Chapter 33 Problem 43 †

Given
$v = 0.35c$
$x = 14\ lm$

Solution
For observers on the spaceship, did the touchdown occur before or after the time of the Pasadena clocks and by how much.

The distance between Mars and Earth is 14 lm or 14 light minutes. If was assume the units for time is in minutes, then the distance can more appropriately be expressed as $14c$, where c is the speed of light.
To solve this problem we need to use the Lorentz transform between the stationary frame and the moving frame.

$$t' = \gamma(t - vx/c^2)$$

The relativistic factor γ is

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{1}{\sqrt{1 - \frac{(0.35c)^2}{c^2}}} = \frac{1}{\sqrt{1 - (.35)^2}} = 1.0675$$

In the stationary frame the distance between Earth and Mars is $14c$. In this frame our time coordinate of 0 is synchronized to the touchdown. Therefore, the observers in the space craft would conclude that

$$t' = (1.0675)(0 - (0.35c)(14c)/c^2) = 5.23$$

Since our distance was expressed in light minutes, the time we calculated is in minutes. Therefore,

$$t' = 5.2\ min$$

†Problem from Essential University Physics, Wolfson