Coulomb's Law

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Charles Augustine De Coulomb in 1784 measured the magnitudes of electric forces between two small charged spheres

He found the force depended on the magnitude of the charges and the distance between them





Consider two point charges 9, and 9, placed at distance^r apart.

The two charges exert force on each other along the line between them.

The force is repulsive if the two charges are the same sign, the force is attraction if the two charges are the opposite sign.





Coulomb's law states that the magnitude of the electric force between two point charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them.

Consider two point charges q_1 and q_2 separated by a $f_1 = \frac{f_1}{2} \frac{f_2}{2}$ distance r, the electric force F between them is given as:

k is called the Coulomb constant



What is the magnitude of the Columbic force between two point charges $q_1 = -2\mu C$ and $q_2 = +3.5\mu C$ separated from each other by a distance of 15cm in air? What is the nature of the force?

Solution

$$q_{1} = -2\mu G_{x} = \|-2| \times 10^{-6} G_{0} q_{2} = +3.5 \times 10^{-6} G_{1}, r_{3} = 515 \rho G_{1} = 0.15 m$$

$$F = \frac{10^{6} R_{1}}{10^{6} N_{1}} \frac{q_{2}}{C^{2}} = 0.15^{-2}$$

$$K = 9 \times 10^{6} N m^{2} / C^{2} = 0.15^{-2}$$

$$F = 2.80 N$$

Since the two charges are unlike charges, the force is attractive.



Coulomb's Law Although Coulomb's law describes only the interaction between two point charges, the net force experienced by any charge can be obtained by the Principle of Superposition. Suppose in a system we have n charges $(q_1, q_2, q_3, ..., q_n)$, the net force experienced by any charge (say q_1) is the vector sum of forces it will experience by interacting with other (n-1) charges. According to the principle of superposition, the net $k q_1 q_2 + k q_1 q_3 + \dots + k q_1 q_n$ force (F₁) experienced by $q_1 i s$: 1.3 " $k q_1 q_1$ F,



Calculate the net electric force exerted on a particle of charge -4 μ C due to the influence of charges +5 μ C and -3 μ C at a distance of 20cm and 50cm respectively from it.



$$F_{3,l} = \frac{k |q_l| |q_3|}{r_{l,3}^2} = \frac{9 \cdot 10^{9}}{0.9} + \frac{4 \cdot 10^{-6}}{0.5} = \frac{3 \cdot 10^{-6}}{0.43} = 0.43 \text{ N}$$

$$F_{axt} = 0.43 + 4.5 + 4.07 \text{ N}$$
The net force, $F_{axt} = 4.07 \text{ N}$. The -ve sign indicates that the net force is an attractive force



Two point charges are located as shown in the fig.



Find the electrostatic force the -2μ C charge exert on the 3μ C charge and the direction.

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Find the position of q_3 so that it has net force equal to

zero acting on it.





- 1. What is the magnitude of the columbic force between two point charges of charge +3µC and +5µC separated from each other by a distance of 30cm in free space. What is the nature of the force?
- 2. Three charges $Q_1 = -2\mu C(0,0)cm$, $Q_2 = 4\mu C(0,10)cm$

and $Q_3 = -3 \ \mu C \ (15,0) \ cm$ acts on one another. Find the magnitude of the total electric force and the angle that the total electric force makes with the positive x-axis.