Problem Set 1

Physics 322
Electrodynamics II

Due on Friday, January 26th, 2024

Problem 1

A meter stick is at rest in $\bar{L}$. The $\bar{L}$ frame moves to the right at speed v in L. In L, the measured length of the stick is $12/13$ m, what is v?

Problem 2

A clock moves through a lab L with speed $v = (12/13)c$. It goes from $x = 0$ m to $x = 5$ m. How long did its trip take in the lab? How long did the trip take in the rest frame of the clock?
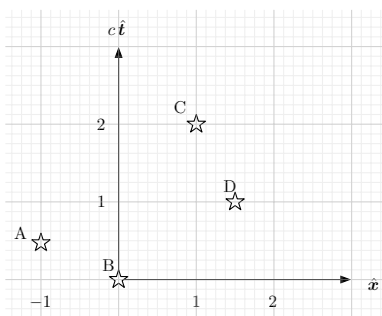
Problem 3

You take off in a rocket, heading away from the earth at a speed of $v = 3/5c$. After a year of traveling, you turn around, and head back to the earth at the same speed. When you return, how much time has passed on earth?

Problem 4

a.   Two events (t_1 at x_1 and t_2 at x_2) are causally related if $-c^2 (t_2 - t_1)^2 + (x_2 - x_1)^2 \leq 0$. Show that if event one causes event two in L (i.e. the two events are causally related with $t_1 < t_2$), then event one causes event two in any $\bar{L}$ (where L and $\bar{L}$ are related as usual) – you are showing that for causally related events, if $t_1 < t_2$ then $\bar{t}_1 < \bar{t}_2$ in any $\bar{L}$.

b.   Which of the points shown below could cause the others (make a list)?

Problem 5

For the boost factor associated with a speed a:

$$\gamma_a \equiv \frac{1}{\sqrt{1 - \frac{a^2}{c^2}}}, \tag{1}$$

show that

$$\gamma_w = \gamma_u \gamma_v \left[1 - \frac{uv}{c^2} \right] \quad \text{with } w \equiv \frac{v - u}{1 - \frac{uv}{c^2}}. \tag{2}$$