

203a Homework 1, due Jan. 25

1. Jackson 11.3
2. Jackson 11.4.
3. Jackson 11.5
4. Jackson 11.6.
5. Show $\partial(t', x', y', z')/\partial(t, x, y, z) = 1$ for a general Lorentz transformation. Hint: decompose the general transformation into a product of boosts and rotations.
6. Show that δ_{ν}^{μ} transforms as a tensor, with the same components in every frame.
7. Let $A^{\mu}(x)$ transform as a vector, which we call a vector field because it depends on position. Verify that $\partial_{\mu}A^{\mu}$ transforms as a scalar and $\partial^{\nu}A^{\mu}$ transforms as a tensor. Note that these statements require that the transformations, for example $\frac{\partial x^{\mu'}}{\partial x^{\mu}}$, be spacetime constants. (In general relativity we allow for non-constant such transformations, and correspondingly have to extend ordinary derivatives to covariant ones, involving the affine connection. This will not be considered at all in this class.)