41. (a) We integrate the volume charge density over the volume and require the result be equal to the total charge:

$$\int dx \int dy \int dz\, \rho = 4\pi \int_0^R dr\, r^2\, \rho = Q\ .$$

Substituting the expression $\rho = \rho_s r/R$ and performing the integration leads to

$$4\pi \left(\frac{\rho_s}{R}\right)\left(\frac{R^4}{4}\right) = Q \quad \Longrightarrow \quad Q = \pi\rho_s R^3\ .$$

(b) At a certain point within the sphere, at some distance r_o from the center, the field (see Eq. 24-8 through Eq. 24-10) is given by Gauss' law:

$$E = \frac{1}{4\pi\varepsilon_0}\frac{q_\mathrm{enc}}{r_\mathrm{o}^2}$$

where q_enc is given by an integral similar to that worked in part (a):

$$q_\mathrm{enc} = 4\pi \int_0^{r_\mathrm{o}} dr\, r^2\, \rho = 4\pi\left(\frac{\rho_s}{R}\right)\left(\frac{r_\mathrm{o}^4}{4}\right)\ .$$

Therefore,

$$E = \frac{1}{4\pi\varepsilon_0}\frac{\pi\rho_s r_\mathrm{o}^4}{R\, r_\mathrm{o}^2}$$

which (using the relation between ρ_s and Q derived in part (a)) becomes

$$E = \frac{1}{4\pi\varepsilon_0}\frac{\pi\left(\frac{Q}{\pi R^3}\right) r_\mathrm{o}^2}{R}$$

and simplifies to the desired result (shown in the problem statement) if we change notation $r_\mathrm{o} \to r$.