1. **Find the electric field a distance z above the center of a flat circular disc of radius a which carries a uniform surface charge density σ. Work out the limits $z << a$ and $z >> a$.**

2. **If $\vec{\mathbf{E}} = kr^3\hat{\mathbf{r}}$ in a region find the charge density in the region.**

3. **A hollow spherical shell carries a charge density $\rho = k/r^2$ in the region $a \le r \le b$. Find the electric field in the three regions , $r < a, \quad a < r < b, \quad r > b$.**

4. **Two infinite parallel planes carry equal but opposite uniform charge densities $\pm\sigma$. Find the electric field in the three regions, into which the planes partition the space.**

5. **Evaluate**
   (a) $\int (r^2 + \vec{\mathbf{r}} \cdot \vec{\mathbf{a}} + a^2)\delta^3(\vec{\mathbf{r}} - \vec{\mathbf{a}})dV$ **over the whole space where $\vec{\mathbf{a}}$ is a fixed vector.**

   (b) $\int_V |\vec{\mathbf{r}} - \vec{\mathbf{b}}|^2\delta^3(5\vec{\mathbf{r}})dV$ **over a cube of side 2, centered at the origin, and $\vec{\mathbf{b}} = 4\hat{\mathbf{y}} + 3\hat{\mathbf{z}}$**

6. **We have seen that $\vec{\nabla} \cdot \left(\frac{\hat{r}}{r^2}\right) = 4\pi\delta^3(\vec{r})$. In a similar manner justify that**
$$\vec{\nabla} \cdot \left(\frac{\hat{s}}{s}\right) = 2\pi\delta^2(\vec{s})$$
   Here s is the distance from the z axis in cylindrical coordinates and $\delta^2(\vec{s})$ is a two dimensional delta function on the xy plane.

7. **Prove that $\delta(r) = 4\pi r^2\delta^3(\vec{r})$ and $\delta(s) = 2\pi s\delta^2(\vec{s})$.**
   Here $\int_0^\epsilon \delta(r)dr = 1$ for any $\epsilon > 0$. The integral is 0 otherwise. $\delta(s)$ is defined likewise.

8. The electric field in a region is given as

$$\vec{E} = \frac{\lambda}{2\pi\epsilon_0 s}\hat{s}$$

Find the charge densities in the region.