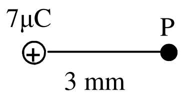
Name: ____________________

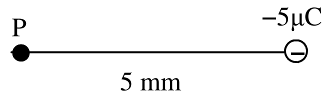
Period: ____________________

Calculating net E, F, PE, and V—PreAP Electrostatics 6

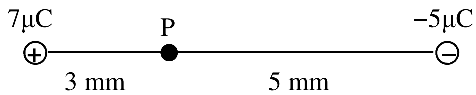
Key on back



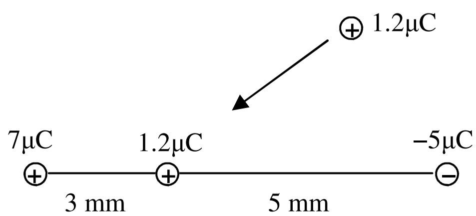
1. Calculate the four electrostatic quantities (E, F, PE, and V) at a position 3 mm to the right of a 7μC charge. Be sure to give direction for vectors. Some quantities may be zero.



2. Calculate the four electrostatic quantities at a point 5mm to the left of a −5μC charge.

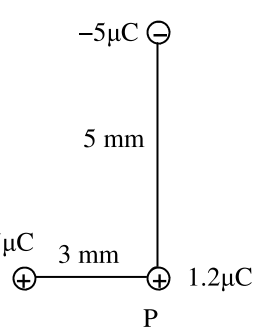


3. Now put the two previous problems together. Using the numbers you found in Q1 and 2, find the net electric field, net voltage, net force, and net energy at point P due to both charges. Again, some may be zero.



4. A 1.2μC 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 the negative charge is moved to the positive y-axis. Using the same individual numbers you calculated in Q2 and Q3, calculate the four quantities at point P.

6. A. Which way will the 1.2μC charge move when released?

   B. If a negative charge was put at P, which way would it move?

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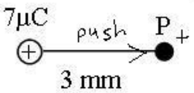
remember to use a + test charge

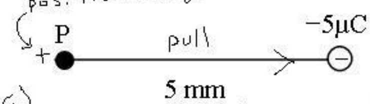


1. Calculate the four electrostatic quantities (E, F, PE, and V) at a position 3 mm to the right of a 7μC charge. Be sure to give direction for vectors. Some quantities may be zero.

$\vec{E} = \frac{k(7\times10^{-6})}{(3E-3)^2} = 7\times10^{9}\frac{N}{C}$ to Right

$V = \frac{k(7E-6)}{3E-3}$ or $Er = (7\times10^9)3E-3 = 2.1\times10^7$ J/c no direction (scalar)

PE and $\vec{F} = 0$, since only 1 charge.



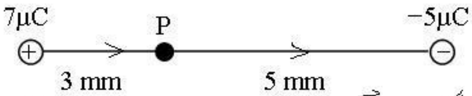
2. Calculate the four electrostatic quantities at a point 5mm to the left of a −5μC charge.

$\vec{E} = \frac{k(5\mu C)}{(5mm)^2} = 1.8\times10^9$ N/c to right

$V = Er = (1.8E9)(5E-3) = -9\times10^6$ J/c (no direction)

↑ neg. charges have neg. voltages

$PE = \vec{F} = 0$ (only 1 q)

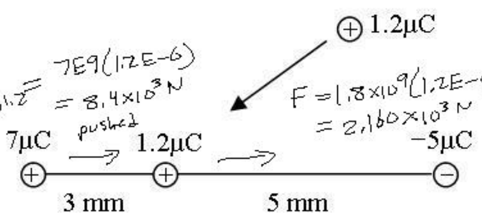


3. Now put the two previous problems together. Using the numbers you found in Q1 and 2, find the net electric field, net voltage, net force, and net energy at point P due to both charges. Again, some may be zero.

$\vec{E}_7 + \vec{E}_5$, since same dir, so $\vec{E}_{net} = (1.8E9) + (7E9) = 8.8\times10^9$ N/c →

$V_{net} = (-9E6) + (2.1E7) = 1.2\times10^7$ J/c

F_{net} and PE = 0, of course. Nothing at the position, so no F or PE.



$F_{7,1.2} = 7E9(1.2E-6) = 8.4\times10^3$ N

$F = 1.8\times10^9(1.2E-6) = 2.160\times10^3$ N

Add em (same dir) $= 1.056\times10^4$ N →

4. A 1.2μC 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.

Just use net V and net E, which don't change

E is in N/c, so $\vec{F} = q\vec{E}$, so $(1.2E-6c)\,8.8\times10^9\frac{N}{c} = 1.056\times10^4$ N to R → (since +'s go dir. of $\vec{E}$)

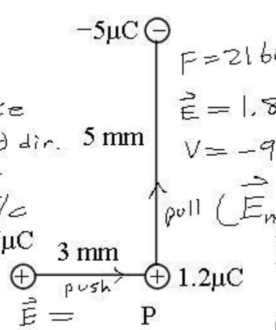
PE is in J, so $PE = qV$, so $(1.2\times10^7\frac{J}{c})(1.2\times10^{-6}c) = 14.4$ J

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

$PE = KE = W = 14.4$ J

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

Easiest to calculate Vnet and Enet, then just multiply by the q at point P. That way you don't have to do pyth and inverse tan twice.



$F = 2160$ N ↑

$\vec{E} = 1.8\times10^9\frac{N}{c}$ ↑

$V = -9\times10^6$ J/c

V_{net} = same, since it is a scalar and dir. doesn't matter

$V_{net} = 1.2\times10^7$ J/c

since $PE = qV$ and is also a scalar, it stays same $= 14.4$ J

$\vec{E} = 7\times10^9\frac{N}{c}$ →

$V = 2.1\times10^7$ J/c

$F = 8400$ N →

$(\vec{E}_{net})^2 = (1.8E9)^2 + (7E9)^2$ (can do without exponents. All are $\times10^9$)

$\vec{E}_{net} = 7.23\times10^9$ N/c and $\vec{F} = q\vec{E} = [1.2E-6](7.23E9) = 8.68\times10^3$ N at 14.4°

$\theta = \tan^{-1}(y/x) = 14.4°$ [N] = [c][N/c]

R ↗ ↑ E_5, E_7 →

6. A. Which way will the 1.2μC charge move when released?

↗ at 14.4°, same way $\vec{E}$ points.

B. If a negative charge was put at P, which way would it move?

↙ 14.4 + 180 = 194.4°, negs move opp. dir. of electric field

so instead of $F_{net} = qE_{net}$ use $\vec{F}_{net} = \sqrt{F_1^2 + F_2^2} = \sqrt{8400^2 + 2160^2} = 8680$ N (same as above)