Physics 7311 Professor Scalise
Homework Assignment #2

5. (a) Prove that the dipole moment of an electrically **neutral** system is independent of the coordinate origin.

   (b) Prove that if the multipole moment tensors of a system vanish for orders $0, 1, 2, \ldots, n-1$, then the multipole moment tensor of order n (the 2^n-pole moment tensor) is independent of the coordinate origin.

6. Show that $\dfrac{\partial^2}{\partial x_i \partial x_j}\left(\dfrac{1}{r}\right) = \dfrac{1}{r^5}(3x_i x_j - r^2\delta_{ij})$.

7. Verify that $\nabla^2\left(\dfrac{1}{|\vec{r} - \vec{r}\,'|}\right) = 0$ for $\vec{r} \neq \vec{r}\,'$ by direct calculation in Cartesian coordinates. (Hint: Use problem #6.)