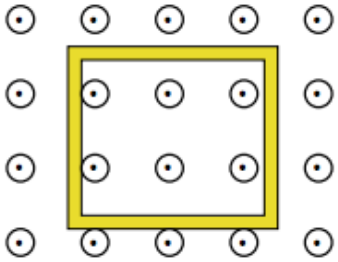
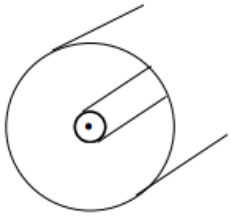
Chapter 20 – XtraWrk – Magnetic induction, Faraday, and Lenz

20.1) Determine the magnetic flux through a rectangular coil in the plane of the page as shown, due to a 0.5-T magnetic field oriented out of the page. Assume the coil's dimensions are 0.08 m by 0.12 m.

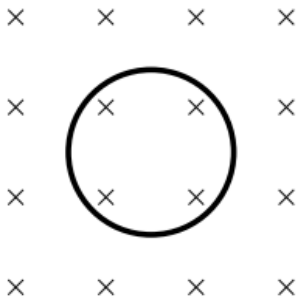


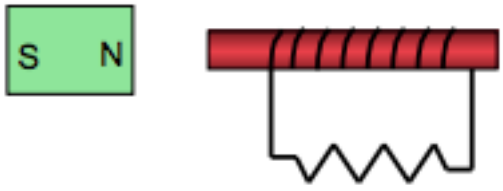


20.4) A long, straight, current-carrying wire (I = 2 A) resides along the central axis of a cylinder with L = 3.00 m and radius = 0.500 m. What is the magnetic flux through the cylinder?

20.8) A magnetic field rises from zero to 1.5 T in 0.12 seconds. What's the induced EMF in a coil of radius 0.0016 m placed within that changing field?

20.10) Determine the magnetic flux through a coil (with a face in the plane of the page) due to a 0.15 T magnetic field oriented perpendicular to the page as shown. The coil's radius is 0.12 m. If the field goes to zero in 0.2 seconds, what's the induced EMF?

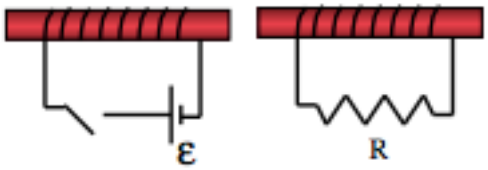


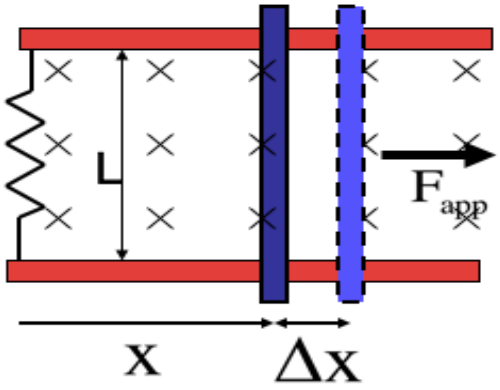


20.15) What is the direction of current in the resistor if the magnet (in green) is moved:
a.) to the left, relative to its starting position shown?
b.) to the right, relative to its starting position shown?

20.16) What's the direction of current in the secondary coil (e.g. through the resistor):

a.) at the moment that the primary switch is closed?
b.) several minutes after the switch is closed?
c.) at the moment the switch is opened?

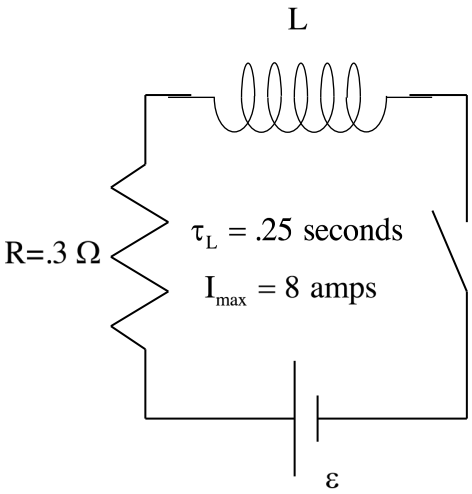


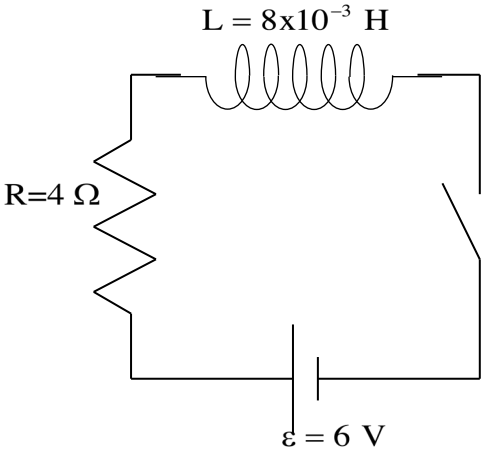


20.30) At what speed should the blue bar move to produce a current of 0.5 A in the resistor if R = 6 Ω, L = 1.2 m, and B = 2.5 T into the page?

20.45) For the circuit shown, determine:

a.) the battery voltage
b.) the inductance in the circuit
c.) the current after one time constant
d.) the voltage across the resistor after one time constant
e.) the voltage across the inductor after one time constant



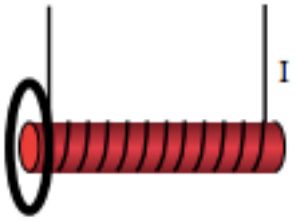


20.48) For the circuit shown:

a.) what's the time constant?
b.) What's the current in the circuit after 250 microseconds?
c.) what is the final steady-state current?
d.) how long does the current take to reach 80% of its maximum value?

20.61) The charge flow in a bolt of lightning drops from 6.02×10^6 A to zero in 10.5 microseconds. A 100-turn coil of radius 0.8 m is 200 meters away. What is the induced EMF in the coil?

20.64) A 5-cm aluminum ring with resistance 3×10^{-4} Ω is placed around a 1000 *turn per meter* solenoid. If the current in the solenoid increases at a constant rate of 270 A/s, what's the induced current in the ring? Assume the solenoid's magnetic field at its end is half its magnetic field at its center, which can be found by the equation $\mu_o nI$, where n is the number of turns per meter in the coil.



20.67) A loop of mass m, resistance R, and dimensions w and L falls from rest into a magnetic field as shown. During the time interval <u>before</u> the top edge of the loop reaches the field, the loop reaches terminal velocity.

a.) What's that terminal velocity?
b.) Why is the terminal velocity proportional to R?
c.) Why is the terminal velocity inversely proportional to B^2?