

34. (a) Since \vec{E} points down and we need an upward electric force (to cancel the downward pull of gravity), then we require the charge of the sphere to be negative. The magnitude of the charge is found by working with the absolute value of Eq. 23-28:

$$|q| = \frac{F}{E} = \frac{mg}{E} = \frac{4.4 \text{ N}}{150 \text{ N/C}} = 0.029 \text{ C} .$$

- (b) The feasibility of this experiment may be studied by using Eq. 23-3 (using k for $1/4\pi\epsilon_0$).

$$E = k \frac{|q|}{r^2} \quad \text{where} \quad \rho_{\text{sulfur}} \left(\frac{4}{3} \pi r^3 \right) = m_{\text{sphere}}$$

Since the mass of the sphere is $4.4/9.8 \approx 0.45 \text{ kg}$ and the density of sulfur is about $2.1 \times 10^3 \text{ kg/m}^3$ (see Appendix F), then we obtain

$$r = \left(\frac{3m_{\text{sphere}}}{4\pi\rho_{\text{sulfur}}} \right)^{1/3} = 0.037 \text{ m} \implies E = k \frac{|q|}{r^2} \approx 2 \times 10^{11} \text{ N/C}$$

which is much too large a field to maintain in air (see problem #32).