Ex Time

A neon sign flashes at a rate of 1 flash each 4.5 s as measured by a cook standing in front of a sign. How much time elapses between each flash as measured by a person on a ship moving at 0.84c relative to the sign?

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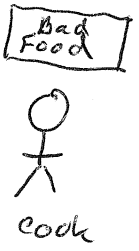
Neon Sign

$\Delta t_0 = 4.5_s$



$V = 0.84c$

$\Delta t = ?$

Sign is by cook, so cook measures proper time.

$$\Delta t = \frac{\Delta t_0}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{4.5_s}{\sqrt{1 - \frac{(0.84c)^2}{c^2}}} = \frac{4.5_s}{\sqrt{1 - (.84)^2}}$$

$$= \boxed{8.3_s}$$

Ex Time

A particle with a lifetime of 2.6E-8 s when at rest moves at 0.99c relative to a particle accelerator.

(1) What is the lifetime as measured by a lab attendant at the accelerator

(2) How far does the particle move during its lifetime as measured by the lab attendant?

(3) If there were no relativistic time dilation, how far would the particle move?

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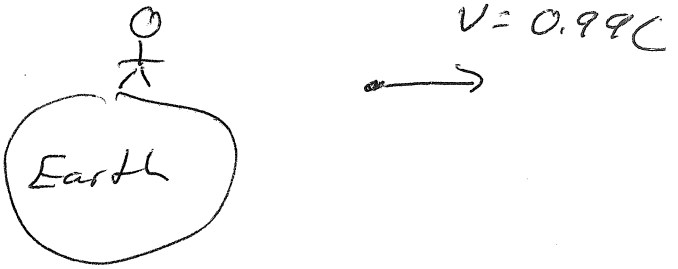
rest lifetime = 2.6E-8 s

Δt_0 = 2.6E-8 s

clock moves with muon



a) Earth Δt = ?

$$\Delta t = \frac{\Delta t_0}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{2.6E\text{-}8\ s}{\sqrt{1 - .99^2}} = \boxed{1.8E\text{-}7\ s}$$

b) Earth distance

$$d = v\Delta t = 0.99c\,(1.8E\text{-}7\ s) = \boxed{53\ m}$$

c) $$d = v\Delta t = 0.99c\,(2.6E\text{-}8\ s) = \boxed{7.7\ m}$$

Ex time

An observer on a spaceship traveling at 0.95c toward Earth notices that it takes someone 5.0 minutes to steal a car. If the observer had been moving away at 0.80c, what time would she record for the same crime?

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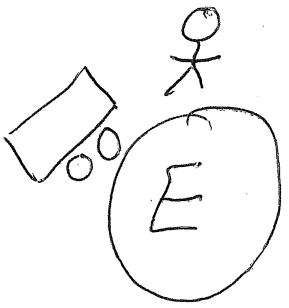
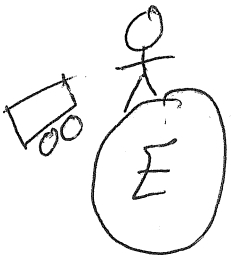


$V = 0.95c$

$\Delta t = 5.0 \text{ min}$



$V = 0.80c$

$\Delta t = ?$

Determine proper time, because it will be the same in each case

$$\Delta t = \frac{\Delta t_0}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad \Delta t_0 = \Delta t \sqrt{1 - \frac{v^2}{c^2}}$$

$$\Delta t_0 = 5.0\,\text{min}\sqrt{1-0.95^2} = \underline{1.56\,\text{min}}$$

$$\Delta t = \frac{1.56\,\text{min}}{\sqrt{1-0.80^2}} = \boxed{2.6\,\text{min}}$$