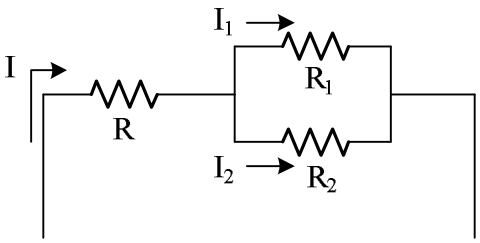
Practice problems for the 2nd midterm (Fall 2010)

1. The resistivity of some material is $2.34 \times 10^{-7}$ Ωm at 20.0 degrees of Celsius. The resistivity of the same material becomes $5.88 \times 10^{-7}$ Ωm. If the temperature coefficient is 0.0134 $(^{o}C)^{-1}$, what is the final temperature?

2. There is a positive point charge, 1.03 μC. Find the potential created by the charge at a point, P, where the distance from the charge is 0.520 m. Then, what will the potential energy be when you put a positive charge 1.78 μC at the point P?

3. In an electric potential mapping lab, you find two equipotential lines. With multimeter, the potential difference between them is 2.6 V. With a ruler, the distance between the lines is 0.022 m. Find the magnitude of the electric field.

4. The total current of the circuit is 3.40 A. Find the current $I_1$ and $I_2$, knowing that $R_1$ = 20 Ω; and $R_2$ = 30 Ω.




(i) Solve this with $\frac{I_1}{I_2} = \frac{R_2}{R_1}$.

(ii) Solve this with Ohm's law.

5. Here is a circular loop. The number of the loop is 38, and the current flow is 1.8 A. When the magnetic field created by the current is 0.0050 T, what is the radius of the loop?

6. One-capacitor circuit is connected to a voltage source. The maximum charge, $8.2 \times 10^{-5}$ C, stored in a capacitor. If the energy stored in the capacitor is 0.11 J, what is the capacitance?

7. A wire has length 6.50 m, and the resistivity is $4.50 \times 10^{-7}$ Ωm. The measured resistance is 21.8 Ω. What is the cross-sectional area of the wire?

8. A singly ionized positive charge is accelerated by a potential difference from rest. The initial and final electric potential are $+4.12 \times 10$ V and $-3.20 \times 10^{3}$ V, respectively. If the mass of the particle is $1.4 \times 10^{-27}$ kg, what is the final velocity?

9. There is a parallel plate capacitor. The separation distance between the plates is $1.7 \times 10^{-5}$ m. The area of each plate is $2.8 \times 10^{-4}$ $m^2$. The capacitance is found to be $8.9 \times 10^{-9}$ F. What is the dielectric constant? If you remove the dielectric, what will the capacitance be?

10. A force exerted on a wire is 0.58 N. The magnetic field is 1.6 T, and 0.030-A current flows in the wire. What is the length of the wire? The angle between the magnetic field and current flow is $45^{o}$.)

11. There is a solenoid (thin, long, helical coil). The number of per unit length is 39000. The magnetic field is found as $6.2 \times 10^{-4}$ T. What is the current going through the solenoid? If the length of the solenoid is 0.12 m, what is the total number of turns?

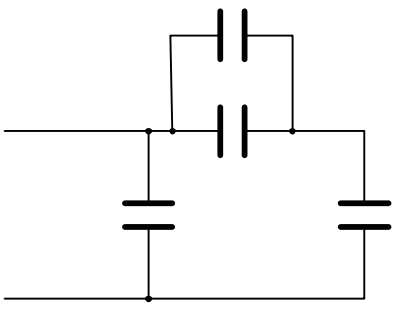
12. A current of 6.00 A is carried by a metal wire of diameter $1.00 \times 10^{-3}$ m. Knowing the density of electron as $3.38 \times 10^{27}$ electron/$m^3$, how long does it take for a conduction electron to move 0.78 m along the wire?

13. There is an RC circuit. The resistance and the capacitance are $2.8 \times 10^{6}$ Ω and $51 \times 10^{-7}$ F. The circuit is connected to a power supply, and then the capacitor is fully charged. After 1.4-second discharging, the charge in the capacitor becomes $7.1 \times 10^{-3}$ C. What is the maximum charge that the capacitor can hold? Calculate also the time constant.

14. There is a charged particle whose charge is $6.9 \times 10^{-5}$ C. The particle is moved in an electric field, 0.52 N/C. If the work done by the field is $23 \times 10^{-4}$ J, what is the displacement?

15. A charged particle moves at 34 m/s in a magnetic field. If the force exerted on the particle is 0.92 N, and the charge of the particle is $9.4 \times 10^{-5}$ C, what is the magnetic field? The moving direction and the magnetic field are perpendicular each other.

16. The circuit has four capacitors. Each one of them has 1 F. Find the equivalent capacitance.

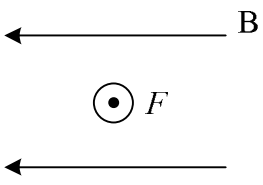


17. There is a long, straight wire. The current going through the wire is 3.7 A. You find the magnetic field at some point as $6.6 \times 10^{-5}$ T. What is the distance between the wire and the point where you find the magnetic field? Draw the picture.

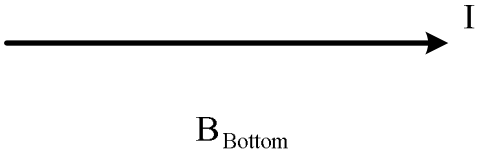
18. There is a battery. The Emf is 50 V, and the internal resistance is unknown. If you connect a resistor, 30 Ω, to the battery, you find that the total current going through the circuit is 1.55 A. What is the internal resistance? Draw the picture.

19. There is an electric motor. The coil inside a magnetic field has 1600 turns. The maximum torque of the motor is 8.5 Nm. The area of the coil and the magnetic field are $2.8 \times 10^{-3}$ $m^2$ and 0.67 T, respectively. What is the current in the coil?

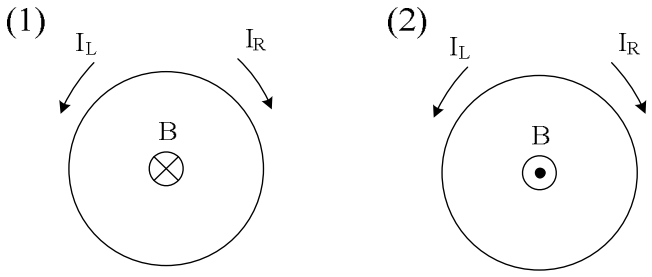
20. The directions of magnetic field and the Lorentz force of a positive charge are shown in the figure. Find the moving direction.



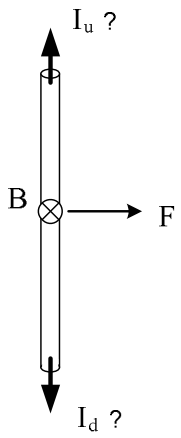

21. Find the directions of the magnetic fields, $B_{Top}$ and $B_{Bottom}$. However, the magnetic field is created by only the current flow, I.




22. Find the direction of the current flow, knowing the direction of the magnetic field inside a coil.



23. Find the direction of current flow, knowing the directions of a magnetic field and the force found at the wire. (The magnetic field shown is from an external source.)




24. There are two coils whose diameters are equal. The number of turns of one coil is 20, and that of the other is 50. The 20-turn coil uses 0.5 A to create the magnetic field. If both magnetic fields are equal, what will the current of the other coil be?

**Answer keys:**

1. 133 $^{o}$C
2. Potential = $1.78 \times 10^{4}$ V; Potential Energy = $3.17 \times 10^{-2}$ J
3. $1.2 \times 10^{2}$ V/m (or 118 V/m)
4. For (i) and (ii), $I_1$=2.04 A and $I_2$=1.36 A
5. $8.6 \times 10^{-3}$ m
6. $3.1 \times 10^{-8}$ F (or $3.06 \times 10^{-8}$ F)
7. $1.34 \times 10^{-7}$ m$^2$
8. $8.61 \times 10^{5}$ m/s
9. $6.1 \times 10$; $1.46 \times 10^{-10}$ F
10. 17 m
11. Current = 0.013 A; Total number of turns = 4700 turns (or 4680 turns)
12. 55.2 seconds
13. $7.8 \times 10^{-3}$ C; and 14.28 s
14. $6.4 \times 10$ m
15. 290 T (or 287 T)
16. 5/3 or 1.67 F
17. 0.011 m
18. 2.3 Ω
19. 2.8 A
20. upward
21. $B_{Top}$ = out of the paper; $B_{Bottom}$ = into the paper
22. (1) $I_R$; (2) $I_L$
23. $I_d$
24. 0.2 A

**Check out the following before the exam:**

- **Can you solve all the questions from the beginning without any help and hints?**
- **Do you understand the concept behind each question? Can you relate the above problems to the lecture topics?**