

Problems

Electric Force

- Find the net force on charge q_1 due to the three other charges in figure. Take $q_1 = -5\mu\text{C}$, $q_2 = -8\mu\text{C}$, $q_3 = 15\mu\text{C}$ and $q_4 = -16\mu\text{C}$, $a = 5\text{cm}$. ($2.3\text{ i} - 2.4\text{ j}$)

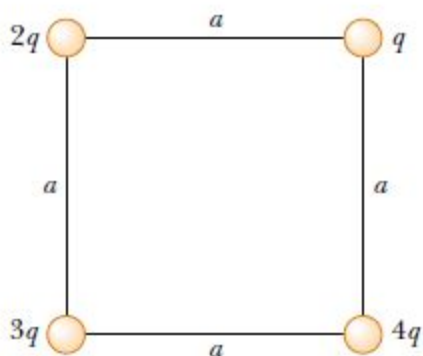


Fig-1

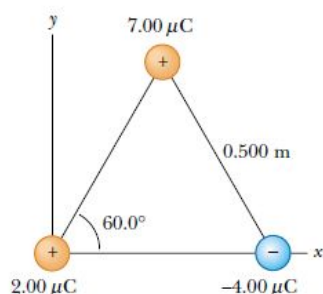


Fig-2

- Three point charges are located at the corners of an equilateral triangle, as shown in Figure -2 . Calculate the net electric force on the $7\mu\text{C}$ charge.
- A point charge $q_1 = -9\mu\text{C}$ is at $x=0$, while $q_2 = 4\mu\text{C}$ is at $x=1\text{ m}$. At what point, besides infinity, would the net force on a positive charge q_3 be zero ? ($d=2\text{m}$)
- The electron and the proton in a hydrogen atom are $0.53 \times 10^{-10}\text{ m}$ apart. Compare the electrostatic and gravitational forces between them. $F_g/F_e = 4.4 \times 10^{-40}$
- At what separation would the force between a proton and an electron be 1 N ? ($1.52 \times 10^{-14}\text{m}$)
- A proton orbits with a speed $v = 294\text{ km/s}$ just outside a charged sphere of radius $r = 1.13\text{cm}$. Find the charged sphere. ($e = 1.9 \times 10^{-19}\text{C}$ and $m = 1.67 \times 10^{-27}$) (1.13×10^{-9})

Electric Field

1. On a clear day there is an electric field of approximately 100N/C directed vertically down at the earth's surface. Compare the electrical and gravitational field on an electron.
2. A point charge $Q_1 = 20 \mu\text{C}$ is at $(-d, 0)$ while $Q_2 = -10 \mu\text{C}$ is at $(+d, 0)$. Find the resultant field strength at a point with coordinates (x, y) . Take $d = 1\text{m}$ and $x=y=2\text{m}$.
3. Consider the electric dipole shown in Figure -3. Show that the electric field at a distant

$$E_x \cong 4k_e qa / x^3.$$

point along the x axis is :

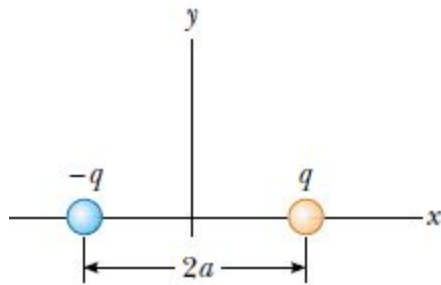
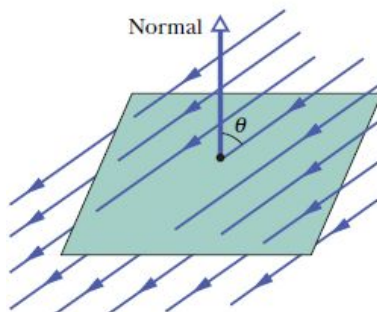


Fig-3

4. What is the electric field strength needed to balanced the weight of the following particles near the Earth's surface : (a) an electron and (b) a proton.
5. What is the magnitude of a point charge that would create an electric field of 1 N/C at a point 1 m away ?
6. Two particles are fixed to an x axis : particle 1 of charge $-2 \times 10^{-7}\text{C}$ at $x=6\text{cm}$ and particle 2 of charge $+2 \times 10^{-7}\text{C}$ at $x = 21\text{cm}$. Mid way between the particles, what is their net electric field in unit-vector notation?

Gauss Law

1. A circular plate has a radius of 12 cm. The plane of the plate is set at a 30° angle to a uniform fields $E = 450\text{N/C}$, as shown in figure. What is the flux through the plate.



2. Two charges $q_1 = 6 \mu\text{C}$ and $q_2 = -8 \mu\text{C}$ are within a spherical surface of radius 5 cm. What is the total flux through the surface?
3. An isolated conductor of arbitrary shape carries a net charge $+10 \mu\text{C}$. Inside the conductor is a hollow cavity within which is a point charge $q = +3 \mu\text{C}$. What is the charge (a) on the cavity wall and (b) on the outer surface of the conductor?
4. A point charge of $1.8 \mu\text{C}$ is at the center of a cubical Gaussian surface 55cm on edge. What is the net flux through the surface?
5. A uniform charged conducting sphere of 1.2 m diameter has a surface charge density of $8.1 \mu\text{C}/\text{m}^2$. (a) Find the net charge on the sphere (b) what is the total electric flux leaving the surface of the sphere?
6. An infinite line of charge produces a field of $4.52 \times 10^4 \text{ N/C}$ at a distance of 1.96m. Calculate the linear charge density.
7. A $60 \mu\text{C}$ charge is at the center of a cube of side 10 cm .(a) what is the total flux through the cube ?(b) What is the flux through the face ? (c) would your answers to (a) or (b) change if the charge were not at the center?
8. A spherical conductor of radius 8cm has a uniform surface charge density $0.1 \text{ nC}/\text{m}^2$. Find the electric field (a) at the surface (b) at a distance 10 cm from the center.