

Chapter 32 Electrostatics

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?

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

4. _____ 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 _____
- b. protons _____
- c. neutrons _____

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

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 _____ and opposite charges _____.

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32.2 Conservation of Charge (pages 646–647)

9. Explain why there is no net charge in a neutral atom.

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

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 _____ charged and the fur becomes _____ charged.

13. What is the principle of conservation of charge?

32.3 Coulomb’s Law (pages 648–650)

14. What does Coulomb’s law state?

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

- | | |
|-----------------|----------|
| _____ 15. m_1 | a. d |
| _____ 16. m_2 | b. k |
| _____ 17. d | c. q_1 |
| _____ 18. G | d. q_2 |

19. The SI unit of charge is the _____.

20. How many electrons are contained in 1 C of charge?

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

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32.4 Conductors and Insulators (pages 651–652)

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

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

24. Define semiconductor.

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

- | | |
|--------------------|------------------|
| _____ a. aluminum | _____ d. glass |
| _____ b. copper | _____ e. rubber |
| _____ c. germanium | _____ f. silicon |

26. What effect will adding an impurity level of one atom in ten million to a crystal of semiconductor have?

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. _____

28. Thin layers of semiconducting materials sandwiched together make up _____, 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.

- _____ a. sliding across the seat of an automobile
- _____ b. scuffing your shoes as you walk across a rug
- _____ c. touching a charged rod to a metal sphere
- _____ d. combing your hair with a plastic comb
- _____ 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.

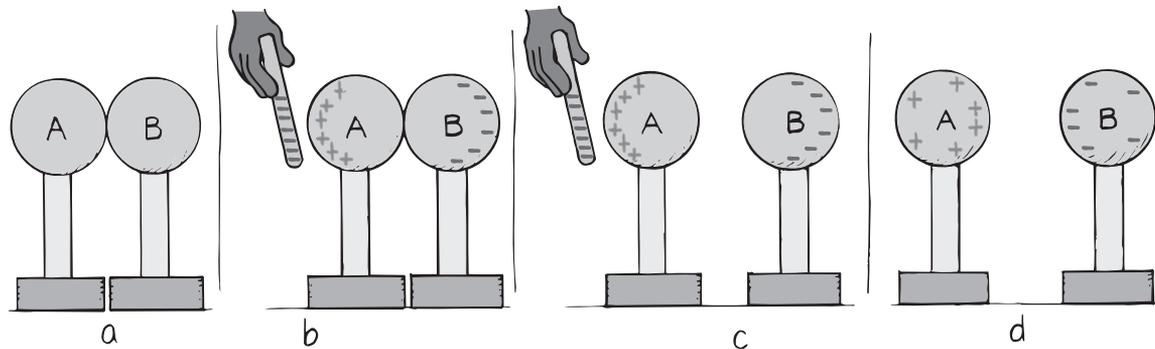
a. The second object is a good conductor.

b. The second object is a poor conductor.

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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)?

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

33. Why is the process illustrated in the figure an example of charging by induction?

34. The _____ 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.

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. _____

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32.7 Charge Polarization (pages 655–657)

38. Describe an electrically polarized atom or molecule.

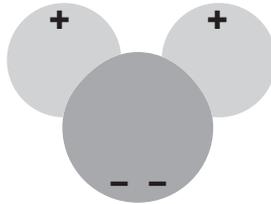
39. Why can an insulator become polarized when you bring a conducting rod near it?

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.

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



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

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

- a. _____
- b. _____
- c. _____