7 The book's suggested procedure, while physically correct, is needlessly complex. My apologies: I had not realized as much when I assigned the problem.

Instead, apply the Lorentz transformations for a distance Δx & a ~~tie~~ interval Δt, both ~~and~~ in the rest frame, and $\Delta x', \Delta t'$ in the moving frame.

The Lorentz transforms are

$$\Delta x' = \frac{\Delta x - u\,\Delta t}{\sqrt{1-u^2/c^2}}$$ or, equivalently (interchange roles) $$\Delta x = \frac{\Delta x' + u\,\Delta t'}{\sqrt{1-u^2/c^2}}$$

$$\Delta t' = \frac{\Delta t - \frac{u}{c^2}\Delta x}{\sqrt{1-u^2/c^2}} \qquad \Delta t = \frac{\Delta t' + \frac{u}{c^2}\Delta x'}{\sqrt{1-u^2/c^2}}$$

$$\lim_{\substack{\Delta x \to 0 \\ \Delta t \to 0}} \frac{\Delta x}{\Delta t} \equiv v = \lim_{\substack{\Delta x' \to 0 \\ \Delta t' \to 0}} \frac{\Delta x' + u\,\Delta t'}{\Delta t' + \frac{u}{c^2}\Delta x'}$$

$$= \;'' \; \frac{\Delta t'\left(\frac{\Delta x'}{\Delta t'} + u\right)}{\Delta t'\left(1 + \frac{u}{c^2}\frac{\Delta x'}{\Delta t'}\right)}$$

$$= \frac{v' + u}{1 + \frac{u v'}{c^2}}$$