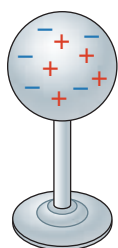


Static Electricity

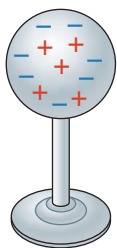
Key Ideas

Static electric charges can build up on objects.

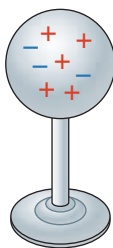
- A static electric charge remains at rest until it is discharged.
- A neutral object has an equal number of positive and negative charges.
- Neutral objects can be given static charges that are either negative (by gaining electrons) or positive (by losing electrons).
- Neutral objects are attracted to charged objects because of separation of charges.



(a) a neutral sphere



(b) a sphere with a negative charge (more electrons than protons)



(c) a sphere with a positive charge (fewer electrons than protons)

Objects become charged by friction, conduction, and induction.

- Friction causes one object to gain electrons from another object.
- Some materials, such as metals, are conductors of electricity, while other materials are insulators.
- An object is charged by conduction when the excess charge on one object is transferred through contact to another object.
- Induction occurs when a charged object influences the charge distribution in another object.



Vocabulary

static charge, p. 274

discharge, p. 274

electrostatics, p. 274

law of electric charges, p. 275

induced charge separation, p. 277

charging by friction, p. 279

charging by conduction, p. 279

charging by induction, p. 280

insulator, p. 282

conductor, p. 282

grounded, p. 283

Van de Graaff generator, p. 285

electric force, p. 285

Coulomb's law, p. 286

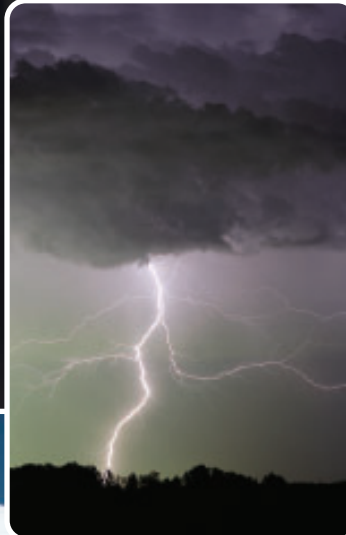
coulomb (C), p. 286

An electric force between static charges can either attract or repel the charges.

- Like charges repel each other, and opposite charges attract each other.
- The size of the electric force between two charged objects increases with the sizes of the charges on the objects and decreases as the distance between the objects increases.

The discharge of static electricity in the form of lightning can be dangerous, but static electricity also has useful applications.

- Lightning is a spectacular example of static electric discharge.
- A metal-leaf electroscope is a device that can be given a known charge to determine the type and size of charge on an object.
- A Van de Graaff generator is a device that separates large quantities of static charge.
- Laser printers and electrostatic precipitators apply the principles of static electricity.



Review Key Ideas and Vocabulary

1. What happens when an atom gains or loses electrons? Use diagrams in your answer.
2. A student rubs a glass rod with a vinyl raincoat. What charge does the glass rod acquire? Explain your answer.
3. Is the change in mass significant when an object gains or loses electrons? Explain.
4. Figure 1 shows an acetate strip brought near, without touching, an aluminum sphere on an insulating stand. Which row of the table correctly indicates the charges on the sphere at positions X and Y?

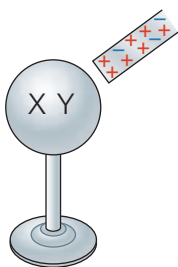


Figure 1

	Position X	Position Y
(a)	positive	positive
(b)	positive	negative
(c)	negative	positive
(d)	negative	negative

5. Which material is an insulator?
 - (a) glass
 - (b) copper
 - (c) mercury
 - (d) selenium
6. Draw each situation and indicate the charges on the objects.
 - (a) A negatively charged pith ball is repelled from a negatively charged rod.
 - (b) A positively charged pith ball is attracted to a negatively charged rod.
 - (c) Two pith balls are positively charged and suspended from a common point.
7. Two socks and a shirt come out of a dryer stuck together. After the socks are pulled off the shirt, they are repelled by each other. Why did this happen?

8. Match each term on the left with the correct description on the right. Some terms may not be used.

Table 1

Term	Description
acetate	(a) a charge that stays put for some time
charging by friction	(b) a type of clear plastic
charging by induction	(c) a process in which an electric charge is transferred when objects rub together
conductor	(d) a material that allows electrons to flow
coulomb	(e) a machine that produces static charges
electric force	(f) a push or pull between two electrically charged objects
grounded	(g) a material in which electrons are tightly bound to atoms or molecules
insulator	(h) an amount of electrical charge
static charge	(i) a process in which an object is connected to a large neutral object
Van de Graaff generator	

Use What You've Learned

9. Is an electron attracted to a neutron? Explain your answer.
10. Figure 2 shows two neutral aluminum spheres touching each other. It is possible to charge the spheres by induction or by conduction with a negatively charged rod? Draw diagrams to show how this can be done. Include charge distributions in your diagrams to indicate static charges.

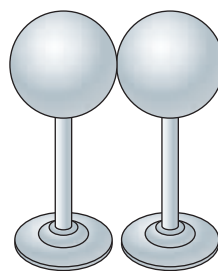


Figure 2

11. If you get caught in a thunderstorm in a large open field, as shown in Figure 3, should you lie flat and spread out, or crouch into a small ball? Explain your answer.



Figure 3

12. Electrostatics is used to spray-paint cars. Research to determine how and why this is done.

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13. When clear cellophane tape is pulled from a roll, it always seems to get tangled. Explain why this occurs.
14. In the summer, the moisture content of the air is higher than it is during winter, which makes it a better conductor. Would the spark from a Van de Graaff generator be longer in the summer or in the winter? Explain your answer.
15. St. Elmo's fire is a bright blue-white glow that can be seen on tall, pointed structures, such as church spires and ships' masts (Figure 4). Research this phenomenon. Is it related to static electricity? Explain your answer.

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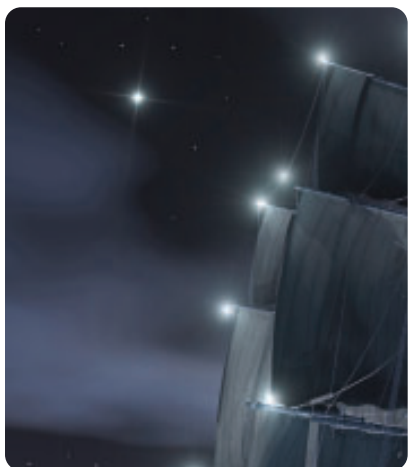


Figure 4

Think Critically

16. Why do birds not get sparks when flying near high voltage lines?

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17. Laser printers are named after the laser that is used to produce the light that writes the image. Does laser light have an electric charge? Explain your reasoning.

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18. James Wimshurst invented the Wimshurst machine, shown in Figure 5, in England in about 1880. The device produced electric charges using friction. Research to learn more about the Wimshurst machine, how it worked, and its uses. Use the information to write a report or create a poster about the Wimshurst machine that you can present to the class.

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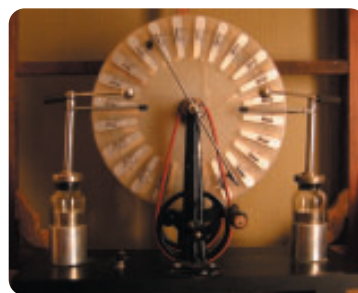


Figure 5

19. A manufacturer claims that attaching a rubber strap to a car so that it hangs down and touches the road can help to prevent motion sickness. Research the idea behind this theory, and determine if using such a strap could prevent motion sickness.

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Reflect On Your Learning

20. Has your appreciation of static electricity changed as a result of studying this chapter? Explain how and why.

Visit the Quiz Centre at

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