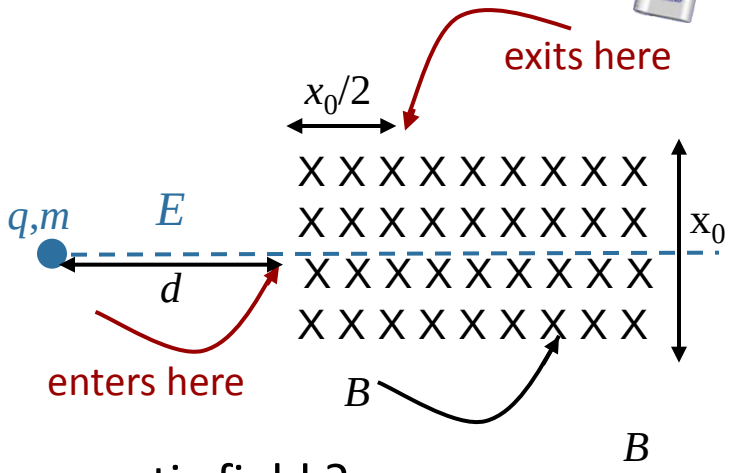
Calculation

A particle of charge q and mass m is accelerated from rest by an electric field E through a distance d and enters and exits a region containing a constant magnetic field B at the points shown. Assume q,m,E,d, and x_0 are known.

What is B?



What is v_0, the speed of the particle as it enters the magnetic field ?

$v_o = \sqrt{\frac{2E}{m}}$ A

$v_o = \sqrt{\frac{2qEd}{m}}$ B

$v_o = \sqrt{2ad}$ C

$v_o = \sqrt{\frac{2qE}{md}}$ D

$v_o = \sqrt{\frac{qEd}{m}}$ E

Why?

Conservation of Energy

Initial: $Energy = U = qV = qEd$

Final: $Energy = KE = \frac{1}{2}\, mv_0^2$

$\rightarrow \frac{1}{2}mv_o^2 = qEd \rightarrow v_o = \sqrt{\frac{2qEd}{m}}$

Newton's Laws

$a = F/m = qE/m$

$v_0^2 = 2ad$

$\rightarrow v_o^2 = 2\frac{qE}{m}d \rightarrow v_o = \sqrt{\frac{2qEd}{m}}$