45. (a) According to Eq. 26-17 the capacitance of an air-filled spherical capacitor is given by

$$C_0 = 4\pi\varepsilon_0 \frac{ab}{b-a} \ .$$

When the dielectric is inserted between the plates the capacitance is greater by a factor of the dielectric constant κ. Consequently, the new capacitance is

$$C = 4\pi\kappa\varepsilon_0 \frac{ab}{b-a} \ .$$

(b) The charge on the positive plate is

$$q = CV = 4\pi\kappa\varepsilon_0 \frac{ab}{b-a} V \ .$$

(c) Let the charge on the inner conductor to be $-q$. Immediately adjacent to it is the induced charge q'. Since the electric field is less by a factor $1/\kappa$ than the field when no dielectric is present, then $-q + q' = -q/\kappa$. Thus,

$$q' = \frac{\kappa - 1}{\kappa} q = 4\pi(\kappa - 1)\varepsilon_0 \frac{ab}{b-a} V \ .$$