1. **Starting from the defination of a Coulomb of charge in the M.K.S system and an e.s.u of charge in the C.G.S system determine how much e.s.u of charge make one coulomb of charge.**

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** $a \leq r \leq b$**. 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. **The electric field in a region is cylindrically symmetric, given as follows:**

$$\begin{aligned} \vec{\mathbf{E}}(\vec{\mathbf{r}}) &= \frac{c\hat{\mathbf{s}}}{s}; \quad \textbf{when} \quad s \geq a \\ &= 0; \quad \textbf{when} \quad s < a \end{aligned}$$

   Find the charge distribution in the region using Gauss' law.

6. **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** $\vec{\mathbf{b}} = 4\hat{\mathbf{y}} + 3\hat{\mathbf{z}}$

7. **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.**

8. **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.**

9. **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.