Notes from Presentation / Quiz

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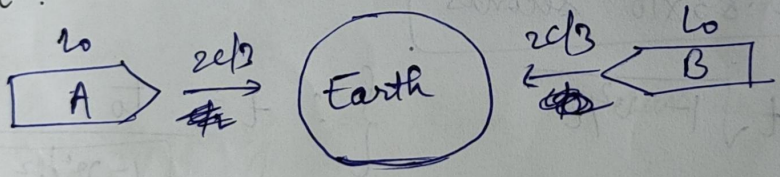
Topic: Problem Solving based on L.T./I.L.T.

Introduction: what I'll be trying to do during the next 10 mins is roughly to give a simple idea regarding what kind of questions can be asked from the Lorentz transformations. I'll be presenting 2 questions and solving them on the board. I'll leave 2 questions for the class to attempt on their own and potentially discuss their doubts on the group.

Q.1 Two rockets each of rest length L_0 are approaching the Earth from opposite directions at the same speed $2c/3$. Find the length of one rocket in the frame of the other rocket.

→



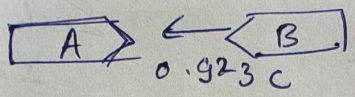
NOTE: ① L_0 is the rest length.
② $2c/3$ is from the frame of reference of Earth.

→ Velocity of B in the frame of A:

$$v = \frac{v_1 + v_2}{1 + \frac{v_1 v_2}{c^2}} = \frac{\frac{2c}{3} + \frac{2c}{3}}{1 + \frac{4c^2}{9c^2}} = \frac{\frac{4c}{3}}{\frac{13}{9}}$$

$$= \frac{4c \cdot 3}{13} = \frac{12c}{13}$$

$$\therefore \boxed{v \simeq 0.923\ c}$$

→ 

length of B $= L_0\sqrt{1-v^2/c^2} = L_0\sqrt{1-0.852}$

$\boxed{L' \simeq 0.385\, L_0}$ (length contraction)

Q.2

Some hypothetical particle created in some nuclear reactor leaves a 2 cm track before decaying. Assuming that the particle moved at 0.8c, calculate the life of the particle (a) in lab frame (b) in frame of the particle

→ (a) life, $t = \frac{d}{v} = \frac{2\text{ cm}}{0.8 \times 3\times10^{10}\text{ cm/s}} = \frac{10^{-10}}{0.4\times 3}$

$\boxed{t \simeq 0.83\times10^{-10}\text{ seconds}}$

→ (b) life, $t_0 = t\sqrt{1-v^2/c^2}$ $\left\{\because t = \frac{t_0}{\sqrt{1-v^2/c^2}}\right\}$

$= 0.83\times10^{-10}\sqrt{1-0.64c^2/c^2}$

$\boxed{t_0 = 0.498\times10^{-10}\text{ seconds}}$.

Practice Problem :

Q.3 At time 't', a particular clock

P.T.O →

...ctice Problem :

Q.3 At time 't', a particular clock 'A' fixed on the x-axis of the frame 'S' agrees with clock 'B' fixed on the x'-axis of S' frame, and opposite to 'A'.

(a) find the x-coordinate of these clocks as seen by S.

(b) What does the clock 'C' fixed in S', opposite to the origin of S, read at this instant 't', as observed in 'S'?

(c) Show that rear clock 'C' leads the front clock by $\frac{Lv}{c^2}$ where 'L' is the rest seperation between the clocks.

Q.4 A person standing on a platform finds that a train moving with velocity $v = 0.5c$ takes 1.5 seconds to pass by him. Find:

(a) The length of the train as seen by the person.

(b) Rest length of the train.