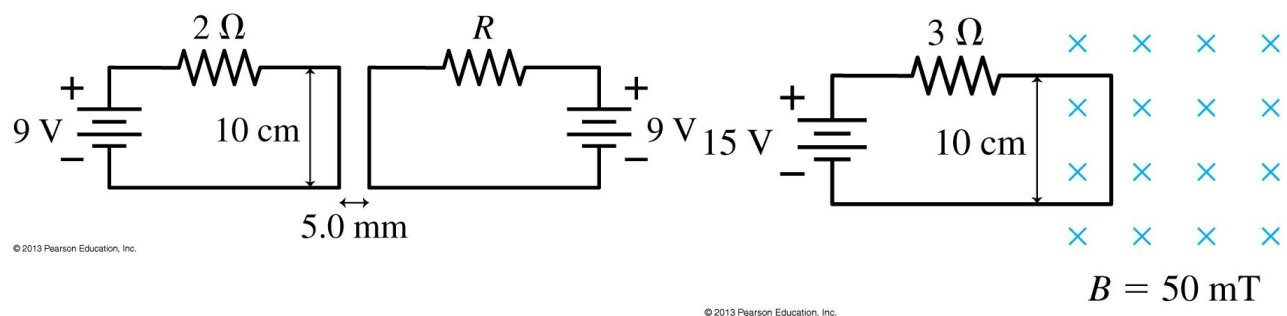


Summer and Fall 2015 – Electromagnetism and Light Course
HW05

[If you cannot find something on Canvas, all the same materials are posted here:
<http://kestrel.nmt.edu/~rsonnenf/phys571/>]

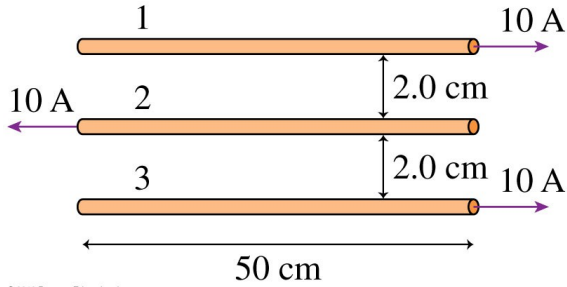
Answer the following questions and upload to Canvas. Some of these are amenable to a word processor, but you will probably need to scan in sketches. I put this out in “doc” format so you can use the homework itself as a template. (* problems are harder)

- 1) A long straight wire carries a 100 Ampere current. At what distance from the wire is the B-field 2.5 mT?
- 2) The on-axis magnetic field strength 10 cm from a small bar magnet is 5 micro-Tesla.
 - a) What is the bar magnet's dipole moment?
 - b) What is the on-axis field strength 15 cm from the magnet?
- 3) A 100 A current circulates around a 2.0-mm-diameter superconducting ring.
 - a) What is the ring's magnetic dipole moment?
 - b) What is the on-axis field 5.0 cm from the ring?
- 4) A small, square loop carries a 25 A current. The on-axis magnetic field strength 50 cm from the loop is 7.5 nT. What is the edge length of the square?
- 5) The Earth's magnetic dipole moment is $8.0 \times 10^{22} \text{ A} \cdot \text{m}^2$
 - a) What is the magnetic field strength on the surface of the Earth at the North magnetic pole? (How does this compare to the value in the table above?)
 - b) Astronauts discover an earth-size planet without a magnetic field. To create a magnetic field with the same strength as Earth's, they propose running a current through a wire around the equator. What size current would be needed?



- 6) The two 10-cm-long parallel wires in the figure at left above are separated by 5.0 mm. For what value of resistor R will the force between the two wires be $5.4 \times 10^{-5} \text{ N}$?
- 7) The right edge of the circuit shown in the figure at right above extends into a 50 mT uniform magnetic field. What are the magnitude and direction of the net force on the circuit?

8) What is the net force (magnitude and direction) on each wire in the figure above?



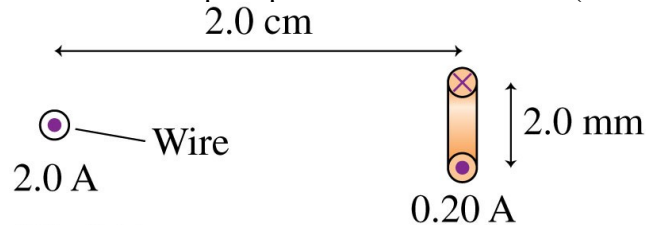
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9*) A small bar magnet experiences a 0.020 N-m torque when the axis of the magnet is at 45 degrees to a 0.10 T magnetic field. What is the magnitude of its magnetic dipole moment?

10) A square current loop 5.0 cm on each side carries a 500 mA current. The loop is in a uniform 1.2 T magnetic field. The axis of the loop, perpendicular to the plane of the loop, is 30 degrees away from the the field direction. Sketch this situation, indicating the field direction and this angle. What is the magnitude of torque on the current loop?

11*) What is the magnitude of the torque on the current loop shown in the figure?

What is the loop's equilibrium orientation? (Sketch this).



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