TECHNICIAN Class.
FCC License Preparation
Element 3A

To go to an explanation press the Search button and select the required question designator.

T1A01:
Every ham radio station is required to have a control point. This is the place where you have control of the station and can switch it off if required. [97.3]

T1A02:
The control point may be physically remote from the station. This is a common situation with unmanned repeaters where the control point may be a transceiver used by the control operator. [97.3]

T1A03:
All changes and renewals must be done on FCC Form 610. Some on-line systems have image files available that allow you to print out your own copies of Form 610. [97.21]

T1A04:
You can keep your privileges, but not operate, for two years from the expiration date. After this you must start all over again. So, do not forget to renew your license when it is due. [97.21]

T1A05:
21.1-21.2 MHz are the upper and lower limits to the 15 meter band. [97.301]

T1A06
This question has been withdrawn by the FCC.

T1A07
This question has been withdrawn by the FCC.

T1A08
This question has been withdrawn by the FCC.

T1A09
This question has been withdrawn by the FCC.

T1A10:
As a No code Technician operator you do not have a Novice code privileges until you have passed the 5 wpm code test. (Passing the 13 and 20 wpm tests would also be accepted) When you have passed the Morse code test you become a Technician Plus operator. [97.501]

T1A11:
When you pass your Morse code test you become a Technician plus operator. On passing you will be given a CSCE (Certificate of Successful Completion of Examination) Keep this as proof until your new FCC Technician Plus license arrives. [97.501]

T1B01:
The antenna output of your transceiver is where you measure power output using a watt meter that is suitable for the frequency. [97.313]

T1B02:
The crest of the RF modulation envelope is its peak; it is called peak envelope power. (PEP) [97.313]

T1B03:
Radio beacons automatically transmit a call sign on a specific frequency. This allows hams to tune in to determine band conditions. If you can hear a distant beacon you can probably communicate on that band in the direction of that beacon. [97.203]

T1B04:
An example of a band where Amateurs are secondary users is the 70 cm band. It is shared with military radio services. [97.303]

T1B05:
You must change frequency to prevent interference with another station if it is a primary user. (You would probably change frequency to avoid interference with any station out of politeness.) [97.303]

T1B06:
No Radio Amateur is assigned any particular frequency within the Amateur bands. [97.101]

T1B07:
CW stands for continuous wave; it is otherwise known as Morse code or telegraphy. Morse code may be used for station identification on any band. [97.305]

T1B08:
Phone (voice modulation) is allowed throughout the 6 meter wavelength band except between 50.1 and 50.0 MHz. [97.305]

T1B09:
Image emissions are allowed on the 2 meter Amateur band from 144.1 MHz to 148.0 MHz. [97.305]

T1B10:
You can run 1500 watts on 2 meters. This sort of power level is hardly needed for day to day communications, but is useful for experimental work such as moon bounce. [97.313]

T1B11:
There are no satellite uplink frequencies on the 6 meter band. [97.209]

T1C01
This question has been withdrawn by the FCC.

T1C02:
The maximum separation below 50 MHz is 1,000 hertz.   [97.307]

T1C03:
The mark and space signals are represented by two different frequencies. There are no rules for a maximum frequency separation above 50 MHz. [97.307]

T1C04:
A data transfer rate of 1200 baud is quite slow compared to telephone based data rates. However, using radio is a lot cheaper than the telephone! [97.307]

T1C05:
The faster we send data transmissions the more bandwidth they occupy. The higher frequency bands can accommodate these broader signals. [97.307]

T1C06:
The faster we send data transmissions the more bandwidth they occupy. The lower frequency bands tend to be narrower and so the maximum data rate is restricted. [97.307]

T1C07:
The faster we send data transmissions the more bandwidth they occupy. The higher frequency bands can accommodate these broader signals. [97.307]

T1C08:
The maximum permitted band width for this type of signal is 20 kHz. [97.307]

T1C09:
A data rate of 56 Kilobaud is much faster than the data rate that a normal telephone line will support.
[97.307]

T1C10:
The maximum permitted band width of this type of signal is 100 kHz. [97.307]

T1C11:
Between 420 and 450 MHz, a bandwidth of up to 100 kHz is allowed. [97.307]

T1D01:
Automatic beacon stations exist on most Amateur bands. They use CW to send their call signs.
[97.203]

T1D02:
Radio Amateurs are required to know the code at a maximum of 20 WPM (for Extra class). [97.119]

T1D03:
You must identify in English or Morse code. [97.119]

T1D04:
Use the International Phonetic Alphabet for your call sign if you think that the other station may have reception or language problems. [97.119]

T1D05:
Any Ham who is a Technicians class or above may operate a beacon station. [97.203]

T1D06:
The operator of an amateur repeater that is uncoordinated will be required to sort out any interference problems that occur with repeaters that do conform to the frequency coordination scheme. [97.205]

T1D07:
Both repeater licensees must work out the interference problem. [97.205]

T1D08:
Both repeater licensees must work out the interference problem. [97.205]

T1D09:
Possession of a Technician class license allows you to use the relatively uncrowded 6 meter band for model craft control purposes. [97.215]

T1D10:
No identification is required. [97.215]

T1D11:
Model craft are normally within sight of the operator.   Therefore, this low power level is quite adequate. [97.215]

T1E01:
You may not operate your station as a broadcast station. [97.3]

T1E02:
As an amateur radio licensee you may not broadcast to the public. [97.3]

T1E03:
You may not receive payment for any third party traffic. [97.113]

T1E04:
Apart from it being illegal, you would make yourself quite unpopular. Also, children may be listening.
[97.113]

T1E05:
Apart from it being illegal, you would make yourself quite unpopular.   Also, children may be listening.
[97.113]

T1E06:
Apart from it being illegal, you would make yourself quite unpopular.   Also, children may be listening.
[97.113]

T1E07:
NASA often gives blanket permission to retransmit Space Shuttle audio by repeaters. [97.113]

T1E08:
Third party communications must be of a personal nature. Some countries (such as Great Britain) do not allow their Radio amateurs to send third party communications. [97.115]

T1E09:
When someone is using your station, stay with them. You are responsible for making sure that all FCC rules are followed. [97.115]

T1E10:
All restrictions are waived if the emergency is severe enough. [97.401]

T1E11:
Avoid transmitting on a frequency used for emergency transmissions unless specifically requested to do so. [97.401]

T2A01:
Call the other station by its call sign and then give your call sign.   The best way to get the hang of operating procedures is to listen to other hams on the air.

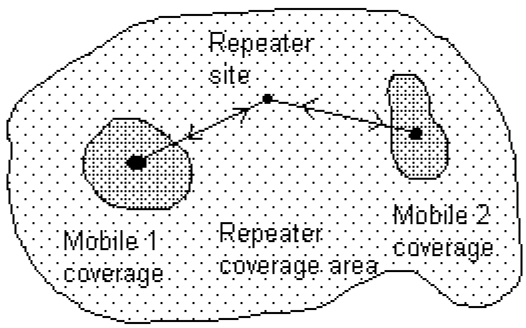
T2A02:
A repeater is a community resource, leaving a short pause gives others a chance to use it.

T2A03:
There may be someone with an urgent message waiting to get onto the repeater. They cannot pass on the message until there is a pause.

T2A04:
Repeater users should leave a pause between transmissions. When they do, this is your chance to interject by saying your call sign.

T2A05:
Repeaters are usually located on hills or tall buildings. They have efficient antenna for receiving and transmitting. This means that a weak local signal from a handheld transceiver will be rebroadcast at higher power and with a tremendously increased range. On the receiving side, a repeater will pick up the weakest of signals from a wide area. Then, it will retransmit them at higher power to the handheld.

Principle of repeater operation:



T2A06:
Many repeaters have a timer to limit transmission times. This is to give everyone a fair chance at using it.

T2A07:
During rush hour, repeaters are often used to distribute traffic news amongst radio amateurs.

T2A08:
Many repeaters have a beep tone that operates for a short period when the other person has stopped transmitting.

T2A09:
Weak signals have a hissing noise superimposed on them. Some of this noise is received and some is generated by the receiver. If a signal is strong enough to completely overcome this noise then it is regarded as a strong signal.

T2A10:
The signal that you are receiving from the repeater may be very strong. However, this does not relate to the signal strength being received by the repeater. In this case a better measure would be the amount of noise quieting that you experience. You should be able to hear this even with a strong signal from the repeater output.

T2A11:
Open repeaters are listed in the American Radio Relay League (ARRL) repeater directory.

T2A12:
Some radios come with the repeater input/output splits pre-loaded while other transceivers require this to be programmed.

T2A13:
On the 222 MHz band, input to output repeater separation is 1.6 MHz.

T2A14:
On the 450 MHz band, input to output repeater separation is 5 MHz.

T2A15:
At VHF and UHF frequencies, radio signals are normally limited in range. At lower frequencies, (the HF bands) the range of radio signals is often world-wide. This is due to the ability for HF signals to be reflected from ionized layers in the upper atmosphere. The HF amateur bands are a valuable resource that should be reserved for long-distance use.

T2A16:
Closed repeaters are supported by group membership. Often they incorporate features not found in open repeaters. To find out who controls the repeater, listen to the repeater traffic. You may hear announcements giving details of how to join the repeater group.

T2A17:
A dummy load is simply a resistance designed to convert RF energy into heat instead of allowing it to be radiated. A dummy load may be as simple as a standard light bulb, or it may be a complex oil cooled device depending on the power levels and frequencies involved.

T2A18:
It is conventional to use plain language over repeaters.

T2B01:
In this context, simplex mode is when you communicate directly with another station communicate without the help of a repeater. Every VHF band has simplex channels. Use them to relieve repeater congestion. The term "simplex" also means that you both share the same frequency and take turns to transmit. This is as opposed to "duplex" where two frequencies are used for simultaneous two way conversation.

T2B02:
Modern VHF/UHF FM equipment has a control marked REV. This temporarily switches the receiver frequency to the repeater input frequency. If you can hear the other station on the repeater input frequency then there is no need to use the repeater and you can both change frequency to a simplex channel.

T2B03:
If you are operating on the input channel it is likely that you are blocking access to the repeater for everyone else.   Also it is possible that the repeater will be retransmitting your signals and so everyone will know exactly who the culprit is!

T2B04:
It is essential to set up your repeater frequencies with the advice of a repeater coordinator. This is to make sure that your repeater does not cause interference to other repeaters and is not interfered with by other repeaters.

T2B05:
A list of Q codes can be found in most amateur radio reference books. You do not need to know all of these Q codes. Just learn the ones mentioned in Questions T2B05 - T2B08. These are sufficient for the Technician class examination.

T2B06:
A list of Q codes can be found in most amateur radio reference books. For example, "QSY" means: Change frequency.

T2B07:
A list of Q codes can be found in most amateur radio reference books. For example, a "QSO" is a conversation between two Hams.

T2B08:
A list of Q codes can be found in most amateur radio reference books. For example, "QRZ" means: Who is calling?

T2B09:
The RST systemuses three digits to represent the Readability, Signal Strength and Tone quality of a received signal.

T2B10:
The RST system uses three digits to represent the Readability, Signal Strength and Tone quality of a received signal.

T2B11:
Any signal over "S9" is a good one. It will be perfectly clear and readable. The plus 20 dB means that the signal is 100 times more powerful than an "S9" signal.

T2C01:
Mayday messages are used in cases of dire life-threatening emergency.   They must always be taken seriously.

T2C02:
A Morse code "SOS indicates a grave emergency involving danger to life.

T2C03:
On repeaters, the word "break" is used to indicate an emergency call.

T2C04:
RACES stand for "Radio Amateur Civil Emergency Service."   You must be registered to take part in RACES exercises.

T2C05:
No more than one hour per week is allowed for RACES drills.

T2C06:
If the messages are not clearly understood to be practice messages, considerable worry and wasted effort could result for people who may be listening.

T2C07:
In an emergency situation, public service personnel may be communicating with radio amateurs. They will understand tactical callsigns better than standard amateur radio station callsigns.

T2C08:
All transmissions that can affect human health have priority.

T2C09:
All transmissions that can affect human health have priority.

T2C10:
It is quite possible that in an emergency the first service to be disrupted will be the AC power to your station.

T2C11:
If there is no AC power to your station (quite possible in an emergency) you have no means of charging hand-held batteries.

T2C12:
A dipole is the simplest antenna to erect.   It can be as simple as a piece of wire cut to 468/(operating frequency) feet in length and strung between two objects as high as possible with the ends insulated.

T3A01:
The ions are generated by X-rays and ultraviolet radiation from the sun. Charged particles from the sun also make a contribution to the strength of the charge in these electrified layers. There are up to four distinct layers during daylight hours:

D As low as 30 miles and absorbing signals in the 3.5 MHz and 1.8 MHz bands.
E About 70 miles and affecting higher frequencies or even VHF signals.
F1 About 140 miles, the F layers are the main layers facilitating world-wide radio communications.
F2 At about 200 miles the F2 layer is also responsible for multiple hop transmission of radio signals around the world.

At night the D and E layers disappear and the F1 and F2 layers combine to form the F layer.

This is just a summary. For a more detailed explanation consult the ARRL handBook.

T3A02:
MF and HF radio waves are prevented from shooting off into space by the ionosphere. Instead, they are bent back toward the surface of the Earth where they may reflect skyward again. This process can be repeated many times and is the basis of world-wide radio communications.

T3A03:
The ionosphere is a region where electrically charged layers form. These layers gain their electrical charge from X-rays and ultraviolet rays emitted by the sun. Charged particles from the sun also make a contribution.

T3A04:
The ultraviolet rays make the biggest contribution.   X-rays and solar particles are the next biggest contributors.

T3A05:
The ionized layers can absorb radio waves as well as bending them. On the 80-meter band, daytime signals are rapidly absorbed by the D-layer before they can be reflected back to the surface by any of the other layers. Hence this band is only suitable for short distance communications during daylight. The 1.8 MHz band also suffers from D-layer absorption during daylight hours.

T3A06:
The D-layer is closest at around 30 miles.

T3A07:
The 6 meter band is normally regarded as a short-range VHF band.   In summer the E-layer can become sufficiently highly ionized to allow sky wave propagation over long distances, just like the HF bands.

T3A08:
The D layer absorbs long wave signals during daylight hours and disappears at night.   It does not contribute toward sky wave propagation of radio waves.

T3A09:
The F2 layer is higher than the F1 layer and so each hop is longer.

T3A010:
Although the D and E layers exist only in the daytime, the question is asking about "sub-regions." The F-layer is the one that splits into two "sub-regions".

T3A011:
The F-layer is in two parts during daylight. It combines into one layer at night.

T3B01:
During daylight hours, the D layer absorbs signals in the 1.8 MHz and 3.75 MHz bands. Therefore, they are absorbed before they reach the higher reflecting layers.

T3B02:
During daylight hours, the D layer absorbs signals in the 1.8 MHz and 3.75 MHz bands.   Therefore, they are absorbed before they can get to the higher reflecting layers.

T3B03:
During daylight hours, the D layer absorbs signals in the 1.8 MHz and 3.75 MHz bands.   Therefore, they are absorbed before they can get to the higher reflecting layers.

T3B04:

During daylight hours, the D layer absorbs signals in the 1.8 MHz and 3.75 MHz bands. Therefore, they are absorbed before they can get to the higher reflecting layers. The D-layer disappears at night when there is no sunlight to keep it ionized.

T3B05:
Even the F layer becomes weaker during the night. It is at its weakest just before sunrise. The reason for this is that in the absence of solar radiation the charged particles in the layer gradually recombine and neutralize each other.

T3B06:
Maximum ionization occurs during midday when the sun's radiation is at its maximum.

T3B07:
Minimum ionization occurs before dawn after the longest period of darkness.

T3B08:
In all layers, ionization is at its maximum during midday when solar radiation is at a maximum.

T3B09:
The critical frequency is determined by shooting a signal upwards and measuring the strength of the reflected signal from each layer.   Above the critical frequency of an ionized layer the waves pass straight through, below the critical frequency they are reflected back.

T3B10:
The maximum useable frequency (MUF) is somewhat higher than the critical frequency. This is because the waves are approaching the layers at a lower angle. The MUF is influenced by the amount of ionization in the layer, which is in turn affected by the amount of radiation from the sun.

T3B11:
The maximum useable frequency (MUF) is somewhat higher than the critical frequency. This is because the waves are approaching the layers at a lower angle. For F-layer propagation, the MUF is about five times greater than the critical frequency.

T3C01:
A skip zone occurs where the distance is too great from the transmitter for ground waves (direct path) signals and too close to the transmitter to catch the sky waves reflected from the ionosphere. Within the skip zone there are no strong signals from the transmitter. There are, however, weak signals present. This is due to the scattering of radio waves from the atmosphere itself as well as imperfections and irregularities in the ionized layers. There are also transient patches of ionization resulting from meteor trails. Communicating by scatter mode requires use of higher transmit power due to the small amount of scattered signal that is available for reception.

T3C02:
If the signal is close to the maximum useable frequency (MUF) and it is weak and distorted, then it is probably a scatter mode signal.   The other options in this question all give strong or undistorted signals.

T3C03:
VHF signals propagate like light, in straight lines.

T3C04:
Ducting is due to multiple hops within the lower atmosphere (as low as a few hundred feet). These hops occur due to layers of air that have different levels of temperature and humidity. This effect is more pronounced at higher frequencies, right up to microwaves.

T3C05:
The normally line-of-sight characteristics of VHF bands can suddenly change during certain weather conditions that favor tropospheric bending. Ranges of several thousands of miles become possible during these periods. They may last for several days.

T3C06:
To get the waves to bend in the right direction, downwards, the air needs to be in a state of temperature inversion. This means instead of the usual condition where high elevation air is cooler, the air closest to the ground is cooler. VHF enthusiasts soon learn to spot the types of weather conditions that favor widespread temperature inversions.

T3C07:
It is widespread temperature inversions that allow ducting of radio signals to take place. Generally, the higher the frequency, the more effective the ducting becomes. Even at a frequency as high as 432 MHz, signals can travel many thousands of miles.

T3C08:
VHF, UHF, and microwave signals can all be bent by layers of different density or humidity in the atmosphere.   They can be ducted over thousands of miles.

T3C09:
The ionized layers of the upper atmosphere generally do not reflect VHF signals.   (However, there are exceptions.)

T3C10:
You can watch your local weather maps for high pressure systems. They are associated with clear weather, fog in the fall, and poor air quality.

T3C11:
Look out for short skip stations on 28 MHz. If you start hearing stations at about 500 miles then go listen on 6 and 2 meters. It could be interesting!

T4A01:
It is important that the metal exposed parts and chassis of radio equipment are connected to the ground conductor. It is normally green in color. Be aware that foreign radio equipment may use different colors in the AC cord.

T4A02:
The fuse should always be on the "live" or "hot" side of the supply.   This wire will be red or black.   Be aware that foreign radio equipment may use different colors in the AC cord.

T4A03:
The white wire is the "return" conductor of the supply.   Be aware that foreign radio equipment may use different colors in the AC cord.

T4A04:
The National Electrical Code specifies electrical safety requirements in the US.

T4A05:
The National Electrical Code specifies electrical safety requirements in the US. Check with this to make sure you comply with safety standards.

T4A06:
The fuse on the positive (red) conductor is a safeguard against supply short circuits.   The fuse on the negative (black) conductor is a safeguard against excessive ground currents under certain fault conditions.

T4A07:
The silver colored screw is always the "neutral" connection.   The brass colored screw is the "live" or "hot" terminal.

T4A08:
If this amount of current flows across the heart it can be lethal. It is quite easy to disturb the normal pumping of the heart by exposure to external currents.

T4A09:
The heart is very sensitive to quite modest amounts of current. If you accidentally touch a live conductor with one hand while resting the other hand on a conductor at earth potential (such as a grounded chassis) then much of the resulting current will flow through your chest.

T4A10:
We begin feel pain at 2 milliamperes of current. By the time you feel pain it may be too late to get away. This is because the current causes your muscles to contract. Depending on the orientation of your hands, this might cause you to involuntarily increase your grip on a live conductor.

T4A11:
Most people assume that secondary cells do not provide harmful voltages. This is not so! Many battery-powered vehicles operate at 48 volts or more.

T4A12:
If you accidentally receive a shock it may be impossible to let go of the live object. This will be due to involuntary muscle contractions that cause you to strengthen your grip on the object. Other people may have to turn off the main power supply to your station so that they can rescue you.

T4A13:
Jewelry is highly conductive and is often in good contact with your skin. It is perfect for giving you a lethal shock.

T4A14:
If you accidentally receive a shock it may be impossible to let go of the live object due to involuntary muscle contractions. Other people may have to turn off the main power supply to your house so that they can rescue you. They may also need to turn off the main supply in case of a fire.

T4A15:
The victim may be paralyzed or tightly gripping the live conductor. This action is caused by the current flow contracting his/her muscles. You must turn off the power before touching the victim. Otherwise you will also be trapped. Alternatively, you may be able to find an insulating object that can be used to drag the victim clear. It is quite possible that the victim's heart will have stopped beating and/or the victim has stopped breathing. In that case, you will need to carry out resuscitation procedures.

T4B01:
We always check for voltage across the lines of a circuit.

T4B02:
For this technique to work, you need to know certain details about the meter. It is not often necessary with modern equipment. One case where you might need to use this method is if you are extending the range to cover the high voltages associated with tube power amplifiers.

T4B03:
A voltmeter is really a current meter that measures current flowing through a fixed resistance. It uses Ohms law to derive a voltage reading.

T4B04:
An ammeter measures electrical current. The unit used to describe the current level is called "Amperage" or "Amps" for short. To measure current you need to break the circuit (first make sure it is switched off) and insert the meter in series.

T4B05:
To make an Ammeter measure more current than it is rated for, we will have to allow a known proportion of current to bypass the meter. This is done by putting a known resistance in parallel with it.

T4B06:
A "multimeter" is a multipurpose meter. This means that it can measure multiple things such as voltage, amperage, and resistance. As a Ham radio operator, you will find multiple uses for it. The "multimeter" should be one of your first purchases.

T4B07:
You want to measure power coming out of the transmitter; so measure at the output. In practice a short length of cable will be required between the transmitter and the meter. At VHF and UHF frequencies, you need to be sure that the loss in this cable is as small as possible.

T4B08:
All Amateur radio transmitters are designed to work at an impedance of 50 Ohms. Make sure that the meter and connecting cables are also designed for this impedance.

T4B09:
You need to know what power is being output from a transmitter as well as the power that is being reflected back due to any impedance mismatch.   Most watt meters allow measurements in both directions (forward and reflected).

T4B10:

Reflected power is power that was not able to be radiated from the antenna due to an impedance mismatch. It is reflected back down the feed line and ends up as heat. The components that will receive this heat are the antenna feedline itself and the transmitter power amplifier. An excessive amount of heat can damage the output devices in the amplifier. It is a good idea to purchase a watt meter so you can monitor reflected power.

T4B11:
Reflected power is power that was not able to be radiated from the antenna due to an impedance mismatch. It is reflected back down the feed line and ends up as heat. The components that will receive this heat are the antenna feedline itself and the transmitter power amplifier. An excessive amount of heat can damage the output devices in the amplifier. It is a good idea to purchase a watt meter so you can monitor reflected power.

T4C01:
A marker generator is a highly accurate signal source that gives calibration points at known frequencies on 100 kHz or 1 MHz intervals. It is a useful tool for checking the calibration of your receiver frequency display.

T4C02:
A marker generator is a highly accurate signal source that gives calibration points at known frequencies on 100 kHz or 1 MHz intervals.   It is a useful tool for checking the calibration of your receiver frequency display.

T4C03:
A "crystal calibrator" is another name for a marker generator. A marker generator is a highly accurate signal source that gives calibration points at known frequencies on 100 kHz or 1 MHz intervals. It is a useful tool for checking the calibration of your receiver frequency display.

T4C04:
WWV signals are used throughout the US for calibration purposes.   Other stations perform this function around the world.

T4C05:
WWV signals are used throughout the US for calibration purposes. Other stations perform this function around the world. The modulation and carrier are locked to highly accurate atomic frequency standards.

T4C06:
A signal generator can be used to check receiver calibration and sensitivity. It operates by injecting a low level RF signal of known frequency into the input of a receiver. You can then test the performance and/or calibration of the receiver because you are controlling the input with a calibrated device.

T4C07:
Tuned circuits are very common in radio equipment. They select or reject signals of certain frequencies.

T4C08:
Radio antennas and feedlines have a specific impedance which should match the designed impedance of your transmitter. A reflectometer allows you to measure how good a match you have in your antenna system. A bad match results in reflected power. Reflected power is power that was not able to be radiated from the antenna due to an impedance mismatch. It is reflected back down the feed line and ends up as heat. The components that will receive this heat are the antenna feedline itself and the transmitter power amplifier. An excessive amount of heat can damage the output devices in the amplifier.

T4C09:
In practice this could be difficult. This is because the feed point should be at the center of a dipole that is strung between two tall objects. As a "second best" option many amateurs make their measurements at the transmitter output. This is not as good because it does not isolate the effects of the feedline itself.

T4C10:
You must use a power meter designed for the frequencies you are measuring. VHF and UHF power meters are more expensive because of the delicate components required to build them.

T4C11:
You should use a SWR meter designed for the frequencies you are measuring. You may find that some brands of HF SWR meters are useable, though. VHF and UHF SWR meters are more expensive because of the delicate components required to build them.

T4D01:
A dummy antenna is designed to act like a normal antenna except that it does not radiate a signal. This is because test signals can cause interference to others during transmitter adjustments. However, there is generally enough leakage to allow you to hear the transmitter signal on the nearby receivers in your shack.

T4D02:
You could use a standard electric light bulb as a low power dummy antenna. Unlike a special purpose device that is designed as a dummy load, there can be significant radiation of RF energy from an electric light bulb.

T4D03:
The resistor should be a 50 Ohm type to simulate a 50 Ohm impedance antenna. The best component to use in a home made dummy antenna is a high power, non-inductive resistor. A set of these resistors connected in parallel makes a good dummy antenna that can be used at high power levels. You might consider putting the resistor in a metal box to reduce the amount of RF leakage. You will need to leave plenty of room for air circulation to allow the heat created by the resistor to dissipate.

T4D04:
A dummy antenna is designed to act like a normal antenna except that it does not radiate a signal that could cause interference to others during transmitter adjustments.   High power commercial dummy antennas are elaborate affairs with cooling fins or oil cooling.   Your dummy antenna can be as simple as an electric light bulb or it could be a large non inductive 50 Ohm resistor.

T4D05:
A dummy antenna is designed to act like a normal antenna except that it does not radiate a signal that could cause interference to others during transmitter adjustments.   High power commercial dummy antennas are elaborate affairs with cooling fins or oil cooling.   Your dummy antenna can be as simple as an electric light bulb or it could be a large non inductive 50 Ohm resistor.

T4D06:
You will need a dummy load capable of handling at least 100 watts continuous power.   This is because a 100-watt single side band transmitter is capable delivering this much power (even though it is not normally used to output a continuous carrier).

T4D07:
Dummy loads function by converting RF energy into heat. Therefore, it is not surprising that they get warm. Be careful not to allow the dummy load to get extremely hot. You can burn it out.

T4D08:
All modern Ham receivers have an S-meter.

T4D09:
The heating effect on body tissue causes permanent damage. The tissues can be cooked as meat is cooked in a microwave oven.

T4D10:
The eyes are most sensitive to RF radiation. This is especially important to know because the damage can be painless while it is being inflicted.

T4D11:
This organization is the US RF protection agency.

T4D12:
RF protection is essential because damage to human tissue can occur with little or no pain.

T4D13:
Exposure to RF at VHF and UHF frequencies is especially dangerous because at these frequencies the energy is readily absorbed and converted to heat by human tissue. Also, VHF and UHF energy are easily reflected giving local concentrations of energy even at relatively low powers.

T4D14:
Exposure to RF at VHF and UHF frequencies is especially dangerous because at these frequencies the energy is readily absorbed and converted to heat by human tissue.   Also, VHF and UHF energy are easily reflected giving local concentrations of energy even at relatively low powers.

T4D15:
Do not allow a hand held antenna too near your eyes and head.

T4D16:
Transmitter shielding has several functions. It prevents radiation of RF energy to your body. In the case of tube amplifiers it prevents exposure to high voltages.

T5A01:
A resistor restricts the flow of current in a circuit.   It works by converting some of the electrical power into heat.

T5A02:
An inductor often consists of a coil of wire that concentrates the magnetic field, exactly the same way as an electromagnet.

T5A03:
The "Henry" unit is too large for use in electronic circuits.   We use millihenrys (thousandths of a Henry) or microhenrys (millionths of a Henry).

T5A04:
The "Henry" unit is too large for use in electronic circuits.   We use millihenrys (thousandths of a Henry) or microhenrys (millionths of a Henry).

T5A05:
Capacitors store their energy in a static electrical field within the dielectric. The dielectric is an insulating medium (sometimes air) that separates the two electrodes of a capacitor.

T5A06:
In electronics, we use microfarads (millionths of a farad) or picofarads (million millionths) of a farad.

T5A07:
In electronics, we use microfarads (millionths of a farad) or picofarads (million millionths) of a farad.

T5A08:
You can use the resistor formula for calculating inductance in series and parallel. (Press the NuTest "Formula" button for more information.)

T5A09:
You can use the resistor formula for calculating inductance in series and parallel.   (Press the NuTest "Formula" button for more information.)

T5A10:
With capacitors you have to be careful to use the opposite of the resistance series and parallel formulae. Remember, they store electrical energy. They do not convert it into heat. (Press the NuTest "Formula" button for more information.)

T5A11:
With capacitors you have to be careful to use the opposite of the resistance series and parallel formulae. Remember, they store electrical energy. They do not convert it into heat. (Press the NuTest "Formula" button for more information.)

T5B01:
Press the NuTest "Formula" button for more information.

T5B02:
Press the NuTest Formula button for more information.

T5B03:
Press the NuTest "Formula" button for more information.

T5B04:
Press the NuTest "Formula" button for more information.

T5B05:
R = V/I = 12/0.25 = 48 Ohms.   (Press the NuTest "Formula" button for more information.)

T5B06:
R = V/I = 12/0.15 = 80 Ohms.   (Press the NuTest "Formula" button for more information.)

T5B07:
I = E/R = 120/4800 = 0.025 A = 25 mA.   (Press the NuTest "Formula" button for more information.)

T5B08:
I = E/R = 120/48000 = 0.0025 A = 2.5 mA.   (Press the NuTest "Formula" button for more information.)

T5B09:
I = E/R = 12/4800 = 0.0025 A = 2.5 mA.   (Press the NuTest "Formula" button for more information.)

T5B10:
I = E/R = 12/48000 = 0.00025 A = 250 uA.   (Press the NuTest "Formula" button for more information.)

T5B11:
If we have voltage, current and resistance then it is an Ohms law problem.

T6A01:
Film resistors consist of a thin film of conductor (often metal) deposited on an insulating core. The film is protected by a coat of enamel or paint that may have bands of color signifying the resistance value. (Press the NuTest "Formula" button for more information on resistor color codes.) A wire wound resistor resembles an inductor (and it will have inductance) except that the wire is a resistive metal alloy rather than copper. Also, the component is often designed to withstand and dissipate heat.

T6A02:
This is how volume controls work.

T6A03:
Press the NuTest "Formula" button for more information on resistor color codes. Close tolerance resistors are more expensive to manufacture. Therefore, they cost more and are not always required.

T6A04:
Press the NuTest "Formula" button for more information on resistor color codes. You do not need to memorize the resistor color code for the exam.

T6A05:
This band may not always exist. In the case where it does not, the resistor has a 20% tolerance. In other words the actual resistance value may vary up to 20% of the stated resistance. This allows the manufacturers of resistors to produce them more cheaply. Resistors with a closer tolerance will cost more. Press the NuTest "Formula" button for more information on resistor color codes. You do not need to memorize the resistor color code for the exam.

T6A06:
The atoms in a resistor are jiggled around by the current flow as they impede it. This movement results in heat being produced.

T6A07:
A large resistor (with plenty of surface area) can dissipate more power at a given temperature. Another way to increase power dissipation is to make the resistor out of materials that are able to withstand high temperatures. The heat created in the resistor must be transferred to another substance (such as air) to prevent it from burning out. Some high power resistors have cooling fins and others are designed to be fixed to a heat conductive surface such as a chassis.

T6A08:
If you calculate 10% of 100 Ohms you will have 10 Ohms. The tolerance is given as 10 percent. So, the resistance can be between (100 - 10) and (100 + 10) Ohms, or 90 to 110 Ohms.

T6A09:
Press the NuTest "Formula" button for more information on resistor color codes. You do not need to memorize the resistor color code for the exam.

T6A10:
High quality, close tolerance resistors are more expensive to manufacture.   Therefore, they cost more. They may be marked with the resistance, tolerance and power rating rather than being color coded. They are often are designed to work at lower temperatures.

T6A11:
Lower quality resistors with looser tolerances are less expensive to manufacture. Therefore, they cost less and are fine for most purposes. A 20% tolerance resistor will have no tolerance band. Press the NuTest "Formula" button for more information on resistor color codes. You do not need to memorize the resistor color code for the exam.

T6B01:
Inductor cores are often made from compressed iron dust that is held together with glue. Therefore, they are very fragile. Do not use a metal screwdriver to adjust them. You can damage them and end up having to replace the whole inductor. Also, placing a metal screwdriver inside them to turn the screw will temporarily change their inductance rating. When you remove the metal screwdriver, it will return to the original rating. This makes proper adjustment with a metal tool impossible. Special plastic adjustment tools are available. One may have even been provided inside the case of your transceiver. Even when you have the correct adjustment tool, do not attempt to adjust the inductor cores unless you know what you are doing.

T6B02:
The opposition to the change in voltage is caused by the magnetic field.

T6B03:
Press the NuTest "Formula" button for more information on how physical characteristics of an inductor affect its inductance.

T6B04:
Inductor cores are often made from compressed iron dust that is held together with glue. Therefore, they are very fragile. Do not use a metal screwdriver to adjust them. You can damage them and end up having to replace the whole inductor. Also, placing a metal screwdriver inside them to turn the screw will temporarily change their inductance rating. When you remove the metal screwdriver, it will return to the original rating. This makes proper adjustment with a metal tool impossible. Special plastic adjustment tools are available. One may have even been provided inside the case of your transceiver. Even when you have the correct adjustment tool, do not attempt to adjust the inductor cores unless you know what you are doing.

T6B05:
Placing a metal screwdriver inside an inductor to turn the screw will temporarily change its inductance rating. When you remove the metal screwdriver, it will return to the original rating. This makes proper adjustment with a metal tool impossible. Special plastic adjustment tools are available. One may have even been provided inside the case of your transceiver. Even when you have the correct adjustment tool, do not attempt to adjust the inductor cores unless you know what you are doing.

T6B06:
The arrow indicates an adjustable component.   The symbol resembles a coil of wire.

T6B07:
The lines above the coil symbol represent a core.

T6B08:
A schematic diagram represents function rather than physical characteristics. A toriod is functionally identical to a coil with a core. The specific shape of the inductor is not represented in the schematic diagram.

T6B09:
A capacitor with a normal dielectric can be connected either way. An electrolytic capacitor must be connected with the correct polarity. The plus sign printed near one of the leads of the capacitor is the clue.

T6B10:
An arrow through a symbol represents the variable version of that component. A variable capacitor often has moving sets of electrodes separated by a small air gap. The electrodes mesh and unmesh to vary the capacitance.

T6B11:
The electrodes of a capacitor should never touch. It is designed to be an insulator to direct current. One test for a capacitor is to attempt to pass a DC current through it by applying a steady voltage. If a steady current passes then the component is faulty.

T6B12:
Capacitors store their energy in a static electric field that builds up in the insulating dielectric material between its plates. (This dielectric can be any good insulator, such as air or a special plastic film.)

T6B13:

Press the NuTest "Formula" button for more information on how the physical characteristics of a capacitor can affect its capacitance rating.

T6B14:
Variable capacitors usually work in one of two ways. Either the amount of plate area is varied or the distance between the plates is varied. Varying amount of plate area gives a larger range of adjustment. Varying the distance between the plates gives a finer range of adjustment. In either case, this is done by physically moving one set of plates while the other set stays stationary. A third way of varying the capacitance would be by varying the dielectric material. This method is not often used on radio equipment, however. Press the NuTest "Formula" button for more information on how the physical characteristics of a capacitor can affect its capacitance rating.

T7A01:
All modern HF transmitters have low pass filters built in to the output circuitry.

T7A02:
A filter that blocks both high and low frequencies only passes frequencies within a limited band. Therefore, it is called a "band pass" filter.

T7A03:
Band pass filters are used in many parts of radio equipment.

T7A04:
A detector is the part of a radio receiver that extracts the required information from the RF carrier signal.

T7A05:
The letters "VFO" stand for "Variable Frequency Oscillator." A "VFO" can be set to virtually any frequency within its design range. It is much more versatile than a crystal controlled oscillator that can be set to only one frequency. However, it is more likely to drift off frequency than a crystal controlled oscillator.

T7A06:
A detector circuit is the part of a radio receiver that extracts the required information from the RF carrier signal. This question tests for knowledge of one particular type of detector circuit.

T7A07:
A detector circuit is the part of a radio receiver that extracts the required information from the RF carrier signal. In the case of frequency modulated (FM) transmissions the detector is also called a discriminator.

T7A08:
You can see that this is a transmitter because a power amplifier is connected to the antenna. It has a telegraph key so it cannot be a single side band transmitter or a packet radio transmitter. Block 1 is a Variable Frequency Oscillator which abbreviates to "VFO" and so the diagram is a VFO controlled transmitter.

T7A09:
A detector circuit is the part of a radio receiver that extracts the required information from the RF carrier signal. One common type of detector combines a second RF signal with the received signal to produce an audio output. This second signal is generated by a beat frequency oscillator.

T7A10:
A detector circuit is the part of a radio receiver that extracts the required information from the RF carrier signal. In the case of frequency modulated (FM) transmissions, the detector is also called a discriminator and this is the vital clue in this question.

T7A11:
This is a circuit diagram of a transmitter; it has a power amplifier connected to the antenna. The part of a transmitter that combines audio signals with the RF carrier is called a modulator. There is no such term as a "rectifier modulator", which leaves "reactance modulator" as the correct answer.

T8A01:
An unmodulated carrier is conveying no information. Therefore, it is not being used for communications purposes.

T8A02:
Continuous wave (CW) is a term used for Morse code because during the transmission of a "dit" or "dah" the carrier is continuous.

T8A03:
Frequency shift keying (FSK) and RTTY are two names for the same thing. The transmission of text using data codes that were originally designed for typewriter like machines.

T8A04:
The data rate of packet radio transmissions is much higher than RTTY.

T8A05:
This modulation method is not normally used.   Keying of the carrier to produce CW is much better.

T8A06:
We use frequency modulation (FM) on most VHF and UHF bands.

T8A07:
Frequency modulation is inherently more broad band that amplitude modulation (AM), especially single side band AM. It would not be acceptable to use FM on the crowded HF bands.

T8A08:
By convention, upper side band is used by Hams on the 10 to 20 meter bands. Lower side band is used on the 40 to 160 meter bands.

T8A09:
Some VHF transmitters use phase modulation and others use frequency modulation. Both types of signal are detected in the same way, using a discriminator.

T8A10:
Frequency modulation and phase modulation are almost the same thing.

T8A11:
MCW stands for modulated CW.   This transmission mode is rarely used.

T8B01:
The unmodulated RF carrier contains no information and would normally be transmitted only for test purposes.

T8B02:

There are many ways to modulate a radio signal. Basically, they fall into two main areas. We either vary the amplitude of the RF carrier signal as we modulate it or we vary the frequency of the RF carrier signal as we modulate it. These are known as Amplitude Modulation (AM) and Frequency Modulation (FM).

T8B03:
No modulation would be present so the RF carrier from your transmitter would be unmodulated.

T8B04:
The transceiver would still be transmitting FM signals.   It is the content of the modulation that makes it packet radio.

T8B05:
This high quality audio is gained at a cost of higher bandwidth but this is not a big problem on the VHF and UHF bands.

T8B06:
For example an amateur FM transmission might require as much as 20 kHz bandwidth whereas a Morse code signal may require as little as 20 Hz.

T8B07:
CW occupies the smallest bandwidth and FM voice the largest.

T8B08:
A single side band signal is fairly economical in bandwidth while allowing reasonable voice quality.

T8B09:
An amateur FM transmission has better audio quality than an amateur single side band (SSB) transmission, but at the cost of higher bandwidth. This is one reason why FM is not generally used on the crowded HF bands.

T8B10:
Overdriving an FM transmitter makes the bandwidth even greater than the recommended maximum of about 20 kHz.

T8B11:
A transmission that is splattering shows that either the operator is using the transmitter incorrectly or that it is faulty.

T9A01:
The most basic FM radio antenna is a directional Yagi.   It consists of a dipole active element surrounded by a larger reflector behind it and a shorter director in front of it.

T9A02:
The Yagi antenna should be familiar to everyone since the most basic FM radio antenna is a directional Yagi. It consists of a dipole active element surrounded by a larger reflector behind it and a shorter director in front of it.

T9A03:
The Yagi antenna is the only antenna in the options that fits the description.

T9A04:
In the Yagi, for example, only one element is driven by RF energy. The other elements are passive; they are known as parasitic elements because they obtain their power by induction or radiation from the driven element. Parasitic elements do not have a feedline attached.

T9A05:
In most beam antenna only one element is driven by RF energy. The other elements are passive; they are known as parasitic elements because they obtain their power by induction or radiation from the driven element. Parasitic elements do not have a feedline attached to them. They operate from energy that is radiated to them by the driven element. That is why they are called "Parasitic." They operate as a parasite, living off the driven element.

T9A06:
Parasitic elements do not have a feedline attached to them. They operate from energy that is radiated to them by the driven element. That is why they are called "Parasitic." They operate as a parasite, living off the driven element.

T9A07:
Cubical quad antennas often have reflectors and directors of similar shape (square) but slightly longer and shorter than the driven element. It is the most directive design because it acts like a Yagi in both the horizontal and vertical planes. It is the equivalent of a RF telescope. The Yagi design allows RF energy to be radiated straight up (where there is no chance for the signal to ever be received). The cubical quad design does not. It focuses the energy into a straight line. However, the cubical quad design is very fragile. It is much more likely to be torn apart during a wind storm than a Yagi.

T9A08:
A delta loop antenna is electrically the same as a cubical quad but can be easier to erect. It is also less likely to be torn apart during a wind storm.

T9A09:
The ground plane is the only non-directional antenna in the options presented. Ground planes are popular for mobile use due to their non-directional properties.

T9A10:
Ground planes are popular for mobile use due to their non-directional properties. Mounting the ground plane in the middle of a flat metal car roof makes it even more efficient.

T9A11:
The radiation will be in horizontal directions only if it is mounted on a flat horizontal surface such as the middle of a car roof.

T9B01:
It is always the electric field that is used to define polarization of radio waves. Most mobiles on VHF use ground planes that emit vertically polarized waves and so everyone else follows suit.

T9B02:
It is always the electric field that is used to define polarization of radio waves. Most mobiles on VHF use ground planes that emit vertically polarized waves and so everyone else follows suit.

T9B03:
It so happens that a Yagi with horizontal elements emits horizontally polarized waves. So, this is an easy one to remember.

T9B04:
This is an easy one to remember.   A vertical radiator emits vertically polarized waves.

T9B05:
Antenna polarization is usually chosen based on factors other than the polarization of man-made electrical noise.   For example, a mobile ground plane must be erected vertically and so will have vertical polarization.

T9B06:
Stationary areas of minimum and maximum voltage on a feedline are called standing waves. They are a result of the interaction between the forward and reflected power. If the feedline, transmitter, and antenna are perfectly matched then the standing wave ratio (SWR) will be 1:1. In this condition, there would be zero reflected power. All the power going to antenna would be radiated. None would be reflected back down the feedline.

T9B07:
Forward power is useful power that may be radiated by the antenna if it is an efficient radiator and if the feedline losses are low.

T9B08:
A large amount of reflected power is a sure sign that something is wrong with the antenna or the feedline.

T9B09:
A poor quality coaxial cable will result in less transmitted energy. High losses will also occur on receive and result in loss of weak signals.

T9B10:
Coaxial cable is the most commonly used unbalanced feedline. The outer braid conductor is connected to ground. The advantages of using this unbalanced feedline (such as being able to rout it near a metal object such as a tower) usually outweigh the disadvantages of having to use a balun to correct the inherent impedance mismatch.

T9B11:
Coaxial cable is an unbalanced feedline. Signals from coaxial cable must go through a special transformer called a balun (balance to unbalance converter) to obtain a balanced signal that is suitable to feed a balanced antenna.

T9C01:
Type PL-259 connectors have fairly low loss at VHF frequencies.   They are robust and are not very expensive.

T9C02:
Good quality BNC connectors are useable up to 5,000 MHz!

T9C03:
On frequencies above 300 MHz a PL-259 does not present a constant impedance of 50 Ohms. For this reason it may cause reflected power problems. It also may cause signal loss. The familiar F-connector is a very cheap device that is unsuitable for UHF use. BNC connectors have low loss but the lowest loss of all is obtained with type-N connectors that can be used at up to 10,000 MHz!

T9C04:
The main consideration with coaxial feedline is the loss. This is often given in dB per 100 feet at a particular frequency. Here are the losses (at 50 MHz) of the feedlines in the options:

RG-213	1.5 dB
RG-58	3.0 dB
RG-59	2.4 dB
RG-174	5.5 dB

The feedline should also be of the correct impedance. Feedline with an impedance rating of 50 Ohms is most commonly used in Amateur radio. Mechanical stability and weather resistance also need to be considered.

T9C05:
Keep your feedline as short as possible.

T9C06:
Keep your feedline as short as possible.

T9C07:
The higher the frequency, the higher the losses per 100 feet.   At higher frequencies it becomes more important to use the best quality feedline.   It generally has low losses.

T9C08:
If the feedline is experiencing signal loss, it will be absorbing a significant amount of RF energy and converting it to heat. If a high standing wave ratio (SWR) is present, then high voltages and currents will be present in some sections of the feeder that will also cause heating. With a high SWR, it is possible that your transmitter power amplifier is overheating as well.

T9C09:
The conductors of an open-wire feedline have high voltages on them. Strong RF fields exist near the conductors.

T9C10:
Placing your antennas as high as possible is beneficial in other ways as well. It can increase your transmit and receive range by getting the antenna clear of local obstructions, especially on VHF and UHF.

T9C11:
Resistance converts electrical power to heat. You will want all of your RF power to go up to the antenna and be radiated. You will not want it wasted in heating up bad connections on the back side of your transceiver.

Commonly used Q-Codes:

QRA	Station name.
QRM	Interference.
QRN	Static type noise.
QRO	High power.
QRP	Low power.
QRQ	Send Morse faster.
QRS	Send Morse slower.
QRT	Closing down.
QRX	Please call me again.
QRZ	Who is calling?
QSB	fading signal.
QSL	Acknowledgement of contact.
QSO	A radio contact.
QSY	Change of frequency.
QTH	Location of station.

The explanations given here refer to Amateur Radio usage of Q-Codes.

The RST system

RST Stands for Readability, Signal strength and Tone. Three digits are used as follows:

Readability:

1 Unreadable.
2 Barely readable.
3 Readable with difficulty.
4 Readable with little difficulty.
5 Perfectly readable.

Signal strength:

1 Very weak signal, hardly detectable.
2 Very weak signal.
3 Weak signal.
4 Fair signal.
5 Fairly good signal.
6 Good signal.
7 Fairly strong signal.
8 Strong signal.
9 Very strong signal.

Tone: (Used with CW only)

1 Carrier is highly modulated, with AC hum. Broad bandwidth.
2 Carrier is highly modulated, with AC hum.
3 Rough tone, some AC hum.
4 Rough tone moderate AC hum.
5 Some AC ripple present on carrier.
6 A little AC modulation present.
7 Traces of modulation can be heard.
8 Slight trace of modulation.
9 Perfect carrier with no modulation.