25-P4, 26-E16, 26-P2, 25-P7*

25-P4 Two Similar tiny balls of mass m are hung from silk threads of length L and carry equal charges q as in Fig. 14. Assume that θ is so small that $\tan\theta$ can be replaced by its approximate equal, $\sin\theta$.

(a) To this approximation show that, for equilibrium,

$$x = \left(\frac{q^2 L}{2\pi\epsilon_0 mg} \right)^{1/3},$$

where x is the separation between the balls.

(b) If $L = 122\,\text{cm}$, $m = 11.2\,\text{g}$, and $x = 4.70\,\text{cm}$, what is the value of q?
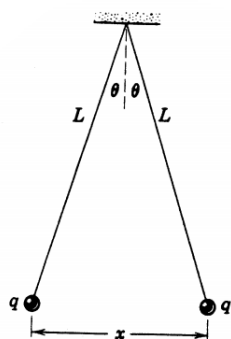

Figure 14 Problems 16, 17, and 18.

26-E16 A thin glass rod is bent into a semicircular of radius r. A charge $+q$ is uniformly distributed along the upper half and a charge $-q$ is uniformly distributed along the lower half, as shown in Fig. 26-28. Find the electric field $\vec{\mathbf{E}}$ at P, the center of the semicircle.
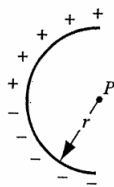

FIGURE 26-28. Exercise 16.

26-P2   Show that the components of $\vec{\mathbf{E}}$ due to a dipole are given, at distant points, by

$$E_x = \frac{1}{4\pi\epsilon_0}\frac{3pxz}{(x^2+z^2)^{5/2}}, \qquad E_z = \frac{1}{4\pi\epsilon_0}\frac{p(2z^2-x^2)}{(x^2+z^2)^{5/2}},$$

where x and z are coordinates of point P in Fig. 26-37. Show that this general result includes the special results of Eq. 26-12 and Problem 1.
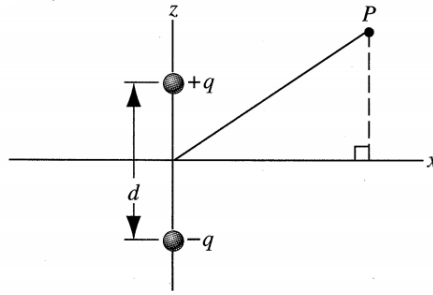

FIGURE 26-37. Problem 2.

25-P7* A certain charge Q is to be divided into two parts, $Q - q$ and q. What is the relation of Q to q if two parts, placed a given distance apart, are to have a maximum Coulomb repulsion.

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