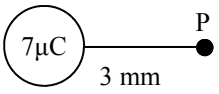
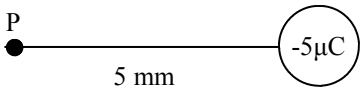
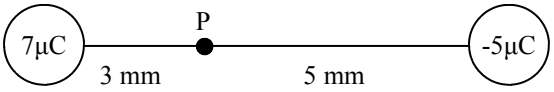


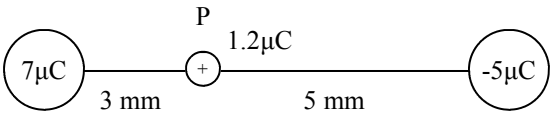
1. Calculate the four electrostatic quantities at point P for the first diagram. Be sure to give direction for vectors. Some may be zero.



2. Calculate the four electrostatic quantities at point P in the second diagram.

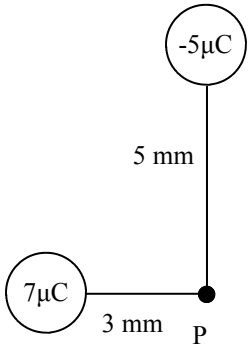


3. Now put the two previous problems together. Using the numbers you found in Q1 and 2, find the four electrostatic quantities for point P due to both charges.



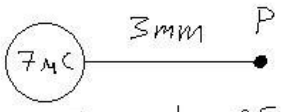
4. A 1.5μC charge is then brought to point P from infinity.
   A. Again, using your previous numbers, calculate the four electrostatic quantities for this charge at point P.

   B. How much work was done to move the charge to point P from infinity?



5. Now let's move the negative charge to the positive y-axis. Using the same individual numbers you calculated in Q2 and Q3, calculate the four quantities at point P.

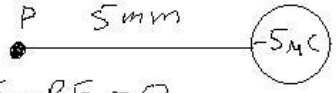
Key



$F = 0\ N \quad PE = 0\ J$

$E = 7 \times 10^9 \frac{N}{C}$ Right

$V = 2.1 \times 10^7$ volts

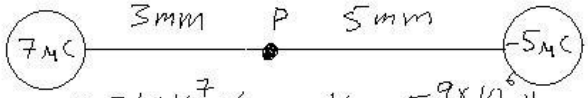


$F = PE = 0$

$E = 1.8 \times 10^9 N/C$ Right

Now put them together.

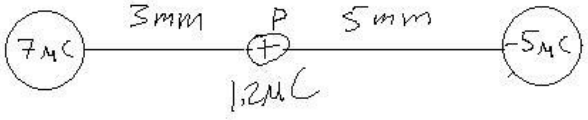
$E = 7 \times 10^9 \frac{N}{C} \rightarrow \quad E = 1.8 \times 10^9 N/C \rightarrow \quad E_{net} = 8.8 \times 10^9 \frac{N}{C}$



$V = 2.1 \times 10^7 V \quad V = -9 \times 10^6 V$

$V = 1.2 \times 10^7$ volts (J/C)

Now, put a charge at point P.



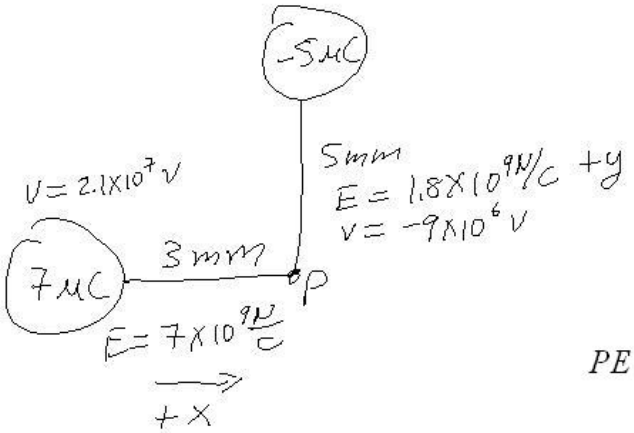
$E_{net} = 8.8 \times 10^9 N/C$ at P

$V = 1.2 \times 10^7$ volts (J/C)

$F = Eq = 8.8 \times 10^9 (1.2 \times 10^{-6}) = 1.056 \times 10^4 N$

$PE = Vq = 14.4\ J$

Now move one of the charges by 90 degrees.



V is still $1.2 \times 10^7 V$

net E: use Pyth. theor. + inv tang.

$E_{net} = 7.23 \times 10^9 \frac{N}{C}$

$\theta = \tan^{-1}\left(\frac{1.8}{7}\right) = 14.4°$

PE and F are still zero.