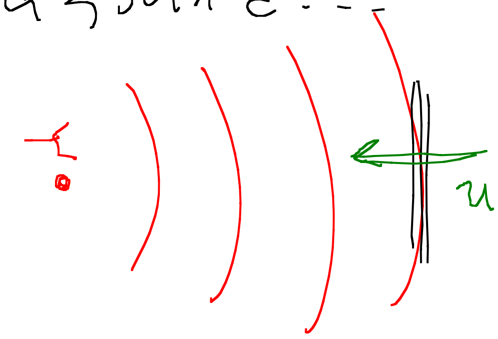
Phys 2110-3 12/10/10

Note Title 12/10/2010

14.74 Obstetricians, ultrasound...
measure speed of the thing
bouncing sound waves



$$f' = f\frac{\left(1 \pm \frac{u_{obs}}{v}\right)}{\left(1 \mp \frac{u_{sour}}{v}\right)}$$

$f = 5.0$ MHz

(a) Moving wall "hears"

(b) Moving wall re-emits

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

$u = u_{wall}$
$= u_{obs}$
$= u_{sour}$

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

Shift in freq

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

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

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

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

$f = 5\ \text{MHz}$

x is small

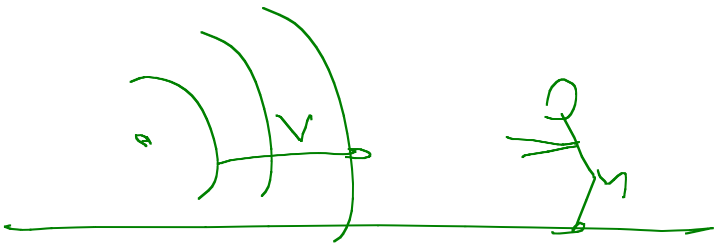
$$2x = \frac{100\ \text{Hz}}{5\ \text{MHz}}$$

$x = 1 \times 10^{-5}$

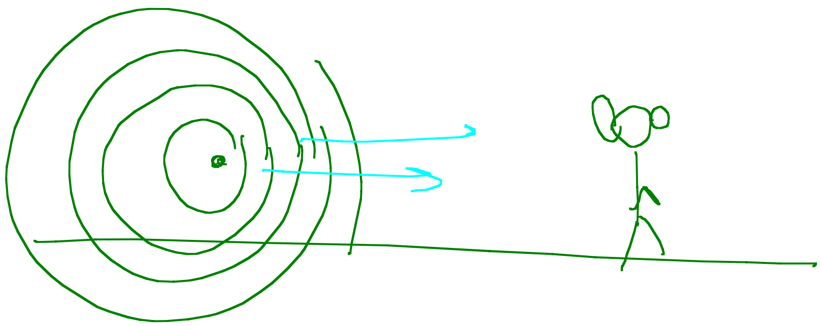
$u = 1.5\ \frac{m}{s}$

$v = 1440\ \frac{m}{s}$

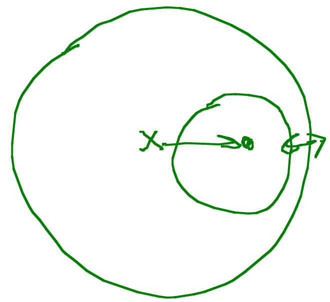
water



$v_{eff} = v + u$



wavelength is eff shorter



New wavelength

λ − distance in T

$\lambda - uT$

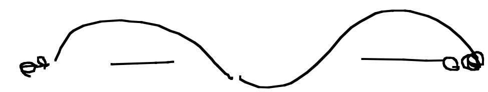
$= \lambda - u\frac{\lambda}{v}$

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

$T = \frac{1}{f}$

$f = \frac{v}{\lambda}$

Standing Waves



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

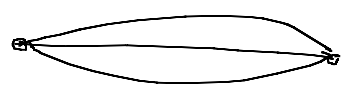
$\lambda = 2L/n$

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

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

14.66 A string on piano is 38.9 cm long (440 Hz)
Tension is 667 N.
What is mass?

$n = 1$ $L = \lambda/2$



$\lambda = 0.778\,m$

$v = \lambda f = 342\,\frac{m}{s}$

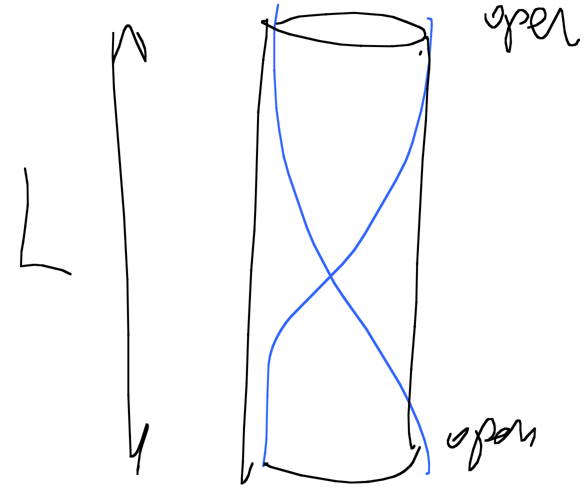
$= \sqrt{\frac{F}{\mu}}$

$\mu = \frac{F}{v^2} = \frac{667\,N}{(342\,\frac{m}{s})^2} = 5.69 \times 10^{-3}\,\frac{kg}{m}$

$m = \mu L = 2.21\,g$

$L = \lambda/2$ $\quad n\lambda/2$

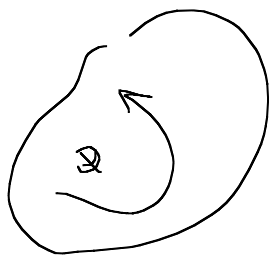
$$f_n = \frac{nv}{2L}$$



Closed on one end

$$f_n = \frac{nv}{4L} \qquad n = 3, 5, 7, \ldots$$

Rot'ns



θ, ω, α

1 rev $= 2\pi$ rad

$$\tau = \sum r F \sin\theta$$

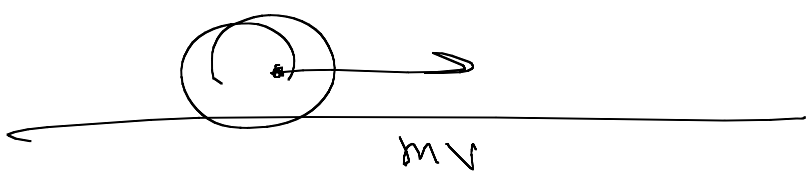
$$I = \sum m_i r_i^2$$

$I_{disk} = \frac{1}{2} M R^2$ etc

$$\tau_{net} = I\alpha$$

$$K_{rot} = \frac{1}{2} I \omega^2$$

$v_{cm} = \omega R$ rolling w/ slipping



$K_{roll} = K_{trans} + K_{rot}$ etc.

$v = \omega R$

$$L = I\omega$$

Oscillations

$$\longrightarrow \frac{d^2x}{dt^2} = -\cancel{}\, x = -\omega^2 x$$

$$x = A\cos(\omega t + \phi)$$

$$\omega = \sqrt{\frac{k}{m}}$$

$$\omega = \sqrt{\frac{g}{L}}$$

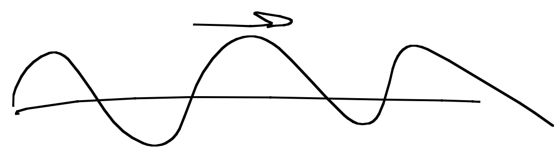
$$\omega = \sqrt{\frac{MgI}{L}}$$

etc.

Waves

λ, f, v

$$\lambda f = v$$



$$y = A\cos(kx \mp \omega t)$$

$k = 2\pi/\lambda$, etc...

Beats, Standing waves

Doppler Effect.

Intensity.

Thermal Physics

Gravity, Fluid forces

dynamics.

Electricity & Magnetism & Light