23. SSM ***REASONING*** The only force acting on the moving charge is the conservative electric force. Therefore, the sum of the kinetic energy KE and the electric potential energy EPE is the same at points A and B:

$$\tfrac{1}{2}mv_A^2 + \text{EPE}_A = \tfrac{1}{2}mv_B^2 + \text{EPE}_B$$

Since the particle comes to rest at B, $v_B = 0$. Combining Equations 19.3 and 19.6, we have

$$\text{EPE}_A = qV_A = q\left(\frac{kq_1}{d}\right)$$

and

$$\text{EPE}_B = qV_B = q\left(\frac{kq_1}{r}\right)$$

where $d$ is the initial distance between the fixed charge and the moving charged particle, and $r$ is the distance between the charged particles after the moving charge has stopped. Therefore, the expression for the conservation of energy becomes

$$\tfrac{1}{2}mv_A^2 + \frac{kqq_1}{d} = \frac{kqq_1}{r}$$

This expression can be solved for $r$. Once $r$ is known, the distance that the charged particle moves can be determined.

***SOLUTION*** Solving the expression above for $r$ gives

$$r = \frac{kqq_1}{\tfrac{1}{2}mv_A^2 + \dfrac{kqq_1}{d}}$$

$$= \frac{(8.99\times10^9\ \text{N}\cdot\text{m}^2/\text{C}^2)(-8.00\times10^{-6}\ \text{C})(-3.00\times10^{-6}\ \text{C})}{\tfrac{1}{2}(7.20\times10^{-3}\ \text{kg})(65.0\ \text{m/s})^2 + \dfrac{(8.99\times10^9\ \text{N}\cdot\text{m}^2/\text{C}^2)(-8.00\times10^{-6}\ \text{C})(-3.00\times10^{-6}\ \text{C})}{0.0450\ \text{m}}}$$

$$= 0.0108\ \text{m}$$

Therefore, the charge moves a distance of $0.0450\ \text{m} - 0.0108\ \text{m} = \boxed{0.0342\ \text{m}}$.