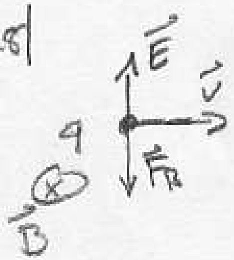
PHYS 115 HW #4

20.28|



$\vec{v} = v_0\hat{x}$

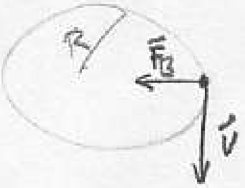
$\vec{F}_B = \vec{F}_E$

$q\vec{v}\times\vec{B} = q\vec{E}$

$v_0\hat{x}\times\vec{B} = E_0\hat{y}$ hence $\hat{x}\times\vec{B} = \hat{y} \rightarrow \hat{B} = \hat{z}$

$|\vec{B}| = \frac{E_0}{v}$

20.29| Since $q>0$



$\vec{B}$ points out of the page

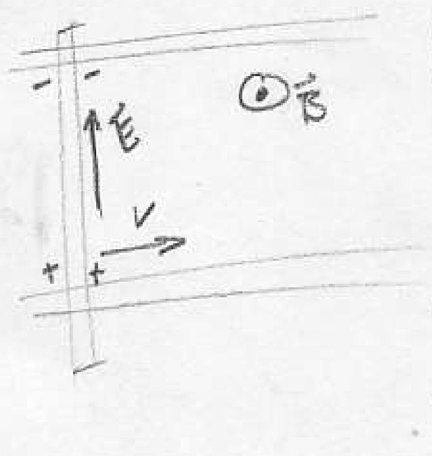
$T = \frac{2\pi}{\omega}$ $v = \omega R$ $F_B = qvB = \frac{mv^2}{R}$

$B = \frac{mv^2}{R}\frac{1}{qv} = \frac{m}{qR}\omega R = \frac{m}{q}\frac{2\pi}{T}$

$T = 80\cdot10^{-9}\,s$

$m = 4m_p$ $q = 2e$ $|\vec{B}| \approx 1.64\,T$

20.36|



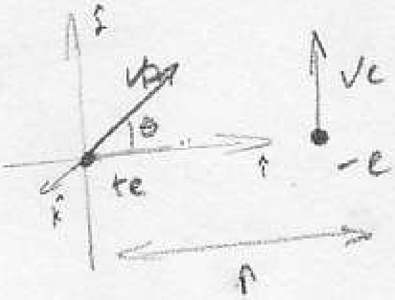
At a steady speed $q|\vec{v}\times\vec{B}| = q|\vec{E}|$

$vB = E$

$\Delta V = -\int\vec{E}\cdot d\vec{l} = EL = vBL$ as $\vec{E}$ is constant in rod

Pushing to the right is not needed to maintain $\vec{v}$ as the work to polarize the bar is already done

20.49



$$\vec{V}_p = V_p(\cos\theta\,\hat{i} + \sin\theta\,\hat{j})$$
$$\vec{V}_e = V_e\,\hat{j}$$

At the electron

$$\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{e}{r^2}\,\hat{i} \qquad \vec{B} = \frac{\mu_0}{4\pi}\frac{q\vec{v}\times\hat{r}}{r^2}$$

$$\vec{B} = \frac{\mu_0 e}{4\pi r^2} V_p \sin\theta\,(-\hat{k})$$

$$\vec{F} = \frac{-e^2}{r^2}\left(\frac{1}{4\pi\epsilon_0}\,\hat{i} - \frac{\mu_0}{4\pi}V_eV_p\sin\theta\,\hat{i}\right)$$

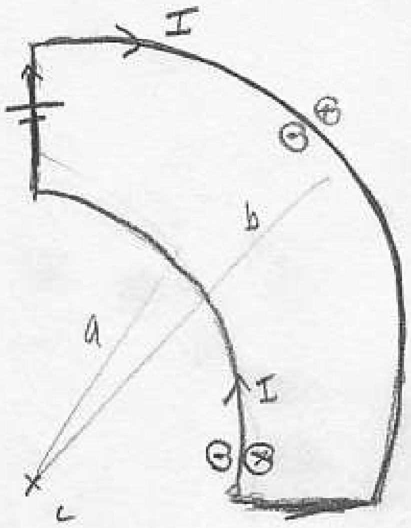
At the proton:

$$\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{e}{r^2}\,\hat{i} \qquad \vec{B} = \frac{\mu_0}{4\pi}\frac{q\vec{v}\times\hat{r}}{r^2} = \frac{\mu_0 e V_e}{4\pi r^2}\hat{k}$$

$$\vec{F} = q\vec{E} + q\vec{v}\times\vec{B} = -\frac{e^2}{r^2}\left(\frac{1}{4\pi\epsilon_0}\,\hat{i} + \frac{\mu_0}{4\pi}V_eV_p\left[\cos\theta\,\hat{j} - \sin\theta\,\hat{i}\right]\right)$$

Forces are <u>not</u> equal and and opp. for F_B, momentum will not be conserved – the fields around the particle will carry the "missing" momentum.

20.48|



Only the curved sections will contribute to $\vec{B}$ at point C, the field from wire a is stronger thus $\vec{B}$ is <u>out of the page.</u>

$$|\vec{B}_{loop}| = \frac{\mu_0}{4\pi} I \int \frac{|d\vec{\ell} \times \hat{r}|}{r^2}$$

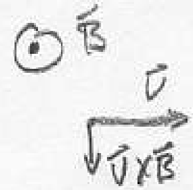
$$= \frac{\mu_0}{4\pi} I \int_0^{\pi/2} \frac{1}{r^2} (r\,d\theta)$$

$$= \frac{\mu_0}{4\pi} \frac{I}{r} \frac{\pi}{2} = \frac{\mu_0 I}{4r} \frac{1}{2}$$

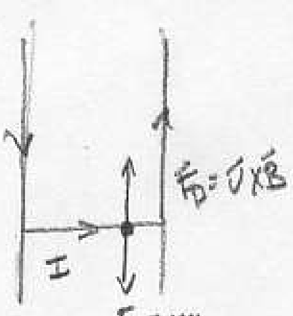
$$\vec{B} = \frac{\mu_0}{4} \frac{I}{2} \left(\frac{1}{a} - \frac{1}{b} \right)$$ out of the page

$$\vec{F} = -e \vec{v} \times \vec{B} = -evB$$ downwards

$= evB$ upwards



20.62|



$$\vec{F}_B = \vec{F}_g$$

$$ILB = mg$$

$\vec{B}$ must point out of the page — $\vec{v} \times \vec{B}$ needs to be up

$$B = \frac{mg}{IL} = \frac{(70g)(9.8\,m/s^2)}{(5A)(.12\,m)} = 1.14T$$

20.69|

We first aim to find I of the circuit ε R $R = \frac{L}{\sigma A} = \frac{L}{|q| n u A}$

With a current we have the hall effect $I = \mathcal{E}/R$

$$\Delta V_{hall} = vBh = \frac{\mathcal{E} u B h}{L} \approx -1.77 \cdot 10^{-5} V$$

voltmeter will be (+)