Chapter 5 Review Questions

Solutions can be found in Chapter 12.

Section I: Multiple Choice

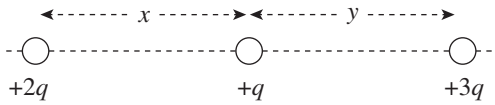
1. If the distance between two positive point charges is tripled, then the strength of the electrostatic repulsion between them will decrease by a factor of

   (A) 3
   (B) 6
   (C) 8
   (D) 9

2. Two 1 kg spheres each carry a charge of magnitude 1 C. How does F_E, the strength of the electric force between the spheres, compare to F_G, the strength of their gravitational attraction?

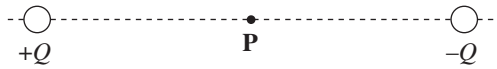
   (A) $F_E < F_G$
   (B) $F_E = F_G$
   (C) $F_E > F_G$
   (D) If the charges on the spheres are of the same sign, then $F_E > F_G$; but if the charges on the spheres are of the opposite sign, then $F_E < F_G$.

3. The figure below shows three point charges, all positive. If the net electric force on the center charge is zero, what is the value of y/x ?



   (A) $\frac{4}{9}$
   (B) $\sqrt{\frac{2}{3}}$
   (C) $\sqrt{\frac{3}{2}}$
   (D) $\frac{3}{2}$

4.



   The figure above shows two point charges, $+Q$ and $-Q$. If the negative charge were absent, the electric field at Point P due to $+Q$ would have strength E. With $-Q$ in place, what is the strength of the total electric field at P, which lies at the midpoint of the line segment joining the charges?

   (A) 0
   (B) $\frac{E}{2}$
   (C) E
   (D) $2E$

5. A sphere of charge $+Q$ is fixed in position. A smaller sphere of charge $+q$ is placed near the larger sphere and released from rest. The small sphere will move away from the large sphere with

   (A) decreasing velocity and decreasing acceleration
   (B) decreasing velocity and increasing acceleration
   (C) increasing velocity and decreasing acceleration
   (D) increasing velocity and increasing acceleration

6. An object of charge $+q$ feels an electric force $\mathbf{F}_E$ when placed at a particular location in an electric field, **E**. Therefore, if an object of charge $-2q$ were placed at the same location where the first charge was, it would feel an electric force of

   (A) $\frac{-\mathbf{F}_E}{2}$

   (B) $-2\mathbf{F}_E$

   (C) $-2q\mathbf{F}_E$

   (D) $\frac{-2\mathbf{F}_E}{q}$

7. A charge of $-3Q$ is transferred to a solid metal sphere of radius r. How will this excess charge be distributed?

   (A) $-Q$ at the center, and $-2Q$ on the outer surface

   (B) $-3Q$ at the center

   (C) $-3Q$ on the outer surface

   (D) $-Q$ at the center, $-Q$ in a ring of radius $\frac{1}{2}r$, and $-Q$ on the outer surface

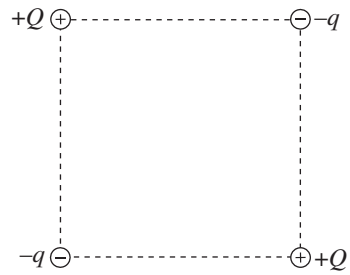
Section II: Free Response

1. In the figure shown, all four charges ($+Q$, $+Q$, $-q$, and $-q$) are situated at the corners of a square. The net electric force on each charge $+Q$ is zero.

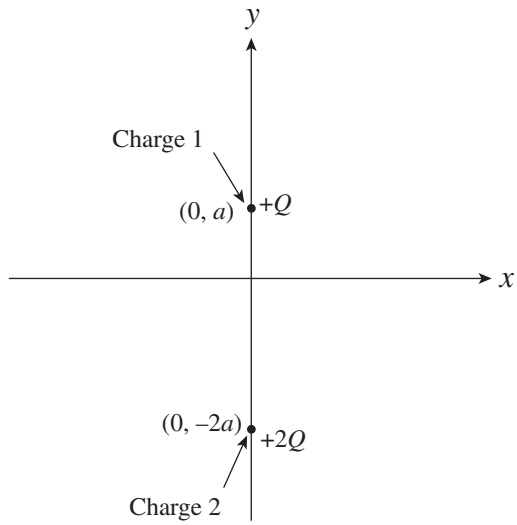
   (a) Express the magnitude of q in terms of Q.

   (b) Is the net electric force on each charge $-q$ also equal to zero? Justify your answer.

   (c) Determine the electric field at the center of the square.



2. Two charges, $+Q$ and $+2Q$, are fixed in place along the y-axis of an x-y coordinate system as shown in the figure below. Charge 1 is at the point $(0, a)$, and Charge 2 is at the point $(0, -2a)$.



(a) Find the electric force (magnitude and direction) felt by Charge 1 due to Charge 2.

(b) Find the electric field (magnitude and direction) at the origin created by both Charges 1 and 2.

(c) Is there a point on the x-axis where the total electric field is zero? If so, where? If not, explain briefly.

(d) Is there a point on the y-axis where the total electric field is zero? If so, where? If not, explain briefly.

(e) If a small negative charge, $-q$, of mass m were placed at the origin, determine its initial acceleration (magnitude and direction).