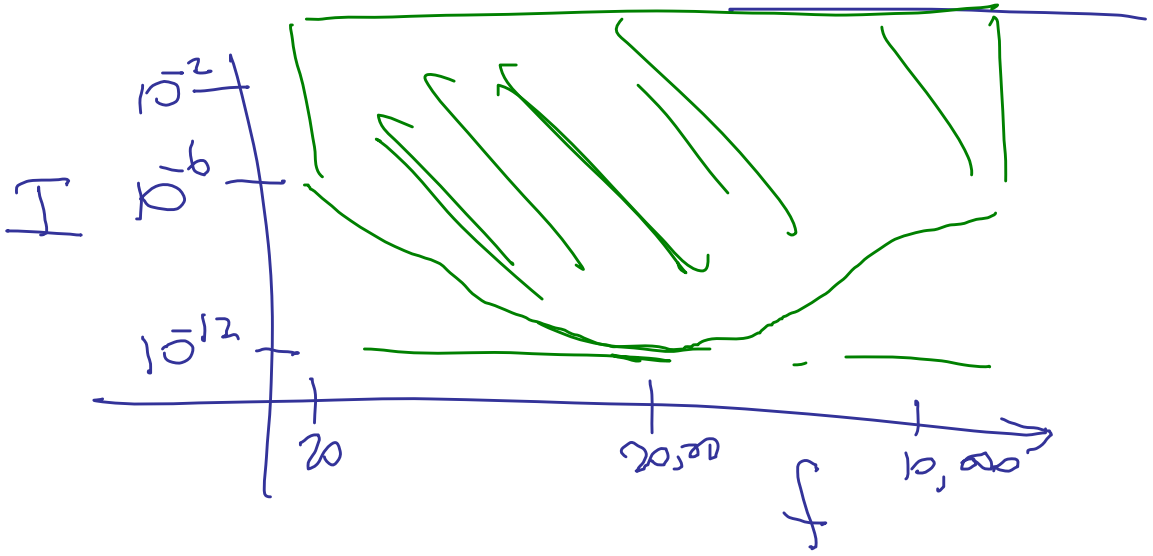
To express loudness conveniently

$\log_{10}\left(I/I_0\right)$ (Mult by 10!)

$$\beta = 10 \log_{10}\left(\frac{I}{I_0}\right)$$

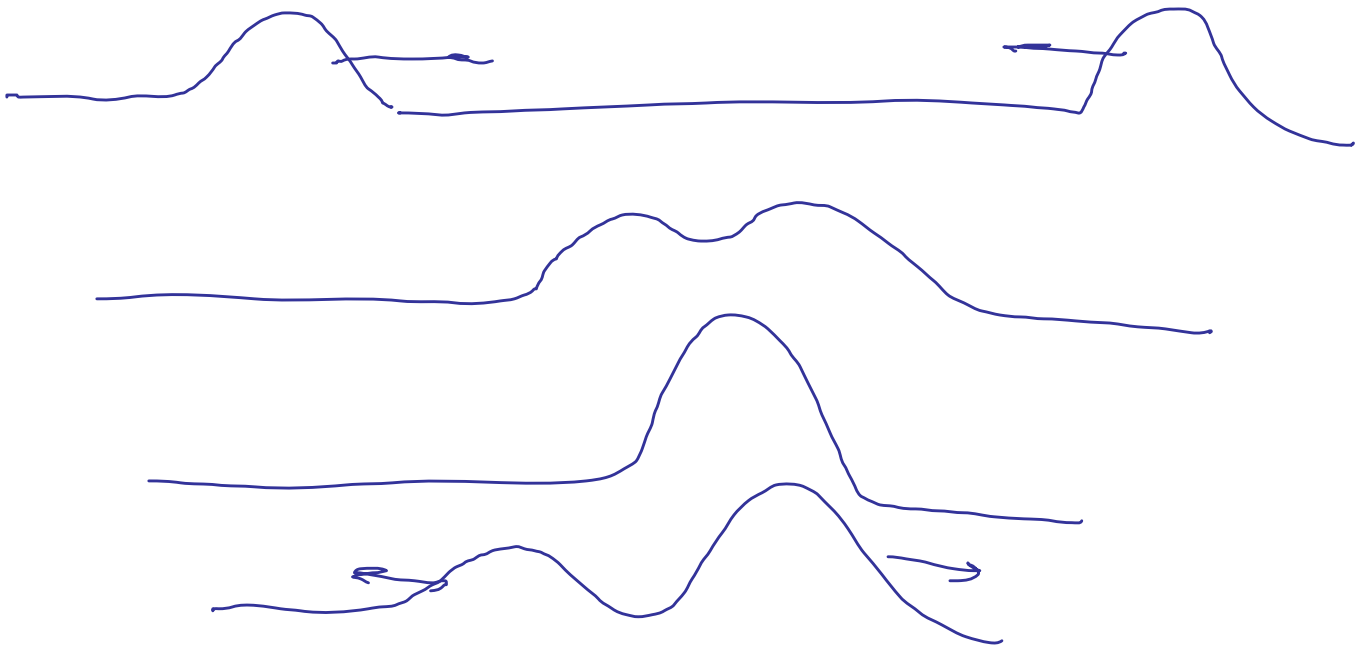
Intensity level, decibels

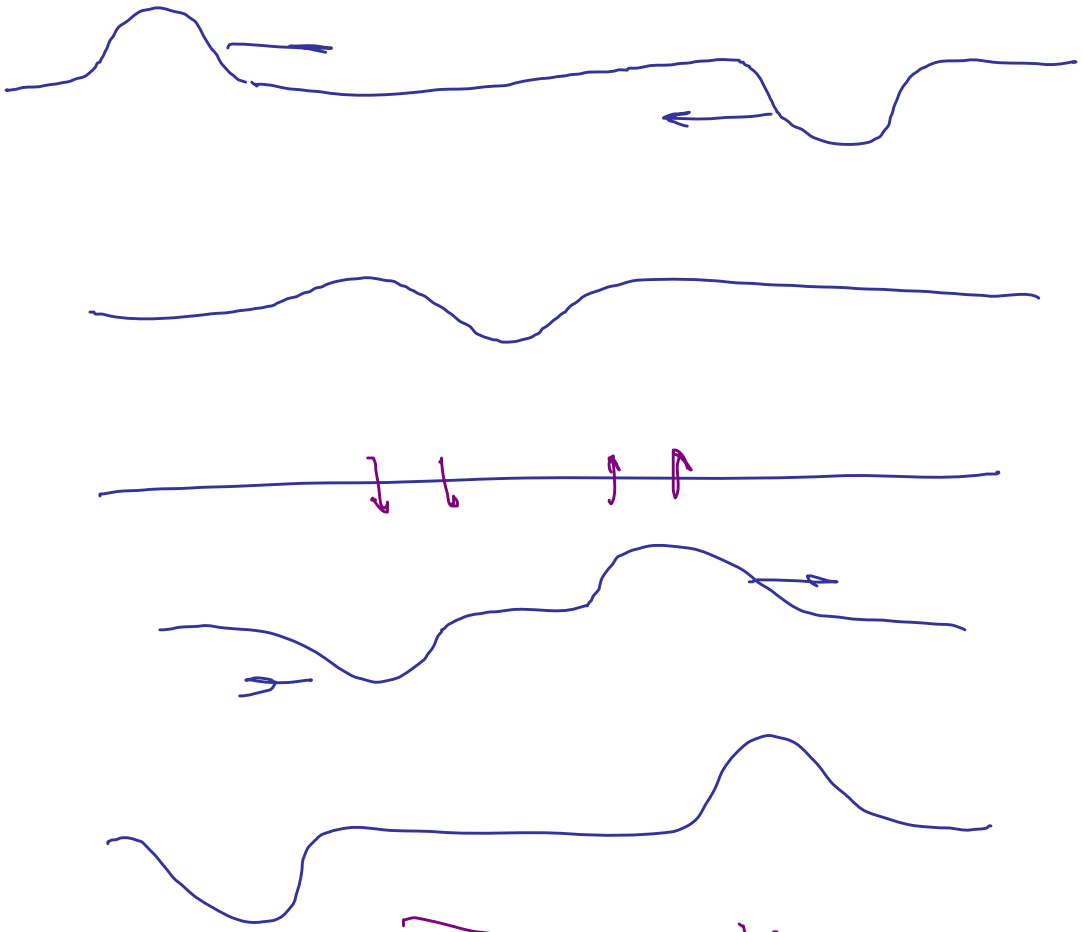
(p 231)



Interference of Waves

Superposition Principle: Waves Add

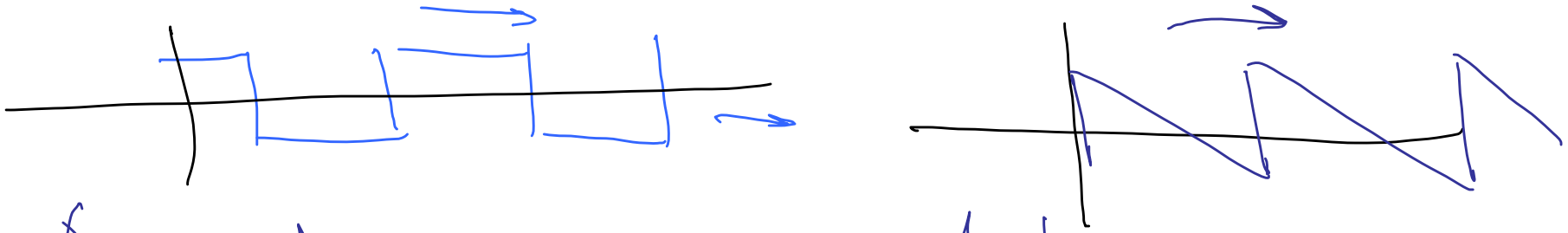




Interesting cases . . .

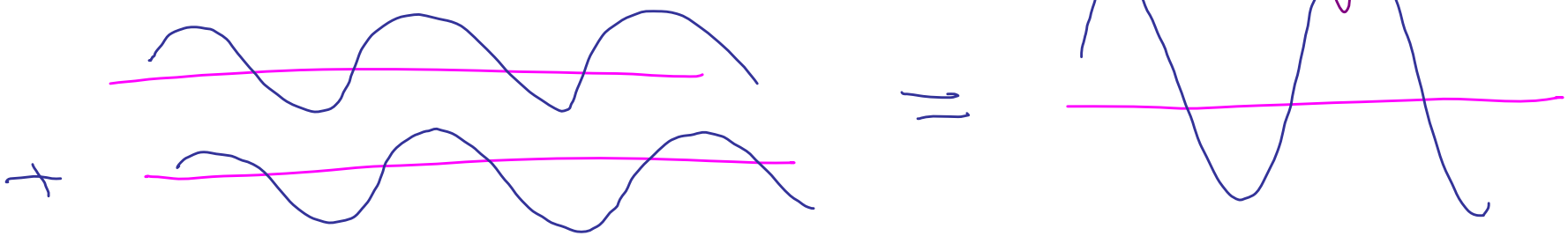
P.232

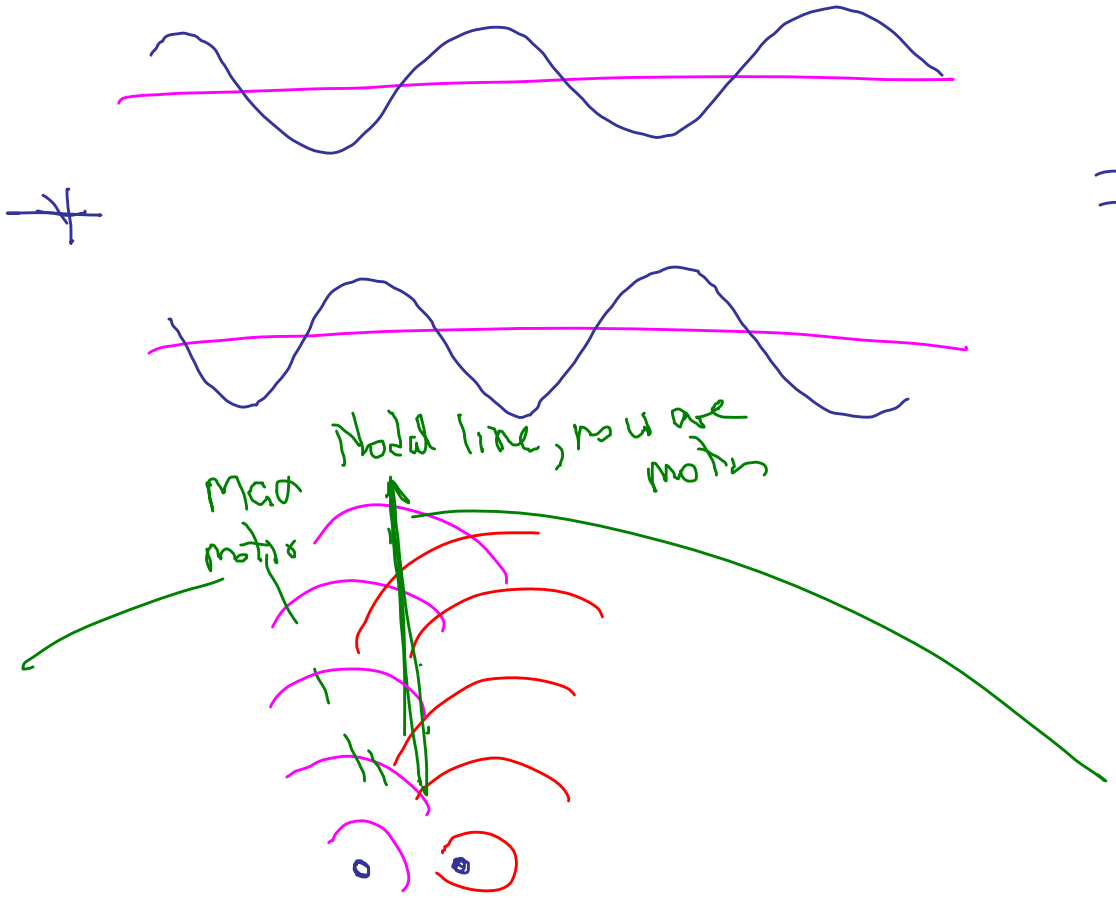
Any periodic wave can be decomposed into harmonic waves



Any such wave is a sum of harmonic waves

Fourier analysis





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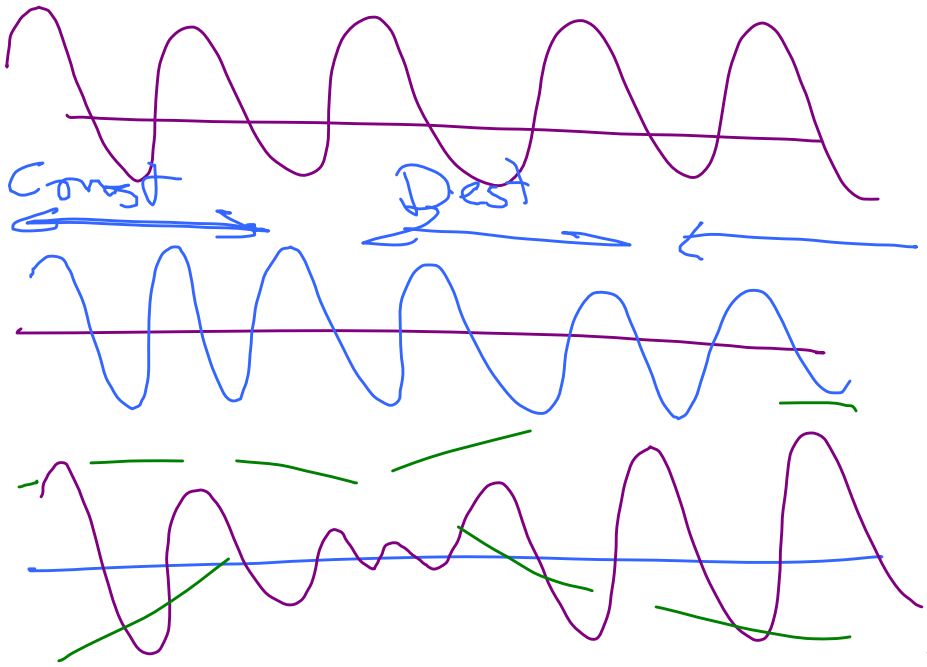
Destructive interference

p. 234

Add two waves together same speed
Slightly diff freq's



Sound waves

Play two sounds
nearly same freq
800 Hz, 803 Hz

Beats

Pulses

$f_{Beat} = |f_1 - f_2| = 3\ Hz$

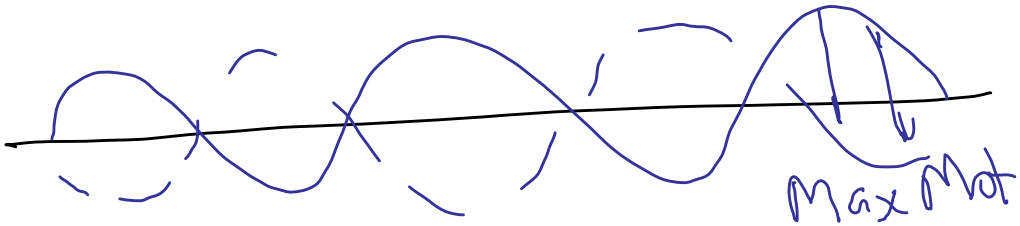
Reflection

See video on recorded lecture

Standing Waves

Two waves same λ, f.

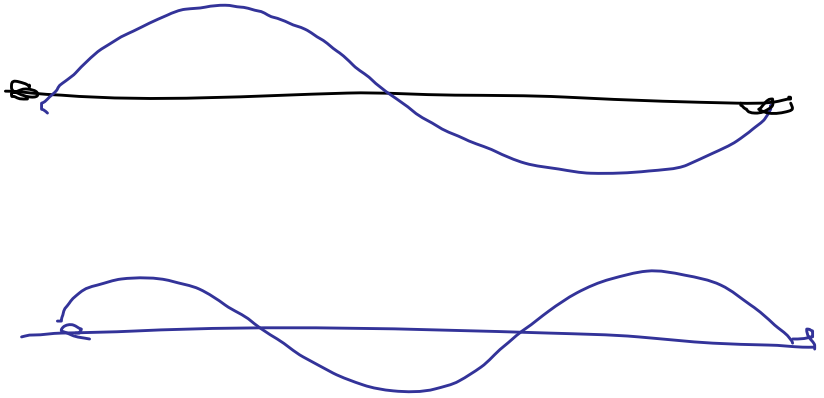
Opp. directions!



Some points don't move: Nodes

Max Motion: Antinodes

Strings:



etc.