Assignment 7

10 1. The length of a 4-vector x_μ is a Lorenty invariant.
i.e. $x_\mu x_\mu = x'_\mu x'_\mu$

a) Use this property to show that $\lambda \lambda^T = 1$
i.e. $\lambda_{\mu\sigma} \lambda_{\mu\rho} = \delta_{\sigma\rho}$

b) Verify by multiplying matrices that $\lambda \lambda^T = 1$.

20 2 a) Show that $(\vec{x}, o)$ is not a 4-vector.

b) Show that $\Box$ is a 4-vector.

c) Show that t is not a Lorenty invariant.

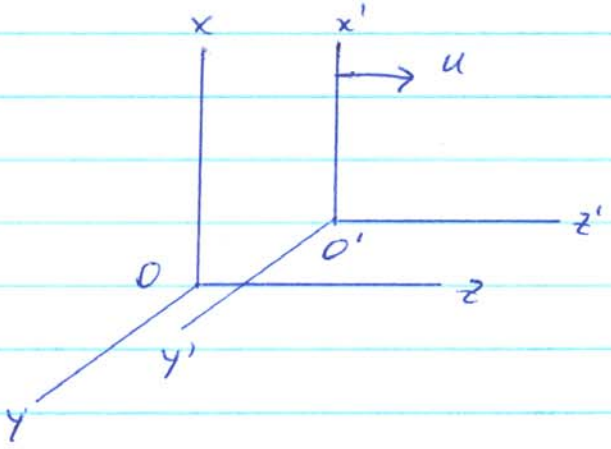
d) Prove $\delta_{\mu\rho}$ is a tensor.

5 3) Show that $\frac{\partial F_{\mu\nu}}{\partial x_\nu} = \frac{4\pi}{c} J_\mu$ is an expression of two of Maxwell's equations.

10 4) a) Prove that the energy momentum tensor $T_{\mu\nu}$ is indeed a tensor.

b) Evaluate T_{11}, T_{41}, T_{44} using the definition.

30 5) A particle is at rest in frame S'.
It is seen to have a speed u in frame S.



Observer O' sees: electric field $\vec{E}'$
magnetic field $\vec{B}'$
particle charge density ρ_0.

Observer O sees: electric field $\vec{E}$
magnetic field $\vec{B}$
particle charge density ρ

a) Write down the Lorenty force density K'.

b) Find K by applying a Lorenty transformation to K'.

c) What are the relations between $\vec{E}'$, $\vec{B}'$ and $\vec{E}$, $\vec{B}$?

d) How is ρ related to ρ_0?

e) Derive the expression for the Lorenty force density.
i.e. Show $\vec{K} = \rho(\vec{E} + \vec{B} \times \vec{B})$.

Tot = 75