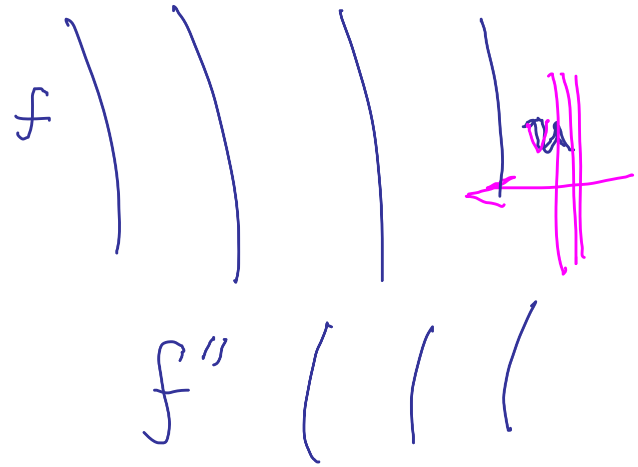
Phys 2110-5 12/7/12

Note Title 12/7/2012

14.78



Recall

$$f' = f\left(1+\frac{u}{v}\right)$$

freq. "heard by" object

emits f', In lab, $f'' = \dfrac{f'}{\left(1-\frac{u}{v}\right)} = f\left(\dfrac{1+\frac{u}{v}}{1-\frac{u}{v}}\right)$ $\quad \frac{u}{v} = x$

$$f'' = f\left(\frac{1+x}{1-x}\right)$$

$f = 5$ MHz

$\Delta f = f'' - f = 100$ Hz

Do math,

$$f'' - f = \cancel{100}\,Hz = f\left(\frac{1+x}{1-x} - 1\right)$$

$f = 5\ MHz$

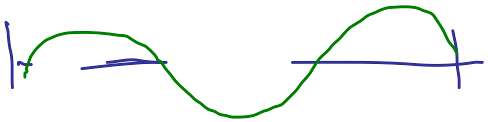
$$f\left(\frac{2x}{1-x}\right) = 100\,Hz$$

x small $\qquad \frac{1}{1-x} \approx 1+x \qquad v = 1490\,\frac{m}{s}$

Solve for x $\qquad x = 1.0 \times 10^{-5} = \frac{v}{V}$

$$\Longrightarrow v = 1.5 \times 10^{-2}\,\frac{m}{s} = 1.5\,\frac{cm}{s}$$

Standing Waves



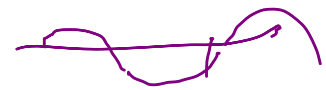
$n = 3$

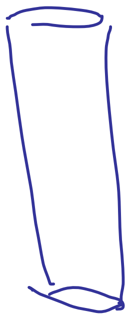
$L = \frac{n}{2}\lambda$

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

$f_n = \frac{n}{2L}\sqrt{\frac{F}{\mu}}$

v = waves on string



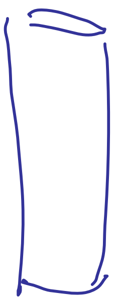


Open pipe

$L = \frac{n}{2}\lambda$ $\qquad f_n = \frac{nv}{2L}$

v = speed of sound

$= 343 \frac{m}{s}$



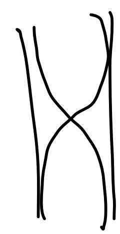
$L = \frac{n}{4}\lambda$ $\qquad f_n = \frac{nv}{4V}$ $\qquad n = 1, 3, 5, \ldots$

$n = 1, 3, 5, \ldots$

14.70 Organ for concert hall lowest note is 22 Hz

a) Pipe is open both ends.

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



$$L = \frac{v}{2f} = \frac{343 \ \frac{m}{s}}{2 \cdot 22 \ \frac{1}{s}} = \boxed{15.6 \text{ m}}$$

b) Closed one end

$$f = \frac{1 \cdot v}{4L} = \boxed{7.8 \text{ m}}$$

14.68 A-string on piano is 38.9 cm long clamped both ends. If string under 667 N of tension what's its mass.

Fundamental $n = 1$

$\lambda = 2L = 0.778$ m

$v = \lambda f = 342.3 \frac{m}{s} = \sqrt{\frac{F}{\mu}}$

$\mu = 5.69 \times 10^{-3} \frac{kg}{m}$

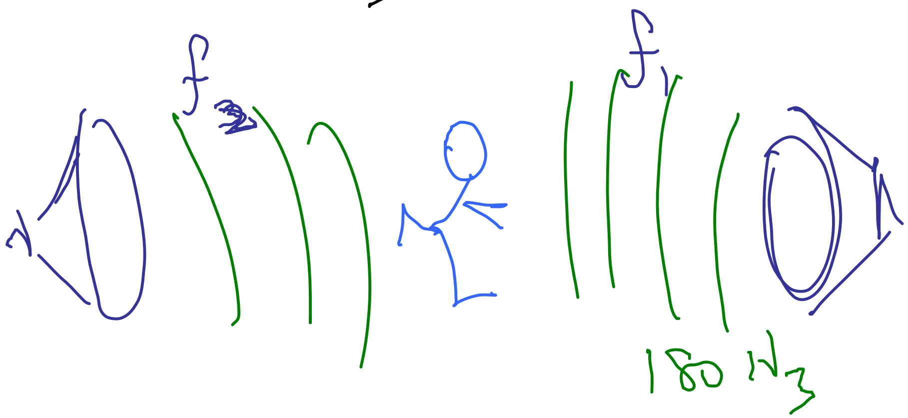
$L = 0.389 m$

$\text{mass} = \mu L$

$= \boxed{2.21 g}$

14.74 Two loudspeakers 180-Hz tones

How fast you move to hear beat freq. 1.5 Hz.



$f_1 > f$

$f_2 < f$

$f = 180\text{ Hz}$

$f_1 - f_2 = 1.5\text{ Hz}$

$f_1 = f\left(1 + \frac{u}{v}\right)$

$f_2 = f\left(1 - \frac{u}{v}\right)$

$\frac{u}{v} = x$

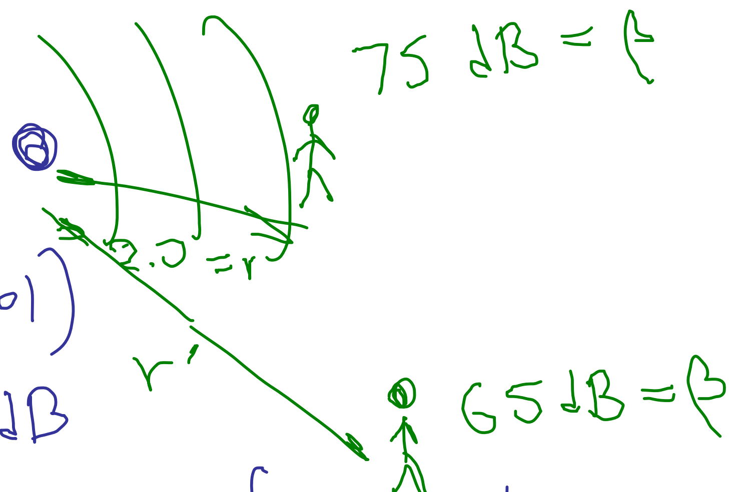
$f\left((1+x) - (1-x)\right) = 1.5\text{ Hz}$

$2xf = 1.5\text{ Hz}$

Sol x, $u = 1.43\ \frac{m}{s}$

14.67 At 2.0 from localized sound source intensity level is 75 dB. How far away must you be for perceived loudness to drop in half (to I = 65 dB).

? 14.65



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

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

Suppose new intensity $I' = \frac{1}{2} I$

What is new β β'

$$\beta' - \beta = 10\left[\log_{10}\left(\frac{I'}{I_0}\right) - \log_{10}\left(\frac{I}{I_0}\right)\right] = 10\left[\log\left(\frac{I'}{I}\right)\right]$$

$$= 10 \log\left[\frac{1}{2}\right]$$

$$= 10(-0.301)$$

$$= -3.0\ \text{dB}$$

$\beta = 75\ dB$ $\quad\quad$ $\beta' = 65\ dB$

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

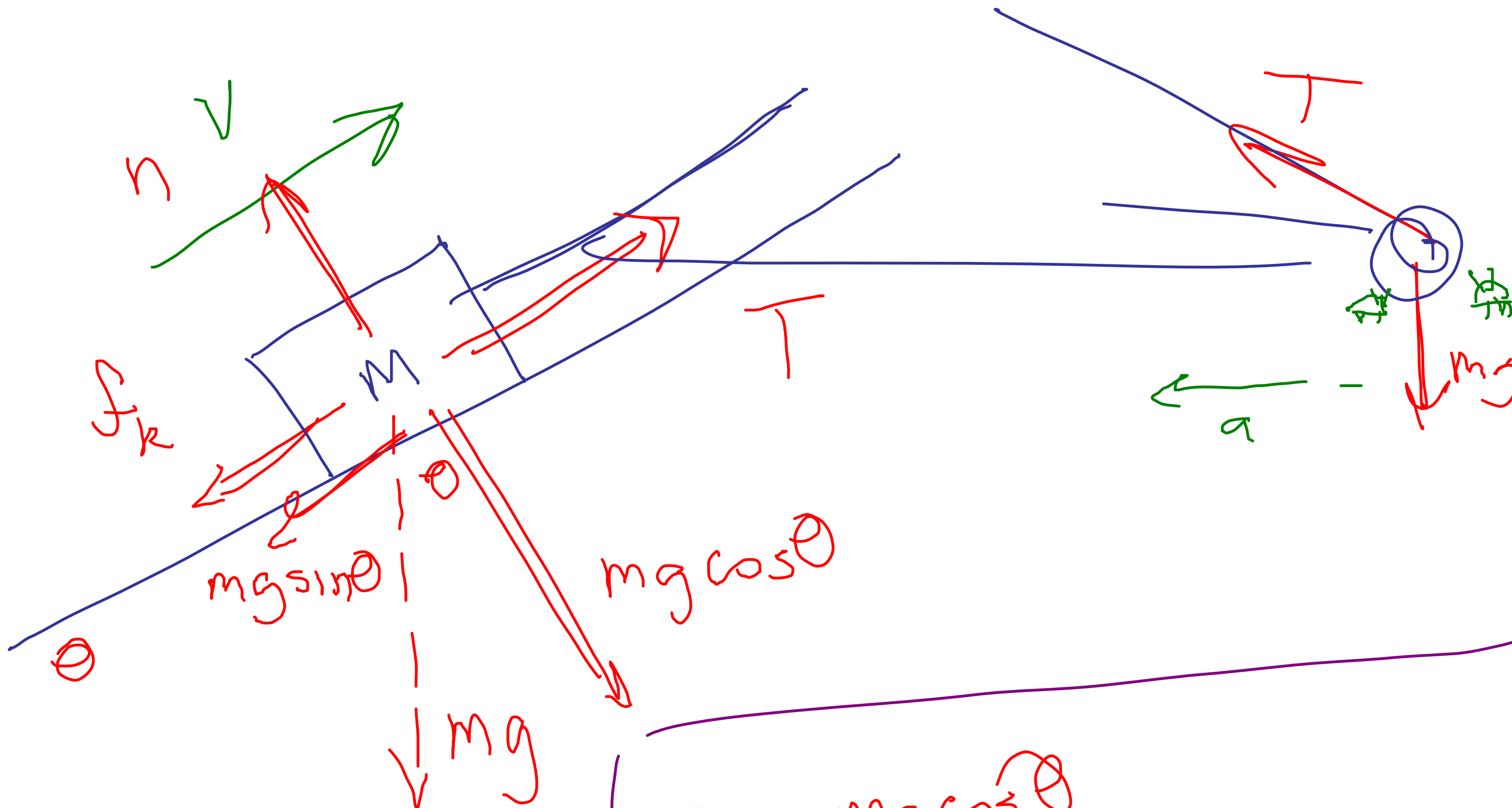
$$\log_{10}\left(\frac{I'}{I}\right) = -1 \quad\quad \frac{I'}{I} = 0.10$$

$$I' = (0.10)\ I$$

$$I = \frac{P}{4\pi r^2} \quad\quad \frac{I'}{I} = \frac{r^2}{r'^2} = 0.10$$

$r = 2m$

$$\underline{\underline{r' = 6.3m}}$$



$F_{net} = ma$

$$\boxed{\begin{aligned} n &= mg\cos\theta \\ T - mg\sin\theta - f_k &= ma \end{aligned}}$$