 Solutions

Name: ____________________

Coulombs Law $F = KQQ/R^2$ — vector

Electric field = $E = F/q = Kq/R^2$ — vector

(use polarity to determine direction.)

Ep= electric potential energy = KQQ/r — scalar

V = electric potential ~~energy~~ = Work/q= E x d = KQ/r — scalar

(use polarity inside calculation.)

1. Calculate the electric potential energy stored be placing an electron 6 cm away from a 0.007 C charge.

$$E_p = \frac{KQQ}{R} = \frac{(9\times10^{9})(-1.6\times10^{-19})(0.007)}{0.06}$$

$$= -1.68\times10^{-10} \text{ Joules.}$$

→ ⊖ indicates no energy stored, would need to put energy in to seperate!

2. How much work (change in Ep) to move an electron from 0.9 m (R_i) to 0.3 m (R_f) away from a 0.016 C charge.

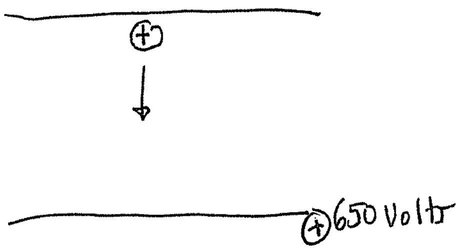
$$\text{Work} = \Delta E_p = E_{p_f} - E_{p_i} =$$

$$= \frac{(9\times10^{9})(-1.6\times10^{-19})(0.016)}{.3} - \frac{(9\times10^{9})(-1.6\times10^{-19})(0.016)}{.9}$$

$$= (-7.68\times10^{-11}) - (-2.56\times10^{-11}) = -5.12\times10^{-11} \text{ Joules}$$

→ you actually get energy out. they want to get closer.

3. Calculate the work required to move an proton from the top plate (0 volts) to the bottom plate (+ 650 volts).



$$V = \frac{E}{q} = \frac{\text{work}}{q}$$

$$\text{work} = V \cdot q$$

$$= (650)(1.6 \times 10^{-19})$$

$$\boxed{\text{Work} = 1.04 \times 10^{-16}\ J}$$

energy and work can be used interchangably.

4. Calculate the voltage 0.07 m from a 6μC charge.

$$V = \frac{KQ}{R} = \frac{(9 \times 10^9)(6\mu C)}{.07} = 7.71 \times 10^5 \text{ Volts}$$

for a point charge.

5. Calculate the electric field strength 0.07 m from a 6μC charge.

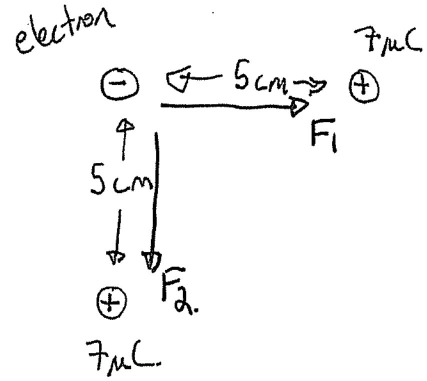
$$E = \frac{F}{q} = \frac{KQ}{R^2} = \frac{(9 \times 10^9)(6\mu C)}{(.07)^2} = 1.10 \times 10^7 \text{ N/C}$$

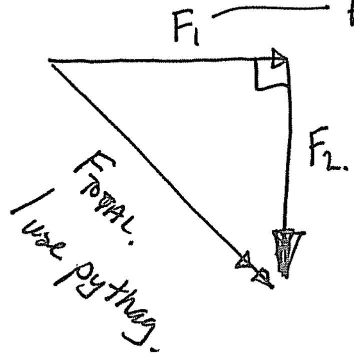
Similar to "g"

$\sqrt{a^2+b^2} = c^2$.

6. Calculate the force on an electron for the following charge arrangement, 5 cm from two 7μC charges at right angles.

Force is a vector, add $F_1 + F_2$. tip to tail





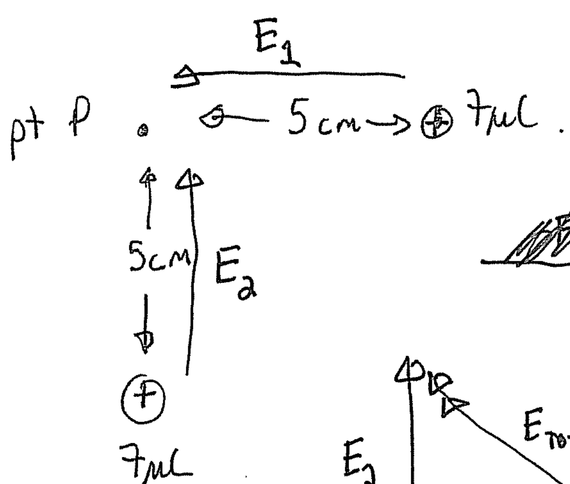
$F_1 = F_2 = \frac{KQQ}{R^2} = \frac{(9\times10^9)(7\mu C)(1.6\times10^{-19})}{(.05)^2}$

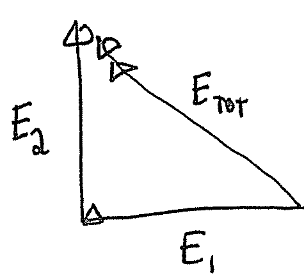
$F_1 = 4.032\times10^{-12}$ N

$F_{TOT} = \sqrt{(4.03\times10^{-12})^2 + (4.03\times10^{-12})^2} = 5.70\times10^{-12}$ N

6. Calculate the electric field strength at point P on for the following charge arrangement, 5 cm from two 7μC charges at right angles.

as above, E is a vector.





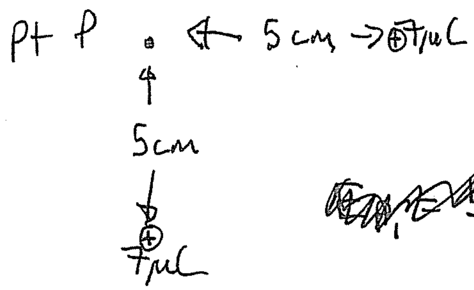
$E_1 = E_2 = \frac{KQ}{R^2} = \frac{(9\times10^9)(7\mu C)}{(.05)^2} = 2.52\times10^7$.

$E_{TOT} = \sqrt{(2.52\times10^7)^2 \times 2}$

$= 3.56\times10^7$ N/C.

voltage.

7. Calculate the electric potential at point P for the following charge arrangement, 5 cm from two 7μC charges at right angles.

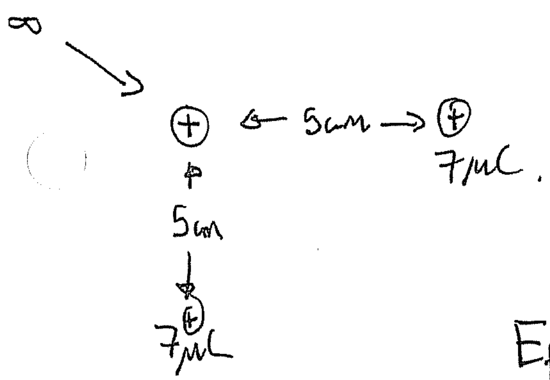


V is a scalar, so add like any other scalar. ie, 4kg + 5kg = 9kg

$V_1 = \frac{KQ}{R} = \frac{(9\times10^9)(7\mu C)}{.05} = 1.26\times10^6$ volts

$V_1 = V_2$ $\qquad V_{TOT} = V_1 + V_2 = 2.52\times10^6$ Volts.

8. Calculate the work to move a proton from infinity (where Ep=0) to point P for the following charge arrangement, 5 cm from two 7μC charges at right angles.



@ ∞ $E_p = 0$

$WORK = E_{p_f} - E_{p_i} = E_{p_f}$ $\qquad E_{p_1} = E_{p_2}$.

$E_{p_1} = \frac{KQQ}{R} = \frac{(9\times10^9)(7\mu C)(1.6\times10^{-19})}{(0.05)} = 2.016\times10^{-13}$ J.

$E_{p_{TOT}} = E_{p_1} + E_{p_2} = 4.032\times10^{-13}$ J.