Name ______________________ Class ______________ Date __________

Exercises

36.1 Magnetic Poles (pages 721–722)

1. List two ways that magnets are like electric charges.

   a. They can both attract and repel without touching

   b. The strength of their interaction depends on the distance of separation.

2. Regions that produce magnetic forces are called magnetic poles.

3. Is the following sentence true or false? Every magnet, regardless of its shape, has both a north pole and a south pole. true

4. Write *attract* or *repel* to describe the effect of bringing the poles listed below together.

   repel a. the north pole of a bar magnet near the north pole of another bar magnet

   attract b. the north pole of a bar magnet near the south pole of another bar magnet

   repel c. the south pole of a bar magnet near the south pole of another magnet

5. Describe what happens if you break a bar magnet in half and then break each of the halves in half.

   Magnetic poles always exist in pairs, so each half still behaves as a complete magnet. If you break the halves in half, you will end up with four complete magnets.

36.2 Magnetic Fields (pages 722–723)

6. Define *magnetic field*.

   a force field that fills the space around a magnet

7. The direction of the magnetic field outside a magnet is from the north pole to the south pole.

8. Circle the letter of each statement about magnetic fields that is correct.

   (a.) Where the magnetic field lines are close together, the field strength is great.

   (b.) Where the magnetic field lines are far apart, the field strength is weak.

   c. Where the magnetic field lines are parallel, the field strength is zero.

   d. The field strength around a magnetic pole does not vary with distance.

9. Describe what happens if you place a magnetic compass near a bar magnet.
The needle of the compass lines up with the magnetic field around the bar magnet.

36.3 The Nature of a Magnetic Field (pages 723–724)

10. Describe the two types of electron motion that produce the magnetic field in a bar magnet.
   a. electrons in constant motion about atomic nuclei
   b. electrons spinning about their own axes like tops

11. Of the two types of electron motion you described above, which one is more important in terms of the material's overall magnetic field?
the spinning of electrons about their axes

12. Explain why certain substances such as iron are magnetic but most substances are not.
Every spinning electron is a tiny magnet. In most atoms, the various fields cancel one another because the electrons spin in opposite directions. In iron and several other substances, the electron spins do not entirely cancel.

36.4 Magnetic Domains (pages 724–725)

13. What are magnetic domains?
clusters of atoms that have aligned magnetic fields

14. Is the following sentence true or false? The difference between a piece of ordinary iron and an iron magnet is the alignment of the magnetic domains. true

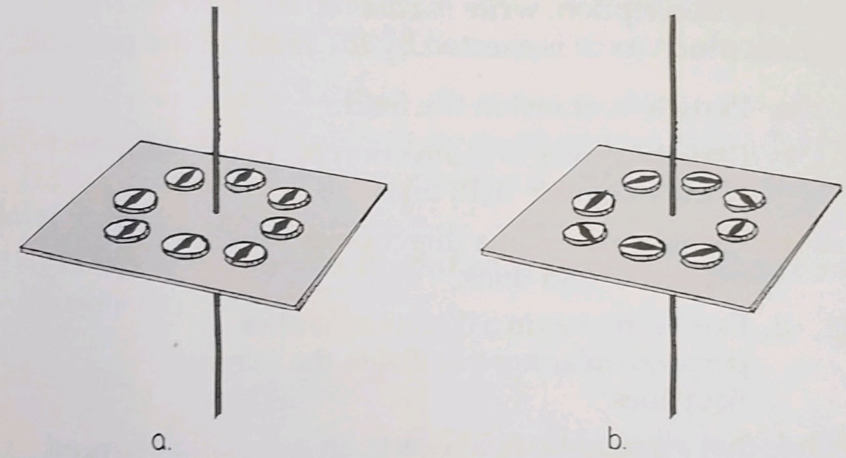
15. Describe what happens to the magnetic domains in an iron nail that is brought near a strong magnet.
Domains that are already oriented in the direction of the magnet's field grow, and domains that are not aligned with the magnet's field rotate into alignment.

16. If an ordinary iron nail is removed from a strong magnet, the nail will lose its magnetism. Explain why this happens.
Ordinary thermal motion causes most or all of the domains in the nail to return to a random arrangement.

17. How can you make a permanent magnet weaker?
Drop or heat the magnet.

36.5 Electric Currents and Magnetic Fields (pages 726–727)

Use the diagrams below to answer Questions 18 and 19. Each diagram shows magnetic compasses placed around a conducting wire.



18. Which of the diagrams shows a current-carrying wire? How do you know?
Diagram (b) has a current carrying wire; the compasses are lined up with the magnetic field produced by the current. In diagram (a), there is no current in the wire so the compasses are aligned with Earth's magnetic field.

19. Circle the letter of each sentence that correctly describes diagram (b).
   a. The compass needles are aligned with Earth's magnetic field.
   b. There is no current passing through the wire.
   c. At the location of each compass, the magnetic field produced by the wire is stronger than Earth's magnetic field.
   d. Charges moving through the wire produce a magnetic field pattern in the form of concentric circles about the wire.

20. Is the following sentence true or false? If a current-carrying wire is bent into a loop, the magnetic field strength inside the loop cancels to zero.
false

21. Describe a simple electromagnet.

a coil of current-carrying wire with many loops

22. Describe some uses for superconducting electromagnets.

They are used to guide high-energy particles around particle accelerators and in magnetic resonance imaging (MRI) devices in hospitals.

36.6 Magnetic Forces on Moving Charged Particles (page 728)

23. Listed below are descriptions of how a charged particle moves within a magnetic field. For each description, write *maximum*, *less than maximum*, or *zero* to describe how much force is exerted by the field on the particle.

zero a. Particle is at rest in the field.

maximum b. Particle moves in a direction perpendicular to the magnetic field lines.

zero c. Particle moves in a direction parallel to the magnetic field lines.

less than maximum d. Particle moves in a direction neither perpendicular nor parallel to the magnetic field lines.

24. The direction of force that a magnetic field exerts on a moving charged particle is always perpendicular to the magnetic field lines and the velocity of the charged particle.

25. Explain how the effect of magnetic forces on charged particles helps protect Earth from cosmic radiation.

Charged particles from outer space are deflected by Earth's magnetic field, reducing the intensity of the radiation.

36.7 Magnetic Forces on Current-Carrying Wires (page 729)

26. Is the following sentence true or false? A conducting wire experiences no deflecting force by a magnetic field as long as the wire carries current.

false

Name ______________________ Class ______________ Date ____________

27. Circle the letter of each correct statement about a current-carrying wire in a magnetic field.
    - (a.) The force on the wire is maximum when the current is perpendicular to the magnetic field lines.
    - b. The force on the wire is parallel to the current.
    - c. If the direction of current in the wire is reversed, the deflecting force on the wire cancels to zero.
    - (d.) If the direction of current in the wire is reversed, the deflecting force on the wire acts in the opposite direction.

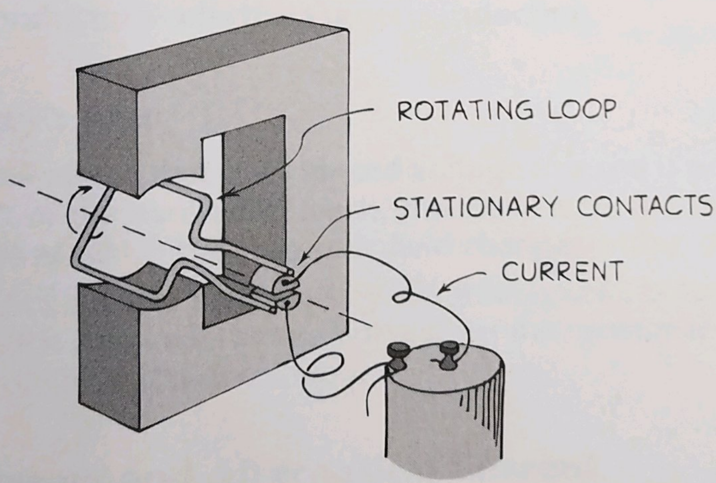
28. Is the following sentence true or false? Just as a current-carrying wire will deflect a magnetic compass, a magnet will deflect a current-carrying wire. ___true___

36.8 Meters to Motors (pages 730–731)

29. What is a galvanometer?
    a sensitive current-indicating instrument

30. If a galvanometer is calibrated to measure current, it is called a(n) ___ammeter___. If a galvanometer is calibrated to measure electric potential, it is called a(n) ___voltmeter___.

31. The diagram below shows a simplified DC motor. Explain the purpose of the stationary contacts.



The stationary contacts allow the current in the rotating loop to reverse during each half revolution. In this way, the current in the loop alternates so that the forces in the upper and lower regions do not change directions as the loop rotates, resulting in continuous rotation.