

Chapter 21
Electric Charge

Q1. Suppose that isolated charges Q and q attract each other with a force F . If the separation between these charges were made half as great, each charge would then experience a force Ans: $4F$.

Q2. Three charges are located as shown in Figure 1. If $a = 3.0$ m, $Q_1 = 2.0$ micro-C, and $Q_2 = Q_3 = 8.0$ micro-C, what is the magnitude of the electric force on charge Q_1 ? Ans: 0.011 N

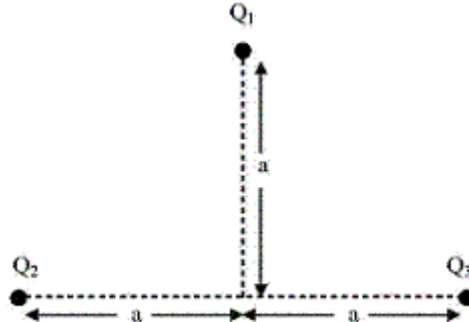


Figure 1

Q3. Three points charges are located on the x-y plane as follows: $Q_1 = -10$ micro-C at $(4$ m, $0)$, $Q_2 = 20$ micro-C at $(0, 10$ m), and Q_3 at $(4$ m, 10 m). If the net force on Q_1 points in the negative x-direction, find the charge Q_3 . Ans: -16 micro-C

Q4. A charge $+2q$ is placed at the origin and a charge $-q$ is placed at $x = 0.200$ m on the x-axis. Where, on the x-axis, can a third charge $+q$ be placed so that the force on it is zero? Ans: 0.683 m

Q5. Consider three point charges, $Q_1 = Q_2 = 2$ micro-C and $Q_3 = 4$ micro-C, located as shown in Figure 1. Find the magnitude of the resultant force on Q_3 . Ans: 8.5×10^{-3} N

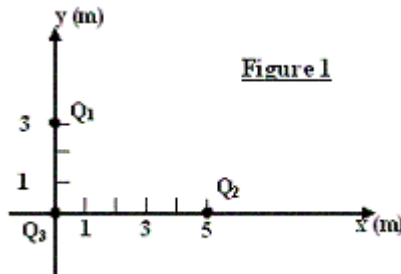


Figure 1

Q6. A negative charge is placed at the center of a square. Each corner of the square has a fixed charge of 1.00×10^{-6} C. If the resulting force acting on each charge is zero, the magnitude of the negative charge is: Ans: 0.96×10^{-6} C.

Q7. Two neutral metal spheres are separated by 0.3 km. How much electric charge must be transferred from one sphere to the other so that their electrical attraction is 10^3 N? Ans: 0.1 C.

Q8. A charge of $+3.2 \times 10^{-6}$ C is placed at the origin. A second charge (q_2) is placed at $x = 3.0$ m. If a charge of 1.0×10^{-6} C experiences no force if placed at $x = 4.0$ m, then q_2 is: Ans: -0.2×10^{-6} C.

Q9. Two small charged objects repel each other with a force F when separated by a distance d . If the charge on each object is reduced to one-fourth of its original value and the distance between them is reduced to $d/2$ the force becomes: Ans: $F/4$.

Q10. Two fixed particles, of charges $q_1 = + 1.0 \times 10^{-6} \text{ C}$ and $q_2 = - 9.0 \times 10^{-6} \text{ C}$, are 10 cm apart. How far from each should a third charge be located so that no net electrostatic force acts on it? Ans: 5 cm from q_1 and 15 cm from q_2 .

Q11. A mass with a charge "Q" is suspended in equilibrium from a beam balance. A point charge $q = + 10 \text{ micro-C}$ is then fixed at a distance $d = 5.0 \text{ cm}$ below "Q" and an extra mass $m = 4.0 \text{ g}$ has to be placed on the pan to obtain equilibrium, see figure (3). Find the value of the charge "Q". Ans:- $1.1 \times 10^{-9} \text{ C}$.

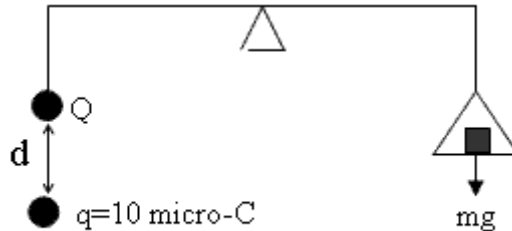


Figure 3

Q12. Two point charges q_1 and q_2 lie along the x-axis. $q_1 = + 16.0 \text{ micro-Coulombs}$ is at $x = 2.00 \text{ m}$ and $q_2 = + 9.00 \text{ micro-Coulombs}$ is at the origin. Where a negative charge q_3 must be placed on the x-axis such that the net electrostatic force on it is zero? Ans: $x = + 0.857 \text{ m}$

Q13. Consider two identical conductor spheres, A and B. Initially, sphere A has a charge of $-80 Q$ and Sphere B has a charge of $+20 Q$. If the spheres touched and then are separated by a distance of 0.3 m , what is the resultant force between them? [Take $Q = 5.7 \times 10^{-8} \text{ C}$] Ans: 0.3 N , repulsive.

Q14. In figure 3, $Q = 60 \text{ micro-C}$, $q = 20 \text{ micro-C}$, $a = 3.0 \text{ m}$, and $b = 4.0 \text{ m}$. Calculate the total electric force on q . [i and j are the unit vectors in the positive direction of x-axis and y-axis, respectively]. Ans: 0.69 i (N).

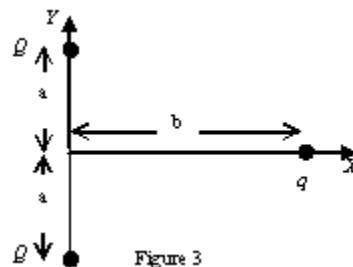


Figure 3

Q15. In figure (1), if $Q = 30 \text{ micro-C}$, $q = 5.0 \text{ micro-C}$ and $d = 0.3 \text{ m}$, find the net force on q . [i and j are the unit vectors in the positive direction of x-axis and y-axis, respectively]. Ans: zero.

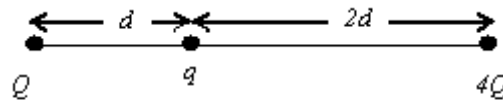


Figure 1

Q16. What is the electric force between two protons which are separated by $1.6 \times 10^{-15} \text{ m}$. Ans: 90 N , repulsive.

Q17. Two positive charges ($+8.0 \text{ C}$ and $+2.0 \text{ C}$) are separated by 300 m . A third charge is placed a distance r from the $+8.0 \text{ C}$ charge so that the resultant electric force on the third charge due to the other two charges is zero. The distance r is Ans: 200 m .