Electric Charge and Force Skills Sheet

Prefixes:
Mega (M) = $\times 10^6$
Kilo (k) = $\times 10^3$
Centi (c) = $\times 10^{-2}$
Milli (m) = $\times 10^{-3}$
Micro (μ) = $\times 10^{-6}$
Nano (n) = $\times 10^{-9}$

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} m
   C. 8 MHz — 8×10^{6} Hz
   D. 6 mm — 6×10^{-3} m
   E. 7 centicoulombs — 7×10^{-2} C

2. How much charge does 1,200 electrons have?
$$\left(\frac{1{,}200\text{e}}{1}\right)\left(\frac{-1.602\times10^{-19}\text{C}}{1\text{e}}\right) = 1.9224\times10^{-16}\text{ C}$$

Electron Charge
1 electron $= -1.602\times10^{-19}$ C

3. An object has a charge of 2.4 μC.
   A. Is it positive or negative? Pos
   B. Did it gain or lose electrons? Lost
   C. How many electrons were gained or lost?
$$\left(\frac{2.4\times10^{-6}\text{C}}{1}\right)\left(\frac{1\text{e}}{-1.602\times10^{-19}\text{C}}\right) = -1.5\times10^{13}\text{ electrons}$$

4. How many electrons were gained or lost by a 4.5 milliC charge?
$$\frac{4.5\times10^{-3}\text{C}}{1}\times\frac{1\text{e}}{-1.602\times10^{-19}\text{C}} = -2.8\times10^{16}\text{ electrons}$$

5. Possible or impossible:
   A. 12 electrons — Yes
   B. 15.5 electron — no
   C. 6.3 electrons — no
   D. 1,507 electrons — Yes

6. A 3 C charge is 4 mm away from a 6 C charge.
   Find the force between them.
$$F_e = 9\times10^9\ \text{Nm}^2/\text{C}^2\cdot\frac{3\text{C}\cdot6\text{C}}{(.004\text{m})^2} = 1.01\times10^{16}\text{ N}$$ Repel

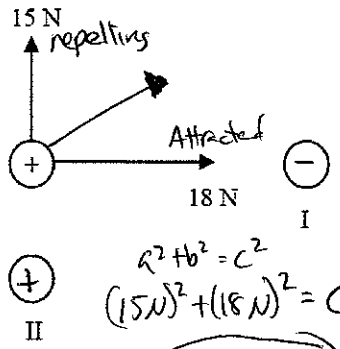
Coulomb's Law
Charge 1 (*in Coulombs*) · Charge 2 (*in C*)
Electric Force (*in N*) → $F_e = k_c\dfrac{q_1q_2}{r^2}$ ← Distance between the two charges (*in m*)
Coulomb's Constant $= 9\times10^9\ \text{Nm}^2/\text{C}^2$

7. A 7.2 μC charge is 20 cm away from a 3.8 μC charge. Find the force.
$$F_e = 9\times10^9\cdot\frac{7.2\times10^{-6}\text{C}\cdot3.8\times10^{-6}\text{C}}{(.20\text{m})^2} = 6.16\text{ N}$$ repel

$\frac{1}{r^2}$

8. How does the electric force change?
   A. If one of the charges is tripled? 3F (3 times)
   B. If the distance doubles? $\frac{1}{4}$F
   C. If one of the charges is halved? F/2
   D. If the distance is halved? 4x 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*).
$a^2+b^2=c^2$
$(15\text{N})^2+(18\text{N})^2=c^2$
23.4 N
$\theta = 39.8°$

   C. If the positive charge has a mass of 0.65 kg, what is its acceleration?
$F=ma \quad a=\frac{F}{m}=\frac{23.4\text{N}}{0.65\text{kg}}=36\text{ m/s}$

   D. How much force is acting on charge I?
Same: 18N only to the Left