

# **Coulomb's Law - Worksheet**

15 Free-Response Questions

Organic Chemistry Tutor

1. A  $+10 \mu\text{C}$  point charge is 25 cm away from a  $-20 \mu\text{C}$  point charge. Calculate the magnitude of the electric force between them.

3. A force of 500N exists between two identical point charges separated by a distance of 40 cm. Calculate the magnitude of the two point charges.

2. The electric force between two point charges with a magnitude of  $+800 \text{ nC}$  and  $+900 \text{ nC}$  is 15 N. How far apart are the two charges from each other in centimeters?

4. How many electrons represent a charge of  $-70 \mu\text{C}$ ?

5. What is the electric charge in  $\mu\text{C}$  of  $5 \times 10^{14}$  protons?

7. A  $+100 \mu\text{C}$  charge is placed at the origin. A  $-50 \mu\text{C}$  charge is placed at  $x = 2\text{m}$  and a  $+200 \mu\text{C}$  charge is placed at  $x = -4\text{m}$  along the x-axis.  
(a) What is the net electric force acting on the  $+100 \mu\text{C}$  charge? (b) What is the net electric force acting on the  $+200 \mu\text{C}$  charge?

6. A metal sphere has  $4.3 \times 10^{21}$  protons and  $6.8 \times 10^{21}$  electrons. What is the net electric charge on this metal sphere?

8. An attractive force of  $1500 \text{ N}$  exists between a  $+900 \text{ nC}$  charge and another point charge. The two charges are separated by a distance of  $50 \text{ mm}$ . What is the magnitude and sign of the other charge?

9. The electric force between two point charges is 40 N. What will be the magnitude of the electric force if (a) the magnitude of one of the charges double in value? (b) the distance between the two charges doubles? (c) the distance is reduced to  $1/3$  of its original value? (d) the magnitude of one charge doubles and the other charge triples in magnitude? (e) the magnitude of the 1<sup>st</sup> charge triples, the 2<sup>nd</sup> charge quadruples, and if the distance is reduced to  $1/4$  of its original value?

10. A metal sphere has a charge of  $-50 \mu\text{C}$ . If the sphere contains  $5.2 \times 10^{14}$  protons, what is the total number of electrons present in the sphere?

11. A metal sphere and a metal rod has a net charge of  $-40 \text{ C}$  and  $+20 \text{ C}$  respectively. If  $-10 \text{ C}$  of electric charge is transferred from the metal sphere to the metal rod, what is the final charge on each metal object?

12. A metal sphere and a metal rod has a net charge of  $+30 \text{ C}$  and  $+80 \text{ C}$  respectively. After a transfer of electrons occurred between the two metal objects, the electric charge on the metal sphere is now  $+50 \text{ C}$ . (a) What is the electric charge on the metal rod? (b) How much electric charge was transferred? (c) In which direction did the flow of electrons occur?

13. A  $+100 \mu\text{C}$  point charge is placed at the origin. A  $-200 \mu\text{C}$  is located at  $(1\text{m}, 0)$  and a  $+400 \mu\text{C}$  charge is located at  $(0, -2\text{m})$ . (a) What is the net electric force acting on the  $+100 \mu\text{C}$  charge? (b) What is the net electric force acting on the  $-200 \mu\text{C}$  charge?

15. A simple electroscope is made with two  $0.5 \text{ Kg}$  metal spheres attached to two separate  $1.2\text{m}$  long wires as shown below. A charge  $+Q$  is added to the electroscope causing the metal spheres to separate forming a  $20^\circ$  angle with the vertical. Calculate the total charge  $Q$  that was applied to the electroscope.

14. Four identical point charges with magnitude  $+100 \mu\text{C}$  form a square with a side length of  $2\text{m}$ . Calculate the magnitude and direction of the net electric force acting on the charge on the bottom right of the square.

## Answers:

1. 28.8 N
2. 2.08 cm
3. 94.3  $\mu\text{C}$
4.  $4.375 \times 10^{14}$  electrons
5. +80  $\mu\text{C}$
6. -400 C
- 7a. 22.5 N due east
- 7b. 8.75 N due west
8. -463  $\mu\text{C}$  or  $-4.63 \times 10^5$  nC
- 9a. 80 N
- 9b. 10 N
- 9c. 360 N
- 9d. 240 N
- 9e. 7,680 N
10.  $8.325 \times 10^{14}$  electrons
11. Sphere = -30 C, Rod = +10 C.
- 12a. +60 C
- 12b. -20 C
- 12c. Electric charge in the form of electrons flowed from the sphere to the rod.
- 13a. 201 N at  $26.6^\circ$  above the +x-axis.
- 13b. 276 N at  $208^\circ$  counterclockwise from the +x-axis.
14. 43.1 N at  $315^\circ$  counterclockwise from the +x-axis.
15. 23.1  $\mu\text{C}$