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,

At 0.99c, it will take

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

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

Then,