Name _____ Class _____ Date _____

Exercises

32.1 Electrical Forces and Charges (pages 645–646)

1. Circle the letter beside the correct comparison of the strengths of the gravitational force and the electrical force.

a. The gravitational force is slightly stronger than the electrical force.

b. The electrical force is slightly stronger than the gravitational force.

c. The gravitational force is much stronger than the electrical force.

(d.) The electrical force is much stronger than the gravitational force.

2. Why don't you feel the electrical forces that act on you all the time?

Both repelling and attracting forces act on you, and the forces cancel each other out.

3. Describe the simple model of the atom proposed in the early 1900s by Rutherford and Bohr.

The atom has a positively charged nucleus surrounded by electrons. The protons attract and hold the electrons in orbit.

4. Charge is the fundamental electrical property to which the mutual attractions or repulsions between electrons or protons is attributed.

5. By convention, what is the charge of the following?

a. electrons negative

b. protons positive

c. neutrons no charge

6. Is the following sentence true or false? The mass of a proton is 2000 times greater than the mass of an electron. true

7. Circle the letter beside the correct comparison of the *magnitudes* of the charges of a proton and an electron.

a. The magnitude of the proton's charge is slightly greater.

b. The magnitude of the electron's charge is slightly greater.

c. The magnitudes of a proton's charge and an electron's charge are always equal, but they vary for different atoms.

(d.) The magnitudes of a proton's charge and an electron's charge are always equal and never change.

8. Like charges repel and opposite charges attract.

32.2 Conservation of Charge (pages 646–647)

9. Explain why there is no net charge in a neutral atom.
There are as many electrons as protons. The positive and negative charges balance.

10. A charged atom is called a(n) ion.

11. The _____ of many atoms are bound very loosely to an atom and can be easily dislodged. Circle the correct answer.

(a.) outermost electrons
b. innermost electrons
c. outermost protons
d. innermost protons

12. If a rubber rod is rubbed by a piece of fur, the rubber becomes negatively charged and the fur becomes positively charged.

13. What is the principle of conservation of charge?
Electrons are neither created nor destroyed but are simply transferred from one material to another.

32.3 Coulomb's Law (pages 648–650)

14. What does Coulomb's law state?
For charged particles or objects that are small compared with the distance between them, the force between the charges varies directly as the product of the charges and inversely as the square of the distance between them.

Match each variable or constant in Newton's law of gravitation with its analogous variable or constant in Coulomb's law.

c	**15.** m_1	a. d
d	**16.** m_2	b. k
a	**17.** d	c. q_1
b	**18.** G	d. q_2

19. The SI unit of charge is the coulomb.

20. How many electrons are contained in 1 C of charge?
6.24×10^{18}

21. Is the following sentence true or false? The electrical force between two protons is very small compared to the gravitational force. false

32.4 Conductors and Insulators (pages 651–652)

22. A material through which electric charge can flow is a(n) electric conductor.

23. A material that is a poor conductor of electricity is a(n) electric insulator.

24. Define semiconductor.
material that can be made to behave sometimes as insulators and sometimes as conductors

25. Classify the following by writing *C* beside each conductor, *I* beside each insulator, and *S* beside each semiconductor.

C a. aluminum
C b. copper
S c. germanium
I d. glass
I e. rubber
S f. silicon

26. What effect will adding an impurity level of one atom in ten million to a crystal of semiconductor have?
The impurity adds or removes an electron from the crystal structure, which increases conductivity.

27. Is the following sentence true or false? Atoms in a semiconductor hold their electrons until the atoms of the semiconductor are given small energy boosts. true

28. Thin layers of semiconducting materials sandwiched together make up transistors, which are used in a variety of electrical applications.

32.5 Charging by Friction and Contact (page 652)

29. Classify each of the following by writing *F* if it is an example of charging an object by friction and *C* if it is an example of charging an object by contact.

F a. sliding across the seat of an automobile
F b. scuffing your shoes as you walk across a rug
C c. touching a charged rod to a metal sphere
F d. combing your hair with a plastic comb
C e. touching your hand to a slightly charged metal plate

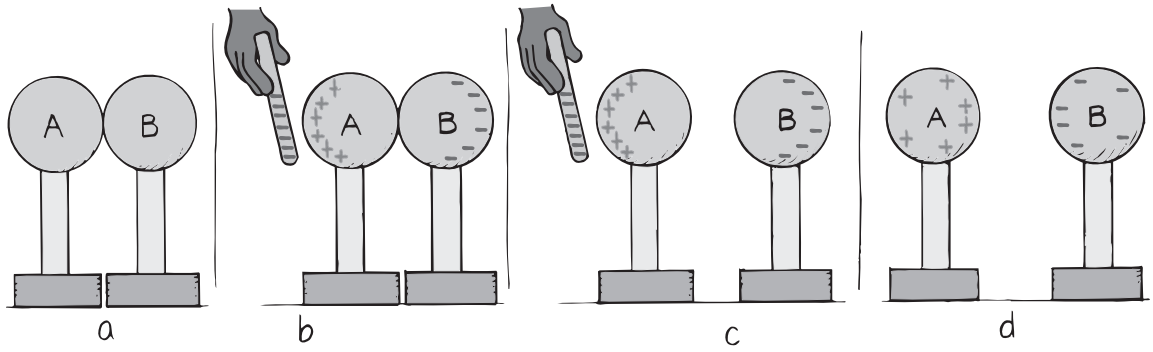
30. One object charges a second object by contact. Describe what will happen to the charge on the second object in each of the cases below.

a. The second object is a good conductor.
The charge will spread to all parts of the second object's surface.

b. The second object is a poor conductor.
The extra charge will stay close to where the second object was touched.

32.6 Charging by Induction (pages 653–654)

Use the figure below to answer Questions 31–33.



31. Why do the positive and negative charges separate in part (b)?
A negatively charged rod near sphere A repels electrons, and excess negative charge moves onto sphere B, leaving sphere A with excess positive charge.

32. Why do the positive and negative charges spread out on each on the spheres in part (d)?
The like charges repel each other on each of the spheres.

33. Why is the process illustrated in the figure an example of charging by induction?
A charged object charged each of the spheres without touching them.

34. The ground is a practically infinite reservoir for electric charge.

35. Circle each letter next to a discovery made by Benjamin Franklin.

a. electricity
(b.) Lightning is an electrical phenomenon.
(c.) lightning rods
d. Electricity can travel along metal wires.

36. Describe what causes lightning to occur during thunderstorms.
The negatively charged bottoms of clouds induce a positive charge on the surface of Earth below. Lightning can occur as an electrical discharge between the clouds and the oppositely charged ground below.

37. Is the following sentence true or false? A lightning rod placed above a building repels electrons in the air to prevent leaking of the charge onto the ground. false

32.7 Charge Polarization (pages 655–657)

38. Describe an electrically polarized atom or molecule.

One side of the atom or molecule is slightly more positive (or negative) than the opposite side.

39. Why can an insulator become polarized when you bring a conducting rod near it?

There are no free electrons to migrate through the insulating material. Instead, there is a rearrangement of the positions of charges within the atoms and molecules.

40. Circle the letter beside the sentence that explains why a charged comb attracts an uncharged piece of paper.

a. The forces of attraction and repulsion on opposite sides of the paper cancel.

b. The forces of attraction and repulsion on the paper disappear with the comb nearby.

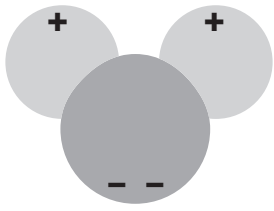
(c.) The force of attraction for the closer charge is greater than the force of repulsion for the farther charge.

d. The force of repulsion for the closer charge is greater than the force of attraction for the farther charge.

41. Explain why the bits of paper sometimes suddenly fly off when a comb attracts bits of uncharged paper.

This indicates charging by contact. The paper bits have acquired the same sign of charge as the comb, and are then repelled.

42. When you rub an inflated balloon on your hair and it becomes negatively charged, the charge on the balloon induces a positive charge on the surface of the wall.



43. Why is the water molecule shown in the figure above an electric dipole?

It has a little more negative charge on one side than the other.

44. What are the three ways objects can become electrically charged?

a. friction

b. contact

c. induction