SUBELEMENT T0

Antennas & Feed Lines

[2 Exam Questions]

PREPPERNET

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

PREPPERNET

Shorting the terminals of a 12-volt storage battery with a good conductor can result in a very high current flow.

Because P = I x E, high I (Current) means high P (Power), which can be exhibited in burns, fire, or even explosion due to rapid battery discharge.

PREPPERNET

T0A02

WHAT HEALTH HAZARD IS PRESENTED BY ELECTRICAL CURRENT FLOWING THROUGH THE BODY?

A. It may cause injury by heating tissue

B. It may disrupt the electrical functions of cells

C. It may cause involuntary muscle contractions

D. All of these choices are correct

PREPPERNET

Your nervous system functions using electrical signals. Further, your body acts as a resistor. These two factors are the basis for electricity causing a health hazard.

Because your nervous system uses electrical impulses, electricity can disrupt the cells' normal functions, cause muscles to contract or even disrupt the electrical signals to your heart causing it to beat irregularly or stop.

Since your body acts as a resistor, an electrical current through the body will dissipate heat.

As the current increases, the heat dissipated also increases and may transfer enough heat energy to damage tissue.

PREPPERNET

T0A03
IN THE UNITED STATES, WHAT IS CONNECTED TO THE GREEN WIRE IN A THREE-WIRE ELECTRICAL AC PLUG?

A. Neutral

B. Hot

C. Equipment ground

D. The white wire

PREPPERNET

Standard electrical cable contains three wires. The black wire is the 'hot' wire or source. The white wire is the return. The third wire is the safety ground and may be either bare (no sheath) or green.

If there is a green wire, it's the safety ground.

Normally, current does not flow in the safety ground.

It's there to prevent accidental shocks.

If you need a last second reminder, just remember that green (grass) usually means ground (earth).

PREPPERNET

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

PREPPERNET

When a circuit draws too much current, it is described as 'overloaded.

This condition may damage the equipment or pose a shock hazard.

The method to respond to an overload condition is to use a fuse.

The fuse is designed to vaporize a small wire if the current becomes too large, thereby creating an open circuit. The fuse is always placed in series with the source, or 'hot,' wire.

PREPPERNET

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

Fuses are selected based on the capability of the circuit they protect to handle a specific amount of current.

If the current exceeds the current rating of the circuit, it can create too much heat and start a fire.

A rather vivid demonstration of this is sometimes used in college physics classes where a 12 gauge copper wire is directly connected across the terminals to a 12 v car battery.

Because the wire is unprotected and the car battery can supply hundreds of amps, so much heat will be generated in the copper wire that it glows bright white and melts. (This is NOT recommended to try, because it splatters very hot, molten copper.)

PREPPERNET

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

PREPPERNET

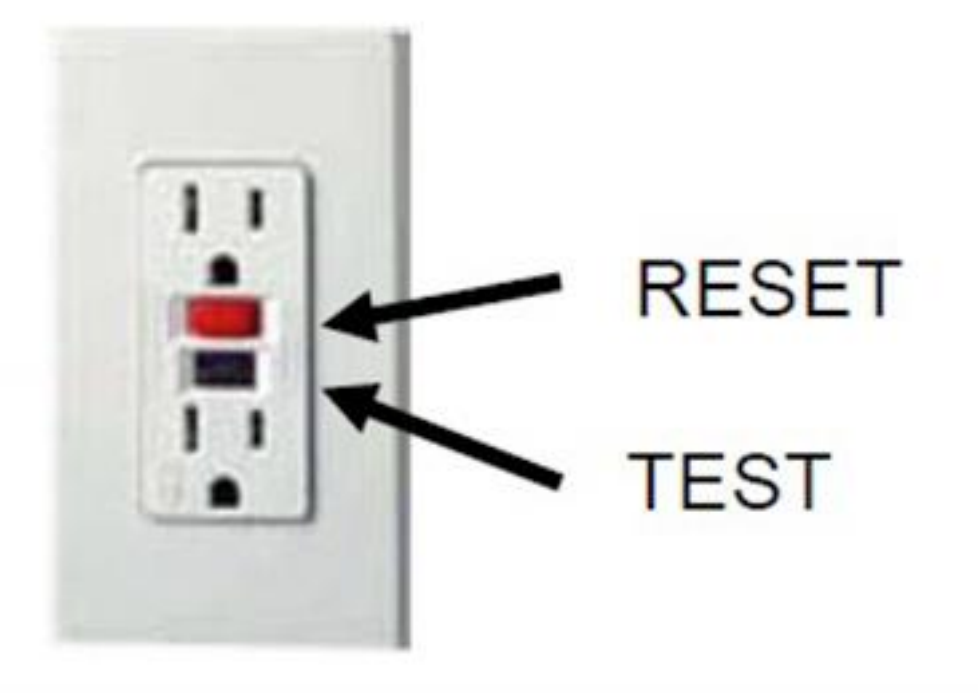
The key to avoiding electrical shock is to use properly connected electrical wires and good safety grounds.

A three wire ground includes the safety ground and should be used for all equipment. Two wire cords should be avoided because they lack the ground wire.

The use of a common ground ensures proper grounding of the equipment and avoids 'ground loops,' which may circulate currents and pose a shock hazard.

PREPPERNET

Finally, a GFI (ground-fault interrupter) will sense cases where current is flowing in the safety ground wire and disconnect the power.



PREPPERNET

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. Mount all of the protectors on a metal plate that is in turn connected to an external ground rod

Connect the protectors to a common plate, giving them a heavy duty connection point that channels the current to an external ground wire.

PREPPERNET

Be sure to observe local building codes for correct grounding. Also note that any ground wires should be large, short and follow a direct path.

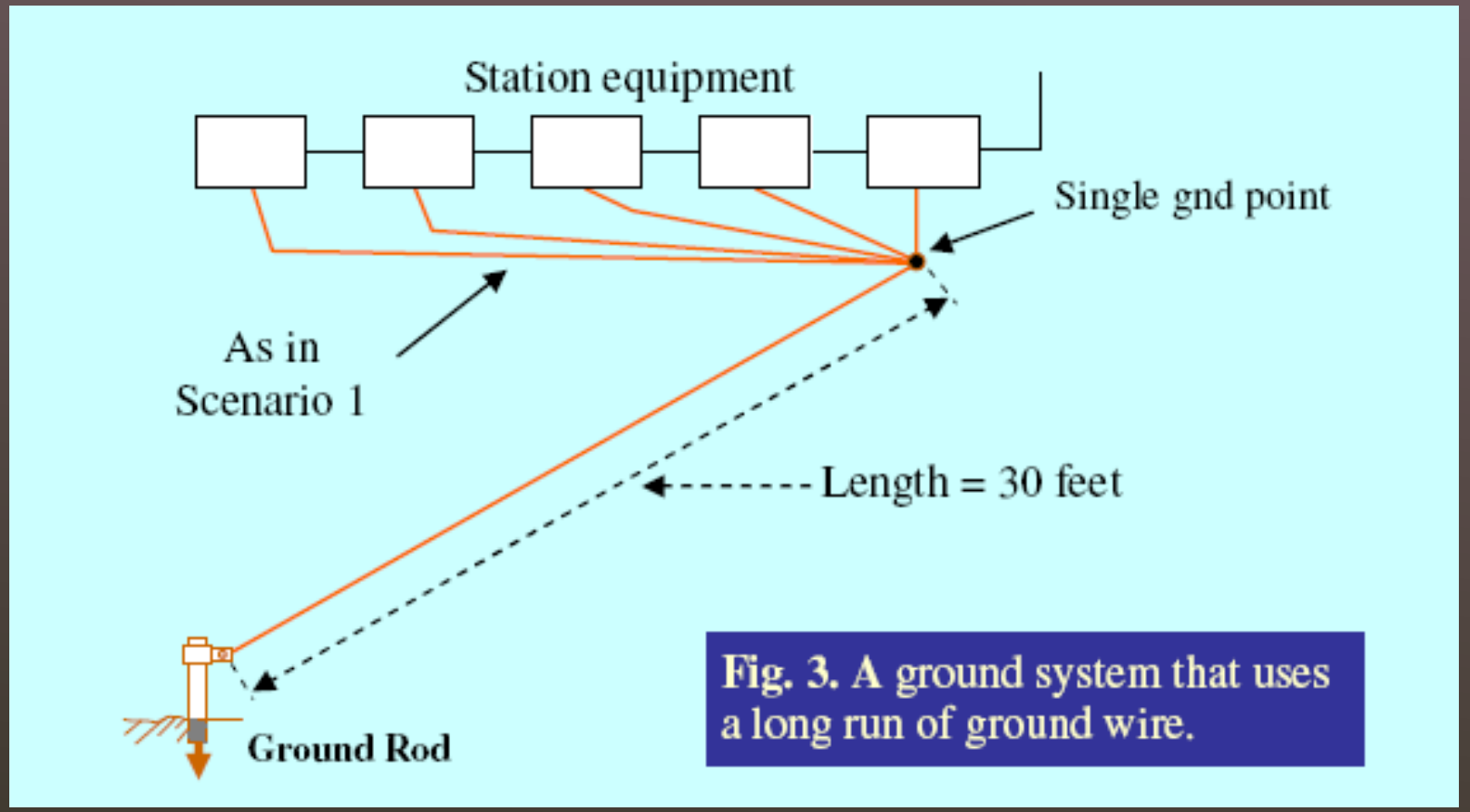


Fig. 3. A ground system that uses a long run of ground wire.

PREPPERNET

Avoid sharp turns and wires longer than necessary.

Also, avoid inadvertently creating a ground loop.

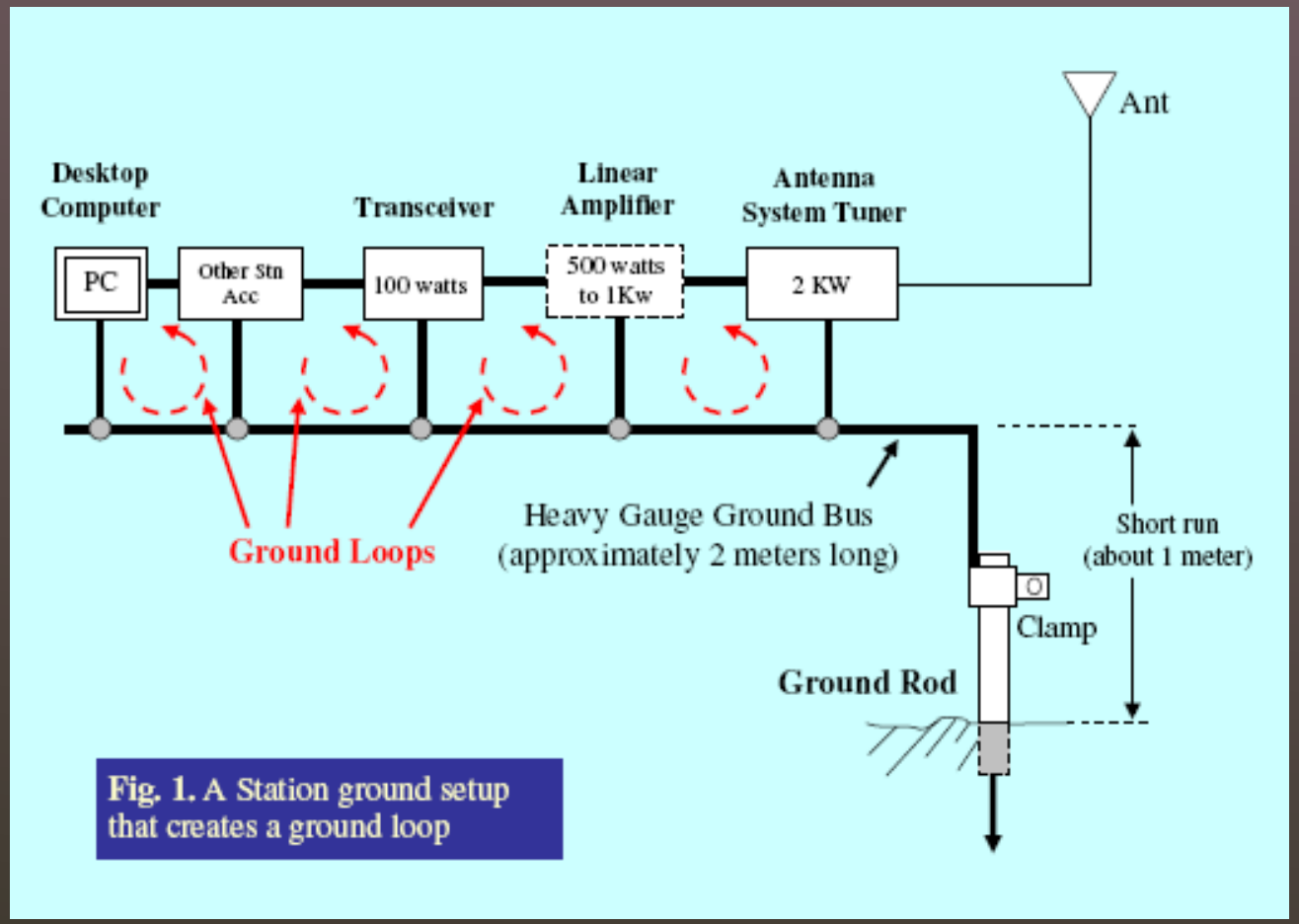


Fig. 1. A Station ground setup that creates a ground loop

PREPPERNET

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

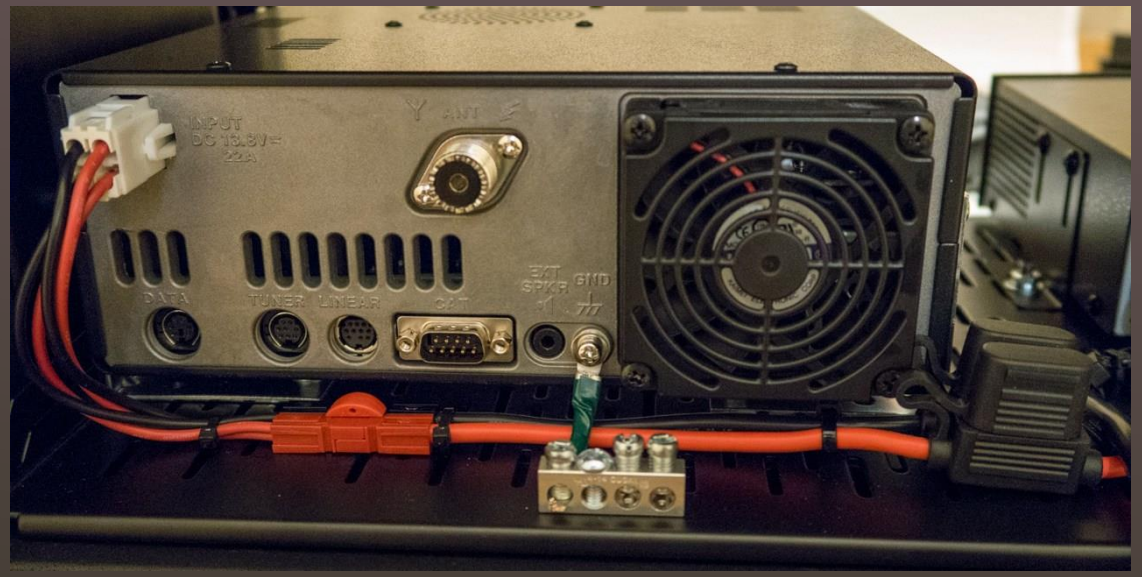
C. An inductor in parallel with the AC power source

D. A capacitor in series with the AC power source

PREPPERNET

Refer to question T0A04 for a discussion on fuses.

As noted there, the fuse should always be in series with the source, or 'hot' conductor.



PREPPERNET

T0A09

WHAT SHOULD BE DONE TO ALL EXTERNAL GROUND RODS OR EARTH CONNECTIONS?

A. Waterproof them with silicone caulk or electrical tape

B. Keep them as far apart as possible

C. Bond them together with heavy wire or conductive strap

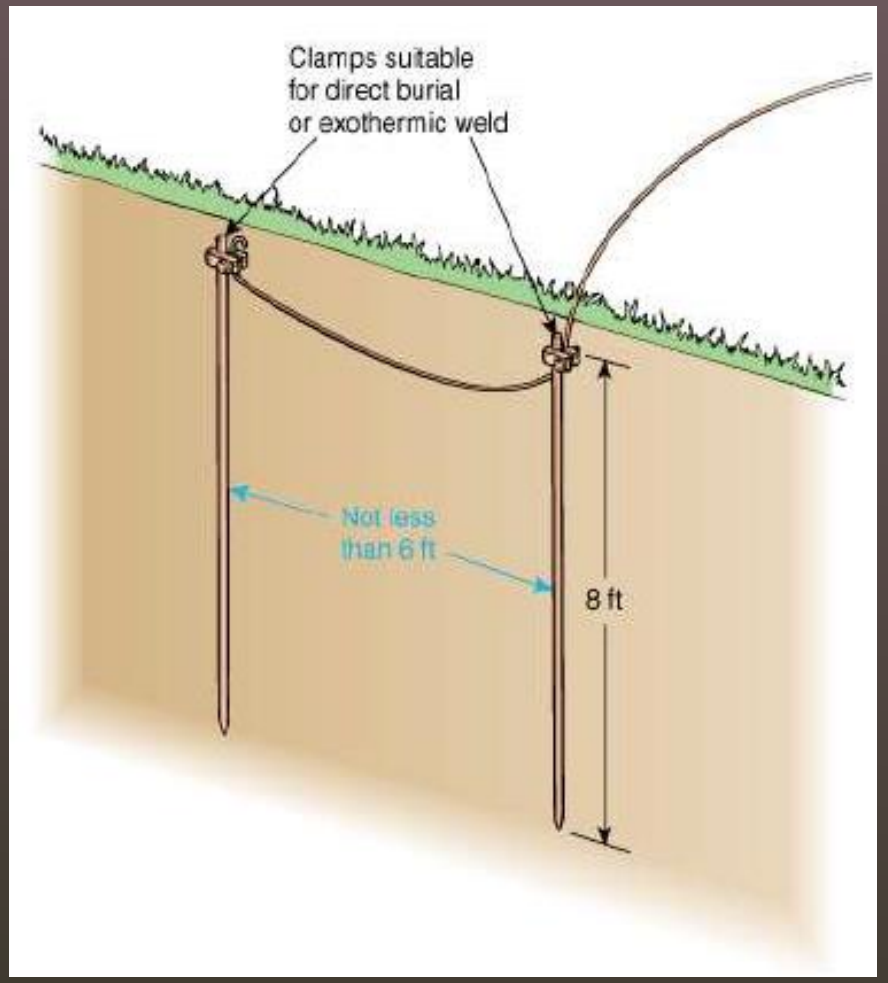
D. Tune them for resonance on the lowest frequency of operation

Bonding external ground rods or earth connections is a best practice.

The reference to heavy wire or a conductive strap is to make them useful for high current situations, such as a lightening strike, and to minimize resistance between them so they all participate in connecting to ground without having high resistance.

PREPPERNET

Grounds do not need to be waterproofed or taped, except, perhaps, to keep connections from oxidizing.



PREPPERNET

T0A10
WHAT CAN HAPPEN IF A LEAD-ACID STORAGE BATTERY IS CHARGED OR DISCHARGED TOO QUICKLY?

A. The battery could overheat, 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

Fast charging or discharging generates hydrogen faster which makes it easier to create concentrations capable of exploding.

Also, the chemical processes that occur when charging or discharging are exothermic (heat generating), so it is possible to overheat and damage the battery.

PREPPERNET

PREPPERNET

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 charge stored in large capacitors

Power supplies may use large capacitors to help provide smooth output voltages.

These capacitors can store a significant amount of energy and may store it at large enough voltages (more than 30 volts) to pose a shock hazard.

The charge could last quite a few minutes, depending on the size of the power supply capacitors.

If there is a charge on the capacitor, you may inadvertently become the low resistance drain,

PREPPERNET

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

It only takes one time that you don't use safety equipment to cause permanent injury or death.

The small inconvenience of a hard hat and safety glasses is not worth the risk of injury.

Find your motivation and stay safe.

PREPPERNET

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 carefully inspected climbing harness(fall arrester)and safety glasses

D. All of these choices are correct

PREPPERNET

Safety comes first in regards to tower work.

Make sure that your climbing harness is in working order, fitted tightly and comfortably, and you have safety glasses protecting your eyes.

PREPPERNET

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

Always take the time to get someone to help.

Never climb a tower without someone else to help or observe.

PREPPERNET

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

PREPPERNET

A very important safety precaution is to look for and stay clear of overhead electrical wires.

The tower, guy wires and you should be well clear of any overhead electrical wires.

Refer to question B06 for more information on safe distances.

A grounded wrist strap is for use on electronics and won't help when working on a tower. WRONG ANSWER…

Insulating the base won't stop lightning strikes and eliminates the grounding system that protects the tower. WRONG ANSWER…

A good practice in erecting a tower is to ensure that if the tower were to fall, that it does not come to rest on surrounding power lines.

PREPPERNET

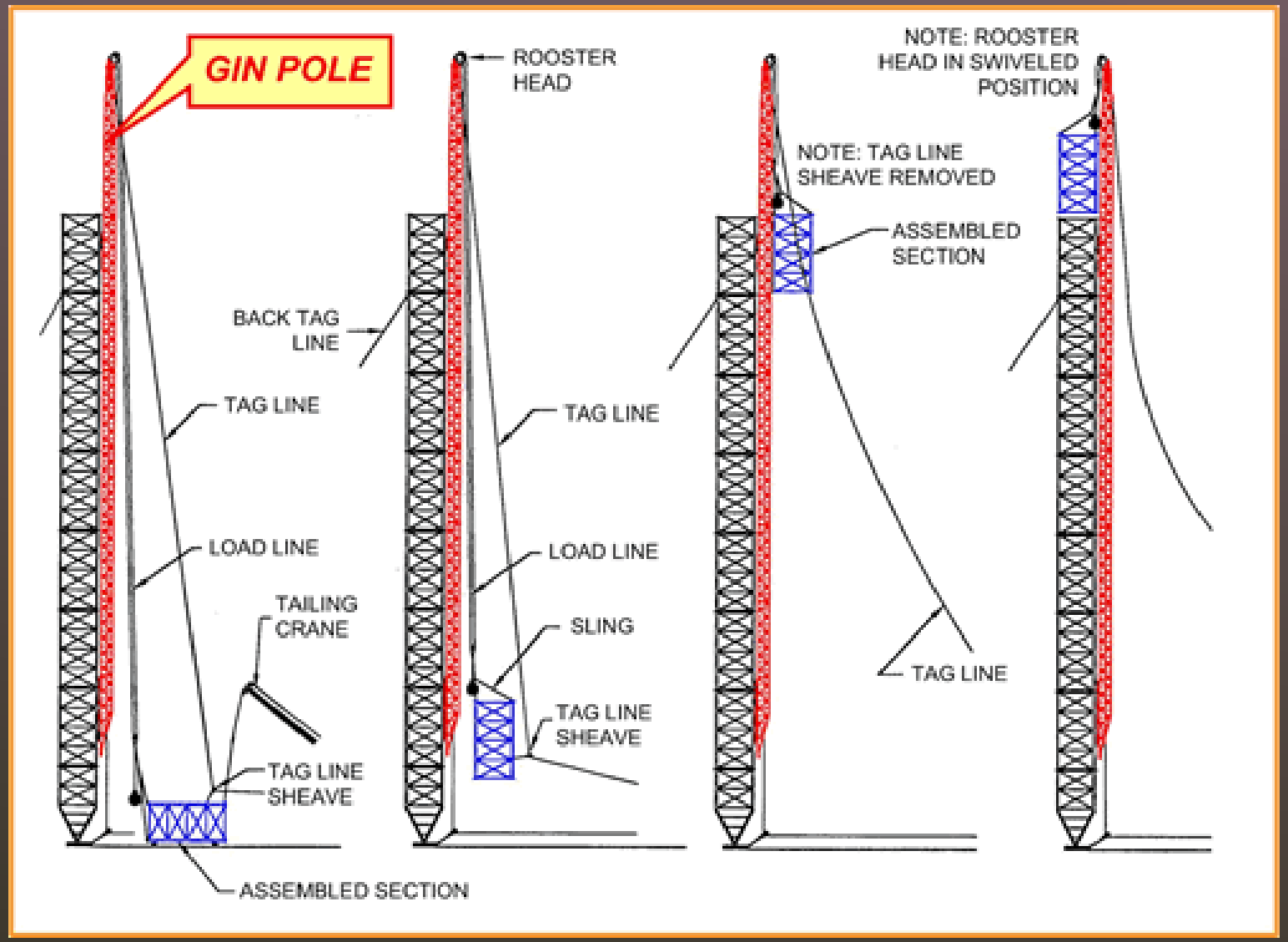
T0B05
WHAT IS THE PURPOSE OF A GIN POLE?

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



A gin pole is a temporary mast that is used to lift materials for tower construction.

It also supports the materials while they are installed on the tower.

PREPPERNET

It is much safer than lifting materials directly because you can focus on the installation instead of the heavy lifting.

PREPPERNET

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

PREPPERNET

Note that this is the minimum and should only be used when necessary. It is better to create more distance than the 10 foot minimum whenever practical.

None of the other three answers provide any indication of how close the antenna will be to the power line if it falls.

PREPPERNET

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 not be climbed unless retracted or mechanical safety locking devices have been installed

D. All of these choices are correct

Climbing the tower requires that your hands and feet are placed between the parts of the tower that slide adjacent to each other.

You can think of the tower as a possible guillotine that can severely injure and even remove body parts that are in the way if it accidently slips.

Even when retracted, it is a good idea to block the tower to prevent the sections from moving.

PREPPERNET

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

The general idea of grounding a tower is to provide a short, direct path for high voltage/current lightning strikes to ground.

If a single ground rod is used, it increases the distance required and drops the efficiency of the grounding system.

A single four-foot grounding rod is not adequate to handle typical electrical energy generated in a lightning strike.

PREPPERNET

The best answer is long (8-10ft) grounding rods, one for each tower leg, that are bonded to the tower and to each other.

Also, it is best to keep your grounding materials of the same type. This will prevent electrolysis and corrosion from occurring…copper-clad rods being the most common since most wiring and coax use copper.

PREPPERNET

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 lines

D. All of these choices are correct

PREPPERNET

It should be pretty obvious that any antenna should be far away from power lines, both to avoid accidental contact and to avoid interference.

Also consider that installing and maintaining the antenna exposes you to the risk of accidental contact with the power wires as well.

PREPPERNET

T0B10

WHICH OF THE FOLLOWING IS TRUE WHEN INSTALLING 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

PREPPERNET

Sharp bends, which includes right angles, must be avoided.

While non-insulated wire is generally used for grounding, it is not required.

Lightening and surges try to find ground using the path of least resistance!!!

The best grounding system uses conductors that are as short and straight as possible.

Short & Direct is the key!!!

PREPPERNET

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. UL recommended practices

Because the grounding system falls under an electrical installation, it is governed by local electrical codes.

Most local codes are based on the National Electrical Code (NEC), so in most cases they will just refer you to the NEC.

However, you should be aware that local codes vary dramatically throughout the United States in terms of who can inspect and approve electrical installations, so it's always a good idea to check with your local code enforcement office to find out what the requirements are.

PREPPERNET

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

Use large wires over short distances on a direct path to the grounding rods - Lightning is high voltage, high current electricity, short and direct paths will lesson the chance of electricity to jump to near by conductors.

Bends in the wire may allow the electricity to 'jump' from the wire to nearby conductors, thereby defeating the grounding system.

The longer the wires are, the more resistance there is and the hotter the wire will get.

Once again: Use large wires over short distances on a direct path to the grounding rods

Remember…Short & Direct.

PREPPERNET

T0B13

WHAT IS THE PURPOSE OF A SAFETY WIRE THROUGH A TURNBUCKLE USED TO TENSION GUY LINES?

A. Secure the guy if the turnbuckle breaks

B. Prevent loosening of the guy line from vibration

C. Prevent theft or vandalism

D. Deter unauthorized climbing of the tower

You tighten turnbuckles by turning them, but with vibration, they can come loose. The safety wire keeps them from turning, once they're tight.

PREPPERNET

They won't help if the turnbuckle breaks - they're too fragile.

They won't prevent theft or vandalism because they're easily removed.

They have nothing to do with climbing the tower, because they're just used on the turnbuckles.

PREPPERNET

T0C01
WHAT TYPE OF RADIATION ARE VHF AND UHF RADIO SIGNALS?

A. Gamma radiation

B. Ionizing radiation

C. Alpha radiation

D. Non-ionizing radiation

PREPPERNET

Electromagnetic energy may be considered as ionizing and non-ionizing radiation.

When radiation is 'ionizing,' it means that it can separate electrons from an atom to create ions. Lower frequency radiation, which includes all amateur radio frequencies, is non-ionizing.

Regardless of the power of the signal, the frequencies of VHF and UHF signals are too low to dislodge the electrons. (Gamma and Alpha radiation are both ionizing radiation.)

PREPPERNET

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

Experimental data indicates the frequencies that are easiest for the human body to absorb are between 30MHz and 300MHz (VHF, Very High Frequency).

This means that this range requires the lowest exposure or MPE.

Since only 50MHz falls in this range, it is the correct answer.

All other frequencies are not within MPE limits.

Tricky question since easy absorption gives 30 – 300Mhz the HIGHEST value, or risk, of reaching a maximum exposure limit.

PREPPERNET

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

The FCC considers power levels less than 50 watts PEP as not being a significant risk to people and has issued rules excluding stations operating in the range from performing an evaluation.

Obviously, this includes the smaller hand-held radios.

Therefore, when a station reaches or exceeds 50 watts PEP at the antenna, an RF exposure evaluation is required.

PREPPERNET

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

Each of these answers affect a persons exposure to RF energy radiating from an antenna.

The frequency of the signal determines how easily the body absorbs the RF energy.

As the power level of the signal increases, more energy can be absorbed, increasing the exposure.

The distance is important because the power level of the signal drops rapidly with distance.

Finally, the radiation pattern indicates the areas where the energy is directed and how it is concentrated.

PREPPERNET

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

PREPPERNET

As noted in question C02, the body absorbs energy differently at different frequencies.

This is because your body has a resonant frequency.

(Actually several, depending on the body part.)

The other answers listed are not correct.

RF field energy does not depend on frequency, lower RF frequencies can penetrate the body and higher frequency RF fields are not transient in nature any more than any other frequency.

PREPPERNET

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

All of these are correct. In most cases, either the FCC OET Bulletin 65

(http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65b.pdf)

or computer modeling are sufficient.

PREPPERNET

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

PREPPERNET

The human body absorbs RF energy and acts like a resistor.

A resistor turns electrical energy into heat energy.

If the body absorbs too much RF energy, it means that it will create enough heat to damage tissue in the form of a burn, a painful RF burn.

Touching an antenna will not cause radiation poisoning because RF is non-ionizing radiation.

PREPPERNET

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

RF radiation "radiates" outward from the antenna, therefore, it is the antenna that must be moved.

Relocating the transmitter will have no effect, provided the transmitter is connected to the antenna correctly.

Increasing the duty cycle would have the reverse effect - it would increase your exposure.

Duty cycle is the ratio of how much time the transceiver spends transmitting to how much it spends receiving; thus, the more you transmit, the higher your duty cycle.

PREPPERNET

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

PREPPERNET

Any time you change your equipment, it's a good idea to re-evaluate your station to ensure compliance.

You do not inform the FCC because the amateur service is designed to be self-policing.

The SWR of your system will only ensure efficient power transfer, not compliance with safety regulations.

PREPPERNET

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

PREPPERNET

Duty cycle affects average exposure level and it is the average exposure is what the Maximum Permissible Exposure (MPE) limits are based on.

A person is more likely to tolerate a one-time, high peak exposure of very short duration than a lower exposure over a long period of time.

This is where duty cycle is important because it is a measure of the transmit and non-transmit times, which determines the average exposure.

Antenna feedline losses and amplifier thermal effects have nothing to do with RF exposure.

PREPPERNET

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

The duty cycle is made up of 'on' times and 'off' times.

It is defined as the ratio of on-air time to total operating time.

A 50% duty cycle means that 50% of the time, the station will be transmitting.

PREPPERNET

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

PREPPERNET

RF energy cannot break chemical bonds, they don't have the energy required to cause genetic damage.

PREPPERNET

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

This is about as straightforward a calculation as you can get.

Just calculate the duty cycle (ratio of ON time and OFF time) and multiply that by the exposure during the ON time to get your total exposure time.

PREPPERNET

END OF SUBELEMENT T0

PREPPERNET