Problem set 8
Due April 22

Problem 1) Do problem 1 from Problems in Classical Electrodynamics.

Problem 2) Do problem 3 from Problems in Classical Electrodynamics.

Problem 3) Do problem 1 from Problems in Relativistic Electrodynamics.

Problem 4) Do problem 3 from Problems in Relativistic Electrodynamics.

Problem 5) Given vector fields $X$ and $Y$ and functions $f$ and $h$, prove that

$$[fX, hY] = fX(h)Y - hY(f)X + fh[X, Y].$$

Problem 6) Prove that the Riemann curvature tensor is indeed a tensor. That is, given vector fields $X$, $Y$, and $Z$ and a function $f$, prove that

a) $R(fX, Y)Z = fR(X, Y)Z$

b) $R(X, fY)Z = fR(X, Y)Z$

c) $R(X, Y)fZ = fR(X, Y)Z$

Problem 7) Let $g = dr \otimes dr + \varphi^2 d\theta \otimes d\theta$ be the metric on the sphere, where $\varphi = \varphi(r)$ is the function computed in the previous homework. Using results from that homework,

a) Compute $R\left(\frac{\partial}{\partial r}, \frac{\partial}{\partial r}\right) \frac{\partial}{\partial r}$.

b) Compute the sectional curvature $\sec \left(\frac{\partial}{\partial r}, \frac{\partial}{\partial r}\right)$. 