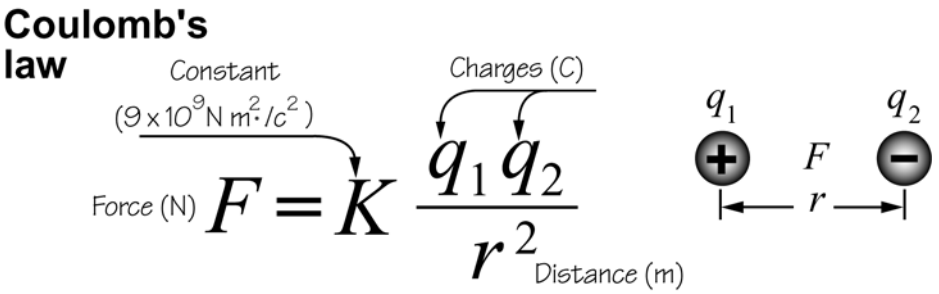
Name: _____ Date: _____ Skill and Practice

14B Coulomb's Law

Read:

In this skill sheet, you will work with Coulomb's law. There are many similarities and some differences between the equation for universal gravitation and the equation for Coulomb's law. They are both inverse square law relationships, and they have similar arrangements of variables.

When two charges q_1 and q_2 are separated by a distance r, there exists a force between them that is given by:



where F equals the force in newtons and K is a constant equal to 9×10^9 N-m^2/c^2. The units of q_1 and q_2 are the coulombs (C). Distance is given in meters. Here are some important points about the relationships of the variables in Coulomb's law.

- Force is inversely proportional to the square of the distance between the charges. Therefore, if the distance increases by a factor of 2, the force decreases by a factor of 4.
- Force is proportional to the strength of each charge.
- When the two charges have the same sign (positive or negative), the force between them is repulsive because like charges repel.
- When the charges have opposite signs, the force between them is attractive because unlike charges attract.

1. What happens to the force between two charges if the distance between them is tripled?
2. What happens to the force between two charges if the distance between them is quadrupled?
3. What happens to the force between two charges if the distance between them is cut in half?
4. What happens to the force between two charges if the magnitude of one charge is doubled?
5. What happens to the force between two charges is the magnitude of both charges is doubled?
6. What happens to the force between two charges if the magnitude of both charges is doubled and the distance between them is doubled?
7. What happens to the force between two charges if the magnitude of both charges is doubled and the distance between them is cut in half?

Example:

The example below shows how to use Coulomb's law to calculate the strength of the force between two charges.

A 0.001 coulomb charge and a 0.002 coulomb charge are 2 meters apart. Calculate the force between them.

Given	**Solution**
The charges have magnitudes of 0.003 C and 0.005 C. The charges are 2 meters apart.	$F = (9\times10^{9}\ \text{N}\cdot\text{m}^2/\text{C}^2)\dfrac{(0.001\ \text{C})(0.002\ \text{C})}{(2\ \text{m})^2}$ $F = 4500\ \text{N}$ The force is 4500 newtons.
Looking for The force between the charges.	
Relationships $F = k\dfrac{q_1 q_2}{r^2}$	

1. Two particles, each with a charge of 1 C, are separated by a distance of 1 meter. What is the force between the particles?

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2. What is the force between a 3 C charge and a 2 C charge separated by a distance of 5 meters?

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3. Calculate the force between a 0.006 C charge and a 0.001 C charge 4 meters apart.

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4. Calculate the force between a 0.05 C charge and a 0.03 C charge 2 meters apart.

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5. Two particles are each given a charge of 5×10^{-5} C. What is the force between the charged particles if the distance between them is 2 meters?

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6. The force between a pair of charges is 100 newtons. The distance between the charges is 0.01 meter. If one of the charges is 2×10^{-10} C, what is the strength of the other charge?

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7. Two equal charges separated by a distance of 1 meter experience a repulsive force of 1,000 newtons. What is the strength in coulombs of each charge?

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8. The force between a pair of 0.001 C charges is 200 N. What is the distance between them?

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9. The force between two charges is 1000 N. One has a charge of 2×10^{-5} C, and the other has a charge of 5×10^{-6} C. What is the distance between them?

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10. The force between two charges is 2 newtons. The distance between the charges is 2×10^{-4} m. If one of the charges is 3×10^{-6} C, what is the strength of the other charge?
