1. Provide the detail for the steps between (9.53) and (9.57).

2. Jackson 9.1

3. Two Lorentz transformations are carried out in succession: $v_1$ along the $x$-axis and $v_2$ along the $y$ axis. Show the resulting transformation cannot be put in the form of a single Lorentz transformation. Show it can be written terms of a transformation plus a rotation.

4. Given an initial $\Phi_1$ and $\vec{A}_1$ a gauge transformation corresponds to

$$\Phi_2 = \Phi_1 + \frac{\partial \chi}{\partial t}$$

and

$$\vec{A}_2 = \vec{A}_2 - \vec{\nabla} \chi$$

The new function $\chi$ is required to satisfy

$$\Box \chi = 0$$

Show the following:
(a) The Lorentz condition is unchanged
(b) The new potentials satisfy the same inhomogeneous wave equation as did the originals
(c) The fields $\vec{E}$ and $\vec{B}$ are unchanged.
(d) Write all this in four vector form.

5. Because the quadrupole contraction of a fourth-rank pseudo-tensor and two second-rank tensors

$$\epsilon_{\alpha\beta\gamma\delta} F^{\alpha\beta} F^{\gamma\delta}$$

is clearly a pseudo-scaler, evaluate it.


7. Expand the scaler expression

$$-\frac{1}{4} F_{\alpha\beta} j^{\alpha\beta} + j_\alpha A^\alpha$$

in terms of fields and potentials. What does this correspond to?

8. Jackson 11.10

9. Jackson 11.11