solutions

Physics 12 U7 – Electrostatics Worksheet #1

Name: ____________________

Coulombs Law $F = KQQ/R^2$

Electric field = $E = F/q = Kq/R^2$ (similar to "g")

1. Calculate the force between two 6 μC charges that are 0.6 m apart.

(+6μC) ← 0.6 m → (+6μC)

$$F = \frac{KQQ}{R^2} = \frac{(9\times10^9)(6\times10^{-6})(6\times10^{-6})}{(0.6)^2} = 0.9\ N$$

2. Calculate the force between an electron and a 6 μC charge 0.45 m apart.

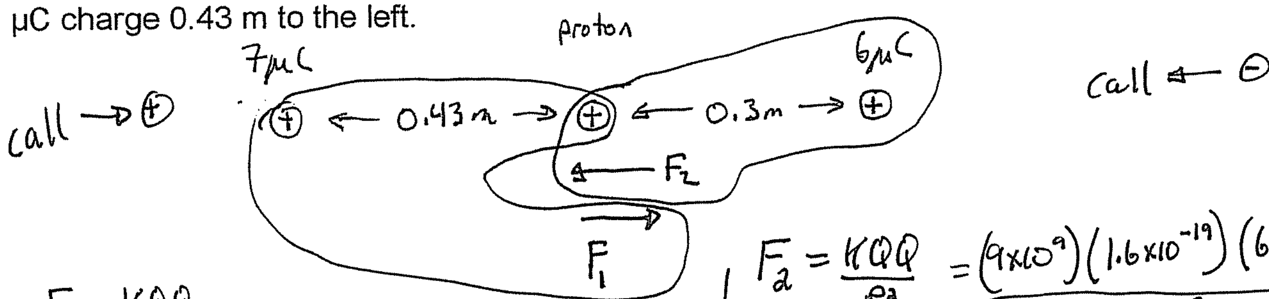
e ⊖ ← 0.45 m → ⊕ 6μC.

elementary charge is the charge on a proton ⊕ or electron ⊖

$$F = \frac{KQQ}{R^2} = \frac{(9\times10^9)(1.6\times10^{-19})(6\times10^{-6})}{(0.45)^2}$$

$$= 4.27\times10^{-14}\ N$$

3. Calculate the net force on a proton that has a 6 μC charge 0.3m to the right and a 7 μC charge 0.43 m to the left.



$F_1 = \frac{KQQ}{R^2}$

$= \frac{(9\times10^9)(7\times10^{-6})(1.6\times10^{-19})}{(.43)^2} = 5.45\times10^{-14}\ N$ →

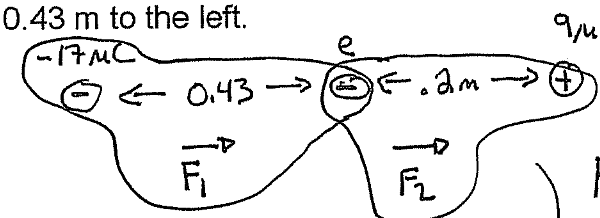
$F_2 = \frac{KQQ}{R^2} = \frac{(9\times10^9)(1.6\times10^{-19})(6\times10^{-6})}{(.3)^2}$

$= ⊖ 9.6\times10^{-14}\ N$ ←

$F_{NET} = F_1 + F_2 = (5.45 - 9.6)\times10^{-14}$

$F_{NET} = 4.15\times10^{-14}$ (to the left)

4. Calculate the net force on an electron that has a 9 μC charge 0.2m to the right and a -17 μC charge 0.43 m to the left.



$F_1 = \frac{KQQ}{R^2}$

$= \frac{(9\times10^9)(17\mu C)(1.6\times10^{-19})}{(.43)^2}$

$= 1.324\times10^{-13}\ N$

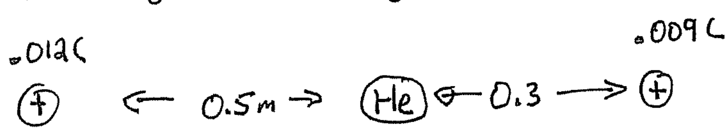
$F_2 = \frac{KQQ}{R^2} = \frac{(9\times10^9)(1.6\times10^{-19})(9\mu C)}{(.2)^2}$

$= 3.24\times10^{-13}\ N$

$F_{NET} = F_1 + F_2$

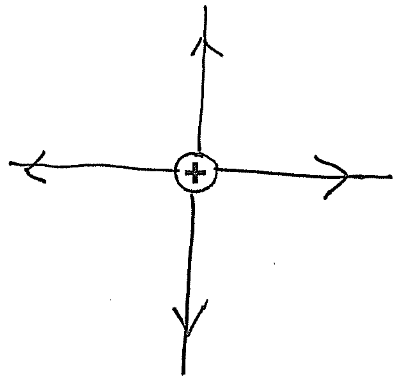
$= 4.56\times10^{-13}\ N$

5. Calculate the net force on a helium nucleus that has a 0.009 C charge 0.3m to the right and a 0.012C charge 0.5 m to the right.

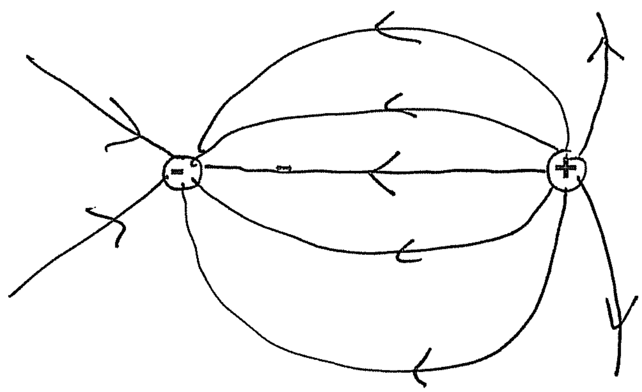


6. Draw the electric field lines for the following three charge arrangments.

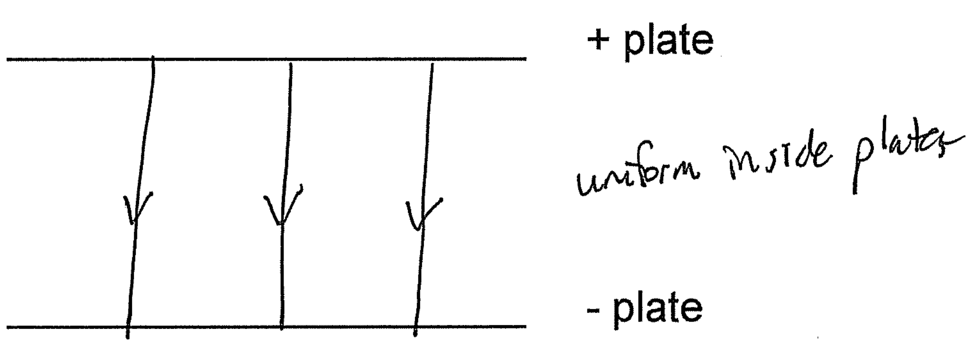
a)



b)



c)



$E = F/q$ similar to "g"

scalar.

7. Calculate the electric field at point P, 0.45 m from a 0.078 C charge.

(+) ← 0.45 m → • P

0.078

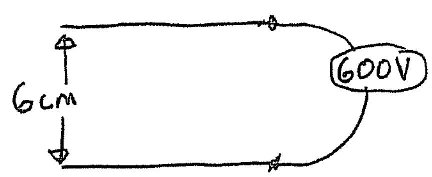
$$E = \frac{KQ}{R^2} = \frac{(9\times10^9)(.078)}{(.45)^2}$$

$$= 3.47 \times 10^9 \text{ N/C} \quad (\text{to the right @ P})$$

8. A proton is pushed with a 0.0006 N force when in an electric field. Calculate the strength of E.

$$E = F/q = \frac{.0006}{1.6\times10^{-19}} = 3.75\times10^{15} \text{ N/C}$$

9. Calculate the E field between two plates that are separated by 0.06 ~~c~~m that are connected to a 600 V power source.



$$E = \frac{V}{d} = \frac{600\text{ V}}{.06\text{ m}} = 10{,}000 \text{ V/m}.$$

(only between plates where E is constant)

10. Calculate the electric field at point P which has a 0.05 C charge 4 cm to the right and a 0.009 C charge 1 cm to the left.

E is a vector, keep direction in mind.

Call to the right +
call to the left −

0.009C   P   0.05C

(+) 1cm • ← 4cm → (+)

E_1 → ← E_2

$$E_1 = \frac{KQ}{R^2} = \frac{(9\times10^9)(.009)}{(.01)^2}$$

$$= 8.1\times10^{11} \text{ N/C}$$

$$E_2 = \frac{KQ}{R^2} = \frac{(9\times10^9)(.05)}{(.04)^2} = 2.81\times10^{11}$$

$$E_{TOT} = E_1 + E_2$$

$$= (8.1\times10^{11}) + (-2.81\times10^{11})$$

$$E_{TOT} = 5.29\times10^{11} \text{ – to the right}$$