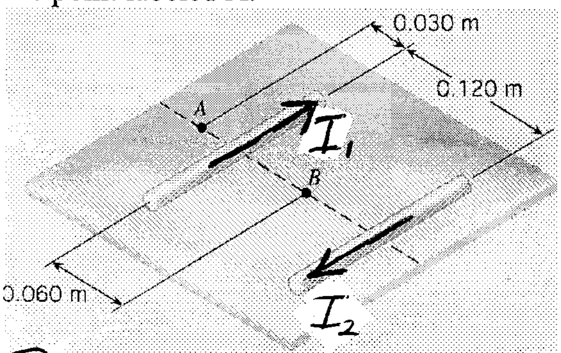
Phys 132 - Fund Phys 2 - Homework 17
Due: Thursday, April 11, 2007

Name: Solutions

1. Chapter 21, Problem 72a: Two long, straight wires are separated by 0.120 m. The wires carry currents of 8.0 A in opposite directions, as the drawing indicates. Find the magnitude of the net magnetic field at the point labeled A.



$B_{1A} = \frac{\mu_0 I}{2\pi R_{1A}} = \frac{\mu_0 (8.0 A)}{2\pi (0.030 m)} = 5.33 \times 10^{-5} T$

$B_{2A} = \frac{\mu_0 (8.0 A)}{2\pi (0.150 m)} = 1.07 \times 10^{-5} T$

$B_A = B_{1A} - B_{2A} = 4.3 \times 10^{-5} T$ (Up)

$B_B = B_{2A} + B_{2B} = 2(2.67 \times 10^{-5} T) = 5.33 \times 10^{-5} T$ (Down)

(A) 4.3×10^{-5} T B) 1.1×10^{-5} T C) 5.3×10^{-5} T D) 2.7×10^{-5} T E) 3.7×10^{-5} T

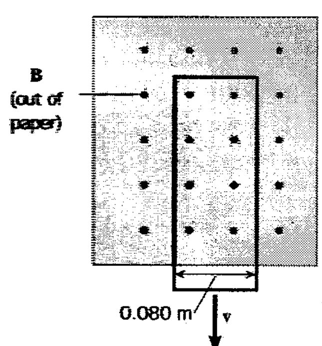
2. Chapter 21, Problem 72b: Repeat the previous problem for the point labeled B.
A) 4.3×10^{-5} T B) 1.1×10^{-5} T (C) 5.3×10^{-5} T D) 2.7×10^{-5} T E) 3.7×10^{-5} T

3. Chapter 22, Problem 4: In 1996, NASA performed an experiment called the Tethered Satellite experiment. In this experiment, a 20000 m length of wire was let out by the space shuttle Atlantis to generate a motional EMF. The shuttle had an orbital speed of 7600 m/s, and the magnitude of the earth's magnetic field at the location of the wire was 5.1×10^{-5} T. If the wire was moving perpendicular to the magnetic field, what would have been the motional EMF generated between the ends of the wire?
A) 8600 V (B) 7800 V C) 5500 V D) 4600 V E) 9100 V

$\mathcal{E} = vLB = (7600 \ m/s)(20000)(5.1 \times 10^{-5} T)$

4. A conducting loop of wire is placed in a magnetic field that is normal to the plane of the loop. Which one of the following actions will not result in an induced current in the loop?
(A) Rotate the loop about an axis that is parallel to the field and passes through the center of the loop.
B) Increase the strength of the magnetic field. Only A changes flux.
C) Decrease the area of the loop.
D) Decrease the strength of the magnetic field.
E) Rotate the loop about an axis that is perpendicular to the field and passes through the center of the loop.

5. **A long and narrow rectangular loop of wire is moving toward the bottom of the page (see the drawing). The loop is leaving a region in which a magnetic field points out of the page, and the magnetic field outside this region is zero. What is the *direction* of the EMF and induced current in the loop of wire?**



Lenz's Law:
1. B is out
2. Φ is decreasing (eventually is zero)
3. Must have $\vec{B}_{new}$ out
4. I_{new} should be CCW

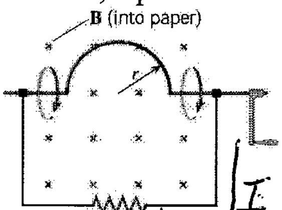
Also, in top segment, RHR says ⊕ charges pushed Left.

A) Clockwise (B) Counter-Clockwise C) Down D) Up

6. Chapter 22, Problem 16: A long and narrow rectanglular loop of wire is moving toward the bottom of the page with a speed of 0.020 m/s (see diagram in previous problem). The loop is leaving a region in which a 2.4 T magnetic field exists; the magnetic field outside this region is zero. During a time of 2.0 s, what is the magnitude of the *change* in magnetic flux?
A) 3.2×10^{-3} Wb B) 3.9×10^{-3} Wb C) 7.7×10^{-3} Wb D) 8.4×10^{-3} Wb E) 9.1×10^{-3} Wb

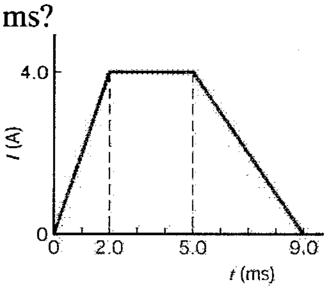
7. Chapter 22, Problem 22a: (Interactive LearningWare 22.2 at www.wiley.com/college/cutnell reviews the fundamental approach in problems such as this.) A constant magnetic field passes through a single rectangular loop whose dimensions are 0.35 m by 0.55 m. The magnetic field has a magnitude of 2.1 T and is inclined at an angle of 65° with respect to the normal plane of the loop. (a) If the magnetic field decreases to zero in a time of 0.45 s, what is the magnitude of the average EMF induced in the loop?
A) 0.22 V B) 0.38 V C) 0.45 V D) 0.81 V E) 0.90 V

8. Chapter 22, Problem 30: The semicircular piece of wire rotates through half a revolution in the direction shown, starting from the position indicated in the drawing. Which end of the resistor, the left or the right end, is positive? Explain your reasoning. (Remember that to push a current through a resistor, a positive voltage is required on the side that the current is coming from.)



A) The left end is positive since the induced current in the circuit flows counterclockwise around the circuit
B) The left end is positive since the induced current in the circuit flows clockwise around the circuit
C) The right end is positive since the induced current in the circuit flows counterclockwise around the circuit
D) The right end is positive since the induced current in the circuit flows clockwise around the circuit
E) Neither end is positive since there is no induced current.

9. Chapter 22, Problem 46a: The current through a 3.2 mH inductor varies with time according to the graph shown in the drawing. What is the average induced EMF during the time interval from 0 to 2.0 ms?



A) −3.2 V B) +3.2 V C) zero volts D) +6.4 V E) −6.4 V

10. Chapter 22, Problem 54a: A neon sign requires 12000 V for its operation. It operates from a 220 V receptacle. (a) What type of transformer, step-up or step-down, is needed?
A) a step-up transformer B) a step-down transformer

11. Chapter 22, Problem 54b: What must be the turns ration N_S/N_P of the transformer?
A) 1:220 B) 1:110 C) 1:100 D) 1:78 E) 1:55