Homework #2 (10 points) - Show all work on the following problems:

Problem 1 (2 points): Evaluate the following volume integrals.

a. $\iiint (r^2 + \vec{r} \cdot \vec{a} + a^2)\delta^3(\vec{r} - \vec{a})dV$ over all space ($\vec{a}$ is a fixed vector of magnitude a)

b. $\iiint (r^4 + r^2\vec{r} \cdot \vec{c} + c^4)\delta^3(\vec{r} - \vec{c})dV$ over a spherical volume with radius 6 centered at the origin, for the vector $\vec{c} = 5\hat{x} + 3\hat{y} + 2\hat{z}$.

Problem 2 (3 points): Take the vector functions $\overrightarrow{F_1} = x^2\hat{z}$ and $\overrightarrow{F_2} = x\hat{x} + y\hat{y} + z\hat{z}$.

a. Calculate the divergence and curl of each one of these functions.

b. Which one can be written as the gradient of a scalar function? For this one, find a scalar function that has the right gradient.

c. Which one can be written as the curl of a vector function? For this one, find a vector function that has the right curl.

Problem 3 (3 points): Find the vector electric field a distance z above the center of a circular loop of radius R that carries a uniform line charge density λ.

Problem 4 (2 points): Find the vector electric field a distance z above the center of a flat circular disk of radius R that carries a uniform surface charge density σ.