GAUSS'S LAW

Each group will be given one of the charge distributions given below: (α and k are constants with appropriate dimensions.)

1. A positively charged (dielectric) spherical shell of inner radius a and outer radius b with a spherically symmetric internal charge density $\rho(\vec{r}) = \alpha\, r^3$.

2. A positively charged (dielectric) spherical shell of inner radius a and outer radius b with a spherically symmetric internal charge density $\rho(\vec{r}) = \alpha\, e^{(kr)^3}$.

3. A positively charged (dielectric) spherical shell of inner radius a and outer radius b with a spherically symmetric internal charge density $\rho(\vec{r}) = \alpha\, \frac{1}{r^2}\, e^{kr}$.

4. An infinite positively charged (dielectric) cylindrical shell of inner radius a and outer radius b with a cylindrically symmetric internal charge density $\rho(\vec{r}) = \alpha\, r^3$.

5. An infinite positively charged (dielectric) cylindrical shell of inner radius a and outer radius b with a cylindrically symmetric internal charge density $\rho(\vec{r}) = \alpha\, e^{(kr)^2}$.

6. An infinite positively charged (dielectric) cylindrical shell of inner radius a and outer radius b with a cylindrically symmetric internal charge density $\rho(\vec{r}) = \alpha\, \frac{1}{r}\, e^{kr}$.

For your group's case, answer each of the following questions:

1. Use Gauss's Law and symmetry arguments to find the electric field at each of the three radii below:
   - (i) $r_1 > b$
   - (ii) $a < r_2 < b$
   - (iii) $r_3 < a$

2. What dimensions do α and k have?

3. For $\alpha = 1$, $k = 1$, sketch the magnitude of the electric field as a function of r.