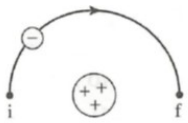
1.

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



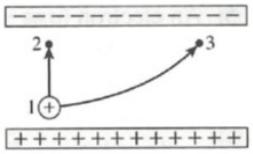
a. How much work is done on the electron as it moves from i to f? Give either a numerical value or an expression from which you could calculate the value if you knew the radius. Justify your answer.

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?

2.

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.

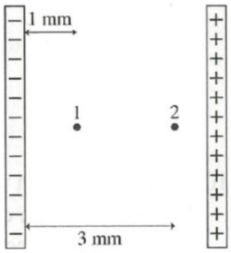


a. Is $\Delta U_{1\to 2}$, the change in potential energy along the path $1 \to 2$, larger than, smaller than, or equal to $\Delta U_{1\to 3}$? Explain.

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

3.

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 potentials at these two points? Explain.

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

4.

A capacitor with plates separated by distance d is charged to a potential difference ΔV_C. All wires and batteries are disconnected, then the two plates are pulled apart (with insulated handles) to a new separation of distance $2d$.

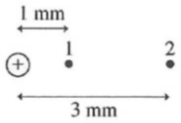
a. Does the capacitor charge Q change as the separation increases? If so, by what factor? If not, why not?

b. Does the electric field strength E change as the separation increases? If so, by what factor? If not, why not?

c. Does the potential difference ΔV_C change as the separation increases? If so, by what factor? If not, why not?

5.

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.

6.

An inflatable metal balloon of radius R is charged to a potential of 1000 V. After all wires and batteries are disconnected, the balloon is inflated to a new radius $2R$.

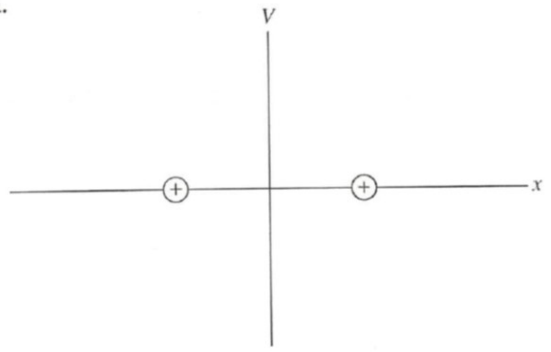
a. Does the potential of the balloon change as it is inflated? If so, by what factor? If not, why not?

b. Does the potential at a point at distance $r = 4R$ change as the balloon is inflated? If so, by what factor? If not, why not?

7.

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

a.



b.