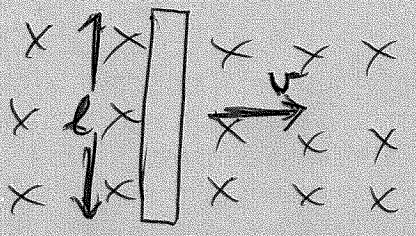
Ch 13 Prob 43

$\ell = 25\,cm$

$v = 5.0\,m/s$

$B = 0.25\,T$



a) Find the magnetic force on an electron

$$\vec{F}_m = q\vec{v}\times\vec{B} = (-1.6\times10^{-19}C)\left[(5.0\,\hat{i}\,\tfrac{m}{s})\times(0.25\,\hat{k}\,T)\right]$$

$$\boxed{\vec{F}_m = -2.0\times10^{-19}\,\hat{j}\;N}$$

b) Find the electric field in the rod

$$\vec{F}_e = -\vec{F}_m \rightarrow q\vec{E} = -q(\vec{v}\times\vec{B}) \rightarrow \vec{E} = -\vec{v}\times\vec{B}$$

$$\vec{E} = -(5.0\,\hat{i}\,m/s)\times(-0.25\,\hat{k}\,T)$$

$$\boxed{\vec{E} = -1.25\,\hat{j}\;\frac{V}{m}}$$

c) Find the potential difference between the ends of the rod.

$$E = \frac{\Delta V}{\ell} \rightarrow \Delta V = -\ell\cdot\vec{E} = -(0.25m)(-1.25\,\hat{j}\,\tfrac{V}{m})$$

$$\boxed{\Delta V = 0.313\,V}$$

Higher potential at the top of the rod

d) What is the speed of the rod if the potential difference is 1.0V?

$$\Delta V = \ell\cdot vB \Rightarrow v = \frac{\Delta V}{\ell B} = \frac{(1.0V)}{(0.25m)(0.25T)}$$

$$\boxed{v = 16\,m/s}$$