15. An electromagnet can exert a force of 600 N on a metal block. If the current through the electromagnet must be reduced to one-quarter of its initial value,
    a) what would the force become?
    b) what must happen to the number of turns per centimetre if the strength of the magnet is to remain at 600 N?

16. An electromagnet contains 2000 turns in its length. A current of 2.5 A provides a lifting force of 100 N.
    a) What current would be required to provide a lifting force of 300 N?
    b) If the current is 2.5 A, how many turns would be required to provide a lifting force of 600 N?

Applying Inquiry/ Communication Skills

17. Three magnets are placed as shown in Figure 14.44. Draw this diagram in your notes and sketch how the magnetic fields would likely appear.

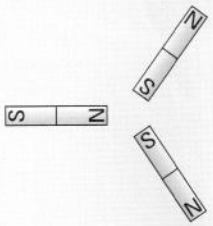


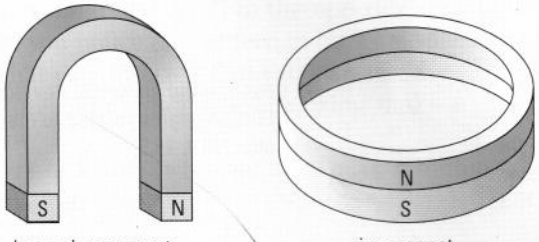
FIGURE 14.45

18. In liquids and gases, both negative and positive charges can flow. If the flow actually consists of negative charges,
    a) explain why the rule for predicting the direction of the magnetic field about that flow is called the left-hand rule
    b) state what the rule would be

19. Explain why a liquid cannot become a permanent magnet.

20. Explain why it is impossible for two lines of force to cross.

21. Copy Figure 14.46 into your notes. Indicate on your diagrams the lines of force and their direction both outside and inside the magnets.



horseshoe magnet ring magnet

FIGURE 14.46

22. In an experiment to measure the magnetic force between two disk magnets, the following data were obtained:

Separation between Magnets, *d* (cm)	Force *F* (N)
1.0	2.0
1.5	0.40
2.0	0.12
2.5	0.051
3.0	0.025

Using a graphing calculator,
    a) plot the scatter points with force on the y-axis and separation on the x-axis
    b) find the equation relating force in newtons and separation in centimetres as a power function in the form, $F = kd^n$
    c) What are the units for "k"?
    d) At what separation would the force be (i) 0.25 N and (ii) 0.10 N?

23. Write an equation for F_2 in terms of F_1, I_1, I_2, N_1 and N_2, where F_1 is the initial force I_1 is the initial electric current, and N_1 is the initial number of turns. F_2, I_2, and N_2 represent the final values of these quantities.

24. a) Describe three separate ways by which you could increase the strength of an electromagnet 10 times.
    b) If you made all three changes, by what factor would the strength of the electromagnet increase?

Making Connections

25. Would you expect the casing of an "antimagnetic" watch to have a low or high relative permeability? Explain your answer.

26. Explain why compasses do not work properly near the magnetic poles of Earth.

27. Design a way of using a compass and a helix to measure the current in a circuit.

28. Why is an electromagnet more useful in a junkyard than a permanent magnet?

29. Investigate the electric appliances in your home to find out which ones use an electromagnet. Make a list.