Electrodynamics III: Assignment 4.
Not graded.

1. Show that Jackson's expressions 11.152 for the electric fields of a static charge q evaluated in another inertial frame can be written as

$$\mathbf{E}(r,t) = q\frac{1}{\gamma^2(1-\beta^2\sin^2\theta)^{3/2}}\frac{\hat{r}}{r^2}$$

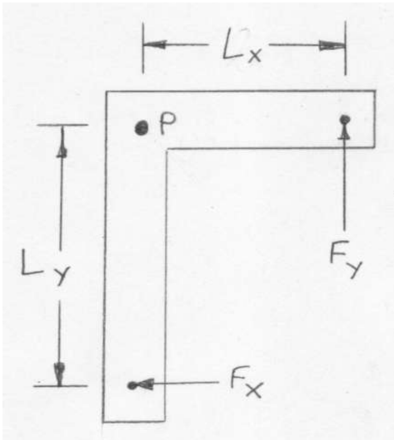
where r is the displacement vector pointing from the "present" position of the charge to the field point, and θ is the angle between the velocity axis and the field point at the present position of the charge.

2. Show that Jackson's expressions 11.152 for the electric fields of a static charge q evaluated in another inertial frame can be written as

$$\mathbf{E}(r,t) = q\frac{r}{(\mathbf{r}\cdot\mathbf{u})^3}(c^2-v^2)\mathbf{u}$$

where r is the displacement vector pointing from the retarded position of the charge to the field point, and $\mathbf{u} = c\hat{r} - \mathbf{v}$.

2. The Minkowski right-angle lever consists of two rigid arms allowed to pivot in the x-y plane about the point *P*. External forces F_x and F_y are applied and in this rest-frame the lever is at rest in rotational and longitudinal equilibrium (see the figure below). Now suppose this system is viewed by an observer moving in the *x*-direction at speed *v*.
a. What's the torque according to the moving observer?
b. Explain the principle that forbids the system from undergoing rotation in one inertial frame and not undergoing rotation in another inertial frame.
c. Explain how you can reconcile the result of part a and part b.



4. You should look at the simple reductions of relativistic kinematics to Newtonian kinematics at the low-velocity limit. For instance, you should be able to quickly show that the total energy mc^2 reduces to the rest-mass energy (as the potential) plus the Newtonian kinetic energy.