5. (a) Prove that the dipole moment of an electrically **<u>neutral</u>** 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.)

Bonus:(5 points)

A right circular conical surface (an empty ice cream cone) carries a uniform surface charge density σ. The height of the cone is a, as is the radius of the circular opening at the base. Letting the potential at infinity be zero, find the potential

1. at the apex (A) of the cone.

2. at the point (C) in the center of the circular opening of the cone.