Coulomb's Law

COULOMB'S LAW

$$F = \frac{kq_1q_2}{r^2}$$

where F = the electrostatic force between the charges (N)
k = 9.0×10^{9} N·m²/C²
q_1, q_2 = the strengths of the charges (C)
r = the radius (distance) between the charges (m)

NOTES

[1] The charge on one electron (e) = -1.60×10^{-19} C (and therefore the charge on one proton is $+1.60 \times 10^{-19}$ C). Charge is sometimes expressed in terms of e rather than in coulombs.

[2] Like charges repel each other; unlike charges attract. For the purposes of Coulomb's Law, use the unsigned charges for q_1 and q_2 and decide from the charges whether the result is an attraction or a repulsion.

[3] For several charges present in one region, the net force on one of the charges is equal to the vector sum of the forces of each individual charge acting alone on the charge of interest.

[4] When an uncharged sphere is touched with an identically-sized sphere with charge q and then removed, each sphere will carry a charge equal to q ÷ 2.

EXERCISES

A. What effect would each of the following have on the electrostatic force between two charges?
1) The distance between the charges is doubled.
2) The distance between the charges is tripled.
3) The distance between the charges is halved.
4) One of the charges is doubled.
5) Both charges are doubled.
6) One charge is tripled while the other charge is halved.
7) One charge is tripled, the other is halved, and the distance between the charges is halved.

B. What is the force of repulsion between two small charges 75.0 cm apart if each has a charge of 1.65×10^{-12} C?

C. What is the force between two electrons if they are placed 15.0 cm apart?

D. What is the distance between two protons when they repel each other with a force of 4.75×10^{-11} N?

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