1) Short Answer cont'd (Show Your Work!)

a) What is the magnitude of the force on a proton moving at a velocity of 100 m/s if the proton is moving at an angle of 97 degrees with respect to a B field iof strength 10 mT?

$|F| = 1.59 \times 10^{-19}\ N$

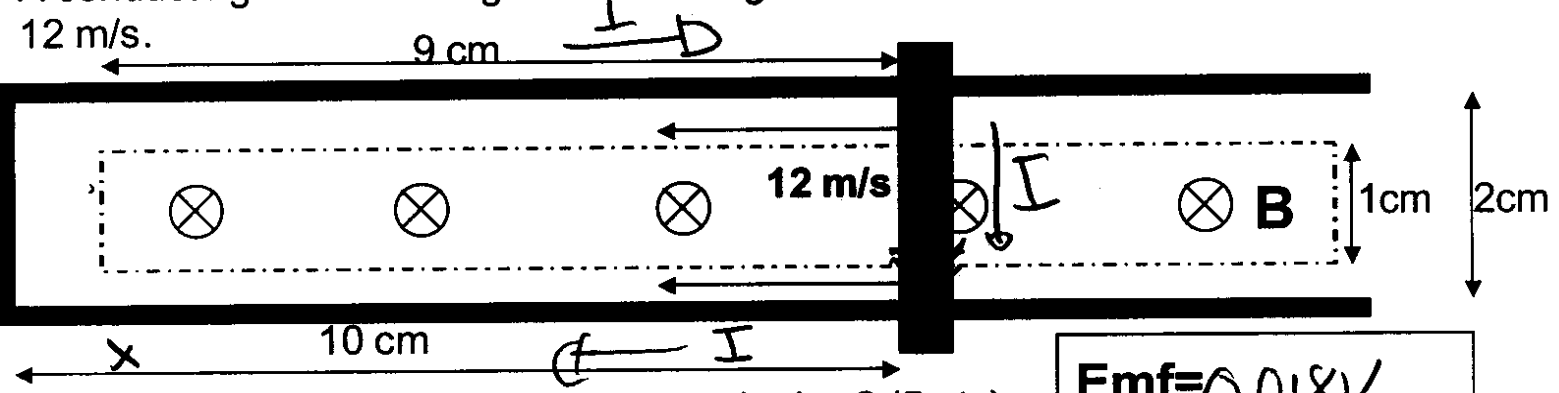
$\vec{F} = q\vec{v} \times \vec{B}$

$|F| = |q||v||B|\sin\theta$

$= (1.6 \times 10^{-19} C)\left(100 \frac{m}{s}\right)\left(0.01 \frac{N}{mA}\right) \sin 97^\circ$

$= 1.59 \times 10^{-19}\ N$

The B Field inside the dashed area shown below has a magnitude of 0.150T. A conducting bar is moving on conducting rails as shown with a constant velocity of 12 m/s.



b) What is the EMF induced across the bar? (5 pts)

Emf = 0.018V

$\mathcal{E} = -\frac{d\Phi}{dt} = -\frac{d}{dt}(0.150T)(0.01m)(x)$

$= (0.150T)(0.01m)(12 m/s) = 0.018V$

c) Indicate the direction current flows in the bar due to the induced emf.

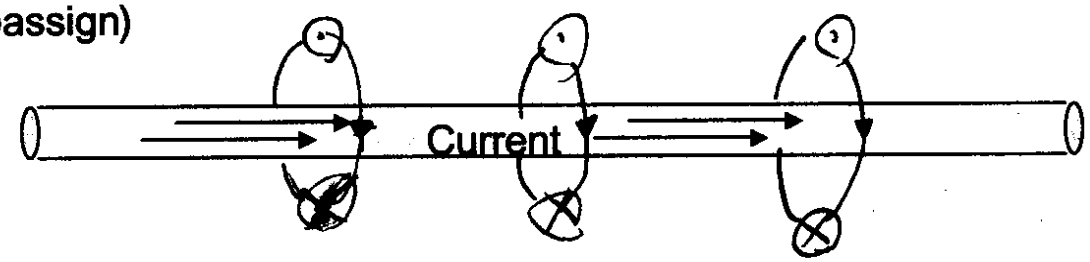
goes down

$I\vec{\ell} \times \vec{B}$ to right

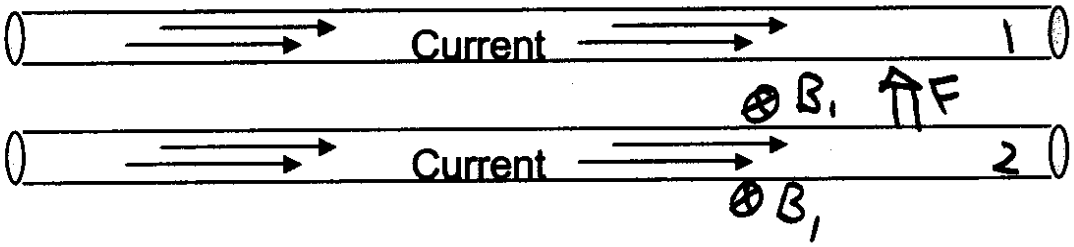
opposes v

1) Short Answer cont'd (don't forget to justify your answer!)

d) What does the B field around a wire carrying current look like?(Not in Webassign)



e) Are the wires below attracted to each other or ~~repelled~~?(Not in Webassign)



f) If I make a solenoid of length 1.0 m length of thin (~1 mm diameter) wire wrapped in a single layer around a plastic pipe, which pipe is likely to give me the bigger total magnetic flux inside the ~~solenoid~~?

1cm diameter pipe

2cm diameter pipe

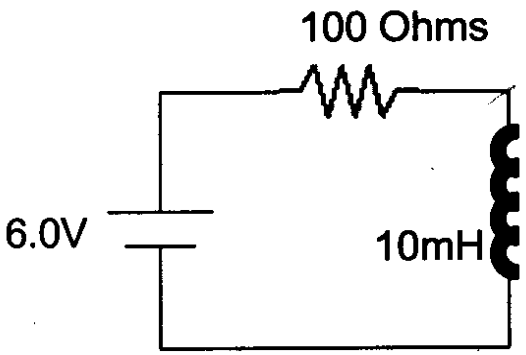
A bigger

N is same

$\frac{N}{l}$ is same

~ B is same

g) For L = 10mH, how fast is energy being stored in the inductor if the current in the circuit is 10mA?



I = 10mA

Battery gives 60mW or 1V loss across Resistor

Resistor burns 10mW

5V across L

(5V)(.01A) = 50mV

so 50mW in inductor

$P_{IND} = 50mW$

g) If Current was 0 at t = 0s how long till the power being dissipated by the resistor is greater than the power being stored in the inductor?

occurs @ point where $P_R = P_L = I^2R$

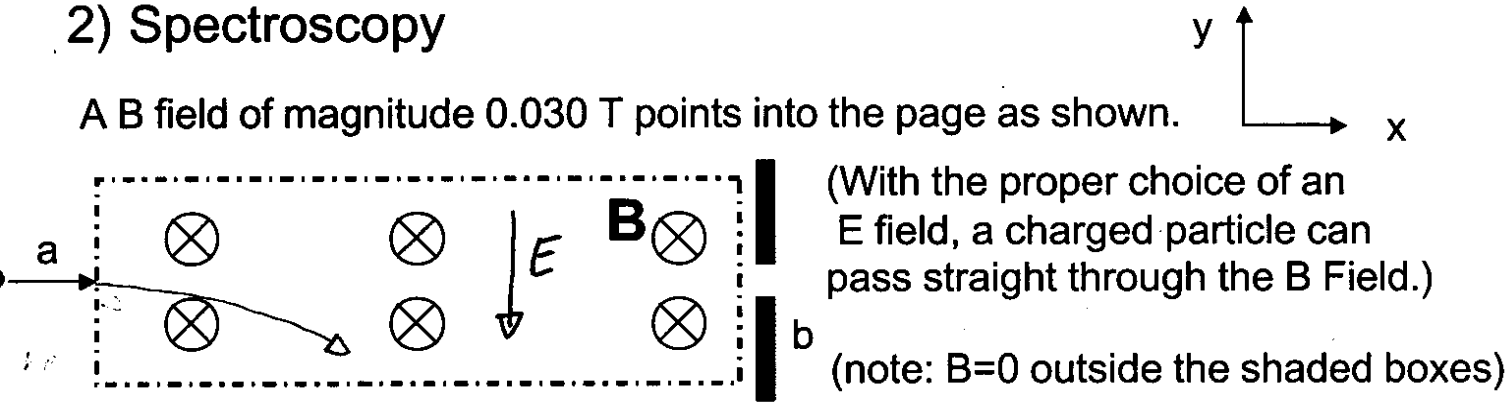
or $2I^2R = V_{batt} I$ $\quad I = \frac{1}{2}\left(\frac{V}{R}\right) = \frac{V}{R}(1 - e^{-t/(L/R)})$

$t = 69.3\mu s$

$\ln(0.5) = -t/(L/R)$ $\quad t = -\frac{10mH}{100\Omega}\ln(0.5) = 69.3\mu s$

2) Spectroscopy

A B field of magnitude 0.030 T points into the page as shown.



(With the proper choice of an E field, a charged particle can pass straight through the B Field.)

(note: B=0 outside the shaded boxes)

A charged particle, moving in the x direction, is incident on this B field at "a" (as shown). Indicate on the figure how the particle moves in the B field if it has a negative charge. (2 pts)

We want to force the particle to move straight along the x direction in the magnetic field by using an electric field to counteract the force on the particle due to the magnetic field. If the particle is moving at 10,000 m/s and has a charge of -1e, what is the magnitude of the E field needed, and which direction should it point? Is it different for a positively charged particle? (explain) (8 pts)

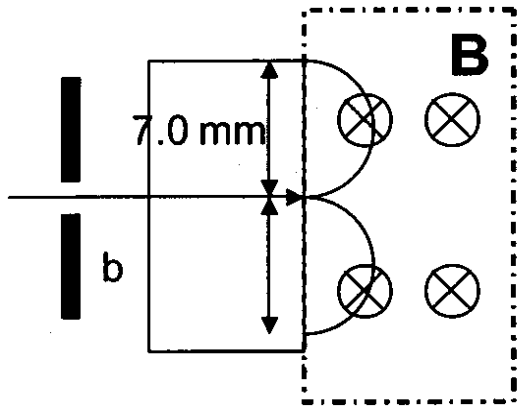
$F = qvB = qE \qquad |E| = vB$

$= 10^4 \frac{m}{s}\ 0.030 \frac{N}{Am}$

$= 300 N/C$

|E| = 300 N/C

show direction on figure



After the 10,000 m/s negatively (-1e) charged particle passes through the slit at b, it enters another area of magnetic field of magnitude 0.030 T, and the particle moves in a half circle of diameter 7.0 mm. What is the mass of this particle? (10 points)

Mass=

$F = qvB = \frac{mv^2}{r}$

$m = \frac{rqB}{v} = \frac{\left(\frac{0.007 m}{2}\right)(1.6\times10^{-19} C)\,0.030 \frac{N}{Am}}{10^4 m/s}$

$= 1.68\times10^{-27} kg$

We just discovered the anti-proton!