

HW # 1**Due Monday, Jan. 26, 2021**

#1) Show that the usual Lorentz Boost follows from the invariance of the interval. Start with an arbitrary linear transformation of the (unprimed frame) coordinates,

$$\begin{pmatrix} t' \\ x' \end{pmatrix} = \begin{pmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{pmatrix} \begin{pmatrix} t \\ x \end{pmatrix}$$

and use the fact that the primed frame moves to the right with speed v as viewed in the unprimed frame.

#2) Using the Lorentz transformation, show that the length of a moving object is given by $\Delta x' = s/\gamma$, where s is the proper length (length of object in its rest frame). Consider the object to be lying along the x-axis, and define the spacetime points by coordinates in the object rest frame $\bar{x}_1 = (0, 0)$ and $\bar{x}_2 = (0, s)$.

#3) The boost angle is defined as $v = \tanh \theta$ where v is the relative velocity of the Lorentz transformation. Show that the product of two boosts in the x direction is another boost in the x direction. Derive the addition of velocities formula.

#4) Griffiths 3.3

#5) Griffiths 3.4

#6) Griffiths 3.15

Check the limit $m_\mu \rightarrow 0$.

Note: I get a different answer with $\tan \theta = p_y^\mu / p_x^\mu$. For some reason, Griffiths has calculated the tangent of $|\vec{p}^\mu| / |\vec{p}^\pi|$.

#7) Griffiths 3.16