SUBELEMENT T0

Electrical safety: AC and DC power circuits; antenna installation; RF hazards

3 Exam Questions - 3 Groups

T0A –

Power circuits and hazards: hazardous voltages; fuses and circuit breakers; grounding; lightning protection; battery safety; electrical code compliance

When dealing with electricity, caution is the name of the game. Even experienced amateurs have lost their life because they forgot how dangerous an electric shock can be.

A safety hazard of a 12-volt storage battery is that shorting the terminals can cause burns, fire, or an explosion.

Current flowing through a body can cause several health hazards:

- **By heating the tissue**
- **It disrupts the electrical functions of cells**
- **It causes involuntary muscle contractions**
- **All of these choices are correct**

A commonly accepted value for the lowest voltage that can cause a dangerous electric shock is 30 volts.

A good way to guard against electrical shock at your station:

- **Use three-wire cords and plugs for all AC powered equipment**
- **Connect all AC powered station equipment to a common safety ground**
- **Use a circuit protected by a ground-fault interrupter**
- **All these choices are correct**

The safety ground is connected to the green wire in a three-wire electrical AC plug.

Make sure all your equipment has this ground wire attached, especially on home built equipment or cables you may wire yourself.

T0A01

Which of the following is a safety hazard of a 12-volt storage battery?

A. Touching both terminals with the hands can cause electrical shock

B. Shorting the terminals can cause burns, fire, or an explosion

C. RF emissions from the battery

D. All of these choices are correct

T0A01

Which of the following is a safety hazard of a 12-volt storage battery?

B. Shorting the terminals can cause burns, fire, or an explosion

T0A02

How does current flowing through the body cause a health hazard?

A. By heating tissue

B. It disrupts the electrical functions of cells

C. It causes involuntary muscle contractions

D. All of these choices are correct

T0A02

How does current flowing through the body cause a health hazard?

D. All of these choices are correct

T0A03

What is connected to the green wire in a three-wire electrical AC plug?

A. Neutral

B. Hot

C. Safety ground

D. The white wire

T0A03

What is connected to the green wire in a three-wire electrical AC plug?

C. Safety ground

T0A06

What is a good way to guard against electrical shock at your station?

A. Use three-wire cords and plugs for all AC powered equipment

B. Connect all AC powered station equipment to a common safety ground

C. Use a circuit protected by a ground-fault interrupter

D. All of these choices are correct

T0A06

What is a good way to guard against electrical shock at your station?

D. All of these choices are correct

The purpose of a fuse in an electrical is to interrupt power in case of overload

It is unwise to install a 20-ampere fuse in the place of a 5-ampere fuse because excessive current could cause a fire.

This is just common sense. Your equipment is protected by fuses. To put a replace a 5 amp fuse with a 20 amp one is just asking for trouble!

A fuse or circuit breaker in series with the AC hot conductor should always be included in home-built equipment that is powered from 120V AC power circuits.

T0A04

What is the purpose of a fuse in an electrical circuit?

A. To prevent power supply ripple from damaging a circuit

B. To interrupt power in case of overload

C. To limit current to prevent shocks

D. All of these choices are correct

T0A04

What is the purpose of a fuse in an electrical circuit?

B. To interrupt power in case of overload

T0A05

Why is it unwise to install a 20-ampere fuse in the place of a 5-ampere fuse?

A. The larger fuse would be likely to blow because it is rated for higher current

B. The power supply ripple would greatly increase

C. Excessive current could cause a fire

D. All of these choices are correct

T0A05

Why is it unwise to install a 20-ampere fuse in the place of a 5-ampere fuse?

C. Excessive current could cause a fire

T0A08

What safety equipment should always be included in home-built equipment that is powered from 120V AC power circuits?

A. A fuse or circuit breaker in series with the AC hot conductor

B. An AC voltmeter across the incoming power source

C. An inductor in series with the AC power source

D. A capacitor across the AC power source

T0A08

What safety equipment should always be included in home-built equipment that is powered from 120V AC power circuits?

A. A fuse or circuit breaker in series with the AC hot conductor

Explosive gas can collect if not properly vented is one hazard presented by a conventional 12-volt storage battery.

If a lead-acid storage battery is charged or discharged too quickly the battery could overheat and give off flammable gas or explode.

T0A09

What kind of hazard is presented by a conventional 12-volt storage battery?

A. It emits ozone which can be harmful to the atmosphere

B. Shock hazard due to high voltage

C. Explosive gas can collect if not properly vented

D. All of these choices are correct

T0A09

What kind of hazard is presented by a conventional 12-volt storage battery?

C. Explosive gas can collect if not properly vented

T0A10

What can happen if a lead-acid storage battery is charged or discharged too quickly?

A. The battery could overheat and give off flammable gas or explode

B. The voltage can become reversed

C. The memory effect will reduce the capacity of the battery

D. All of these choices are correct

T0A10

What can happen if a lead-acid storage battery is charged or discharged too quickly?

A. The battery could overheat and give off flammable gas or explode

Think a power supply is safe to touch when turned off or disconnected from the power mains? Not necessarily.

The kind of hazard that might exist in a power supply when it is turned off and disconnected is that you might receive an electric shock from stored charge in large capacitors.

If troubleshooting a power supply, use caution.. Even if it is unplugged!

Ground all of the protectors to a common plate which is in turn connected to an external ground is one of the precautions that should be taken when installing devices for lightning protection in a coaxial cable feed line.

T0A11

What kind of hazard might exist in a power supply when it is turned off and disconnected?

A. Static electricity could damage the grounding system

B. Circulating currents inside the transformer might cause damage

C. The fuse might blow if you remove the cover

D. You might receive an electric shock from the charged stored in large capacitors

T0A11

What kind of hazard might exist in a power supply when it is turned off and disconnected?

D. You might receive an electric shock from the charged stored in large capacitors

T0A07

Which of these precautions should be taken when installing devices for lightning protection in a coaxial cable feed line?

A. Include a parallel bypass switch for each protector so that it can be switched out of the circuit when running high power

B. Include a series switch in the ground line of each protector to prevent RF overload from inadvertently damaging the protector

C. Keep the ground wires from each protector separate and connected to station ground

D. Ground all of the protectors to a common plate which is in turn connected to an external ground

T0A07

Which of these precautions should be taken when installing devices for lightning protection in a coaxial cable feed line?

D. Ground all of the protectors to a common plate which is in turn connected to an external ground

T0B –

Antenna safety: tower safety; erecting an antenna support; overhead power lines; installing an antenna

The most common accidental death of an amateur radio operator when participating in his hobby is when installing antennas and putting up towers. Here is a list of tower issues that should be followed:

- **It is never safe to climb a tower without a helper or observer.**

- **Putting on a climbing harness and safety glasses is a good precaution to observe before climbing an antenna tower.**

- **Members of a tower work team should wear a hard hat and safety glasses at all times when any work is being done on the tower.**

- **Looking for and staying clear of any overhead electrical wires is an important safety precaution to observe when putting up an antenna tower.**

- An important safety rule to remember when using a crank-up is that this type of tower must never be climbed unless it is in the fully retracted position.

- The minimum safe distance to allow from a power line when installing an antenna so that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires.

The purpose of a gin pole is to lift tower sections or antennas.

A gin pole consists of a long sturdy pole that can be secured to the tower. A pulley at the top of the gin pole allows rope to be run through.

When installing tower sections or heavy antennas, the ground crew does the heavy lifting by pulling on the gin pole rope. The person on the tower simply guides the piece into place and secures it.

T0B01

When should members of a tower work team wear a hard hat and safety glasses?

A. At all times except when climbing the tower

B. At all times except when belted firmly to the tower

C. At all times when any work is being done on the tower

D. Only when the tower exceeds 30 feet in height

T0B01

When should members of a tower work team wear a hard hat and safety glasses?

C. At all times when any work is being done on the tower

T0B02

What is a good precaution to observe before climbing an antenna tower?

A. Make sure that you wear a grounded wrist strap

B. Remove all tower grounding connections

C. Put on a climbing harness and safety glasses

D. All of the these choices are correct

T0B02

What is a good precaution to observe before climbing an antenna tower?

C. Put on a climbing harness and safety glasses

T0B03

Under what circumstances is it safe to climb a tower without a helper or observer?

A. When no electrical work is being performed

B. When no mechanical work is being performed

C. When the work being done is not more than 20 feet above the ground

D. Never

T0B03

Under what circumstances is it safe to climb a tower without a helper or observer?

D. Never

T0B04

Which of the following is an important safety precaution to observe when putting up an antenna tower?

A. Wear a ground strap connected to your wrist at all times

B. Insulate the base of the tower to avoid lightning strikes

C. Look for and stay clear of any overhead electrical wires

D. All of these choices are correct

T0B04

Which of the following is an important safety precaution to observe when putting up an antenna tower?

C. Look for and stay clear of any overhead electrical wires

T0B05

What is the purpose of a gin pole?

A. To temporarily replace guy wires

B. To be used in place of a safety harness

C. To lift tower sections or antennas

D. To provide a temporary ground

T0B05

What is the purpose of a gin pole?

C. To lift tower sections or antennas

T0B06

What is the minimum safe distance from a power line to allow when installing an antenna?

A. Half the width of your property

B. The height of the power line above ground

C. 1/2 wavelength at the operating frequency

D. So that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires

T0B06

What is the minimum safe distance from a power line to allow when installing an antenna?

D. So that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires

T0B07

Which of the following is an important safety rule to remember when using a crank-up tower?

A. This type of tower must never be painted

B. This type of tower must never be grounded

C. This type of tower must never be climbed unless it is in the fully retracted position

D. All of these choices are correct

T0B07

Which of the following is an important safety rule to remember when using a crank-up tower?

C. This type of tower must never be climbed unless it is in the fully retracted position

More important hints concerning tower and antenna safety:

- **Proper grounding method for a tower is to have separate eight-foot long ground rods for each tower leg, bonded to the tower and each other.**

- **You should avoid attaching an antenna to a utility pole as the antenna could contact high-voltage power wires.**

- **Concerning grounding conductors used for lightning protection, sharp bends must be avoided.**

- **Grounding requirements for an amateur radio tower or antenna are established by local electrical codes**

- **when installing ground wires on a tower for lightning protection, ensure that connections are short and direct.**

T0B08

What is considered to be a proper grounding method for a tower?

A. A single four-foot ground rod, driven into the ground no more than 12 inches from the base

B. A ferrite-core RF choke connected between the tower and ground

C. Separate eight-foot long ground rods for each tower leg, bonded to the tower and each other

D. A connection between the tower base and a cold water pipe

T0B08

What is considered to be a proper grounding method for a tower?

C. Separate eight-foot long ground rods for each tower leg, bonded to the tower and each other

T0B09

Why should you avoid attaching an antenna to a utility pole?

A. The antenna will not work properly because of induced voltages

B. The utility company will charge you an extra monthly fee

C. The antenna could contact high-voltage power wires

D. All of these choices are correct

T0B09

Why should you avoid attaching an antenna to a utility pole?

C. The antenna could contact high-voltage power wires

T0B10

Which of the following is true concerning grounding conductors used for lightning protection?

A. Only non-insulated wire must be used

B. Wires must be carefully routed with precise right-angle bends

C. Sharp bends must be avoided

D. Common grounds must be avoided

T0B10

Which of the following is true concerning grounding conductors used for lightning protection?

C. Sharp bends must be avoided

T0B11

Which of the following establishes grounding requirements for an amateur radio tower or antenna?

A. FCC Part 97 Rules

B. Local electrical codes

C. FAA tower lighting regulations

D. Underwriters Laboratories' recommended practices

T0B11

Which of the following establishes grounding requirements for an amateur radio tower or antenna?

B. Local electrical codes

T0B12

Which of the following is good practice when installing ground wires on a tower for lightning protection?

A. Put a loop in the ground connection to prevent water damage to the ground system

B. Make sure that all bends in the ground wires are clean, right angle bends

C. Ensure that connections are short and direct

D. All of these choices are correct

T0B12

Which of the following is good practice when installing ground wires on a tower for lightning protection?

C. Ensure that connections are short and direct

T0C –

RF hazards: radiation exposure; proximity to antennas; recognized safe power levels; exposure to others; radiation types; duty cycle

Radio waves, especially at VHF, UHF, and the Microwaves can be a serious threat to a human body even though VHF and UHF radio signals are non-ionizing radiation.

When running high power you are required to run an RF exposure evaluation. Just follow the guidelines and you will be perfectly safe using your ham radio equipment.

Exposure limits vary with frequency because the human body absorbs more RF energy at some frequencies than at others.

A 50 MHz frequency has the lowest Maximum Permissible Exposure limit.

The maximum power level that an amateur radio station may use at frequencies above VHF frequencies before an RF exposure evaluation is required is **50 watts PEP at the antenna.**

Factors affecting the RF exposure of people near an amateur station antenna:

- Frequency and power level of the RF field
- Distance from the antenna to a person
- Radiation pattern of the antenna
- All of these choices are correct

T0C01

What type of radiation are VHF and UHF radio signals?

A. Gamma radiation

B. Ionizing radiation

C. Alpha radiation

D. Non-ionizing radiation

T0C01

What type of radiation are VHF and UHF radio signals?

D. Non-ionizing radiation

T0C02

Which of the following frequencies has the lowest value for Maximum Permissible Exposure limit?

A. 3.5 MHz

B. 50 MHz

C. 440 MHz

D. 1296 MHz

T0C02

Which of the following frequencies has the lowest value for Maximum Permissible Exposure limit?

B. 50 MHz

T0C03

What is the maximum power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required?

A. 1500 watts PEP transmitter output

B. 1 watt forward power

C. 50 watts PEP at the antenna

D. 50 watts PEP reflected power

T0C03

What is the maximum power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required?

C. 50 watts PEP at the antenna

T0C04

What factors affect the RF exposure of people near an amateur station antenna?

A. Frequency and power level of the RF field

B. Distance from the antenna to a person

C. Radiation pattern of the antenna

D. All of these choices are correct

T0C04

What factors affect the RF exposure of people near an amateur station antenna?

D. All of these choices are correct

T0C05

Why do exposure limits vary with frequency?

A. Lower frequency RF fields have more energy than higher frequency fields

B. Lower frequency RF fields do not penetrate the human body

C. Higher frequency RF fields are transient in nature

D. The human body absorbs more RF energy at some frequencies than at others

T0C05

Why do exposure limits vary with frequency?

D. The human body absorbs more RF energy at some frequencies than at others

Acceptable methods to determine that your station complies with FCC RF exposure regulations:

- **By calculation based on FCC OET Bulletin 65**
- **By calculation based on computer modeling**
- **By measurement of field strength using calibrated equipment**
- **All of these choices are correct**

You can make sure your station stays in compliance with RF safety regulations by re-evaluating the station whenever an item of equipment is changed.

An action amateur operators might take to prevent exposure to RF radiation in excess of FCC-supplied limits is to **relocate antennas.**

If a person accidentally touched your antenna while you were transmitting they might receive a painful RF burn.

T0C06

Which of the following is an acceptable method to determine that your station complies with FCC RF exposure regulations?

A. By calculation based on FCC OET Bulletin 65

B. By calculation based on computer modeling

C. By measurement of field strength using calibrated equipment

D. All of these choices are correct

T0C06

Which of the following is an acceptable method to determine that your station complies with FCC RF exposure regulations?

D. All of these choices are correct

T0C07

What could happen if a person accidentally touched your antenna while you were transmitting?

A. Touching the antenna could cause television interference

B. They might receive a painful RF burn

C. They might develop radiation poisoning

D. All of these choices are correct

T0C07

What could happen if a person accidentally touched your antenna while you were transmitting?

B. They might receive a painful RF burn

T0C08

Which of the following actions might amateur operators take to prevent exposure to RF radiation in excess of FCC-supplied limits?

A. Relocate antennas

B. Relocate the transmitter

C. Increase the duty cycle

D. All of these choices are correct

T0C08

Which of the following actions might amateur operators take to prevent exposure to RF radiation in excess of FCC-supplied limits?

A. Relocate antennas

T0C09

How can you make sure your station stays in compliance with RF safety regulations?

A. By informing the FCC of any changes made in your station

B. By re-evaluating the station whenever an item of equipment is changed

C. By making sure your antennas have low SWR

D. All of these choices are correct

T0C09

How can you make sure your station stays in compliance with RF safety regulations?

B. By re-evaluating the station whenever an item of equipment is changed

Duty cycle is one of the factors used to determine safe RF radiation exposure levels because it affects the average exposure of people to radiation.

When referring to RF exposure, "duty cycle" is the ratio of "on" time to "off" time of a transmitted signal.

The definition of duty cycle during the averaging time for RF exposure is the percentage of time that a transmitter is transmitting.

- FM is considered 100% duty cycle
- SSB is 50% duty cycle
- CW is 50 % duty cycle
- Most digital modes are 100% duty cycle

If the averaging time for exposure is 6 minutes, then the power density permitted if the signal is present for 3 minutes and absent for 3 minutes rather than being present for the entire 6 minutes is 2 times as much.

This sounds confusing. To further explain:

If you are doing a 6 minute evaluation and transmit for 3 minutes and then turn the transmitter off and receive for 3 minutes, you are only transmitting for 50% of the time.

Therefore the power density allowed would be twice as much.

RF radiation differs from ionizing radiation (radioactivity) because RF radiation does not have sufficient energy to cause genetic damage.

T0C10

Why is duty cycle one of the factors used to determine safe RF radiation exposure levels?

A. It affects the average exposure of people to radiation

B. It affects the peak exposure of people to radiation

C. It takes into account the antenna feed line loss

D. It takes into account the thermal effects of the final amplifier

T0C10

Why is duty cycle one of the factors used to determine safe RF radiation exposure levels?

A. It affects the average exposure of people to radiation

T0C11

What is the definition of duty cycle during the averaging time for RF exposure?

A. The difference between the lowest power output and the highest power output of a transmitter

B. The difference between the PEP and average power output of a transmitter

C. The percentage of time that a transmitter is transmitting

D. The percentage of time that a transmitter is not transmitting

T0C11

What is the definition of duty cycle during the averaging time for RF exposure?

C. The percentage of time that a transmitter is transmitting

T0C12

How does RF radiation differ from ionizing radiation (radioactivity)?

A. RF radiation does not have sufficient energy to cause genetic damage

B. RF radiation can only be detected with an RF dosimeter

C. RF radiation is limited in range to a few feet

D. RF radiation is perfectly safe

T0C12

How does RF radiation differ from ionizing radiation (radioactivity)?

A. RF radiation does not have sufficient energy to cause genetic damage

T0C13

If the averaging time for exposure is 6 minutes, how much power density is permitted if the signal is present for 3 minutes and absent for 3 minutes rather than being present for the entire 6 minutes?

A. 3 times as much

B. 1/2 as much

C. 2 times as much

D. There is no adjustment allowed for shorter exposure times

T0C13

If the averaging time for exposure is 6 minutes, how much power density is permitted if the signal is present for 3 minutes and absent for 3 minutes rather than being present for the entire 6 minutes?

C. 2 times as much