Overview for test

1.) Know the definition of magnetic flux, including definition of *direction of area vector* and being able to do calculation when *B-fld vector* and *area vector* don't line up (i.e., when angle between the two isn't zero or 180 degrees).

2.) Be able to look at a coil and tell if there is a magnetic flux through it.

3.) Be able to look at a coil and tell if it is experiencing an induced EMF and, if so, be able to calculate the EMF's magnitude. (EMF = -N(delta flux)/(delta time))

4.) Be able to use Lenz's Law.

5.) Be able to use Ohm's Law to calculate the current in a coil experiencing an induced EMF. (EMF = iR)

6.) In a motional EMF problem, be able to determine the direction of the force on a coil experiencing an induced EMF while in an external B-fld. (always fighting change)

7.) Understand Eddy Currents.

8.) Look at Multiple Choice problems for the Faraday's Law section.

9.) Know the algebraic symbols and units for magnetic flux, induced EMF and inductance.

10.) Know the *circuit symbols* for transformers and inductors.

11.) Know the difference between a step-up and step-down transformer

12.) Be able to "do" a transformer problem (using the winds-ratio relationship Nprim/Nsec).

13.) Know the various names for a coil in a circuit.

14.) Know how an inductor acts in a DC circuit. That is, when a switch is closed, what does the current do? What does the current do after the switch has been closed for a long period of time?

15.) Be able to calculate the time constant for an RL circuit

16.) Understand what the time constant of an RL circuit tells you.

Overview for test

9.) Look at the multiple choice problems for Faraday's Law (i.e., "induction" problems)

10.) Know the symbol and unit for magnetic flux, induced EMF, inductance.

Actually, I did, but still know it!

11.) Know the symbol for a transformer (I didn't give this to you in class, but it can now be found as the last page of the TRANSFORMERS pdf in the "class pdfs" Faraday's Law folder---FYI: it is two coils side by side with three lines between them—it is meant to depict two coils that are not electrically connected but that are magnetically coupled by the three lines)

12.) Be able to use the relationship associated with transformers, and be able to tell the difference between a step-up and step-down transformer.

Both for voltage and for current

13.) Know how an inductor acts in a DC circuit (what's the initial and final current in a circuit when the switch it thrown and opened, and what is the time constant . . . and what does the time constant tell you).

Modified Fletch's 17.9

17.9) For the *RL circuit* shown in Figure III, the inductance is 1.5 henrys and the inductor's internal resistance is 6 ohms. A current of 2.5 amps has been flowing in the circuit for a long time. At $t = 0$, the power is switched off and the current begins to die.

a.) What is the voltage across the inductor BEFORE $t = 0$?

b.) After .05 seconds, the current has dropped to approximately one-third of its original value. Determine the resistance of the resistor R. (Hint: think about the *time constant* of an RL circuit and what it tells you).

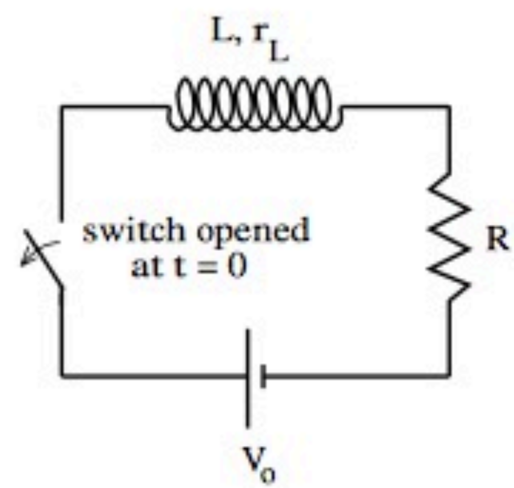


FIGURE III

c.) What's the voltage of the power source?

Modified Fletch's 17.9 - solution

a.) Before t = 0, the circuit has steady-state current flowing at 2.5 A, so the voltage drop across the inductor can be found by Ohm's Law:

V = IR = (2.5 A)(6 ohms) = **15 V**

b.) For opening a switch, after one time constant, the circuit will lose about 63% of its max current, or reach about 37% of its max current. That's close enough to 1/3 for us to use, so the time constant is about 0.05 seconds. Knowing that, and L:

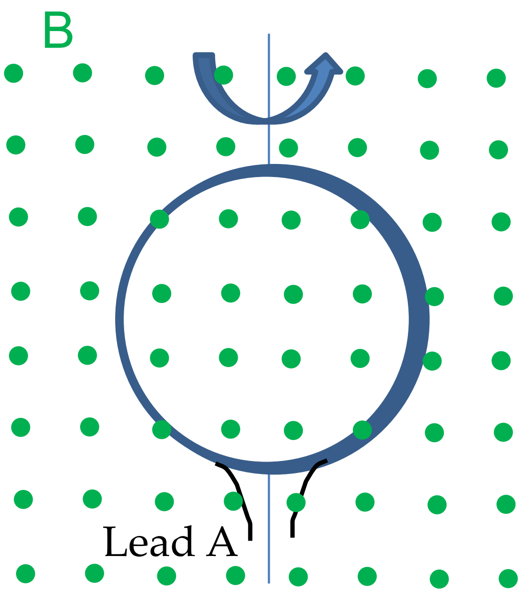
$$\boldsymbol{\tau = \frac{L}{(R+r_L)} \rightarrow R = \left(\frac{L}{\tau}\right) - r_L = \left(\frac{1.5\ H}{0.05\ s}\right) - 6\Omega = 24\ \Omega}$$

c.) To get the voltage of the battery, add up the voltage drops across each element during steady-state current:

V = IR = (2.5 A)(6 ohms + 24 ohms) = **75 V**

Another quick review

Consider the loop (radius r) shown below, in the external magnetic field B as shown. The loop has two leads (A and B) as shown. The coil begins to rotate into the page -- as it passes through all four quadrants of a rotation (that is, from 0-90, 90-180 etc), which way will a current be in induced, and which lead (A or B) will be the "positive" one for each quadrant?



What is this producing?

AC current!

Demos!

- Wheel + magnet (eddy brake)
- More eddy brakes
- Transformer (hopefully)
- Pretty blinky lights
- Motional EMF problem…in ACTION!
- Maybe some others…?

Fletch's 17.4

17.4) Each of the loops in the figure are identical. Each has a length of .2 meters, a width of .08 meters, and a resistance of 4 ohms. Each is moving with a velocity magnitude of .28 m/s, and *Loops A, C,* and *F* each have .05 meters of their lengths *not in the magnetic field* at the time shown in the sketch (that is, the length *outside the field* at the time shown is .05 meters for each of those loops). The magnetic field in the shaded region is *into the page* with a magnitude of $B = 3x10^{-2}$ *teslas.*

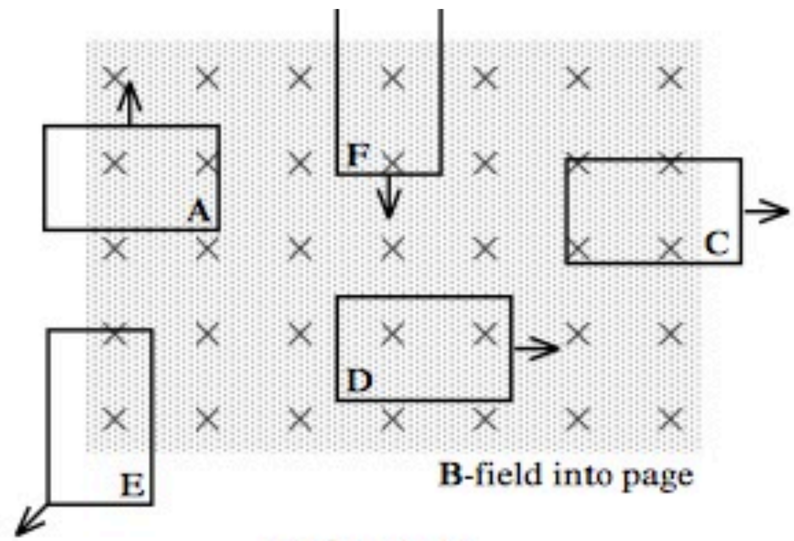


FIGURE II

a.) What is the direction of the induced current for each loop at the instant shown in the sketch?

b.) What is the induced EMF generated in *Loops A, C,* and *F* at the instant shown?

c.) What is the magnitude and direction of the induced magnetic force felt by *Loop F* at the instant shown?

d.) What is the direction of the induced magnetic force on *Loops A, C,* and *D* at the instant shown?