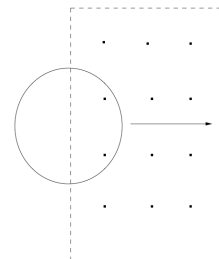


PHYS 2401-H01 Practice exam #3, Spring 2008

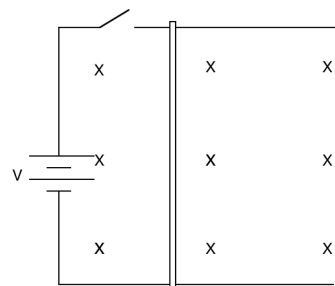
Short questions

1. The loop is being pushed into the field, which points out of the paper. Find the direction of the induced current. (clockwise or counterclockwise)



2. A wire of circular cross section and radius 2.0 cm carries a uniform current density with a total current of 5.5 A. What is the magnitude of the magnetic field a distance of 1.20 cm from the axis of the wire? (this is inside the wire!)

3. The linear motor on the right has its switch closed at $t=0$. Describe the subsequent motion of the bar and WHY it does what it does.



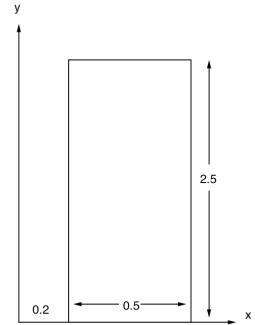
4. When an air conditioner (with a large compressor motor) turns on in a house, the lights dim briefly. Why do they dim, then come back to their original power level?

5. The current in a 45 mH inductor decreases from 25 A to 0 A in 2.5 ms. Find the average induced EMF across the inductor.

6. A transformer steps-up an input voltage by a factor of 20. If the input current is 5.5 A, what is the output current assuming perfect efficiency?

7. A 2.5 N force is pushing a 10 turn, 1.5 Ohm rectangular coil into a rectangular region of 5.0 T field perpendicular to the plane of the coil. Find the terminal velocity of the coil before it is fully immersed in the magnetic field.

8. The rectangular loop on the right lies in a magnetic field of $\mathbf{B} = (2.5 \text{ T/m})x$ in the +z direction. Find the magnetic flux through the loop. The dimensions are in meters.



9. The current in a series RL circuit rises from zero to 1/3 of its final value in 2.5 ms. If the capacitance is 45 microFarads, what is the inductance?

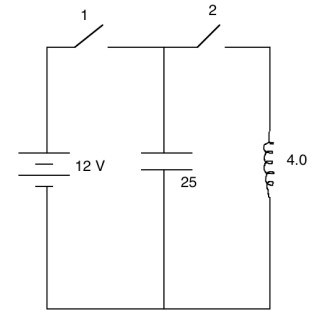
Long problems

1. A 200 turn, circular coil with a radius of 0.052 m lies in the x-y plane. A magnetic field in the z direction has an initial magnitude of 2.3 T.

a) If the field strength drops to 1.2 T in 0.035 seconds, what is the average EMF induced in the coil?

b) After the field is decreased, its magnitude and direction are held constant. Now the coil is flipped by 90 degrees clockwise about the y axis in 0.012 s. Find the average EMF induced.

2. In the circuit on the right, switch 1 has been closed for a long time. C is in microFarads and L is in milliHenrys.
- a) What is the charge on the capacitor?



Now at $t=0$ we open switch 1 and close switch 2.

- b) What is the frequency of oscillation of the current through the inductor?

- c) What is the current through the inductor 2.0 milliseconds after switch 2 is closed?

- d) How much energy is stored in the capacitor at the time in part c)?

3. A long straight wire lies on the y axis and carries a current of 25 A in the positive y direction.

- a) If there is a second wire in the x - y plane at $x=23$ cm which is parallel to the first wire and carries a current of 15 A in the $-y$ direction, for what value of x is the magnetic field zero?

- b) Now remove the second wire. A 20 cm long piece of wire is parallel to the y axis and lies in the x - y plane. It is being pulled in the x direction at a constant speed v . Find the motional EMF induced between the ends of the wire as a function of the distance it is away from the first wire. (Hint: use the chain rule for derivatives and $v=dx/dt$).

