PHYS 483: First Midterm Exam, 24 October 2007

QUESTIONS.

1. Two events occur at the same place in the laboratory frame of reference and are separated in time by 3 seconds. (a) What is the spatial distance between these two events in a rocket frame in which the events are separated in time by 5 seconds? (b) What is the relative speed v_{rel} of the rocket and laboratory frames. (c) What is the spacetime distance between the two events?

2. A particle moves with uniform speed $v'_y = \Delta y'/\Delta t'$ along the y'-axis of the rocket frame. Transform $\Delta y'$ and $\Delta t'$ to laboratory displacements $\Delta x, \Delta y$ and Δt using the Lorentz transformation equations. Show that the x-component and the y-component of the velocity of this particle in the laboratory frame are given by the expressions

$$v_x = v_{rel}$$

$$v_y = v'_y \, (1 - v_{rel}^2/c^2)^{1/2}$$

3. A rod moves along x-axis with speed u and has length L relative to S. What is its length L' relative to the usual second frame S'? (S and S' move relative to each other with speed v_{rel})

4. (a) Show that the combination of two successive Lorentz transformations is also a Lorentz transformation. (b) Using part (a) show that when a frame moves with the speed of light with respect a second frame then its speed will be the same with respect a third frame.(Frames are all inertial)