Soln 1-3

Easiest to use length contraction from Astrid’s point of view. That is, Astrid is stationary and the sun and Tau Ceti system slides by her at speed 0.99c.

Lo = 12 lyrs

L is the distance between the sun and Tau Ceti as seen by Astrid.

to is the time Astrid measures for this to happen.

From Astrid’s POV,

$$L= γ^{-1}L\_{o}= \sqrt{1-β^{2}}L\_{o}= \sqrt{1-0.99^{2}}\left(12\right)=1.69 lys$$

At 0.99c, it will take

$$t\_{o}=L/v= \frac{1.69 lyrs}{.99c}=1.71 years$$

So, she’ll be 21 years, 8½ months old.

Alternatively, let’s imagine that Astrid has a clock that ‘ticks’ once during her trip; to is the length of the tick as seen by Astrid, which is what we’re trying to find. An observer in the sun-Tau Ceti POV would observe this tick to take time t, where

$$t= γt\_{o} .$$

This t is also the time required for Astrid to travel 12 lyrs at 0.99c:

$$t= \frac{12 lyrs}{0.99c}=12.12 years .$$

Then,

$$t\_{o}=\frac{t}{γ}=12.12\sqrt{1-0.99^{2}}=1.71 years . $$