Modern Physics
Fall 2018

Read Chapter 1 in Serway

Assignment 3: Due Monday, October 1

1. I measure a meter stick that is moving in my frame to have a length of 0.8m. How fast is the meter stick moving relative to me?

2. A person in the frame of the meter stick in #1 above measures another meter stick that's at rest in my frame. How long will it appear to be to him?

3. Two events occur in my frame, frame A, 1µs apart. They are at x = 0 and x = 600m, the one at 0m occurring first in my frame. In another person's frame, frame B, they are simultaneous.

    a) How fast is frame B moving along the x-axis relative to me?

    b) Are they (i.e. B) moving in the +x or – x direction?

    c) How far apart are the two events in space in frame B, i.e. Δx_B.

4. Is it possible for the event at the origin in frame A in problem 3 above to occur 1µs AFTER the one at 600m in some other frame? Call this frame D. This means that the order of events is reversed in frame D. If so, how fast is frame D moving relative to frame A and in which direction, +x or – x?

5. In my frame, frame A, a muon is moving downward. It takes 10µs in my frame for the muon to go from the top of a tall mountain to the bottom, 2.4km in my frame.

    a) How fast is the muon moving in my frame?

    b) How long will it be between those two events in the muon's frame?

    c) What will be the distance from the top of the mountain to the bottom in the muon's frame? (That is, what is the height of the mountain to the muon.)

6. A rocket ship is traveling in the +x direction in my frame, A, with a speed of 0.5c. In another person's frame, frame B, it is traveling in the +x direction with a speed of 0.8c. How fast and in what direction (+ or – x) is frame B moving relative to me?

7. A rectangular box at rest in my frame has sides of length 2m × 0.5m × 1m in my frame, with the sides parallel to the x, y and z axes. What would be its volume in another frame, B, that is moving in the +x direction relative to my frame with a speed = 0.8c?

8. A spacecraft is heading out of the solar system with a velocity v, directly away from the earth. They transmit data back at a frequency of 1 MHz. If we receive the data at a frequency of 0.9 MHz, how fast are they traveling?

We will have an Exam on Waves on Monday, September 24.