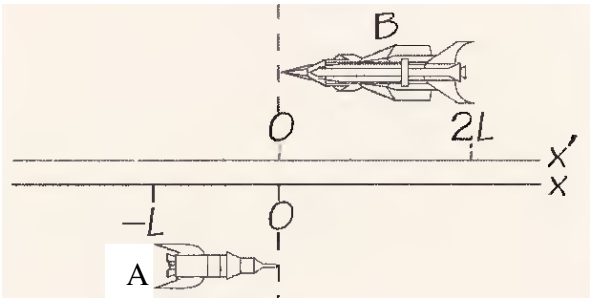
YOUR NAME:_____ ROLL NUMBER:_____

Quiz # 1 Saturday, September 22, 2012

Answers must be given on this sheet of paper only. Use the backsides for rough calculations. No calculators, mobile phones or crib sheets are permitted. Time=90 minutes.

Q.1 As seen from Earth, space ship A of proper length L is travelling to the right at speed v_1 and spaceship B of proper length 2L is travelling to the left at speed v_2. The pilot of spaceship A sets his clock to zero when the front of spaceship B passes him. (The spaceship pilots sit in the nose cones.) Use the Lorentz transformation to calculate the time at which, according to spaceship A, the tail of spaceship B passes by him. [10 points]



Q.2 A source on Earth emits pulses with a frequency ν_0. A spaceship moving at speed u_1 away from the source will receive a red - shifted frequency ν_1. Suppose that the spaceship immediately re - emits the signals with frequency ν_1. A second spaceship, moving with speed u_2 relative to the first spaceship and in the same direction will receive the signals with a red - shifted frequency ν_2.

a) Find ν_1 and ν_2. [5 points]

b) What is the speed of the second spaceship as viewed from Earth? [5 points]

Q.3 A heavy nucleus M which is initially at rest decays into a lighter nucleus m and a photon. Find the kinetic energy of the lighter nucleus after the decay. [5 points]

Q.4 In order to remove an electron from a certain metal, it is necessary to give at least 2 eV energy to the electron. What is the longest wavelength of a beam of light that ensures that photoelectrons are just emitted? Give your answer in Angstroms and use $\hbar c = 197.3 \text{MeV fm} \approx 200 \text{ MeV fm}$ $(1\dot{A} = 10^{-8} cm,\ 1\text{fm} = 10^{-13} cm)$. [5 points]