THE EXAM CORNER #2

By Steve Weeks, AA8SW

The subject last time was Electrical Safety in the Ham Shack. For #2, let's finish the safety subject with RF Safety. Again, I will briefly discuss what you need to know about an aspect of that subject, then show you the only exam questions that could appear on that aspect, and follow each one with a hint as to how you can remember the right answer. The correct answer is in **bold.**

● An RF signal, if strong enough, can heat human tissue and possibly cause other damage (think: microwave oven). The risk varies by RF frequency as well as power level and "duty cycle". Duty cycle is the percentage of power that your station is actually emitting, averaged over a period of time ("time averaging"), compared to a constant 100% transmission at that power level. Most amateur radio emissions have duty cycles far less than 100% -- for example, in a typical CW conversation, you are sending only about half of the time (and listening to the other ham sending the rest of the time) so the duty cycle is automatically 50% or less, and even while you are sending, the key is down only part of the time, so the overall duty cycle might be only 30 or 40%. Power density at the place where a person is located is also affected by the type of antenna and how close you are to it – you don't want to stand right in front of a directional antenna operating at high power.

G0A02 Which of the following properties is important in estimating whether an RF signal exceeds the maximum permissible exposure (MPE)?

A. Its duty cycle
B. Its frequency
C. Its power density
D. All of these choices are correct

G0A01 What is one way that RF energy can affect human body tissue?

A. It heats body tissue
B. It causes radiation poisoning
C. It causes the blood count to reach a dangerously low level
D. It cools body tissue

Hint: Like a microwave. But the wrong answers here are ridiculous, so even if you forgot the answer, you should still get the question correct by eliminating the wrong ones. It is often possible on this test to eliminate one or more unreasonable wrong answers to improve your chances in case you have to guess.

G0A07 What effect does transmitter duty cycle have when evaluating RF exposure?

A. A lower transmitter duty cycle permits greater short-term exposure levels
B. A higher transmitter duty cycle permits greater short-term exposure levels
C. Low duty cycle transmitters are exempt from RF exposure evaluation requirements
D. High duty cycle transmitters are exempt from RF exposure requirements

Hint: the FCC limits total exposure over a period of time, so if the exposure is zero part of the time, it can be higher at other times and remain, on average, within the rules.

G0A04 What does "time averaging" mean in reference to RF radiation exposure?

A. The average amount of power developed by the transmitter over a specific 24 hour period
B. The average time it takes RF radiation to have any long-term effect on the body
C. The total time of the exposure
D. The total RF exposure averaged over a certain time

Hint: time averaging means averaged over time. Those key words along with "RF exposure" appear in both the question and the answer. Don't make the mistake of thinking that an answer is too obvious so it must be wrong, like you may have seen on some other standardized tests – with very few exceptions, the General exam is not designed to be tricky and the obvious answers are almost always the correct ones.

- Do you have to do anything to be sure your station is not exceeding recommended RF exposure levels? Not in most cases. However, if your output power exceeds a certain level for each frequency that is published in an FCC chart (in Section 97.13 of the amateur radio rules), you have to evaluate the exposure you are causing. That evaluation can be a calculation based on an FCC method or using a website, or you can measure your emissions with a field strength meter. If you are one of the few whose calculated or measured levels exceed the guidelines, you have to take common-sense measures to reduce human exposure – such as keeping people farther away from your antenna, or making sure that you don't point a directional antenna at a neighbor's house.

G0A08 Which of the following steps must an amateur operator take to ensure compliance with RF safety regulations when transmitter power exceeds levels specified in FCC Part 97.13?

A. Post a copy of FCC Part 97.13 in the station
B. Post a copy of OET Bulletin 65 in the station
C. Perform a routine RF exposure evaluation
D. All of these choices are correct

Hint: this is yet another example of the wrong answers being silly.

G0A03 How can you 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

Hint: for the exam you have to know that all 3 of these approaches are possible, but in reality you would just go to the ARRL website, put in your station data and get an answer.

G0A09 What type of instrument can be used to accurately measure an RF field?

A. A receiver with an S meter
B. A calibrated field strength meter with a calibrated antenna
C. An SWR meter with a peak-reading function
D. An oscilloscope with a high-stability crystal marker generator

Hint: key word "field" appears in both the question and the answer. Again, you may instinctively think that this is too obvious – to measure the strength of a field, you use a field strength meter. Don't outsmart yourself; go with the obvious answer.

G0A05 What must you do if an evaluation of your station shows RF energy radiated from your station exceeds permissible limits?

A. Take action to prevent human exposure to the excessive RF fields
B. File an Environmental Impact Statement (EIS-97) with the FCC
C. Secure written permission from your neighbors to operate above the controlled MPE limits
D. All of these choices are correct

Hint: what must you do if you find a problem? Fix it! Another obvious answer that is again the correct one.

G0A10 What is one thing that can be done if evaluation shows that a neighbor might receive more than the allowable limit of RF exposure from the main lobe of a directional antenna?

A. Change to a non-polarized antenna with higher gain
B. Post a warning sign that is clearly visible to the neighbor
C. Use an antenna with a higher front-to-back ratio
D. Take precautions to ensure that the antenna cannot be pointed in their direction

Hint: if pointing an antenna at a neighbor causes a problem, don't point it at them.

G0A11 What precaution should you take if you install an indoor transmitting antenna?

A. Locate the antenna close to your operating position to minimize feed line radiation
B. Position the antenna along the edge of a wall to reduce parasitic radiation
C. Make sure that MPE limits are not exceeded in occupied areas
D. Make sure the antenna is properly shielded

Hint: this one is easy if you remember that the key word, MPE, means maximum permissible exposure.

- Touching a bare metal antenna while it is transmitting can cause a nasty RF burn – or a fall if someone is climbing a ladder or tower at the time. Avoid this by setting up ground-mounted antennas with protection against unauthorized access; and turn off the transmitter and disconnect the feedline before working on an antenna, whether on a tower or otherwise.

G0A06 What precaution should be taken when installing a ground-mounted antenna?

A. It should not be installed higher than you can reach
B. It should not be installed in a wet area
C. It should limited to 10 feet in height
D. It should be installed such that it is protected against unauthorized access

G0A12 What precaution should you take whenever you make adjustments or repairs to an antenna?

A. Ensure that you and the antenna structure are grounded
B. Turn off the transmitter and disconnect the feed line
C. Wear a radiation badge
D. All of these choices are correct

That's the end of installment #2. One question on the exam is guaranteed to come from the list above.

Comments are welcome -- contact me at aa8sw@att.net, or Robert at ak3q@ak3q.com.