Answer on Question #68150 Physics / Other

A proton is released from rest at point A in a uniform electric field E that has a magnitude of 8.0×10^4 V/m. The proton undergoes a displacement $d = 0.50$ m to point B in the direction of E. Calculate the speed of the proton after completing the displacement.

Solution:

In the uniform electric field proton moves with constant acceleration

$$a = \frac{F}{m} = \frac{qE}{m}.$$

The displacement is related with acceleration by equation

$$d = \frac{v^2 - v_0^2}{2a}.$$

Thus the final speed of the proton

$$v = \sqrt{v_0^2 + 2ad} = \sqrt{2ad} = \sqrt{2\frac{qE}{m}d}.$$

Because the charge and mass of the proton are

$$q = 1.60{\times}10^{-19}\ \text{C}, \qquad m = 1.67{\times}10^{-27}\ \text{kg}$$

we find

$$v = \sqrt{2{\times}\frac{1.60{\times}10^{-19}{\times}8.00 \times 10^4}{1.67{\times}10^{-27}}0.50} = 2.77{\times}\ 10^6\frac{m}{s}.$$

Answer: $v = 2.77{\times}\ 10^6\frac{m}{s}$.