TAM 611 Homework Set 4 2/11/09

1. Consider spherical coordinates as on p. 47 of the class notes.

(a) Calculate the fields g_{ij} and g^{ij}.

(b) Verify with the change of coordinates formulas (cf. pp. 13 and 50) that at a given point ($\underset{\sim}{r} \neq \underset{\sim}{0}$) we have

$$\bar{g}_{ij} = \bar{g}^{ij} = \delta_{ij},$$

where $\bar{\underset{\sim}{g}}_i = \underset{\sim}{e}_i$, $i = 1, 2, 3$.

2. Show that $Sym(\mathbb{E}^3) = \{ \underset{\sim}{A} \in L(\mathbb{E}^3) : \underset{\sim}{A}^T = \underset{\sim}{A} \}$ is a 6-dimensional subspace of $L(\mathbb{E}^3)$.

(A subset of a vector space is a subspace if all sums and scalar multiples of all elements in the subset also belong to the subset. The dimension of a vector space is the number of vectors in a basis.)

3. Find the set of singular points for spherical coordinates, i.e., those points where 1-1 correspondence breaks down.