

Problem Set 6 Written Problems

Problem 1

You jog for an hour at 2 m/s while your friend sits on the couch and watches episodes of "The Fresh Prince of Bel-Air" while eating Cheezy-Poofs. When you return, how much less have you aged compared with your friend?

Note: for this question, you only need to work out the order of magnitude of the result (e.g. 1s or 10^{-2} s). Since the velocity will be relatively small compared with c , it is useful to use an approximation in the formula for γ . Consider the following: we have $\gamma = f(v^2/c^2)$ where $f(x) = (1 - x)^{-1/2}$. If we zoom in to the region near $x = 0$, the function f looks more and more like a line. So for very small v/c it is a good approximation to replace the function $f(x)$ by a line with the same value at $x = 0$ and the same slope, $f_{\text{approx}}(x) = A + Bx$. You should determine A and B . Then, if v/c is very small, we have $\gamma = f(v^2/c^2) \approx f_{\text{approx}}(v^2/c^2) = A + Bv^2/c^2$. Here, we are using the "first order Taylor expansion" of f as a way to approximate the function f .

Problem 2

Nicki Minaj, approximately 32 years old, is worried that the younger Iggy Azalea (age 24) may be stealing attention away from her. She decides to take a trip to the star Sirius, 8 light years away. She travels to the star and back, always at a constant speed, such that when she returns, she is the same age as Iggy. How old are she and Iggy when she returns (assume that Nicki is exactly eight years older initially).

Hint: For a question like this, it's much more convenient to use years as the units for time, light years (1lyr = $c \cdot 1\text{yr}$) as the unit for distance, and give all velocities as fractions of c , e.g. just write $v = 0.5c$ without ever writing out what c is in m/s.