

## **Radio Teacher Technician Test Subelement T9 Notes**

**These notes cover the information needed to answer the questions on Subelement T9 of the Amateur Radio Technician Test. They can be used by instructors as a reference to make sure that all of the information in this subelement is addressed in class.**

Subelement T9 covers antennas, propagation feedlines and matching.

### **Antennas:**

“Beam” antennas concentrate signals in one direction. Antennas such as the quad, Yagi, and dish are directional or beam antennas.

A vertical antenna consists of a single element mounted perpendicular to the Earth's surface. A horizontal antenna is a simple dipole mounted so the elements are parallel to the Earth's surface.

The "rubber duck" antenna supplied with most hand held radio transceivers does not transmit or receive as effectively as a full sized antenna.

The physical size of a half-wave dipole antenna ***becomes shorter as the frequency increases.***

The vertical 5/8 wavelength antenna radiation pattern concentrates energy at lower angles than you have with a 1/4 wavelength vertical antenna.

A dummy load's primary purpose is not to radiate interfering signals when making tests.

### **Ideal antennas vs. Practical Antennas:**

The fictional ideal antenna uses infinitely thin wire suspended in space. A practical antenna uses real copper wire, aluminum rod or tubing and is suspended over ground or near other objects. Because of the larger wire and interaction with other objects real antennas are about 5% shorter than ideal antennas.

A meter equals 39.37 inches but for practical purposes lets multiply 39.37 inches (a real meter in inches) times .95 and get about 37.4 inches.

For the following equations let's use 37.4 inches for a practical meter for making antennas.

**Antenna Length Questions:**

So if asked: What is the approximate length, in inches, of a quarter wavelength vertical antenna for 146 MHz?

To start with 146 MHz is in the two meter band and our practical meter is 37.4 inches. Well 2 (from the two meter band) times 37.4 equal 74.8. That answer gives us the full wave at 2 meters. Well the question asks for a quarter wave antenna so we need to divide 74.8 inches into 4 and that equals 18.7 inches. As we round up 18.7 inches we see one answer is 19 inches. 19 inches is the correct answer.

To review we use 37.4 inches for a practical meter for antennas.  
 $2 \times 37.4 = 74.8$  inches 74.8 inches divided by 4 is 18.7 inches and we see that one answers is 19 inches. The answer is 19 inches.

What is the approximate length, in inches, of a half wavelength vertical antenna for 6 meters?

$6 \times 37.4 = 224.4$  inches 224.4 inches divided by 2 (the question wants a half wave antenna) is 112.2 inches and we see that one of the answers is 112 inches.

**Mobile Antennas:**

Signals can be 10 to 20 times weaker than when you are outside of the vehicle when using a "rubber duck" antenna inside your car. A magnet mount vertical antenna is one type of antenna that offers good efficiency when operating mobile and can be easily installed or removed.

**Propagation:**

VHF/UHF signals not normally heard over long distances because their signals are usually not reflected by the ionosphere

When we hear a VHF signal from a long distance the possible cause is sporadic E reflection from a layer in the ionosphere. (Editors note: This is really due to refraction but the test answer states "reflection")

If sudden bursts of tones or fragments of different conversations interfere with VHF or UHF communications, strong signals could be overloading the receiver and causing the undesired signals to be heard.

The radio horizon is the point where radio signals between two points are blocked by the curvature of the Earth.

If a station reports that your signals were strong just a moment ago, but now they are weak or distorted try moving a few feet, random reflections may be causing multi-path distortion.

The shorter wavelength of the UHF signals easily penetrates urban areas and buildings than VHF signals.

Keep the antenna as close to vertical as you can when using your hand-held VHF or UHF radio to reach a distant repeater. Signals could be as much as 100 times weaker if the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization.

Try using a directional antenna to find a path that reflects signals to the repeater if buildings or obstructions are blocking the direct line of sight path.

Picket fencing is a commonly used term to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting

VHF and UHF Radio signals usually travel about a third farther than the visual line of sight distance between 2 stations because the Earth seems less curved to radio waves than to light.

**Feedlines:**

Standing wave ratio (SWR) in general terms is a measure of how well a load is matched to a transmitter.

A "1 to 1" (normally written 1:1) reading on a SWR meter indicates a perfect impedance match between the antenna and the feed line.

A better match produces a better transfer of power.

A loose connection in your antenna or feedline might be indicated by erratic changes in SWR readings.

A 2 to 1 (2:1) SWR value is when the protection circuits in most solid-state transmitters begin to reduce transmitter power.

Power lost in a feed line converts into heat by losses in the feedline.

One can use a directional wattmeter to determine if your feedline and antenna are properly matched.

Maintaining low SWR in an antenna system that uses coaxial cable feedline allows the efficient transfer of power and reduces losses. Losses can increase dramatically in older coaxial cables that are exposed to weather and sunlight for several years.

Moisture contamination is the most common reason for failure of coaxial cables.

The outer sheath of most coaxial cables is black in color to provide protection against ultraviolet damage.

50 Ohms is the impedance of the most commonly used coaxial cable in typical amateur radio installations.

Because of its ease of use and few special installation considerations coaxial cable is used more often than any other feed line for amateur radio antenna systems.

\*The Technicians Question Pool release 2 and Rules for Amateur Radio, Part 97 are the source documents of these notes. This information is available to the public.

If you have any questions, comments or corrections please post a message at <http://groups.google.com/group/RadioTeacher>