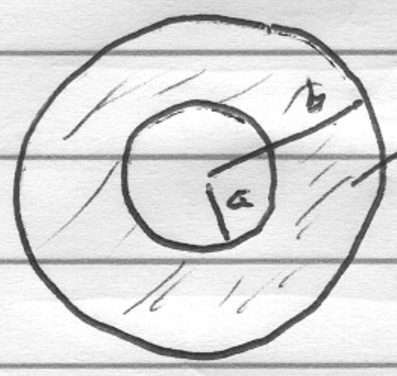
5. W. 4-6



ρ_{ch} uniform.

$\underline{r<a}$

$\Phi = q_{in}/\varepsilon_0$

$E(4\pi r^2) = q_{in}/\varepsilon_0 = 0$

so $E = 0$

$\underline{a<r<b}$

(Volume enclosed by sphere of radius r) - (volume empty for r<a)

$= V_{charge} = \frac{4\pi}{3}(r^3 - a^3)$

$q_{in} = \rho_{ch} V_{charge} = \frac{4\pi\rho_{ch}}{3}(r^3 - a^3)$

Now

$E(4\pi r^2) = \frac{1}{\varepsilon_0}\frac{4\pi}{3}\rho_{ch}(r^3 - a^3)$

$\underline{E = \frac{\rho_{ch}}{3\varepsilon_0}\left(r - \frac{a^3}{r^2}\right)}$

$a \to 0 \quad E = \frac{\rho_{ch} r}{3\varepsilon_0}$ ✓

$\underline{r>b}$ $\quad V_{charge} = \frac{4\pi}{3}(b^3 - a^3)$

$E(4\pi r^2) = \frac{4\pi}{3}\rho_{ch}\frac{1}{\varepsilon_0}(b^3 - a^3)$

$\underline{E = \frac{\rho_{ch}(b^3 - a^3)}{3\varepsilon_0}\frac{1}{r^2}}$ $\quad a \to 0 \quad E = \frac{\rho_{ch} b^3}{3\varepsilon_0}\frac{1}{r^2}$ ✓

Since $Q = \frac{4\pi}{3}(b^3 - a^3)\rho_{ch}$.

for $\underline{r>b}$ $\quad E = \frac{Q}{4\pi\varepsilon_0}\frac{1}{r^2}$ Point charge!

for $\underline{a<r<b}$ $\quad E = \frac{3Q}{4\pi(b^3 - a^3)}\frac{1}{3\varepsilon_0}\left(r - \frac{a^3}{r^2}\right)$

$E = \frac{Q(r^3 - a^3)}{4\pi\varepsilon_0(b^3 - a^3)}\frac{1}{r^2}$