PHY151H1F – Practice Problem Set 2

Review this box from pg.91 of the Practice Mazur book:

Procedure: Applying Galilean relativity

In problems dealing with more than one reference frame, you need to keep track not only of objects, but also of reference frames. For this reason, each quantity is labeled with two subscripts. The first subscript denotes the observer; the second denotes the object of interest. For example, if we have an observer on a train and also a car somewhere on the ground but in sight of the train, then $\vec{a}_{Tc}$ is the train observer's measurement of the acceleration of the car. Once you understand this notation and a few basic operations, working with relative quantities is easy and straightforward.

observer A's measurement of velocity of car:

$$\vec{v}_{Ac}$$

observer ⋯ object of interest

1. Begin by listing the quantities given in the problem, using this double-subscript notation.
2. Write the quantities you need to determine in the same notation.
3. Use subscript cancellation (Eq. 6.13) to write an equation for each quantity you need to determine, keeping the first and the last subscripts on each side the same. For example, in a problem where you need to determine $\vec{v}_{Tc}$ involving a moving observer B, write

$$\vec{v}_{Tc} = \vec{v}_{TB} + \vec{v}_{Bc}.$$

4. If needed, use subscript reversal (Eq. 6.15) to eliminate any unknowns.
5. Use the kinematics relationships from Chapters 2 and 3 to solve for any remaining unknowns, making sure you stay in one reference frame.

You can use this procedure and the subscript operations for any of the three basic kinematic quantities (position, velocity, and acceleration).

Practice Problem 1 Not from Mazur:
A passenger walks toward the back of a train at 3.0 m/s. The train is traveling at 46.0 km/hr. What is the speed of the passenger relative to the Earth?

Ch. 6, Q. 33

33. Riding up an escalator while staying on the same step for the whole ride takes 30 s. Walking up the same escalator takes 20 s. How long does it take to walk down the up escalator? ••

Ch. 14, Q. 33

33. *Principles* Section 14.3 describes how the number of muons reaching Earth's surface is greater than the number expected based on the muon half-life of 1.5×10^{-6} s. How fast, relative to Earth, must muons be moving in order for one of every million muons to pass through a distance equal to Earth's diameter without decaying? ••