

Conductors & Insulators Answer Key

Question #1

- A. Water is a good conductor of electricity.
- B. Power lines are made to conduct electricity efficiently and are usually made of aluminum or copper with no insulation.
- C. Ladders that are made of metal or aluminum are good conductors. A wooden ladder that is wet can also be a good conductor.
- D. Kite string that is wet or has shiny aluminum threads woven though it is a conductor. Please keep in mind that shiny Mylar balloons that are coated with aluminum are also conductive.
- E. Tree branches contain water and sap which is mostly water and therefor are good conductors that can provide a path to ground through the tree trunk.
- F. The human body is made up of about 65 percent water and will conduct electricity very well.

Question #2

Air does not conduct electricity so it is a good insulator. This is why it's important that you keep a lot of space between yourself and any wires. The more "air space, or distance, between you and any power lines, the safer you are. That's why power lines are installed high in the air on tall utility poles.

Question #3

All the pictured items are good conductors of electricity. All of them can create a path to ground under the right conditions.

Question #4

Only photo B shows a good insulator. The air space between the power line and the person pointing to the wire is a good insulator. Note that the steel tower that the wires are hanging from is a good conductor but the wires are insulated from the steel by the porcelain (glass) insulators between the wires and the steel tower.

- 1. Air is a good insulator
- 2. Porcelain and glass are good insulators
- 3. Fiberglass – if it is clean and dry – is a good insulator

Question #5

- A. If a conductor that uses electricity, such as a hair dryer or radio, falls into water (lake, swimming pool, bathtub, etc.) and a person comes into contact with the water, he or she could complete a circuit (make a path to ground) and be shocked or even killed.
- B. If the insulators between the power pole (or tower) and the wire are damaged, the power pole could become energized. If a person touches a power pole with a damaged insulator, he or she could be seriously injured and could die. Lightning and high winds can cause a wire to fall to the ground. If you ever see a downed wire, stay away and tell an adult. It's always best to stay away from utility poles and other electrical equipment.
- C. If an aluminum ladder is used around the house or close to power lines there is a high risk of being shocked or killed because aluminum is a good conductor. Notice the electric arc between the ladder and the power line going into the house. The current will flow down the ladder – and the person – and into the ground. This can lead to serious injury or death.
- D. Never fly a kite near power lines. A kite string that is moist or wet can conduct electricity and cause you to be shocked or killed. Kite string that's shiny may have an aluminum thread woven into it that can conduct electricity. Avoid using this kind of kite string. Electric current is always looking for a path to flow to ground – the current will flow down the kite string and through the person and into the ground. Again, this can lead to serious injury or death.
- E. Tree branches contain water and sap. This makes them a very good conductor of electricity that can cause serious injury or death if you come into contact with the branches. Always look for power lines before climbing a tree – if a tree is near power lines, stay away!
- F. There is no hazard in this photo.

Electromagnets Answer Key

Question #3

A, C, D and E are electromagnets.

Question #4

B and F are not electromagnets. These are called “switches”. When you press the doorbell and it rings, you’ve completed the circuit.

Question #5

Pad-mounted transformers contain high voltage circuits and high current capability. All pad-mounted transformers are locked. Never touch, play near or sit on a pad-mounted transformer. If you see something that does not look right, tell an adult.

Question #6

It’s dangerous because the high voltage and current in the transformer could be exposed and anyone who tries to touch or get inside the transformer is at risk of being injured or killed. If you see damage to a pad-mounted transformer, tell an adult right away.

Simple Circuit Answer Key

Question #4

A, B, D, and F are examples of closed circuits. In A, the conductors are intact and current is flowing as it was designed. In B, while there is an air gap, if the voltage is high enough and the contact points are close enough together, the current can actually bridge the gap and flow. This is easy to re-create in a lab situation. A real world example of this is a lightning strike between the ground and the clouds. D, –like “A” the conductors are intact and the current is flowing. In F, the light is on indicating that the circuit is complete and current is flowing.

Question #5

C and E are examples of open circuits. While the conductors in C are on the ground and may still be energized it appears that there are broken conductors which would cause the circuit to be open. In E the tree has fallen across the conductors and taken them to the ground breaking them and opening the circuit. They may still be hot or energized but at least part of the circuit will be open.

Question #6

If you touch a downed power line or anything that is in contact with the power line, you could complete a path to ground. This can lead to serious injury and you could die. Always stay well away from downed power lines and tell an adult.

Question #7

Sometimes wires on the ground will fire up and spark or move around. This makes it easy to see if they are energized. However, sometimes they will lie on the ground and not smoke or burn or move or give any indication that they are energized. Always assume they are energized and stay away. If you see a downed power line, always notify an adult.

Static Electricity Answer Key

Question #4

A, B, C, D, and G represent static electricity. All either represent what static can do or can cause static (for example, socks on your feet moving across carpet build static electricity). The items in photos E and F are a power source, not a static source. A battery converts chemical energy into a Direct Current (DC) electric potential or voltage. In the case of F – the power outlet – you have a source of Alternating Current (AC) power to your house direct from the power plant.

Question #5

A, D, F and G pose the greatest danger. Lightning can be extremely dangerous because there is so much energy discharged in such a short period of time – it is very powerful. An electrical outlet, while commonplace, is an easy source of energy and there is sufficient energy to shock and do a human body great harm. Never insert foreign objects into an electrical outlet.

Warning! If you hear thunder, seek shelter. Don't go outside in the open until 30 minutes have passed with no more thunder.

Question #6

Lightning tends to hit the tallest object in an open field. If you are standing in an open field, you will be the tallest object and could get struck by lightning. If you're struck by lightning, your body will experience a strong electric shock and it can be powerful enough to kill you. An average lightning strike has about 250,000 volts and more than 1,000 amps of current.

Question #7

A tree is usually the tallest object around and therefore more likely to be hit. Metal objects are good conductors and are also likely to be hit by lightning. This is why it's important that golfers seek shelter when they hear thunder. A golfer holding a metal golf club (a conductor) in an open field is in danger of being shocked or killed if lightning is around.

Electrical Circuit Answer Key

Question #2

A, B, C, D, E, and F are all examples of an electrical circuit.

- A – The switch is a part of the circuit and this switch is in the off position. When you turn it on you complete the circuit and turn on the lights in a room.
- B – The TV working is evidence that the circuit providing power to the TV is on and complete.
- C, D, E, and F are all part of the electrical utility system and represent different types of circuits. It's important to know that even though some of the circuits in the pictures are damaged, they could still be energized and dangerous.

Question #4

- D – This power pole has been damaged by a storm, vehicle accident or other occurrence. Notify an adult if you see a leaning or damaged pole.
- E – This power pole and power lines have been damaged by a car. Never go near downed power lines or other equipment. Stay away and notify an adult.
- F – This is an electrical substation – it's a part of the electrical system that provides power to your neighborhood. Substations are surrounded by a fence to keep people away from electrical equipment. Never climb the fence or go near a substation. If a ball or toy goes into a substation tell an adult and stay away.

Question #5

A downed power line could result in serious injury and you could die. You should never touch a downed power line. Always stay away and tell an adult.

Question #6

Do not touch the exposed or bare wires and tell an adult. If you touch the exposed wires you could be a path to ground (complete a circuit) and become seriously injured or die.

Question #7

Because the vehicle could be energized and, like the power line, you can't tell by looking if it's energized or safe to touch or not. Stay well away, warn others to stay away and call 911 or an adult.

Question #8

If a power line falls on your vehicle, stay inside the vehicle. The voltage will flow around the vehicle to the ground without flowing through you. Don't be fooled by the vehicle's rubber tires – they are not insulators at power line voltages. If you try to leave the vehicle and you touch the vehicle and the ground at the same time, you will provide a path (complete a circuit) for current to flow through your body to ground and you could be seriously injured or killed.