PHYS 5180: Homework 1 (due Thurs Jan. 22)

1. The Levi-Civita tensor $\varepsilon^{\mu\nu\alpha\beta}$ is defined as being antisymmetric under permutation of any two indices (e.g., $\varepsilon^{\mu\nu\alpha\beta} = -\varepsilon^{\mu\alpha\nu\beta}$) and $\varepsilon^{0123} = +1$.

- What is ε_{0123}?

- Show that $\varepsilon^{\mu\nu\alpha\beta}$ is invariant under Lorentz transformations. (You may consider only rotations and boosts about the $\hat{z}$ axis using the explicit form for $\Lambda^{\mu}{}_{\nu}$ given in class.)

2. Consider a four-dimensional spacetime integral $\int d^4x \, f(x)$. Show that the integration measure d^4x is invariant under a Lorentz transformation $x^{\mu} \to x'^{\mu} = \Lambda^{\mu}{}_{\nu}x^{\nu}$.

3. Peskin & Schroeder (PS) problem 2.1.

4. PS problem 2.2.