PHYSICS 225A
HOMEWORK 2

Prof: Kim Griest
DUE: Tuesday April 24 , 2012

Do the following problems from Shutz Chapter 3: 3,7,9,10,24,30

1. Let $F^{\alpha\beta}$ be an antisymmetric tensor. Show that

$$F_{\mu}{}^{\alpha}{}_{,\nu} F^{\nu}{}_{\alpha} = -F_{\mu\alpha,\beta} F^{\alpha\beta}$$

2. Is the determinant of the metric tensor, $g \equiv \det(g_{\mu\nu})$ a scalar, i.e. is it the same in all frames? Check for both the ordinary Lorentz transformation, and the more general coordinate transformation we discussed:

$$\Lambda^{\beta}_{\bar{\alpha}} = \frac{\partial x^{\beta}}{\partial x^{\bar{\alpha}}}.$$

3. A two indexed "object" $X^{\mu\nu}$ is defined as the "direct sum" of two vectors: $X^{\mu\nu} = A^{\mu} + B^{\nu}$. Is $X^{\mu\nu}$ a tensor? Is there a transformation law to take X from coordinate frame $\mathcal{O}$ to a new coordinate frame $\bar{\mathcal{O}}$? i.e. obtain $X^{\bar{\mu}\bar{\nu}}$?