Electric Charge and Force

Prefixes:
Mega (M) = $x10^{6}$
Kilo (k) = $x10^{3}$
Centi (c) = $x10^{-2}$
Milli (m) = $x10^{-3}$
Micro (μ) = $x10^{-6}$
Nano (n) = $x10^{-9}$

1. Prepare these numbers for calculations by putting them into standard units:
   A. 15 μC B. 4.9 nm C. 8 MHz D. 6 mm E. 7 centicoulombs

2. How much charge does 1,200 electrons have?

3. An object has a charge of 2.4 μC.
   A. Is it positive or negative?
   B. Did it gain or lose electrons?
   C. How many electrons were gained or lost?

Electron Charge

$1\ electron = -1.602 \times 10^{-19}\ C$

4. How many electrons were gained or lost by a 4.5 milliC charge?

5. Possible or impossible:
   A. 12 electrons B. 15.5 electron C. 6.3 electrons D. 1,507 electrons

6. A 3 C charge is 4 mm away from a 6 C charge.
   Find the force between them.

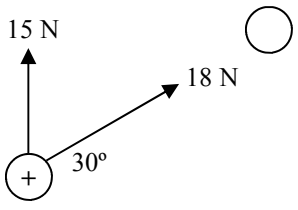
Coulomb's Law

Charge 1 (*in Coulombs*) and Charge 2 (*in C*)

Electric Force (*in N*) $= F_e = k_c \frac{q_1 q_2}{r^2}$ Distance between the two charges (*in m*)

Coulomb's Constant $= 9 \times 10^{9}\ Nm^2/C^2$

7. A 7.2 μC charge is 20 cm away from a 3.8 μC charge. Find the force.



8. How does the electric force change?
   A. If one of the charges is tripled?
   B. If the distance doubles?
   C. If one of the charges is halved?
   D. If the distance is halved?

9. Two electric forces are acting on a positive charge, as seen at the right.
   A. Using the ideas of attraction and repulsion, decide whether the two blank charges are positive or negative.

   B. Calculate the net force on the charge (including magnitude and direction).

   C. If the positive charge has a mass of $9.4x10^{-6}$ kg, what is its acceleration?

   D. How much force is acting on the charge at the upper right?

Speed in m/s

Electric Charge and Force

Prefixes:
Mega (M) = x10^6
Kilo (k) = x10^3
Centi (c) = x10^{-2}
Milli (m) = x10^{-3}
Micro (μ) = x10^{-6}
Nano (n) = x10^{-9}

1. Prepare these numbers for calculations by putting them into standard units:
   A. 15 μC 15×10^{-6}C B. 4.9 nm 4.9×10^{-9} C. 8 MHz 8×10^{6} D. 6 mm 6×10^{-3} or .006 E. 7 centicoulombs 7×10^{-2} or .07

2. How much charge does 1,200 electrons have?
$$\frac{1{,}200\text{ e}}{1}\left(\frac{-1.602\times10^{-19}\text{C}}{1\text{ e}}\right) = -1.92\times10^{-16}\text{C}$$

3. An object has a charge of 2.4 μC.
   A. Is it positive or negative?
   B. Did it gain or lose electrons?
   C. How many electrons were gained or lost?
$$\left(\frac{2.4\times10^{-6}\text{ C}}{1}\right)\left(\frac{1\text{ e}}{-1.602\times10^{-19}\text{ C}}\right) = \text{div.}$$

Electron Charge
1 electron = -1.602 x 10^{-19} C

4. How many electrons were gained or lost by a 4.5 milliC charge?
$$\frac{4.5\times10^{-3}\text{C}}{1}\left(\frac{1\text{e}}{-1.602\times10^{-19}\text{C}}\right) = \text{div.}$$

5. Possible or impossible:
   A. 12 electrons yes B. 15.5 electron No C. 6.3 electrons N D. 1,507 electrons y

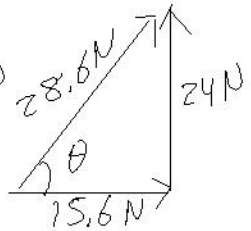
---

6. A 3 C charge is 4 mm away from a 6 C charge.
   Find the force between them.
$$F = \frac{9\times10^{9}(3)(6)}{(.004)^2} = 1.01\times10^{16}\text{N}$$
same as $(4\times10^{-3})^2$

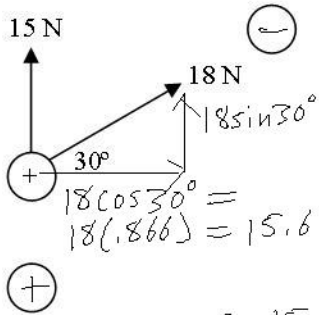
Coulomb's Law
Charge 1 (*in Coulombs*), Charge 2 (*in C*)
Electric Force (*in N*) → $F_e = k_c \frac{q_1 q_2}{r^2}$ ← Distance between the two charges (*in m*)
Coulomb's Constant = 9 x 10^9 Nm^2/C^2

7. A 7.2 μC charge is 20 cm away from a 3.8 μC charge. Find the force.
$$F = 9\times10^{9}\frac{(7.2\times10^{-6})(3.8\times10^{-6})}{(.2)^2} = 6.16\text{ N}$$

8. How does the electric force change?
   A. If one of the charges is tripled? 3F (3 times)
   B. If the distance doubles? 1/4 F
   C. If one of the charges is halved? F/2
   D. If the distance is halved? 4 X force



9. Two electric forces are acting on a positive charge, as seen at the right.
   A. Using the ideas of attraction and repulsion, decide whether the two blank charges are positive or negative.
   B. Calculate the net force on the charge (including magnitude and direction).
   C. If the positive charge has a mass of 9.4x10^{-6} kg, what is its acceleration?
   F = ma
   D. How much force is acting on the charge at the upper right?



$F_{y\,total} = 9+15 = 24\text{N}$
$F_{x_t} = 15.6\text{N}$
$F_{net} = \sqrt{24^2+15.6^2} = 28.6\text{N}$
$\theta = \tan^{-1}\left(\frac{y}{x}\right) = 57°$