

Joe drives at $v = 50$ mph for 60 years. How much "extra life" does he gain?

$$v = 50 \text{ mph} \times \frac{1609 \text{ m}}{\text{mile}} \times \frac{1 \text{ hour}}{3600 \text{ s}} = 22.3 \frac{\text{m}}{\text{s}}$$

$$\begin{aligned} \gamma &= \left(1 - \frac{v^2}{c^2}\right)^{-1/2} \approx 1 - \left(-\frac{1}{2}\right) \frac{v^2}{c^2} \approx 1 + \frac{1}{2} \frac{v^2}{c^2} \\ &= 1 + 2.8 \times 10^{-15} \end{aligned}$$

So

$$\Delta t_{\text{Joe}} = \frac{1}{\gamma} \Delta t_{\text{normal}}$$

$$= \Delta t_{\text{normal}} \left(1 + 2.8 \times 10^{-15}\right)^{-1}$$

$$\approx \Delta t_{\text{normal}} \left(1 - 2.8 \times 10^{-15}\right)$$

$$\text{Now, } \Delta t_{\text{Joe}} = 60 \text{ years} = 1.89 \times 10^9 \text{ s}$$

$$\rightarrow \Delta t_{\text{Joe}} \approx \Delta t_{\text{normal}} - 2.8 \times 10^{-15} \Delta t_{\text{normal}}$$

$$\left(\Delta t_{\text{normal}} - \Delta t_{\text{Joe}}\right) = \text{"extra life"} \approx 2.8 \times 10^{-15} \left(\Delta t_{\text{normal}}\right)$$

$$= 2.8 \times 10^{-15} \left(1.89 \times 10^9 \text{ s}\right)$$

$$= \underline{5 \text{ microseconds}}$$