

45. (a) Since $r_1 = 10.0 \text{ cm} < r = 12.0 \text{ cm} < r_2 = 15.0 \text{ cm}$,

$$E(r) = \frac{1}{4\pi\epsilon_0} \frac{q_1}{r^2} = \frac{(8.99 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2)(4.00 \times 10^{-8} \text{ C})}{(0.120 \text{ m})^2} = 2.50 \times 10^4 \text{ N/C}.$$

(b) Since $r_1 < r_2 < r = 20.0 \text{ cm}$,

$$E(r) = \frac{1}{4\pi\epsilon_0} \frac{q_1 + q_2}{r^2} = \frac{(8.99 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2)(4.00 + 2.00)(1 \times 10^{-8} \text{ C})}{(0.200 \text{ m})^2} = 1.35 \times 10^4 \text{ N/C}.$$