HealthStream Regulatory Script

[Electrical Safety]

Version: [April 2005]

Lesson 1: Introduction
Lesson 2: Electric Shock Hazards
Lesson 3: Reporting Hazards and Preventing Accidents
Lesson 1: Introduction

1001

Introduction

Welcome to the introductory lesson on electrical safety.

Most equipment in the healthcare setting is electric. For example, ECG machines, bedside monitors, anesthesia machines, ventilators, and incubators all run on electricity.

Patients and staff are often in contact with these devices. Therefore, electric shock is always a risk in the healthcare setting.

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<table>
<thead>
<tr>
<th>Course Outline</th>
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<tbody>
<tr>
<td>This course addresses:</td>
</tr>
<tr>
<td>• The basics of electricity</td>
</tr>
<tr>
<td>• How and why electric shock occurs</td>
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<tr>
<td>• Reporting electrical hazards</td>
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<tr>
<td>• Preventing electrical accidents</td>
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Point 2 of 10
<table>
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<tr>
<th><strong>1003</strong></th>
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<tbody>
<tr>
<td><strong>Warning Signs</strong></td>
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<tr>
<td>Do you pay attention to warning signs of electrical hazards?</td>
</tr>
<tr>
<td>Many people think, “It could never happen to me.” But thousands of electrical accidents do happen each year.</td>
</tr>
<tr>
<td>Electrical accidents often cause injuries, fires, and death.</td>
</tr>
</tbody>
</table>

**Heed Warnings**

![Image: 1003.GIF]

Point 3 of 10
Electrical Hazards

Electrical safety requires the cooperation of all personnel and departments in your facility.

All personnel must know the warnings signs of electrical hazards. This can help keep staff and patients safe.

The remainder of this lesson covers the basics of electricity. This will help you understand how and why electrical hazards occur.

Risk Factors
- Faulty electrical equipment or wiring
- Damaged receptacles or connectors
- Unsafe work practices
A conductor is any material that can transmit electricity.

There are many examples of conductors. The ground, or earth, is a conductor. Metals such as aluminum, silver, gold and iron also make good conductors.

Other examples of conductors are:
- Moist body tissues
- Body fluids
- Water

Electric current flows readily through all of these conductors.
Electricity Basics: Insulators

Some materials block the flow of electric current. These materials are **insulators**.

Examples of insulators include:
- Rubber
- Plastic
- Glass
- Cloth
- Wood
Electricity always travels in a loop. This loop starts and ends with the source of the electricity.

Another name for a loop of electric current is a circuit [glossary].

Electricity must travel in a circuit to power the electric devices you use every day.

In this case, the circuit starts and ends with the power plant.
Electricity Basics: Short Circuits

Electricity always returns to its source. And it always takes the shortest circuit possible.

Insulators can force electricity to take a more difficult path. For example, the insulation on a power cord forces electricity to flow through a piece of equipment. This is a difficult path because the electricity must do work to power the equipment.

Electricity will take an easier path if it can. This is a “short-circuit.”

Electric shock happens when YOU become part of a short-circuit.

For example, suppose you are holding a power cord in one hand, and touching a metal chair with the other hand. The insulation on the power cord is damaged. You are a conductor. The metal chair is a conductor. The ground is a conductor.

Electricity will flow from the damaged cord, to you, to the chair, to the ground.

This is much easier than flowing from the power cord into a piece of equipment! From the ground, electricity easily returns to the power plant. This completes its circuit.

Meanwhile, you may have serious electric burns or other injuries. Even death is possible.

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<table>
<thead>
<tr>
<th>FLASH INTERACTION: 1009.SWF/FLA</th>
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</thead>
<tbody>
<tr>
<td>Which of these is most likely to be a conductor of electricity?</td>
</tr>
<tr>
<td>Image of Rubber shoes</td>
</tr>
<tr>
<td>Image of puddle of water</td>
</tr>
<tr>
<td>Image of wooden horse</td>
</tr>
<tr>
<td>Correct:</td>
</tr>
<tr>
<td>(Puddle of water on the floor)</td>
</tr>
</tbody>
</table>
Summary

You have completed the introductory lesson on electrical safety.

Remember:

- Electric current moves easily through conductors. Conductors include metals, water, and the moist tissues of the human body.
- Insulators block the flow of electricity. Examples of insulators include rubber, wood, and plastic.
- Electricity always returns to its source. It does this by traveling in a circuit.
- Electricity takes the shortest circuit it can find. Electric shock happens when a person becomes a shortcut in an electric circuit.
<table>
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<th>Introduction</th>
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</table>

Welcome to the lesson on electric shock hazards.

**IMAGE: 2001.JPG**

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**Point 1 of 11**
### Objectives

After completing this lesson, you should be able to:

- Explain how electric shock occurs.
- List potential electrical injuries.
- List factors affecting the likelihood and severity of electric shock and injury.
<table>
<thead>
<tr>
<th>Electric Shock: How</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Remember:</strong> Electric shock happens when a person becomes part of a short-circuit.</td>
</tr>
<tr>
<td>This can happen if a person touches:</td>
</tr>
<tr>
<td>- A damaged electric device</td>
</tr>
<tr>
<td>- An electrified object</td>
</tr>
</tbody>
</table>

Point 3 of 11
Electric Shock: Why

Remember: Electricity always takes the easiest path to return to its source.

Think about it:
- Electric current flows easily through moist body tissues.
- Inside a piece of equipment, electricity is slowed down by having to do work.

Therefore, electricity would much rather travel through a person than a piece of equipment!

Electric shock happens when a person becomes a shortcut for electricity that is meant to return to its source *after* powering a piece of equipment.

![Electric shock happens when electricity flows through the body.](2004.GIF)
### Electric Shock: Potential Injuries

Electric shock can cause:
- Burns
- Muscle spasms
- Abnormal heartbeats
- Stopping of breathing
- **Electrocution** [link to glossary]

Knowing CPR can help save the life of an electric shock victim!
### Potential for Injury: Physical Condition

Several factors can increase the risk of injury when a person is shocked.

The first factor has to do with whether the person is a good or bad conductor.

Remember: Moist body tissues are conductors. This makes people conductors.

But some people are better conductors than others.

For example, babies and children are usually better conductors than adults. Electricity flows through babies and children EXTREMELY easily. Therefore, babies and children are more likely to be injured if they are shocked.
Potential for Injury: Physical Condition of Person Receiving Shock

There are many other factors that can make a person a better conductor. These factors include:
  • Wet clothes
  • High humidity
  • Sweating
  • Being barefooted
  • Standing in a puddle of water

All of these factors increase the risk of injury if the person is shocked.

On the other hand, insulators make a person a bad conductor.

For example, rubber-soled shoes make it difficult for electric current to pass through a person’s feet directly into the ground. A person wearing rubber-soled shoes may no longer be such an easy path for electricity to take! This person is less likely to be injured if he or she is exposed to electricity.
Path of Current

The path of the current also affects the severity of injury when a person is shocked.

For example, suppose a nurse accidentally touches a live wire with one hand, and a set of metal shelves with the other hand. Electric current will always take the shortcut. Electricity will flow from the wire, across the nurse’s chest, to the shelves, to the ground. From the ground, the current easily returns to the power plant. This completes the circuit.

Now, think about what happened to the nurse. The current passed directly across her heart.

Current across the heart is very likely to cause the heart to stop beating normally.

Current through other areas of the body is less likely to affect the heart in a life-threatening way.
| True or False:  
Electric shock can be startling. However, shock can cause no long-term damage. | TRUE/FALSE INTERACTION |
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>a. True</td>
<td>[Correct Answer: B]</td>
</tr>
<tr>
<td>b. False</td>
<td>[FEEDBACK FOR A: Incorrect. Electric shock can cause burns, muscle spasms, abnormal heartbeats, stopping of breathing, and electrocution.]</td>
</tr>
<tr>
<td></td>
<td>[FEEDBACK FOR B: Correct. Electric shock can cause burns, muscle spasms, abnormal heartbeats, stopping of breathing, and electrocution.]</td>
</tr>
</tbody>
</table>
Electric shock happens when a person’s body becomes part of a short-circuit.

- **True**
- **False**

**TRUE/FALSE INTERACTION**

[CORRECT ANSWER: A]

[FEEDBACK FOR A: Correct. Electric shock happens when current flows through the body. This occurs whenever the body becomes part of a shortcut for electricity to complete a circuit.]

[FEEDBACK FOR B: Incorrect. Electric shock happens when current flows through the body. This occurs whenever the body becomes part of a shortcut for electricity to complete a circuit.]
You have completed the lesson on electric shock hazards.

Remember:

- Electric shock happens when the body becomes part of a short-circuit.
- Electric shock can cause burns, muscle spasms, abnormal heartbeats, stopping of breathing, and death.
- When a person is shocked, injury is more likely if:
  - Humidity is high.
  - The person is sweating or wearing wet clothes.
  - The person has bare feet.
  - The person is standing in a puddle of water.
- Wearing rubber-soled shoes decreases the risk of electric shock.
- Current across the heart is likely to cause the heart to stop beating normally. Current through other areas of the body may cause burns or muscle spasms. However, it is less likely to affect the heart in a life-threatening way.
Welcome to the lesson on reporting hazards and preventing accidents.
### Objectives

After completing this lesson, you should be able to:

- Identify what to do if you spot an electric hazard.
- List what to look for during an equipment check.
- List what to do before performing maintenance on an electric device.
- List safety guidelines for power cords and outlets.
- List best practices for protecting patients from electric shock.
### Preventing Accidents

To help prevent electrical accidents in your facility, follow best practices for:

- Reporting hazards
- Using electrical equipment
- Equipment inspection and testing
- Equipment maintenance and repair
- Power cords and outlets
- Circuit boxes

Let’s take a closer look at best practices in each category.
### Reporting Hazards

All employees should be on the lookout for electric hazards. Hazardous equipment should be removed from service right away. Equipment is hazardous if it:

- Does not work correctly
- Shows signs of damage
- Gets too hot when it is used
- Smells like burning when it is used
- Shocks staff or patients

Follow facility procedures for turning in hazardous equipment to be repaired.

You may need to contact the equipment maintenance department. You may need to fill out a work order. Check with your supervisor to find out exactly what to do.

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Using Electrical Equipment

<table>
<thead>
<tr>
<th>Before using electrical equipment:</th>
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<tbody>
<tr>
<td>• Learn how to use the equipment properly.</td>
</tr>
<tr>
<td>• Check the equipment for damage and wear. Do not use damaged equipment. Turn it in to be repaired.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Do not use electrical equipment:</th>
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</thead>
<tbody>
<tr>
<td>• If liquid has been spilled on the equipment</td>
</tr>
<tr>
<td>• If the floor is wet and you are standing in the wet area</td>
</tr>
<tr>
<td>• If your hands are wet</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Finally:</th>
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<tbody>
<tr>
<td>• Do not stack anything on or behind electrical equipment.</td>
</tr>
<tr>
<td>• Turn equipment off before plugging it in or unplugging it.</td>
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</tbody>
</table>
Equipment Inspection and Testing

All medical equipment should be inspected and tested regularly. Your facility should have schedules and procedures for this.

Inspection procedures should include at least the following:
- Check the device’s power cord for fraying, splicing, and wear.
- Check the device’s casing for cracks, holes, and other damage.
- Check to make sure all device covers are in place.
- Check all circuit interlocks (if applicable).

Equipment brought in by patients also should be inspected before use. Items such as radios and razors should be battery-operated whenever possible.
Equipment Maintenance and Repair

Before equipment is inspected, serviced, or repaired, it must be removed from its power source.

Many devices can simply be unplugged.

Other devices must be removed from power by using a procedure known as lockout/tagout.

For more information on lockout/tagout, see the course **Control of Hazardous Energy: Lockout/Tagout**.
## Power Cords and Outlets

Best practices for power cords and outlets include:

- Do not use outlets or cords with exposed wiring. Report damaged outlets or cords to your supervisor or a repairperson.
- Outlets that get too hot may not be wired safely. Unplug cords from the outlet. Report the problem.
- Do not bend, stretch, or kink power cords.
- Do not jerk cords from outlets. Pull on the plug to remove a cord from an outlet.
- Do not staple, tack, or nail power cords to walls or floors. This could damage the insulation and expose bare wires. Use tape, if necessary.
- Do not rest equipment on power cords.
- Use only power cords with three-prong plugs. Never use adapters, two-prong plugs, or broken three-prong plugs.

Extension cords are usually not allowed in patient care areas. Check with your supervisor.
Remember: Electricity travels in a circuit. The overall circuit starts and ends with the power plant.

Within your facility, there are smaller circuits that branch off from the main circuit. Each of these starts and ends with a circuit breaker in a breaker box.

Overloading one of these circuits can be extremely dangerous. Never overload a circuit.

To keep from overloading a circuit:
- Install equipment systems according to the manufacturer’s instructions
- Follow national and local electric codes when installing equipment systems.

Also, each breaker should be clearly labeled with the names of the equipment on that circuit. This makes it easy to see if a circuit is overloaded. Clear labeling also makes it easy to turn off the right circuit, right away, in an emergency.

Breaker boxes should be accessible at all times.
Patients come into contact with many electric devices in the healthcare setting. Examples include:
- Adjustable beds
- Nurse call systems
- Lamps
- Treatment devices

This puts patients at risk of electric shock and injury.

To help protect patients:
- Place electric equipment at a distance from patients, whenever possible.
- Make sure the floors in patient areas stay dry.
- If possible, do not touch patients and electric equipment at the same time.
Which of the following statements is true?

a. It is okay to use electric equipment when your hands are wet, as long as you are wearing rubber-soled shoes.
b. It is okay to unplug equipment without turning it off, as long as you jerk the cord from the outlet.
c. It is okay to use damaged equipment, as long as you report that it is damaged.
d. It is okay to attach power cords to walls or floors, as long as you use tape, and not staples, tacks, or nails.

**MULTIPLE CHOICE INTERACTION**

[CORRECT ANSWER: D]

[FEEDBACK FOR A: Incorrect. Rubber-soled shoes can help protect against electric shock. Even so, never use electric equipment when your hands are wet. The correct answer is D.]

[FEEDBACK FOR B: Incorrect. Always turn equipment off before plugging it in or unplugging it. Never jerk cords from outlets. Pull on the plug to remove a cord from an outlet. The correct answer is D.]

[FEEDBACK FOR C: Incorrect. Report damaged equipment, remove it from service, and turn it in for repair. Never use damaged equipment. The correct answer is D.]

[FEEDBACK FOR D: Correct!]
Patients come into contact with many electric devices in the healthcare setting. This puts patients at risk of electric shock and injury. Certain best practices can help protect patients. What are these practices?

- Type your thoughts in the box below. Then click Submit to compare your answer to ours.

[FEEDBACK: Did you remember the following practices?]

To help protect patients:
- Place electric equipment at a distance from patients, whenever possible.
- Make sure the floors in patient areas stay dry.
- If possible, do not touch patients and electric equipment at the same time.
### Summary

You have completed the lesson on reporting hazards and preventing accidents.

Remember:
- Most electrical accidents are preventable.
- Report hazards promptly.
- Use equipment properly.
- Inspect and test equipment regularly.
- Use lockout/tagout procedures for equipment maintenance.
- Use power cords and outlets properly.
- Do not overload circuits.
- Protect patients from electric shock hazards.
<table>
<thead>
<tr>
<th>#</th>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>1.</td>
<td>adapter</td>
<td>connector that makes it possible to plug a three-pronged plug into a two-pronged outlet</td>
</tr>
<tr>
<td>2.</td>
<td>conductor</td>
<td>material capable of transmitting electricity; readily allows for flow of electrons; has low resistance</td>
</tr>
<tr>
<td>3.</td>
<td>insulator</td>
<td>material that blocks the flow of electricity; does not readily allow for flow of electrons; has high resistance</td>
</tr>
<tr>
<td>4.</td>
<td>electrical ground</td>
<td>object with a physical electrical connection to the earth, and, therefore, having a voltage of 0</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>electrocution</td>
<td>death as a result of electrical shock</td>
</tr>
<tr>
<td>7.</td>
<td>circuit</td>
<td>the complete path of an electric current, usually including the source of electric energy</td>
</tr>
</tbody>
</table>
Pre assessment

1. Which of the following statements is (are) true?
   a. Moist body tissues and tissue fluids are good conductors.
   b. Glass and plastic are good conductors.
   c. A conductor is a material that blocks the flow of electricity.
   d. All of these statements are true.
   e. None of these statements is true.

Correct answer: A
Rationale: Electricity travels easily through conductors. Moist body tissues and tissue fluids are good conductors. Glass and plastic are examples of good insulators. These materials block the flow of electricity.

2. All of the following statements are true EXCEPT:
   a. Electricity completes a circuit by traveling from a power plant to an ECG machine.
   b. Electricity always looks for the easiest way to complete a circuit.
   c. Electric shock happens when a person becomes part of a short-circuit.
   d. Electricity must travel in a circuit to power electric devices.

Correct answer: A
Rationale: To complete a circuit, electricity must return to its source. In this case, the complete circuit would be: power plant – ECG machine – power plant.

3. Electric shock can cause:
   a. Muscle spasms
   b. Abnormal heartbeats
   c. Stopping of breathing
   d. All of these
   e. None of these

Correct answer: D
Rationale: Electric shock can cause all of the injuries listed. It also can cause burns and electrocution.

4. Electrocution means:
   a. Exposing body tissues to electric shock
   b. Injury due to electric shock
   c. Death due to electric shock
d. Exposing body tissues to AC current

Correct answer: C
Rationale: Electric shock can cause death. This is electrocution.

5. It is impossible to be shocked when wearing rubber-soled shoes.
   a. True
   b. False

Correct answer: B
Rationale: Electricity is unlikely to look for a path through rubber shoes. However, electric shock could still happen. For example, electricity could find a way to pass through the body and go to ground without passing through the rubber shoes.

6. You are preparing to perform an ECG on one of your patients. Another staff member is using the ECG machine that you most often use. You retrieve a second machine from storage. Before performing the ECG, you should:
   a. Make sure that you know how to use this particular machine.
   b. Make sure that the machine is turned off before plugging it in.
   c. Make sure that the machine does not have any signs of damage or wear.
   d. Do all of these things.
   e. Do none of these things.

Correct answer: D
Rationale: Never use equipment that you do not know how to operate. Before using any piece of equipment, check for damage and wear. Always turn equipment off before plugging or unplugging it.

7. Your patient's bedside monitor seems to be overheating. You turn off the monitor. You pull the plug from the wall outlet. You mark the monitor "out of order," and turn it in for repair. You then retrieve a replacement monitor from storage. You inspect the new monitor. You transport it to your patient's bedside and plug it in. You tack the extra few feet of power cord to the wall, so that no one will trip over it. In this scenario, where have you gone wrong?
   a. It is not necessary to turn a device in for repair simply because it overheats. Lots of equipment heats up when it is being used.
   b. Pulling on a plug puts your hand too close to a live energy source. It is best to remove a cord from an outlet by jerking on the cord a foot or two away from the plug.
   c. It is not necessary to inspect equipment before using it. In fact, inspections can create a false sense of security. Most problems are not obvious until after the equipment is placed in service.
   d. Power cords should not be tacked to walls. Tacks can damage the cord covering.

Correct answer: D
Rationale: Do not staple, tack, or nail power cords to walls or floors. This could damage the cord covering and expose bare wires. Use tape, if necessary.
8. To help protect patients from the risk of electric shock and injury:
   a. Place electrical equipment as far as possible from patients.
   b. Use extension cords in patient-care areas whenever possible, to increase the distance between patients and equipment.
   c. Tack extension cords to walls or floors, so that patients will not trip over them.
   d. All of these are best practices.
   e. None of these is a best practice.

Correct answer: A
Rationale: Electrical equipment should be placed as far as possible from patients. Extension cords are usually not allowed in patient-care areas. Power cords should not be stapled, tacked, or nailed to walls or floors. This could damage the cord cover and expose bare wires.

9. A patient has just been admitted to your unit. He brought his electric razor with him. Hospital staff should inspect this razor for electrical hazards before the patient uses it.
   a. True
   b. False

Correct answer: A
Rationale: Equipment brought in by patients should be inspected before use.

10. It is okay to use electrical equipment when your hands are wet, as long as you are wearing rubber-soled shoes.
   a. True
   b. False

Correct answer: B
Rationale: Never use electrical equipment when your hands are wet.
[Electrical Safety]

Final Exam

Question Title: Question 1
Question: ECG machines, bedside monitors, anesthesia machines, ventilators, and incubators all run on electricity.

Answer 1: True
Answer 2: False

Correct Answer: True
Answer Rationale: These are all electrical devices.

Question Title: Question 2
Question: Electrical accidents can cause fires.

Answer 1: True
Answer 2: False

Correct Answer: True
Answer Rationale: Electrical accidents can cause fires, injuries, and death.

Question Title: Question 3
Question: Which of the following is a good conductor?

Answer 1: Rubber
Answer 2: Water
Answer 3: Plastic
Answer 4: Glass

Correct Answer: Water
Answer Rationale: Rubber, plastic, and glass are insulators. Water is a good conductor.
Question Title: Question 4
Question: Electricity completes a circuit when it travels from a power plant to an electrosurgical unit.

Answer 1: True
Answer 2: False

Correct Answer: False
Answer Rationale: Electricity completes a circuit by returning to its source. In this case, the complete circuit is: power plant – ESU – power plant.

Question Title: Question 5
Question: Electricity looks for:

Answer 1: Good conductors
Answer 2: The shortest circuit
Answer 3: An easy way to return to its source
Answer 4: All of these
Answer 5: None of these

Correct Answer: All of these
Answer Rationale: Electricity likes good conductors and short circuits. It wants to return to its source along the quickest, easiest path.

Question Title: Question 6
Question: All of the following statements are true EXCEPT:

Answer 1: Electric shock can happen when a person touches a damaged electric device.
Answer 2: Electric shock happens when electricity flows through the body.
Answer 3: Electric shock happens when the body provides a shortcut for electricity to return to its source.
Answer 4: Electric shock makes the skin tingle, but cannot cause serious injury.

Correct Answer: Electric shock makes the skin tingle, but cannot cause serious injury.
Answer Rationale: Electric shock can cause burns, muscles spasms, abnormal heartbeats, stopping of breathing, and electrocution.
Question Title: Question 7
Question: Babies and children are usually better conductors than adults. Therefore, babies and children are more likely to be injured if they are shocked.

Answer 1: True
Answer 2: False

Correct Answer: True
Answer Rationale: This is a true statement.

Question Title: Question 8
Question: It is okay to plug ______.

Answer 1: An intact three-prong plug into a three-prong outlet
Answer 2: An intact two-prong plug into a three-prong outlet
Answer 3: An intact three-prong plug with an adapter into a two-prong outlet
Answer 4: All of these are okay.
Answer 5: None of these is okay.

Correct Answer: An intact three-prong plug into a three-prong outlet
Answer Rationale: Use only power cords with three-prong plugs. Never use adapters, two-prong plugs, or broken three-prong plugs.

Question Title: Question 9
Question: Overloading an electric circuit can be extremely dangerous. Overloading should never be allowed.

Answer 1: True
Answer 2: False

Correct Answer: True
Answer Rationale: Electric circuits should not be overloaded.

Question Title: Question 10
Question: Hospital equipment should be inspected on a regular basis. Equipment brought in by patients does not need to be inspected before use.

Answer 1: True
Answer 2: False

Correct Answer: False
Answer Rationale: Equipment brought in by patients should be inspected before use. Items such as radios and razors should be battery-operated whenever possible.