

Students should be able to:

1. Given a magnet draw its magnetic field
2. From a magnetic field determine the location of a magnet's poles
3. From the magnetic fields describe if two magnets are attracted or repelled
4. List the three types of magnetism
5. Define the three types of magnetism
6. Identify an example from each of the three types of magnetism
7. Describe how materials become magnetic on a molecular level
8. Describe how ceramics can be made to be magnetic
9. Describe the relationship between the Earth's magnetic and geographic poles.
10. Describe the why we care about the Sun's solar flairs (cme's).
11. Describe how an MRI works.
12. Define Lenz's Law and use it to solve problems
13. Define Faraday's Law.
14. Define and calculate flux (specifically magnetic flux).
15. Describe what smart stoplights and anti theft security systems have in common.
16. Calculate the relationship between a current and the b-field at a distance from the current
 - a. Ampere's Rule formula for magnitude
 - b. Ampere's Rule closed right hand rule for direction
17. Calculate the force (magnitude and direction) on a current OR flow of individual charges immersed in an EXTERNAL electric field.
 - a. Formula for magnitude
 - b. Open right hand rule for direction
18. Be able to site and/or identify applications utilizing Faraday's law

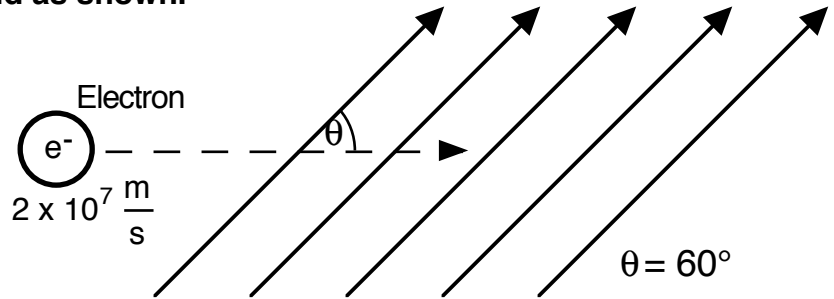
Electricity and Magnetism

$$q_e = 1.6 \times 10^{19} \text{ C}$$

$$M_e = 9.11 \times 10^{31} \text{ kg}$$

$$B = \frac{1}{10} \text{ T}$$

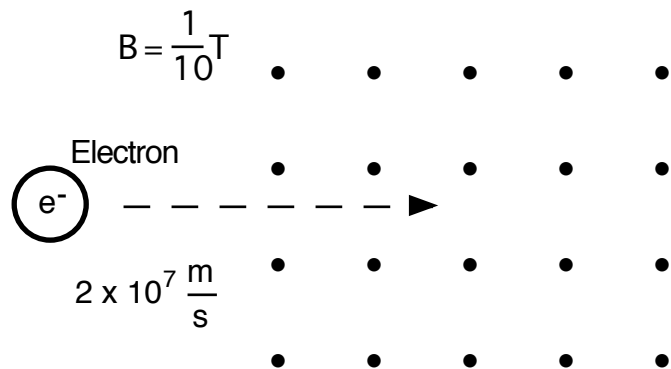
An electron enters a b-field as shown.



- 1 What force does the electron feel? (magnitude and direction)

- 2 What acceleration does the electron feel?

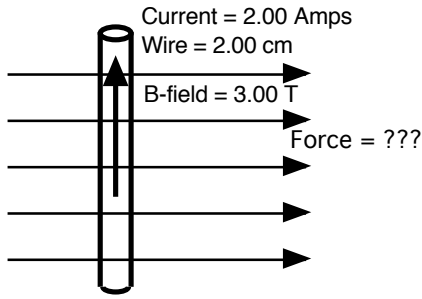
- 3 What radius does the electron travel in?
- 4 How much time does it take for the electron go around in a complete circle?



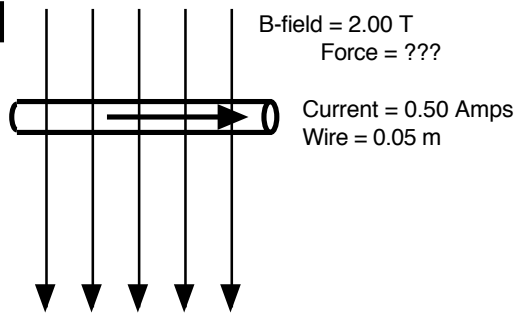
The electron is traveling perpendicular to the b-field.

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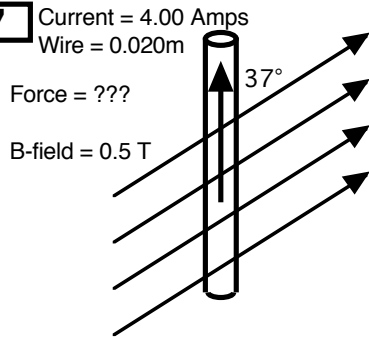
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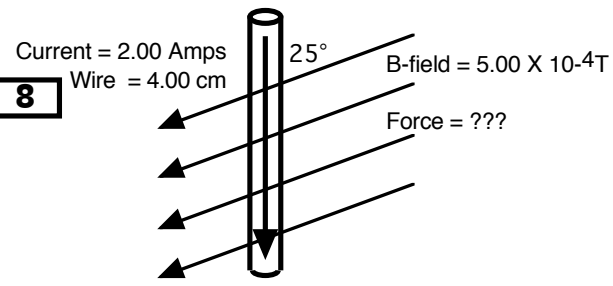
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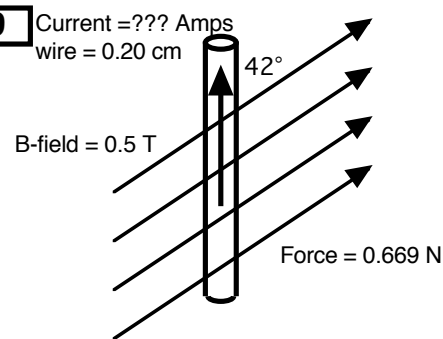
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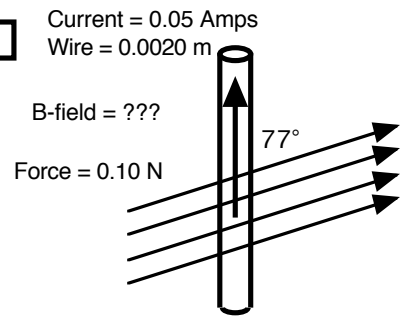
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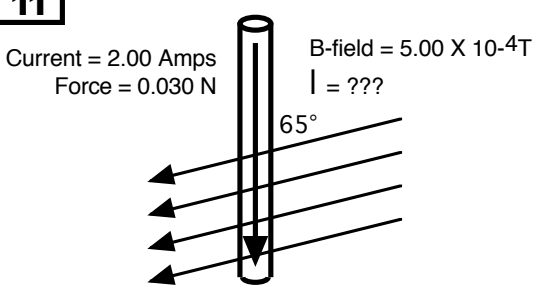
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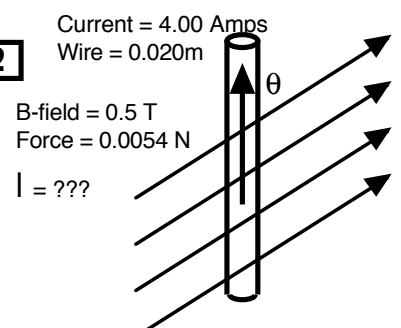
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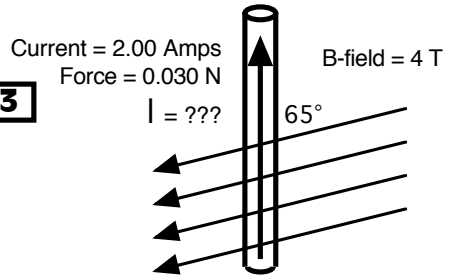
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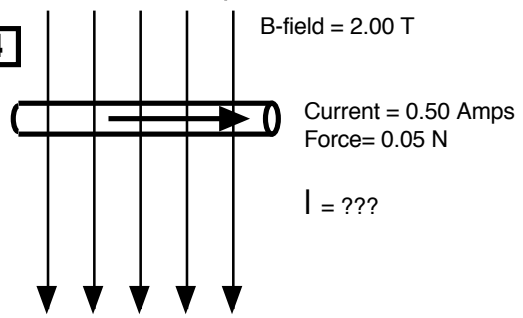
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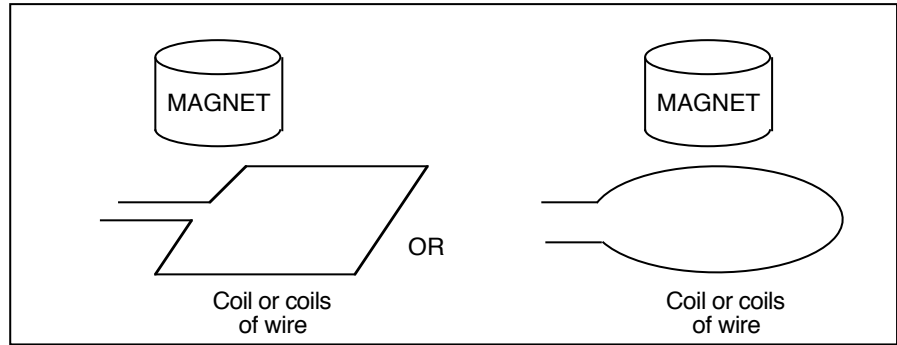


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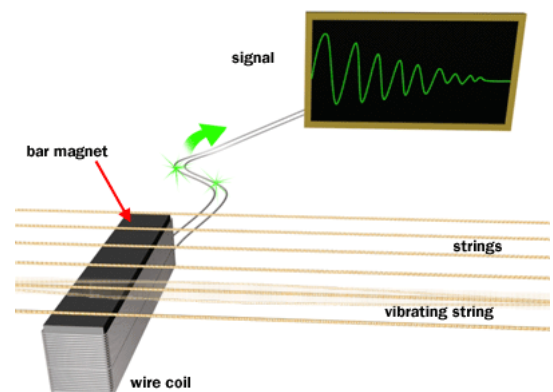
15. A current travels from the right side of the page to the left side of the page. A B-field travels from the top of the page to the bottom of the page. What is the direction of the force?
16. A current is traveling from the top of the page to the bottom of the page. A force pushes a wire the right side of the page. What is the direction of the magnetic field?
17. A current is traveling from to the ceiling to the floor. The B-field is traveling from the top of the page to the bottom of the page. What is the direction of the force on the current carrying wire?
18. A current travels from the left side of the page to the right side of the page. The B-field travels from the right side of the page to the left side of the page. What is the direction of the force on the wire?
19. A flow of positive ions travels the left side of the page to the right side of the page. The top of the page pole of a magnet is to the ceiling and the bottom of the page pole is to the floor. What is the direction of the force on the flow of charge?
20. A flow of electrons travel from the top of the page to the bottom of the page. A force pushes the flow of charge to the ceiling. Where is the north pole of the magnetic field?
21. A flow of electrons travel from the top of the page to the bottom of the page. A force pushes the wire the bottom of the page. Where is the south pole of the magnetic field?
22. A flow positive ions travel from the top of the page to the bottom of the page. The south pole of a magnet is on the right side of the page and the north pole of a magnet is on the left side of the page. What direction is the force that pushes the flow of charged particles?
23. Electrons flow from the right side of the page to the left side of the page. They feel a force pulling them to the bottom of the page. Where is the north pole of the magnetic field?
24. Electrons flow from the top of the page to the bottom of the page. The magnetic field points from to the floor to the ceiling. Which direction is the force pointing?
25. The positive terminal of as battery is to your right. The negative terminal is to your left. When this battery is turned on, charge will flow by in front of you. The current carrying wire feels a force pushing it to the ceiling. Where is south pole of the magnetic field?
26. The positive terminal of as battery is above you. The negative terminal is at your feet. When this battery is turned on, charge will flow by in front of you. The magnetic field points from the right side of the page to the left side of the page. Which direction is the force pointing?

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27. A coil is made up of 100 wraps of wire. The coil is a square 1 cm on each side. The b-field changes from 0.50 T to 2.50 T in 1/100 of a second by passing a magnet across the top of the coil. How much voltage does this process generate?



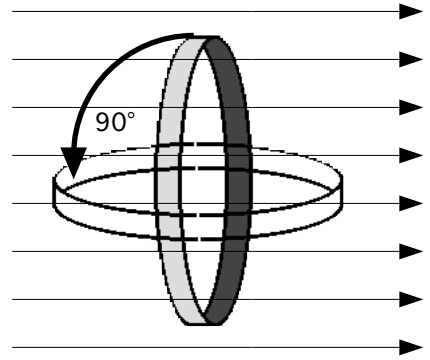
28. A circular coil of wire is made of 1000 loops of wire. The b-field in the wire changes from 0.10 T to 0.30 T in 0.03 seconds. This generates a 5 Volt difference in the coil. What is the AREA of the circular coil?
29. A rectangular coil with an area of 10 cm² is made of 500 wraps of wire. What change in b-field is needed to create a 2 Volt difference if the change is to occur in 1/10 of a second?
30. A square coil is made up of 300 wraps of wire. The coil is 5.00 cm on each side. The b-field in the coil changes from 0.55 to 0.25 in 1/10 of a second. How much voltage is generated in the coil?
31. A circular coil made from 200 wraps of wire generates 2.0 volts when the b-field changes from 1.00 T to 2.5 T in 1/100 of a second. What is the radius of the coil?
32. A square coil is made from 2500 wraps of wire. The coil generates 5.0 volts when the b-field changes from 3.4 T to 1.1 T in 1/33 of a second. What is the length of each side of the square shaped coil?
33. A rectangular coil has one side that is 5.0 cm wide. It is made of 1500 wraps of wire. This coil generates 4000 volts when the b-field changes from 1.5 T to 1 T in 1/100 of a second. What is the length of the other side of the rectangle?
34. A coil with an area of 0.08 m² generates a voltage of 8 volts when the b-field is changes in 1/10 of a second. What is the magnitude of the change if the magnetic field?
35. The pickup assembly of an electric guitar is a rectangular coil of wire made up of 700 wraps of wire. The rectangle is 1.0 cm by 7.0 cm. The b-field across the pickups changes from 0.001 T to 0.0025T in 1/2000 of a second by a vibrating guitar string. How much voltage does the vibrating string generate? (<http://entertainment.howstuffworks.com/electric-guitar1.htm>)



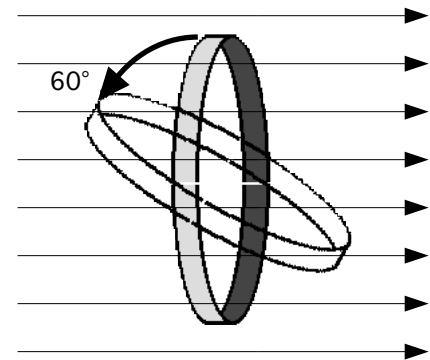
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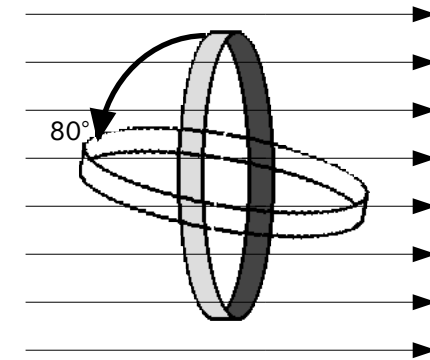
36. A looped single coil of wire has a radius of 5.5 cm. The wire is immersed perpendicular to a 0.66 Tesla b-field. The coil is rotated 90° in 2 seconds. What voltage is generated in the loop?



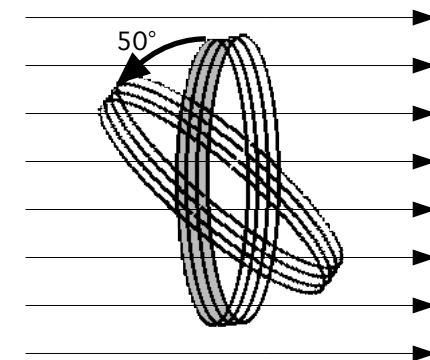
37. A looped single coil of wire has a radius of 7.5 cm. The wire is immersed perpendicular to a 1.54 Tesla b-field. The coil is rotated 60° in 0.50 seconds. What voltage is generated in the loop?



38. A looped single coil of wire is immersed perpendicular to a 12.5 T b-field. The coil is rotated 80° in 0.05 seconds. 0.10 volts is generated in the loop. If the loop is a circle then what is its radius?



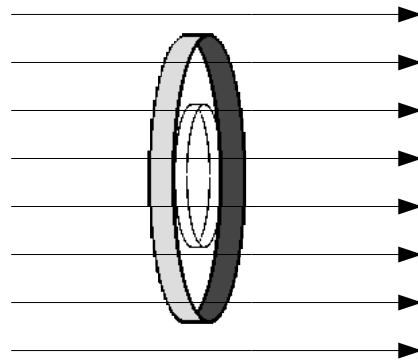
39. A circular coil of wire has a radius of 7.5 cm. The coil has 20 individual coils. The wire is immersed perpendicular to a 0.4 Tesla b-field. The coil is rotated 50° in 0.10 seconds. What voltage is generated in the coil?



40. A circular coil of wire has 300 individual coils. The wire is immersed perpendicular to a 20.2 T magnetic field. The coil is rotated 75° in 0.005 seconds. What is the radius of the coils if 1.5 volts are generated by this action?

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41. A looped single coil of wire has a radius of 10.0 cm. The wire is immersed perpendicular to a 1.2 T magnetic field. The radius of the coil is reduced in 0.050 seconds. When this is done, the coil generates 0.0022 volts. What is the new radius of the coil?



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42. A current carrying wire is perpendicular to a magnetic field. The field strength is 100 N/Am. The current in the wire is 2.0 Amps. 0.37 m of the wire is in the magnetic field. What is the force on the wire?
43. A current carrying wire is perpendicular to a magnetic field. The field strength is 250 N/Am. The current in the wire is 5.5 Amps. 0.78 m of the wire is in the magnetic field. What is the force on the wire?
44. A current carrying wire is 53° to a magnetic field. The field strength is 25 T. The current in the wire is 5.5 Amps. 0.78 m of the wire is in the magnetic field. What is the force on the wire?
45. A current carrying wire is 15° to a magnetic field. The field strength is 15 T. The current in the wire is 1.5 Amps. 1.00 m of the wire is in the magnetic field. What is the force on the wire?
46. A current travels from east to west. What is the direction of the B-field above the wire?
47. A current is traveling from north to south. What is the direction of the B-field below the wire?
48. A current is traveling from up to down. What is the direction of the B-field to the right of the wire?
49. A current travels from west to east. What is the direction of the B-field above the wire?
50. A flow of positive ions travels west to east. What is the direction of the B-field above the flow?
51. A flow of electrons travel from north to south. What is the direction of the B-field to the right of the flow?
52. A flow of electrons travel from north to south. What is the direction of the B-field to the left of the flow?
53. What EMF is induced in a 6 cm long wire moving with a speed of 100 cm/s across a field of 200 N/Am?
54. What EMF is induced in a 0.020 cm long wire moving with a speed of 40 cm/s across a field of 1097 N/Am?
55. What EMF is induced in a 10 cm long wire moving with a speed of 4654 cm/s across a field of 1.2 T?
56. An EMF of 1.5 volts is induced in a wire 2.54 cm in length. The wire is traveling across a field of 1970 T. What is the speed of this wire?
57. An EMF of 45 Volts is induced in a wire traveling at 11.5 m/s across a magnetic field. If the length of the wire is 60 cm, then what is the magnitude of the magnetic field?