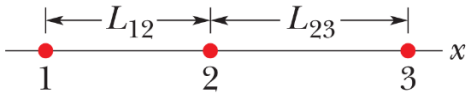
CHAPTER 21 | Coulombs' Law

1 | The charges of an electron and a positron are $-e$ and $+e$. The mass of each is $9.11 \times 10^{-31}\ kg$. What is the ratio of the electrical force to the gravitational force between an electron and a positron? $(Ans: 4.16 \times 10^{42})$

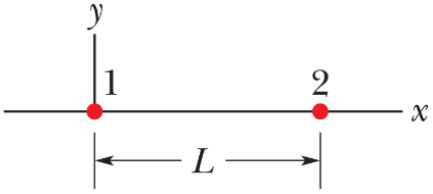
2 | A neutron consists of one "up" quark of charge $+2e/3$ and two "down" quarks each having charge $-e/3$. If we assume that the down quarks are $2.6 \times 10^{-15}\ m$ apart inside the neutron, what is the magnitude of the electrostatic force between them? $(Ans: 3.8\ N)$

3 | In the figure, three charged particles lie on an x -axis. Particles 1 and 2 are fixed in place. Particle 3 is free to move, but the net electrostatic force on it from particles 1 and 2 happens to be zero. If $L_{23} = L_{21}$, what is the ratio q_1/q_2? $(Ans: -4.00)$

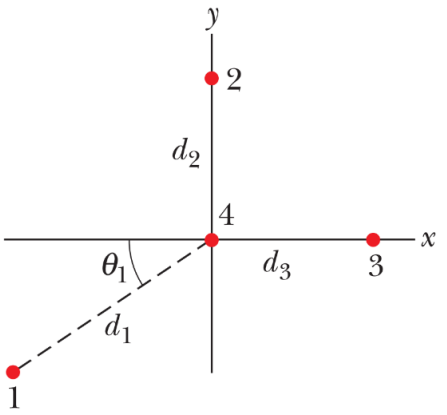


4 | Two identical conducting spheres, fixed in place, attract each other with an electrostatic force of $0.108\ N$ when their center-to-center separation is $50.0\ cm$. The spheres are then connected by a thin conducting wire. When the wire is removed, the spheres repel each other with an electrostatic force of $0.0360\ N$. Of the initial charges on the spheres, with a positive net charge, what was
(a) the negative charge on one of them $(Ans - 1.00 \times 10^{-6}\ C)$ and
(b) the positive charge on the other? $(Ans\ 3.00 \times 10^{-6}\ C)$

5 | In the figure, particle 1 of charge $+1.0\ \mu C$ and particle 2 of charge $-3.0\ \mu C$ are held at separation $L = 10.0\ cm$ on an x axis. If particle 3 of unknown charge q_3 is to be located such that the net electrostatic force on it from particles 1 and 2 is zero, what must be the
(a) x $(Ans: -14.00\ cm)$ and
(b) y coordinates of particle 3? $(Ans: 0.00)$

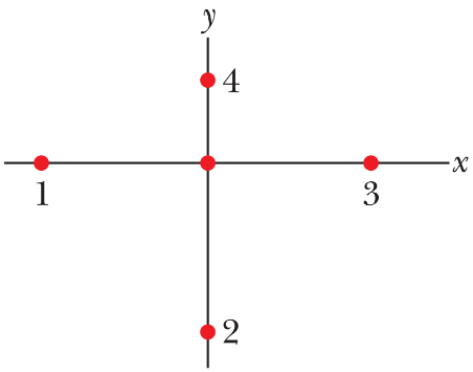


6 | In the figure in front, what are the magnitude and direction of the net electrostatic force on particle 4 due to the other three particles? (*Ans*: $6.16 \times 10^{-24}\ N, 208°$)



$q_1 = -3.20 \times 10^{-19}\ C, q_2 = +3.20 \times 10^{-19}\ C$
$q_3 = +6.40 \times 10^{-19}\ C, q_4 = +3.20 \times 10^{-19}\ C$
$\theta_1 = 35.0°$
$d_1 = 3.00\ cm, d_2 = d_3 = 2.00\ cm$

7 | In the following figure, particles 2 and 4, of charge $-e$, are fixed in place on a y axis, at $y_2 = -10.0\ cm$ and $y_4 = 5.0\ cm$. Particles 1 and 3, of charge $-e$, can be moved along the x axis. Particle 5, of charge $+e$, is fixed at the origin. Initially particle 1 is at $x_1 = -10.0\ cm$ and particle 3 is at $x_3 = 10.0\ cm$.



(a) To what x value must particle 1 be moved to rotate the direction of the net electric force on particle 5 by 30° counterclockwise? (*Ans*: $-6.05\ cm$)

(b) With particle 1 fixed at its new position, to what x value must you move particle 3 to rotate back to its original direction? (*Ans*: $6.05\ cm$)

8 | The figure ahead shows an arrangement of four charged particles, with angle $\theta = 30°$ and distance $d = 2.00\ cm$. Particle 2 has charge $q_2 = +8.00 \times 10^{-19}\ C$; particle 3 and 4 have charges $q_3 = q_4 = -1.60 \times 10^{-19}\ C$. What is the distance D between the origin and particle 2 if the net electrostatic force on particle 1 due to the other particles is zero? (*Ans*: $1.92\ cm$)