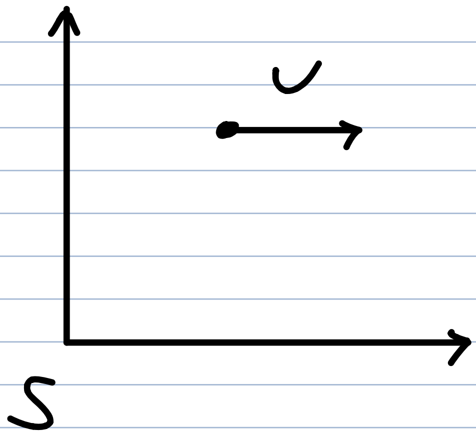
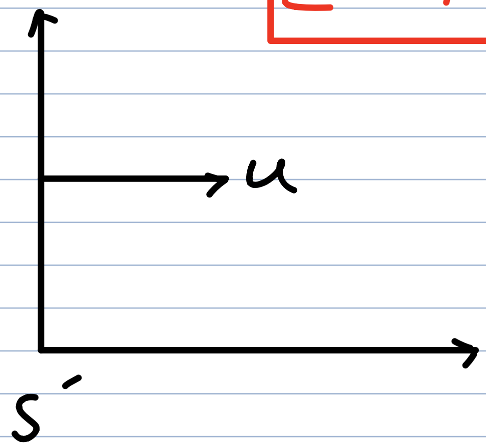
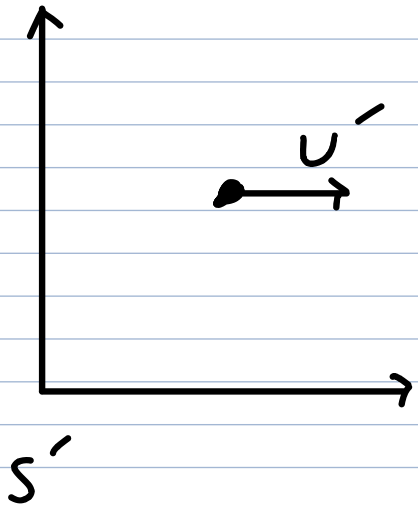
$\boxed{c = 1}$







$$\underbrace{V^\mu = \gamma_v \begin{pmatrix} 1 \\ v \end{pmatrix}}_{\text{In frame } S}$$

want to switch to frame S'

$$\underline{\underline{\Lambda}}_u = \begin{pmatrix} \gamma_u & -u\gamma_u \\ -u\gamma_u & \gamma_u \end{pmatrix}$$

$$V'^\mu = \underline{\underline{\Lambda}}_u V^\mu = \begin{pmatrix} \gamma_u & -u\gamma_u \\ -u\gamma_u & \gamma_u \end{pmatrix} \gamma_v \begin{pmatrix} 1 \\ v \end{pmatrix}$$

$$V'^\mu = \gamma_v \gamma_u \begin{pmatrix} 1 - uv \\ -u + v \end{pmatrix}$$

$$v'^{\mu} = \gamma_{v'} \begin{pmatrix} 1 \\ v' \end{pmatrix}$$

$$\gamma_u \gamma_v \begin{pmatrix} 1 - uv \\ -u + v \end{pmatrix} = \gamma_{v'} \begin{pmatrix} 1 \\ v' \end{pmatrix}$$

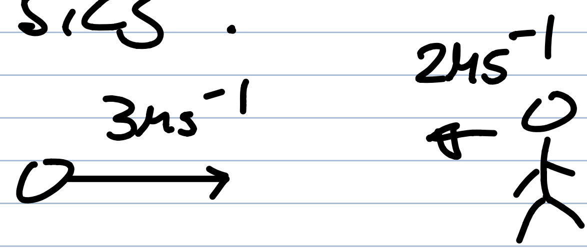
$$v' = \frac{\gamma_u \gamma_v}{\gamma_{v'}} (v - u)$$

$$\gamma_{v'} = \gamma_u \gamma_v (1 - uv)$$

$$\frac{\gamma_u \gamma_v}{\gamma_{v'}} = \frac{1}{1 - uv}$$

$$v' = \frac{v - u}{1 - uv} = \frac{v - u}{1 - \frac{uv}{c^2}}$$

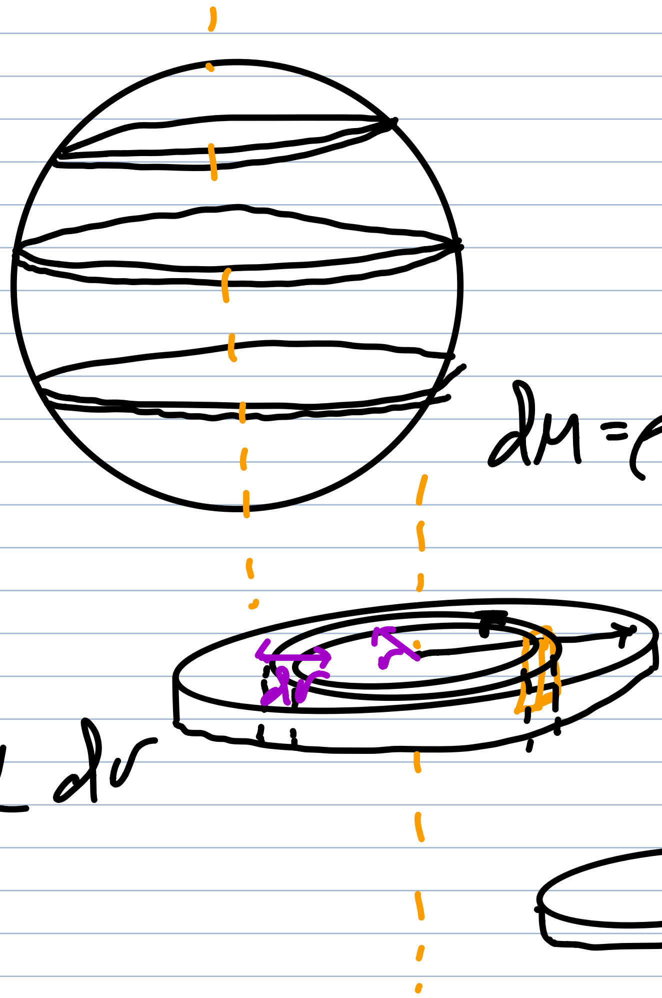
Galilean Physics :



$v' = 5 ms^{-1}$
(Galilean)

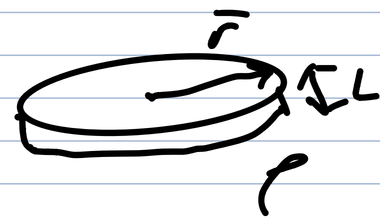
$$v' = \frac{5}{1 + \frac{6}{c^2}} \sim 5ms^{-1}$$

$$I = \int r^2 \, dM$$



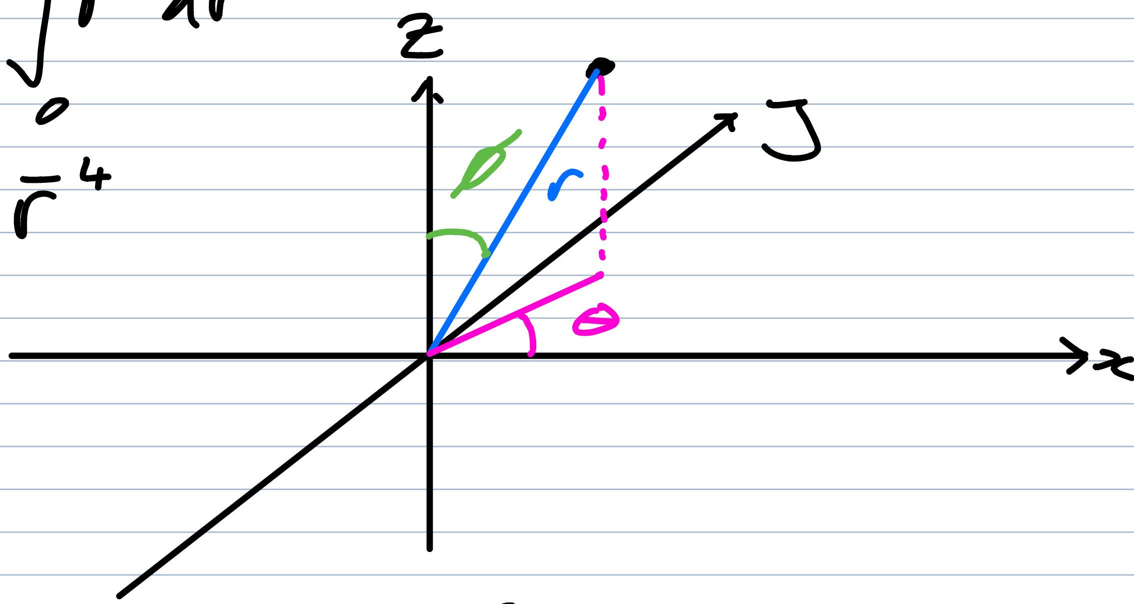
$$dM = \rho \, 2\pi r \, dr \, L$$

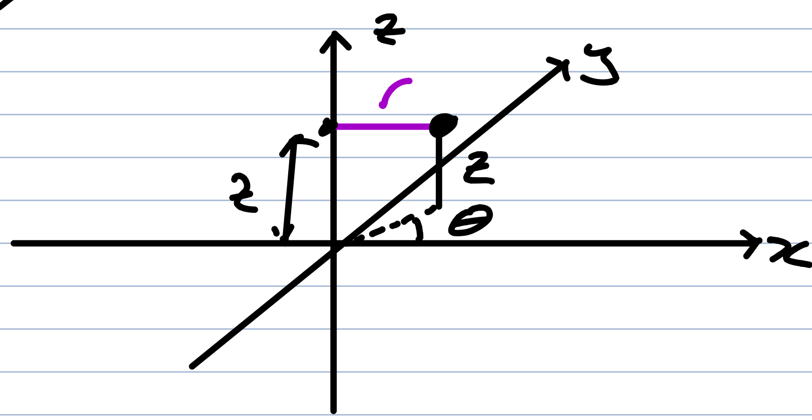
$$I_{disk} = \int_0^{\bar{r}} r^2 \rho \, 2\pi r L \, dr$$



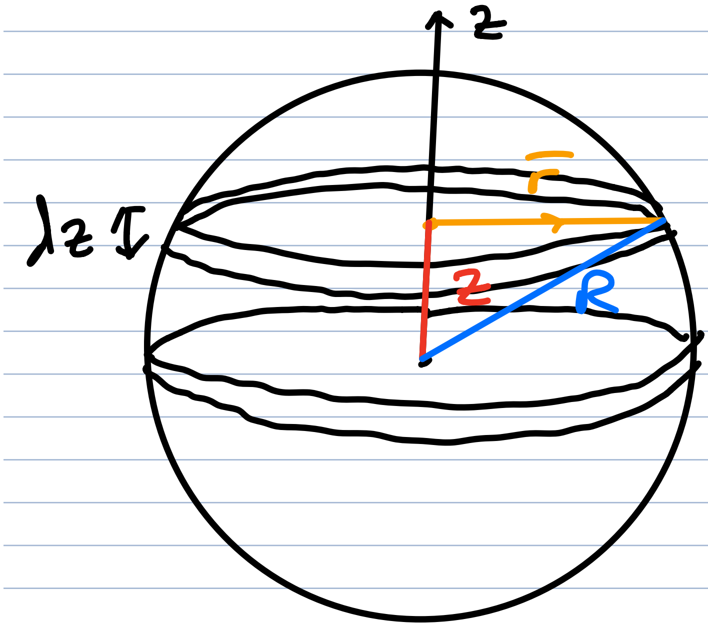
$$= 2\pi \rho L \int_0^{\bar{r}} r^3 \, dr$$

$$= \frac{1}{2} \pi \rho L \bar{r}^4$$





$$I_{disk} = \frac{1}{2}\pi\rho L \bar{r}^4$$



$$R^2 = z^2 + \bar{r}^2$$

$$\bar{r}^2 = R^2 - z^2$$

$$I_{sphere} = \int dI_{disk}$$

$$dI_{disk} = \frac{1}{2}\pi\rho\bar{r}^4 dz$$

$$\bar{r}^4 = (R^2 - z^2)^2$$

$$= R^4 + z^4 - 2R^2z^2$$

$$I_{sphere} = \int_{-R}^{R} \frac{1}{2}\pi\rho\bar{r}^4\, dz$$

$$I_{sphere} = \int_{-R}^{R} \frac{1}{2}\pi\rho\left[R^4 + z^4 - 2R^2z^2\right] dz$$

$$= \frac{1}{2}\pi\rho\int_{-R}^{R}\left[R^4 + z^4 - 2R^2z^2\right]dz$$

$$= \frac{1}{2}\pi\rho\left[2R^5 + \frac{2}{5}R^5 - \frac{4}{3}R^5\right]$$

$$\pi\rho\left[R^5 + \frac{1}{5}R^5 - \frac{2}{3}R^5\right]$$

$$I_{sphere} = \pi\rho\left[\frac{8}{15}R^5\right]$$

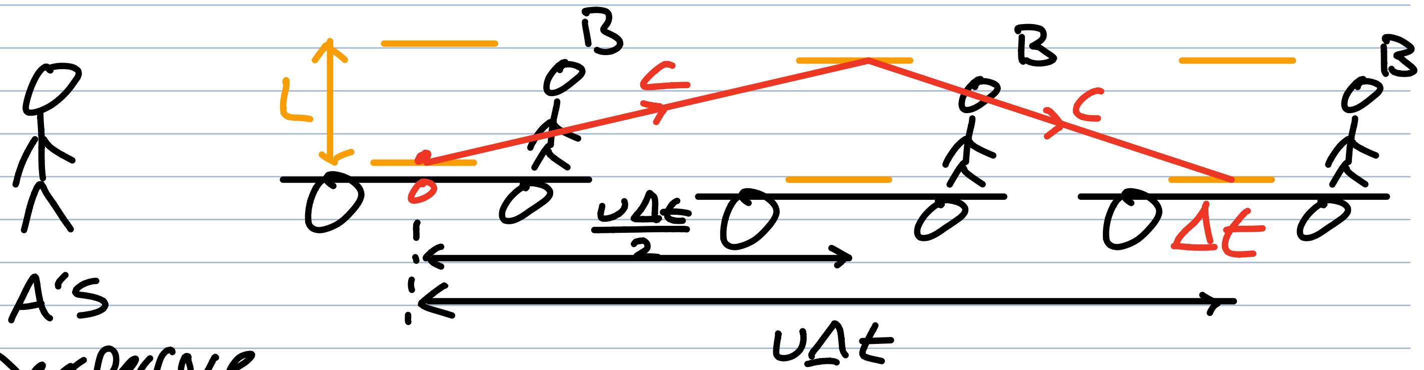
$$= \frac{2}{5}R^2\underbrace{\left[\frac{4}{3}\pi R^3\rho\right]}_{M} \qquad M = \frac{4}{3}\pi R^3\rho$$

$$I_{sphere} = \frac{2}{5}MR^2$$

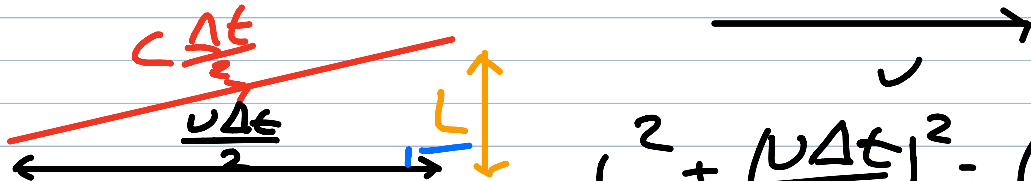
$$M_D < M_p + M_n$$

$$\Delta M = (M_\alpha + M_N - M_D)$$

$$\Delta E = \Delta M c^2$$

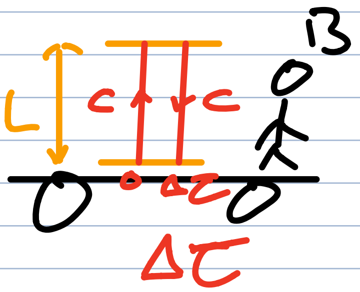


A's perspective



$$L^2 + \left(\frac{v\Delta t}{2}\right)^2 = \left(\frac{c\Delta t}{2}\right)^2$$

B's perspective



$\rightarrow$ $L = c\frac{\Delta\tau}{2}$

$$\left(\frac{c\Delta\tau}{2}\right)^2 + \left(\frac{v\Delta t}{2}\right)^2 = \left(\frac{c\Delta t}{2}\right)^2$$

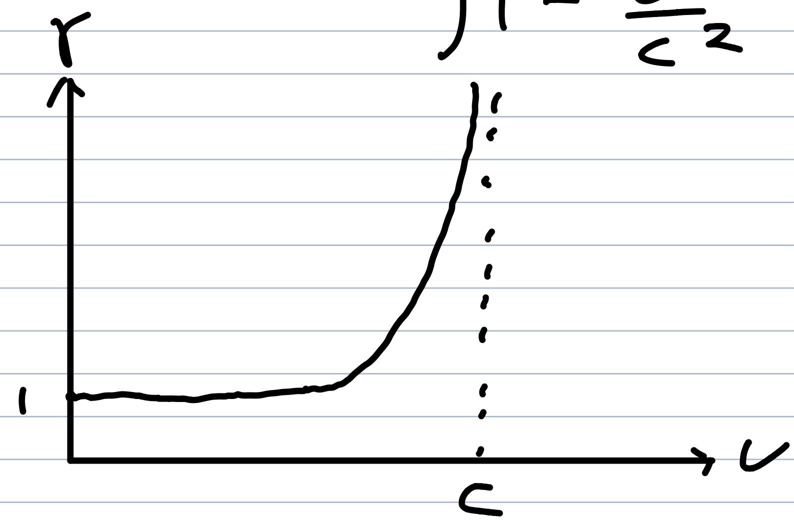
$$(\Delta t)^2\left[c^2 - v^2\right] = c^2(\Delta\tau)^2$$

$$(\Delta t)^2 = \frac{c^2}{c^2 - v^2}(\Delta \tau)^2$$

$$(\Delta t)^2 = \frac{1}{1 - \frac{v^2}{c^2}}(\Delta \tau)^2$$

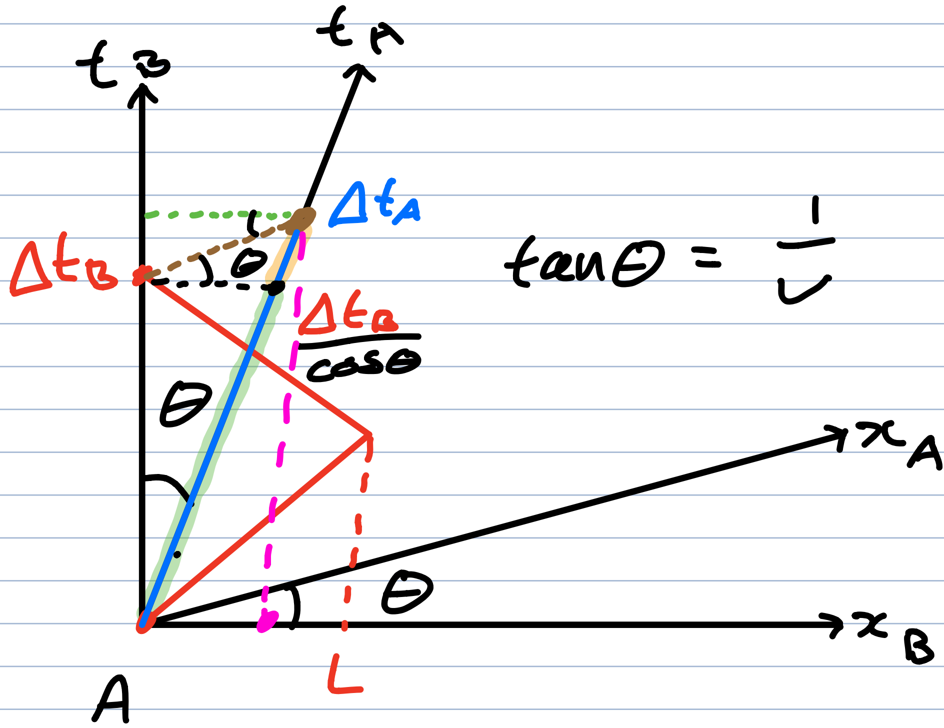
$$\boxed{\Delta t = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}\Delta \tau}$$

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



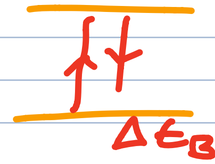
$v << c$

$\Delta t \simeq \Delta \tau$



$\tan\theta = \frac{1}{v}$

A $\quad \overset{v}{\rightarrow}$ B



$$\Delta t_A = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\Delta t_B$$

$$t_B = x_B \frac{1}{\tan\theta}$$

$$t_B = \Delta t_B + x_B \tan\theta$$

$$\frac{x_B}{\tan\theta} = \Delta t_B + x_B \tan\theta$$

$$x_B\left(v - \frac{1}{v}\right) = \Delta t_B$$

$\sec\theta$

$$\Delta t_A = \frac{1}{\cos\theta}\frac{\Delta t_B}{\left(v - \frac{1}{v}\right)}$$

$$s^2 + c^2 = 1$$

$$\tan\theta = \frac{1}{v}$$

$$t^2 + 1 = \sec^2$$

$$\sec\theta = \sqrt{1 + \left(\frac{1}{v}\right)^2}$$

$$\Delta t_A = \frac{\sqrt{1 + \frac{1}{v^2}}}{v\left(1 - \frac{1}{v^2}\right)} \Delta t_B$$

Next time