SAMPLE PROBLEM A

Potential Energy and Potential Difference

PROBLEM

A charge moves a distance of 2.0 cm in the direction of a uniform electric field whose magnitude is 215 N/C. As the charge moves, its electrical potential energy decreases by 6.9×10^{-19} J. Find the charge on the moving particle. What is the potential difference between the two locations?

SOLUTION

Given: $\Delta PE_{electric} = -6.9 \times 10^{-19}$ J $\quad d = 0.020$ m
$E = 215$ N/C

Unknown: $q = ?$ $\quad \Delta V = ?$

Use the equation for the change in electrical potential energy.

$$\Delta PE_{electric} = -qEd$$

Rearrange to solve for q, and insert values.

$$q = -\frac{\Delta PE_{electric}}{Ed} = -\frac{(-6.9 \times 10^{-19}\ \text{J})}{(215\ \text{N/C})(0.020\ \text{m})}$$

$$\boxed{q = 1.6 \times 10^{-19}\ \text{C}}$$

The potential difference is the magnitude of E times the displacement.

$$\Delta V = -Ed = -(215\ \text{N/C})(0.020\ \text{m})$$

$$\boxed{\Delta V = -4.3\ \text{V}}$$

TIP *Remember that a newton·meter is equal to a joule and that a joule per coulomb is a volt. Thus, potential difference is expressed in volts.*

PRACTICE A

Potential Energy and Potential Difference

1. As a particle moves 10.0 m along an electric field of strength 75 N/C, its electrical potential energy decreases by 4.8×10^{-16} J. What is the particle's charge?
2. What is the potential difference between the initial and final locations of the particle in Problem 1?
3. An electron moves 4.5 m in the direction of an electric field of strength 325 N/C. Determine the change in electrical potential energy.