Assignment in Relativistic Electrodynamics

1. Using the Lorentz transformations of E and B, determine the transformations of ρ and J using Maxwell's equations.

2. Using the linear transformations $t \to at - bx$, $x \to cx - dt$, $y \to y$, $z \to z$, show that a, b, c, d that leave Maxwell's equations invariant can only be the Lorentz transformations.

3. Write down the components of the 4-d force dp^i/ds in terms of the 3-d force $\vec{f}$ and the velocity of the particle.

4. A and B are at rest in a given frame S at time t. If B accelerates uniformly in x direction in its own reference frame, what is its motion $x(t)$ as observed by A ?

5. Show that the term $\int A_i J^i d\Omega$ in the action is Gauge invariant under $A_i \to A_i + \partial_i f$ where f is any scalar function.

6. Determine the force between two charges moving with the same velocity $\vec{v}$.

7. Find the motion of a particle in uniform electric and magnetic fields that are parallel to each other.