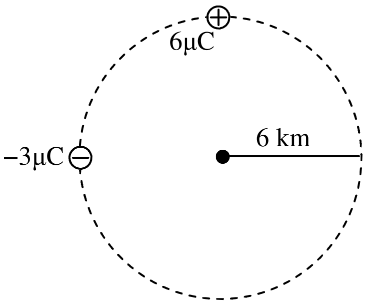
PreAP Electrostatics 16



1. Two charges are equidistant from a point.
   A. What is "r" for the 6C charge?
   B. When is "r" negative?
   C. Calculate the potential at the center due to the −3C charge.

   D. Calculate the potential at the center due to the 6C charge.

1A: 6E3 m
B. Never. r is always +
C. k(−3E-6)/6E3 = −4.5V

D: k(+6E-6)/6E3= +9V

E. How much bigger is the top charge, compared with the left charge?

F. How much bigger (magnitude wise) is the voltage due to the positive charge than the negative charge?

Notice that the voltage is twice as big because the charge is twice as: the potential (voltage) is proportion to charge, since both q and V are on top.

E: Twice as big

F: Twice as big. Hmmm

G. Calculate the net voltage at the center of the circle due to BOTH charges.

G. Add 'em = +4.5V

H. Calculate the net voltage if the 6μC charge was moved to the right side of the circle.

H. No change, they are scalars and direction doesn't matter = +4.5V

Now that you remember how to calculate net voltages and do proportionality, let's expand upon the concept, but simplify it at the same time.

2. Two charges are set in space as seen below.
   A. You know the potential due to the 6C and 6 m, already (Q1). Write it on the diagram at point B.
   B. Realizing that 3 m is half as far as 6 m, how big is the potential 3 m from the charge?
   C. Write this at point A.
   D. Use proportionality or calculate anew to find the potential at C due to the 6C charge.

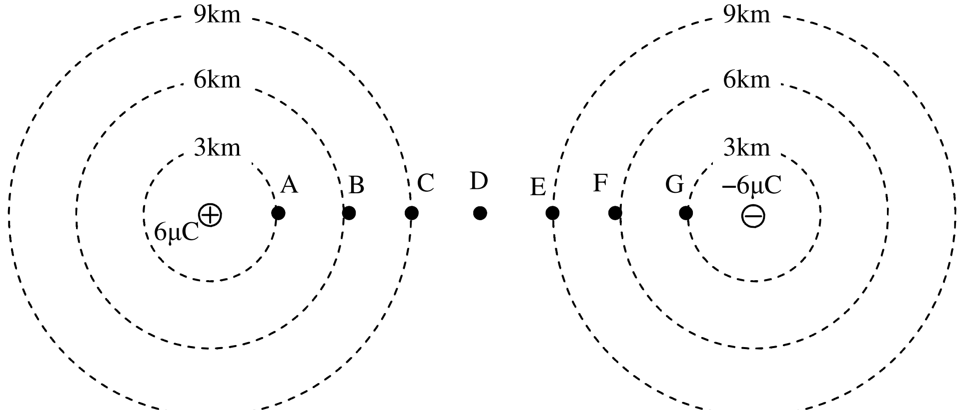
2A. 9V

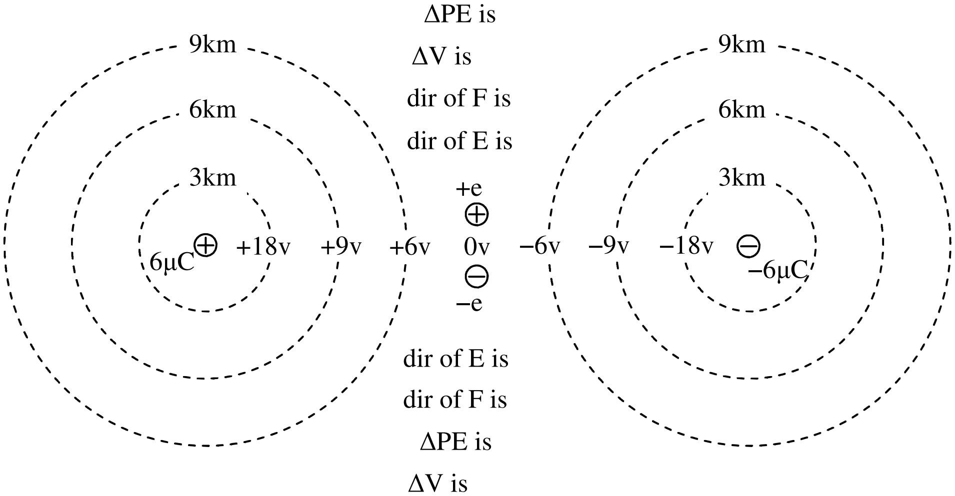
B. Twice as big = 18V

D. 3 times as far = 1/3 th potential = 6V

   E. Noticing that the distances are the same, but that the charge is negative, calculate the voltages at points E, F, and G.

   Now, we know that we would have to add the individual voltages together to get the net voltages at these points, but for our discussion it is sufficient to realize that the voltages near to the + charge are going to be more + and the ones near the − are more −. We should also see that the voltage at D is zero, since you are equidistant from the + and − charge.





I have now put all of the potentials (voltages) on the diagram for you, to simplify the following discussion. Notice that I have placed a +e and a −e at the 0V point. The +e stands for a positive elemental charge: a proton. The −e stands for a negative elemental charge: an electron.

3. In the spaces given on the diagram, give the direction of E and F (with arrows) and the change of PE and V (+ or −).

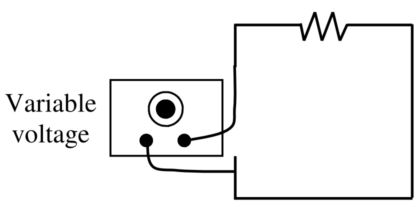
4. Describe the motion of the proton if released from rest.

5. Describe the motion of the electrons if released from rest.

6. Which one will have greater acceleration and why?

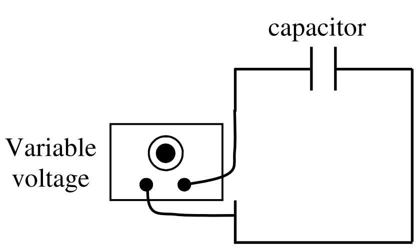
7. Which one will have the greater magnitude of change of PE?

8. Imagine a resistor is connected to a variable voltage supply.



A. If the voltage is increased, what changes in the circuit?
B. If the voltage is increased, how does that affect the resistance of the circuit?
C. How could you change the resistance?

9. The resistor is then replaced with a capacitor.



A. If the voltage is increased, what changes in the circuit?
B. If the voltage is increased, how does that affect the capacitance of the capacitor?
C. How could you change the capacitance?

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3. For +: E is →; F is →; ΔPE is − ; ΔV is − ;
For − : E is → (based on + test charge) F is ←; ΔPE is −; ΔV is + (toward + q);

4. accel to the right.

5. Accel to the left

6. Electron, 1/10,000 the mass of a proton

7. Same. Same V, same charge.

8.
A. Only current
B. No effect.
C. Change the resistor.

9.
A. Current
B. Doesn't—that's a fixed value for a fixed capacitor. But it will change the amount of q it holds.
C. Plates closer, bigger plates, insert a dielectric.