**Homework #2 (100 points) - Show all work on the following problems:**
*(Grading rubric: Solid attempt = 50% credit, Correct approach but errors = 75% credit, Correct original solution = 100% credit, Copy of online solutions = 0% credit)*

**Problem 1 (20 points):** Check the divergence theorem $\iiint \left(\nabla \cdot \vec{A}\right) \mathrm{dV} = \oiint \vec{A} \cdot \overrightarrow{da}$ for the function $\vec{A}(r, \theta, \phi) = r^2 \hat{r}$, using as your volume a sphere of radius R centered at the origin.

**Problem 2 (20 points):** Evaluate the following volume integrals.

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

b. $\iiint (r^4 + r^2\vec{r} \cdot \vec{c} + c^4)\delta^3(\vec{r} - \vec{c})d\tau$ 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 3 (20 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 an example of 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 an example of a vector function that has the right curl.

**Problem 4 (20 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 5 (20 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.