Newton's Law

$$F_{NET} = ma$$

$$F_{NET} = m\frac{\Delta v}{\Delta t}$$ mass is constant

$$F_{NET} = \frac{\Delta(mv)}{\Delta t}$$

$$F_{NET} = \frac{\Delta p}{\Delta t}$$

speed of light

$$c = 3 \cdot 10^8 \text{ m/s}$$

$$= 186{,}000 \text{ mi/s}$$

Einstein's correction: rest mass

$$m = \frac{m_0}{\sqrt{1 - v^2/c^2}}$$

$$\gamma = \frac{1}{\sqrt{1-(v/c)^2}}$$

Special Theory of Relativity

$$m = \gamma m_0$$

$v = 1$ mi/s $\quad \gamma = 1.0000 \ldots\ldots$

$v = 100$ mi/s $\quad \gamma = 1.000000145$

$v = 1000$ mi/s $\quad \gamma = 1.00001$

$\frac{v}{c} = \frac{1}{2}$ $\gamma = 1.15$

$\frac{v}{c} = 3/4$ $\gamma = 1.5$

$\frac{F}{a} = m$

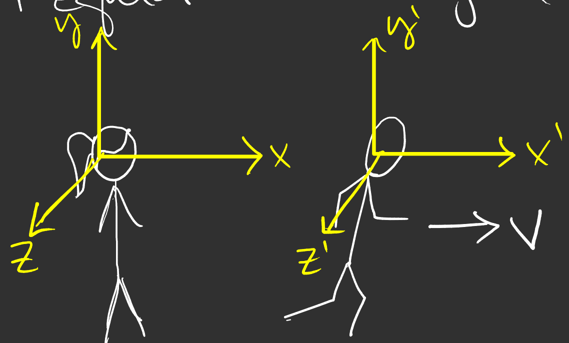
$\frac{v}{c} = 95\%$ $\gamma = 3.2$

$\frac{F}{m} = a$

$\frac{v}{c} = 99\%$ $\gamma = 7.1$

$\frac{v}{c} = 99.9999$ $\gamma = 707$

Regular Relativity (Galilean Relativity)



Sara Henry

P (x, y, z)

or

$\underbrace{(x', y', z')}$

$x' = x - vt$

$y' = y$

$z' = z$

$t' = t$

$$mv_f - mv_i = F\Delta t$$ ← Sara

$$mv_f' - mv_i' = F\Delta t'$$

$$m\frac{\Delta x_f'}{\Delta t} - m\frac{\Delta x_i'}{\Delta t} = F\Delta t'$$

Newton's Laws

$$\underbrace{F = \frac{\Delta p}{\Delta t}}$$

Maxwell's Equations

$\underbrace{\hspace{6em}}$

Galilean transform changed the form of these equations

Michelson - Morley Experiment

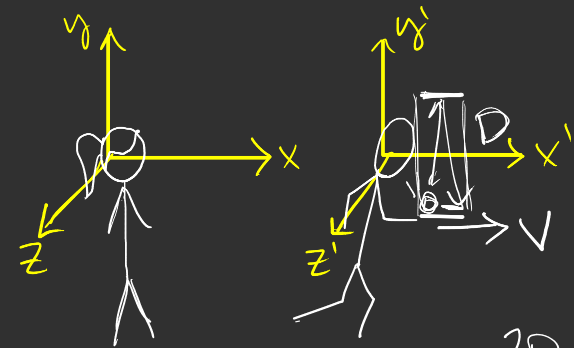
↳ "failed"

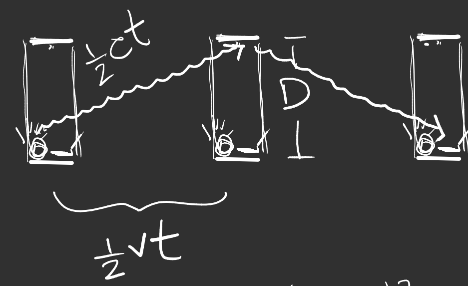
Lorentz → $x' = \dfrac{x - vt}{\sqrt{1 - v^2/c^2}}$ $t' = \dfrac{t - \frac{vx}{c^2}}{\sqrt{1 - v^2/c^2}}$

$y' = y$

$z' = z$

} leave Maxwell's unchanged





$$t' = \frac{2D}{c}$$

$$D = \frac{ct'}{2}$$

$$\left(\tfrac{1}{2}vt\right)^2 = \left(\tfrac{1}{2}ct\right)^2 - D^2$$

$$\left(\cancel{\tfrac{1}{2}}vt\right)^2 = \left(\cancel{\tfrac{1}{2}}ct\right)^2 - \left(\cancel{\tfrac{1}{2}}ct'\right)^2$$

$$(ct')^2 = (ct)^2 - (vt)^2$$

$$t' = t\sqrt{1 - v^2/c^2}$$

$$t = \frac{t'}{\underbrace{\sqrt{1 - v^2/c^2}}_{<1}}$$

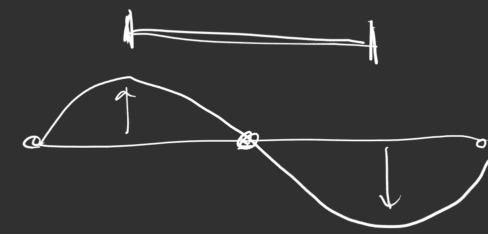
$$\lambda_n = \frac{2L}{n}$$

$$v = f_n \cdot \lambda_n$$

$$f = 2450\,MHz$$

$$f = 2450 \cdot 10^6\,Hz$$

$$= \underline{2.450 \cdot 10^9\,Hz}$$



$$6.5\,cm = \frac{\lambda}{2}$$

$$13\,cm = \lambda$$

$$0.13\,m = \lambda$$

$$c = 0.13\,m \cdot 2.450 \cdot 10^9\,Hz$$

$$= \underline{3.18 \times 10^8\,m/s}$$