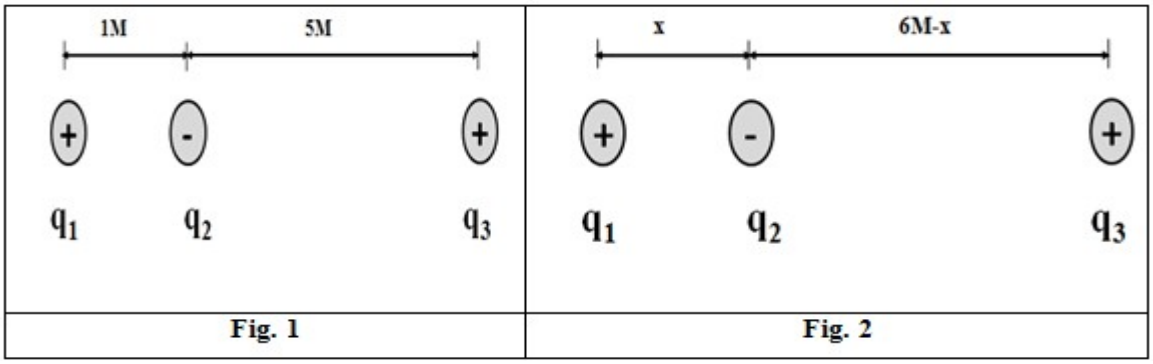
Series 1

Exercise 1:

Consider the three point charges q_1 = +2 μC, q_2 = -5 μC, and q_3 = +8 μC that are shown in Fig. 1.



a- Find the resultant force exerted on the charge q_2 by the two charges q_1 and q_3.

b- In a different layout (see Fig. 2), q_2 experiences a resultant force of zero. Find the position of q_2 and find the magnitude of each force exerted on q_2.

Exercise 2:

Consider a configuration in space of three point charges at the corners of a right triangle. Their charges are $q_1 = q_3 = 5.0$ µC, $q_2 = -2.0$ µC, and a = 0.10 m, as shown in Fig. 3.

a- Find the resultant force vector exerted on q_3.

b- Find the resultant force vector exerted on q_2.

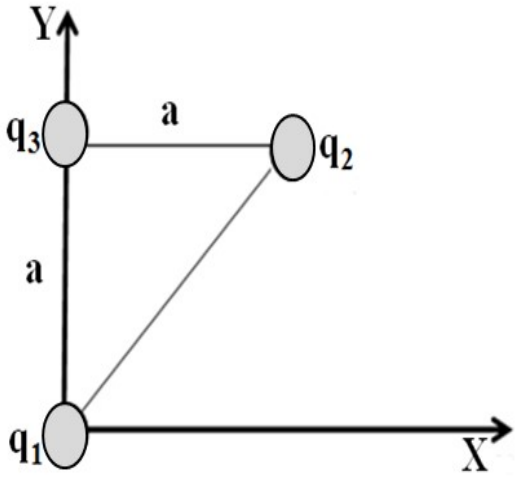


Fig. 3

Exercise 3:

Four point charges $q_1 = q_2 = Q$ and $q_3 = q_4 = -Q$, where $Q = \sqrt{2}\ \mu C$, are placed at the four corners of a square of side $a = 0.4$ m, see Fig. 4.

a- Find the electric field vector at the center P of the square.

b- What is the total electric potential created by these charges at the point P?

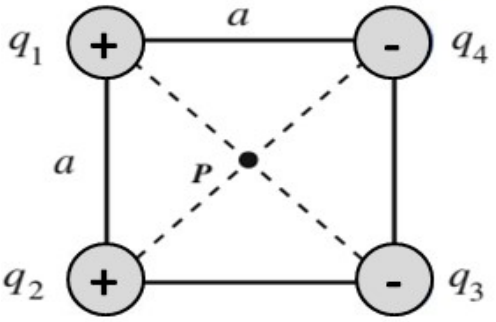


Fig. 4

Exercise 4:

A charge $q_1 = 7.0\ \mu C$ is located at the origin, and a second charge $q_2 = -5.0\ \mu C$ is located on the x-axis, 0.30 m from the origin .

a- What is the electric field at the point P with coordinates (0, 0.40) m?

b- What is the total electric potential created by these charges at the point P?

c- A charge Q3 of 3.0 μC is placed at point P, deduce the force vector acting on this charge.

d- What is the potential energy change of a charge Q_3.

Exercise 5:

A proton and an electron separated by 2×10^{-10} m form an electric dipole. calculate the electric field on the x-axis at a distance 20×10^{-10} m to the right of the dipole's center.

Exercise 6:

Find the electric flux through a sphere of radius r enclosing at its center: (a) a positive charge q, and (b) a negative charge −q.

Exercise 7:

A solid sphere of radius R has a uniform volume charge density ρ and carries a total positive charge Q. Find and sketch the electric field at any distance r away from the sphere's center.

Exercise 8:

A thin spherical shell of radius R has a total positive charge Q distributed uniformly over its surface. Find the electric field inside and outside the shell.