EASTERN UNIVERSITY, SRI LANKA

SECOND EXAMINATION IN SCIENCE 2003/2004 (OCTOBER 2007)

SECOND SEMESTER

EXTERNAL DEGREE

EXTPH 205 – RELATIVITY

Time: 01 hour.

Answer ALL Questions.

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1. Use the Lorentz transformations to obtain the velocity transformation laws

$$U_x' = \frac{U_x - V}{1 - \frac{U_x V}{c^2}},\quad U_y' = \frac{U_y}{\gamma\left[1 - \frac{U_x V}{c^2}\right]} \text{ and } U_z' = \frac{U_z}{\gamma\left[1 - \frac{U_x V}{c^2}\right]}$$

Where the symbols have their usual meaning

Spaceship A passes earth at time t=0 at speed 0.8c in the direction of the star Xerxes. At the same time (according to earth frame clocks) spaceship B passes Xerxes at speed 0.625c in the direction of earth. Assume earth and Xerxes are at rest relative to one another and the distance between them is 10 light years (earth frame measurements).

a) At what rate are the spaceships approaching each other according to earth frame observers? Does this result violate the principles of relativity? Explain.

b) Find the time when the spaceships meet according to earth frame measurements. How far is the meeting place from earth?

c) Use the Lorentz transformation to find the time of meeting according to clocks on ship A. (Assume that spaceship clock read zero when it passed earth)

d) What is the speed of the ship B according to observers on A?

e) What is the distance between earth and Xerxes in A's frame?

2. Define an inertial frame. State the principle of relativity and explain it's significance.

a) Derive the equations

(i) $dT = m.(\bar{u}.d\bar{u}) + (\bar{u}.\bar{u}).dm$

(ii) $E = m_0c^2 + T$

(iii) $\bar{a} = \frac{\bar{F}}{m} - \frac{\bar{u}}{mc^2}(\bar{F}.\bar{u})$

b) A particle is given a kinetic energy equals to n times it's rest mass energy. What are

(i) it's speed and

(ii) it's momentum

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