7 Electric charge

$$\vec{F} = k\frac{q_1 q_2}{r^2}\hat{r} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}\hat{r} \qquad \vec{F} = Q\vec{E} \qquad \vec{E} = \frac{kQ}{r^2}\hat{r}$$

27-7 Three charged particles lie on a straight line and are separated by a distance d as shown in Fig. 12. Charges q_1 and q_2 are held fixed. Charge q_3, which is free to move, is found to be in equilibrium under the action of the electric forces. Find q_1 in terms of q_2.

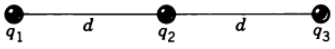

Figure 12 Problem 7.

27-14 A charge Q is fixed at each of two opposite comers of a square. A charge q is placed at each of the other two comers. *(a)* If the resultant electrical force on Q is zero, how are Q and q related? *(b)* Could q be chosen to make the resultant electrical force on every charge zero? Explain your answer.

27-22 Two positive charges $+Q$ are held fixed a distance d apart. A particle of negative charge $-q$ and mass m is placed midway between them and then given a small displacement perpendicular to the line joining them and released. Show that the particle describes simple harmonic motion of period $(\epsilon_0 m\pi^3 d^3/qQ)^{1/2}$.

28-8 Find the electric field at the center of the square of Fig. 21.

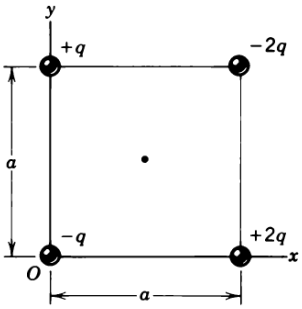

Figure 21 Problem 8.

28-9 A clock face has negative point charges $-q, -2q, -3q, \ldots, -12q$ fixed at the positions of the corresponding numerals. (The clock hands do not perturb the field.) At what time does the hour hand point in the same direction as the electric field at the center of the dial?

28-22 Charges $+q$ and $-2q$ are fixed a distance d apart as in Fig. 29. Find $\vec{E}$ at points A, B, and C.

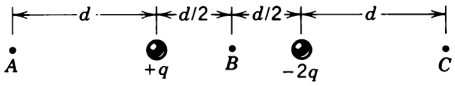

Figure 29 Problem 22.

28-44 A uniform vertical field $\vec{E}$ is established in the space between two large parallel plates. A small conducting sphere of mass m is suspended in the field from a string of length L. Find the period of this pendulum when the sphere is given a charge if the lower plate *(a)* is charged positively and *(b)* is charged negatively.

28-53 Consider two equal positive point charges $+q$ a distance a apart. *(a)* Derive an expression for dE/dz at the point midway between them, where z is the distance from the midpoint along the line joining the charges. *(b)* Show that the force on a small dipole placed at this point, its axis along the line joining the charges, is given by $F = p(dE/dz)$ where p is the dipole moment.