

Topic 3.2: How do electrical charges behave?

- Electrons carry a negative charge, and protons carry a positive charge.
- Opposite charges attract each other, and like charges repel each other.



Concept 1: Electrons carry a negative charge, and protons carry a positive charge.

Negative charges:

- The charges of electrons
- Surround the nucleus; not permanently attached, can be rubbed off a material

Positive charges:

- The charges of protons
- Part of the nucleus of atoms and are held firmly in place

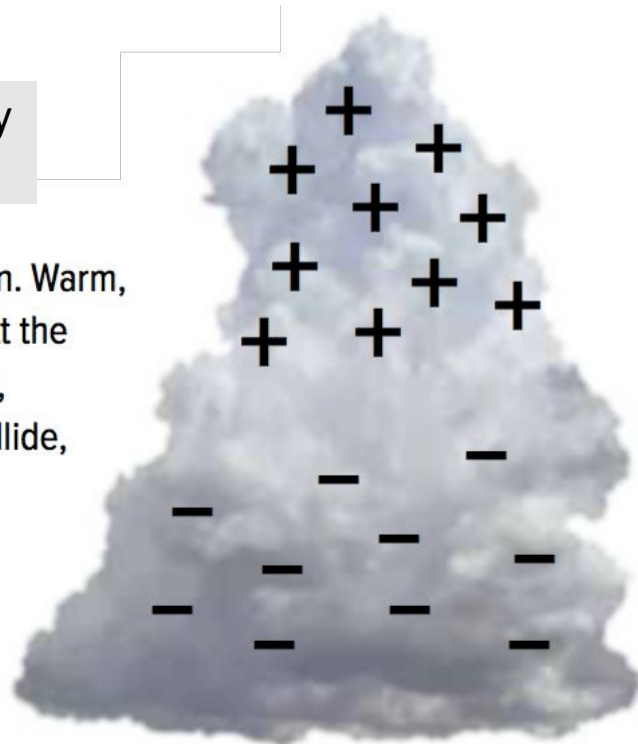
Negative Charges and Positive Charges

Charging by friction: Charging a material by rubbing

- When electrons are rubbed off a material, it becomes positively charged
- Material gains electrons and becomes negatively charged

Figure 3.9: Clouds may be charged by friction in a thunderstorm.

Clouds in storms can become charged by friction. Warm, moist air causes strong updrafts in the clouds. At the same time, hail and ice crystals fall from the top, causing downdrafts. As droplets and crystals collide, electrons are stripped from upward-moving particles and are carried downward. As a result, clouds are negatively charged at the bottom and positively charged at the top.

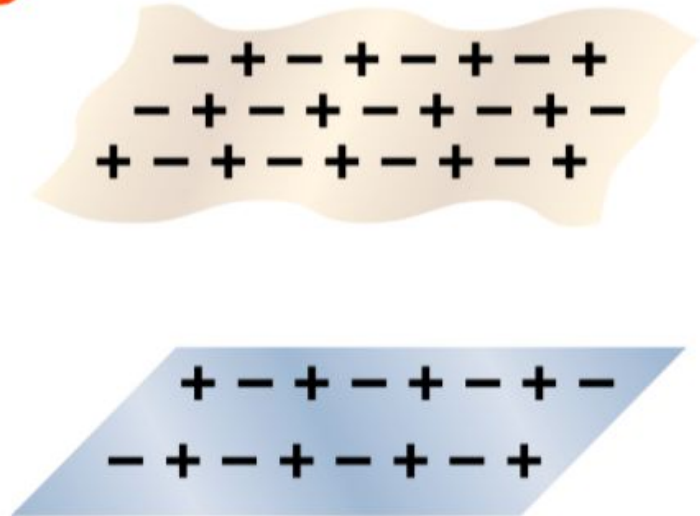


Electrically Neutral and Electrically Charged Materials

Uncharged Materials:

- Before two materials are rubbed together: they have equal numbers of protons and electrons
- Materials are *electrically neutral* (equal numbers of positive and negative charges cancel each other out)

A

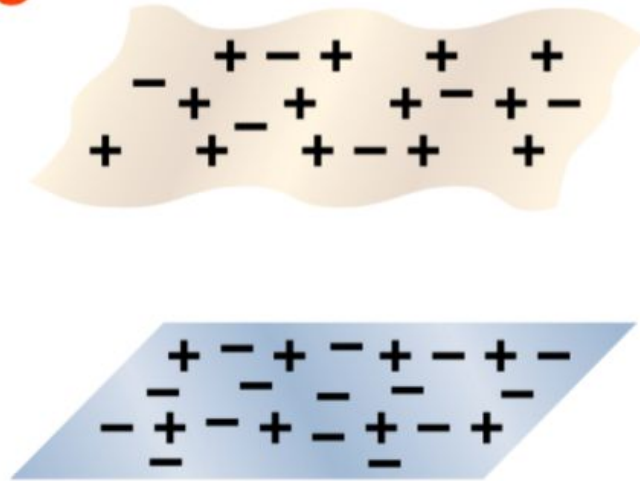


This diagram shows a paper towel (top) and an acetate strip (bottom) before they are rubbed together. Therefore, each one has an equal number of positive and negative charges. These cancel each other out so each material is electrically neutral.

Electrically Neutral and Electrically Charged Materials (continued)

Charged Materials:

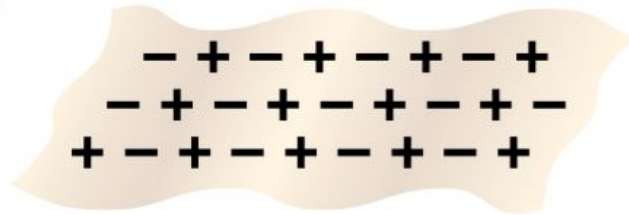
- If electrons rubbed off one material, the protons stay behind and the material becomes *electrically charged*
- The material that gains the electrons also becomes electrically charged
- Electrically charged materials have an unequal number of positive and negative charges

B

This diagram shows the two materials after they are rubbed together. Electrons are rubbed off the paper towel and transferred to the acetate strip. The paper towel now has fewer negative charges, and the acetate strip has more negative charges. The paper towel is positively charged, and the acetate strip is negatively charged.

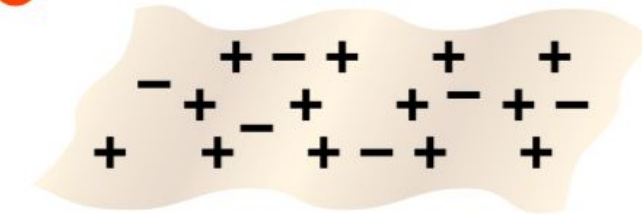
Electrically Neutral and Electrically Charged Materials (continued)

A



This diagram shows a paper towel (top) and an acetate strip (bottom) before they are rubbed together. Therefore, each one has an equal number of positive and negative charges. These cancel each other out so each material is electrically neutral.

B



This diagram shows the two materials after they are rubbed together. Electrons are rubbed off the paper towel and transferred to the acetate strip. The paper towel now has fewer negative charges, and the acetate strip has more negative charges. The paper towel is positively charged, and the acetate strip is negatively charged.

Figure 3.10: Two materials before and after being rubbed together.

Discussion Questions

1. Explain the relationship among negative charges, positive charges, electrons, and protons.

1. Describe what sometimes happens in terms of charges when you rub two different types of materials together.

Concept 2: Opposite charges attract each other, and like charges repel each other.

The Law of Electric Charge

- Opposite charges attract each other
- Like charges repel each other

The law of electric charge applies to all individual charges

- Every negative charge attracts every positive charge
- Every negative charge repels every other negative charge
- Every positive charge repels every other positive charge

Attraction Between Charged Objects and Neutral Objects

The law of electric charge explains why charged objects attract neutral objects

- All neutral objects have an equal number of protons and electrons



Figure 3.11: The comb is charged, and the water is neutral.

Attraction Between Charged Objects and Neutral Objects (continued)

Why a charged balloon sticks to an electrically neutral wall:

- When a charged object (balloon) is brought near a neutral object (wall), the electrons in the neutral object do not come off
- Negative charges in the wall are pushed away from the surface by the negative charges on the balloon
- Positive ends of the molecules in the wall are attracted to the negative charges on the balloon
- This attraction is strong enough to hold the balloon to the wall

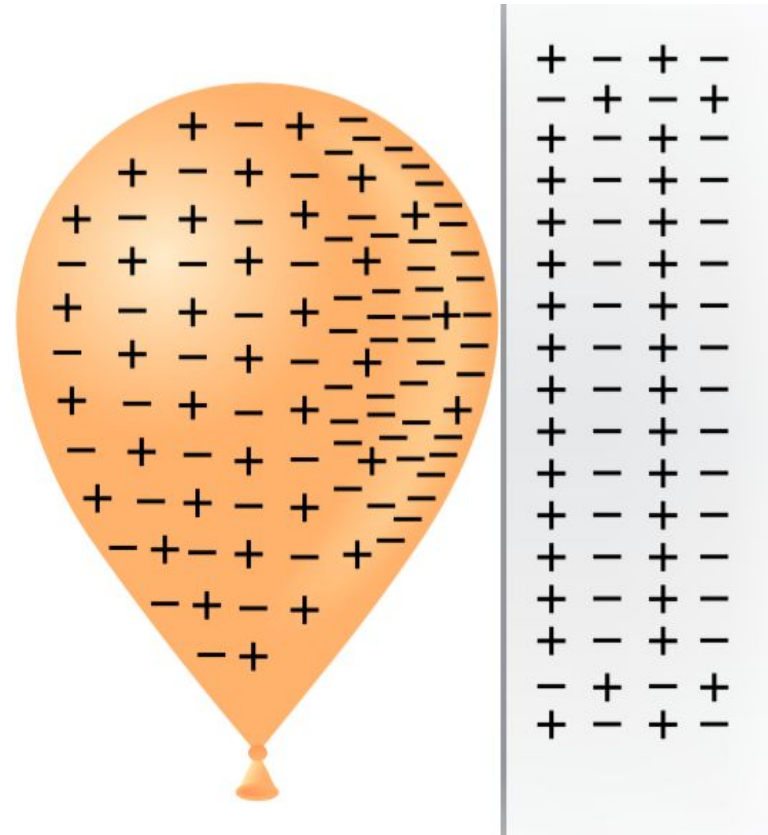


Figure 3.12

Discussion Questions

1. State the law of electric charge.
1. Refer to Figures 3.11 and 3.12. Make a labelled sketch, including charges, to explain why a stream of neutral water bends toward a positively charged comb.

Topic 3.2 Summary: How do electrical charges behave?

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