PHY151 Practical Questions for Nov 28 to Dec 2

1. You take a photograph of a rocket moving away from you at speed v = 0.8c (where c is the speed of light). From the photograph, you make the following observations of the rocket: the rear of the rocket was at the 1200 m mark (as measured by your rulers) 4 μs (as measured by your clocks) before you took the photograph; the front of the rocket was at the 1800 m mark (as measured by your rulers) 6 μs (as measured by your clocks) before you took the photograph. This means that your photographs makes the rocket appear to be 600 m long.

   How long do you measure the rocket really is in your reference frame?

2. A person inside the previously described rocket (and moving with the rocket) would agree with all your observations and your calculations for the previous question, but they would disagree with your measured distance (due to length contraction). Without mentioning length contraction, using only notions of simultaneity and your definition of how one should measure a length, explain why the other observer believes your measurements are wrong.

3. You see a rocket moving away from you at v = 0.8c. You measure that the rocket is 1080 m long. A person at the back of the rocket shines light toward the front of the rocket and measures how long it takes to get to the front, bounce off a mirror, and return to the person at the back of the rocket.

   (a) Based on the fact that you observe the light going in the same direction as the rocket at speed c, and the rocket moving forward at speed v = 0.8c, calculate the time for the light to travel from the back of the rocket to the front in your reference frame, in which the rocket is 1080 m long. Similarly, when the light is moving opposite the direction as the rocket at speed c, and the rocket is moving forward at speed v = 0.8c, calculate the time for the light to travel from the front of the rocket to the back in your reference frame. What do you calculate to be the time of the round trip?

   (b) Based on time dilation, how much time should the person in the rocket observe the round trip takes? Note that the observer in the rocket is measuring the 'proper time'.

   (c) Use your answer to the previous question to determine how long the person in the rocket thinks the rocket is.

   (d) Find the ratio of the two measured rocket lengths (their measured value divided by your measured value). Compare this with γ.