Electric Discharge—Lightning

Electrons that move from one object to another and cause the buildup of charges at rest, or static electricity, eventually leave the object. Sometimes they move onto another object. Usually, these extra electrons escape onto water molecules in the air. (This is why static electricity is much more noticeable on dry days. On dry days the air contains fewer water molecules. Objects are more easily charged because charges cannot escape into the air.) When the charged object loses its static electricity, it becomes neutral once again. The balloon eventually falls off the wall because it loses its charge and there is no longer a force of attraction between it and the wall.

The loss of static electricity as electric charges move off an object is called **electric discharge.** Sometimes electric discharge is slow and quiet. Sometimes it is very rapid and accompanied by a shock, a spark of light, or a crackle of noise.

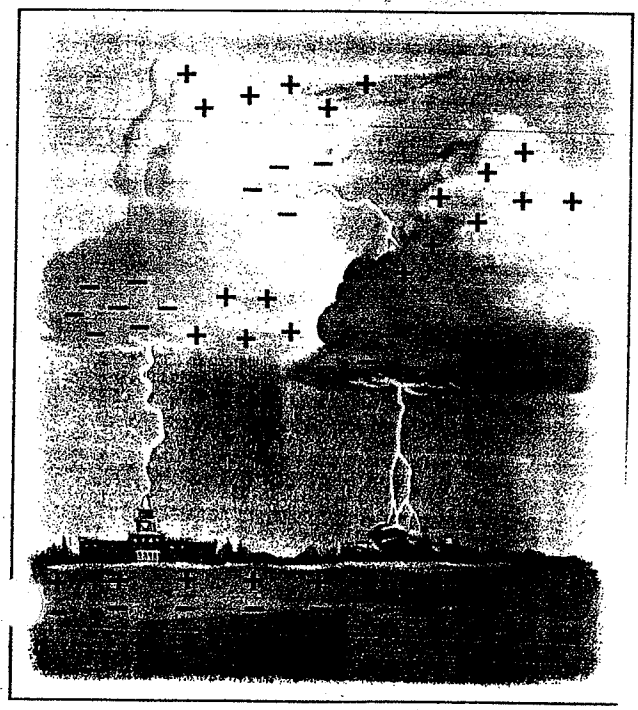
One of the most dramatic examples of the discharge of static electricity is lightning. During a storm, particles contained in clouds are moved about by the wind. Charges may become separated, and there are buildups of positive and negative charges in different parts of the cloud. If a negatively charged edge of a cloud passes near the surface of the Earth, objects on the Earth become electrically charged by induction. Negative charges move away from the cloud, and positive charges are left closest to the cloud. Soon electrons jump from the cloud to the Earth. The result of this transfer of electrons is a giant spark called lightning.

Lightning can also occur as electrons jump from cloud to cloud. As electrons jump through the air, they produce intense light and heat. The light is the bolt of lightning you see. The heat causes the air to expand suddenly. The rapid expansion of the air is the thunder you hear.

One of the first people to understand lightning as a form of electricity was Benjamin Franklin. In the mid-1700s, Franklin performed experiments that provided evidence that lightning is a form of static electricity, that electricity moves quickly through certain materials, and that a pointed surface attracts electricity more than a flat surface. Franklin suggested that pointed metal rods be placed above the roofs of buildings as protection from lightning. These rods were the first lightning rods.

Lightning rods work according to a principle called grounding. The term grounding comes from the fact that the Earth (the ground) is extremely large and is a good conductor of electric charge.

Figure 1–10 *Lightning is a spectacular discharge of static electricity between two areas of different charge. Lightning can occur between a portion of a cloud and the ground, between different clouds, or between different parts of the same cloud. Benjamin Franklin's famous experiments provided evidence that lightning is a form of static electricity.*



The Earth can easily accept or give up electric charges. Objects in electric contact with the Earth are said to be grounded. A discharge of static electricity usually takes the easiest path from one object to another. So lightning rods are attached to the tops of buildings, and a wire connects the lightning rod to the ground. When lightning strikes the rod, which is taller than the building, it travels through the rod and the wire harmlessly into the Earth. Why is it dangerous to carry an umbrella during a lightning storm?

Unfortunately, other tall objects, such as trees, can also act as grounders. That is why it is not a good idea to stand near or under a tree during a lightning storm. Why do you think it is dangerous to be on a golf course during a lightning storm?

PRACTICAL USES OF STATIC ELECTRICITY

1. *Electrostatic spray painting*
When a spray gun is used to paint a wire mesh fence, normally a lot of paint is wasted! But when the fence is given a static charge and the paint is given the opposite charge, the paint will be attracted to the wire mesh instead of going through the fence.

2. *Electrostatic sandpaper*
If the paper backing for sandpaper is coated with adhesive and given a strong charge, the grit particles will be attracted to the paper.

3. *Electrostatic flocking*
Using a static charge, small nylon fibres can be made to stick to backing material in the manufacture of carpets. Velvets are made in this way, too.

4. *Insecticide powders*
When electrically charged, insecticide powders can be applied very efficiently to certain plants. There is very little waste of insecticide, and little damage is done because of accidental spraying of the wrong plants.

5. *Electrostatic precipitators*
Tall chimneys in chemical plants, smelters, and mills may have electrically charged parts inside them. These attract dust particles and polluting droplets before they can escape from the smokestacks. Smaller electrostatic precipitators are used to remove dust from the air of hospitals, and from factories that manufacture electronic parts.

6. *Sandwich wrap*
The thin plastic used for wrapping foods tends to cling to itself because of static electricity. This makes it easy to get an airtight package.

7. Air fresheners

Some people purchase what are called *air ionizers* to freshen and purify the air in their homes. They work on a similar principle as the smokestack pollution control. These devices strip electrons from smoke molecules, dust particles, and pollen in the air, just as what happens in creating static electricity.
These charged dust and smoke particles are then attracted to and stick to a plate on the device with the opposite charge. After a while, much of the pollution is drawn from the air. Since charged particles will also stick to neutral surfaces, some of them can stick to the wall near the ionizer, making it very dirty and difficult to clean.

8. Xerography

Your photocopier or Xerox machine uses static electricity to copy print to a page. This is done through the science of xerography.
One version gives ink an electrical charge so that it will stick to the paper in the designated areas. Another version of a photocopier uses charges to stick the ink to a drum, which then transfers it to the paper.

NAME:_____

BLOCK: ___; DATE:_____

DANGERS AND USES OF STATIC ELECTRICITY

Part 1: Electric discharge - Lightning

1. Why is static electricity more noticable on dry days?

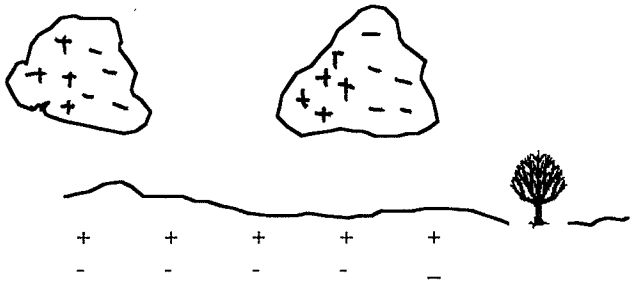
2. What combination of 2 factors result in static electricity being produced in abundance (i.e. **lots!**) in clothes dryers?

3. a) What causes the loud noise known as 'thunder'?

b) Which would you notice first? Thunder or lightening? Explain.

4. What must happen in a cloud in order for it to be capable of causing a lightning strike?

5. Examine the following diagram. Sketch in 2 likely (but different) paths for a lightning strike. Indicate the direction of the strike with an arrow.



6. Zsa-zsa noticed that during a storm, thunder followed a lightning flash by about 8 seconds. Later that evening thunder followed lightning by only about a second. Provide an explanation for her observations.

(note: the speed of light is about 300 000 km/s, the speed of sound is about 330 m/s)

7. Two neighbours with identical houses install identical lightning rods. Both houses are hit by lightning but only one burns down. Which house likely burned down and why?

The Jones house The Smith house:

Part 2: Practical uses of static electricity

8. List two uses of static that are designed to keep small dust particles of out the air.

9. List two uses of static that are designed to prevent the waste of sprayed materials.

10. Food wraps like *Saran Wrap* clings to it's-self and to dishes. Why?

11. How do photocopiers make use of static charges?