Amateur Radio Technician Class Course.

Version 2.0
For Exams
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How to study using this course:

1. **Read over the brief explanation at the beginning of each question period. Note that statements in "BOLD" are correct answers on the test.**
2. **Use an index card or piece of paper to cover up the correct answer at the very end of each question (answer is in bold letters).**
3. **Read over the question and multiple choice answers and then select your answer**
4. **Uncover the correct answer to check your work.**
5. **As one progresses, read through the QUESTIONS WITH ANSWERS ONLY in Appendix A starting on page 103.**

The questions in this course are the exact questions in the question pool. There will be no surprises. If you learn the answer to these questions, you will pass the exam.

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SUBELEMENT T1

FCC Rules, descriptions and definitions for the Amateur Radio Service, operator and station license responsibilities
6 Exam Questions - 6 Groups

T1A - Amateur Radio Service: purpose and permissible use of the Amateur Radio Service; operator/primary station license grant; where FCC rules are codified; basis and purpose of FCC rules; meanings of basic terms used in FCC rules; interference; spectrum management

The Amateur Radio Service is intended for persons who are interested in radio technique solely with a personal aim and without pecuniary reasons. Ham Radio is a hobby for people from all walks of life. Factory Workers, Mail Carriers, Janitors, and High School students are just a small sample of those that enjoy the magic of Ham Radio.

Anyone may become a ham regardless of age. Children as young as 8 years old have passed the exam. Seniors as old as 80 or more have become new hams. Ham Radio is indeed a hobby of the people.

The agency that regulates and enforces the rules for the Amateur Radio Service in the United States is the Federal Communications Commission, or **the FCC**. **Part 97** of the FCC regulations contains the rules governing the Amateur Radio Service.

Advancing skills in the technical and communication phases of the radio art is a purpose of the Amateur Radio Service as stated in the FCC rules and regulations. **Enhancing international goodwill** is another purpose of the Amateur Radio Service rules and regulations as defined by the FCC.

A station in the Amateur Radio Service consisting of the apparatus necessary for carrying on radio communications is the FCC Part 97 definition of an amateur station.

Allowing a person to conduct radio experiments and to communicate with other licensed hams around the world is a permissible use of the Amateur Radio Service.

T1A01
Which of the following is a purpose of the Amateur Radio Service as stated in the FCC rules and regulations?
A. Providing personal radio communications for as many citizens as possible
B. Providing communications for international non-profit organizations
C. Advancing skills in the technical and communication phases of the radio art
D. All of these choices are correct

C. Advancing skills in the technical and communication phases of the radio art

T1A02
Which agency regulates and enforces the rules for the Amateur Radio Service in the United States?
A. FEMA
B. The ITU
C. The FCC
D. Homeland Security

C. The FCC

T1A03
Which part of the FCC regulations contains the rules governing the Amateur Radio Service?
A. Part 73
B. Part 95
C. Part 90
D. Part 97

D. Part 97

T1A05
Which of the following is a purpose of the Amateur Radio Service rules and regulations as defined by the FCC?
A. Enhancing international goodwill
B. Providing inexpensive communication for local emergency organizations
C. Training of operators in military radio operating procedures
D. All of these choices are correct

A. Enhancing international goodwill

T1A10
What is the FCC Part 97 definition of an amateur station?
A. A station in the Amateur Radio Service consisting of the apparatus necessary for carrying on radio communications
B. A building where Amateur Radio receivers, transmitters, and RF power amplifiers are installed
C. Any radio station operated by a non-professional
D. Any radio station for hobby use

A. A station in the Amateur Radio Service consisting of the apparatus necessary for carrying on radio communications

T1A12
Which of the following is a permissible use of the Amateur Radio Service?
A. Broadcasting music and videos to friends
B. Providing a way for amateur radio operators to earn additional income by using their stations to pass messages
C. Providing low-cost communications for start-up businesses
D. Allowing a person to conduct radio experiments and to communicate with other licensed hams around the world

D. Allowing a person to conduct radio experiments and to communicate with other licensed hams around the world

Amateur Radio Stations are not allowed to intentionally interfere with one another. No one in the Amateur Radio Service "owns" a frequency.

The FCC definition of harmful interference is **that which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations**. **At no time** is willful interference to other amateur radio stations permitted.

The **Radionavigation Services** are protected from interference by amateur signals under all circumstance. If you are operating on the 23 cm band and learn that you are interfering with a radiolocation station outside the United States, you must **stop operating or take steps to eliminate the harmful interference**.

T1A04
Which of the following meets the FCC definition of harmful interference?
A. Radio transmissions that annoy users of a repeater
B. Unwanted radio transmissions that cause costly harm to radio station apparatus
C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations
D. Static from lightning storms

C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations

T1A11
When is willful interference to other amateur radio stations permitted?
A. Only if the station being interfered with is expressing extreme religious or political views
B. At no time
C. Only during a contest
D. At any time, amateurs are not protected from willful interference

B. At no time

T1A14
What must you do if you are operating on the 23 cm band and learn that you are interfering with a radiolocation station outside the United States?
A. Stop operating or take steps to eliminate the harmful interference
B. Nothing, because this band is allocated exclusively to the amateur service
C. Establish contact with the radiolocation station and ask them to change frequency
D. Change to CW mode, because this would not likely cause interference

A. Stop operating or take steps to eliminate the harmful interference

T1A06
Which of the following services are protected from interference by amateur signals under all circumstances?
A. Citizens Radio Service
B. Broadcast Service
C. Land Mobile Radio Service
D. Radionavigation Service

D. Radionavigation Service

Frequency Coordinators recommend transmit/receive channels and other parameters for auxiliary and repeater stations. Frequency Coordinators are groups of volunteer hams that assist is assigning repeater frequencies to hams wishing to set up a repeater station. **Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations** are the ones that select the frequency coordinators.

The Ohio Area Repeater Council has been selected by hams in Ohio to coordinate repeater and auxiliary frequencies.

T1A08
Which of the following entities recommends transmit/receive channels and other parameters for auxiliary and repeater stations?
A. Frequency Spectrum Manager
B. Frequency Coordinator
C. FCC Regional Field Office
D. International Telecommunications Union

B. Frequency Coordinator

T1A09
Who selects a Frequency Coordinator?
A. The FCC Office of Spectrum Management and Coordination Policy
B. The local chapter of the Office of National Council of Independent Frequency Coordinators
C. Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations
D. FCC Regional Field Office

C. Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations

Many of the U.S. astronauts are hams and use of ham radio aboard the International Space Station is common practice. Hams aboard the International Space Station routinely conduct question and answer sessions with Schools across the United States and sometimes the world via ham radio. It is fun for the students and fun for the astronauts.

The Amateur Radio Service worldwide has established a fleet of communications satellite that are used by many hams. These satellites must be monitored and controlled.

A one-way transmission of measurements at a distance from the measuring instrument is the FCC Part 97 definition of telemetry. **A one-way transmission to initiate, modify or terminate functions of a device at a distance** is the FCC Part 97 definition of telecommand.

T1A07
What is the FCC Part 97 definition of telemetry?
A. An information bulletin issued by the FCC
B. A one-way transmission to initiate, modify or terminate functions of a device at a distance
C. A one-way transmission of measurements at a distance from the measuring instrument
D. An information bulletin from a VEC

C. A one-way transmission of measurements at a distance from the measuring instrument

T1A13
What is the FCC Part 97 definition of telecommand?
A. An instruction bulletin issued by the FCC
B. A one-way radio transmission of measurements at a distance from the measuring instrument
C. A one-way transmission to initiate, modify or terminate functions of a device at a distance
D. An instruction from a VEC

C. A one-way transmission to initiate, modify or terminate functions of a device at a distance

T1B - Authorized frequencies: frequency allocations; ITU regions; emission modes; restricted sub-bands; spectrum sharing; transmissions near band edges

The ITU or the International Telecommunications Union is **a United Nations agency for information and communication technology issues**. There are 3 ITU Regions and North American Amateur Stations are located in ITU Region 2. **Some U. S. Territories are located in ITU regions other than region 2** is why the frequency assignments for some U.S. Territories are different from those in the 50 U.S. States.

Frequency assignments for U.S. stations operating maritime mobile are not the same everywhere in the world because **Amateur frequency assignments can vary among the three ITU regions**.

Frequency bands in the radio spectrum have primary and secondary users. Hams are the primary user on many bands, however there are a few bands that amateurs share on a secondary basis. On these bands, someone else is the primary user. It may be a government agency or a business. A result of the fact that the amateur service is secondary in some portions of the 70 cm band is that **U.S. amateurs may find non-amateur stations in the bands, and must avoid interfering with them**.

T1B01
What is the ITU?
A. An agency of the United States Department of Telecommunications Management
B. A United Nations agency for information and communication technology issues
C. An independent frequency coordination agency
D. A department of the FCC

B. A United Nations agency for information and communication technology issues

T1B02
Why are the frequency assignments for some U.S. Territories different from those in the 50 U.S. States?
A. Some U. S. Territories are located in ITU regions other than region 2
B. Territorial governments are allowed to select their own frequency allocations
C. Territorial frequency allocations must also include those of adjacent countries
D. Any territory that was in existence before the ratification of the Communications Act of 1934 is exempt from FCC frequency regulations

A. Some U. S. Territories are located in ITU regions other than region 2

T1B08
Which of the following is a result of the fact that the amateur service is secondary in some portions of the 70 cm band?
A. U.S. amateurs may find non-amateur stations in the bands, and must avoid interfering with them
B. U.S. amateurs must give foreign amateur stations priority in those portions
C. International communications are not permitted on 70 cm
D. Digital transmissions are not permitted on 70 cm

A. U.S. amateurs may find non-amateur stations in the bands, and must avoid interfering with them

T1B12
Why are frequency assignments for U.S. stations operating maritime mobile not the same everywhere in the world?
A. Amateur maritime mobile stations in international waters must conform to the frequency assignments of the country nearest to their vessel
B. Amateur frequency assignments can vary among the three ITU regions
C. Frequency assignments are determined by the captain of the vessel
D. Amateur frequency assignments are different in each of the 90 ITU zones

B. Amateur frequency assignments can vary among the three ITU regions

Amateur Radio Operators are allocated many bands across the radio spectrum. A band is set frequency spread. For instance, the 6 meter ham band ranges in frequency from 50.000 MHz to 54.000 MHz. This is a spread of 4 MHZ and will allow hundreds of stations to operate on the 6 meter band simultaneously.

Bands below 30 MHz are considered the shortwave bands. Frequencies above 30 MHz are the VHF, UHF, and Microwave bands. As a Technician Class ham, you will have all amateur privileges above 30 MHz. There are also a few bands below 30 MHz that Technician Class hams may use.

These are a few frequencies that one must remember to pass the Technician Class test. Sorry, you will just have to memorize these frequencies and their associated band.

- **52.525 MHz** is a frequency within the 6 meter band.
- 146.52 MHz is a frequency within the **2 meter band**.
- **443.350 MHz** is a 70 CM frequency authorized to a Technician Class license holder operating in Region 2.
- **1296 MHz** is a 23 CM frequency authorized to a Technician Class operator license.
- Transmitting on 223.50 MHz, you are using the **1.25 meter band**.

Remember these frequencies. At least one is sure to be on the test.

T1B03
Which frequency is within the 6 meter band?
A. 49.00 MHz
B. 52.525 MHz
C. 28.50 MHz
D. 222.15 MHz

B. 52.525 MHz

T1B04
Which amateur band are you using when your station is transmitting on 146.52 MHz?
A. 2 meter band
B. 20 meter band
C. 14 meter band
D. 6 meter band

A. 2 meter band

T1B05
Which 70 cm frequency is authorized to a Technician Class license holder operating in ITU Region 2?
A. 53.350 MHz
B. 146.520 MHz
C. 443.350 MHz
D. 222.520 MHz

C. 443.350 MHz

T1B06
Which 23 cm frequency is authorized to a Technician Class licensee?
A. 2315 MHz
B. 1296 MHz
C. 3390 MHz
D. 146.52 MHz

B. 1296 MHz

T1B07
What amateur band are you using if you are transmitting on 223.50 MHz?
A. 15 meter band
B. 10 meter band
C. 2 meter band
D. 1.25 meter band

D. 1.25 meter band

The 6 meter, 2 meter, and 1.25 meter bands available to Technician Class operators have mode-restricted sub bands. In the mode-restricted sub bands at 50.0 to 50.1 MHz and 144.0 to 144.1 MHz **only CW emission modes** are permitted. CW in the ham lingo for Morse Code. You will learn more about the CW mode later in this course.

Data emission may be used between 219 and 220 MHz.

Since amateurs are allowed to operate only inside their assigned frequency bands, one must be careful not to transmit out of band. All radio transmission modes contain a certain bandwidth. That is how wide the signal is. CW or Morse Code has a very narrow bandwidth. The popular FM voice mode commonly used by Technician Class operators has a much wider bandwidth. You should not set your transmit frequency to be exactly at the edge of an amateur band or sub-band

- to allow for calibration error in the transmitter frequency display
- so that modulation sidebands (bandwidth) do not exceed beyond the band edge
- to allow for transmitter frequency drift.
- **All of these choices are correct**

T1B09
Why should you not set your transmit frequency to be exactly at the edge of an amateur band or sub-band?
A. To allow for calibration error in the transmitter frequency display
B. So that modulation sidebands do not extend beyond the band edge
C. To allow for transmitter frequency drift
D. All of these choices are correct

D. All of these choices are correct

T1B10
Which of the bands above 30 MHz that are available to Technician Class operators have mode-restricted sub-bands?
A. The 6 meter, 2 meter, and 70 cm bands
B. The 2 meter and 13 cm bands
C. The 6 meter, 2 meter, and 1.25 meter bands
D. The 2 meter and 70 cm bands

C. The 6 meter, 2 meter, and 1.25 meter bands

T1B11
What emission modes are permitted in the mode-restricted sub-bands at 50.0 to 50.1 MHz and 144.0 to 144.1 MHz?
A. CW only
B. CW and RTTY
C. SSB only
D. CW and SSB

A. CW only

T1B13
Which emission may be used between 219 and 220 MHz?
A. Spread spectrum
B. Data
C. SSB voice
D. Fast-scan television

B. Data

T1C - Operator licensing: operator classes; sequential, special event, and vanity call sign systems; international communications; reciprocal operation; station license and licensee; places where the amateur service is regulated by the FCC; name and address on FCC license database; license term; renewal; grace period

Ham radio call signs in the United States begin with A, K, N, or W. They also contain one number from 0 to 9. The number is often an indication of where in the U.S. an amateur station is located. However, people move and hams may take their call signs with them wherever they go in the United States. In Ohio, a newly licensed ham will have the number 8 in his call, such as K8EEN, W8PEN, and WA8YRS. **W3ABC** is a valid US amateur radio station call sign.

A special event station is an amateur radio station celebrating a special event. This event could be a local community event, a family event, etc. Temporary call signs may be acquired for such events. A call sign that has a single letter in the prefix and suffix of a call is used for a **special event**. W8V, K8C, N8M are examples of special event call signs.

For a Fee, **any licensed amateur** may select a vanity call sign. Availability depends on the Class of license the applicant has. **K1XXX** is a vanity call sign which a technician class amateur operator might select if available. **Only the person named as trustee on the club station license grant** may select a vanity call sign for a club station.

T1C01
Which type of call sign has a single letter in both its prefix and suffix?
A. Vanity
B. Sequential
C. Special event
D. In-memoriam

C. Special event

T1C02
Which of the following is a valid US amateur radio station call sign?
A. KMA3505
B. W3ABC
C. KDKA
D. 11Q1176

B. W3ABC

T1C05
Which of the following is a vanity call sign which a technician class amateur operator might select if available?
A. K1XXX
B. KA1X
C. W1XX
D. All of these choices are correct

A. K1XXX

T1C12]
Who may select a desired call sign under the vanity call sign rules?
A. Only licensed amateurs with general or extra class licenses
B. Only licensed amateurs with an extra class license
C. Only an amateur licensee who has been licensed continuously for more than 10 years
D. Any licensed amateur

D. Any licensed amateur

T1C14
Who may select a vanity call sign for a club station?
A. Any Extra Class member of the club
B. Any member of the club
C. Any officer of the club
D. Only the person named as trustee on the club station license grant

D. Only the person named as trustee on the club station license grant

In addition to places where the FCC regulates communications, an FCC licensed amateur station can transmit from **any vessel or craft that is documented or registered in the United States**. As a licensed amateur radio operator, you are also allowed to operate in a foreign country **when the foreign country authorizes it**.

When communicating with hams from other countries, **communications incidental to the purposes of the amateur radio service and remarks of a personal character** are types of international communications permitted by an FCC licensed amateur station. This is to protect citizens in other countries. Unlike the United States, not all countries allow their citizens total free speech. Use common sense when talking to a person from another country and you will be okay.

T1C03
What types of international communications are permitted by an FCC-licensed amateur station?
A. Communications incidental to the purposes of the amateur service and remarks of a personal character
B. Communications incidental to conducting business or remarks of a personal nature
C. Only communications incidental to contest exchanges, all other communications are prohibited
D. Any communications that would be permitted by an international broadcast station

A. Communications incidental to the purposes of the amateur service and remarks of a personal character

T1C04
When are you allowed to operate your amateur station in a foreign country?
A. When the foreign country authorizes it
B. When there is a mutual agreement allowing third party communications
C. When authorization permits amateur communications in a foreign language
D. When you are communicating with non-licensed individuals in another country

A. When the foreign country authorizes it

T1C06
From which of the following locations may an FCC-licensed amateur station transmit, in addition to places where the FCC regulates communications?
A. From within any country that belongs to the International Telecommunications Union
B. From within any country that is a member of the United Nations
C. From anywhere within in ITU Regions 2 and 3
D. From any vessel or craft located in international waters and documented or registered in the United States

D. From any vessel or craft located in international waters and documented or registered in the United States

The Technician, General, and Amateur Extra are the new licenses currently available from the FCC.

The normal term for an FCC-issued primary station/operator amateur radio license grant is **10 years**. The grace period following the expiration of an amateur license within which the license may be renewed is

two years. Although your license has expired and is still within the allowable grace period, **transmitting is not allowed until the FCC license database shows that the license has been renewed**.

After passing the examination for your first amateur radio license may you operate a transmitter on an amateur service frequency **as soon as your operator/station license grant appears in the FCC's license database**.

It is very important to keep the FCC informed of your current mailing address. **Revocation of the station license or suspension of the operator's license** may result when correspondence from the FCC is returned as undeliverable because the grantee failed to provide the correct mailing address.

T1C08
What is the normal term for an FCC-issued primary station/operator amateur radio license grant?
A. Five years
B. Life
C. Ten years
D. Twenty years

C. Ten years

T1C09
What is the grace period following the expiration of an amateur license within which the license may be renewed?
A. Two years
B. Three years
C. Five years
D. Ten years

A. Two years

T1C11
If your license has expired and is still within the allowable grace period, may you continue to operate a transmitter on amateur service frequencies?
A. No, transmitting is not allowed until the FCC license database shows that the license has been renewed
B. Yes, but only if you identify using the suffix GP
C. Yes, but only during authorized nets
D. Yes, for up to two years

A. No, transmitting is not allowed until the FCC license database shows that the license has been renewed

T1C10
How soon after passing the examination for your first amateur radio license may you operate a transmitter on an amateur service frequency?
A. Immediately
B. 30 days after the test date
C. As soon as your operator/station license grant appears in the FCC's license database
D. You must wait until you receive your license in the mail from the FCC

C. As soon as your operator/station license grant appears in the FCC's license database

T1C13
For which licenses classes are new licenses currently available from the FCC?
A. Novice, Technician, General, Advanced
B. Technician, Technician Plus, General, Advanced
C. Novice, Technician Plus, General, Advanced
D. Technician, General, Amateur Extra

D. Technician, General, Amateur Extra

T1C07
What may result when correspondence from the FCC is returned as undeliverable because the grantee failed to provide the correct mailing address?
A. Fine or imprisonment
B. Revocation of the station license or suspension of the operator license

C. Require the licensee to be re-examined
D. A reduction of one rank in operator class

B. Revocation of the station license or suspension of the operator license

T1D - Authorized and prohibited transmission: communications with other countries; music; exchange of information with other services; indecent language; compensation for use of station; retransmission of other amateur signals; codes and ciphers; sale of equipment; unidentified transmissions; broadcasting

A very popular activity in Amateur Radio is "chasing DX". DX is ham lingo for long distance communications and generally when a ham talks about "working DX" he or she is talking about working a station outside of their own country. For hams in the United States, communicating with a station in Europe, Africa, Asia, etc is considered "working DX". This activity is fun. Awards can be obtained for obtaining certain goals such as contacting stations in 100 different countries.

There are some countries however, that hams are not allowed to talk to. FCC licensed amateur are prohibited from exchanging communications with **any country whose administration has notified the ITU that it objects to such communications**.

Amateurs generally may only talk to each other. They are not allowed to communicate with stations from other services except in a life or death situation. Only **during Armed Forces Day Communications Test** may an FCC licensed amateur station exchange messages with a U.S. military station.

Transmissions that contain obscene or indecent words or language **are prohibited by the FCC**. While the FCC has not come out with an official list, please respect others and refrain from using obscene language on our ham bands. Remember, children interested in ham radio (and their parents) may be listening to you.

Music is not allowed to be transmitted by an amateur radio station. Remember: we are communicators not broadcasters, so turn your broadcast radio or TV off when using the ham bands. The only time an amateur station is authorized to transmit music is **when it is incidental to an authorized retransmission of manned spacecraft communications**. The FCC makes this exception because it is common practice for some stations to retransmit space station communications when authorized to do so.

Only when transmitting control commands to space stations or radio control craft is the transmission of codes or ciphers that hide the meaning of a message allowed by an amateur station.

The only transmissions an amateur may make without identifying with his or her call sing is **when transmitting signals to control a model craft**

T1D01
With which countries are FCC-licensed amateur stations prohibited from exchanging communications?
A. Any country whose administration has notified the ITU that it objects to such communications
B. Any country whose administration has notified the ARRL that it objects to such communications
C. Any country engaged in hostilities with another country
D. Any country in violation of the War Powers Act of 1934

A. Any country whose administration has notified the ITU that it objects to such communications

T1D02
On which of the following occasions may an FCC-licensed amateur station exchange messages with a U.S. military station?
A. During an Armed Forces Day Communications Test
B. During a Memorial Day Celebration
C. During an Independence Day celebration
D. During a propagation test

A. During an Armed Forces Day Communications Test

T1D03
When is the transmission of codes or ciphers that hide the meaning of a message allowed by an amateur station?
A. Only during contests
B. Only when operating mobile

C. Only when transmitting control commands to space stations or radio control craft
D. Only when frequencies above 1280 MHz are used

C. Only when transmitting control commands to space stations or radio control craft

T1D04
What is the only time an amateur station is authorized to transmit music?
A. When incidental to an authorized retransmission of manned spacecraft communications
B. When the music produces no spurious emissions
C. When the purpose is to interfere with an illegal transmission
D. When the music is transmitted above 1280 MHz

A. When incidental to an authorized retransmission of manned spacecraft communications

T1D06
What, if any, are the restrictions concerning transmission of language that may be considered indecent or obscene?
A. The FCC maintains a list of words that are not permitted to be used on amateur frequencies
B. Any such language is prohibited
C. The ITU maintains a list of words that are not permitted to be used on amateur frequencies
D. There is no such prohibition

B. Any such language is prohibited

T1D11
When may an amateur station transmit without identifying?
A. When the transmissions are of a brief nature to make station adjustments
B. When the transmissions are unmodulated
C. When the transmitted power level is below 1 watt
D. When transmitting signals to control a model craft

D. When transmitting signals to control a model craft

Amateurs are allowed to sell their equipment over the air as long as it is not done on a regular basis. Amateur radio operators may use their stations to notify other hams of the availability of equipment for sale or trade **when the equipment is normally used in an amateur radio station and such activity is not conducted on a regular basis**.

The control operator of an amateur radio station may accept compensation **when the communications is incidental to classroom instruction at an educational institution**. In other words, a teacher at a high school may bring his amateur radio station to the class room to demonstrate ham radio to his students.

T1D05
When may amateur radio operators use their stations to notify other amateurs of the availability of equipment for sale or trade?
A. When the equipment is normally used in an amateur station and such activity is not conducted on a regular basis
B. When the asking price is $100.00 or less
C. When the asking price is less than its appraised value
D. When the equipment is not the personal property of either the station licensee or the control operator or their close relatives

A. When the equipment is normally used in an amateur station and such activity is not conducted on a regular basis

T1D08
In which of the following circumstances may the control operator of an amateur station receive compensation for operating the station?
A. When engaging in communications on behalf of their employer
B. When the communication is incidental to classroom instruction at an educational institution
C. When re-broadcasting weather alerts during a RACES net
D. When notifying other amateur operators of the availability for sale or trade of apparatus

B. When the communication is incidental to classroom instruction at an educational institution

Amateurs are not allowed to hide the meaning of their transmissions. No secret "spy type" communications are allowed by the FCC. However, the transmission of codes or ciphers is allowed to hide the meaning of a message transmitted by an amateur station only when transmitting control commands to space stations or radio control craft.

Transmissions intended for reception by the general public is the meaning of the term broadcasting in the FCC rules for the amateur services. Amateurs are authorized to transmit signals related to broadcasting, program production, or news gathering, assuming no other means is available **only where such communications directly relates to the immediate safety of human life or protection of property**.

Brief transmissions to make station adjustments is a type of communications permitted in the Amateur Radio Service.

Amateurs may engage in broadcasting only **when transmitting code practice, information bulletins, or transmissions necessary to provide emergency communications.**

Auxiliary, repeater, or space stations are types of amateur stations that can automatically retransmit the signals of other amateur stations.

T1D09
Under which of the following circumstances are amateur stations authorized to transmit signals related to broadcasting, program production, or news gathering, assuming no other means is available?
A. Only where such communications directly relate to the immediate safety of human life or protection of property
B. Only when broadcasting communications to or from the space shuttle
C. Only where noncommercial programming is gathered and supplied exclusively to the National Public Radio network
D. Only when using amateur repeaters linked to the Internet

A. Only where such communications directly relate to the immediate safety of human life or protection of property

T1D10
What is the meaning of the term "broadcasting" in the FCC rules for the amateur services?
A. Two-way transmissions by amateur stations
B. Transmission of music
C. Transmission of messages directed only to amateur operators
D. Transmissions intended for reception by the general public

D. Transmissions intended for reception by the general public

T1D12
Under which of the following circumstances may an amateur radio station engage in broadcasting?
A. Under no circumstances
B. When transmitting code practice, information bulletins, or transmissions necessary to provide emergency communications
C. At any time as long as no music is transmitted
D. At any time as long as the material being transmitted did not originate from a commercial broadcast station

B. When transmitting code practice, information bulletins, or transmissions necessary to provide emergency communications

T1D07
What types of amateur stations can automatically retransmit the signals of other amateur stations?
A. Auxiliary, beacon, or Earth stations
B. Auxiliary, repeater, or space stations
C. Beacon, repeater, or space stations
D. Earth, repeater, or space stations

B. Auxiliary, repeater, or space stations

T1E - Control operator and control types: control operator required; eligibility; designation of control operator; privileges and duties; control point; local, automatic and remote control; location of control operator

An Amateur Station is **never** permitted to transmit without a control operator. As a licensed amateur radio operator, you are usually the control operator of your own station. However, you may appoint another licensed amateur to be the control operator of your station.

The class of operator license the control operator holds determines the transmit privileges of the station being controlled. An Extra class operator may be the control operator of a Technician class station and operate on all frequencies available to the Extra class ham. A Technician class ham may be the control operator of an Extra class station; however, the Technician class ham is limited to using only frequencies allowed to the technician class amateur.

Here is what the FCC says:

- An amateur station must have a control operator only when the station is transmitting.
- **Only persons for whom an amateur operator/primary station license grant appears in the FCC database or who is authorized for alien reciprocal operation is eligible to be the control operator of an amateur station.**
- **The station licensee** must designate the station control operator.
- **The class of operator license held by the control** operator determines the transmitting privileges of an amateur station.
- The FCC presumes the station licensee to be the control operator of an amateur station unless documentation to the contrary is in the station records.
- **The control operator and the station licensee are equally responsible** for the proper operation of an Amateur Radio Station.

T1E01
When is an amateur station permitted to transmit without a control operator?
A. When using automatic control, such as in the case of a repeater
B. When the station licensee is away and another licensed amateur is using the station
C. When the transmitting station is an auxiliary station
D. Never

D. Never

T1E02
Who may a station licensee designate to be the control operator of an amateur station?
A. Any U.S. citizen or registered alien
B. Any family member of the station licensee
C. Any person over the age of 18
D. Only a person for whom an amateur operator/primary station license grant appears in the FCC database or who is authorized for alien reciprocal operation

D. Only a person for whom an amateur operator/primary station license grant appears in the FCC database or who is authorized for alien reciprocal operation

T1E03
Who must designate the station control operator?
A. The station licensee
B. The FCC
C. The frequency coordinator
D. The ITU

A. The station licensee

T1E04
What determines the transmitting privileges of an amateur station?
A. The frequency authorized by the frequency coordinator
B. The class of operator license held by the station licensee
C. The highest class of operator license held by anyone on the premises
D. The class of operator license held by the control operator

D. The class of operator license held by the control operator

T1E07
When the control operator is not the station licensee, who is responsible for the proper operation of the station?
A. All licensed amateurs who are present at the operation
B. Only the station licensee
C. Only the control operator
D. The control operator and the station licensee are equally responsible

D. The control operator and the station licensee are equally responsible

The location at which the control operator function is performed is considered the amateur station control point. The control operator and station licensee are equally responsible for the proper operation of the station when the control operator is not the station licensee.

At no time under normal circumstances, may a Technician Class licensee be the control operator of a station operating in an exclusive Extra Class operator segment of the amateur bands.

The FCC presumes the **Station Licensee** to be the control operator of an amateur station, unless documentation to the contrary is in the station records.

Remote control is the type of control defined by the FCC when controlling a station over the internet. Remote control is used when the control operator is not at the station location, but can indirectly manipulate the operating adjustments of a station. An example of remote control as defined in Part 97 is **operating the station over the internet.**

Local control is personally being at the station and controlling it directly. An example of local control would be transmitting using a hand held radio.

Automatic control is the type of control that is permissible for the control operator to be at a location other than the control point. Automatic control is the type of control being used for **repeater operation** when the control operator is not present at a control point. APRS network digipeaters operate under **automatic** control.

T1E05
What is an amateur station control point?
A. The location of the station's transmitting antenna
B. The location of the station transmitting apparatus
C. The location at which the control operator function is performed
D. The mailing address of the station licensee

C. The location at which the control operator function is performed

T1E06
Under what type of control do APRS network digipeaters operate?
A. Automatic
B. Remote
C. Local
D. Manual

A. Automatic

T1E08
Which of the following is an example of automatic control?
A. Repeater operation
B. Controlling the station over the Internet
C. Using a computer or other device to automatically send CW
D. Using a computer or other device to automatically identify

A. Repeater operation

T1E09
What type of control is being used when the control operator is at the control point?
A. Radio control

B. Unattended control
C. Automatic control
D. Local control

D. Local control

T1E10
Which of the following is an example of remote control as defined in Part 97?
A. Repeater operation
B. Operating the station over the Internet
C. Controlling a model aircraft, boat or car by amateur radio
D. All of these choices are correct

B. Operating the station over the Internet

T1E11
Who does the FCC presume to be the control operator of an amateur station, unless documentation to the contrary is in the station records?
A. The station custodian
B. The third party participant
C. The person operating the station equipment
D. The station licensee

D. The station licensee

T1E12
When, under normal circumstances, may a Technician Class licensee be the control operator of a station operating in an exclusive Extra Class operator segment of the amateur bands?
A. At no time
B. When operating a special event station
C. As part of a multi-operator contest team
D. When using a club station whose trustee is an Extra Class operator licensee

A. At no time

T1F - Station identification; repeaters; third party communications; club stations; FCC inspection

An amateur station is required to transmit its assigned call sign **at least every 10 minutes during and at the end of a contact**. While not required, it is considered common courtesy to also identify on your first transmission so that everyone listening will know who you are.

Call sign identification can be done in several ways:

- Call sign identification is required for a station transmitting phone signals by **sending the call sign using CW or phone emission.**
- Phone emission **in the English language** is an acceptable method of station identification when operating in the phone sub-band.

It is not necessary to wait 10 minutes to identify your station. You may identify at any time during the 10 minutes and thus reset the countdown.

During public service, emergency, or training events, amateur stations may use **tactical call signs** such as "Race Headquarters", "Checkpoint one", etc. However, you still must identify your stations FCC assigned call sign **At the end of each communication and every ten minutes during a communication.** The best way to insure that you identify your FCC assigned call every 10 minutes or at the end of a contact when using tactical calls is to simply say your call after delivering you communications.

T1F01
What type of identification is being used when identifying a station on the air as Race Headquarters?
A. Tactical call sign
B. An official call sign reserved for RACES drills
C. SSID
D. Broadcast station

A. Tactical call sign

T1F02
When using tactical identifiers such as "Race Headquarters" during a community service net operation, how often must your station transmit the station's FCC-assigned call sign?
A. Never, the tactical call is sufficient
B. Once during every hour
C. At the end of each communication and every ten minutes during a communication
D. At the end of every transmission

C. At the end of each communication and every ten minutes during a communication

T1F03
When is an amateur station required to transmit its assigned call sign?
A. At the beginning of each contact, and every 10 minutes thereafter
B. At least once during each transmission
C. At least every 15 minutes during and at the end of a communication
D. At least every 10 minutes during and at the end of a communication

D. At least every 10 minutes during and at the end of a communication

T1F04
Which of the following is an acceptable language to use for station identification when operating in a phone sub-band?
A. Any language recognized by the United Nations
B. Any language recognized by the ITU
C. The English language
D. English, French, or Spanish

C. The English language

T1F05
What method of call sign identification is required for a station transmitting phone signals?
A. Send the call sign followed by the indicator RPT
B. Send the call sign using CW or phone emission
C. Send the call sign followed by the indicator R
D. Send the call sign using only phone emission

B. Send the call sign using CW or phone emission

Using-self assigned indicators when identifying is allowed by the FCC. **KL7CC stroke W3, KL7CC slant W3 and KL7CC slash W3 are acceptable uses of self-assigned indicators when identifying using a phone transmission**.

The indicators **/KT, /AE or /AG when using new license privileges earned by CSCE while waiting for an upgrade to a previously issued license to appear in the FCC license database** are required by the FCC.

T1F06
Which of the following formats of a self-assigned indicator is acceptable when identifying using a phone transmission?
A. KL7CC stroke W3
B. KL7CC slant W3
C. KL7CC slash W3
D. All of these choices are correct

D. All of these choices are correct

T1F08
Which indicator is required by the FCC to be transmitted after a station call sign?
A. /M when operating mobile
B. /R when operating a repeater
C. / followed the FCC Region number when operating out of the region in which the license was issued
D. /KT, /AE or /AG when using new license privileges earned by CSCE while waiting for an upgrade to a previously issued license to appear in the FCC license database

D. /KT, /AE or /AG when using new license privileges earned by CSCE while waiting for an upgrade to a previously issued license to appear in the FCC license database

A **Repeater station** is the type of amateur station that simultaneously retransmits the signal of another amateur station on a different channel or channels. **The control operator of the originating station** is accountable should a repeater inadvertently retransmit communications that violate the FCC rules.

T1F09
What type of amateur station simultaneously retransmits the signal of another amateur station on a different channel or channels?
A. Beacon station
B. Earth station
C. Repeater station
D. Message forwarding station

C. Repeater station

T1F10
Who is accountable should a repeater inadvertently retransmit communications that violate the FCC rules?
A. The control operator of the originating station
B. The control operator of the repeater
C. The owner of the repeater
D. Both the originating station and the repeater owner

A. The control operator of the originating station

FCC rules authorize the transmission of non-emergency third party communications to **any station whose government permits such communications**. In this case, the FCC is talking about a non-ham as being a third party. An example of third party communications would be if a ham was giving a demonstration of his station and allowed the non-ham to make comments over the air to the station being communicated with.

When is a non-licensed person allowed to speak to a foreign station using a station under the control of a Technician Class control operator? **The foreign station must be one with which the U.S. has a third party agreement.**

T1F07
Which of the following restrictions apply when a non-licensed person is allowed to speak to a foreign station using a station under the control of a Technician Class control operator?
A. The person must be a U.S. citizen
B. The foreign station must be one with which the U.S. has a third party agreement
C. The licensed control operator must do the station identification
D. All of these choices are correct

B. The foreign station must be one with which the U.S. has a third party agreement

T1F11
To which foreign stations do the FCC rules authorize the transmission of non-emergency third party communications?
A. Any station whose government permits such communications
B. Those in ITU Region 2 only
C. Those in ITU Regions 2 and 3 only
D. Those in ITU Region 3 only

A. Any station whose government permits such communications

At least 4 persons are required to be members of a club for a club station license to be issued by the FCC.

Any time upon request by an FCC representative is when the station licensee must make the station and its records available for FCC inspection.

T1F12
How many persons are required to be members of a club for a club station license to be issued by the FCC?
A. At least 5
B. At least 4
C. A trustee and 2 officers
D. At least 2

B. At least 4

T1F13
When must the station licensee make the station and its records available for FCC inspection?
A. At any time ten days after notification by the FCC of such an inspection
B. At any time upon request by an FCC representative
C. Only after failing to comply with an FCC notice of violation
D. Only when presented with a valid warrant by an FCC official or government agent

B. At any time upon request by an FCC representative

SUBELEMENT T2

Operating Procedures
3 Exam Questions - 3 Groups

T2A - Station operation: choosing an operating frequency; calling another station; test transmissions; procedural signs; use of minimum power; choosing an operating frequency; band plans; calling frequencies; repeater offsets

A repeater system uses two frequencies. One frequency for receiving the distant hand held or mobile, called the input frequency; and one frequency for retransmitting what it hears on the receive frequency, which is the output frequency. Since repeaters are duplex, meaning that it receives and transmits at the same time, the two frequencies must be separated by a certain frequency spread so that the repeater transmitter does not interfere with its own receiver. This frequency spread is called the repeater frequency offset.

The most common repeater frequency offset in the 2 meter band is **plus or minus 600 kHz**. For example, a repeater receives on 146.190 MHz and simultaneously retransmits what it receives on 146.790 MHz. 146.790 minus 146.190 equals 600 (KHz). The receive frequency is lower than the transmit frequency, so the repeater operates at a minus offset. Therefore this repeater operates with an offset of minus 600 KHz. **Plus or minus 5 MHz** is a common repeater frequency offset in the 70 cm band. The plus or minus spread is determined by what frequency the repeater receive signals on. If the receive signal is lower than the repeater transmit frequency then it is a minus offset. If the receive signal is higher than the repeater transmitter, then it is a plus offset.

T2A01
What is the most common repeater frequency offset in the 2 meter band?
A. Plus 500 kHz
B. Plus or minus 600 kHz
C. Minus 500 kHz
D. Only plus 600 kHz

B. Plus or minus 600 kHz

T2A03
What is a common repeater frequency offset in the 70 cm band?
A. Plus or minus 5 MHz
B. Plus or minus 600 kHz
C. Minus 600 kHz
D. Plus 600 kHz

A. Plus or minus 5 MHz

There are several ways in which an amateur station may engage in a contact. The fun thing about ham radio is that you often do not know who you are going to talk to next. You are always meeting new people on the "ham bands".

One way to attract stations is to call "CQ". CQ is ham lingo for **calling any station**; "I am available and looking for someone to talk to". Some hams call it "Seek You", meaning they are seeking anyone wishing to talk to them. The proper way to do this is to say CQ three times and your callsign three times. This is called a 3 x 3 CQ. Example: CQ CQ CQ, this is K8EEN K8EEN K8EEN and standing by for a call". Calling CQ is rarely used on repeaters or a simplex channel using the FM mode. It is usually reserved for our shortwave bands or on SSB on 2 meters and 6 meters. By the way, SSB (Single Side Band) is another voice mode that Technician Class hams are allowed to use. SSB is more efficient than FM.

Here is a guideline to use when choosing an operating frequency for calling CQ:

- Listen first to be sure that no one else is using the frequency
- Ask if the frequency is in use
- Make sure you are in your assigned band
- **All of these choices are correct**

When using the FM mode on 2 meters and the 70 cm band, it is common practice to make a brief

statement and then say your call sign. Try: "This is K8EEN listening" , "K8EEN monitoring", or "K8EEN listening on frequency". **You call sign** is a brief statement that is often transmitted in place of "CQ" to indicate that you are listening on a repeater. Hams listening will know you are looking for someone to talk to and perhaps give you a call.

An appropriate way to call another station on a repeater if you know the other stations call is to **say the stations callsign then identify with your call sign**. Example: "K8EEN this is W8PEN". Likewise, if you are responding to a CQ or station monitoring call, you should **transmit the other stations call sign followed by your call sign**.

T2A04
What is an appropriate way to call another station on a repeater if you know the other station's call sign?
A. Say break, break then say the station's call sign
B. Say the station's call sign then identify with your call sign
C. Say CQ three times then the other station's call sign
D. Wait for the station to call CQ then answer it

B. Say the station's call sign then identify with your call sign

T2A05
How should you respond to a station calling CQ?
A. Transmit CQ followed by the other station's call sign
B. Transmit your call sign followed by the other station's call sign
C. Transmit the other station's call sign followed by your call sign
D. Transmit a signal report followed by your call sign

C. Transmit the other station's call sign followed by your call sign

T2A08
What is the meaning of the procedural signal "CQ"?
A. Call on the quarter hour
B. A new antenna is being tested (no station should answer)
C. Only the called station should transmit
D. Calling any station

D. Calling any station

T2A12
Which of the following is a guideline to use when choosing an operating frequency for calling CQ?
A. Listen first to be sure that no one else is using the frequency
B. Ask if the frequency is in use
C. Make sure you are in your assigned band
D. All of these choices are correct

D. All of these choices are correct

T2A09
What brief statement is often transmitted in place of "CQ" to indicate that you are listening on a repeater?
A. The words "Hello test" followed by your call sign
B. Your call sign
C. The repeater call sign followed by your call sign
D. The letters "QSY" followed by your call sign

B. Your call sign

A band plan, beyond the privileges established by the FCC, is **a voluntary guideline for using different modes or activities within an amateur band**. According to the band plan for 70 cm, **446.000 MHz** is the national calling frequency for FM simplex operation.

There are times when one needs to test his transmitter or antenna and not really need to talk to another station. When making on-air transmissions to test equipment or antennas an amateur operator must **properly identify the transmitting station**. When making a test transmission a **station identification is required at least every ten minutes during the test and at the end of the last transmission**. The same procedure as if you were in a contact with another ham.

FCC rules regarding power levels used in the amateur bands state that **while not exceeding the maximum power permitted on a given band, use the minimum power necessary to carry out the desired communication**

T2A02
What is the national calling frequency for FM simplex operations in the 70 cm band?
A. 146.520 MHz
B. 145.000 MHz
C. 432.100 MHz
D. 446.000 MHz

D. 446.000 MHz

T2A06
What must an amateur operator do when making on-air transmissions to test equipment or antennas?
A. Properly identify the transmitting station
B. Make test transmissions only after 10:00 p.m. local time
C. Notify the FCC of the test transmission
D. State the purpose of the test during the test procedure

A. Properly identify the transmitting station

T2A07
Which of the following is true when making a test transmission?
A. Station identification is not required if the transmission is less than 15 seconds
B. Station identification is not required if the transmission is less than 1 watt
C. Station identification is only required once an hour when the transmissions are for test purposes only
D. Station identification is required at least every ten minutes during the test and at the end of the test

D. Station identification is required at least every ten minutes during the test and at the end of the test

T2A10
What is a band plan, beyond the privileges established by the FCC?
A. A voluntary guideline for using different modes or activities within an amateur band
B. A mandated list of operating schedules
C. A list of scheduled net frequencies
D. A plan devised by a club to indicate frequency band usage

A. A voluntary guideline for using different modes or activities within an amateur band

T2A11
Which of the following is an FCC rule regarding power levels used in the amateur bands, under normal, non-distress circumstances?
A. There is no limit to power as long as there is no interference with other services
B. No more than 200 watts PEP may be used
C. Up to 1500 watts PEP may be used on any amateur frequency without restriction
D. While not exceeding the maximum power permitted on a given band, use the minimum power necessary to carry out the desired communication

D. While not exceeding the maximum power permitted on a given band, use the minimum power necessary to carry out the desired communication

T2B – VHF/UHF operating practices: SSB phone; FM repeater; simplex; splits and shifts; CTCSS; DTMF; tone squelch; carrier squelch; phonetics; operational problem resolution; Q signals

As a new Technician Class ham, you likely will be using the most popular voice mode and ham band. FM voice mode has been mentioned many times because it is the most popular mode of communications today. You will also have plenty of people to talk to because the 2 meter ham band is the most popular ham band in the United States. As a new ham, you will probably start on 2 meter FM. It is recommended that you start out with what is called a dual band radio. While a bit more expensive than a single band radio, the 70 cm band is becoming very popular due to the fact that 2 meters is pretty well packed.

There are several things that one needs to know to be successful in operating the FM mode on either 2

meters or 70 cm.

Simplex communication is the term used to describe an amateur station that is transmitting and receiving on the same frequency. Not through a repeater.

Carrier squelch describes the muting of receiver audio controlled solely by the presence or absence of an RF signal. **CTCSS** is a term used to describe the use of a sub audible tone transmitted with normal voice audio to open the squelch of a receiver.

Most repeater systems use a CTCSS decoder to tell it when a signal is on its receive frequency to avoid repeated key ups from distant stations using another repeater on the same frequency. Most repeater systems also transmit a CTCSS tone so that the CTCSS decoder in a ham transceiver can be set to listen to the local system while keeping the distant repeater systems from making too much noise.

Common problems that that causes you to be able to hear but not access a repeater even when transmitting with the proper offset:

- The repeater receiver requires audio tone burst for access.
- The repeater receiver requires a CTCSS tone for access.
- The repeater receiver requires a DCS tone sequence for access.
- **All of these choices are correct**

Tone burst and DCS tone have the same purpose as CTCSS, but are not as popular.

T2B01
What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?
A. Full duplex communication
B. Diplex communication
C. Simplex communication
D. Multiplex communication

C. Simplex communication

T2B02
What is the term used to describe the use of a sub-audible tone transmitted with normal voice audio to open the squelch of a receiver?
A. Carrier squelch
B. Tone burst
C. DTMF
D. CTCSS

D. CTCSS

T2B03
Which of the following describes the muting of receiver audio controlled solely by the presence or absence of an RF signal?
A. Tone squelch
B. Carrier squelch
C. CTCSS
D. Modulated carrier

B. Carrier squelch

T2B04
Which of the following common problems might cause you to be able to hear but not access a repeater even when transmitting with the proper offset?
A. The repeater receiver may require an audio tone burst for access
B. The repeater receiver may require a CTCSS tone for access
C. The repeater receiver may require a DCS tone sequence for access
D. All of these choices are correct

D. All of these choices are correct

What makes an FM voice signal loud? Weak? Of good quality? Most adjustments that effect these three items evolve around the microphone gain control. Most FM radios allow one to adjust the microphone gain control. If your FM signal interferes with stations on nearby frequencies, the **microphone gain may be too high, causing over-deviation**

The amplitude of the modulating signal determines the amount of deviation of an FM signal. When the deviation of an FM signal is increased **its signal occupies more bandwidth**. The amplitude of the modulating signal is adjusted to 5 KHz via the microphone gain control. Turning the gain up too high can cause the transmitted signal to sound really bad.

If you receive a report that your station's transmissions are causing interference on nearby frequencies check your for off-frequency operation or spurious emissions. Obviously, you need to be on the correct frequency to be successful. The spurious emissions are a result of setting your microphone gain too high.

When two stations on the same frequency interfere with each other, **common courtesy should prevail, but no one has absolute right to an amateur frequency**.

T2B05
What determines the amount of deviation of an FM (as opposed to PM) signal?
A. Both the frequency and amplitude of the modulating signal
B. The frequency of the modulating signal
C. The amplitude of the modulating signal
D. The relative phase of the modulating signal and the carrier

C. The amplitude of the modulating signal

T2B06
What happens when the deviation of an FM transmitter is increased?
A. Its signal occupies more bandwidth
B. Its output power increases
C. Its output power and bandwidth increases
D. Asymmetric modulation occurs

A. Its signal occupies more bandwidth

T2B07
What could cause your FM signal to interfere with stations on nearby frequencies?
A. Microphone gain too high, causing over-deviation
B. SWR too high
C. Incorrect CTCSS Tone
D. All of these choices are correct

A. Microphone gain too high, causing over-deviation

T2B08
Which of the following applies when two stations transmitting on the same frequency interfere with each other?
A. Common courtesy should prevail, but no one has absolute right to an amateur frequency
B. Whoever has the strongest signal has priority on the frequency
C. Whoever has been on the frequency the longest has priority on the frequency
D. The station which has the weakest signal has priority on the frequency

A. Common courtesy should prevail, but no one has absolute right to an amateur frequency

Hams use Q Signals to abbreviate things they want to say. One Q signal that you will need to know for the exam is QRM. **QRM** is the Q signal used to indicate that you are receiving interference from other stations. This would be the case if you were having trouble hearing a station because another station is very close to your frequency. You might say "Copy is not very good. There is a lot of QRM on Frequency". Or you may be causing QRM to another station. The proper course of action to take if your station's transmission unintentionally interferes with another station is to properly identify your transmission and move to a different frequency.

Another Q Signal you will need to know is QSY. **QSY** is the Q signal used to indicate that you are changing frequency.

The list of Q signals is too large to be presented in this course. Do an internet search, or check out other books on ham radio for a list of Q signals. QRM and QSY are the only ones on the exam. You will learn the other popular ones as you get more experience.

The **use of a phonetic alphabet** is the method encouraged by the FCC when identifying your station using phone (voice) modes. Example: "This is Whiskey 8 Papa Echo November, W8PEN".

Here is the phonetic alphabet use in ham radio:

A - Alfa	**B - Bravo**	**C - Charlie**	**D - Delta**	**E - Echo**	**F- Foxtrot**
G - Golf	**H - Hotel**	**I - India**	**J - Juliet**	**K - Kilo**	**L - Lima**
M - Mike	**N - November**	**O - Oscar**	**P - Papa**	**Q - Quebec**	**R - Romeo**
S - Sierra	**T - Tango**	**U - Uniform**	**V - Victor**	**W - Whiskey**	**X - X-Ray**
Y - Yankee	**Z - Zulu**				

T2B09
Which of the following methods is encouraged by the FCC when identifying your station when using phone?
A. Use of a phonetic alphabet
B. Send your call sign in CW as well as voice
C. Repeat your call sign three times
D. Increase your signal to full power when identifying

A. Use of a phonetic alphabet

T2B10
Which Q signal indicates that you are receiving interference from other stations?
A. QRM
B. QRN
C. QTH
D. QSB

A. QRM

T2B11
Which Q signal indicates that you are changing frequency?
A. QRU
B. QSY
C. QSL
D. QRZ

B. QSY

Repeaters are nice ways to keep in touch with the locals. In small towns, the repeater may be used as a "Ham Community" where everyone gets to know each other. However, repeaters can be busy. **When the stations can communicate directly without using a repeater**, they should consider communicating via simplex rather than a repeater.

When using SSB phone in the amateur bands above 50 MHz, **it (SSB) is permitted in at least some portion of all the amateur bands above 50 MHz**.

T2B12
Under what circumstances should you consider communicating via simplex rather than a repeater?
A. When the stations can communicate directly without using a repeater
B. Only when you have an endorsement for simplex operation on your license
C. Only when third party traffic is not being passed
D. Only if you have simplex modulation capability

A. When the stations can communicate directly without using a repeater

T2B13
Which of the following is true of the use of SSB phone in amateur bands above 50 MHz?
A. It is permitted only by holders of a General Class or higher license

B. It is permitted only on repeaters
C. It is permitted in at least some portion of all the amateur bands above 50 MHz
D. It is permitted only on when power is limited to no more than 100 watts

C. It is permitted in at least some portion of all the amateur bands above 50 MHz

T2C – Public service: emergency and non-emergency operations; applicability of FCC rules; RACES and ARES; net and traffic procedures; emergency restrictions

Amateur Radio is a service. The FCC expects that in times of need, amateur radio will be there to assist. This generally means emergency situations, natural disasters, or simply providing communications for a public event. Not all hams are interested in this phase of our hobby, but it can be a very rewarding endeavor.

The FCC rules always apply to proper operation of your station when using amateur radio at the request of public service officials.

The Radio Amateur Civil Emergency Service (RACES) is a radio service using amateur stations for emergency management and civil defense communications. The Amateur Radio Emergency Service (ARES) are **licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service**. **Both organizations may provide communications during emergencies**.

For the test, the following describes the Radio Amateur Civil Emergency Service (RACES):

- A radio service using amateur frequencies for emergency management or civil defense communications
- A radio service using amateur stations for emergency management or civil defense communications
- An emergency service using amateur operators certified by a civil defense organization as being enrolled in that organization
- **All of these choices are correct**

T2C01
When do the FCC rules NOT apply to the operation of an amateur station?
A. When operating a RACES station
B. When operating under special FEMA rules
C. When operating under special ARES rules
D. Never, FCC rules always apply

D. Never, FCC rules always apply

T2C04
What do RACES and ARES have in common?
A. They represent the two largest ham clubs in the United States
B. Both organizations broadcast road and weather information
C. Neither may handle emergency traffic supporting public service agencies
D. Both organizations may provide communications during emergencies

D. Both organizations may provide communications during emergencies

T2C05
Which of the following describes the Radio Amateur Civil Emergency Service (RACES)?
A. A radio service using amateur frequencies for emergency management or civil defense communications
B. A radio service using amateur stations for emergency management or civil defense communications
C. An emergency service using amateur operators certified by a civil defense organization as being enrolled in that organization
D. All of these choices are correct

D. All of these choices are correct

T2C12
What is the Amateur Radio Emergency Service (ARES)?
A. Licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service
B. Licensed amateurs who are members of the military and who voluntarily agreed to provide message handling services in the case of an emergency
C. A training program that provides licensing courses for those interested in obtaining an amateur license to use during emergencies
D. A training program that certifies amateur operators for membership in the Radio Amateur Civil Emergency Service

A. Licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service

During an emergency, hams may not have commercial power available to them and may be on battery power for extended periods of time. One way to recharge the battery is to **connect the battery in parallel with a vehicle's battery and run the engine**.

Amateur station control operators are permitted to operate outside the frequency privileges of their license class **only if necessary in situations involving the immediate safety of human life or protection of property**.

During an emergency, a communications net will be formed. There will be one station in control of the net. This is the Net Control Station and all other stations follow the directions of the Net Control Station. Stations check into the emergency net as they become available and ready to participate. Stations should **remain on frequency without transmitting until asked to do so by the net control station**.

Common practice during net operations to get the immediate attention of the net control station when reporting an emergency is to **begin your transmission with "Priority" or "Emergency" followed by your call sign**. This is to be used only when you have a true priority or emergency communication to relay.

Passing messages exactly as received is a characteristic of good emergency traffic handling. In a formal traffic message **the information needed to track the message as it passes through the amateur radio traffic handling system** is called the preamble**. The term "check" in reference to a formal traffic message is a count of the number of words in the message**.

To insure that voice message traffic containing proper names and unusual words are copied correctly by the receiving station **such words and terms should be spelled out using a standard phonetic alphabet.**

There are many things that must be learned before one relays formal net messages. The best way to learn these procedures is to join a RACES or ARES organization in your local area. It is a serious, yet fun ham radio activity.

T2C02
What is one way to recharge a 12-volt lead-acid station battery if the commercial power is out?
A. Cool the battery in ice for several hours
B. Add acid to the battery
C. Connect the battery in parallel with a vehicle's battery and run the engine
D. All of these choices are correct

C. Connect the battery in parallel with a vehicle's battery and run the engine

T2C03
What should be done to insure that voice message traffic containing proper names and unusual words are copied correctly by the receiving station?
A. The entire message should be repeated at least four times
B. Such messages must be limited to no more than 10 words
C. Such words and terms should be spelled out using a standard phonetic alphabet
D. All of these choices are correct

C. Such words and terms should be spelled out using a standard phonetic alphabet

T2C06
Which of the following is an accepted practice to get the immediate attention of a net control station when reporting an emergency?
A. Repeat the words SOS three times followed by the call sign of the reporting station
B. Press the push-to-talk button three times
C. Begin your transmission by saying "Priority" or "Emergency" followed by your call sign
D. Play a pre-recorded emergency alert tone followed by your call sign

C. Begin your transmission by saying "Priority" or "Emergency" followed by your call sign

T2C07
Which of the following is an accepted practice for an amateur operator who has checked into an emergency traffic net?
A. Provided that the frequency is quiet, announce the station call sign and location every 5 minutes
B. Move 5 kHz away from the net's frequency and use high power to ask other hams to keep clear of the net frequency
C. Remain on frequency without transmitting until asked to do so by the net control station
D. All of the choices are correct

C. Remain on frequency without transmitting until asked to do so by the net control station

T2C08
Which of the following is a characteristic of good emergency traffic handling?
A. Passing messages exactly as received
B. Making decisions as to whether or not messages should be relayed or delivered
C. Communicating messages to the news media for broadcast outside the disaster area
D. All of these choices are correct

A. Passing messages exactly as received

T2C09
Are amateur station control operators ever permitted to operate outside the frequency privileges of their license class?
A. No
B. Yes, but only when part of a FEMA emergency plan
C. Yes, but only when part of a RACES emergency plan
D. Yes, but only if necessary in situations involving the immediate safety of human life or protection of property

D. Yes, but only if necessary in situations involving the immediate safety of human life or protection of property

T2C10
What is the preamble in a formal traffic message?
A. The first paragraph of the message text
B. The message number
C. The priority handling indicator for the message
D. The information needed to track the message as it passes through the amateur radio traffic handling system

D. The information needed to track the message as it passes through the amateur radio traffic handling system

T2C11
What is meant by the term “check” in reference to a formal traffic message?
A. The check is a count of the number of words or word equivalents in the text portion of the message
B. The check is the value of a money order attached to the message
C. The check is a list of stations that have relayed the message
D. The check is a box on the message form that tells you the message was received

A. The check is a count of the number of words or word equivalents in the text portion of the message

SUBELEMENT T3

Radio wave characteristics: properties of radio waves; propagation modes
3 Exam Questions - 3 Groups

T3A - Radio wave characteristics: how a radio signal travels; fading; multipath; wavelength vs. penetration; antenna orientation

Electromagnetic waves carry radio signals between transmitting and receiving stations. VHF frequencies are "line of site", but tend to bounce around between obstructions such as buildings and antenna towers.

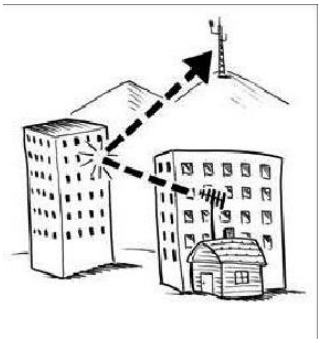
Should another operator report that your stations 2 meter signals were strong just a moment ago, but now they are weak or distorted, **try moving a few feet, as random reflections may be causing multi-path distortion**.

T3A01
What should you do if another operator reports that your station's 2 meter signals were strong just a moment ago, but now they are weak or distorted?
A. Change the batteries in your radio to a different type
B. Turn on the CTCSS tone
C. Ask the other operator to adjust his squelch control
D. Try moving a few feet or changing the direction of your antenna if possible, as reflections may be causing multi-path distortion

D. Try moving a few feet or changing the direction of your antenna if possible, as reflections may be causing multi-path distortion

T3A07
What type of wave carries radio signals between transmitting and receiving stations?
A. Electromagnetic
B. Electrostatic
C. Surface acoustic
D. Magnetostrictive

A. Electromagnetic



When using a directional antenna, your station might be able to access a distant repeater if buildings or other obstructions are blocking the direct line of sight path. Do so by **trying to find a path that reflects signals to the repeater**. The idea is to find a structure that will reflect you signal towards the distant repeater instead of in some other direction.

Picket fencing is the term commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting. Again, reflections are the culprit.

Many hams take their hand held radios to work with them so they can listen in on activity during the day. Do this at your own risk. Not all companies approve. Or you may take your radio to the shopping mall. You should be aware that UHF signals are often more effective from inside buildings than VHF signals as the **shorter wavelength allows them to more easily penetrate the structure of buildings**.

T3A05
When using a directional antenna, how might your station be able to access a distant repeater if buildings or obstructions are blocking the direct line of sight path?
A. Change from vertical to horizontal polarization
B. Try to find a path that reflects signals to the repeater
C. Try the long path
D. Increase the antenna SWR

B. Try to find a path that reflects signals to the repeater

T3A06
What term is commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting?
A. Flip-flopping
B. Picket fencing
C. Frequency shifting
D. Pulsing

B. Picket fencing

T3A02
Why are UHF signals often more effective from inside buildings than VHF signals?
A. VHF signals lose power faster over distance
B. The shorter wavelength allows them to more easily penetrate the structure of buildings
C. This is incorrect; VHF works better than UHF inside buildings
D. UHF antennas are more efficient than VHF antennas

B. The shorter wavelength allows them to more easily penetrate the structure of buildings

Signals could be significantly weaker if the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization. In ham radio, when we talk about polarization, we usually mean whether the antenna is vertical in relationship to the ground or horizontal in relationship to the ground. Since Mobile operation is common on the 2 meter and 70 cm bands, all repeaters, base stations, and mobiles use vertically polarized antennas. **Horizontal** antenna polarization is normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands.

T3A03
What antenna polarization is normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands?
A. Right-hand circular
B. Left-hand circular
C. Horizontal
D. Vertical

C. Horizontal

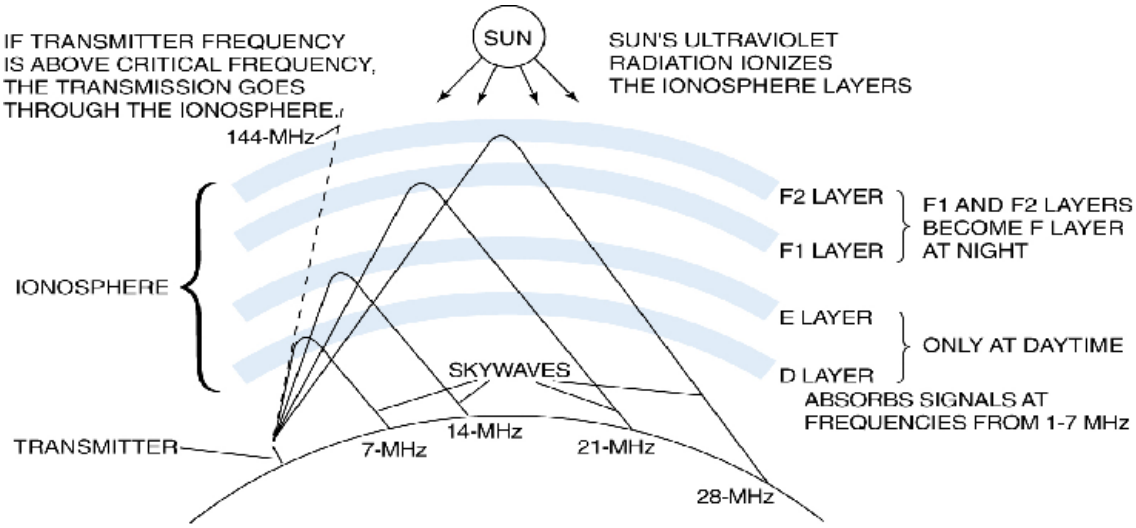
T3A04
What can happen if the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization?
A. The modulation sidebands might become inverted
B. Signals could be significantly weaker
C. Signals have an echo effect on voices
D. Nothing significant will happen

B. Signals could be significantly weaker

The ionosphere is the part of the atmosphere that enables the propagation of radio signals around the world. Under certain conditions signals bounce off the ionosphere. This reflection is often called "skip".

The cause of irregular fading of signals from distant stations during times of generally good reception is due to **random combining of signals arriving via different paths**.

Due to this irregular fading, **error rates are likely to increase** on VHF or UHF data signals propagated over multiple paths. Skip signals refracted from the ionosphere are elliptically polarized and **either vertically or horizontally polarized antennas may be used for transmission or reception**.



During skip conditions, two stations having the same antenna polarization becomes less important because the resultant signals can be either vertical, horizontal, or mixture of both.

T3A08
Which of the following is a likely cause of irregular fading of signals received by ionospheric reflection?
A. Frequency shift due to Faraday rotation
B. Interference from thunderstorms
C. Random combining of signals arriving via different paths
D. Intermodulation distortion

C. Random combining of signals arriving via different paths

T3A09
Which of the following results from the fact that skip signals refracted from the ionosphere are elliptically polarized?
A. Digital modes are unusable
B. Either vertically or horizontally polarized antennas may be used for transmission or reception
C. FM voice is unusable
D. Both the transmitting and receiving antennas must be of the same polarization

B. Either vertically or horizontally polarized antennas may be used for transmission or reception

T3A10
What may occur if data signals propagate over multiple paths?
A. Transmission rates can be increased by a factor equal to the number of separate paths observed
B. Transmission rates must be decreased by a factor equal to the number of separate paths observed
C. No significant changes will occur if the signals are transmitting using FM
D. Error rates are likely to increase

D. Error rates are likely to increase

T3A11
Which part of the atmosphere enables the propagation of radio signals around the world?
A. The stratosphere
B. The troposphere
C. The ionosphere
D. The magnetosphere

C. The ionosphere

T3B - Radio and electromagnetic wave properties: the electromagnetic spectrum; wavelength vs. frequency; velocity of electromagnetic waves; calculating wavelength

The two components of a radio wave are the **electric and magnetic fields**. **The orientation of the electric field** determines the radio waves polarization.

Radio waves travel through free space **at the speed of light**. Another way to say it is the approximate velocity of a radio wave as it travels through free space is **300,000,000 meters per second**. That is so fast that it is almost instantaneously received at any point in the world from the time it is transmitted. Even when bouncing a signal off the moon, which amazingly, is common practice on the ham bands, the radio wave is back to earth in about 3 seconds!

The name for the distance a radio wave travels during one complete cycle is **wavelength**.

The term that describes the number of times per second that an alternating current reverses direction is frequency. Take our 146.520 MHz simplex frequency. It completes 146,520,000 cycles per second. That is the frequency in Hertz. We shorten it to 146.520 Megahertz just to make it easier to say and remember. The wavelength of a radio wave relates to its frequency inversely, **as the wavelength gets shorter the frequency increases**. As you get more experience in the ham radio world, you will take this for granted.

On the shortwave bands, 40 meters is 7.1 MHz and 20 meters is 14.1 MHz. As the frequency goes up, the wavelength in meters goes down. Another thing you will need to know for the exam is that **Electric and magnetic fields** are the two components of a radio wave.

T3B01
What is the name for the distance a radio wave travels during one complete cycle?
A. Wave speed
B. Waveform
C. Wavelength
D. Wave spread

C. Wavelength

T3B04
How fast does a radio wave travel through free space?
A. At the speed of light
B. At the speed of sound
C. Its speed is inversely proportional to its wavelength
D. Its speed increases as the frequency increases

A. At the speed of light

T3B05
How does the wavelength of a radio wave relate to its frequency?
A. The wavelength gets longer as the frequency increases
B. The wavelength gets shorter as the frequency increases
C. There is no relationship between wavelength and frequency
D. The wavelength depends on the bandwidth of the signal

B. The wavelength gets shorter as the frequency increases

T3B02
What property of a radio wave is used to describe its polarization?
A. The orientation of the electric field
B. The orientation of the magnetic field
C. The ratio of the energy in the magnetic field to the energy in the electric field
D. The ratio of the velocity to the wavelength

A. The orientation of the electric field

T3B03
What are the two components of a radio wave?
A. AC and DC
B. Voltage and current
C. Electric and magnetic fields
D. Ionizing and non-ionizing radiation

C. Electric and magnetic fields

T3B11
What is the approximate velocity of a radio wave as it travels through free space?
A. 3000 kilometers per second
B. 300,000,000 meters per second
C. 300,000 miles per hour
D. 186,000 miles per hour

B. 300,000,000 meters per second

The formula for converting frequency to **wavelength in meters is the wavelength in meters equals 300 divided by frequency in megahertz**. Don't want to memorize the frequency and band relationships mentioned in T1? Then just remember this formula. What band is 146.520 MHz located in? 300 / 146.520 = 2.047 meters. Hey! That is the 2 meter ham band! What about 52.525 MHz? 300 / 52.525 = 5.712 meters. Close enough to 6 meters to know that 6 meters would be the correct answer on the test. The property of radio waves often used to identify the different frequency bands is the **approximate wavelength**. Just like the IRS, we like to round off our numbers so 2.047 is rounded down to 2 meters and 5.712 is rounded up to 6 meters.

T3B06
What is the formula for converting frequency to approximate wavelength in meters?
A. Wavelength in meters equals frequency in hertz multiplied by 300
B. Wavelength in meters equals frequency in hertz divided by 300
C. Wavelength in meters equals frequency in megahertz divided by 300
D. Wavelength in meters equals 300 divided by frequency in megahertz

D. Wavelength in meters equals 300 divided by frequency in megahertz

You will need to know the frequency limits of the radio spectrum used in ham radio. It is really simple and you need know only three of them.

- The frequency range referred to as HF is **3 MHz to 30 MHz.**
- The frequency limits of the VHF spectrum are **30 MHz to 300 MHz**.
- The frequency limits of the UHF spectrum are **300 MHz to 3000 MHz**.

T3B08
What are the frequency limits of the VHF spectrum?
A. 30 to 300 kHz
B. 30 to 300 MHz
C. 300 to 3000 kHz
D. 300 to 3000 MHz

B. 30 to 300 MHz

T3B09
What are the frequency limits of the UHF spectrum?
A. 30 to 300 kHz
B. 30 to 300 MHz
C. 300 to 3000 kHz
D. 300 to 3000 MHz

D. 300 to 3000 MHz

T3B10
What frequency range is referred to as HF?
A. 300 to 3000 MHz
B. 30 to 300 MHz
C. 3 to 30 MHz
D. 300 to 3000 kHz

C. 3 to 30 MHz

T3B07
What property of radio waves is often used to identify the different frequency bands?
A. The approximate wavelength

B. The magnetic intensity of waves
C. The time it takes for waves to travel one mile
D. The voltage standing wave ratio of waves

A. The approximate wavelength

T3C - Propagation modes: line of sight; sporadic E; meteor and auroral scatter and reflections; tropospheric ducting; F layer skip; radio horizon

UHF signals "direct" (not via a repeater) are rarely heard from stations outside your local coverage area because **UHF signals are usually not reflected by the ionosphere**. UHF signals are mostly line of sight. That being if there is no obstructions between the path of two stations, they should be able to communicate with each other.

VHF signals, while mostly line of sight, are occasionally reflected by the ionosphere. When VHF signals are being received from long distances these **signals are being refracted from a sporadic E layer**. Sporadic E propagation is most commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2 meter bands.

From dawn to shortly after sunset during periods of high sunspot activity is generally the best time for long-distance 10 meter band propagation via the F layer.

T3C01
Why are direct (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?
A. They are too weak to go very far
B. FCC regulations prohibit them from going more than 50 miles
C. UHF signals are usually not reflected by the ionosphere
D. They collide with trees and shrubbery and fade out

C. UHF signals are usually not reflected by the ionosphere

T3C02
Which of the following might be happening when VHF signals are being received from long distances?
A. Signals are being reflected from outer space
B. Signals are arriving by sub-surface ducting
C. Signals are being reflected by lightning storms in your area
D. Signals are being refracted from a sporadic E layer

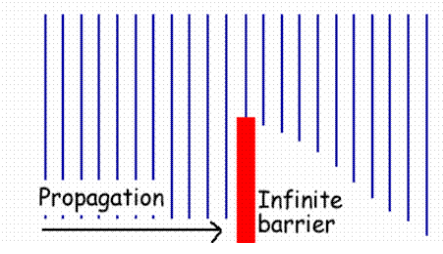
D. Signals are being refracted from a sporadic E layer

T3C09
What is generally the best time for long-distance 10 meter band propagation via the F layer?
A. From dawn to shortly after sunset during periods of high sunspot activity
B. From shortly after sunset to dawn during periods of high sunspot activity
C. From dawn to shortly after sunset during periods of low sunspot activity
D. From shortly after sunset to dawn during periods of low sunspot activity

A. From dawn to shortly after sunset during periods of high sunspot activity

A characteristic of VHF signals received via auroral reflection is that **the signals exhibit rapid fluctuations of strength and often sound distorted**. Heard of the Northern Lights? This is nothing more than an atmospheric condition caused by the sun. It is also called an aurora. Hams can reflect VHF signals off of an aurora to increase communications distance, however there is a lot of distortion to the reflected signal. In an odd ham sense, that makes it fun to talk to stations using aurora reflections.

Sporadic E is most commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2 meter bands. **Tropospheric scatter** is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis.



If you are looking to work DX, then **Six or ten meters** may provide long distance communications during the peak of the sunspot cycle. These are two really fun bands!

Knife-Edge diffraction refers to signals that are partially refracted around solid objects exhibiting sharp edges. See picture.

T3C03
What is a characteristic of VHF signals received via auroral reflection?
A. Signals from distances of 10,000 or more miles are common
B. The signals exhibit rapid fluctuations of strength and often sound distorted
C. These types of signals occur only during winter nighttime hours
D. These types of signals are generally strongest when your antenna is aimed west

B. The signals exhibit rapid fluctuations of strength and often sound distorted

T3C04
Which of the following propagation types is most commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2 meter bands?
A. Backscatter
B. Sporadic E
C. D layer absorption
D. Gray-line propagation

B. Sporadic E

T3C05
Which of the following effects might cause radio signals to be heard despite obstructions between the transmitting and receiving stations?
A. Knife-edge diffraction
B. Faraday rotation
C. Quantum tunneling
D. Doppler shift

A. Knife-edge diffraction

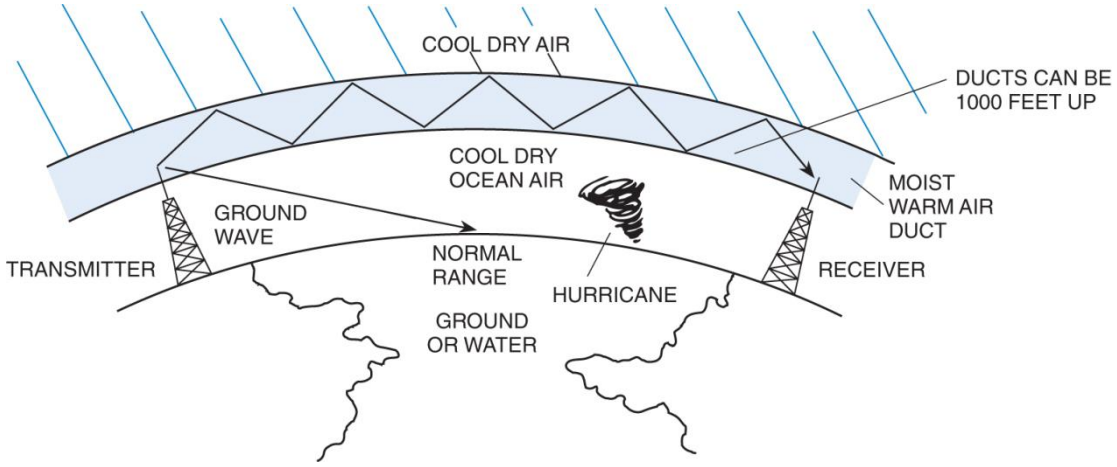
T3C06
What mode is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis?
A. Tropospheric scatter
B. D layer refraction
C. F2 layer refraction
D. Faraday rotation

A. Tropospheric scatter

T3C12
Which of the following bands may provide long distance communications during the peak of the sunspot cycle?
A. Six or ten meters
B. 23 centimeters
C. 70 centimeters or 1.25 meters
D. All of these choices are correct

A. Six or ten meters

A really fun way to communicate is by using meteor scatter. Yes, hams not only bounce signals off the moon, but they also bounce signals off of meteor tails. This is really fun, and action can be had almost anytime. Most meteor scatter takes place during the many meteor showers throughout the year, however. The **6 meter band** is best suited to communicating via meteor scatter. 2 meters is also used, but meteor scatter gets more difficult as one goes up in frequency.



A way to extend range on the 2 meter band is by using tropospheric ducting. **Temperature inversions in the atmosphere** causes "tropospheric ducting".

T3C07
What band is best suited for communicating via meteor scatter?
A. 10 meters
B. 6 meters
C. 2 meters
D. 70 cm

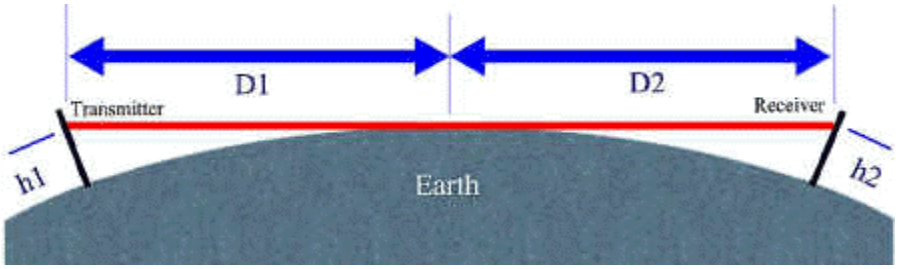
B. 6 meters

T3C08
What causes tropospheric ducting?
A. Discharges of lightning during electrical storms
B. Sunspots and solar flares
C. Updrafts from hurricanes and tornadoes
D. Temperature inversions in the atmosphere

D. Temperature inversions in the atmosphere

There are just a few more things you need to know about how radio waves travel.

The distance over which two stations can communicate by direct path is the radio horizon. VHF and UHF signals are generally line of sight. So, obviously, the signals will go right out into space instead of curving around the planet.



There is an exception to this fact though: VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations because **the Earth seems less curved to radio waves**

than to light. So, yes, VHF and UHF signals do go right out into space. It just takes them a bit longer than it does light.

T3C10
What is the radio horizon?
A. The distance over which two stations can communicate by direct path
B. The distance from the ground to a horizontally mounted antenna
C. The farthest point you can see when standing at the base of your antenna tower
D. The shortest distance between two points on the Earth's surface

A. The distance over which two stations can communicate by direct path

T3C11
Why do VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations?
A. Radio signals move somewhat faster than the speed of light
B. Radio waves are not blocked by dust particles
C. The Earth seems less curved to radio waves than to light
D. Radio waves are blocked by dust particles

C. The Earth seems less curved to radio waves than to light

SUBELEMENT T4

Amateur radio practices and station set up
2 Exam Questions - 2 Groups

T4A – Station setup: connecting microphones; reducing unwanted emissions; power source; connecting a computer; RF grounding; connecting digital equipment; connecting an SWR meter

Just as in consumer electronics, every ham radio manufacturer does things differently. Concerning the microphone connectors on amateur transceivers, **some connectors include push-to-talk and voltages for powering the microphone**. This is to accommodate some microphones that actually have electronic circuitry built in. The electronics require some sort of voltage source.

T4A01
Which of the following is true concerning the microphone connectors on amateur transceivers?
A. All transceivers use the same microphone connector type
B. Some connectors include push-to-talk and voltages for powering the microphone
C. All transceivers using the same connector type are wired identically
D. Un-keyed connectors allow any microphone to be connected

B. Some connectors include push-to-talk and voltages for powering the microphone

Ham radio equipment is very sensitive. Using a 12 volt battery usually provides a very stable power source. However, it is more convenient for ham equipment at home to be powered by a power supply. A power supply converts 117 AC Voltage from the common household electrical box to 12 volts DC commonly used by ham radio transceivers. The power supply cannot be just any design though. **Preventing voltage fluctuations from reaching sensitive circuits** is a good reason to use a regulated power supply for communications equipment. When looking for a power supply to run your "rig" from home, look for a regulated power supply of the proper voltage and enough amperage to run your equipment.

Speaking of power supplies, all equipment including power supplies, radios, and accessories need to be grounded. A **Flat strap** conductor is best to use for RF grounding. This flat strap should run to your closest grounding point.

T4A03
Which is a good reason to use a regulated power supply for communications equipment?
A. It prevents voltage fluctuations from reaching sensitive circuits
B. A regulated power supply has FCC approval
C. A fuse or circuit breaker regulates the power
D. Power consumption is independent of load

A. It prevents voltage fluctuations from reaching sensitive circuits

T4A08
Which type of conductor is best to use for RF grounding?
A. Round stranded wire
B. Round copper-clad steel wire
C. Twisted-pair cable
D. Flat strap

D. Flat strap

At one time or another, hams need to deal with interference issues. Most of these issues are easy to resolve. Help is as close a the nearest radio club.

Ham Radio transmitters are designed to operate on one selected frequency at a time. Sometimes due to poor engineering design, poor grounding, or just an improper station set up, a transmitter may transmit on one of its harmonic frequencies. A harmonic frequency is simply an even multiple of the designed transmit frequency. For example, the second harmonic of 7.100 MHZ is 2 X 7.100 = 14.200 Mhz. Many hams install a filter **between the transmitter and antenna** to reduce harmonic emissions.

In dealing with TV interference, A band-reject filter should be connected to a TV receiver as the first step in

trying to prevent RF overload from a nearby 2 meter transmit

Hum in the Speaker or distorted transmit audio caused by RF flowing on the shield of a microphone are the result of not keeping RF out of your station cables. You could use a **ferrite choke** to reduce RF current flowing on the shield of an audio cable.

T4A04
Where must a filter be installed to reduce harmonic emissions from your station?
A. Between the transmitter and the antenna
B. Between the receiver and the transmitter
C. At the station power supply
D. At the microphone

A. Between the transmitter and the antenna

T4A09
Which of the following could you use to cure distorted audio caused by RF current flowing on the shield of a microphone cable?
A. Band-pass filter
B. Low-pass filter
C. Preamplifier
D. Ferrite choke

D. Ferrite choke

When installing a mobile radio, precautions must be taken to provide a good sounding setup. A mobile radio power negative connection should be made **at the battery or engine block ground strap**. The positive connection should be made at the battery and not through an accessory socket. Not doing so can cause what is called alternator whine. **The alternator** is the source of a high-pitched whine that varies with engine speed in a mobile transceiver audio. Two fuses, one for the negative side and one for the positive side of the voltage cable should be used at the battery.

If another operator reports a variable high-pitched whine on the audio from your mobile transmitter then **Noise on the vehicle's electrical system is being transmitted along with your speech audio**.

T4A10
What is the source of a high-pitched whine that varies with engine speed in a mobile transceiver's receive audio?
A. The ignition system
B. The alternator
C. The electric fuel pump
D. Anti-lock braking system controllers

B. The alternator

T4A11
Where should the negative return connection of a mobile transceiver's power cable be connected?
A. At the battery or engine block ground strap
B. At the antenna mount
C. To any metal part of the vehicle
D. Through the transceiver's mounting bracket

A. At the battery or engine block ground strap

T4A12
What could be happening if another operator reports a variable high-pitched whine on the audio from your mobile transmitter?
A. Your microphone is picking up noise from an open window
B. You have the volume on your receiver set too high
C. You need to adjust your squelch control
D. Noise on the vehicle's electrical system is being transmitted along with your speech audio

D. Noise on the vehicle's electrical system is being transmitted along with your speech audio

Ham Radio has something for everyone. Want to communicate like one does on an internet chat site? Then the Ham Radio digital modes may be for you. Using digital modes, one uses the keyboard of the computer to send messages back and forth. The digital modes are a benefit during emergency communications because the operators can be assured, assuming no operator typo, that what is on the screen is the correct information. Packet Radio is a very common digital mode used by Technician Class hams. A **terminal node controller** would be connected between a transceiver and computer in a packet radio station. The computer simply acts like a dumb terminal.

Hams love computers. Many hams have spent untold hours writing programs that create new and exciting digital modes. In fact, it is no longer required to have a terminal node controller to use the packet digital mode. There are many digital modes to choose from when using a program designed for digital communications. **The sound card provides audio to the microphone input and converts received audio to digital form** when conducting digital communications using a computer. If you already own a computer and radio, one may get on digital very cheaply.

Computers have many uses as part of an amateur radio station:

- For logging contacts and contact information
- For sending and/or receiving CW
- For generating and decoding digital signals
- **All of these choices are correct**

T4A06
Which of the following would be connected between a transceiver and computer in a packet radio station?
A. Transmatch
B. Mixer
C. Terminal node controller
D. Antenna

C. Terminal node controller

T4A07
How is a computer's sound card used when conducting digital communications using a computer?
A. The sound card communicates between the computer CPU and the video display
B. The sound card records the audio frequency for video display
C. The sound card provides audio to the microphone input and converts received audio to digital form
D. All of these choices are correct

C. The sound card provides audio to the microphone input and converts received audio to digital form

T4A02
How might a computer be used as part of an amateur radio station?
A. For logging contacts and contact information
B. For sending and/or receiving CW
C. For generating and decoding digital signals
D. All of these choices are correct

D. All of these choices are correct

SWR will be discussed in the antenna section of this study guide. An SWR meter would be **connected in series with the feed line, between the transmitter and antenna**.

T4A05
Where should an in-line SWR meter be connected to monitor the standing wave ratio of the station antenna system?
A. In series with the feed line, between the transmitter and antenna
B. In series with the station's ground
C. In parallel with the push-to-talk line and the antenna
D. In series with the power supply cable, as close as possible to the radio

A. In series with the feed line, between the transmitter and antenna

T4B - Operating controls: tuning; use of filters; squelch function; AGC; repeater offset; memory channels

Amateur Radio operators can adjust certain features of their radio either by external switches and knobs or by an internal software based menu system. Many of these adjustments affect how well the radio works, or even the quality by which it transmits and receives.

If a transmitter is operated with the microphone gain set too high, **the output signal might become distorted**. It is very important to have your microphone gain set properly. There is no such thing as a "power mic" in ham radio.

One can change frequencies on a ham radio in one of two ways. **The keypad or VFO knob** can be used to enter the operating frequency on a modern transceiver. With the VFO Knob, you can actually "tune" through a frequency range. Using a keypad on your hand held or your mobile microphone, the frequency you wish can be entered directly.

While ham radio is not channelized the way FMRS, Business Band, or CB radios are, quick access to a favorite frequency on your transceiver can be done by **storing the frequency in a memory channel**. Most hams store favorite repeater and simplex frequencies into the memory of their radios.

T4B01
What may happen if a transmitter is operated with the microphone gain set too high?
A. The output power might be too high
B. The output signal might become distorted
C. The frequency might vary
D. The SWR might increase

B. The output signal might become distorted

T4B02
Which of the following can be used to enter the operating frequency on a modern transceiver?
A. The keypad or VFO knob
B. The CTCSS or DTMF encoder
C. The Automatic Frequency Control
D. All of these choices are correct

A. The keypad or VFO knob

T4B04
What is a way to enable quick access to a favorite frequency on your transceiver?
A. Enable the CTCSS tones
B. Store the frequency in a memory channel
C. Disable the CTCSS tones
D. Use the scan mode to select the desired frequency

B. Store the frequency in a memory channel

Nobody likes listening to noise all day long. The purpose of the squelch control on a transceiver is **to mute receiver output noise when no signal is being received**. If not for the squelch control, one would have to listen to noise whenever monitoring a frequency, even when a signal was not present. The squelch control basically disables the speaker during times when there is no signal present.

The squelch control is mainly used when operating the FM voice mode.

Many mobile radio installations suffer from noise from the ignition system. **Turning on the noise blanker** would reduce ignition interference to a receiver.

One problem with the SSB voice mode is that even when the frequency is correctly adjusted, the audio being received may sound weird. Too high pitched, or even too low pitched. Some like the higher or lower pitch. To allow operators to adjust the receive frequency without affecting transmit frequency, an RIT or **Receiver Incremental Tuning** is used. **The receiver RIT or clarifier** control could be used if the voice pitch of a single-sideband signal seems too high or low.

There is a control on some transceivers that help save the operators ears. Especially when wearing earphones. The function of an automatic gain control or AGC is **to keep received audio relatively**

constant.

T4B03
What is the purpose of the squelch control on a transceiver?
A. To set the highest level of volume desired
B. To set the transmitter power level
C. To adjust the automatic gain control
D. To mute receiver output noise when no signal is being received

D. To mute receiver output noise when no signal is being received

T4B05
Which of the following would reduce ignition interference to a receiver?
A. Change frequency slightly
B. Decrease the squelch setting
C. Turn on the noise blanker
D. Use the RIT control

C. Turn on the noise blanker

T4B06
Which of the following controls could be used if the voice pitch of a single-sideband signal seems too high or low?
A. The AGC or limiter
B. The bandwidth selection
C. The tone squelch
D. The receiver RIT or clarifier

D. The receiver RIT or clarifier

T4B07
What does the term "RIT" mean?
A. Receiver Input Tone
B. Receiver Incremental Tuning
C. Rectifier Inverter Test
D. Remote Input Transmitter

B. Receiver Incremental Tuning

T4B12
What is the function of automatic gain control or AGC?
A. To keep received audio relatively constant
B. To protect an antenna from lightning
C. To eliminate RF on the station cabling
D. An asymmetric goniometer control used for antenna matching

A. To keep received audio relatively constant

Many transceivers meant for SSB and CW have selectable bandwidths for receive. The bandwidth of an SSB signal is much greater than a CW signal. The advantage of having multiple receive bandwidth choices on a multimode transceiver is that it will **permit noise or interference reduction by selecting a bandwidth matching the mode**.

2400 Hz is an appropriate receive filter to select in order to minimize noise and interference for SSB reception.

500 Hz is an appropriate receive filter to select in order to minimize noise and interference for CW reception.

The difference between the repeater's transmit and receive frequencies is the repeater offset frequency. While plus or minus 600 KHz offset is standard for 2 meters and plus or minus 5 MHz is standard for 70 cm, all FM radios can be set to different offsets to accommodate some repeaters with what are called "odd offset" frequencies.

T4B08
What is the advantage of having multiple receive bandwidth choices on a multimode transceiver?
A. Permits monitoring several modes at once
B. Permits noise or interference reduction by selecting a bandwidth matching the mode
C. Increases the number of frequencies that can be stored in memory
D. Increases the amount of offset between receive and transmit frequencies

B. Permits noise or interference reduction by selecting a bandwidth matching the mode

T4B09
Which of the following is an appropriate receive filter bandwidth to select in order to minimize noise and interference for SSB reception?
A. 500 Hz
B. 1000 Hz
C. 2400 Hz
D. 5000 Hz

C. 2400 Hz

T4B10
Which of the following is an appropriate receive filter bandwidth to select in order to minimize noise and interference for CW reception?
A. 500 Hz
B. 1000 Hz
C. 2400 Hz
D. 5000 Hz

A. 500 Hz

T4B11
Which of the following describes the common meaning of the term "repeater offset"?
A. The distance between the repeater's transmit and receive antennas
B. The time delay before the repeater timer resets
C. The difference between the repeater's transmit and receive frequencies
D. Matching the antenna impedance to the feed line impedance

C. The difference between the repeater's transmit and receive frequencies

SUBELEMENT T5

Electrical principles: math for electronics; electronic principles; Ohm's Law
4 Exam Questions - 4 Groups

T5A - Electrical principles, units, and terms: current and voltage; conductors and insulators; alternating and direct current

While one does not have to be an Electronic Engineer to pass the Technician Class ham license (That comes later with the General and Extra Class ham licenses…… Just kidding!), you do have to know a few of the basics. That is what this course will cover. Just the basics.

- **Voltage** is the force that causes electrons to flow in an electrical circuit. **The Volt** is also called EMF for Electro Motive Force and is measured with a volt meter. The volt is the basic unit of EMF. In a schematic or block drawing, the letter "V" is used to indicate volts. In an electronic formula, the letter "E" is used to indicate voltage.
- Electrical current is measured in **amperes**. **Current** is the name for the flow of electrons through an electrical circuit in which voltage causes to flow. An ammeter is used to measure current. The letter "I" is used in electrical formulas to indicate the amount of current being used.
- Electrical power is measured in **watts**. **Power** is the rate at which electrical energy is consumed. Example: A 100 watt light bulb consumes 100 watts of power to generate light.

T5A01
Electrical current is measured in which of the following units?
A. Volts
B. Watts
C. Ohms
D. Amperes

D. Amperes

T5A02
Electrical power is measured in which of the following units?
A. Volts
B. Watts
C. Ohms
D. Amperes

B. Watts

T5A03
What is the name for the flow of electrons in an electric circuit?
A. Voltage
B. Resistance
C. Capacitance
D. Current

D. Current

T5A10
Which term describes the rate at which electrical energy is used?
A. Resistance
B. Current
C. Power
D. Voltage

C. Power

T5A05
What is the electrical term for the electromotive force (EMF) that causes electron flow?
A. Voltage
B. Ampere-hours

C. Capacitance
D. Inductance

A. Voltage

T5A11
What is the basic unit of electromotive force?
A. The volt
B. The watt
C. The ampere
D. The ohm

A. The volt

- **Direct current** is the name for a current that flows only in one direction. Examples of Direct Current or DC is a 12 volt car battery, Flashlight batteries, and etc.
- **Alternating current** is the name for a current that reverses direction on a regular basis. An example of Alternating Current, or AC is the typical house electrical outlet.
- **Frequency** is the term that describes the number of times per second that an alternating current reverses direction.

A mobile transceiver usually requires **about 12 volts**. This is true for most modern day ham equipment. To use a mobile transceiver, or other 12 volt radio in the house, one would usually use a Power Supply. A power supply simply converts the 117 Volts AC house outlet to 12 Volts DC that the radio needs to operate properly.

T5A04
What is the name for a current that flows only in one direction?
A. Alternating current
B. Direct current
C. Normal current
D. Smooth current

B. Direct current

T5A06
How much voltage does a mobile transceiver usually require?
A. About 12 volts
B. About 30 volts
C. About 120 volts
D. About 240 volts

A. About 12 volts

T5A09
What is the name for a current that reverses direction on a regular basis?
A. Alternating current
B. Direct current
C. Circular current
D. Vertical current

A. Alternating current

T5A12
What term describes the number of times per second that an alternating current reverses direction?
A. Pulse rate
B. Speed
C. Wavelength
D. Frequency

D. Frequency

There are many metals that make good conductors: silver, gold, copper, aluminum, etc. You will only need to remember one though. **Copper** is a good electrical conductor. There are many good insulators

as well: Glass, plastic, even air. Again, you will only need to remember one for the exam. **Glass** is a good electrical insulator

T5A07
Which of the following is a good electrical conductor?
A. Glass
B. Wood
C. Copper
D. Rubber

C. Copper

T5A08
Which of the following is a good electrical insulator?
A. Copper
B. Glass
C. Aluminum
D. Mercury

B. Glass

T5B - Math for electronics: conversion of electrical units; decibels; the metric system

An ampere is a very large unit for most of our electrical work. Hams usually measure currents using the smaller scale of milliamperes. Milliamperes is simply 1 one-thousandth of an ampere. 1 ampere is 1000 milliamperes. The easiest way to convert an ampere is to simply move the decimal place to the right by three spaces. 1 ampere equals 1000 milliamperes. 1.5 ampere equals **1,500 milliamperes**. Or you can do it the hard way and multiply amperes by 1,000: 1 X 1,000 = 1,000 milliamperes. 1.5 X 1,000 = 1,500 milliamperes.

If an ammeter calibrated in amperes is used to measure a 3000-milliampere of current, the reading would be **3 amperes**. To convert milliamperes to amperes, simply move the decimal place to the left by three. Or do the math: 3,000 / 1,000 equals 3 ampere.

Here are some other need to know conversions:

- Milli (as in above): 1 one-thousandth of a quantity. Divide or multiply by 1,000 or simply move the decimal place to the right or left by 3 places.
- Micro: is 1 millionth of a quantity. Divide by or multiply by 1,000,000 or simply move the decimal place to the right or left by 6 places.
- Pico: 1 trillionth of a quantity.
- Kilo: 1 thousand of a quantity. 1,000 volts is 1 KV (Kilovolt) 1,000 hertz is 1 Khz. (Kilohertz) To convert 1 Kilovolt to volts, simply move the decimal place to the right by 3. To convert Volts to Kilovolts, simply move the decimal place to the left by three.
- Mega: 1 million of a quantity. 1 MHz is 1,000,000 Hertz. To convert from Hertz to Mega Hertz (Mhz) simply move the 6 spaces to the left. To convert from Mega Hertz to Hertz, simply move the decimal place to the right 6 spaces.

- **1500 kHz** is another way to specify a radio signal frequency of 1,500,000 hertz.
- **One thousand volts** are equal to one kilovolt.
- **One one-millionth of a volts** is equal to one microvolt.
- **0.5 watts** is equivalent to 500 milliwatts.
- **One microfarads is equal to 1,000,000 picofarads**.

T5B01
How many milliamperes is 1.5 amperes?
A. 15 milliamperes
B. 150 milliamperes
C. 1,500 milliamperes
D. 15,000 milliamperes

C. 1,500 milliamperes (move the decimal place to the right by 3 spaces.) or (1.5 x 1000 = 1500)

T5B02

What is another way to specify a radio signal frequency of 1,500,000 hertz?
A. 1500 kHz
B. 1500 MHz
C. 15 GHz
D. 150 kHz

A. 1500 kHz (move the decimal place to left 3 spaces) or (1,500,00 / 1000 = 1500)

T5B03
How many volts are equal to one kilovolt?
A. One one-thousandth of a volt
B. One hundred volts
C. One thousand volts
D. One million volts

C. One thousand volts

T5B04
How many volts are equal to one microvolt?
A. One one-millionth of a volt
B. One million volts
C. One thousand kilovolts
D. One one-thousandth of a volt

A. One one-millionth of a volt

T5B05
Which of the following is equivalent to 500 milliwatts?
A. 0.02 watts
B. 0.5 watts
C. 5 watts
D. 50 watts

B. 0.5 watts (move the decimal place to the left 3 places) or (500/1,000 = .5)

T5B06
If an ammeter calibrated in amperes is used to measure a 3000-milliampere current, what reading would it show?
A. 0.003 amperes
B. 0.3 amperes
C. 3 amperes
D. 3,000,000 amperes

C. 3 amperes (move the decimal place to the left 3 places) or (3,000 / 1,000 = 3)

T5B08
How many microfarads are 1,000,000 picofarads?
A. 0.001 microfarads
B. 1 microfarad
C. 1000 microfarads
D. 1,000,000,000 microfarads

B. 1 microfarad (1 million = 1 micro)

- If a frequency readout calibrated in megahertz shows a reading of 3.525 MHz, it would show **3525 kHz** if it were calibrated in kilohertz.
- The following frequency is equal to 28,400 kHz: **28.400 MHz**
- A frequency readout showing a reading of 2425 MHz is **2.425 GHz**

T5B07
If a frequency readout calibrated in megahertz shows a reading of 3.525 MHz, what would it show if it were calibrated in kilohertz?

A. 0.003525 kHz
B. 35.25 kHz
C. 3525 kHz
D. 3,525,000 kHz

C. 3525 kHz (move the decimal place to the right 3 places) or (3.525 x 1,000 = 3525)

T5B12
Which of the following frequencies is equal to 28,400 kHz?
A. 28.400 MHz
B. 2.800 MHz
C. 284.00 MHz
D. 28.400 kHz

A. 28.400 MHz

T5B13
If a frequency readout shows a reading of 2425 MHz, what frequency is that in GHz?
A. 0.002425 GHZ
B. 24.25 GHz
C. 2.425 GHz
D. 2425 GHz

C. 2.425 GHz

We use decibels when we are describing power ratios. A good example in ordinary life would be a rock band at the local high school. It is really loud! What high school rock band wouldn't be! If you lower the loudness by half, you would be lowering the loudness by 3 decibels, or db for short. If, heaven forbid, you wanted to make the band twice as loud, you would need to up the volume by 3 db!

- The approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts is **3dB**.
- The approximate amount of change, measured in decibels (dB), of a power decrease from 12 watts to 3 watts is **-6dB**. (take it in steps: 3db would be 6 watts, then another 3db would be 3 watts.)
- The approximate amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts is **10dB**.

T5B09
What is the approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts?
A. 2 dB
B. 3 dB
C. 5 dB
D. 10 dB

B. 3 dB

T5B10
What is the approximate amount of change, measured in decibels (dB), of a power decrease from 12 watts to 3 watts?
A. -1 dB
B. -3 dB
C. -6 dB
D. -9 dB

C. -6 dB

T5B11
What is the approximate amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts?
A. 10 dB
B. 12 dB

C. 18 dB
D. 28 dB

A. 10 dB

T5C - Electronic principles: capacitance; inductance; current flow in circuits; alternating current; definition of RF; DC power calculations; impedance

The ability to store energy in an electric field is called **capacitance**. A capacitor consists of two or more conductors separated by some sort of insulator. The basic unit of capacitance is the **farad**.

The ability to store energy in a magnetic field is called **inductance**. The basic unit of inductance is the **Henry**. An inductor is often made by wrapping wire around a "coil form". Sometimes however, self-supporting wire can simply be formed into a coil of 1 or more turns. The greater the number of turns, the greater the inductance.

A resistor is used to oppose the flow of current in a DC circuit and is measured in ohms. Resistors can be of fixed value or variable. An example of a variable resistor would be the volume control on a radio. A variable resistor is also called a potentiometer.

T5C01
What is the ability to store energy in an electric field called?
A. Inductance
B. Resistance
C. Tolerance
D. Capacitance

D. Capacitance

T5C02
What is the basic unit of capacitance?
A. The farad
B. The ohm
C. The volt
D. The henry

A. The farad

T5C03
What is the ability to store energy in a magnetic field called?
A. Admittance
B. Capacitance
C. Resistance
D. Inductance

D. Inductance

T5C04
What is the basic unit of inductance?
A. The coulomb
B. The farad
C. The henry
D. The ohm

C. The henry

Hertz is the unit of frequency. The hertz is one cycle of Alternating Current. The voltage outlet of your house is 117 Volts AC. The frequency of the AC is 60 Hertz, meaning the current alternates at a rate of 60 times per second.

RF is the abbreviation that refers to **radio frequency signals of all types**. **Radio waves** is the usual name for electromagnetic waves that travel through space.

T5C05
What is the unit of frequency?
A. Hertz
B. Henry
C. Farad
D. Tesla

A. Hertz

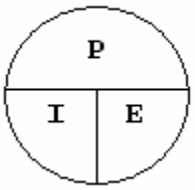
T5C06
What does the abbreviation "RF" refer to?
A. Radio frequency signals of all types
B. The resonant frequency of a tuned circuit
C. The real frequency transmitted as opposed to the apparent frequency
D. Reflective force in antenna transmission lines

A. Radio frequency signals of all types

T5C07
What is a usual name for electromagnetic waves that travel through space?
A. Gravity waves
B. Sound waves
C. Radio waves
D. Pressure waves

C. Radio waves

You will need to know the power formulas for the test. Using the pie chart is one of the easiest ways to remember these three formulas. During the exam will be given a blank page of paper in which you may do your calculations on. When the exam begins, you may draw this pie chart. The pie chart itself is easy to remember because it actually spells "PIE". All you need to remember is that the P goes on top and the I and E goes on the bottom.



Power (P) equals voltage (E) multiplied by current (I) is the formula used to calculate electrical power in a DC circuit. (Here are the power formulas:: P = E X I E = P / I I = P / E)

If one needs to know the power, just cover up "P" and you will see: I X E.
Looking for the Current? Cover up "I" and you will see: P / E.
For Volts, cover up "E" and you will see: P / I.

- **138 watts** of power is being used in a circuit when the applied voltage is 13.8 volts DC and the current is 10 amperes (13.8 x 10 = 138)
- **30 watts** of power is being used in a circuit when the applied voltage is 12 volts D and the current is 2.5 amperes. (12 x 2.5 = 30)
- **10 amperes** are flowing in a circuit when the applied voltage is 12 volts and the load is 120 watts. (120 x 12 = 10)

T5C08
What is the formula used to calculate electrical power in a DC circuit?
A. Power (P) equals voltage (E) multiplied by current (I)
B. Power (P) equals voltage (E) divided by current (I)

C. Power (P) equals voltage (E) minus current (I)
D. Power (P) equals voltage (E) plus current (I)

A. Power (P) equals voltage (E) multiplied by current (I)

T5C09
How much power is being used in a circuit when the applied voltage is 13.8 volts DC and the current is 10 amperes?
A. 138 watts
B. 0.7 watts
C. 23.8 watts
D. 3.8 watts

A. 138 watts

T5C10
How much power is being used in a circuit when the applied voltage is 12 volts DC and the current is 2.5 amperes?
A. 4.8 watts
B. 30 watts
C. 14.5 watts
D. 0.208 watts

B. 30 watts

T5C11
How many amperes are flowing in a circuit when the applied voltage is 12 volts DC and the load is 120 watts?
A. 0.1 amperes
B. 10 amperes
C. 12 amperes
D. 132 amperes

B. 10 amperes

Impedance **is a measure of the opposition to AC current flow in a circuit** and is measured in **Ohms**.

T5C12
What is meant by the term impedance?
A. It is a measure of the opposition to AC current flow in a circuit
B. It is the inverse of resistance
C. It is a measure of the Q or Quality Factor of a component
D. It is a measure of the power handling capability of a component

A. It is a measure of the opposition to AC current flow in a circuit

T5C13
What are the units of impedance?
A. Volts
B. Amperes
C. Coulombs
D. Ohms

D. Ohms

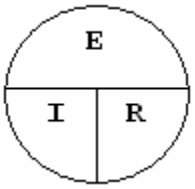
T5D – Ohm's Law: formulas and usage

Using Ohm's law, one can calculate the value of Resistance, Current, or Voltage as long as two of the values are known.

- **The formula Current (I) equals voltage (E) divided by resistance (R).is used to calculate current in a circuit.**
- **The formula Voltage (E) equals current (I) multiplied by resistance (R) is used to calculate voltage in a circuit.**

- **The formula Resistance (R) equals voltage (E) divided by current (I) is used to calculate resistance in a circuit.**

Just as in the Power calculations, Ohm's law is easy to remember by using a pie chart:



An easy trick to remember this chart is to realize that the letters E, I, and R are in a alphabetical order and the first Letter E is on top. As with the power chart, one may draw this chart on your scratch paper once the test begins.

Similar to the Power chart, just cover up the missing item to see how to solve the problem.

- The resistance of a circuit in which a current of 3 amperes flows through a resistor connected to 90 volts is **30 ohms**. (R = E / I: 90 / 3 = 30 Ohms)
- The resistance in a circuit for which the applied voltage is 12 volts and the current flow is 1.5 amperes is **8 ohms**. (R = E / I: 12 / 1.5 = 8 Ohms)
- The resistance of a circuit that draws 4 amperes from a 12-volt source is **3 ohms**. (R = E/I: 12 / 4 = 3 Ohms)
- The current flow in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms is **1.5 ampere**s. (I = E / R: 120 / 80 = 1.5 Amps)
- The current flowing through a 100-ohm resistor connected across 200 volts is **2 amperes**. (I = E / R: 200 / 100 = 2 Amps)
- The current flowing through a 24-ohm resistor connected across 240 volts **10 amperes**. (I = E / R: 240 / 24 = 10 Amps)
- The voltage across a 2-ohm resistor if a current of 0.5 amperes flows through it is **1 volt**. (E = I X R: 0.5 X 2 = 1 Volt)
- The voltage across a 10-ohm resistor if a current of 1 ampere flows through it is **10 volts**. (E = I X R: 1 X 10 = 10 Volts)
- The voltage across a 10-ohm resistor if a current of 2 amperes flows through it **20 volts**. (E = I / R: 2 X 10 = 20 Volts)

T5D01
What formula is used to calculate current in a circuit?
A. Current (I) equals voltage (E) multiplied by resistance (R)
B. Current (I) equals voltage (E) divided by resistance (R)
C. Current (I) equals voltage (E) added to resistance (R)
D. Current (I) equals voltage (E) minus resistance (R)

B. Current (I) equals voltage (E) divided by resistance (R)

T5D02
What formula is used to calculate voltage in a circuit?
A. Voltage (E) equals current (I) multiplied by resistance (R)
B. Voltage (E) equals current (I) divided by resistance (R)
C. Voltage (E) equals current (I) added to resistance (R)
D. Voltage (E) equals current (I) minus resistance (R)

A. Voltage (E) equals current (I) multiplied by resistance (R)

T5D03
What formula is used to calculate resistance in a circuit?
A. Resistance (R) equals voltage (E) multiplied by current (I)
B. Resistance (R) equals voltage (E) divided by current (I)
C. Resistance (R) equals voltage (E) added to current (I)
D. Resistance (R) equals voltage (E) minus current (I)

B. Resistance (R) equals voltage (E) divided by current (I)

T5D04
What is the resistance of a circuit in which a current of 3 amperes flows through a resistor connected to 90 volts?
A. 3 ohms
B. 30 ohms
C. 93 ohms
D. 270 ohms

B. 30 ohms (R = E / I: 90 / 3 = 30 Ohms

T5D05
What is the resistance in a circuit for which the applied voltage is 12 volts and the current flow is 1.5 amperes?
A. 18 ohms
B. 0.125 ohms
C. 8 ohms
D. 13.5 ohms

C. 8 ohms (R = E / I: 12 / 1.5 = 8 Ohms)

T5D06
What is the resistance of a circuit that draws 4 amperes from a 12-volt source?
A. 3 ohms
B. 16 ohms
C. 48 ohms
D. 8 Ohms

A. 3 ohms (R = E / I: 12 / 1.5 = 8 Ohms)

T5D07
What is the current flow in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms?
A. 9600 amperes
B. 200 amperes
C. 0.667 amperes
D. 1.5 amperes

D. 1.5 amperes (I = E / R: 120 / 80 = 1.5 Amps)

T5D08
What is the current flowing through a 100-ohm resistor connected across 200 volts?
A. 20,000 amperes
B. 0.5 amperes
C. 2 amperes
D. 100 amperes

C. 2 amperes (I = E / R: 200 / 100 = 2 Amps)

T5D09
What is the current flowing through a 24-ohm resistor connected across 240 volts?
A. 24,000 amperes
B. 0.1 amperes
C. 10 amperes
D. 216 amperes

C. 10 amperes (I = E / R: 240 / 24 = 10 Amps)

T5D10
What is the voltage across a 2-ohm resistor if a current of 0.5 amperes flows through it?
A. 1 volt
B. 0.25 volts

C. 2.5 volts
D. 1.5 volts

A. 1 volt (E = I X R: 0.5 X 2 = 1 Volt)

T5D11
What is the voltage across a 10-ohm resistor if a current of 1 ampere flows through it?
A. 1 volt
B. 10 volts
C. 11 volts
D. 9 volts

B. 10 volts (E = I X R: 1 X 10 = 10 Volts)

T5D12
What is the voltage across a 10-ohm resistor if a current of 2 amperes flows through it?
A. 8 volts
B. 0.2 volts
C. 12 volts
D. 20 volts

D. 20 volts (E = I X R: 2 X 10 = 20 Volts)

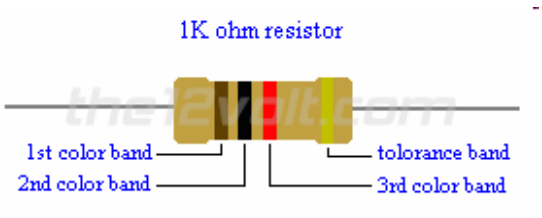
SUBELEMENT T6

Electrical components: semiconductors; circuit diagrams; component functions
4 Exam Questions - 4 Groups

T6A - Electrical components: fixed and variable resistors; capacitors and inductors; fuses; switches; batteries

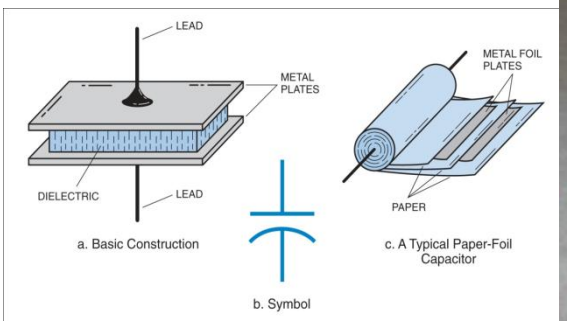
A brief review of some things we learned in section T5 simply because there are some questions about this information also in T6:

- A **resistor** is the electrical component used to oppose the flow of current in a circuit.

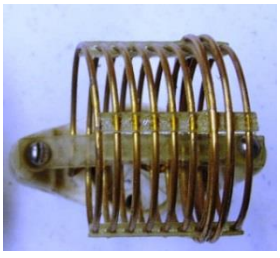


- The **potentiometer** is the type of component often used as an adjustable volume control.

- **Resistance** is the electrical parameter controlled by a potentiometer.
- A **capacitor** is the electrical component that stores energy in an electric field.



- The **capacitor** is the type of electrical component consisting of two or more conductive surfaces separated by an insulator.
- An **inductor** is the type of electrical component that stores energy in a magnetic field.



- The **inductor** is an electrical component usually composed of a coil of wire.

T6A01
What electrical component is used to oppose the flow of current in a DC circuit?
A. Inductor
B. Resistor
C. Voltmeter
D. Transformer

B. Resistor

T6A02
What type of component is often used as an adjustable volume control?
A. Fixed resistor
B. Power resistor
C. Potentiometer
D. Transformer

C. Potentiometer

T6A03
What electrical parameter is controlled by a potentiometer?
A. Inductance
B. Resistance
C. Capacitance
D. Field strength

B. Resistance

T6A04
What electrical component stores energy in an electric field?
A. Resistor
B. Capacitor
C. Inductor
D. Diode

B. Capacitor

T6A05
What type of electrical component consists of two or more conductive surfaces separated by an insulator?
A. Resistor
B. Potentiometer
C. Oscillator
D. Capacitor

D. Capacitor

T6A06
What type of electrical component stores energy in a magnetic field?
A. Resistor
B. Capacitor
C. Inductor
D. Diode

C. Inductor

T6A07
What electrical component is usually composed of a coil of wire?
A. Switch
B. Capacitor
C. Diode
D. Inductor

D. Inductor

Now on to some new stuff.

A switch is an electrical component that is used to connect or disconnect an electrical circuit. You have used a switch when turning house lights off and on.

A fuse is an electrical component used to protect other circuit components from current overloads. Most house electrical boxes now use breakers. Many years ago they used fuses. Your car still use fuses. Those flat colored things with legs! Most ham equipment have at least one fuse that will blow (burn out) if there is a sudden increase in current that is not part of the plan.

T6A08
What electrical component is used to connect or disconnect electrical circuits?
A. Magnetron
B. Switch
C. Thermistor
D. All of these choices are correct

B. Switch

T6A09
What electrical component is used to protect other circuit components from current overloads?
A. Fuse
B. Capacitor
C. Inductor
D. All of these choices are correct

A. Fuse

Hams make use of rechargeable batteries. Think about it. If one uses a handheld radio, he/she would go through a lot of batteries if it were not for rechargeable batteries. Today's batteries are small and light weight and hold a pretty large charge.

There are several types of rechargeable batteries:

- Nickel-metal hydride
- Lithium-ion
- Lead-acid gel-cell
- **All of these choices are correct**

1.2 volts is the nominal voltage of a fully charged nickel-cadmium cell. Six cells or more make up a handhelds battery. They are all in a case nice and neatly soldered together for a total voltage of 7.4 volts or more.

A **carbon-zinc** battery type is not rechargeable. This would be your normal dry cell battery used in flashlights, toys, etc. Trying to recharge one of these batteries is very dangerous and can possibly lead to an explosion. Don't try it!

T6A10
Which of the following battery types is rechargeable?
A. Nickel-metal hydride
B. Lithium-ion
C. Lead-acid gel-cell
D. All of these choices are correct

D. All of these choices are correct

T6A11
Which of the following battery types is not rechargeable?
A. Nickel-cadmium
B. Carbon-zinc
C. Lead-acid

D. Lithium-ion

B. Carbon-zinc

T6B – Semiconductors: basic principles and applications of solid state devices; diodes and transistors

Transistors are a class of electronic components capable of using a voltage or current signal to control current flow. **Transistors** can be used as an electronic switch or as an amplifier.

The **transistor** is a component that is made of three layers of semiconductor material. The three electrodes of a PNP or NPN transistor are the **Emitter, base, and collector.**

The abbreviation "FET" stands for **Field Effect Transistor**. The three electrodes of a field effect transistor are the **Source, gate, and drain**.

The **transistor** is an electronic components that can amplify signals. **Gain** is the term that describes a transistor's ability to amplify a signal.

T6B01
What class of electronic components is capable of using a voltage or current signal to control current flow?
A. Capacitors
B. Inductors
C. Resistors
D. Transistors

D. Transistors

T6B03
Which of these components can be used as an electronic switch or amplifier?
A. Oscillator
B. Potentiometer
C. Transistor
D. Voltmeter

C. Transistor

T6B04
Which of the following components can be made of three layers of semiconductor material?
A. Alternator
B. Transistor
C. Triode
D. Pentagrid converter

B. Transistor

T6B05
Which of the following electronic components can amplify signals?
A. Transistor
B. Variable resistor
C. Electrolytic capacitor
D. Multi-cell battery

A. Transistor

T6B08
What does the abbreviation FET stand for?
A. Field Effect Transistor
B. Fast Electron Transistor
C. Free Electron Transition
D. Field Emission Thickness

A. Field Effect Transistor

T6B10

What are the three electrodes of a PNP or NPN transistor?
A. Emitter, base, and collector
B. Source, gate, and drain
C. Cathode, grid, and plate
D. Cathode, drift cavity, and collector

A. Emitter, base, and collector

T6B11
What at are the three electrodes of a field effect transistor?
A. Emitter, base, and collector
B. Source, gate, and drain
C. Cathode, grid, and plate
D. Cathode, gate, and anode

B. Source, gate, and drain

T6B12
What is the term that describes a transistor's ability to amplify a signal?
A. Gain
B. Forward resistance
C. Forward voltage drop
D. On resistance

A. Gain

A **diode** is an electronic component that allows current to flow in only one direction. **Anode and cathode** are the names of the two electrodes of a diode. A semiconductor diode's cathode lead is usually identified **with a stripe.**

An LED, or **Light Emitting Diode**, can be used as light indicators to show whether a switch is off or on. The LED have also become popular in flashlights and are just now showing up as light bulbs. This is because the low current drain of LED's make them more efficient for lighting than even the economical fluorescent light bulb.

T6B02
What electronic component allows current to flow in only one direction?
A. Resistor
B. Fuse
C. Diode
D. Driven Element

C. Diode

T6B06
How is the cathode lead of a semiconductor diode usually identified?
A. With the word cathode
B. With a stripe
C. With the letter C
D. All of these choices are correct

B. With a stripe

T6B07
What does the abbreviation LED stand for?
A. Low Emission Diode
B. Light Emitting Diode
C. Liquid Emission Detector
D. Long Echo Delay

B. Light Emitting Diode

T6B09
What are the names of the two electrodes of a diode?
A. Plus and minus
B. Source and drain
C. Anode and cathode
D. Gate and base

C. Anode and cathode

T6C - Circuit diagrams; schematic symbols

- **Schematic symbols** is the name for standardized representations of components in an electrical wiring diagram.
- The symbols on an electrical schematic diagram represent electrical components.
- **The way electrical components** are interconnected accurately represent schematic diagrams.

Here are the schematic symbols you will need to know to pass the Technician Class exam:

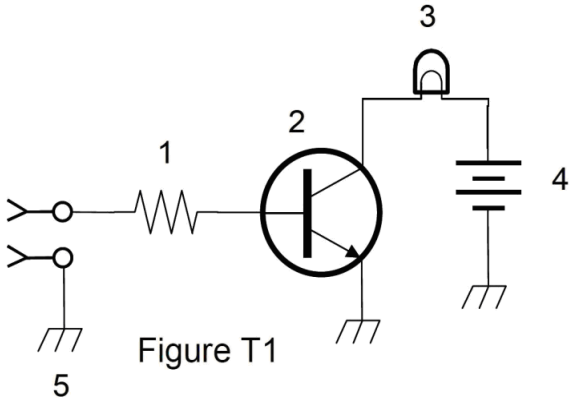


Figure T1

- Component 1 in figure T1 is a **resistor**.
- Component 2 in figure T1 is a **transistor**.
- Component 3 in figure T1 is a **lamp**.
- Component 4 in figure T1 is a **battery**.

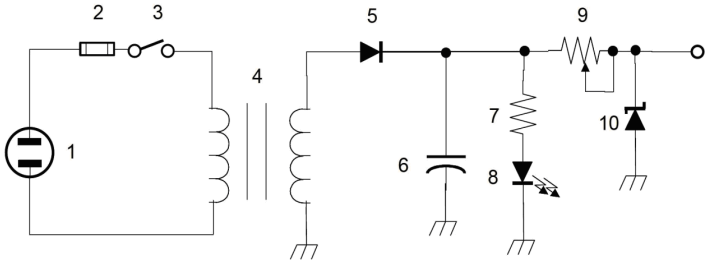


Figure T2

- Component 6 in figure T2 is a **capacitor**.
- Component 8 in figure T2 is a **light emitting diode**.
- Component 9 in figure T2 is a **variable resistor**.
- Component 4 in figure T2 is a **transformer**.

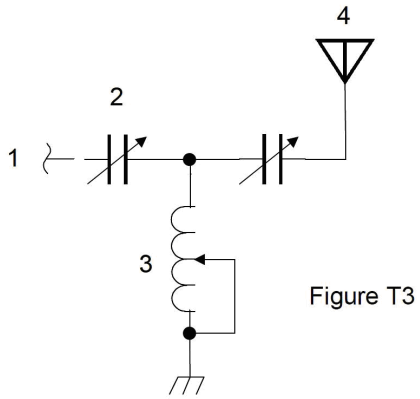


Figure T3

- Component 3 in figure T3 is a **variable inductor**.
- Component 4 in figure T3 is an **antenna**.

T6C01
What is the name for standardized representations of components in an electrical wiring diagram?
A. Electrical depictions
B. Grey sketch
C. Schematic symbols
D. Component callouts

C. Schematic symbols

T6C02
What is component 1 in figure T1?
A. Resistor
B. Transistor
C. Battery
D. Connector

A. Resistor

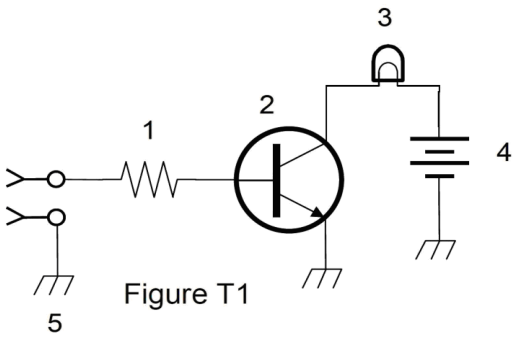


Figure T1

T6C03
What is component 2 in figure T1?
A. Resistor
B. Transistor
C. Indicator lamp
D. Connector

B. Transistor

T6C04
What is component 3 in figure T1?
A. Resistor
B. Transistor

C. Lamp
D. Ground symbol

C. Lamp

T6C05
What is component 4 in figure T1?
A. Resistor
B. Transistor
C. Battery
D. Ground symbol

C. Battery

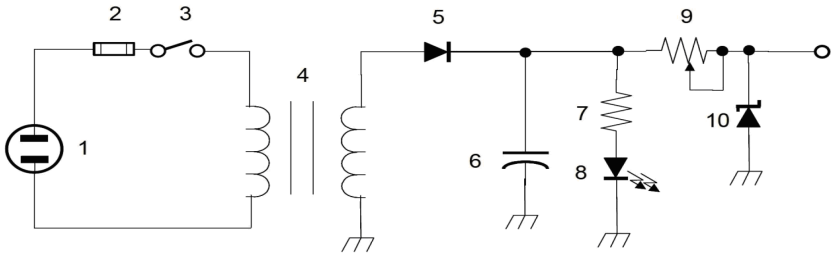


Figure T2

T6C06
What is component 6 in figure T2?
A. Resistor
B. Capacitor
C. Regulator IC
D. Transistor

B. Capacitor

T6C07
What is component 8 in figure T2?
A. Resistor
B. Inductor
C. Regulator IC
D. Light emitting diode

D. Light emitting diode

T6C08
What is component 9 in figure T2?
A. Variable capacitor
B. Variable inductor
C. Variable resistor
D. Variable transformer

C. Variable resistor

T6C09
What is component 4 in figure T2?
A. Variable inductor
B. Double-pole switch
C. Potentiometer
D. Transformer

D. Transformer

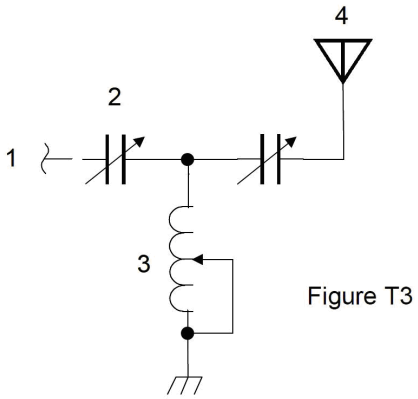


Figure T3

T6C10
What is component 3 in figure T3?
A. Connector
B. Meter
C. Variable capacitor
D. Variable inductor

D. Variable inductor

T6C11
What is component 4 in figure T3?
A. Antenna
B. Transmitter
C. Dummy load
D. Ground

A. Antenna

T6C12
What do the symbols on an electrical circuit schematic diagram represent?
A. Electrical components
B. Logic states
C. Digital codes
D. Traffic nodes

A. Electrical components

T6C13
Which of the following is accurately represented in electrical circuit schematic diagrams?
A. Wire lengths
B. Physical appearance of components
C. The way components are interconnected
D. All of these choices are correct

C. The way components are interconnected

T6D - Component functions: rectification; switches; indicators; power supply components; resonant circuit; shielding; power transformers; integrated circuits

Rectifiers change an alternating into a varying direct current. Remember previously it was said that a diode will convert AC to DC? Well, a rectifier is nothing more than a diode rated for the current level at which a power supply would be designed for. There are ways to configure multiple rectifiers so that the convert DC component is a less pulsating or varying current signal.

A **transformer** is a component commonly used to change 120V AC house current to a lower AC voltage for other uses. Remember that our mobile and most base radios require 12 Volts DC. In order for a power supply to reduce the 117 Volts AC down to something our equipment expects to see, one needs to use a transformer.

A **regulator** is a type of circuit that controls the amount of voltage from a power supply. A regulator is used in conjunction with the transformer, rectifier, and other circuitry in a power supply to keep a power supply regulated very closely to the 12 volts required by today's ham radios.

A switch controlled by an electromagnet best describes a relay. A relay is usually used in some remote application. A good example of a relay would be a remote antenna switch out on a hams radio tower. There would be multiple relays built into this switch so that many different antennas may be selected. All the individual antenna feed lines would go to this switch but only one feed line would go into the radio room (called "radio shack" or just "the shack" in ham lingo). The remote antenna switch would be controlled by a manual switch at the operating desk which will feed voltage to the selected antenna relay, thus energizing the electromagnet and engaging the relay.

A single-pole single-throw switch is represented by item 3 in figure T2 (see previous page).

T6D01
Which of the following devices or circuits changes an alternating current into a varying direct current signal?
A. Transformer
B. Rectifier
C. Amplifier
D. Reflector

B. Rectifier

T6D02
What best describes a relay?
A. A switch controlled by an electromagnet
B. A current controlled amplifier
C. An optical sensor
D. A pass transistor

A. A switch controlled by an electromagnet

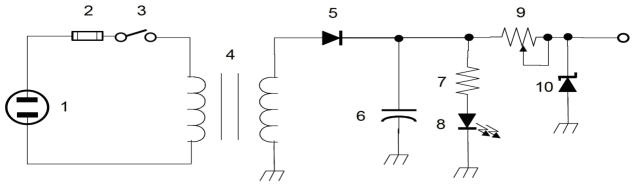


Figure T2

T6D03
What type of switch is represented by item 3 in figure T2?
A. Single-pole single-throw
B. Single-pole double-throw
C. Double-pole single-throw
D. Double-pole double-throw

A. Single-pole single-throw

T6D05
What type of circuit controls the amount of voltage from a power supply?
A. Regulator
B. Oscillator
C. Filter
D. Phase inverter

A. Regulator

T6D06
What component is commonly used to change 120V AC house current to a lower AC voltage for other uses?
A. Variable capacitor

B. Transformer
C. Transistor
D. Diode

B. Transformer

To **control the flow of current** is the function of component 2 in Figure T1. We have already talked about transistors. This is what a transistor does.

Integrated circuit is the name of a device that combines several semiconductors and other components into one package. An integrated circuit can contain hundreds of diodes, transistors, and other components in a size often smaller than your thumbnail. And they are getting smaller!

A **capacitor** is used together with an inductor to make a tuned circuit. In a receiver or transmitter, this could determine your frequency or affect how much power goes to the antenna.

An inductor and a capacitor connected in series or parallel to form a filter is an example of a simple resonant or tuned circuit.

It is common practice to use shielded wire **To prevent coupling of unwanted signals to or from the wire**. An example of this might be using shielded wire from a tuned circuit to the oscillator circuit in a transmitter.

A **meter** can be used to display signal strength on a numeric scale. This is called an "S" meter and is a common way to display the relative signal strength of the station being received.

An **LED** is commonly used as a visual indicator. This has been mentioned previously. It is mentioned here again simply because there is one question pertaining to it in this section.

T6D04
Which of the following can be used to display signal strength on a numeric scale?
A. Potentiometer
B. Transistor
C. Meter
D. Relay

C. Meter

T6D07
Which of the following is commonly used as a visual indicator?
A. LED
B. FET
C. Zener diode
D. Bipolar transistor

A. LED

T6D08
Which of the following is used together with an inductor to make a tuned circuit?
A. Resistor
B. Zener diode
C. Potentiometer
D. Capacitor

D. Capacitor

T6D09
What is the name of a device that combines several semiconductors and other components into one package?
A. Transducer
B. Multi-pole relay
C. Integrated circuit
D. Transformer

C. Integrated circuit

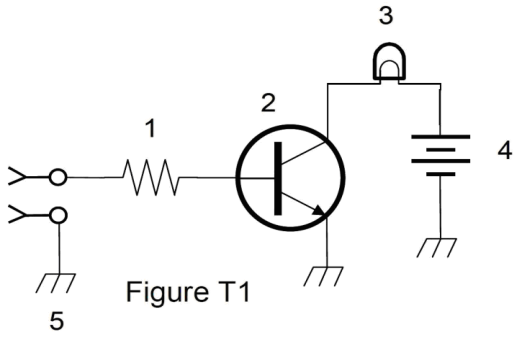


Figure T1

T6D10
What is the function of component 2 in Figure T1?
A. Give off light when current flows through it
B. Supply electrical energy
C. Control the flow of current
D. Convert electrical energy into radio waves

C. Control the flow of current

T6D11
What is a simple resonant or tuned circuit?
A. An inductor and a capacitor connected in series or parallel to form a filter
B. A type of voltage regulator
C. A resistor circuit used for reducing standing wave ratio
D. A circuit designed to provide high fidelity audio

A. An inductor and a capacitor connected in series or parallel to form a filter

T6D12
Which of the following is a common reason to use shielded wire?
A. To decrease the resistance of DC power connections
B. To increase the current carrying capability of the wire
C. To prevent coupling of unwanted signals to or from the wire
D. To couple the wire to other signals

C. To prevent coupling of unwanted signals to or from the wire

SUBELEMENT T7

Station equipment: common transmitter and receiver problems; antenna measurements; troubleshooting; basic repair and testing
4 Exam Questions - 4 Groups

T7A – Station equipment: receivers; transmitters; transceivers; modulation; transverters; low power and weak signal operation; transmit and receive amplifiers

The two basic pieces of radio equipment are the transmitter and receiver. A transceiver is **a unit combining the functions of a transmitter and a receiver**. They may actually share some common circuitry to make things work.

The ability of a receiver to detect the presence of a signal is called **sensitivity**. The ability of a receiver to discriminate between multiple signals is call **selectivity**.

A **mixer** is used to convert a radio signal from one frequency to another.

T7A01
Which term describes the ability of a receiver to detect the presence of a signal?
A. Linearity
B. Sensitivity
C. Selectivity
D. Total Harmonic Distortion

B. Sensitivity

T7A04
Which term describes the ability of a receiver to discriminate between multiple signals?
A. Discrimination ratio
B. Sensitivity
C. Selectivity
D. Harmonic Distortion

C. Selectivity

T7A02
What is a transceiver?
A. A type of antenna switch
B. A unit combining the functions of a transmitter and a receiver
C. A component in a repeater which filters out unwanted interference
D. A type of antenna matching network

B. A unit combining the functions of a transmitter and a receiver

T7A03
Which of the following is used to convert a radio signal from one frequency to another?
A. Phase splitter
B. Mixer
C. Inverter
D. Amplifier

B. Mixer

The **oscillator** is the name of a circuit that generates a signal of a desired frequency. All transmitters and transceivers have an oscillator circuit.

While the oscillator is an important part of the transmitter, other circuitry is needed in order to use speech rather than CW. One would use **modulation** to combine speech with an RF carrier signal.

The push to talk function which switches between receive and transmit, is called the PTT in ham radio lingo.

T7A05
What is the name of a circuit that generates a signal of a desired frequency?
A. Reactance modulator
B. Product detector
C. Low-pass filter
D. Oscillator

D. Oscillator

T7A08
Which of the following describes combining speech with an RF carrier signal?-
A. Impedance matching
B. Oscillation
C. Modulation
D. Low-pass filtering

C. Modulation

T7A07
What is meant by term "PTT"?
A. Pre-transmission tuning to reduce transmitter harmonic emission
B. Precise tone transmissions used to limit repeater access to only certain signals
C. A primary transformer tuner use to match antennas
D. The push to talk function which switches between receive and transmit

D. The push to talk function which switches between receive and transmit

Many hams use **a multi-mode VHF transceiver** for VHF weak-signal communications. Since many HF transceivers do not cover the VHF bands, one could also use a Transverter. For example, one could use the output of a low-powered 28 MHz SSB exciter and produce a 222 MHz output signal using a **transverter**.

T7A06
What device takes the output of a low-powered 28 MHz SSB exciter and produces a 222 MHz output signal?
A. High-pass filter
B. Low-pass filter
C. Transverter
D. Phase converter

C. Transverter

T7A09
Which of the following devices is most useful for VHF weak-signal communication?
A. A quarter-wave vertical antenna
B. A multi-mode VHF transceiver
C. An omni-directional antenna
D. A mobile VHF FM transceiver

B. A multi-mode VHF transceiver

The first purchase a new ham makes is often a handheld radio. It is often used in the car as a mobile radio. The low power of a handheld may not be suitable for some mobile operations. **An RF power amplifier** is a device that increases the low-power output from a handheld transceiver.

Another problem may be that the hand held transceiver may not be sensitive enough to hear the weaker signals. In this case, an RF preamplifier may be installed **between the antenna and receiver**. Note that if this is done with a handheld radio or a transceiver, then some switching will be required so that the preamplifier is not in the line when transmitting. Most commercial preamplifiers include this feature.

T7A10
What device increases the low-power output from a handheld transceiver?
A. A voltage divider
B. An RF power amplifier
C. An impedance network

D. All of these choices are correct

B. An RF power amplifier

T7A11
Where is an RF preamplifier installed?
A. Between the antenna and receiver
B. At the output of the transmitter's power amplifier
C. Between a transmitter and antenna tuner
D. At the receiver's audio output

A. Between the antenna and receiver

T7B – Common transmitter and receiver problems: symptoms of overload and overdrive; distortion; causes of interference; interference and consumer electronics; part 15 devices; over and under modulation; RF feedback; off frequency signals; fading and noise; problems with digital communications interfaces

Dealing with neighborhood interference issues can be problematic at best. Interference issues can go both ways. You may interfere with a neighbor's telephone, radio, or TV; however, some of his devices may interfere with your enjoyment of amateur radio. Generally, neighbors do not understand or care for the technical reasons they are having interference. They just want the problem solved! Being a good neighbor is part of being a good ham. Patients and understanding benefit both parties.

If someone tells you that your transmissions are interfering with their radio or TV reception **make sure that your station is operating properly and that it does not cause interference to your own television**.

Fundamental overload is not a problem with your transmitter. **The receiver is unable to reject strong signals outside the AM or FM band**. This would cause a broadcast AM or FM radio to receive an amateur radio transmission unintentionally. Overload of a non-amateur radio or TV receiver by an amateur signal can be reduced or eliminated by **blocking the amateur signal with a filter at the antenna input of the affected receiver**.

A first step in resolving inference to a cable TV from your ham radio transmissions is to **be sure all TV coaxial connectors are installed properly.**

One way to reduce or eliminate interference by an amateur transmitter to a nearby telephone would be to **put a RF filter on the telephone**.

Causes of Radio Frequency Interference:

- Fundamental overload
- Harmonics
- Spurious emissions.
- **All of these choices are correct**

Unlike fundamental overload, harmonics and spurious emissions are problems with the transmitter. Filters can eliminate harmonics. Proper transmitter adjustments will solve spurious emission problems. The following may be useful in correcting a radio frequency interference problem:

- Snap-on ferrite chokes
- Low-pass and high-pass filters
- Band-reject and band-pass filters.
- **All of these choices are correct**

A Part 15 device is **an unlicensed device that may emit low powered radio signals on frequencies used by a licensed service**. If a "Part 15" device in your neighbor's home is causing harmful interference to your amateur station:

- Work with your neighbor to identify the offending device
- Politely inform your neighbor about the rules that require him to stop using the device if it causes interference
- Check your station and make sure it meets the standards of good amateur practice.
- **All these choices are correct**

T7B02
What would cause a broadcast AM or FM radio to receive an amateur radio transmission unintentionally?
A. The receiver is unable to reject strong signals outside the AM or FM band
B. The microphone gain of the transmitter is turned up too high
C. The audio amplifier of the transmitter is overloaded
D. The deviation of an FM transmitter is set too low

A. The receiver is unable to reject strong signals outside the AM or FM band

T7B03
Which of the following may be a cause of radio frequency interference?
A. Fundamental overload
B. Harmonics
C. Spurious emissions
D. All of these choices are correct

D. All of these choices are correct

T7B04
Which of the following is a way to reduce or eliminate interference by an amateur transmitter to a nearby telephone?
A. Put a filter on the amateur transmitter
B. Reduce the microphone gain
C. Reduce the SWR on the transmitter transmission line
D. Put a RF filter on the telephone

D. Put a RF filter on the telephone

T7B05
How can overload of a non-amateur radio or TV receiver by an amateur signal be reduced or eliminated?
A. Block the amateur signal with a filter at the antenna input of the affected receiver
B. Block the interfering signal with a filter on the amateur transmitter
C. Switch the transmitter from FM to SSB
D. Switch the transmitter to a narrow-band mode

A. Block the amateur signal with a filter at the antenna input of the affected receiver

T7B06
Which of the following actions should you take if a neighbor tells you that your station's transmissions are interfering with their radio or TV reception?
A. Make sure that your station is functioning properly and that it does not cause interference to your own radio or television when it is tuned to the same channel
B. Immediately turn off your transmitter and contact the nearest FCC office for assistance
C. Tell them that your license gives you the right to transmit and nothing can be done to reduce the interference
D. Install a harmonic doubler on the output of your transmitter and tune it until the interference is eliminated

A. Make sure that your station is functioning properly and that it does not cause interference to your own radio or television when it is tuned to the same channel

T7B12
What might be the first step to resolve cable TV interference from your ham radio transmission?
A. Add a low pass filter to the TV antenna input
B. Add a high pass filter to the TV antenna input
C. Add a preamplifier to the TV antenna input
D. Be sure all TV coaxial connectors are installed properly

D. Be sure all TV coaxial connectors are installed properly

T7B07
Which of the following may be useful in correcting a radio frequency interference problem?
A. Snap-on ferrite chokes
B. Low-pass and high-pass filters
C. Band-reject and band-pass filters

D. All of these choices are correct

D. All of these choices are correct

T7B08
What should you do if something in a neighbor's home is causing harmful interference to your amateur station?
A. Work with your neighbor to identify the offending device
B. Politely inform your neighbor about the rules that prohibit the use of devices which cause interference
C. Check your station and make sure it meets the standards of good amateur practice
D. All of these choices are correct

D. All of these choices are correct

T7B09
What is a Part 15 device?
A. An unlicensed device that may emit low powered radio signals on frequencies used by a licensed service
B. A type of amateur radio that can legally be used in the citizen's band
C. A device for long distance communications using special codes sanctioned by the International Amateur Radio Union
D. A type of test set used to determine whether a transmitter is in compliance with FCC regulation 91.15

A. An unlicensed device that may emit low powered radio signals on frequencies used by a licensed service

If you are told your FM handheld or mobile transceiver is over deviating **talk farther away from the microphone**. Remember the distortion from turning the microphone gain up too high? You can reduce the microphone gain to solve this problem, but on many radios the gain control is on the inside of the radio. One way to solve the problem is simply to "back off the Mic".

If another operator reports a variable high-pitched whine on the audio from your mobile transmitter, noise on the vehicle's electrical system is being transmitted along with your speech audio. This could be the alternator whine discussed earlier. It affects the transmitter as well as the receiver Remember: Connect your power cable directly to the battery. Do not use accessory sockets!

If you receive a report that your signal through the repeater is distorted or unintelligible:

- Your transmitter may be slightly off frequency,
- Your batteries may be running low,
- You could be in a bad location.
- **All of these choices are correct**

Reports of garbled, distorted, or unintelligible transmissions can be caused by RF feedback in a transmitter or transceiver.

T7B10
What might be the problem if you receive a report that your audio signal through the repeater is distorted or unintelligible?
A. Your transmitter may be slightly off frequency
B. Your batteries may be running low
C. You could be in a bad location
D. All of these choices are correct

D. All of these choices are correct

T7B01
What can you do if you are told your FM handheld or mobile transceiver is over-deviating?
A. Talk louder into the microphone
B. Let the transceiver cool off
C. Change to a higher power level
D. Talk farther away from the microphone

D. Talk farther away from the microphone

T7B11
What is a symptom of RF feedback in a transmitter or transceiver?
A. Excessive SWR at the antenna connection
B. The transmitter will not stay on the desired frequency
C. Reports of garbled, distorted, or unintelligible transmissions
D. Frequent blowing of power supply fuses

C. Reports of garbled, distorted, or unintelligible transmissions

T7C – Antenna measurements and troubleshooting: measuring SWR; dummy loads; coaxial cables; feed line failure modes

Many hams spend much of their "radio activity" experimenting with different kinds of antennas. This is a lot of fun and considering today's world of miniaturization of radio components, antenna building is still an easy "do it yourself" adventure. To keep your antenna tuned properly, a few pieces of test equipment are quite valuable and not too costly.

A dummy load is a good piece to start with. While it does not test an antenna, it does take the place of one for testing purposes. A dummy load consists of **a non-inductive resistor and a heat sink**. The primary purpose of a dummy load is to **prevent the radiation of signals when making tests**. A dummy load is shielded so that test signals do not go far.

An **antenna analyzer** can be used to determine if an antenna is resonant at the desired operating frequency. These are quite pricey however and one can do just fine with an SWR meter. An SWR meter, obviously, measures SWR. In general terms, standing wave ratio (SWR) is **a measure of how well a load is matched to a transmission line**.

A 1 to 1 reading on an SWR meter indicates a perfect impedance match between the antenna and the feedline. Amateur Radio Transmitters are designed for an impedance of 50 ohms. The idea when adjusting an antenna is to tune the antenna for an impedance of 50 ohms giving you a **perfect match of 1 to 1**.

2 to 1 is the approximate SWR value above which the protection circuits in most solid-state transmitters Start to reduce transmitter power. **An SWR of 4:1 means there is an impedance mismatch.**

As an alternative to the SWR meter you could use a **directional wattmeter** to determine if a feedline and antenna are properly matched. You measure the power going to the antenna. Then you can reverse the Wattmeter circuit and measure the power coming back from the antenna. The less power coming back, the better the match.

T7C13
What does a dummy load consist of?
A. A high-gain amplifier and a TR switch
B. A non-inductive resistor and a heat sink
C. A low voltage power supply and a DC relay
D. A 50 ohm reactance used to terminate a transmission line

B. A non-inductive resistor and a heat sink

T7C01
What is the primary purpose of a dummy load?
A. To prevent the radiation of signals when making tests
B. To prevent over-modulation of your transmitter
C. To improve the radiation from your antenna
D. To improve the signal to noise ratio of your receiver

A. To prevent the radiation of signals when making tests

T7C02
Which of the following instruments can be used to determine if an antenna is resonant at the desired operating frequency?
A. A VTVM
B. An antenna analyzer
C. A Q meter

D. A frequency counter

B. An antenna analyzer

T7C03
What, in general terms, is standing wave ratio (SWR)?
A. A measure of how well a load is matched to a transmission line
B. The ratio of high to low impedance in a feed line
C. The transmitter efficiency ratio
D. An indication of the quality of your station's ground connection

A. A measure of how well a load is matched to a transmission line

T7C04
What reading on an SWR meter indicates a perfect impedance match between the antenna and the feed line?
A. 2 to 1
B. 1 to 3
C. 1 to 1
D. 10 to 1

C. 1 to 1

T7C05
What is the approximate SWR value above which the protection circuits in most solid-state transmitters begin to reduce transmitter power?
A. 2 to 1
B. 1 to 2
C. 6 to 1
D. 10 to 1

A. 2 to 1

T7C06
What does an SWR reading of 4:1 indicate?
A. Loss of -4dB
B. Good impedance match
C. Gain of +4dB
D. Impedance mismatch

D. Impedance mismatch

T7C08
What instrument other than an SWR meter could you use to determine if a feed line and antenna are properly matched?
A. Voltmeter
B. Ohmmeter
C. Iambic pentameter
D. Directional wattmeter

D. Directional wattmeter

Coaxial cable is commonly used for **carrying RF signals between a radio and antenna**. The 50 ohms provides a good match for the antenna and transmitter, as long as both are also adjusted for 50 ohms. The outer jacket of coaxial cable should be resistant to ultraviolet light because **ultraviolet light can damage the jacket and allow water to enter the cable**.

If the SWR is too high, there is power lost in the coaxial feedline. Power lost in a feedline **is converted into heat**.

The most common cause for failure of coaxial cable is **moisture contamination**. This is usually due to the outer jacket of the cable not being resistant to ultraviolet light or poor weather proofing of outside cables connectors attached to antennas. Easily preventable but often ignored.

A disadvantage of "air core" coaxial cable, when compared to foam or solid dielectric types **is that it requires special techniques to prevent water absorption**.

T7C07
What happens to power lost in a feed line?
A. It increases the SWR
B. It comes back into your transmitter and could cause damage
C. It is converted into heat
D. It can cause distortion of your signal

C. It is converted into heat

T7C09
Which of the following is the most common cause for failure of coaxial cables?
A. Moisture contamination
B. Gamma rays
C. The velocity factor exceeds 1.0
D. Overloading

A. Moisture contamination

T7C10
Why should the outer jacket of coaxial cable be resistant to ultraviolet light?
A. Ultraviolet resistant jackets prevent harmonic radiation
B. Ultraviolet light can increase losses in the cable's jacket
C. Ultraviolet and RF signals can mix together, causing interference
D. Ultraviolet light can damage the jacket and allow water to enter the cable

D. Ultraviolet light can damage the jacket and allow water to enter the cable

T7C11
What is a disadvantage of air core coaxial cable when compared to foam or solid dielectric types?
A. It has more loss per foot
B. It cannot be used for VHF or UHF antennas
C. It requires special techniques to prevent water absorption
D. It cannot be used at below freezing temperatures

C. It requires special techniques to prevent water absorption

T7C12
Which of the following is a common use of coaxial cable?
A. Carrying dc power from a vehicle battery to a mobile radio
B. Carrying RF signals between a radio and antenna
C. Securing masts, tubing, and other cylindrical objects on towers
D. Connecting data signals from a TNC to a computer

B. Carrying RF signals between a radio and antenna

T7D – Basic repair and testing: soldering; using basic test instruments; connecting a voltmeter, ammeter, or ohmmeter

For the exam, you will need to know a little bit about various test equipment. Hams are noted for being able to repair their own equipment. Certainly, it would be a very valuable tool during an emergency. While today's modern equipment is complicated, there are still a few things you can check for yourself.

A **voltmeter** is an instrument you would use to measure electric potential or electromotive force. Remember that electromotive force is measured in volts. The correct way to connect a voltmeter to a circuit is **in parallel with the circuit**.

If you are checking the voltage of the battery, the negative lead of the voltmeter (black lead) goes to the minus side of the battery and the positive lead of the voltmeter (red lead) goes to the plus side of the battery.

If checking a circuit, the negative lead would normally go to the circuits main ground while the positive lead would go to the part of the circuit in which the voltage needs checked.

Precautions should be taken when measuring high voltages with a voltmeter. **Ensure that the voltmeter and leads are rated for use at the voltages to be measured**.

An **ammeter** is used to measure current being drawn by a circuit. You would connect an ammeter **in series with the circuit**.

T7D01
Which instrument would you use to measure electric potential or electromotive force?
A. An ammeter
B. A voltmeter
C. A wavemeter
D. An ohmmeter

B. A voltmeter

T7D02
What is the correct way to connect a voltmeter to a circuit?
A. In series with the circuit
B. In parallel with the circuit
C. In quadrature with the circuit
D. In phase with the circuit

B. In parallel with the circuit

There will be times that one needs to know how much current is being used by a circuit. An ammeter is an instrument used to measure electric current. **An ammeter** is usually connected to a circuit **in series with the circuit**. For example, if you wished to see how much current was being drawn by a light bulb powered by a battery, the ammeter would be placed in series between the battery positive and the light bulb.

T7D03
How is an ammeter usually connected to a circuit?
A. In series with the circuit
B. In parallel with the circuit
C. In quadrature with the circuit
D. In phase with the circuit

A. In series with the circuit

T7D12
Which of the following precautions should be taken when measuring high voltages with a voltmeter?
A. Ensure that the voltmeter has very low impedance
B. Ensure that the voltmeter and leads are rated for use at the voltages to be measured
C. Ensure that the circuit is grounded through the voltmeter
D. Ensure that the voltmeter is set to the correct frequency

B. Ensure that the voltmeter and leads are rated for use at the voltages to be measured

T7D04
Which instrument is used to measure electric current?
A. An ohmmeter
B. A wavemeter
C. A voltmeter
D. An ammeter

D. An ammeter

An ohmmeter is an instrument used to measure resistance. When an ohmmeter is connected across a circuit and initially indicates a low resistance and then shows increasing resistance with time, **the circuit contains a large capacitor**.

A precaution taken when measuring circuit resistance with an ohmmeter is to **ensure that the circuit is not powered**. Otherwise you may damage the meter.

Voltage and resistance are measurements commonly made using a multimeter. **Attempting to measure voltage when using the resistance setting** might damage a multimeter.

T7D05
What instrument is used to measure resistance?
A. An oscilloscope
B. A spectrum analyzer
C. A noise bridge
D. An ohmmeter

D. An ohmmeter

T7D06
Which of the following might damage a multimeter?
A. Measuring a voltage too small for the chosen scale
B. Leaving the meter in the milliamps position overnight
C. Attempting to measure voltage when using the resistance setting
D. Not allowing it to warm up properly

C. Attempting to measure voltage when using the resistance setting

T7D07
Which of the following measurements are commonly made using a multimeter?
A. SWR and RF power
B. Signal strength and noise
C. Impedance and reactance
D. Voltage and resistance

D. Voltage and resistance

T7D10
What is probably happening when an ohmmeter, connected across an unpowered circuit, initially indicates a low resistance and then shows increasing resistance with time?
A. The ohmmeter is defective
B. The circuit contains a large capacitor
C. The circuit contains a large inductor
D. The circuit is a relaxation oscillator

B. The circuit contains a large capacitor

T7D11
Which of the following precautions should be taken when measuring circuit resistance with an ohmmeter?
A. Ensure that the applied voltages are correct
B. Ensure that the circuit is not powered
C. Ensure that the circuit is grounded
D. Ensure that the circuit is operating at the correct frequency

B. Ensure that the circuit is not powered

Many hams enjoy building their own equipment. One of the skills required to do this is good soldering techniques. Even if you do not like to build your own equipment, there will come a time when you have to solder connecters on a cable, or repair an antenna. Soldering is an easy skill to learn and with practice, most hams can do an acceptable job.

You will want to use the correct solder when doing a project. **Rosin-core solder** is best for radio and electronic use.

When soldering, one needs to get the connection to be soldered hot enough to melt the solder. Do not run solder down the soldering iron. That creates a cold solder joint. Just let it flow over the connection. **A grainy or dull surface** is the characteristic appearance of a "cold" solder joint.

T7D08
Which of the following types of solder is best for radio and electronic use?
A. Acid-core solder
B. Silver solder
C. Rosin-core solder
D. Aluminum solder

C. Rosin-core solder

T7D09
What is the characteristic appearance of a cold solder joint?
A. Dark black spots
B. A bright or shiny surface
C. A grainy or dull surface
D. A greenish tint

C. A grainy or dull surface

SUBELEMENT T8

Modulation modes: amateur satellite operation; operating activities; non-voice communications
4 Exam Questions - 4 Groups

T8A – Modulation modes: bandwidth of various signals; choice of emission type

From the previous sections, one should already be familiar with the common modulation modes of SSB and FM. **Single Sideband** is a form of amplitude modulation. FM is a form of frequency modulation.

SSB is the type of voice modulation most often used for long-distance or weak signal contacts on the VHF and UHF bands. **FM** is the type of modulation most commonly used for VHF and UHF voice repeaters. **FM** is also the type of modulation most commonly used for VHF packet radio transmissions.

The primary advantage of single sideband over FM for voice transmissions is that **SSB signals have narrower bandwidth**. The bandwidth of an SSB signal is about **3 KHz**, whereas FM is between 10 and 15 KHz. The approximate bandwidth of a VHF repeater FM phone signal is also between **10 and 15 kHz**.

T8A01
Which of the following is a form of amplitude modulation?
A. Spread-spectrum
B. Packet radio
C. Single sideband
D. Phase shift keying

C. Single sideband

T8A02
What type of modulation is most commonly used for VHF packet radio transmissions?
A. FM
B. SSB
C. AM
D. Spread Spectrum

A. FM

T8A03
Which type of voice mode is most often used for long-distance (weak signal) contacts on the VHF and UHF bands?
A. FM
B. DRM
C. SSB
D. PM

C. SSB

T8A04
Which type of modulation is most commonly used for VHF and UHF voice repeaters?
A. AM
B. SSB
C. PSK
D. FM

D. FM

T8A07
What is the primary advantage of single sideband over FM for voice transmissions?
A. SSB signals are easier to tune
B. SSB signals are less susceptible to interference
C. SSB signals have narrower bandwidth
D. All of these choices are correct

C. SSB signals have narrower bandwidth

T8A08
What is the approximate bandwidth of a single sideband voice signal?
A. 1 kHz
B. 3 kHz
C. 6 kHz
D. 15 kHz

B. 3 kHz

T8A09
What is the approximate bandwidth of a VHF repeater FM phone signal?
A. Less than 500 Hz
B. About 150 kHz
C. Between 10 and 15 kHz
D. Between 50 and 125 kHz

C. Between 10 and 15 kHz

There are two types of SSB signals. One is called LSB for lower sideband. The other is called USB for upper sideband. Technically they are both the same mode. One modulates on the low frequency side of center and the other modulates on the upper side of center. The sideband normally used for 10 meter HF, VHF and UHF single-sideband communications is **upper sideband**.

CW is the type of emission that has the narrowest bandwidth. **150 Hz** is the approximate maximum bandwidth required to transmit a CW signal. CW is a very efficient mode. One can fit about 20 CW signals in the space of one SSB signal.

Ever dream of having your own TV station? Well, as an Amateur Radio Operator, you can! Amateur Fast scan TV uses the same specifications that commercial analog TV does. In fact, one may use a regular unmodified TV to receive these signals. They just happen to already receive on the ham frequencies! For the Technician exam, you only need to know the bandwidth of fast scan TV: The typical bandwidth of analog fast-scan TV transmissions on the 70 cm band **about 6 MHz**.

T8A05
Which of the following types of emission has the narrowest bandwidth?
A. FM voice
B. SSB voice
C. CW
D. Slow-scan TV

C. CW

T8A06
Which sideband is normally used for 10 meter HF, VHF and UHF single-sideband communications?
A. Upper sideband
B. Lower sideband
C. Suppressed sideband
D. Inverted sideband

A. Upper sideband

T8A10
What is the typical bandwidth of analog fast-scan TV transmissions on the 70 cm band?
A. More than 10 MHz
B. About 6 MHz
C. About 3 MHz
D. About 1 MHz

B. About 6 MHz

T8A11
What is the approximate maximum bandwidth required to transmit a CW signal?
A. 2.4 kHz
B. 150 Hz
C. 1000 Hz
D. 15 kHz

B. 150 Hz

T8B - Amateur satellite operation; Doppler shift, basic orbits, operating protocols; control operator, transmitter power considerations; satellite tracking; digital modes

Another fun way to enjoy ham radio is to communicate through a fleet of Amateur Satellites. **Any amateur whose license privileges allow them to transmit on the satellite uplink frequency** may be the control operator of a station communicating through an amateur satellite or space station. Being a Technician Class ham allows you to do just that, as most of the satellites use the 2 meter and 70 cm bands or higher. Some of the satellites or "birds" are simply one channel FM repeaters.

Some use 2 meters as the uplink, and 70 cm as the downlink. Other FM birds do just the opposite using 70 cm as the uplink and 2 meters as the downlink. There are several satellites that use what is called a linear transponder. SSB and CW stations use linear transponders. Unlike single channel FM birds, linear transponders have a very wide bandwidth in which many SSB or CW stations may use at the same time.

Because of the limited power resources of a satellite, **The minimum amount of power needed to complete the contact** is how much transmitter power should be used on the uplink frequency of an amateur satellite or space station.

Besides satellites, **any amateur holding a Technician or higher class license** may make contact with an amateur station on the International Space Station using amateur radio frequencies. Yes, there is a ham radio aboard the International Space Station. They use 2 meters and 70 cm frequently.

T8B01
Who may be the control operator of a station communicating through an amateur satellite or space station?
A. Only an Amateur Extra Class operator
B. A General Class licensee or higher licensee who has a satellite operator certification
C. Only an Amateur Extra Class operator who is also an AMSAT member
D. Any amateur whose license privileges allow them to transmit on the satellite uplink frequency

D. Any amateur whose license privileges allow them to transmit on the satellite uplink frequency

T8B02
How much transmitter power should be used on the uplink frequency of an amateur satellite or space station?
A. The maximum power of your transmitter
B. The minimum amount of power needed to complete the contact
C. No more than half the rating of your linear amplifier
D. Never more than 1 watt

B. The minimum amount of power needed to complete the contact

T8B04
Which amateur stations may make contact with an amateur station on the International Space Station using 2 meter and 70 cm band amateur radio frequencies?
A. Only members of amateur radio clubs at NASA facilities
B. Any amateur holding a Technician or higher class license
C. Only the astronaut's family members who are hams
D. You cannot talk to the ISS on amateur radio frequencies

B. Any amateur holding a Technician or higher class license

A satellite tracking program can be used to determine the time period during which an amateur satellite or space station can be accessed. There are several good tracking programs that can be downloaded free of charge. Tracking programs provide the following useful information:

- Maps showing the real-time position of the satellite track over the earth
- The time, azimuth, and elevation of the start, maximum altitude, and end of a pass
- The apparent frequency of the satellite transmission, including effects of Doppler shift
- **All of these answers are correct**

The Keplerian elements are inputs that provide the tracking program with information about the satellite. These inputs are required so that the satellite can be accurately tracked and are updated on a regular basis.

The first thing one may wish to do after locating a satellite with the tracking program is to listen to the satellites beacon. A satellite beacon is **a transmission from a space station that contains information about a satellite**.

T8B03
Which of the following are provided by satellite tracking programs?
A. Maps showing the real-time position of the satellite track over the earth
B. The time, azimuth, and elevation of the start, maximum altitude, and end of a pass
C. The apparent frequency of the satellite transmission, including effects of Doppler shift
D. All of these answers are correct

D. All of these answers are correct

T8B05
What is a satellite beacon?
A. The primary transmit antenna on the satellite
B. An indicator light that that shows where to point your antenna
C. A reflective surface on the satellite
D. A transmission from a space station that contains information about a satellite

D. A transmission from a space station that contains information about a satellite

T8B06
Which of the following are inputs to a satellite tracking program?
A. The weight of the satellite
B. The Keplerian elements
C. The last observed time of zero Doppler shift
D. All of these answers are correct

B. The Keplerian elements

The available time for communications varies with the orbital pass projected by the satellite tracking software. Another factor is how high the satellite is. If a satellite is in an elliptical orbit, then the satellite will be in view for several hours. Presently all our satellites are in a low earth orbit, which gives one a10 to 25 minute window in which to make contacts. The initials LEO tell you **the satellite is in a Low Earth orbit.**

The statement that a satellite is operating in "mode U/V" means that **the satellite uplink is in the 70 cm band and the downlink is in the 2 meter band**. This is a shortcut for telling everyone that the uplink is on the UHF band and the Downlink is on the VHF band. Many satellites use the mode V/U which of course means that the uplink is on the VHF band and the downlink is on the UHF band.

When listening to a satellite, one will notice a couple of things. The frequency seems to drift so that you have to constantly retune the receiver and there is some fading in and out if the signal is on the weak side. Doppler shift is **an observed change in signal frequency caused by relative motion between the satellite and the earth station**, and **Rotation of the satellite and its antennas** cause "spin fading" when referring to satellite signals.

Besides FM voice, SSB voice, and CW, a commonly used method of sending signals to and from a digital satellite is **FM Packet**.

T8B07
With regard to satellite communications, what is Doppler shift?
A. A change in the satellite orbit
B. A mode where the satellite receives signals on one band and transmits on another
C. An observed change in signal frequency caused by relative motion between the satellite and the earth station
D. A special digital communications mode for some satellites

C. An observed change in signal frequency caused by relative motion between the satellite and the earth station

T8B08
What is meant by the statement that a satellite is operating in mode U/V?
A. The satellite uplink is in the 15 meter band and the downlink is in the 10 meter band
B. The satellite uplink is in the 70 cm band and the downlink is in the 2 meter band
C. The satellite operates using ultraviolet frequencies
D. The satellite frequencies are usually variable

B. The satellite uplink is in the 70 cm band and the downlink is in the 2 meter band

T8B09
What causes spin fading when referring to satellite signals?
A. Circular polarized noise interference radiated from the sun
B. Rotation of the satellite and its antennas
C. Doppler shift of the received signal
D. Interfering signals within the satellite uplink band

B. Rotation of the satellite and its antennas

T8B10
What do the initials LEO tell you about an amateur satellite?
A. The satellite battery is in Low Energy Operation mode
B. The satellite is performing a Lunar Ejection Orbit maneuver
C. The satellite is in a Low Earth Orbit
D. The satellite uses Light Emitting Optics

C. The satellite is in a Low Earth Orbit

T8B11
What is a commonly used method of sending signals to and from a digital satellite?
A. USB AFSK
B. PSK31
C. FM Packet
D. WSJT

C. FM Packet

T8C – Operating activities: radio direction finding; radio control; contests; linking over the Internet; grid locators

As one may have noticed, there are many operating activities that can entertain hams for years. In this section we will review just a few that may be on the exam. One popular activity is called Fox Hunting. No, you don't strap a radio onto a fox and then chase it! Fox hunting is another name used for Transmitter Hunting. In its simplicity, a transmitter is hidden and hams try to find it. It is a fun event which takes up most of an afternoon. Perhaps a picnic will follow the fox hunt. **A directional antenna** would be useful for a hidden transmitter hunt.

On the serious side, hams use fox hunting to prepare for real life situations. **Radio direction finding** methods are used to locate sources of noise interference or jamming.

T8C01
Which of the following methods is used to locate sources of noise interference or jamming?
A. Echolocation
B. Doppler radar
C. Radio direction finding
D. Phase locking

C. Radio direction finding

T8C02
Which of these items would be useful for a hidden transmitter hunt?
A. Calibrated SWR meter
B. A directional antenna
C. A calibrated noise bridge
D. All of these choices are correct

B. A directional antenna

Contesting is a popular operating activity that involves contacting as many stations as possible during a specified period of time. If one has been active in sports, or just likes to watch sports on TV, these contests may be of special interest. The term is actually called Radio Sports. You can figure the rest out.

A good procedure when contacting another station in a radio contest is to **send only the minimum information needed for proper identification and the contest exchange**. The contest exchange is a piece of information that each station in the contest needs to receive accurately. To receive the contest exchange incorrectly voids the contacts and reduces your point total.

One such exchange may be your grid location. A grid locator is **a letter-number designator assigned to a geographic location**. An example would be EN80 is the grid locator for Mt. Vernon, Ohio.

T8C03
What popular operating activity involves contacting as many stations as possible during a specified period of time?
A. Contesting
B. Net operations
C. Public service events
D. Simulated emergency exercises

A. Contesting

T8C04
Which of the following is good procedure when contacting another station in a radio contest?
A. Be sure to sign only the last two letters of your call if there is a pileup calling the station
B. Work the station twice to be sure that you are in his log
C. Send only the minimum information needed for proper identification and the contest exchange
D. All of these choices are correct

C. Send only the minimum information needed for proper identification and the contest exchange

T8C05
What is a grid locator?
A. A letter-number designator assigned to a geographic location
B. A letter-number designator assigned to an azimuth and elevation
C. An instrument for neutralizing a final amplifier
D. An instrument for radio direction finding

A. A letter-number designator assigned to a geographic location

Another fun activity is controlling model crafts. Most popular are cars and airplanes, but the choice is yours. There are a few things that need abided by though:

- The maximum power allowed when transmitting telecommand signals to radio controlled models is **1 watt**.

- It is required that **a label indicating the licensee's call sign and address must be affixed to the transmitter** in place of on-air station identification when sending signals to a radio control model using amateur frequencies.

Two rules easy enough to follow considering the enjoyment of using your own frequency for model control

T8C07
What is the maximum power allowed when transmitting telecommand signals to radio controlled models?
A. 500 milliwatts
B. 1 watt
C. 25 watts
D. 1500 watts

B. 1 watt

T8C08
What is required in place of on-air station identification when sending signals to a radio control model using amateur frequencies?
A. Voice identification must be transmitted every 10 minutes
B. Morse code ID must be sent once per hour
C. A label indicating the licensee's name, call sign and address must be affixed to the transmitter
D. A flag must be affixed to the transmitter antenna with the station call sign in 1 inch high letters or larger

C. A label indicating the licensee's name, call sign and address must be affixed to the transmitter

Communicating with hams over the internet has become a popular activity. In fact, if one does not have his or own station he or she can use a computer to talk world-wide to other hams. Yes, Technician Class hams are allowed to participate it this activity.

A gateway is the name given to an amateur radio station that is used to connect other amateur stations to the Internet. You might obtain a list of active nodes that use VoIP (Voice Over Internet Protocol) **from a repeater directory**. The Internet Radio Linking Project (IRLP) is **a technique to connect amateur radio systems, such as repeaters, via the Internet using Voice Over Internet Protocol .** Voice Over Internet Protocol (VoIP) as used in amateur radio is **a method of delivering voice communications over the Internet using digital techniques.**

You can select a specific IRLP node when using a portable transceiver **by using DTMF signals** via the radios **keypad to transmit the IRLP node ID**.

T8C06
How is access to an IRLP node accomplished?
A. By obtaining a password which is sent via voice to the node
B. By using DTMF signals
C. By entering the proper Internet password
D. By using CTCSS tone codes

B. By using DTMF signals

T8C09
How might you obtain a list of active nodes that use VoIP?
A. From the FCC Rulebook
B. From your local emergency coordinator
C. From a repeater directory
D. From the local repeater frequency coordinator

C. From a repeater directory

T8C10
How do you select a specific IRLP node when using a portable transceiver?
A. Choose a specific CTCSS tone
B. Choose the correct DSC tone
C. Access the repeater autopatch
D. Use the keypad to transmit the IRLP node ID

D. Use the keypad to transmit the IRLP node ID

T8C11
What name is given to an amateur radio station that is used to connect other amateur stations to the Internet?
A. A gateway
B. A repeater
C. A digipeater
D. A beacon

A. A gateway

T8C12
What is meant by Voice Over Internet Protocol (VoIP) as used in amateur radio?
A. A set of rules specifying how to identify your station when linked over the Internet to another station
B. A set of guidelines for working DX during contests using Internet access
C. A technique for measuring the modulation quality of a transmitter using remote sites monitored via the Internet
D. A method of delivering voice communications over the Internet using digital techniques

D. A method of delivering voice communications over the Internet using digital techniques

T8C13
What is the Internet Radio Linking Project (IRLP)?
A. A technique to connect amateur radio systems, such as repeaters, via the Internet using Voice Over Internet Protocol
B. A system for providing access to websites via amateur radio
C. A system for informing amateurs in real time of the frequency of active DX stations
D. A technique for measuring signal strength of an amateur transmitter via the Internet

A. A technique to connect amateur radio systems, such as repeaters, via the Internet using Voice Over Internet Protocol

T8D – Non-voice communications: image signals; digital modes; CW; packet; PSK31; APRS; error detection and correction; NTSC

With the advent of computers and soundcards, many digital modes have been created. Most are as efficient or even more efficient than Morse Code. Unlike Morse Code however, one cannot decode these digital signals with the human ear.

The following are examples of digital communications methods.

- Packet
- PSK31
- MFSK
- **All of these choices are correct**

PSK31 is a low-rate data transmission mode and is a very popular digital mode. The abbreviation PSK means **Phase Shift Keying**.

T8D01
Which of the following is an example of a digital communications method?
A. Packet
B. PSK31
C. MFSK
D. All of these choices are correct

D. All of these choices are correct

T8D06
What does the abbreviation PSK mean?
A. Pulse Shift Keying

B. Phase Shift Keying
C. Packet Short Keying
D. Phased Slide Keying

B. Phase Shift Keying

Packet mode arrived about the same time as the internet. Packet has dedicated Radio Bulletin Board Stations that send and retrieve email over the radio waves. Packet stations also have their own mailbox so that other hams may leave messages for them. PSK is **a low-rate data transmission mode**.

Packet transmissions include:

- A check sum which permits error detection;
- A header which contains the call sign of the station to which the information is being sent;
- Automatic repeat request in case of error.
- **All of these choices are correct**

The term APRS means **Automatic Position Reporting System**. Packet stations use APRS as a way to keep track of where their ham friends are. A **Global Positioning System receiver** is normally used when sending automatic location reports via amateur radio. An application of APRS (Automatic Packet Reporting System) would be **providing real time tactical digital communications in conjunction with a map showing the locations of stations.**

T8D02
What does the term "APRS" mean?
A. Automatic Packet Reporting System
B. Associated Public Radio Station
C. Auto Planning Radio Set-up
D. Advanced Polar Radio System

A. Automatic Packet Reporting System

T8D03
Which of the following devices provides data to the transmitter when sending automatic position reports from a mobile amateur radio station?
A. The vehicle speedometer
B. A WWV receiver
C. A connection to a broadcast FM sub-carrier receiver
D. A Global Positioning System receiver

D. A Global Positioning System receiver

T8D05
Which of the following is an application of APRS (Automatic Packet Reporting System)?
A. Providing real time tactical digital communications in conjunction with a map showing the locations of stations
B. Showing automatically the number of packets transmitted via PACTOR during a specific time interval
C. Providing voice over Internet connection between repeaters
D. Providing information on the number of stations signed into a repeater

A. Providing real time tactical digital communications in conjunction with a map showing the locations of stations

T8D07
What is PSK31?
A. A high-rate data transmission mode
B. A method of reducing noise interference to FM signals
C. A method of compressing digital television signals
D. A low-rate data transmission mode

D. A low-rate data transmission mode

T8D08
Which of the following may be included in packet transmissions?
A. A check sum which permits error detection
B. A header which contains the call sign of the station to which the information is being sent
C. Automatic repeat request in case of error
D. All of these choices are correct

D. All of these choices are correct

CW or Morse Code is the oldest form of digital communications. Morse Code is still a very popular mode on the ham bands and one does not need a computer to enjoy "talking" in Morse Code. This may be on the test:

- The digital code used when sending CW in the amateur bands is **International Morse**.
- The following devices can be used to transmit CW in the amateur bands:
    1. Straight Key
    2. Electronic Keyer
    3. Computer Keyboard
    4. **All of these choices are correct**

T8D09
What code is used when sending CW in the amateur bands?
A. Baudot
B. Hamming
C. International Morse
D. Gray

C. International Morse

T8D10
Which of the following can be used to transmit CW in the amateur bands?
A. Straight Key
B. Electronic Keyer
C. Computer Keyboard
D. All of these choices are correct

D. All of these choices are correct

Only two other items in this section need to be addressed:

- an ARQ transmission system is **a digital scheme whereby the receiving station detects errors and sends a request to the sending station to retransmit the information.**
- **An analog fast scan color TV signal** is a type of transmission that is indicated by the term NTSC.

T8D11
What is an ARQ transmission system?
A. A special transmission format limited to video signals
B. A system used to encrypt command signals to an amateur radio satellite
C. A digital scheme whereby the receiving station detects errors and sends a request to the sending station to retransmit the information
D. A method of compressing the data in a message so more information can be sent in a shorter time

C. A digital scheme whereby the receiving station detects errors and sends a request to the sending station

T8D04
What type of transmission is indicated by the term NTSC?
A. A Normal Transmission mode in Static Circuit
B. A special mode for earth satellite uplink
C. An analog fast scan color TV signal
D. A frame compression scheme for TV signals

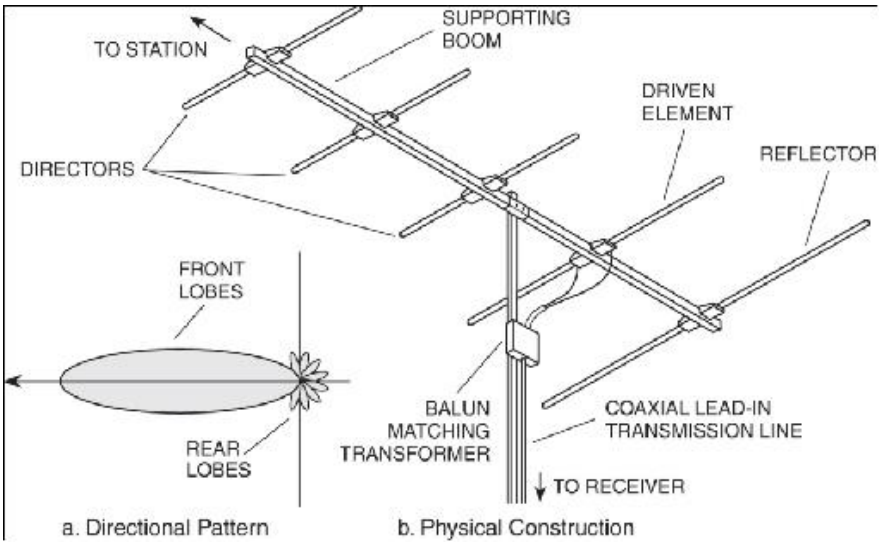
C. An analog fast scan color TV signal

SUBELEMENT T9

Antennas and feed lines
2 Exam Questions - 2 Groups

T9A – Antennas: vertical and horizontal polarization; concept of gain; common portable and mobile antennas; relationships between antenna length and frequency

A beam antenna concentrates signals in one direction.



A beam antenna is an antenna **that concentrates signals in one direction**.

Pictured is a five element beam, or directional antenna. One element is the reflector and one element is the driven element, which is the one that the feedline would be connected to. The last three elements of the beam are the directors.

The three types of **directional antenna** that you need to know for the exam are the quad, Yagi, and dish. The one pictured above is a yagi.

The main reason to use a directional antenna is that the gain of the directional antenna increases signal strength in a specified direction when compared to a reference antenna.

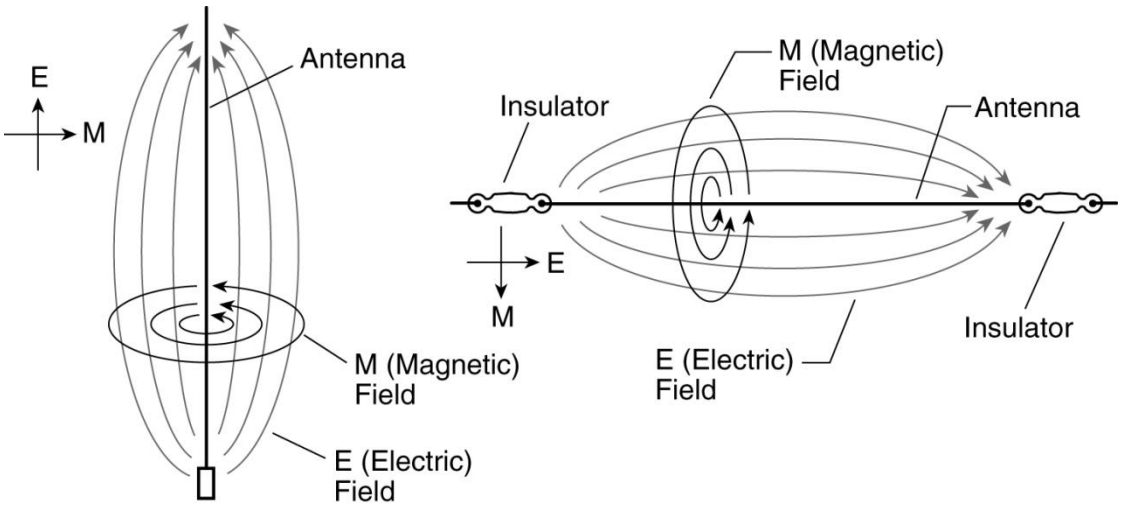
T9A01
What is a beam antenna?
A. An antenna built from aluminum I-beams
B. An omnidirectional antenna invented by Clarence Beam
C. An antenna that concentrates signals in one direction
D. An antenna that reverses the phase of received signals

C. An antenna that concentrates signals in one direction

T9A06
What type of antennas are the quad, Yagi, and dish?
A. Non-resonant antennas
B. Loop antennas
C. Directional antennas
D. Isotropic antennas

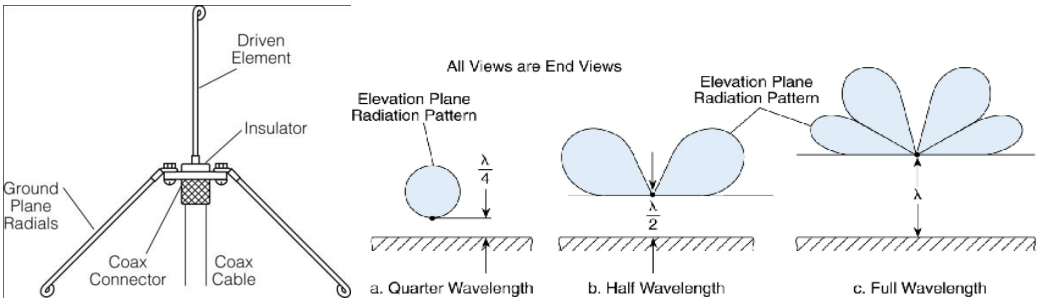
C. Directional antennas

T**he electric field of vertical antennas is perpendicular to the Earth**. Remember the Horizontal vs. Vertical that was discussed earlier? Verticals physically are perpendicular to the earth and the signals they radiate are also perpendicular to the earth. A vertical is simply a radiating element that is ¼ wavelength long.



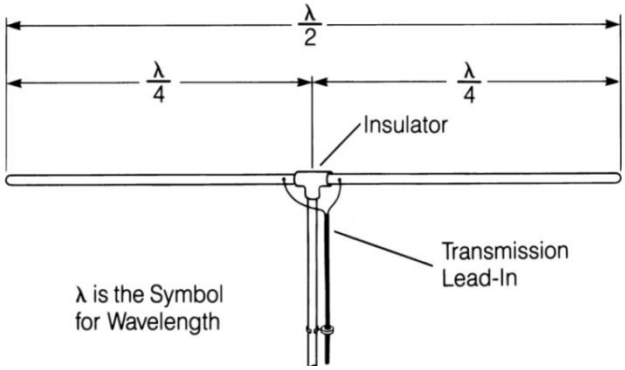
a. Vertically-Polarized Antenna b. Horizontally-Polarized Antenna

The formula for building your own vertical antenna is 234 / F = L, where F is the frequency in megahertz and L is the length in feet. For example, a vertical antenna for 146 MHz. would be 234 / 146 = 1.6 feet. Convert that to inches: 1.6 x 12 = 19.2 inches. The approximate length of a quarter-wavelength vertical for 146 MHz is **19 inches**.



A simple dipole mounted so the conductor is parallel to the Earth's surface is **a horizontally polarized** antenna. A dipole is a poplar ham antenna that is ½ wavelength long and feed with coaxial cable in the center. They are very easy to make at home.

The formula for a dipole is 468 / F = L, where F is frequency in megahertz and L is the length in feet. So, if one would want to make a 6 meter dipole for 50 MHz.: 468 / 50 = 9.36 feet. Convert this to inches: 9.36 X 12 = 112.3 inches. The approximate length of a 6 meter 1/2-wavelength wire dipole antenna is **112 inches**



You would change a dipole antenna to make it resonant on a higher frequency by **making it shorter**.

The strongest radiation from a half-wave dipole antenna in free space is **broadside to the antenna**.

T9A02
Which of the following is true regarding vertical antennas?
A. The magnetic field is perpendicular to the Earth
B. The electric field is perpendicular to the Earth
C. The phase is inverted
D. The phase is reversed

B. The electric field is perpendicular to the Earth

T9A03
Which of the following describes a simple dipole mounted so the conductor is parallel to the Earth's surface?
A. A ground wave antenna
B. A horizontally polarized antenna
C. A rhombic antenna
D. A vertically polarized antenna

B. A horizontally polarized antenna

T9A05
How would you change a dipole antenna to make it resonant on a higher frequency?
A. Lengthen it
B. Insert coils in series with radiating wires
C. Shorten it
D. Add capacity hats to the ends of the radiating wires

C. Shorten it

T9A08
What is the approximate length, in inches, of a quarter-wavelength vertical antenna for 146 MHz?
A. 112
B. 50
C. 19
D. 12

C. 19

T9A09
What is the approximate length, in inches, of a 6 meter 1/2-wavelength wire dipole antenna?
A. 6
B. 50
C. 112
D. 236

C. 112

T9A10
In which direction is the radiation strongest from a half-wave dipole antenna in free space?
A. Equally in all directions
B. Off the ends of the antenna
C. Broadside to the antenna
D. In the direction of the feedline

C. Broadside to the antenna

A disadvantage of the "rubber duck" antenna supplied with most handheld radio transceivers is **that it does not transmit or receive as effectively as a full-sized antenna**. This is obvious when comparing a rubber duck antenna to a 19 inch whip antenna. Generally, a rubber duck antenna is 3 to 8 inches long. A 19 inch

whip would certainly receive and transmit better than a rubber duck antenna. If repeaters are close, the rubber duck antenna has the advantage of not getting in the way when the hand held is attached to your waist.

The gain of a full sized antenna is greater than that of a rubber duck antenna. The gain of a directional antenna is greater than that of an Omni directional antenna. The gain of an antenna is **the increase in signal strength in a specified direction when compared to a reference antenna**.

A good reason not to use a "rubber duck" antenna inside your car is that **signals can be significantly weaker than when it is outside of the vehicle.**

T9A04
What is a disadvantage of the "rubber duck" antenna supplied with most handheld radio transceivers?
A. It does not transmit or receive as effectively as a full-sized antenna
B. It transmits a circularly polarized signal
C. If the rubber end cap is lost it will unravel very quickly
D. All of these choices are correct

A. It does not transmit or receive as effectively as a full-sized antenna

T9A07
What is a good reason not to use a "rubber duck" antenna inside your car?
A. Signals can be significantly weaker than when it is outside of the vehicle
B. It might cause your radio to overheat
C. The SWR might decrease, decreasing the signal strength
D. All of these choices are correct

A. Signals can be significantly weaker than when it is outside of the vehicle

T9A11
What is meant by the gain of an antenna?
A. The additional power that is added to the transmitter power
B. The additional power that is lost in the antenna when transmitting on a higher frequency
C. The increase in signal strength in a specified direction when compared to a reference antenna
D. The increase in impedance on receive or transmit compared to a reference antenna

C. The increase in signal strength in a specified direction when compared to a reference antenna

While a ¼ wave antenna can be effect, many hams use a 5/8 wavelength antenna for VHF or UHF mobile. A properly mounted 5/8 wavelength antenna **offers a lower angle of radiation and more gain than a 1/4 wavelength antenna and usually provides improved coverage**.

When possible, VHF or UHF mobile antennas are often mounted in the center of the vehicle roof because **a roof mounted antenna normally provides the most uniform radiation pattern**.

Using an antenna on some frequencies, especially on the HF bands can be challenging. For example, if one wanted to operate 10 meter SSB, the length of the antenna would be a little bit over 8 feet. If operating 20 meters, the antenna would need to be about 16 feet tall. Not good for going under bridges, stoplights, and trees! **Inserting an inductor in the radiating portion of the antenna to make it electrically longer** is a good way to solve this problem.

T9A12
What is a reason to use a properly mounted 5/8 wavelength antenna for VHF or UHF mobile service?
A. It offers a lower angle of radiation and more gain than a 1/4 wavelength antenna and usually provides improved coverage
B. It features a very high angle of radiation and is better for communicating via a repeater
C. The 5/8 wavelength antenna completely eliminates distortion caused by reflected signals
D. The 5/8 wavelength antenna offers a 10-times power gain over a 1/4 wavelength design

A. It offers a lower angle of radiation and more gain than a 1/4 wavelength antenna and usually provides improved coverage

T9A13
Why are VHF or UHF mobile antennas often mounted in the center of the vehicle roof?
A. Roof mounts have the lowest possible SWR of any mounting configuration
B. Only roof mounting can guarantee a vertically polarized signal
C. A roof mounted antenna normally provides the most uniform radiation pattern
D. Roof mounted antennas are always the easiest to install

C. A roof mounted antenna normally provides the most uniform radiation pattern

T9A14
Which of the following terms describes a type of loading when referring to an antenna?
A. Inserting an inductor in the radiating portion of the antenna to make it electrically longer
B. Inserting a resistor in the radiating portion of the antenna to make it resonant
C. Installing a spring at the base of the antenna to absorb the effects of collisions with other objects
D. Making the antenna heavier so it will resist wind effects when in motion

A. Inserting an inductor in the radiating portion of the antenna to make it electrically longer

T9B – Feed lines: types of feed lines; attenuation vs. frequency; SWR concepts; matching; weather protection; choosing RF connectors and feed lines

Coaxial cable is used more often than any other feedline for amateur radio antenna systems because **it is easy to use and requires few special installation considerations**. **50 ohms** is the impedance of the most commonly used coaxial cable in typical amateur radio installations. This is because the transceiver is designed to be used with an antenna whose impedance is 50 ohms. If the antenna impedance is 50 ohms and the transceiver is designed for 50 ohms, then using 50 ohm coaxial cable will provide a perfect 1 to 1 SWR match.

It is important to have a low SWR in an antenna system that uses coaxial cable **feedline to allow the efficient transfer of power and reduce losses**. There is greater signal loss at a high SWR than there is at a low SWR. The length of coaxial cable has an effect too. The longer the run from the antenna, the greater the signal loss. Another thing that contributes to signal loss is frequency. As the frequency of a signal passing through coaxial cable is increased **the loss increases.**

If an antenna system has a slightly higher SWR than 1 to 1, an antenna tuner may be used. An antenna tuner **matches the antenna system impedance to the transceiver's output impedance**. In other words, the antenna tuner tricks the transciever into thinking that the SWR is 1 to 1. Using antenna systems with an SWR of up to 3 to 1 with an antenna tuner will show little signal loss at the antenna.

T9B01
Why is it important to have a low SWR in an antenna system that uses coaxial cable feedline?
A. To reduce television interference
B. To allow the efficient transfer of power and reduce losses
C. To prolong antenna life
D. All of these choices are correct

B. To allow the efficient transfer of power and reduce losses

T9B02
What is the impedance of the most commonly used coaxial cable in typical amateur radio installations?
A. 8 ohms
B. 50 ohms
C. 600 ohms
D. 12 ohms

B. 50 ohms

T9B03
Why is coaxial cable used more often than any other feedline for amateur radio antenna systems?
A. It is easy to use and requires few special installation considerations
B. It has less loss than any other type of feedline
C. It can handle more power than any other type of feedline
D. It is less expensive than any other types of feedline

A. It is easy to use and requires few special installation considerations

T9B04
What does an antenna tuner do?
A. It matches the antenna system impedance to the transceiver's output impedance
B. It helps a receiver automatically tune in weak stations
C. It allows an antenna to be used on both transmit and receive
D. It automatically selects the proper antenna for the frequency band being used

A. It matches the antenna system impedance to the transceiver's output impedance

T9B05
What generally happens as the frequency of a signal passing through coaxial cable is increased?
A. The apparent SWR increases
B. The reflected power increases
C. The characteristic impedance increases
D. The loss increases

D. The loss increases

PL-259 type coax connectors **are commonly used at HF frequencies**. At HF frequencies, PL-259 fittings have very little loss.

A Type N connector is most suitable for frequencies above 400 Mhz. These are low loss and weather proof. They are also more expensive.

Coax connectors exposed to the weather should be sealed against water intrusion **to prevent an increase in feed line loss**.

Electrical differences exists between the smaller RG-58 and larger RG-8 coaxial cable in that **RG-8 cable has less loss at a given frequency**. The lowest loss feed line at VHF and UHF is an **Air-insulated hard line**.

Lastly, **a loose connection in an antenna or a feed line** might cause erratic changes in SWR readings.

T9B06
Which of the following connectors is most suitable for frequencies above 400 MHz?
A. A UHF (PL-259/SO-239) connector
B. A Type N connector
C. An RS-213 connector
D. A DB-25 connector

B. A Type N connector

T9B07
Which of the following is true of PL-259 type coax connectors?
A. They are preferred for microwave operation
B. They are water tight
C. They are commonly used at HF frequencies
D. They are a bayonet type connector

C. They are commonly used at HF frequencies

T9B08
Why should coax connectors exposed to the weather be sealed against water intrusion?
A. To prevent an increase in feed line loss
B. To prevent interference to telephones
C. To keep the jacket from becoming loose
D. All of these choices are correct

A. To prevent an increase in feed line loss

T9B09
What might cause erratic changes in SWR readings?
A. The transmitter is being modulated
B. A loose connection in an antenna or a feed line
C. The transmitter is being over-modulated
D. Interference from other stations is distorting your signal

B. A loose connection in an antenna or a feed line

T9B10
What electrical difference exists between the smaller RG-58 and larger RG-8 coaxial cables?
A. There is no significant difference between the two types
B. RG-58 cable has less loss at a given frequency
C. RG-8 cable has less loss at a given frequency
D. RG-58 cable can handle higher power levels

C. RG-8 cable has less loss at a given frequency

T9B11
Which of the following types of feed line has the lowest loss at VHF and UHF?
A. 50-ohm flexible coax
B. Multi-conductor unbalanced cable
C. Air-insulated hard line
D. 75-ohm flexible coax

C. Air-insulated hard line

SUBELEMENT T0

Electrical safety: AC and DC power circuits; antenna installation; RF hazards
3 Exam Questions - 3 Groups

T0A – Power circuits and hazards: hazardous voltages; fuses and circuit breakers; grounding; lightning protection; battery safety; electrical code compliance

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

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

Current flowing through a body can cause several health hazards:
- By heating the tissue
- It disrupts the electrical functions of cells
- It causes involuntary muscle contractions
- **All of these choices are correct**

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

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

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

The **safety ground** is connected to the green wire in a three-wire electrical AC plug. Make sure all your equipment has this ground wire attached, especially on home built equipment or cables you may wire yourself.

T0A01
Which of the following is a safety hazard of a 12-volt storage battery?
A. Touching both terminals with the hands can cause electrical shock
B. Shorting the terminals can cause burns, fire, or an explosion
C. RF emissions from the battery
D. All of these choices are correct

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

T0A02
How does current flowing through the body cause a health hazard?
A. By heating tissue
B. It disrupts the electrical functions of cells
C. It causes involuntary muscle contractions
D. All of these choices are correct

D. All of these choices are correct

T0A03
What is connected to the green wire in a three-wire electrical AC plug?
A. Neutral
B. Hot
C. Safety ground
D. The white wire

C. Safety ground

T0A06
What is a good way to guard against electrical shock at your station?
A. Use three-wire cords and plugs for all AC powered equipment

B. Connect all AC powered station equipment to a common safety ground
C. Use a circuit protected by a ground-fault interrupter
D. All of these choices are correct

D. All of these choices are correct

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

It is unwise to install a 20-ampere fuse in the place of a 5-ampere fuse because **excessive current could cause a fire**. This is just common sense. Your equipment is protected by fuses. To put a replace a 5 amp fuse with a 20 amp one is just asking for trouble!

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

T0A04
What is the purpose of a fuse in an electrical circuit?
A. To prevent power supply ripple from damaging a circuit
B. To interrupt power in case of overload
C. To limit current to prevent shocks
D. All of these choices are correct

B. To interrupt power in case of overload

T0A05
Why is it unwise to install a 20-ampere fuse in the place of a 5-ampere fuse?
A. The larger fuse would be likely to blow because it is rated for higher current
B. The power supply ripple would greatly increase
C. Excessive current could cause a fire
D. All of these choices are correct

C. Excessive current could cause a fire

T0A08
What safety equipment should always be included in home-built equipment that is powered from 120V AC power circuits?
A. A fuse or circuit breaker in series with the AC hot conductor
B. An AC voltmeter across the incoming power source
C. An inductor in series with the AC power source
D. A capacitor across the AC power source

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

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

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

T0A09
What kind of hazard is presented by a conventional 12-volt storage battery?
A. It emits ozone which can be harmful to the atmosphere
B. Shock hazard due to high voltage
C. Explosive gas can collect if not properly vented
D. All of these choices are correct

C. Explosive gas can collect if not properly vented

T0A10
What can happen if a lead-acid storage battery is charged or discharged too quickly?
A. The battery could overheat and give off flammable gas or explode
B. The voltage can become reversed
C. The memory effect will reduce the capacity of the battery
D. All of these choices are correct

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

Think a power supply is safe to touch when turned off or disconnected from the power mains? Not necessarily. The kind of hazard that might exist in a power supply when it is turned off and disconnected is that **you might receive an electric shock from stored charge in large capacitors**. If troubleshooting a power supply, use caution.. Even if it is unplugged!

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

T0A11
What kind of hazard might exist in a power supply when it is turned off and disconnected?
A. Static electricity could damage the grounding system
B. Circulating currents inside the transformer might cause damage
C. The fuse might blow if you remove the cover
D. You might receive an electric shock from the charged stored in large capacitors

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

T0A07
Which of these precautions should be taken when installing devices for lightning protection in a coaxial cable feed line?
A. Include a parallel bypass switch for each protector so that it can be switched out of the circuit when running high power
B. Include a series switch in the ground line of each protector to prevent RF overload from inadvertently damaging the protector
C. Keep the ground wires from each protector separate and connected to station ground
D. Ground all of the protectors to a common plate which is in turn connected to an external ground

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

T0B – Antenna safety: tower safety; erecting an antenna support; overhead power lines; installing an antenna

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

- **It is never safe** to climb a tower without a helper or observer.
- **Putting on a climbing harness and safety glasses** is a good precaution to observe before climbing an antenna tower.
- Members of a tower work team should wear a hard hat and safety glasses **at all times when any work is being done on the tower**.
- **Looking for and staying clear of any overhead electrical wires** is an important safety precaution to observe when putting up an antenna tower.
- An important safety rule to remember when using a crank-up is that **this type of tower must never be climbed unless it is in the fully retracted position**.
- The minimum safe distance to allow from a power line when installing an antenna **so that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires**.

The purpose of a gin pole is **to lift tower sections or antennas**. A gin pole consists of a long sturdy pole that can be secured to the tower. A pulley at the top of the gin pole allows rope to be run through. When installing tower sections or heavy antennas, the ground crew does the heavy lifting by pulling on the gin pole rope. The person on the tower simply guides the piece into place and secures it.

T0B01
When should members of a tower work team wear a hard hat and safety glasses?
A. At all times except when climbing the tower
B. At all times except when belted firmly to the tower
C. At all times when any work is being done on the tower
D. Only when the tower exceeds 30 feet in height

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

T0B02
What is a good precaution to observe before climbing an antenna tower?
A. Make sure that you wear a grounded wrist strap
B. Remove all tower grounding connections
C. Put on a climbing harness and safety glasses
D. All of the these choices are correct

C. Put on a climbing harness and safety glasses

T0B03
Under what circumstances is it safe to climb a tower without a helper or observer?
A. When no electrical work is being performed
B. When no mechanical work is being performed
C. When the work being done is not more than 20 feet above the ground
D. Never

D. Never

T0B04
Which of the following is an important safety precaution to observe when putting up an antenna tower?
A. Wear a ground strap connected to your wrist at all times
B. Insulate the base of the tower to avoid lightning strikes
C. Look for and stay clear of any overhead electrical wires
D. All of these choices are correct

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

T0B05
What is the purpose of a gin pole?
A. To temporarily replace guy wires
B. To be used in place of a safety harness
C. To lift tower sections or antennas
D. To provide a temporary ground

C. To lift tower sections or antennas

T0B06
What is the minimum safe distance from a power line to allow when installing an antenna?
A. Half the width of your property
B. The height of the power line above ground
C. 1/2 wavelength at the operating frequency
D. So that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires

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

T0B07
Which of the following is an important safety rule to remember when using a crank-up tower?
A. This type of tower must never be painted
B. This type of tower must never be grounded
C. This type of tower must never be climbed unless it is in the fully retracted position
D. All of these choices are correct

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

More important hints concerning tower and antenna safety:

- Proper grounding method for a tower is to have **separate eight-foot long ground rods for each tower leg, bonded to the tower and each other**.
- You should avoid attaching an antenna to a utility pole as **the antenna could contact high-voltage power wires**.
- Concerning grounding conductors used for lightning protection, **sharp bends must be avoided**.
- Grounding requirements for an amateur radio tower or antenna are established **by local electrical codes**

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

T0B08
What is considered to be a proper grounding method for a tower?
A. A single four-foot ground rod, driven into the ground no more than 12 inches from the base
B. A ferrite-core RF choke connected between the tower and ground
C. Separate eight-foot long ground rods for each tower leg, bonded to the tower and each other
D. A connection between the tower base and a cold water pipe

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

T0B09
Why should you avoid attaching an antenna to a utility pole?
A. The antenna will not work properly because of induced voltages
B. The utility company will charge you an extra monthly fee
C. The antenna could contact high-voltage power wires
D. All of these choices are correct

C. The antenna could contact high-voltage power wires

T0B10
Which of the following is true concerning grounding conductors used for lightning protection?
A. Only non-insulated wire must be used
B. Wires must be carefully routed with precise right-angle bends
C. Sharp bends must be avoided
D. Common grounds must be avoided

C. Sharp bends must be avoided

T0B11
Which of the following establishes grounding requirements for an amateur radio tower or antenna?
A. FCC Part 97 Rules
B. Local electrical codes
C. FAA tower lighting regulations
D. Underwriters Laboratories' recommended practices

B. Local electrical codes

T0B12
Which of the following is good practice when installing ground wires on a tower for lightning protection?
A. Put a loop in the ground connection to prevent water damage to the ground system
B. Make sure that all bends in the ground wires are clean, right angle bends
C. Ensure that connections are short and direct
D. All of these choices are correct

C. Ensure that connections are short and direct

T0C - RF hazards: radiation exposure; proximity to antennas; recognized safe power levels; exposure to others; radiation types; duty cycle

Radio waves, especially at VHF, UHF, and the Microwaves can be a serious threat to a human body even though VHF and UHF radio signals are **non-ionizing radiation**. When running high power you are required to run an RF exposure evaluation. Just follow the guidelines and you will be perfectly safe using your ham radio equipment.

Exposure limits vary with frequency because **the human body absorbs more RF energy at some frequencies than at others**. A **50 MHz** frequency has the lowest Maximum Permissible Exposure limit.

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

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

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

T0C01
What type of radiation are VHF and UHF radio signals?
A. Gamma radiation
B. Ionizing radiation
C. Alpha radiation
D. Non-ionizing radiation

D. Non-ionizing radiation

T0C02
Which of the following frequencies has the lowest value for Maximum Permissible Exposure limit?
A. 3.5 MHz
B. 50 MHz
C. 440 MHz
D. 1296 MHz

B. 50 MHz

T0C03
What is the maximum power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required?
A. 1500 watts PEP transmitter output
B. 1 watt forward power
C. 50 watts PEP at the antenna
D. 50 watts PEP reflected power

C. 50 watts PEP at the antenna

T0C04
What factors affect the RF exposure of people near an amateur station antenna?
A. Frequency and power level of the RF field
B. Distance from the antenna to a person
C. Radiation pattern of the antenna
D. All of these choices are correct

D. All of these choices are correct

T0C05
Why do exposure limits vary with frequency?
A. Lower frequency RF fields have more energy than higher frequency fields
B. Lower frequency RF fields do not penetrate the human body
C. Higher frequency RF fields are transient in nature
D. The human body absorbs more RF energy at some frequencies than at others

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

Acceptable methods to determine that your station complies with FCC RF exposure regulations:
- By calculation based on FCC OET Bulletin 65
- By calculation based on computer modeling
- By measurement of field strength using calibrated equipment
- **All of these choices are correct**

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

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

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

T0C06
Which of the following is an acceptable method to determine that your station complies with FCC RF exposure regulations?
A. By calculation based on FCC OET Bulletin 65
B. By calculation based on computer modeling
C. By measurement of field strength using calibrated equipment
D. All of these choices are correct

D. All of these choices are correct

T0C07
What could happen if a person accidentally touched your antenna while you were transmitting?
A. Touching the antenna could cause television interference
B. They might receive a painful RF burn
C. They might develop radiation poisoning
D. All of these choices are correct

B. They might receive a painful RF burn

T0C08
Which of the following actions might amateur operators take to prevent exposure to RF radiation in excess of FCC-supplied limits?
A. Relocate antennas
B. Relocate the transmitter
C. Increase the duty cycle
D. All of these choices are correct

A. Relocate antennas

T0C09
How can you make sure your station stays in compliance with RF safety regulations?
A. By informing the FCC of any changes made in your station
B. By re-evaluating the station whenever an item of equipment is changed
C. By making sure your antennas have low SWR
D. All of these choices are correct

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

Duty cycle is one of the factors used to determine safe RF radiation exposure levels because **it affects the average exposure of people to radiation**. When referring to RF exposure, "duty cycle" is the ratio of "on" time to "off" time of a transmitted signal. The definition of duty cycle during the averaging time for RF exposure is **the percentage of time that a transmitter is transmitting**.

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

If the averaging time for exposure is 6 minutes, then the power density permitted if the signal is present for 3 minutes and absent for 3 minutes rather than being present for the entire 6 minutes is **2 times as much**. This sounds confusing. To further explain. If you are doing a 6 minute evaluation and transmit for 3 minutes and then turn the transmitter off and receive for 3 minutes, you are only transmitting for 50% of the time. Therefore the power density allowed would be twice as much.

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

T0C10
Why is duty cycle one of the factors used to determine safe RF radiation exposure levels?
A. It affects the average exposure of people to radiation
B. It affects the peak exposure of people to radiation

C. It takes into account the antenna feed line loss
D. It takes into account the thermal effects of the final amplifier

A. It affects the average exposure of people to radiation

T0C11
What is the definition of duty cycle during the averaging time for RF exposure?
A. The difference between the lowest power output and the highest power output of a transmitter
B. The difference between the PEP and average power output of a transmitter
C. The percentage of time that a transmitter is transmitting
D. The percentage of time that a transmitter is not transmitting

C. The percentage of time that a transmitter is transmitting

T0C12
How does RF radiation differ from ionizing radiation (radioactivity)?
A. RF radiation does not have sufficient energy to cause genetic damage
B. RF radiation can only be detected with an RF dosimeter
C. RF radiation is limited in range to a few feet
D. RF radiation is perfectly safe

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

T0C13
If the averaging time for exposure is 6 minutes, how much power density is permitted if the signal is present for 3 minutes and absent for 3 minutes rather than being present for the entire 6 minutes?
A. 3 times as much
B. 1/2 as much
C. 2 times as much
D. There is no adjustment allowed for shorter exposure times

C. 2 times as much

Appendix A

SUBELEMENT T1 – FCC Rules, descriptions and definitions for the Amateur Radio Service, operator and station license responsibilities - [6 Exam Questions - 6 Groups]

T1A - Amateur Radio Service: purpose and permissible use of the Amateur Radio Service; operator/primary station license grant; where FCC rules are codified; basis and purpose of FCC rules; meanings of basic terms used in FCC rules; interference; spectrum management

T1A01 (C) [97.1]
Which of the following is a purpose of the Amateur Radio Service as stated in the FCC rules and regulations?

C. Advancing skills in the technical and communication phases of the radio art

T1A02 (C) [97.1]
Which agency regulates and enforces the rules for the Amateur Radio Service in the United States?

C. The FCC

T1A03 (D)
Which part of the FCC regulations contains the rules governing the Amateur Radio Service?

D. Part 97

T1A04 (C) [97.3(a)(23)]
Which of the following meets the FCC definition of harmful interference?

C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations

T1A05 (A) [97.1 (e)]
Which of the following is a purpose of the Amateur Radio Service rules and regulations as defined by the FCC?

A. Enhancing international goodwill

T1A06 (D) [97.101 (d), 97.303 (o)(2)]
Which of the following services are protected from interference by amateur signals under all circumstances?

D. Radionavigation Service

T1A07 (C) [97.3(a)(46)]
What is the FCC Part 97 definition of telemetry?

C. A one-way transmission of measurements at a distance from the measuring instrument

T1A08 (B) [97.3(a)(22)]
Which of the following entities recommends transmit/receive channels and other parameters for auxiliary and repeater stations?

B. Frequency Coordinator

T1A09 (C) [97.3(a)(22)]
Who selects a Frequency Coordinator?

C. Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations

T1A10 (A) [97.3(a)(5)]
What is the FCC Part 97 definition of an amateur station?

A. A station in the Amateur Radio Service consisting of the apparatus necessary for carrying on radio communications

T1A11 (B) [97.101 (d)]
When is willful interference to other amateur radio stations permitted?

B. At no time

T1A12 (D)
Which of the following is a permissible use of the Amateur Radio Service?

D. Allowing a person to conduct radio experiments and to communicate with other licensed hams around the world

T1A13 (C) [97.3(a)(45)]
What is the FCC Part 97 definition of telecommand?

C. A one-way transmission to initiate, modify or terminate functions of a device at a distance

T1A14 (A) [97.303(d)]
What must you do if you are operating on the 23 cm band and learn that you are interfering with a radiolocation station outside the United States?

A. Stop operating or take steps to eliminate the harmful interference

T1B - Authorized frequencies: frequency allocations; ITU regions; emission modes; restricted sub-bands; spectrum sharing; transmissions near band edges

T1B01 (B)
What is the ITU?

B. A United Nations agency for information and communication technology issues

T1B02 (A) [97.301]
Why are the frequency assignments for some U.S. Territories different from those in the 50 U.S. States?

A. Some U. S. Territories are located in ITU regions other than region 2

T1B03 (B) [97.301(a)]
Which frequency is within the 6 meter band?

B. 52.525 MHz

T1B04 (A) [97.301(a)]
Which amateur band are you using when your station is transmitting on 146.52 MHz?

A. 2 meter band

T1B05 (C) [97.301(a)]
Which 70 cm frequency is authorized to a Technician Class license holder operating in ITU Region 2?

C. 443.350 MHz

T1B06 (B) [97.301(a)]
Which 23 cm frequency is authorized to a Technician Class licensee?

B. 1296 MHz

T1B07 (D) [97.301(a)]
What amateur band are you using if you are transmitting on 223.50 MHz?

D. 1.25 meter band
T1B08 (A) [97.303]
Which of the following is a result of the fact that the amateur service is secondary in some portions of the 70 cm band?

A. U.S. amateurs may find non-amateur stations in the bands, and must avoid interfering with them

T1B09 (D) [97.101(a), 97.301(a-e)]
Why should you not set your transmit frequency to be exactly at the edge of an amateur band or sub-band?

A. To allow for calibration error in the transmitter frequency display
B. So that modulation sidebands do not extend beyond the band edge
C. To allow for transmitter frequency drift
D. All of these choices are correct

T1B10 (C) [97.301(e), 97.305(c)]
Which of the bands above 30 MHz that are available to Technician Class operators have mode-restricted sub-bands?

C. The 6 meter, 2 meter, and 1.25 meter bands

T1B11 (A) [97.301(a), 97.305 (a)(c)]
What emission modes are permitted in the mode-restricted sub-bands at 50.0 to 50.1 MHz and 144.0 to 144.1 MHz?

A. CW only

T1B12 (B) [97.301]
Why are frequency assignments for U.S. stations operating maritime mobile not the same everywhere in the world?

B. Amateur frequency assignments can vary among the three ITU regions

T1B13 (B) [97.305(c)]
Which emission may be used between 219 and 220 MHz?

B. Data

T1C - Operator licensing: operator classes; sequential, special event, and vanity call sign systems; international communications; reciprocal operation; station license and licensee; places where the amateur service is regulated by the FCC; name and address on FCC license database; license term; renewal; grace period

T1C01 (C) [97.3(a)(11)(iii)]
Which type of call sign has a single letter in both its prefix and suffix?

C. Special event

T1C02 (B)
Which of the following is a valid US amateur radio station call sign?

B. W3ABC

T1C03 (A) [97.117]
What types of international communications are permitted by an FCC-licensed amateur station?

A. Communications incidental to the purposes of the amateur service and remarks of a personal character

T1C04 (A) [97.107]
When are you allowed to operate your amateur station in a foreign country?

A. When the foreign country authorizes it

T1C05 (A)
Which of the following is a vanity call sign which a technician class amateur operator might select if available?

A. K1XXX

T1C06 (D) [97.5(a)(2)]
From which of the following locations may an FCC-licensed amateur station transmit, in addition to places where the FCC regulates communications?

D. From any vessel or craft located in international waters and documented or registered in the United States

T1C07 (B) [97.23]
What may result when correspondence from the FCC is returned as undeliverable because the grantee failed to provide the correct mailing address?

A. During an Armed Forces Day Communications Test

B. Revocation of the station license or suspension of the operator license

T1C08 (C) [97.25]
What is the normal term for an FCC-issued primary station/operator amateur radio license grant?

C. Ten years

T1C09 (A) [97.21(a)(b)]
What is the grace period following the expiration of an amateur license within which the license may be renewed?

A. Two years

T1C10 (C) [97.5a]
How soon after passing the examination for your first amateur radio license may you operate a transmitter on an amateur service frequency?

C. As soon as your operator/station license grant appears in the FCC's license database

T1C11 (A) [97.21(b)]
If your license has expired and is still within the allowable grace period, may you continue to operate a transmitter on amateur service frequencies?

A. No, transmitting is not allowed until the FCC license database shows that the license has been renewed

T1C12 (D) [97.19]
Who may select a desired call sign under the vanity call sign rules?

D. Any licensed amateur

T1C13 (D) [97.9(a), 97.17(a)]
For which licenses classes are new licenses currently available from the FCC?

D. Technician, General, Amateur Extra

T1C14 (D) [97.21(a) (1)]
Who may select a vanity call sign for a club station?

D. Only the person named as trustee on the club station license grant

T1D - Authorized and prohibited transmission: communications with other countries; music; exchange of information with other services; indecent language; compensation for use of station; retransmission of other amateur signals; codes and ciphers; sale of equipment; unidentified transmissions; broadcasting

T1D01 (A) [97.111(a)(1)]
With which countries are FCC-licensed amateur stations prohibited from exchanging communications?

A. Any country whose administration has notified the ITU that it objects to such communications

T1D02 (A) [97.111(a)(5)]
On which of the following occasions may an FCC-licensed amateur station exchange messages with a U.S. military station?

A. During an Armed Forces Day Communications Test

T1D03 (C) [97.211(b), 97.215(b)]
When is the transmission of codes or ciphers that hide the meaning of a message allowed by an amateur station?

C. Only when transmitting control commands to space stations or radio control craft

T1D04 (A) [97.113(a)(4), 97.113(c)]
What is the only time an amateur station is authorized to transmit music?

A. When incidental to an authorized retransmission of manned spacecraft communications

T1D05 (A) [97.113(a)(3)(ii)]
When may amateur radio operators use their stations to notify other amateurs of the availability of equipment for sale or trade?

A. When the equipment is normally used in an amateur station and such activity is not conducted on a regular basis

T1D06 (B) [97.113(a)(4)]
What, if any, are the restrictions concerning transmission of language that may be considered indecent or obscene?

B. Any such language is prohibited

T1D07 (B) [97.113(d)]
What types of amateur stations can automatically retransmit the signals of other amateur stations?

B. Auxiliary, repeater, or space stations

T1D08 (B) [97.113(a)(3)(iii)]
In which of the following circumstances may the control operator of an amateur station receive compensation for operating the station?

B. When the communication is incidental to classroom instruction at an educational institution

T1D09 (A) [97.113(5)(b)]
Under which of the following circumstances are amateur stations authorized to transmit signals related to broadcasting, program production, or news gathering, assuming no other means is available?

A. Only where such communications directly relate to the immediate safety of human life or protection of property

T1D10 (D) [97.3(a)(10)]
What is the meaning of the term “broadcasting” in the FCC rules for the amateur services?

D. Transmissions intended for reception by the general public

T1D11 (D) [97.119(a)]
When may an amateur station transmit without identifying?

D. When transmitting signals to control a model craft

T1D12 (B) [97.111(b)(4,5,6)
Under which of the following circumstances may an amateur radio station engage in broadcasting?

B. When transmitting code practice, information bulletins, or transmissions necessary to provide emergency communications

T1E - Control operator and control types: control operator required; eligibility; designation of control operator; privileges and duties; control point; local, automatic and remote control; location of control operator

T1E01 (D) [97.7(a)]
When is an amateur station permitted to transmit without a control operator?

D. Never

T1E02 (D) [97.7(a)]
Who may a station licensee designate to be the control operator of an amateur station?

D. Only a person for whom an amateur operator/primary station license grant appears in the FCC database or who is authorized for alien reciprocal operation

T1E03 (A) [97.103(b)]
Who must designate the station control operator?

A. The station licensee

T1E04 (D) [97.103(b)]
What determines the transmitting privileges of an amateur station?

D. The class of operator license held by the control operator

T1E05 (C) [97.3(a)(14)]
What is an amateur station control point?

C. The location at which the control operator function is performed

T1E06 (A) [97.109(d)]
Under what type of control do APRS network digipeaters operate?

A. Automatic

T1E07 (D) [97.103(a)]
When the control operator is not the station licensee, who is responsible for the proper operation of the station?

D. The control operator and the station licensee are equally responsible

T1E08 (A) [97.3(a)(6), 97.205(d)]
Which of the following is an example of automatic control?

A. Repeater operation

T1E09 (D) [97.109(b)]
What type of control is being used when the control operator is at the control point?

D. Local control

T1E10 (B) [97.3(a)(39)]
Which of the following is an example of remote control as defined in Part 97?

B. Operating the station over the Internet

T1E11 (D) [97.103(a)]
Who does the FCC presume to be the control operator of an amateur station, unless documentation to the contrary is in the station records?

D. The station licensee

T1E12 (A) [97.119(e)]
When, under normal circumstances, may a Technician Class licensee be the control operator of a station operating in an exclusive Extra Class operator segment of the amateur bands?

A. At no time

T1F - Station identification; repeaters; third party communications; club stations; FCC inspection

T1F01 (A)
What type of identification is being used when identifying a station on the air as Race Headquarters?

A. Tactical call sign

T1F02 (C) [97.119 (a)]
When using tactical identifiers such as “Race Headquarters” during a community service net operation, how often must your station transmit the station’s FCC-assigned call sign?

C. At the end of each communication and every ten minutes during a communication

T1F03 (D) [97.119(a)]
When is an amateur station required to transmit its assigned call sign?

D. At least every 10 minutes during and at the end of a communication

T1F04 (C) [97.119(b)(2)]
Which of the following is an acceptable language to use for station identification when operating in a phone sub-band?

C. The English language

T1F05 (B) [97.119(b)(2)]
What method of call sign identification is required for a station transmitting phone signals?

B. Send the call sign using CW or phone emission

T1F06 (D) [97.119(c)]
Which of the following formats of a self-assigned indicator is acceptable when identifying using a phone transmission?

A. KL7CC stroke W3
B. KL7CC slant W3
C. KL7CC slash W3
D. All of these choices are correct

T1F07 (B) [97.115(a)(2)]
Which of the following restrictions apply when a non-licensed person is allowed to speak to a foreign station using a station under the control of a Technician Class control operator?

B. The foreign station must be one with which the U.S. has a third party agreement

T1F08 (D) [97.119(f)]
Which indicator is required by the FCC to be transmitted after a station call sign?

D. /KT, /AE or /AG when using new license privileges earned by CSCE while waiting for an upgrade to a previously issued license to appear in the FCC license database

T1F09 (C) [97.3(a)(40)]
What type of amateur station simultaneously retransmits the signal of another amateur station on a different channel or channels?

C. Repeater station

T1F10 (A) [97.205(g)]
Who is accountable should a repeater inadvertently retransmit communications that violate the FCC rules?

A. The control operator of the originating station

T1F11 (A) [97.115(a)]
To which foreign stations do the FCC rules authorize the transmission of non-emergency third party communications?

A. Any station whose government permits such communications

T1F12 (B) [97.5(b)(2)]
How many persons are required to be members of a club for a club station license to be issued by the FCC?

B. At least 4

T1F13 (B) [97.103(c)]
When must the station licensee make the station and its records available for FCC inspection?

B. At any time upon request by an FCC representative

SUBELEMENT T2 - Operating Procedures [3 Exam Questions - 3 Groups]

T2A - Station operation: choosing an operating frequency; calling another station; test transmissions; procedural signs; use of minimum power; choosing an operating frequency; band plans; calling frequencies; repeater offsets

T2A01 (B)
What is the most common repeater frequency offset in the 2 meter band?

B. Plus or minus 600 kHz

T2A02 (D)
What is the national calling frequency for FM simplex operations in the 70 cm band?

D. 446.000 MHz

T2A03 (A)
What is a common repeater frequency offset in the 70 cm band?

A. Plus or minus 5 MHz

T2A04 (B)
What is an appropriate way to call another station on a repeater if you know the other station's call sign?

B. Say the station's call sign then identify with your call sign

T2A05 (C)
How should you respond to a station calling CQ?

C. Transmit the other station’s call sign followed by your call sign

T2A06 (A)
What must an amateur operator do when making on-air transmissions to test equipment or antennas?

A. Properly identify the transmitting station

T2A07 (D)
Which of the following is true when making a test transmission?

D. Station identification is required at least every ten minutes during the test and at the end of the test

T2A08 (D)
What is the meaning of the procedural signal “CQ”?

D. Calling any station

T2A09 (B)
What brief statement is often transmitted in place of “CQ” to indicate that you are listening on a repeater?

B. Your call sign

T2A10 (A)
What is a band plan, beyond the privileges established by the FCC?

A. A voluntary guideline for using different modes or activities within an amateur band

T2A11 (D) [97.313(a)]
Which of the following is an FCC rule regarding power levels used in the amateur bands, under normal, non-distress circumstances?

D. While not exceeding the maximum power permitted on a given band, use the minimum power necessary to carry out the desired communication

T2A12 (D)
Which of the following is a guideline to use when choosing an operating frequency for calling CQ?

A. Listen first to be sure that no one else is using the frequency
B. Ask if the frequency is in use
C. Make sure you are in your assigned band
D. All of these choices are correct

T2B – VHF/UHF operating practices: SSB phone; FM repeater; simplex; splits and shifts; CTCSS; DTMF; tone squelch; carrier squelch; phonetics; operational problem resolution; Q signals

T2B01 (C)
What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?

C. Simplex communication

T2B02 (D)
What is the term used to describe the use of a sub-audible tone transmitted with normal voice audio to open the squelch of a receiver?

D. CTCSS

T2B03 (B)
Which of the following describes the muting of receiver audio controlled solely by the presence or absence of an RF signal?

B. Carrier squelch

T2B04 (D)
Which of the following common problems might cause you to be able to hear but not access a repeater even when transmitting with the proper offset?

A. The repeater receiver may require an audio tone burst for access
B. The repeater receiver may require a CTCSS tone for access
C. The repeater receiver may require a DCS tone sequence for access
D. All of these choices are correct

T2B05 (C)
What determines the amount of deviation of an FM (as opposed to PM) signal?

C. The amplitude of the modulating signal

T2B06 (A)
What happens when the deviation of an FM transmitter is increased?

A. Its signal occupies more bandwidth

T2B07 (A)
What could cause your FM signal to interfere with stations on nearby frequencies?

A. Microphone gain too high, causing over-deviation

T2B08 (A)
Which of the following applies when two stations transmitting on the same frequency interfere with each other?

A. Common courtesy should prevail, but no one has absolute right to an amateur frequency

T2B09 (A) [97.119(b)(2)]
Which of the following methods is encouraged by the FCC when identifying your station when using phone?

A. Use of a phonetic alphabet

T2B10 (A)
Which Q signal indicates that you are receiving interference from other stations?

A. QRM

T2B11 (B)
Which Q signal indicates that you are changing frequency?

B. QSY

T2B12 (A)
Under what circumstances should you consider communicating via simplex rather than a repeater?

A. When the stations can communicate directly without using a repeater

T2B13 (C)
Which of the following is true of the use of SSB phone in amateur bands above 50 MHz?

C. It is permitted in at least some portion of all the amateur bands above 50 MHz

T2C – Public service: emergency and non-emergency operations; applicability of FCC rules; RACES and ARES; net and traffic procedures; emergency restrictions

T2C01 (D) [97.103(a)]
When do the FCC rules NOT apply to the operation of an amateur station?

D. Never, FCC rules always apply

T2C02 (C)
What is one way to recharge a 12-volt lead-acid station battery if the commercial power is out?

C. Connect the battery in parallel with a vehicle's battery and run the engine

T2C03 (C)
What should be done to insure that voice message traffic containing proper names and unusual words are copied correctly by the receiving station?

C. Such words and terms should be spelled out using a standard phonetic alphabet

T2C04 (D)
What do RACES and ARES have in common?

D. Both organizations may provide communications during emergencies

T2C05 (D) [97.3(a)(38), 97.407]
Which of the following describes the Radio Amateur Civil Emergency Service (RACES)?

A. A radio service using amateur frequencies for emergency management or civil defense communications
B. A radio service using amateur stations for emergency management or civil defense communications
C. An emergency service using amateur operators certified by a civil defense organization as being enrolled in that organization
D. All of these choices are correct

T2C06 (C)
Which of the following is an accepted practice to get the immediate attention of a net control station when reporting an emergency?

C. Begin your transmission by saying "Priority" or "Emergency" followed by your call sign

T2C07 (C)
Which of the following is an accepted practice for an amateur operator who has checked into an emergency traffic net?

C. Remain on frequency without transmitting until asked to do so by the net control station

T2C08 (A)
Which of the following is a characteristic of good emergency traffic handling?

A. Passing messages exactly as received

T2C09 (D)
Are amateur station control operators ever permitted to operate outside the frequency privileges of their license class?

D. Yes, but only if necessary in situations involving the immediate safety of human life or protection of property

T2C10 (D)
What is the preamble in a formal traffic message?

D. The information needed to track the message as it passes through the amateur radio traffic handling system

T2C11 (A)
What is meant by the term “check” in reference to a formal traffic message?

A. The check is a count of the number of words or word equivalents in the text portion of the message

T2C12 (A)
What is the Amateur Radio Emergency Service (ARES)?

A. Licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service

SUBELEMENT T3 – Radio wave characteristics: properties of radio waves; propagation modes – [3 Exam Questions - 3 Groups]

T3A - Radio wave characteristics: how a radio signal travels; fading; multipath; wavelength vs. penetration; antenna orientation

T3A01 (D)
What should you do if another operator reports that your station’s 2 meter signals were strong just a moment ago, but now they are weak or distorted?

D. Try moving a few feet or changing the direction of your antenna if possible, as reflections may be causing multi-path distortion

T3A02 (B)
Why are UHF signals often more effective from inside buildings than VHF signals?

B. The shorter wavelength allows them to more easily penetrate the structure of buildings

T3A03 (C)
What antenna polarization is normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands?

C. Horizontal

T3A04 (B)
What can happen if the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization?

B. Signals could be significantly weaker

T3A05 (B)
When using a directional antenna, how might your station be able to access a distant repeater if buildings or obstructions are blocking the direct line of sight path?

B. Try to find a path that reflects signals to the repeater

T3A06 (B)
What term is commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting?

B. Picket fencing

T3A07 (A)
What type of wave carries radio signals between transmitting and receiving stations?

A. Electromagnetic

T3A08 (C)
Which of the following is a likely cause of irregular fading of signals received by ionospheric reflection?

C. Random combining of signals arriving via different paths

T3A09 (B)
Which of the following results from the fact that skip signals refracted from the ionosphere are elliptically polarized?

B. Either vertically or horizontally polarized antennas may be used for transmission or reception

T3A10 (D)
What may occur if data signals propagate over multiple paths?

D. Error rates are likely to increase

T3A11 (C)
Which part of the atmosphere enables the propagation of radio signals around the world?

C. The ionosphere

T3B - Radio and electromagnetic wave properties: the electromagnetic spectrum; wavelength vs. frequency; velocity of electromagnetic waves; calculating wavelength

T3B01 (C)
What is the name for the distance a radio wave travels during one complete cycle?

C. Wavelength

T3B02 (A)
What property of a radio wave is used to describe its polarization?

A. The orientation of the electric field

T3B03 (C)
What are the two components of a radio wave?

C. Electric and magnetic fields

T3B04 (A)
How fast does a radio wave travel through free space?

A. At the speed of light

T3B05 (B)
How does the wavelength of a radio wave relate to its frequency?

B. The wavelength gets shorter as the frequency increases

T3B06 (D)
What is the formula for converting frequency to approximate wavelength in meters?

D. Wavelength in meters equals 300 divided by frequency in megahertz

T3B07 (A)
What property of radio waves is often used to identify the different frequency bands?

T3B08 (B)
What are the frequency limits of the VHF spectrum?

B. 30 to 300 MHz

T3B09 (D)
What are the frequency limits of the UHF spectrum?

D. 300 to 3000 MHz

T3B10 (C)
What frequency range is referred to as HF?

C. 3 to 30 MHz

T3B11 (B)
What is the approximate velocity of a radio wave as it travels through free space?

B. 300,000,000 meters per second

T3C - Propagation modes: line of sight; sporadic E; meteor and auroral scatter and reflections; tropospheric ducting; F layer skip; radio horizon

T3C01 (C)
Why are direct (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?

C. UHF signals are usually not reflected by the ionosphere

T3C02 (D)
Which of the following might be happening when VHF signals are being received from long distances?

D. Signals are being refracted from a sporadic E layer

T3C03 (B)
What is a characteristic of VHF signals received via auroral reflection?

B. The signals exhibit rapid fluctuations of strength and often sound distorted

T3C04 (B)
Which of the following propagation types is most commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2 meter bands?

B. Sporadic E

T3C05 (A)
Which of the following effects might cause radio signals to be heard despite obstructions between the transmitting and receiving stations?

A. Knife-edge diffraction

T3C06 (A)
What mode is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis?

A. Tropospheric scatter

T3C07 (B)
What band is best suited for communicating via meteor scatter?

B. 6 meters

T3C08 (D)
What causes tropospheric ducting?

D. Temperature inversions in the atmosphere

T3C09 (A)
What is generally the best time for long-distance 10 meter band propagation via the F layer?

A. From dawn to shortly after sunset during periods of high sunspot activity

T3C10 (A)
What is the radio horizon?

A. The distance over which two stations can communicate by direct path

T3C11 (C)
Why do VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations?

C. The Earth seems less curved to radio waves than to light

T3C12 (A)
Which of the following bands may provide long distance communications during the peak of the sunspot cycle?

A. Six or ten meters

SUBELEMENT T4 - Amateur radio practices and station set up – [2 Exam Questions - 2 Groups]

T4A – Station setup: connecting microphones; reducing unwanted emissions; power source; connecting a computer; RF grounding; connecting digital equipment; connecting an SWR meter

T4A01 (B)
Which of the following is true concerning the microphone connectors on amateur transceivers?

B. Some connectors include push-to-talk and voltages for powering the microphone

T4A02 (D)
How might a computer be used as part of an amateur radio station?

A. For logging contacts and contact information
B. For sending and/or receiving CW
C. For generating and decoding digital signals
D. All of these choices are correct

T4A03 (A)
Which is a good reason to use a regulated power supply for communications equipment?

A. It prevents voltage fluctuations from reaching sensitive circuits

T4A04 (A)
Where must a filter be installed to reduce harmonic emissions from your station?

A. Between the transmitter and the antenna

T4A05 (A)
Where should an in-line SWR meter be connected to monitor the standing wave ratio of the station antenna system?

A. In series with the feed line, between the transmitter and antenna

T4A06 (C)
Which of the following would be connected between a transceiver and computer in a packet radio station?

C. Terminal node controller

T4A07 (C)
How is a computer's sound card used when conducting digital communications using a computer?

C. The sound card provides audio to the microphone input and converts received audio to digital form

T4A08 (D)
Which type of conductor is best to use for RF grounding?

D. Flat strap

T4A09 (D)
Which of the following could you use to cure distorted audio caused by RF current flowing on the shield of a microphone cable?

D. Ferrite choke

T4A10 (B)
What is the source of a high-pitched whine that varies with engine speed in a mobile transceiver's receive audio?

B. The alternator

T4A11 (A)
Where should the negative return connection of a mobile transceiver's power cable be connected?

A. At the battery or engine block ground strap

T4A12 (D)
What could be happening if another operator reports a variable high-pitched whine on the audio from your mobile transmitter?

D. Noise on the vehicle's electrical system is being transmitted along with your speech audio

T4B - Operating controls: tuning; use of filters; squelch function; AGC; repeater offset; memory channels

T4B01 (B)
What may happen if a transmitter is operated with the microphone gain set too high?

B. The output signal might become distorted

T4B02 (A)
Which of the following can be used to enter the operating frequency on a modern transceiver?

A. The keypad or VFO knob

T4B03 (D)
What is the purpose of the squelch control on a transceiver?

D. To mute receiver output noise when no signal is being received

T4B04 (B)
What is a way to enable quick access to a favorite frequency on your transceiver?

B. Store the frequency in a memory channel

T4B05 (C)
Which of the following would reduce ignition interference to a receiver?

C. Turn on the noise blanker

T4B06 (D)
Which of the following controls could be used if the voice pitch of a single-sideband signal seems too high or low?

D. The receiver RIT or clarifier

T4B07 (B)
What does the term “RIT” mean?

B. Receiver Incremental Tuning

T4B08 (B)
What is the advantage of having multiple receive bandwidth choices on a multimode transceiver?

B. Permits noise or interference reduction by selecting a bandwidth matching the mode

T4B09 (C)
Which of the following is an appropriate receive filter bandwidth to select in order to minimize noise and interference for SSB reception?

C. 2400 Hz

T4B10 (A)
Which of the following is an appropriate receive filter bandwidth to select in order to minimize noise and interference for CW reception?

A. 500 Hz

T4B11 (C)
Which of the following describes the common meaning of the term "repeater offset"?

C. The difference between the repeater’s transmit and receive frequencies

T4B12 (A)
What is the function of automatic gain control or AGC?

A. To keep received audio relatively constant

SUBELEMENT T5 – Electrical principles: math for electronics; electronic principles; Ohm’s Law – [4 Exam Questions - 4 Groups]

T5A - Electrical principles, units, and terms: current and voltage; conductors and insulators; alternating and direct current

T5A01 (D)
Electrical current is measured in which of the following units?

D. Amperes

T5A02 (B)
Electrical power is measured in which of the following units?

B. Watts

T5A03 (D)
What is the name for the flow of electrons in an electric circuit?

D. Current

T5A04 (B)
What is the name for a current that flows only in one direction?

B. Direct current

T5A05 (A)
What is the electrical term for the electromotive force (EMF) that causes electron flow?

A. Voltage

T5A06 (A)
How much voltage does a mobile transceiver usually require?

A. About 12 volts

T5A07 (C)
Which of the following is a good electrical conductor?

C. Copper

T5A08 (B)
Which of the following is a good electrical insulator?

B. Glass

T5A09 (A)
What is the name for a current that reverses direction on a regular basis?

A. Alternating current

T5A10 (C)
Which term describes the rate at which electrical energy is used?

C. Power

T5A11 (A)
What is the basic unit of electromotive force?

A. The volt

T5A12 (D)
What term describes the number of times per second that an alternating current reverses direction?

D. Frequency

T5B - Math for electronics: conversion of electrical units; decibels; the metric system

T5B01 (C)
How many milliamperes is 1.5 amperes?

C. 1,500 milliamperes

T5B02 (A)
What is another way to specify a radio signal frequency of 1,500,000 hertz?

A. 1500 kHz

T5B03 (C)
How many volts are equal to one kilovolt?

C. One thousand volts

T5B04 (A)
How many volts are equal to one microvolt?

A. One one-millionth of a volt

T5B05 (B)
Which of the following is equivalent to 500 milliwatts?

B. 0.5 watts

T5B06 (C)
If an ammeter calibrated in amperes is used to measure a 3000-milliampere current, what reading would it show?

C. 3 amperes

T5B07 (C)
If a frequency readout calibrated in megahertz shows a reading of 3.525 MHz, what would it show if it were calibrated in kilohertz?

C. 3525 kHz

T5B08 (B)
How many microfarads are 1,000,000 picofarads?

B. 1 microfarad

T5B09 (B)
What is the approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts?

B. 3 dB

T5B10 (C)
What is the approximate amount of change, measured in decibels (dB), of a power decrease from 12 watts to 3 watts?

C. -6 dB

T5B11 (A)
What is the approximate amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts?

A. 10 dB

T5B12 (A)
Which of the following frequencies is equal to 28,400 kHz?

A. 28.400 MHz

T5B13 (C)
If a frequency readout shows a reading of 2425 MHz, what frequency is that in GHz?

C. 2.425 GHz

T5C - Electronic principles: capacitance; inductance; current flow in circuits; alternating current; definition of RF; DC power calculations; impedance

T5C01 (D)
What is the ability to store energy in an electric field called?

D. Capacitance

T5C02 (A)
What is the basic unit of capacitance?

A. The farad

T5C03 (D)
What is the ability to store energy in a magnetic field called?

D. Inductance

T5C04 (C)
What is the basic unit of inductance?

C. The henry

T5C05 (A)
What is the unit of frequency?

A. Hertz

T5C06 (A)
What does the abbreviation “RF” refer to?

A. Radio frequency signals of all types

T5C07 (C)
What is a usual name for electromagnetic waves that travel through space?

C. Radio waves

T5C08 (A)
What is the formula used to calculate electrical power in a DC circuit?

A. Power (P) equals voltage (E) multiplied by current (I)

T5C09 (A)
How much power is being used in a circuit when the applied voltage is 13.8 volts DC and the current is 10 amperes?

A. 138 watts

T5C10 (B)
How much power is being used in a circuit when the applied voltage is 12 volts DC and the current is 2.5 amperes?

B. 30 watts

T5C11 (B)
How many amperes are flowing in a circuit when the applied voltage is 12 volts DC and the load is 120 watts?

B. 10 amperes

T5C12 (A)
What is meant by the term impedance?

A. It is a measure of the opposition to AC current flow in a circuit

T5C13 (D)
What are the units of impedance?

D. Ohms

T5D – Ohm’s Law: formulas and usage

T5D01 (B)

What formula is used to calculate current in a circuit?
B. Current (I) equals voltage (E) divided by resistance (R)

T5D02 (A)
What formula is used to calculate voltage in a circuit?

A. Voltage (E) equals current (I) multiplied by resistance (R)

T5D03 (B)
What formula is used to calculate resistance in a circuit?

B. Resistance (R) equals voltage (E) divided by current (I)

T5D04 (B)
What is the resistance of a circuit in which a current of 3 amperes flows through a resistor connected to 90 volts?

B. 30 ohms

T5D05 (C)
What is the resistance in a circuit for which the applied voltage is 12 volts and the current flow is 1.5 amperes?

C. 8 ohms

T5D06 (A)
What is the resistance of a circuit that draws 4 amperes from a 12-volt source?

A. 3 ohms

T5D07 (D)
What is the current flow in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms?

D. 1.5 amperes

T5D08 (C)
What is the current flowing through a 100-ohm resistor connected across 200 volts?

C. 2 amperes

T5D09 (C)
What is the current flowing through a 24-ohm resistor connected across 240 volts?

C. 10 amperes

T5D10 (A)
What is the voltage across a 2-ohm resistor if a current of 0.5 amperes flows through it?

A. 1 volt

T5D11 (B)
What is the voltage across a 10-ohm resistor if a current of 1 ampere flows through it?

B. 10 volts

T5D12 (D)
What is the voltage across a 10-ohm resistor if a current of 2 amperes flows through it?

D. 20 volts

SUBELEMENT T6 – Electrical components: semiconductors; circuit diagrams; component functions – [4 Exam Questions - 4 Groups]

T6A - Electrical components: fixed and variable resistors; capacitors and inductors; fuses; switches; batteries

T6A01 (B)
What electrical component is used to oppose the flow of current in a DC circuit?

B. Resistor

T6A02 (C)
What type of component is often used as an adjustable volume control?

C. Potentiometer

T6A03 (B)
What electrical parameter is controlled by a potentiometer?

B. Resistance

T6A04 (B)
What electrical component stores energy in an electric field?

B. Capacitor

T6A05 (D)
What type of electrical component consists of two or more conductive surfaces separated by an insulator?

D. Capacitor

T6A06 (C)
What type of electrical component stores energy in a magnetic field?

C. Inductor

T6A07 (D)
What electrical component is usually composed of a coil of wire?

D. Inductor

T6A08 (B)
What electrical component is used to connect or disconnect electrical circuits?

B. Switch

T6A09 (A)
What electrical component is used to protect other circuit components from current overloads?

A. Fuse

T6A10 (D)
Which of the following battery types is rechargeable?

A. Nickel-metal hydride
B. Lithium-ion
C. Lead-acid gel-cell
D. All of these choices are correct

T6A11 (B)
Which of the following battery types is not rechargeable?

B. Carbon-zinc

T6B – Semiconductors: basic principles and applications of solid state devices; diodes and transistors

T6B01 (D)
What class of electronic components is capable of using a voltage or current signal to control current flow?

D. Transistors

T6B02 (C)
What electronic component allows current to flow in only one direction?

C. Diode

T6B03 (C)
Which of these components can be used as an electronic switch or amplifier?

C. Transistor

T6B04 (B)
Which of the following components can be made of three layers of semiconductor material?

B. Transistor

T6B05 (A)
Which of the following electronic components can amplify signals?

A. Transistor

T6B06 (B)
How is the cathode lead of a semiconductor diode usually identified?

B. With a stripe

T6B07 (B)
What does the abbreviation LED stand for?

B. Light Emitting Diode

T6B08 (A)
What does the abbreviation FET stand for?

A. Field Effect Transistor

T6B09 (C)
What are the names of the two electrodes of a diode?

C. Anode and cathode

T6B10 (A)
What are the three electrodes of a PNP or NPN transistor?

A. Emitter, base, and collector

T6B11 (B)
What at are the three electrodes of a field effect transistor?

B. Source, gate, and drain

T6B12 (A)
What is the term that describes a transistor's ability to amplify a signal?

A. Gain

T6C - Circuit diagrams; schematic symbols

T6C01 (C)
What is the name for standardized representations of components in an electrical wiring diagram?

C. Schematic symbols

T6C02 (A)
What is component 1 in figure T1?

A. Resistor

T6C03 (B)
What is component 2 in figure T1?

B. Transistor

T6C04 (C)
What is component 3 in figure T1?

C. Lamp

T6C05 (C)
What is component 4 in figure T1?

C. Battery

T6C06 (B)
What is component 6 in figure T2?

B. Capacitor

T6C07 (D)
What is component 8 in figure T2?

D. Light emitting diode

T6C08 (C)
What is component 9 in figure T2?

C. Variable resistor

T6C09 (D)
What is component 4 in figure T2?

D. Transformer

T6C10 (D)
What is component 3 in figure T3?

D. Variable inductor

T6C11 (A)
What is component 4 in figure T3?

A. Antenna

T6C12 (A)
What do the symbols on an electrical circuit schematic diagram represent?

A. Electrical components

T6C13 (C)
Which of the following is accurately represented in electrical circuit schematic diagrams?

C. The way components are interconnected

T6D - Component functions: rectification; switches; indicators; power supply components; resonant circuit; shielding; power transformers; integrated circuits

T6D01 (B)
Which of the following devices or circuits changes an alternating current into a varying direct current signal?

B. Rectifier

T6D02 (A)
What best describes a relay?

A. A switch controlled by an electromagnet

T6D03 (A)
What type of switch is represented by component 3 in figure T2?

A. Single-pole single-throw

T6D04 (C)
Which of the following can be used to display signal strength on a numeric scale?

C. Meter

T6D05 (A)
What type of circuit controls the amount of voltage from a power supply?

A. Regulator

T6D06 (B)
What component is commonly used to change 120V AC house current to a lower AC voltage for other uses?

B. Transformer

T6D07 (A)
Which of the following is commonly used as a visual indicator?

A. LED

T6D08 (D)
Which of the following is used together with an inductor to make a tuned circuit?

D. Capacitor

T6D09 (C)
What is the name of a device that combines several semiconductors and other components into one package?

C. Integrated circuit

T6D10 (C)
What is the function of component 2 in Figure T1?

C. Control the flow of current

T6D11 (A)
What is a simple resonant or tuned circuit?

A. An inductor and a capacitor connected in series or parallel to form a filter

T6D12 (C)
Which of the following is a common reason to use shielded wire?

C. To prevent coupling of unwanted signals to or from the wire

SUBELEMENT T7 – Station equipment: common transmitter and receiver problems; antenna measurements; troubleshooting; basic repair and testing – [4 Exam Questions - 4 Groups]

T7A – Station equipment: receivers; transmitters; transceivers; modulation; transverters; low power and weak signal operation; transmit and receive amplifiers

T7A01 (B)
Which term describes the ability of a receiver to detect the presence of a signal?

B. Sensitivity

T7A02 (B)
What is a transceiver?

B. A unit combining the functions of a transmitter and a receiver

T7A03 (B)
Which of the following is used to convert a radio signal from one frequency to another?

B. Mixer

T7A04 (C)
Which term describes the ability of a receiver to discriminate between multiple signals?

C. Selectivity

T7A05 (D)
What is the name of a circuit that generates a signal of a desired frequency?

D. Oscillator

T7A06 (C)
What device takes the output of a low-powered 28 MHz SSB exciter and produces a 222 MHz output signal?

C. Transverter

T7A07 (D)
What is meant by term “PTT”?

D. The push to talk function which switches between receive and transmit

T7A08 (C)
Which of the following describes combining speech with an RF carrier signal?-

C. Modulation

T7A09 (B)
Which of the following devices is most useful for VHF weak-signal communication?

B. A multi-mode VHF transceiver

T7A10 (B)
What device increases the low-power output from a handheld transceiver?

B. An RF power amplifier

T7A11 (A)
Where is an RF preamplifier installed?

A. Between the antenna and receiver

T7B – Common transmitter and receiver problems: symptoms of overload and overdrive; distortion; causes of interference; interference and consumer electronics; part 15 devices; over and under modulation; RF feedback; off frequency signals; fading and noise; problems with digital communications interfaces

T7B01 (D)
What can you do if you are told your FM handheld or mobile transceiver is over-deviating?

D. Talk farther away from the microphone

T7B02 (A)
What would cause a broadcast AM or FM radio to receive an amateur radio transmission unintentionally?

A. The receiver is unable to reject strong signals outside the AM or FM band

T7B03 (D)
Which of the following may be a cause of radio frequency interference?

A. Fundamental overload
B. Harmonics
C. Spurious emissions
D. All of these choices are correct

T7B04 (D)
Which of the following is a way to reduce or eliminate interference by an amateur transmitter to a nearby telephone?

D. Put a RF filter on the telephone

T7B05 (A)
How can overload of a non-amateur radio or TV receiver by an amateur signal be reduced or eliminated?

A. Block the amateur signal with a filter at the antenna input of the affected receiver

T7B06 (A)
Which of the following actions should you take if a neighbor tells you that your station’s transmissions are interfering with their radio or TV reception?

A. Make sure that your station is functioning properly and that it does not cause interference to your own radio or television when it is tuned to the same channel

T7B07 (D)
Which of the following may be useful in correcting a radio frequency interference problem?

A. Snap-on ferrite chokes
B. Low-pass and high-pass filters
C. Band-reject and band-pass filters
D. All of these choices are correct

T7B08 (D)
What should you do if something in a neighbor’s home is causing harmful interference to your amateur station?

A. Work with your neighbor to identify the offending device
B. Politely inform your neighbor about the rules that prohibit the use of devices which cause interference
C. Check your station and make sure it meets the standards of good amateur practice
D. All of these choices are correct

T7B09 (A)
What is a Part 15 device?

A. An unlicensed device that may emit low powered radio signals on frequencies used by a licensed service

T7B10 (D)
What might be the problem if you receive a report that your audio signal through the repeater is distorted or unintelligible?

A. Your transmitter may be slightly off frequency
B. Your batteries may be running low
C. You could be in a bad location
D. All of these choices are correct

T7B11 (C)
What is a symptom of RF feedback in a transmitter or transceiver?

C. Reports of garbled, distorted, or unintelligible transmissions

T7B12 (D)
What might be the first step to resolve cable TV interference from your ham radio transmission?

D. Be sure all TV coaxial connectors are installed properly

T7C – Antenna measurements and troubleshooting: measuring SWR; dummy loads; coaxial cables; feed line failure modes

T7C01 (A)
What is the primary purpose of a dummy load?

A. To prevent the radiation of signals when making tests

T7C02 (B)
Which of the following instruments can be used to determine if an antenna is resonant at the desired operating frequency?

B. An antenna analyzer

T7C03 (A)
What, in general terms, is standing wave ratio (SWR)?

A. A measure of how well a load is matched to a transmission line

T7C04 (C)
What reading on an SWR meter indicates a perfect impedance match between the antenna and the feed line?

C. 1 to 1

T7C05 (A)
What is the approximate SWR value above which the protection circuits in most solid-state transmitters begin to reduce transmitter power?

A. 2 to 1

T7C06 (D)
What does an SWR reading of 4:1 indicate?

D. Impedance mismatch

T7C07 (C)
What happens to power lost in a feed line?

C. It is converted into heat

T7C08 (D)
What instrument other than an SWR meter could you use to determine if a feed line and antenna are properly matched?

D. Directional wattmeter

T7C09 (A)
Which of the following is the most common cause for failure of coaxial cables?

A. Moisture contamination

T7C10 (D)
Why should the outer jacket of coaxial cable be resistant to ultraviolet light?

D. Ultraviolet light can damage the jacket and allow water to enter the cable

T7C11 (C)
What is a disadvantage of air core coaxial cable when compared to foam or solid dielectric types?

C. It requires special techniques to prevent water absorption

T7C12 (B)
Which of the following is a common use of coaxial cable?

B. Carrying RF signals between a radio and antenna

T7C13 (B)
What does a dummy load consist of?

B. A non-inductive resistor and a heat sink

T7D – Basic repair and testing: soldering; using basic test instruments; connecting a voltmeter, ammeter, or ohmmeter

T7D01 (B)
Which instrument would you use to measure electric potential or electromotive force?

B. A voltmeter

T7D02 (B)
What is the correct way to connect a voltmeter to a circuit?

B. In parallel with the circuit

T7D03 (A)
How is an ammeter usually connected to a circuit?

A. In series with the circuit

T7D04 (D)
Which instrument is used to measure electric current?

D. An ammeter

T7D05 (D)
What instrument is used to measure resistance?

D. An ohmmeter

T7D06 (C)
Which of the following might damage a multimeter?

C. Attempting to measure voltage when using the resistance setting

T7D07 (D)
Which of the following measurements are commonly made using a multimeter?

D. Voltage and resistance

T7D08 (C)
Which of the following types of solder is best for radio and electronic use?

C. Rosin-core solder

T7D09 (C)
What is the characteristic appearance of a cold solder joint?

C. A grainy or dull surface

T7D10 (B)
What is probably happening when an ohmmeter, connected across an unpowered circuit, initially indicates a low resistance and then shows increasing resistance with time?

B. The circuit contains a large capacitor

T7D11 (B)
Which of the following precautions should be taken when measuring circuit resistance with an ohmmeter?

B. Ensure that the circuit is not powered

T7D12 (B)
Which of the following precautions should be taken when measuring high voltages with a voltmeter?

B. Ensure that the voltmeter and leads are rated for use at the voltages to be measured

SUBELEMENT T8 – Modulation modes: amateur satellite operation; operating activities; non-voice communications – [4 Exam Questions - 4 Groups]

T8A – Modulation modes: bandwidth of various signals; choice of emission type

T8A01 (C)
Which of the following is a form of amplitude modulation?

C. Single sideband

T8A02 (A)
What type of modulation is most commonly used for VHF packet radio transmissions?

A. FM

T8A03 (C)
Which type of voice mode is most often used for long-distance (weak signal) contacts on the VHF and UHF bands?

C. SSB

T8A04 (D)
Which type of modulation is most commonly used for VHF and UHF voice repeaters?

D. FM

T8A05 (C)
Which of the following types of emission has the narrowest bandwidth?

C. CW

T8A06 (A)
Which sideband is normally used for 10 meter HF, VHF and UHF single-sideband communications?

A. Upper sideband

T8A07 (C)
What is the primary advantage of single sideband over FM for voice transmissions?

C. SSB signals have narrower bandwidth

T8A08 (B)
What is the approximate bandwidth of a single sideband voice signal?

B. 3 kHz

T8A09 (C)
What is the approximate bandwidth of a VHF repeater FM phone signal?

C. Between 10 and 15 kHz

T8A10 (B)
What is the typical bandwidth of analog fast-scan TV transmissions on the 70 cm band?

B. About 6 MHz

T8A11 (B)
What is the approximate maximum bandwidth required to transmit a CW signal?

B. 150 Hz

T8B - Amateur satellite operation; Doppler shift, basic orbits, operating protocols; control operator, transmitter power considerations; satellite tracking; digital modes

T8B01 (D) [97.301, 97.207(c)]
Who may be the control operator of a station communicating through an amateur satellite or space station?

D. Any amateur whose license privileges allow them to transmit on the satellite uplink frequency

T8B02 (B) [97.313]
How much transmitter power should be used on the uplink frequency of an amateur satellite or space station?

B. The minimum amount of power needed to complete the contact

T8B03 (D)
Which of the following are provided by satellite tracking programs?

D. All of these answers are correct

T8B04 (B) [97.301, 97.207(c)]
Which amateur stations may make contact with an amateur station on the International Space Station using 2 meter and 70 cm band amateur radio frequencies?

B. Any amateur holding a Technician or higher class license

T8B05 (D)
What is a satellite beacon?

D. A transmission from a space station that contains information about a satellite

T8B06 (B)
Which of the following are inputs to a satellite tracking program?

B. The Keplerian elements

T8B07 (C)
With regard to satellite communications, what is Doppler shift?

C. An observed change in signal frequency caused by relative motion between the satellite and the earth station

T8B08 (B)
What is meant by the statement that a satellite is operating in mode U/V?

B. The satellite uplink is in the 70 cm band and the downlink is in the 2 meter band

T8B09 (B)
What causes spin fading when referring to satellite signals?

B. Rotation of the satellite and its antennas

T8B10 (C)
What do the initials LEO tell you about an amateur satellite?

C. The satellite is in a Low Earth Orbit

T8B11 (C)
What is a commonly used method of sending signals to and from a digital satellite?

C. FM Packet

T8C – Operating activities: radio direction finding; radio control; contests; linking over the Internet; grid locators

T8C01 (C)
Which of the following methods is used to locate sources of noise interference or jamming?

C. Radio direction finding

T8C02 (B)
Which of these items would be useful for a hidden transmitter hunt?

B. A directional antenna

T8C03 (A)
What popular operating activity involves contacting as many stations as possible during a specified period of time?

A. Contesting

T8C04 (C)

Which of the following is good procedure when contacting another station in a radio contest?

C. Send only the minimum information needed for proper identification and the contest exchange

T8C05 (A)
What is a grid locator?

A. A letter-number designator assigned to a geographic location

T8C06 (B)
How is access to an IRLP node accomplished?

B. By using DTMF signals

T8C07 (B) [97.215(c)]
What is the maximum power allowed when transmitting telecommand signals to radio controlled models?

B. 1 watt

T8C08 (C) [97.215(a)]
What is required in place of on-air station identification when sending signals to a radio control model using amateur frequencies?

C. A label indicating the licensee's name, call sign and address must be affixed to the transmitter

T8C09 (C)
How might you obtain a list of active nodes that use VoIP?

C. From a repeater directory

T8C10 (D)
How do you select a specific IRLP node when using a portable transceiver?

D. Use the keypad to transmit the IRLP node ID

T8C11 (A)
What name is given to an amateur radio station that is used to connect other amateur stations to the Internet?

A. A gateway

T8C12 (D)
What is meant by Voice Over Internet Protocol (VoIP) as used in amateur radio?

D. A method of delivering voice communications over the Internet using digital techniques

T8C13 (A)
What is the Internet Radio Linking Project (IRLP)?

A. A technique to connect amateur radio systems, such as repeaters, via the Internet using Voice Over Internet Protocol

T8D – Non-voice communications: image signals; digital modes; CW; packet; PSK31; APRS; error detection and correction; NTSC

T8D01 (D)
Which of the following is an example of a digital communications method?

A. Packet
B. PSK31
C. MFSK
D. All of these choices are correct

T8D02 (A)
What does the term "APRS" mean?

A. Automatic Packet Reporting System

T8D03 (D)
Which of the following devices provides data to the transmitter when sending automatic position reports from a mobile amateur radio station?

D. A Global Positioning System receiver

T8D04 (C)
What type of transmission is indicated by the term NTSC?

C. An analog fast scan color TV signal

T8D05 (A)
Which of the following is an application of APRS (Automatic Packet Reporting System)?

A. Providing real time tactical digital communications in conjunction with a map showing the locations of stations

T8D06 (B)
What does the abbreviation PSK mean?

B. Phase Shift Keying

T8D07 (D)
What is PSK31?

D. A low-rate data transmission mode

T8D08 (D)
Which of the following may be included in packet transmissions?

A. A check sum which permits error detection
B. A header which contains the call sign of the station to which the information is being sent
C. Automatic repeat request in case of error
D. All of these choices are correct

T8D09 (C)
What code is used when sending CW in the amateur bands?

C. International Morse

T8D10 (D)
Which of the following can be used to transmit CW in the amateur bands?

A. Straight Key
B. Electronic Keyer
C. Computer Keyboard
D. All of these choices are correct

T8D11 (C)
What is an ARQ transmission system?

C. A digital scheme whereby the receiving station detects errors and sends a request to the sending station to retransmit the information

SUBELEMENT T9 – Antennas and feed lines - [2 Exam Questions - 2 Groups]

T9A – Antennas: vertical and horizontal polarization; concept of gain; common portable and mobile antennas; relationships between antenna length and frequency

T9A01 (C)
What is a beam antenna?

C. An antenna that concentrates signals in one direction

T9A02 (B)
Which of the following is true regarding vertical antennas?

B. The electric field is perpendicular to the Earth

T9A03 (B)
Which of the following describes a simple dipole mounted so the conductor is parallel to the Earth's surface?

B. A horizontally polarized antenna

T9A04 (A)
What is a disadvantage of the “rubber duck” antenna supplied with most handheld radio transceivers?

A. It does not transmit or receive as effectively as a full-sized antenna

T9A05 (C)
How would you change a dipole antenna to make it resonant on a higher frequency?

C. Shorten it

T9A06 (C)
What type of antennas are the quad, Yagi, and dish?

C. Directional antennas

T9A07 (A)

What is a good reason not to use a “rubber duck” antenna inside your car?

A. Signals can be significantly weaker than when it is outside of the vehicle

T9A08 (C)
What is the approximate length, in inches, of a quarter-wavelength vertical antenna for 146 MHz?

C. 19

T9A09 (C)
What is the approximate length, in inches, of a 6 meter 1/2-wavelength wire dipole antenna?

C. 112

T9A10 (C)
In which direction is the radiation strongest from a half-wave dipole antenna in free space?

C. Broadside to the antenna

T9A11 (C)
What is meant by the gain of an antenna?

C. The increase in signal strength in a specified direction when compared to a reference antenna

T9A12 (A)
What is a reason to use a properly mounted 5/8 wavelength antenna for VHF or UHF mobile service?

A. It offers a lower angle of radiation and more gain than a 1/4 wavelength antenna and usually provides improved coverage

T9A13 (C)
Why are VHF or UHF mobile antennas often mounted in the center of the vehicle roof?

C. A roof mounted antenna normally provides the most uniform radiation pattern

T9A14 (A)
Which of the following terms describes a type of loading when referring to an antenna?

A. Inserting an inductor in the radiating portion of the antenna to make it electrically longer

T9B – Feed lines: types of feed lines; attenuation vs. frequency; SWR concepts; matching; weather protection; choosing RF connectors and feed lines

T9B01 (B)
Why is it important to have a low SWR in an antenna system that uses coaxial cable feed line?

B. To allow the efficient transfer of power and reduce losses

T9B02 (B)
What is the impedance of the most commonly used coaxial cable in typical amateur radio installations?

B. 50 ohms

T9B03 (A)
Why is coaxial cable used more often than any other feed line for amateur radio antenna systems?

A. It is easy to use and requires few special installation considerations

T9B04 (A)
What does an antenna tuner do?

A. It matches the antenna system impedance to the transceiver's output impedance

T9B05 (D)
What generally happens as the frequency of a signal passing through coaxial cable is increased?

D. The loss increases

T9B06 (B)
Which of the following connectors is most suitable for frequencies above 400 MHz?

B. A Type N connector

T9B07 (C)
Which of the following is true of PL-259 type coax connectors?

C. They are commonly used at HF frequencies

T9B08 (A)
Why should coax connectors exposed to the weather be sealed against water intrusion?

A. To prevent an increase in feed line loss

T9B09 (B)
What might cause erratic changes in SWR readings?

B. A loose connection in an antenna or a feed line

T9B10 (C)
What electrical difference exists between the smaller RG-58 and larger RG-8 coaxial cables?

C. RG-8 cable has less loss at a given frequency

T9B11 (C)
Which of the following types of feed line has the lowest loss at VHF and UHF?

C. Air-insulated hard line
SUBELEMENT T0 – Electrical safety: AC and DC power circuits; antenna installation; RF hazards – [3 Exam Questions - 3 Groups]

T0A – Power circuits and hazards: hazardous voltages; fuses and circuit breakers; grounding; lightning protection; battery safety; electrical code compliance

T0A01 (B)
Which of the following is a safety hazard of a 12-volt storage battery?

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

T0A02 (D)
How does current flowing through the body cause a health hazard?

A. By heating tissue
B. It disrupts the electrical functions of cells
C. It causes involuntary muscle contractions
D. All of these choices are correct

T0A03 (C)
What is connected to the green wire in a three-wire electrical AC plug?

C. Safety ground

T0A04 (B)
What is the purpose of a fuse in an electrical circuit?

B. To interrupt power in case of overload

T0A05 (C)
Why is it unwise to install a 20-ampere fuse in the place of a 5-ampere fuse?

C. Excessive current could cause a fire

T0A06 (D)
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

T0A07 (D)
Which of these precautions should be taken when installing devices for lightning protection in a coaxial cable feed line?

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

T0A08 (A)
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

T0A09 (C)
What kind of hazard is presented by a conventional 12-volt storage battery?

C. Explosive gas can collect if not properly vented

T0A10 (A)
What can happen if a lead-acid storage battery is charged or discharged too quickly?

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

T0A11 (D)
What kind of hazard might exist in a power supply when it is turned off and disconnected?

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

T0B – Antenna safety: tower safety; erecting an antenna support; overhead power lines; installing an antenna

T0B01 (C)
When should members of a tower work team wear a hard hat and safety glasses?

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

T0B02 (C)
What is a good precaution to observe before climbing an antenna tower?

C. Put on a climbing harness and safety glasses

T0B03 (D)
Under what circumstances is it safe to climb a tower without a helper or observer?

D. Never

T0B04 (C)
Which of the following is an important safety precaution to observe when putting up an antenna tower?

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

T0B05 (C)
What is the purpose of a gin pole?

C. To lift tower sections or antennas

T0B06 (D)
What is the minimum safe distance from a power line to allow when installing an antenna?

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

T0B07 (C)
Which of the following is an important safety rule to remember when using a crank-up tower?

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

T0B08 (C)
What is considered to be a proper grounding method for a tower?

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

T0B09 (C)
Why should you avoid attaching an antenna to a utility pole?

C. The antenna could contact high-voltage power wires

T0B10 (C)
Which of the following is true concerning grounding conductors used for lightning protection?

C. Sharp bends must be avoided

T0B11 (B)
Which of the following establishes grounding requirements for an amateur radio tower or antenna?

B. Local electrical codes

T0B12 (C)
Which of the following is good practice when installing ground wires on a tower for lightning protection?

C. Ensure that connections are short and direct

T0C - RF hazards: radiation exposure; proximity to antennas; recognized safe power levels; exposure to others; radiation types; duty cycle

T0C01 (D)
What type of radiation are VHF and UHF radio signals?

D. Non-ionizing radiation

T0C02 (B)
Which of the following frequencies has the lowest value for Maximum Permissible Exposure limit?

B. 50 MHz

T0C03 (C)
What is the maximum power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required?

C. 50 watts PEP at the antenna

T0C04 (D)
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

T0C05 (D)
Why do exposure limits vary with frequency?

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

T0C06 (D)
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

T0C07 (B)
What could happen if a person accidentally touched your antenna while you were transmitting?

B. They might receive a painful RF burn

T0C08 (A)
Which of the following actions might amateur operators take to prevent exposure to RF radiation in excess of FCC-supplied limits?

A. Relocate antennas

T0C09 (B)
How can you make sure your station stays in compliance with RF safety regulations?

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

T0C10 (A)
Why is duty cycle one of the factors used to determine safe RF radiation exposure levels?

A. It affects the average exposure of people to radiation

T0C11 (C)
What is the definition of duty cycle during the averaging time for RF exposure?

C. The percentage of time that a transmitter is transmitting

T0C12 (A)
How does RF radiation differ from ionizing radiation (radioactivity)?

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

T0C13 (C)
If the averaging time for exposure is 6 minutes, how much power density is permitted if the signal is present for 3 minutes and absent for 3 minutes rather than being present for the entire 6 minutes?

C. 2 times as much