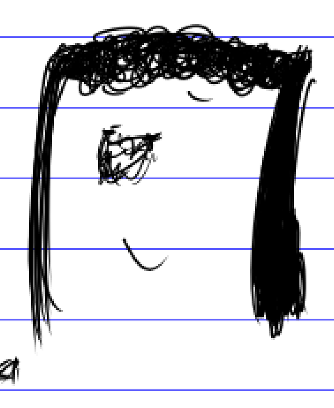
{Optics Notes (Class #2 9-8-2020}

Homework due tomorrow at 5:00 P.M



Problem 1.8

$E_k = mc^2(\gamma - 1)$

When $v << c \rightarrow E_k \approx \frac{1}{2}mv^2$

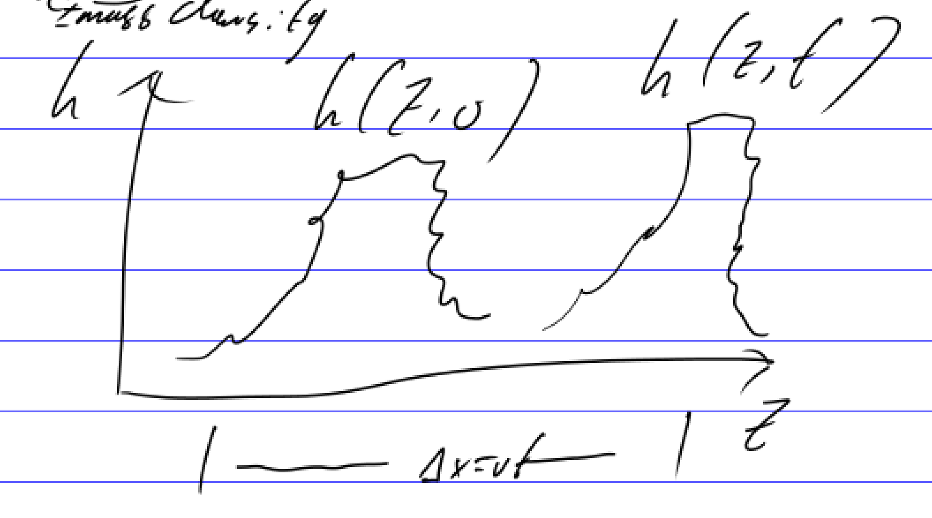
$(1 \pm x)^n \simeq 1 \pm nx \quad x << 1$

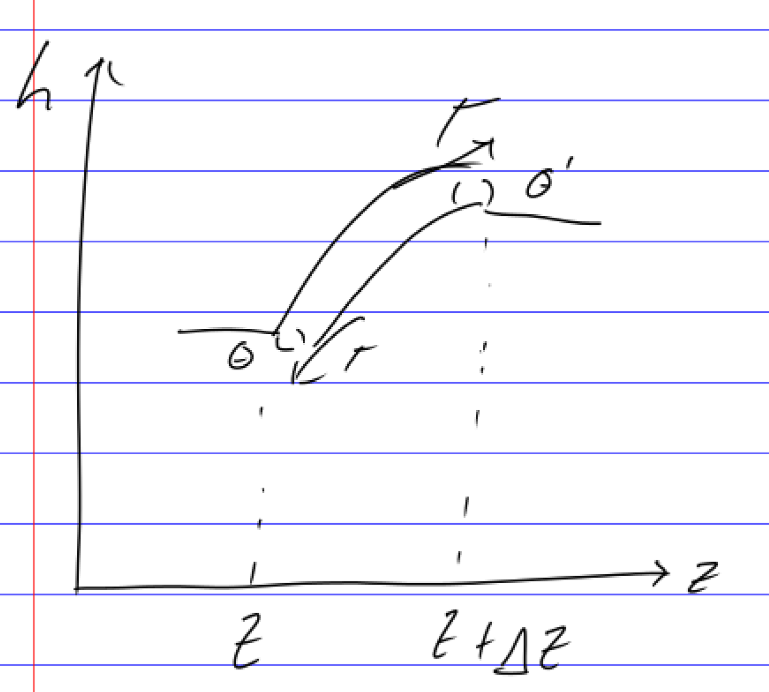
Physics man

$v = f\lambda$ All waves

$v = \sqrt{\frac{T}{\mu}}$ ← String tension

μ = mass density





Sliding = longitudinal

Up+down = transverse

θ h z

Transverse Net Force
$\Delta F_a = T\left[\Delta z \frac{\partial^2 h}{\partial z^2}\right]$

$\Delta F_b = (\mu \Delta z)\left(\frac{\partial^2 h}{\partial t^2}\right)$

$\Delta F_a = \Delta F_b$

$T\left[\cancel{\Delta z} \frac{\partial^2 h}{\partial z^2}\right] = (\mu \cancel{\Delta z})\left(\frac{\partial^2 h}{\partial t^2}\right)$

$\frac{\partial^2 h}{\partial z^2} = \frac{\mu}{T}\frac{\partial^2 h}{\partial t^2}$

$\frac{\partial^2 h}{\partial z^2} = \frac{1}{v^2}\frac{\partial^2 h}{\partial t^2}$

$v = \sqrt{\frac{T}{\mu}}$

$v^2 = \frac{T}{\mu}$

$\frac{1}{v^2} = \frac{\mu}{T}$

1) $y_{example}(x,t) = 4(x-4t)^2$

$\frac{\partial^2 y}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 y}{\partial t^2}$

Basically if you are left with equality

$\frac{1}{16} = \frac{1}{v^2} \quad v = \frac{+}{-}4$

$y_1 = 2e^{\pi(x+2t)}$

$\frac{\partial\left[2e^{\pi(x+2t)}\right]}{\partial x} = 2\pi e^{\pi(x+2t)} = A$

$\frac{\partial A}{\partial x} = 2\pi^2 e^{\pi(x+2t)} = \frac{\partial^2 y}{\partial x^2}$

$\cancel{2\pi^2 e^{\pi(x+2t)}}$
$= \frac{1}{v^2}\cancel{8\pi^2 e^{\pi(x+2t)}}$

$1 = \frac{4}{v^2}$ Describes a wave!

$v = \frac{+}{-}2$

$2e^{\pi x + 2\pi t}$
$= 2e^{\pi x}e^{2\pi t}$

$f(x \pm vt)$ is a wave

But...
What is a wave???

→ A disturbance that moves from a source and carries energy.

Harmonic waves

→ Wave periodicity

Changing A or k does not change the Harmonic Nature of the wave

→ $y = A \begin{matrix}\sin \\ \cos\end{matrix}\left[k(x \pm vt)\right]$

Amplitude

propagation constant

velocity

left

right

Temporal Frequency

Frequency $= \nu\left[\frac{1}{s}, Hz\right]$
Angular frequency $= \omega\left[\frac{1}{s}, Hz\right]$

Spatial Frequency (Is a thing? m^{-1}!?!?)

Wave # = Kappa (κ) $\left[\frac{1}{m}, m^{-1}\right]$
Prop Const = $k\left[\frac{1}{m}, m^{-1}\right]$