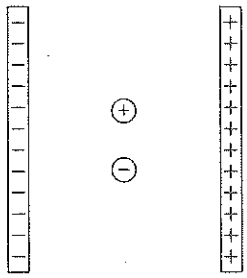
Chapter 28 - "The Electric Potential" Conceptual Questions

Name:_____

28.2 The Potential Energy of Point Charges



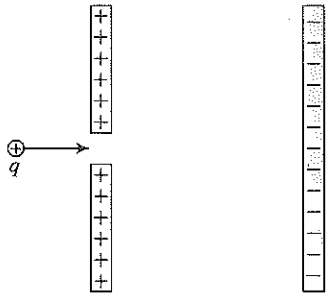
1. A positive point charge and a negative point charge are inside a parallel-plate capacitor. The point charges interact only with the capacitor, not with each other. Let the negative capacitor plate be the zero of potential energy for both charges.
   a. Use a **black** pen or pencil to draw the electric field vectors inside the capacitor.
   b. Use a **red** pen or pencil to draw the forces acting on the two charges.
   c. Is the potential energy of the *positive* point charge positive, negative, or zero? Explain.

   d. In which direction (right, left, up, or down) does the potential energy of the positive charge decrease? Explain.

   e. In which direction will the positive charge move if released from rest? Use the concept of energy to explain your answer.

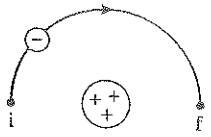
   f. Does your answer to part e agree with the force vector you drew in part b? _____
   g. Repeat steps c to f for the *negative* point charge.

2. A positive charge q is fired through a small hole in the positive plate of a capacitor. Does q speed up or slow down inside the capacitor? Answer this question twice:
   a. First using the concept of force.



   b. Second using the concept of energy.

5. An electron ($q = -e$) completes half of a circular orbit of radius r around a nucleus with $Q = +3e$.



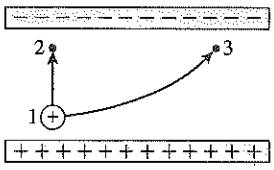
a. How much work is done on the electron as it moves from i to f? Give either a numerical value or an expression from which you could calculate the value if you knew the radius. Justify your answer.

b. By how much does the electric potential energy change as the electron moves from i to f?

c. Is the electron's speed at f greater than, less than, or equal to its speed at i?

d. Are your answers to parts a and c consistent with each other?

7. Inside a parallel-plate capacitor, two protons are launched with the same speed from point 1. One proton moves along the path from 1 to 2, the other from 1 to 3. Points 2 and 3 are the same distance from the negative plate.

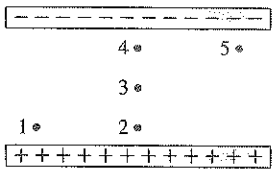


a. Is $\Delta U_{1\to 2}$, the change in potential energy along the path $1 \to 2$, larger than, smaller than, or equal to $\Delta U_{1\to 3}$? Explain.

b. Is the proton's speed v_2 at point 2 larger than, smaller than, or equal to v_3? Explain.

28.5 The Electric Potential Inside a Parallel-Plate Capacitor

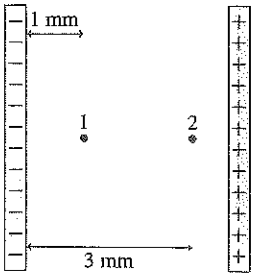
11. Rank in order, from largest to smallest, the electric potentials V_1 to V_5 at points 1 to 5.



Order:

Explanation:

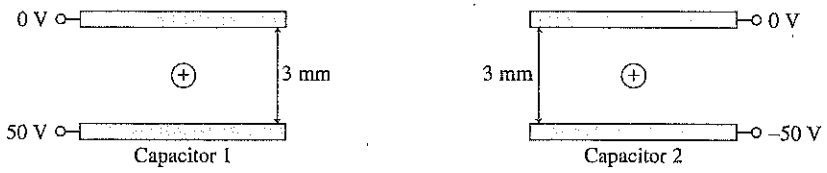
12. The figure shows two points inside a capacitor. Let $V = 0$ V at the negative plate.



a. What is the ratio V_2/V_1 of the electric potential at these two points? Explain.

b. What is the ratio E_2/E_1 of the electric field strength at these two points? Explain.

13. The figure shows two capacitors, each with a 3 mm separation. A proton is released from rest in the center of each capacitor.

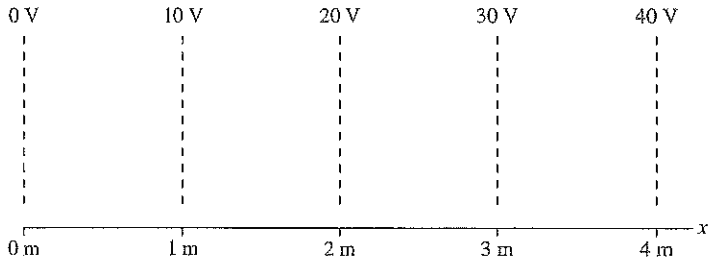


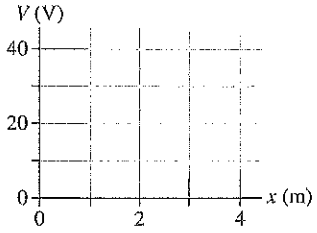
a. Draw an arrow on each proton to show the direction it moves.

b. Which proton reaches a capacitor plate first? Or are they simultaneous? Explain.

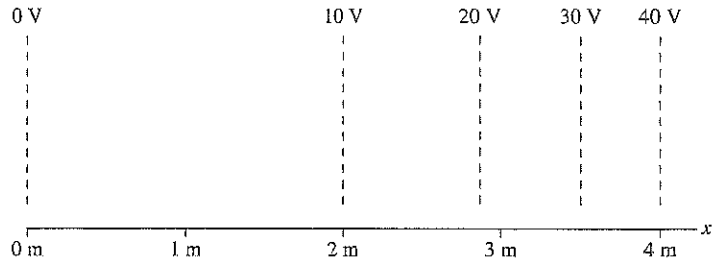
15. Each figure shows a contour map on the left and a set of graph axes on the right. Draw a graph of V versus x. Your graph should be a straight line or a smooth curve.

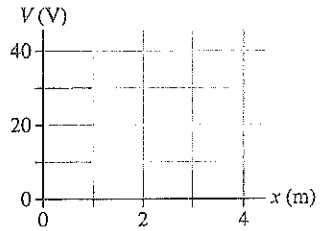
a.



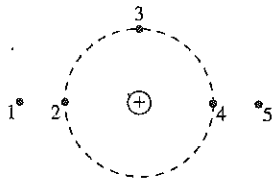


b.





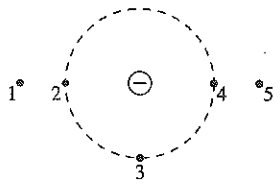
17. Rank in order, from largest to smallest, the electric potentials V_1 to V_5 at points 1 to 5.



Order:

Explanation:

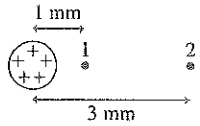
18. Rank in order, from least negative to most negative, the electric potentials V_1 to V_5 at points 1 to 5.



Order:

Explanation:

19. The figure shows two points near a positive point charge.

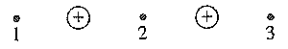


a. What is the ratio V_1/V_2 of the electric potentials at these two points? Explain.

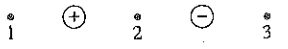
b. What is the ratio E_1/E_2 of the electric field strengths at these two points? Explain.

23. Each figure below shows three points in the vicinity of two point charges. The charges have equal magnitudes. Rank in order, from largest to smallest, the potentials V_1, V_2, and V_3.

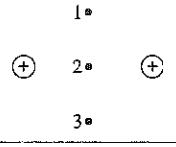
a.



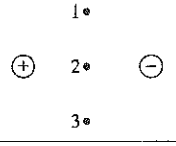
b.



c.

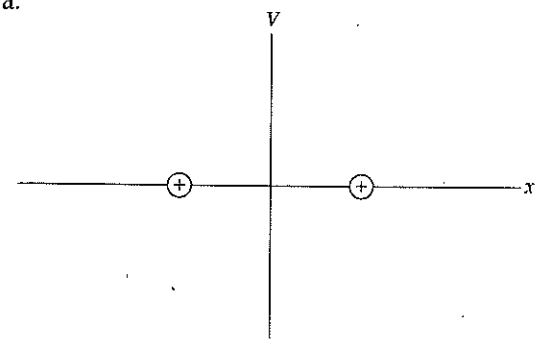


d.



24. On the axes below, draw a graph of V versus x for the two point charges shown.

a.



b.