Physics 267 Problem # 8 solutions,

$O \rightarrow v = 0.8c \qquad \gamma = \frac{5}{3}$

O_{Earth}

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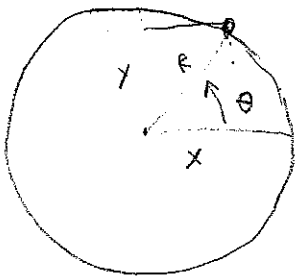
spaceship frame



$g = a = \frac{v^2}{R} \qquad v = \omega R \qquad \omega = 2\pi f = \frac{2\pi}{T}$

$\theta = \omega t$

$g = \omega^2 R = \frac{\theta^2 R}{t^2}$

$\theta = \sqrt{\frac{g t^2}{R}} = t\sqrt{\frac{g}{R}} = t\frac{\sqrt{10}}{10}$

↑ t in seconds

since $\theta = 0$ at $t = 0$.

$x = R\cos\theta$

$y = R\sin\theta$

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earth frame

moving clock on spaceship runs slow

lengths in x-direction are contracted

$\theta = \tan^{-1}\left[\frac{y}{x}\right] = \tan^{-1}\left[\frac{R'\sin\theta'}{(R'\cos\theta')\left(\frac{1}{\gamma}\right)}\right]$

$= \tan^{-1}\left[\frac{\sin\left[\frac{t}{\gamma}\sqrt{\frac{g'}{R'}}\right]}{\frac{1}{\gamma}\cos\left[\frac{t}{\gamma}\sqrt{\frac{g'}{R'}}\right]}\right] = \tan^{-1}\left[\gamma\tan\left[\frac{3\sqrt{10}}{50}t\right]\right]$

$\theta = \tan^{-1}\left[\frac{5}{3}\tan\left[\frac{3\sqrt{10}}{50}t\right]\right]$

Note: compare to Ohanian Fig 3.13 where rotational velocity is comparable to c at the rim.