Element 2 Study Guide

Preliminary Version

2022-2026 FCC Element 2 Question Pool
Effective for VEC Examinations on
July 1, 2022 thru June 30, 2026

SUBELEMENT T1 – COMMISSION'S RULES - [6 Exam Questions - 6 Groups] 67 Questions

T1A - Purpose and permissible use of the Amateur Radio Service; Operator/primary station license grant; Meanings of basic terms used in FCC rules; Interference; RACES rules; Phonetics; Frequency Coordinator

T1A01 [97.1]
Advancing skills in the technical and communication phases of the radio art is part of the Basis and Purpose of the Amateur Radio Service.

T1A02 [97.1]
The agency which regulates and enforces the rules for the Amateur Radio Service in the United States is the FCC (Federal Communications Commission).

T1A03 [97.119(b)(2)]
The FCC rules encourage the use of a phonetic alphabet for station identification in the Amateur Radio Service.

T1A04 [97.5(b)(1)]
One operator/primary station license grant may be held by any one person.

T1A05 [97.7]
A license appearing in the FCC ULS (Universal Licensing System) database is proof that the FCC has issued an operator/primary license grant.

T1A06 [97.3(a)(9)]
FCC Part 97 defines a beacon as an amateur station transmitting communications for the purposes of observing propagation or related experimental activities.

T1A07 [97.3(a)(41)]
FCC Part 97 defines a space station as an amateur station located more than 50 km above Earth's surface.

T1A08 [97.3(a)(22)]
A Volunteer Frequency Coordinator recognized by local amateurs is the entity who recommends transmit/receive channels and other parameters for auxiliary and repeater stations.

T1A09 [97.3(a)(22)]
A Frequency Coordinator is selected by amateur operators in a local or regional area whose stations are eligible to be repeater or auxiliary stations.

T1A10 [97.3(a)(38), 97.407]
The Radio Amateur Civil Emergency Service (RACES) is a radio service using amateur frequencies for emergency management or civil defense communications, using amateur stations for emergency management or civil defense communications, and using amateur operators certified by a civil defense organization as being enrolled in that organization.

T1A11 [97.101 (d)]
Willful interference to other amateur radio stations is permitted at no time.

T1B - Frequency allocations; Emission modes; Spectrum sharing; Transmissions near band edges; Contacting the International Space Station; Power output

T1B01 [97.301 (e)]
The frequency range from 28.300 MHz to 28.500 MHz is available for phone operation by Technician licensees.

T1B02 [97.301, 97.207(c)]
Any amateur holding a Technician class or higher license may contact the International Space Station (ISS) on VHF bands.

T1B03 [97.301(a)]
52.525 MHz is in the 6 meter amateur band; 49.00 MHz, 28.50 MHz, and 222.15 MHz are not.

T1B04 [97.301(a)]
The 2 meter amateur band includes 146.52 MHz.

T1B05 [97.305(c)]
Amateurs may use the 219 to 220 MHz segment of 1.25 meter band for fixed digital message forwarding systems only.

T1B06 [97.301(e), 97.305]
The 10 meter band is the only HF band where a Technician class operator has phone privileges.

T1B07 [97.305(a), (c)]
50.0 MHz to 50.1 MHz, 144.0 MHz to 144.1 MHz, and 222 MHz to 222.1 MHz are the only VHF/UHF band segments limited to CW only.

T1B08 [97.303]
In segments of bands where the Amateur Radio Service is secondary, U.S. amateurs may find non-amateur stations and must avoid interfering with them.

T1B09 [97.101(a), 97.301(a-e)]
You 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 do not extend beyond the band edge, and to allow for transmitter frequency drift.

T1B10 [97.305(c)]
SSB phone be used in at least some segment of all amateur bands above 50 MHz.

T1B11 [97.313]
The maximum peak envelope power output for Technician class operators in their HF band segments is 200 Watts.

T1B12 [97.313(b)]
Except for some specific restrictions, 1500 Watts is the maximum peak envelope power output for Technician class operators using frequencies above 30 MHz.

T1C - Licensing: classes, sequential and vanity call sign systems, places where the Amateur Radio Service is regulated by the FCC, name and address on FCC license database, term, renewal, grace period, maintaining mailing address; International communications

T1C01 [97.9(a), 97.17(a)]
Technician, General, Amateur Extra license classes are the only new licenses currently available from the FCC.

T1C02 [97.19]
Any licensed amateur may select a desired call sign under the vanity call sign rules.

T1C03 [97.117]
An FCC-licensed amateur radio station is only permitted to make international communications incidental to the purposes of the Amateur Radio Service and remarks of a personal character.

T1C04 [97.23]
If the FCC is unable to reach you by email they may revoke your station license or suspend your operator license.

T1C05
KF1XXX is a valid Technician class call sign format, KA1X and W1XX are not.

T1C06 [97.5(a)(2)]
An FCC-licensed amateur station may transmit from any vessel or craft located in international waters and documented or registered in the United States.

T1C07 [97.23]
Failure to provide and maintain a correct email address with the FCC can result in revocation of the station license or suspension of the operator license.

T1C08 [97.25]
The normal term for an FCC-issued amateur radio license is ten years.

T1C09 [97.21(a)(b)]
The grace period for renewal if an amateur license expires is two years.

T1C10 [97.5a]
After passing the examination for your first amateur radio license may you transmit on the amateur radio bands as soon as your operator/station license grant appears in the FCC’s license database.

T1C11 [97.21(b)]
If your license has expired and is still within the allowable grace period, you may not continue to transmit on the amateur radio bands until the license has been renewed.

T1D - Authorized and prohibited transmissions: communications with other countries, music, exchange of information with other services, indecent language, compensation for operating, retransmission of other amateur signals, encryption, sale of equipment, unidentified transmissions, one-way transmission

T1D01 [97.111(a)(1)]
FCC-licensed amateur radio stations prohibited from exchanging communications with any country whose administration has notified the International Telecommunication Union (ITU) that it objects to such communications.

T1D02 (B) [97.113(b), 97.111(b)]
Broadcasting transmissions by an amateur station are prohibited, but one-way transmissions are permissible for International Morse Code Practice, and telecommand or transmissions of telemetry.

T1D03 [97.211(b), 97.215(b), 97.113(a)(4)]
It is not permissible to transmit messages encoded to obscure their meaning except when transmitting control commands to space stations or radio control craft.

T1D04 [97.113(a)(4), 97.113(c)]
An amateur station is only authorized to transmit music using a phone emission when incidental to an authorized retransmission of manned spacecraft communications.

T1D05 [97.113(a)(3)(ii)]
Amateur radio operators may use their stations to notify other amateurs of the availability of equipment for sale or trade only when selling amateur radio equipment and not on a regular basis.

T1D06 [97.113(a)(4)]
Any language that may be considered indecent or obscene is prohibited.

T1D07 [97.113(d)]
Repeater, auxiliary, or space stations are types of amateur stations which can automatically retransmit the signals of other amateur stations.

T1D08 [97.113(a)(3)(iii)]
The control operator of an amateur station receive compensation for operating that station when the communication is incidental to classroom instruction at an educational institution; not when the communication is related to the sale of amateur equipment by the control operator's employer, nor when the communication is made to obtain emergency information for a local broadcast station.

T1D09 [97.113(5)(b)]
Assuming no other means is available, amateur stations may transmit information in support of broadcasting, program production, or news gathering, only when such communications are directly related to the immediate safety of human life or protection of property.

T1D10 [97.3(a)(10)]
The FCC defines broadcasting for the Amateur Radio Service as transmissions intended for reception by the general public.

T1D11 [97.119(a)]
An amateur station may transmit without identifying on the air when transmitting signals to control model craft.

T1E - Control operator: eligibility, designating, privileges, duties, location, required; Control point; Control types: automatic, remote

T1E01 [97.7(a)]
An amateur station may never transmit without a control operator.

T1E02 [97.301, 97.207(c)]
Any amateur allowed to transmit on the satellite uplink frequency may be the control operator of a station communicating through an amateur satellite or space station.

T1E03 [97.103(b)]
The station licensee must designate the station control operator.

T1E04 [97.103(b)]
The class of operator license held by the control operator determines the transmitting frequency privileges of an amateur station.

T1E05 [97.3(a)(14)]
An amateur station’s control point is the location at which the control operator function is performed.

T1E06 [97.301]
Under normal circumstances, a Technician class licensee may at no time be the control operator of a station operating in an Amateur Extra Class band segment.

T1E07 [97.103(a)]
When the control operator is not the station licensee, the control operator and the station licensee are responsible for the proper operation of the station.

T1E08 [97.3(a)(6), 97.205(d)]
Repeater operation is an example of automatic control, controlling a station over the internet, using a computer or other device to send CW automatically, and using a computer or other device to identify automatically are not.

T1E09 [97.109(c)]
Remote control operation requires a control operator at all times, the control operator be at the control point, and the control operator must indirectly manipulate the controls.

T1E10 [97.3(a)(39)]
As defined in Part 97, operating the station over the internet is an example of remote control, repeater operation and controlling a model aircraft, boat, or car by amateur radio are not.

T1E11 [97.103(a)]
The FCC presume the station licensee to be the control operator of an amateur station, unless documentation to the contrary is in the station records.

T1F - Station identification; Repeaters; Third party communications; Club stations; FCC inspection

T1F01 [97.103(c)]
A station and its records must be available for FCC inspection at any time upon request by an FCC representative.

T1F02 [97.119 (a)]
When using tactical call signs such as “Race Headquarters”, you must identify with your FCC-assigned call sign at the end of each communication and every ten minutes during a communication.

T1F03 [97.119(a)]
You required to transmit your assigned call sign at least every 10 minutes during and at the end of a communication.

T1F04 [97.119(b)(2)]
You must use English for identification when operating in a phone sub-band.

T1F05 [97.119(b)(2)]
Sending the call sign using a CW or phone emission is required for a station transmitting phone signals.

T1F06 [97.119(c)]
Using self-assigned indicators such as KL7CC stroke W3, KL7CC slant W3, or KL7CC slash W3 are acceptable when using a phone transmission.

T1F07 [97.115(a)(2)]
A non-licensed person is allowed to speak to a foreign station using a station under the control of a licensed amateur operator only if the foreign station is in a country with which the U.S. has a third party agreement.

T1F08 [97.3(a)(47)]
Third party communications is defined as a message from a control operator to another amateur station control operator on behalf of another person.

T1F09 [97.3(a)(40)]
A repeater station is a type of amateur station which simultaneously retransmits the signal of another amateur station on a different channel or channels

T1F10 [97.205(g)]
The control operator of the originating station is accountable if a repeater inadvertently retransmits communications that violate the FCC rules.

T1F11 [97.5(b)(2)]
A club is required to have at least four members for the issuance of a club station license grant.

SUBELEMENT T2 - OPERATING PROCEDURES - [3 Exam Questions - 3 Groups] 36 Questions

T2A - Station operation: choosing an operating frequency, calling another station, test transmissions; Band plans: calling frequencies, repeater offsets

T2A01
A common repeater frequency offset in the 2 meter band is plus or minus 600 kHz.

T2A02
The national calling frequency for FM simplex operations in the 2 meter band is 146.520 MHz.

T2A03
A common repeater frequency offset in the 70 cm band is plus or minus 5 MHz.

T2A04
An appropriate way to call another station on a repeater if you know the other station's call sign is to say the station's call sign, then identify with your call sign.

T2A05
You should respond to a station calling CQ by transmitting the other station’s call sign followed by your call sign.

T2A06
The only requirement when making on-the-air test transmissions is to identify the transmitting station.

T2A07
"Repeater offset” means the difference between a repeater’s transmit and receive frequencies.

T2A08
The procedural signal “CQ” means calling any station.

T2A09
Saying their station’s call sign followed by the word “monitoring” indicates a station is listening on a repeater and looking for a contact.

T2A10
Beyond the privileges established by the FCC, a band plan is a voluntary guideline for using different modes or activities within an amateur band.

T2A11
Simplex is the term describing an amateur station that is transmitting and receiving on the same frequency.

T2A12
Before calling CQ, you should listen first to be sure that no one else is using the frequency, ask if the frequency is in use, and make sure you are authorized to use that frequency.

T2B – VHF/UHF operating practices: FM repeater, simplex, reverse splits; Access tones: CTCSS, DTMF; DMR operation; Resolving operational problems; Q signals

T2B01
A VHF/UHF transceiver’s “reverse” function is used to listen on a repeater’s input frequency.

T2B02
CTCSS (Continuous Tone Controlled Squelch System) is the term describing the use of a sub-audible tone transmitted along with normal voice audio to open the squelch of a receiver.

T2B03
A linked repeater network is a network of repeaters in which signals received by one repeater are transmitted by all the repeaters in the network.

T2B04
If you are unable to access a repeater whose output you can hear, it may be due to improper transceiver offset, using the wrong CTCSS tone, or using the wrong DCS code.

T2B05
Talking too loudly would cause your FM transmission audio to be distorted on voice peaks.

T2B06
DTMF is a type of signaling which uses pairs of audio tones.

T2B07
You can join a digital repeater’s “talkgroup” by programming your radio with the group’s ID or code.

T2B08
When two stations transmitting on the same frequency interfere with each other the stations should negotiate continued use of the frequency.

T2B09
Simplex channels are designated in the VHF/UHF band plans so stations within range of each other can communicate without tying up a repeater.

T2B10
QRM is the Q signal indicating that you are receiving interference from other stations.

T2B11
QSY is the Q signal indicating that you are changing frequency.

T2B12
The purpose of the color code used on DMR repeater systems is to establish groups of users.

T2B13
The purpose of a squelch function is to mute the receiver audio when a signal is not present.

T2C — Public service: emergency operations, applicability of FCC rules, RACES and ARES, net and traffic procedures, operating restrictions during emergencies, use of phonetics in message handling

T2C01 [97.103(a)]
FCC rules always apply to the operation of an amateur station.

T2C02
Typical duties of a Net Control Station include calling the net to order and directing communications between stations checking in.

T2C03
To ensure that voice messages containing unusual words are received correctly the technique of spelling the words using a standard phonetic alphabet is used.

T2C04
RACES (Radio Amateur Civil Emergency Services) is an FCC part 97 amateur radio service for civil defense communications during national emergencies.

T2C05
In net operation, the term “traffic” refers to messages exchanged by net stations.

T2C06
Amateur Radio Emergency Service (ARES) is a group of licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service.

T2C07
When you participate in a net, standard practice is to transmit only when directed by the net control station, unless you are reporting an emergency.

T2C08
A characteristic of good traffic handling is passing messages exactly as received.

T2C09
Amateur station control operators are permitted to operate outside the frequency privileges of their license class only in situations involving the immediate safety of human life or protection of property.

T2C10
The preamble of a formal traffic message contains information needed to track the message.

T2C11
In a radiogram header, “check” means the number of words or word equivalents in the text portion of the message.

SUBELEMENT T3 – RADIO WAVE PROPAGATION – [3 Exam Questions - 3 Groups] 34 Questions

T3A - Radio wave characteristics: how a radio signal travels, fading, multipath, polarization, wavelength vs absorption; Antenna orientation

T3A01
VHF signal strengths sometimes vary greatly when the antenna is moved only a few feet because multipath propagation cancels or reinforces signals.

T3A02
Absorption is the effect vegetation has on UHF and microwave signals.

T3A03
Horizontal antenna polarization is normally used for long-distance CW and SSB contacts on the VHF and UHF bands.

T3A04
When antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization, received signal strength is reduced.

T3A05
When using a directional antenna, if buildings or obstructions are blocking the direct line of sight path, your station might be able to communicate with a distant repeater by trying to find a path that reflects signals to the repeater

T3A06 (B)
What is the meaning of the term “picket fencing”?
A. Alternating transmissions during a net operation
B. Rapid flutter on mobile signals due to multipath propagation
C. A type of ground system used with vertical antennas
D. Local vs long-distance communications
~~

T3A07 (C)
What weather condition might decrease range at microwave frequencies?
A. High winds
B. Low barometric pressure
C. Precipitation
D. Colder temperatures
~~

T3A08 (D)
What is a likely cause of irregular fading of signals propagated by the ionosphere?
A. Frequency shift due to Faraday rotation
B. Interference from thunderstorms
C. Intermodulation distortion
D. Random combining of signals arriving via different paths
~~

T3A09 (B)
Which of the following results from the fact that signals propagated by 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
~~

T3A10 (D)
What effect does multi-path propagation have on data transmissions?
A. Transmission rates must 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 transmitted using FM
D. Error rates are likely to increase
~~

T3A11 (C)
Which region of the atmosphere can refract or bend HF and VHF radio waves?
A. The stratosphere
B. The troposphere
C. The ionosphere
D. The mesosphere
~~

T3A12 (B)
What is the effect of fog and rain on signals in the 10 meter and 6 meter bands?
A. Absorption
B. There is little effect
C. Deflection
D. Range increase
~~

T3B - Electromagnetic wave properties: wavelength vs frequency, nature and velocity of electromagnetic waves, relationship of wavelength and frequency; Electromagnetic spectrum definitions: UHF, VHF, HF

T3B01 (D)
What is the relationship between the electric and magnetic fields of an electromagnetic wave?
A. They travel at different speeds
B. They are in parallel
C. They revolve in opposite directions
D. They are at right angles
~~

T3B02 (A)
What property of a radio wave defines 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
~~

T3B03 (C)
What are the two components of a radio wave?
A. Impedance and reactance
B. Voltage and current
C. Electric and magnetic fields
D. Ionizing and non-ionizing radiation
~~

T3B04 (A)
What is the velocity of a radio wave traveling through free space?
A. Speed of light
B. Speed of sound
C. Speed inversely proportional to its wavelength

D. Speed that increases as the frequency increases
~~

T3B05 (B)
What is the relationship between wavelength and frequency?
A. Wavelength gets longer as frequency increases
B. Wavelength gets shorter as frequency increases
C. Wavelength and frequency are unrelated
D. Wavelength and frequency increase as path length increases
~~

T3B06 (D)
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
~~

T3B07 (A)
In addition to frequency, which of the following is used to identify amateur radio bands?
A. The approximate wavelength in meters
B. Traditional letter/number designators
C. Channel numbers
D. All these choices are correct
~~

T3B08 (B)
What frequency range is referred to as VHF?
A. 30 kHz to 300 kHz
B. 30 MHz to 300 MHz
C. 300 kHz to 3000 kHz
D. 300 MHz to 3000 MHz
~~

T3B09 (D)
What frequency range is referred to as UHF?
A. 30 to 300 kHz
B. 30 to 300 MHz
C. 300 to 3000 kHz
D. 300 to 3000 MHz
~~

T3B10 (C)
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
~~

T3B11 (B)
What is the approximate velocity of a radio wave in free space?
A. 150,000 meters per second
B. 300,000,000 meters per second
C. 300,000,000 miles per hour
D. 150,000 miles per hour
~~

T3C - Propagation modes: sporadic E, meteor scatter, auroral propagation, tropospheric ducting; F region skip; Line of sight and radio horizon

T3C01 (C)
Why are simplex UHF signals rarely heard beyond their radio horizon?
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 propagated by the ionosphere
D. UHF signals are absorbed by the ionospheric D region
~~

T3C02 (C)
What is a characteristic of HF communication compared with communications on VHF and higher frequencies?
A. HF antennas are generally smaller
B. HF accommodates wider bandwidth signals
C. Long-distance ionospheric propagation is far more common on HF
D. There is less atmospheric interference (static) on HF
~~

T3C03 (B)
What is a characteristic of VHF signals received via auroral backscatter?
A. They are often received from 10,000 miles or more
B. They are distorted and signal strength varies considerably
C. They occur only during winter nighttime hours
D. They are generally strongest when your antenna is aimed west
~~

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

T3C05 (A)
Which of the following effects may allow radio signals to travel beyond obstructions between the transmitting and receiving stations?
A. Knife-edge diffraction
B. Faraday rotation
C. Quantum tunneling
D. Doppler shift
~~

T3C06 (A)
What type of propagation is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis?
A. Tropospheric ducting
B. D region refraction
C. F2 region refraction
D. Faraday rotation
~~

T3C07 (B)
What band is best suited for communicating via meteor scatter?
A. 33 centimeters
B. 6 meters
C. 2 meters
D. 70 centimeters

~~

T3C08 (D)
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
~~

T3C09 (A)
What is generally the best time for long-distance 10 meter band propagation via the F region?
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
~~

T3C10 (A)
Which of the following bands may provide long-distance communications via the ionosphere’s F region during the peak of the sunspot cycle?
A. 6 and 10 meters
B. 23 centimeters
C. 70 centimeters and 1.25 meters
D. All these choices are correct
~~

T3C11 (C)
Why is the radio horizon for VHF and UHF signals more distant than the visual horizon?
A. Radio signals move somewhat faster than the speed of light
B. Radio waves are not blocked by dust particles
C. The atmosphere refracts radio waves slightly
D. Radio waves are blocked by dust particles
~~

SUBELEMENT T4 – AMATEUR RADIO PRACTICES – [2 Exam Questions - 2 Groups]

T4A – Station setup: connecting a microphone, a power source, a computer, digital equipment, an SWR meter; bonding; Mobile radio installation

T4A01 (D)
Which of the following is an appropriate power supply rating for a typical 50 watt output mobile FM transceiver?
A. 24.0 volts at 4 amperes
B. 13.8 volts at 4 amperes
C. 24.0 volts at 12 amperes
D. 13.8 volts at 12 amperes
~~

T4A02 (A)
Which of the following should be considered when selecting an accessory SWR meter?
A. The frequency and power level at which the measurements will be made
B. The distance that the meter will be located from the antenna
C. The types of modulation being used at the station
D. All these choices are correct
~~

T4A03 (A)
Why are short, heavy-gauge wires used for a transceiver’s DC power connection?

A. To minimize voltage drop when transmitting
B. To provide a good counterpoise for the antenna
C. To avoid RF interference
D. All these choices are correct
~~

T4A04 (B)
How are the transceiver audio input and output connected in a station configured to operate using FT8?
A. To a computer running a terminal program and connected to a terminal node controller unit
B. To the audio input and output of a computer running WSJT-X software
C. To an FT8 conversion unit, a keyboard, and a computer monitor
D. To a computer connected to the FT8converter.com website
~~

T4A05 (A)
Where should an RF power meter be installed?
A. In the feed line, between the transmitter and antenna
B. At the power supply output
C. In parallel with the push-to-talk line and the antenna
D. In the power supply cable, as close as possible to the radio
~~

T4A06 (C)
What signals are used in a computer-radio interface for digital mode operation?
A. Receive and transmit mode, status, and location
B. Antenna and RF power
C. Receive audio, transmit audio, and transmitter keying
D. NMEA GPS location and DC power
~~

T4A07 (C)
Which of the following connections is made between a computer and a transceiver to use computer software when operating digital modes?
A. Computer “line out” to transceiver push-to-talk
B. Computer “line in” to transceiver push-to-talk
C. Computer “line in” to transceiver speaker connector
D. Computer “line out” to transceiver speaker connector
~~

T4A08 (D)
Which of the following conductors is preferred for bonding at RF?
A. Copper braid removed from coaxial cable
B. Steel wire
C. Twisted-pair cable
D. Flat copper strap
~~

T4A09 (B)
How can you determine the length of time that equipment can be powered from a battery?
A. Divide the watt-hour rating of the battery by the peak power consumption of the equipment
B. Divide the battery ampere-hour rating by the average current draw of the equipment
C. Multiply the watts per hour consumed by the equipment by the battery power rating
D. Multiply the square of the current rating of the battery by the input resistance of the equipment
~~

T4A10 (A)
What function is performed with a transceiver and a digital mode hot spot?

A. Communication using digital voice or data systems via the internet
B. FT8 digital communications via AFSK
C. RTTY encoding and decoding without a computer
D. High-speed digital communications for meteor scatter
~~

T4A11 (A)
Where should the negative power return of a mobile transceiver be connected in a vehicle?
A. At the 12 volt battery chassis ground
B. At the antenna mount
C. To any metal part of the vehicle
D. Through the transceiver’s mounting bracket
~~

T4A12 (C)
What is an electronic keyer?
A. A device for switching antennas from transmit to receive
B. A device for voice activated switching from receive to transmit
C. A device that assists in manual sending of Morse code
D. An interlock to prevent unauthorized use of a radio
~~

T4B - Operating controls: frequency tuning, use of filters, squelch function, AGC, memory channels, noise blanker, microphone gain, receiver incremental tuning (RIT), bandwidth selection, digital transceiver configuration

T4B01 (B)
What is the effect of excessive microphone gain on SSB transmissions?
A. Frequency instability
B. Distorted transmitted audio
C. Increased SWR
D. All these choices are correct
~~

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

T4B03 (A)
How is squelch adjusted so that a weak FM signal can be heard?
A. Set the squelch threshold so that receiver output audio is on all the time
B. Turn up the audio level until it overcomes the squelch threshold
C. Turn on the anti-squelch function
D. Enable squelch enhancement
~~

T4B04 (B)
What is a way to enable quick access to a favorite frequency or channel on your transceiver?
A. Enable the frequency offset
B. Store it in a memory channel
C. Enable the VOX
D. Use the scan mode to select the desired frequency
~~

T4B05 (C)

What does the scanning function of an FM transceiver do?
A. Checks incoming signal deviation
B. Prevents interference to nearby repeaters
C. Tunes through a range of frequencies to check for activity
D. Checks for messages left on a digital bulletin board
~~

T4B06 (D)
Which of the following controls could be used if the voice pitch of a single-sideband signal returning to your CQ call seems too high or low?
A. The AGC or limiter
B. The bandwidth selection
C. The tone squelch
D. The RIT or Clarifier
~~

T4B07 (B)
What does a DMR “code plug” contain?
A. Your call sign in CW for automatic identification
B. Access information for repeaters and talkgroups
C. The codec for digitizing audio
D. The DMR software version
~~

T4B08 (B)
What is the advantage of having multiple receive bandwidth choices on a multimode transceiver?
A. Permits monitoring several modes at once by selecting a separate filter for each mode
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
~~

T4B09 (C)
How is a specific group of stations selected on a digital voice transceiver?
A. By retrieving the frequencies from transceiver memory
B. By enabling the group’s CTCSS tone
C. By entering the group’s identification code
D. By activating automatic identification
~~

T4B10 (C)
Which of the following receiver filter bandwidths provides the best signal-to-noise ratio for SSB reception?
A. 500 Hz
B. 1000 Hz
C. 2400 Hz
D. 5000 Hz
~~

T4B11 (A)
Which of the following must be programmed into a D-STAR digital transceiver before transmitting?
A. Your call sign
B. Your output power
C. The codec type being used
D. All these choices are correct
~~

T4B12 (D)
What is the result of tuning an FM receiver above or below a signal’s frequency?

A. Change in audio pitch
B. Sideband inversion
C. Generation of a heterodyne tone
D. Distortion of the signal’s audio
~~

SUBELEMENT T5 — ELECTRICAL PRINCIPLES — [4 Exam Questions - 4 Groups]

T5A — Current and voltage: terminology and units, conductors and insulators, alternating and direct current

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

T5A02 (B)
Electrical power is measured in which of the following units?
A. Volts
B. Watts
C. Watt-hours
D. Amperes
~~

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

T5A04 (C)
What are the units of electrical resistance?
A. Siemens
B. Mhos
C. Ohms
D. Coulombs
~~

T5A05 (A)
What is the electrical term for the force that causes electron flow?
A. Voltage
B. Ampere-hours
C. Capacitance
D. Inductance
~~

T5A06 (A)
What is the unit of frequency?
A. Hertz
B. Henry
C. Farad
D. Tesla
~~

T5A07 (B)

Why are metals generally good conductors of electricity?
A. They have relatively high density
B. They have many free electrons
C. They have many free protons
D. All these choices are correct
~~

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

T5A09 (C)
Which of the following describes alternating current?
A. Current that alternates between a positive direction and zero
B. Current that alternates between a negative direction and zero
C. Current that alternates between positive and negative directions
D. All these answers are correct
~~

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

T5A11 (D)
What type of current flow is opposed by resistance?
A. Direct current
B. Alternating current
C. RF current
D. All these choices are correct
~~

T5A12 (D)
What describes the number of times per second that an alternating current makes a complete cycle?
A. Pulse rate
B. Speed
C. Wavelength
D. Frequency
~~

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
The most common use of the “reverse split” function of a VHF/UHF transceiver is to listen on a repeater’s input frequency.

T2B02

The term describing the use of a sub-audible tone transmitted along with normal voice audio to open the squelch of a receiver is CTCSS (Continuous Tone Controlled Squelch System).

T2B03
If a station is not strong enough to keep a repeater’s receiver squelch open, listening to the repeater's input frequemcy might allow you to receive the station’s signal.

T2B04
Reasons you are unable to access a repeater whose output you can hear might be improper transceiver offset, the repeater may require a proper CTCSS tone from your transceiver, or the repeater may require a proper DCS (Digital Controlled Squelch) tone from your transceiver.

T2B05
If a repeater user says your transmissions are breaking up on voice peaks, the problem might be you are talking too loudly.

T2B06
DTMF (Dual Tome Multi-Frequency) tones are used to control repeaters linked by the Internet Relay Linking Project (IRLP) protocol.

T2B07
You can join a digital repeater’s “talk group” by programming your radio with the group’s ID or code.

T2B08
When two stations transmitting on the same frequency interfere with each other, common courtesy should prevail, but no one has absolute right to an amateur frequency.

T2B09
A “talk group” on a DMR (Digital Mobile Radio) digital repeater is way for groups of users to share a channel at different times without being heard by other users on the channel.

T2B10
QRM is the Q signal indicating that you are receiving interference from other stations. QRM = Man-made Noise.

T2B11
QSY is the Q signal indicating that you are changing frequency.

T2B12
Simplex channels are designated in the VHF/UHF band plans so that stations within mutual communications range can communicate without tying up a repeater.

T2B13
SSB (Single SideBand) phone may be used in at least some portion of all the amateur bands above 50 MHz.

T2B14
A linked repeater network is a network of repeaters where signals received by one repeater are repeated by all the repeaters.

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

T2C01 [97.103(a)]
The FCC rules always apply to the operation of an amateur station.

T2C02
In net operation, the term “NSC” means Net Control Station.

T2C03
When using voice modes, to ensure that voice messages containing unusual words are received correctly, spell the words using a standard phonetic alphabet.

T2C04
RACES and ARES have in common the fact that both organizations may provide communications during emergencies.

T2C05
In net operation, the term “traffic” refers to formal messages exchanged by net stations.

T2C06
To get the immediate attention of a net control station when reporting an emergency, an accepted practice is to begin your transmission by saying "Priority" or "Emergency" followed by your call sign.

T2C07
An accepted practice for an amateur operator who has checked into a net is to remain on frequency without transmitting until asked to do so by the net control station.

T2C08
A characteristic of good traffic handling is passing messages exactly as received.

T2C09
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.

T2C10
The preamble of a formal traffic message contains the information needed to track the message.

T2C11
The term “check,” in reference to a formal traffic message means the number of words or word equivalents in the text portion of the message.

T2C12
The Amateur Radio Emergency Service (ARES) is composed of 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; polarization; wavelength vs absorption; antenna orientation

T3A01
If another operator reports that your station’s 2 meter signals were strong just a moment ago, but now they are weak or distorted you should try moving a few feet or changing the direction of your antenna if possible, as reflections may be causing multi-path distortion.

T3A02

The range of VHF and UHF signals might be greater in the winter due to less absorption by vegetation.

T3A03
Horizontal antenna polarization is normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands.

T3A04
If the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization signals could be significantly weaker.

T3A05
When using a directional antenna, your station might be able to access a distant repeater if buildings or obstructions are blocking the direct line of sight path you might ry to find a path that reflects signals to the repeater.

T3A06
The term “picket fencing” is commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting.

T3A07
Electromagnetic waves carry radio signals between transmitting and receiving stations.

T3A08
Random combining of signals arriving via different paths is a likely cause of irregular fading of signals received by ionospheric reflection.

T3A09
Either vertically or horizontally polarized antennas may be used for transmission or reception of skip signals refracted from the ionosphere because these waves are elliptically polarized.

T3A10
If data signals arrive via multiple paths, error rates are likely to increase.

T3A11
The ionosphere is the part of the atmosphere enabling the propagation of radio signals around the world.

T3A12
Fog and light rain will have little effect on the range of signals 10 meters and 6 meters.

T3A13
Precipitation would decrease range at microwave frequencies.

T3B - Radio and electromagnetic wave properties: the electromagnetic spectrum; wavelength vs frequency; nature and velocity of electromagnetic waves; definition of UHF, VHF, HF bands; calculating wavelength

T3B01
The name for the distance a radio wave travels during one complete cycle is the wavelength.

T3B02
The property of a radio wave used to describe its polarization is the orientation of the electric field.

T3B03
The two components of a radio wave are electric and magnetic fields.

T3B04
A radio wave travels through free space at the speed of light.

T3B05
The wavelength of a radio wave gets shorter as the frequency increases.

T3B06
The formula for converting frequency to approximate wavelength in meters is wavelength in meters equals 300 divided by frequency in megahertz.

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

T3B08
The frequency limits of the VHF (Very High Frequency) spectrum are 30 MHz to 300 MHz.

T3B09
The frequency limits of the UHF (Ultra High Frequency) spectrum are 300 MHz to 3000 MHz.

T3B10
The frequency range from 3 MHz to 30 MHz is referred to as HF (High Frequency).

T3B11
The approximate velocity of a radio wave as it travels through free space is 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
Direct (not via a repeater) UHF signals rarely heard from stations outside your local coverage area because UHF signals are usually not reflected by the ionosphere.

T3C02
An advantage of HF vs VHF and higher frequencies are that long distance ionospheric propagation is far more common on HF.

T3C03
A characteristic of VHF signals received via auroral reflection are that signals exhibit rapid fluctuations of strength and often sound distorted.

T3C04
Sporadic E propagation is most commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2 meter bands.

T3C05
Knife-edge diffraction might cause radio signals to be heard despite obstructions between the transmitting and receiving stations.

T3C06
Tropospheric scatter is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis.

T3C07
The 6 meter band is better suited for communicating via meteor scatter than the 10 meter, 2 meter, or 70 cm bands.

T3C08

Temperature inversions in the atmosphere can cause tropospheric ducting.

T3C09
The best time for long-distance 10 meter band propagation via the F layer is generally from dawn to shortly after sunset during periods of high sunspot activity.

T3C10
The six or ten meter bands are more likely to provide long distance communications during the peak of the sunspot cycle than the 70 cm or the 23 cm bands.

T3C11
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.

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
Efficiency of the transmitter at full power output, receiver and control circuit power, and power supply regulation and heat dissipation must all be considered to determine the minimum current capacity needed for a transceiver's power supply.

T4A02
A computer might be used as part of an amateur radio station for logging contacts and contact information, for sending and/or receiving CW, and for generating and decoding digital signals.

T4A03
Wiring between the power source and radio should be heavy-gauge wire and kept as short as possible to avoid voltage falling below that needed for proper operation.

T4A04
The computer sound card's microphone or line input port is connected to a transceiver’s headphone or speaker output for operating digital modes.

T4A05
The proper location for an external SWR meter is in series with the feed line, between the transmitter and antenna.

T4A06
The receive audio, transmit audio, and push-to-talk (PTT) connections might be used between a voice transceiver and a computer for digital operation.

T4A07
When conducting digital communications, a computer’s sound card provides audio to the radio's microphone input and converts received audio to digital form.

T4A08
Flat strap conductors provide lower impedance to RF signals than round stranded wire, round copper-clad steel wire, or twisted-pair cable.

T4A09
You could use a ferrite choke to cure distorted audio caused by RF current on the shield of a microphone cable.

T4A10
The alternator is the source of a high-pitched whine that varies with engine speed in a mobile transceiver’s receive audio.

T4A11
The negative return connection of a mobile transceiver's power cable should be connected at the battery or engine block ground strap.

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

T4B01
If a transmitter is operated with the microphone gain set too high, the output signal might become distorted.

T4B02
The keypad or VFO knob can be used to enter the operating frequency on a modern transceiver.

T4B03
The purpose of the squelch control on a transceiver is to mute receiver output noise when no signal is being received.

T4B04
A way to enable quick access to a favorite frequency on your transceiver is to store the frequency in a memory channel.

T4B05
Turning on the noise blanker would reduce ignition interference to a receiver.

T4B06
The receiver RIT (Receiver Incremental Tuning) or clarifier controls could be used if the voice pitch of a single-sideband signal seems too high or low.

T4B07
The term “RIT” means Receiver Incremental Tuning.

T4B08
The advantage of having multiple receive bandwidth choices on a multimode transceiver is that it permits noise or interference reduction by selecting a bandwidth matching the mode.

T4B09
An appropriate receive filter bandwidth for minimizing noise and interference for SSB reception is 2400 Hz.

T4B10
An appropriate receive filter bandwidth for minimizing noise and interference for CW reception is 500 Hz.

T4B11
The common meaning of the term "repeater offset" is the difference between the repeater’s transmit and receive frequencies.

T4B12
The function of automatic gain control, or AGC is to keep received audio relatively constant.

T4B13
The noise blanker could be used to remove power line noise or ignition noise.

T4B14
A use for the scanning function of an FM transceiver is to scan through a range of frequencies to check for activity.

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; series and parallel circuits

T5A01
Electrical current is measured in Amperes.

T5A02
Electrical power is measured in Watts.

T5A03
Current is the name for the flow of electrons in an electric circuit.

T5A04
Direct current is the name for a current that flows only in one direction.

T5A05
Voltage is the electrical term for the electromotive force (EMF) that causes electron flow.

T5A06
A mobile transceiver typically requires about 12 volts.

T5A07
Copper is a good electrical conductor – much better than glass, wood, or rubber.

T5A08
Glass is a good electrical insulator – much better than copper, aluminum, or mercury.

T5A09
Alternating current is the name for a current that reverses direction on a regular basis.

T5A10
Power is the term describing the rate at which electrical energy is used.

T5A11
The volt is the unit of electromotive force.

T5A12
Frequency describes the number of times per second that an alternating current makes a complete cycle.

T5A13
Current is the same through all components in a series circuit.

T5A14
Voltage the same across all components os a parallel circuit.

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

T5B01
1.5 amperes is equal to 1500 milliAmperes.

T5B02
Another way to specify a radio signal frequency of 1,500,000 Hertz is 1500 kHz.

T5B03
One kiloVolt is equal to one thousand Volts.

T5B04
One one-millionth of a Volt is equal to one microVolt.

T5B05
0.5 Watts is equal to 500 milliWatts.

T5B06
If an ammeter calibrated in Amperes is used to measure a 3000-milliAmpere current, it would show 3 Amperes.

T5B07
If a frequency display calibrated in MegaHertz shows a reading of 3.525 MHz, if it were calibrated in kiloHertz, it would show 3525 kHz.

T5B08
1 microFarad is equal to 1,000,000 picoTarads.

T5B09
The approximate amount of change, measured in decibels (dB), of a power increase from 5 Watts to 10 Watts is 3 dB.

T5B10
The approximate amount of change, measured in decibels (dB), of a power decrease from 12 Watts to 3 Watts is -6 dB.

T5B11
The amount of change, measured in decibels (dB), of a power increase from 20 Watts to 200 Watts is 10 dB.

T5B12
A frequency of 28.400 MHz is equal to 28,400 kHz.

T5B13
If a frequency display shows a reading of 2425 MHz, that frequency is 2.425 GHz.

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

T5C01
The ability to store energy in an electric field is called capacitance.

T5C02
The basic unit of capacitance is the Farad.

T5C03
The ability to store energy in a magnetic field is called inductance.

T5C04
The basic unit of inductance is the Henry.

T5C05
The unit of frequency is the Hertz.

T5C06
The abbreviation “RF” refers to radio frequency signals of all types.

T5C07
A radio wave is made up of electromagnetic energy.

T5C08
The formula used to calculate electrical power in a DC circuit is power (P) equals voltage (E) multiplied by current (I).

T5C09
When the applied voltage to a circuit is 13.8 Volts DC and the current through the circuit is 10 Amperes, the power being used is 138 Watts.

T5C10
When the applied voltage to a circuit is 12 Volts DC and the current through the circuit is 2.5 Amperes, the power being used is 30 Watts.

T5C11
When 12 Volts DC is applied to a circuit and the load is 120 Watts, 10 Amperes are flowing in the circuit.

T5C12
Impedance is a measure of the opposition to AC current flow in a circuit.

T5C13
The units of impedance are Ohms.

T5C14
The proper abbreviation for MegaHertz is MHz.

T5D – Ohm’s Law: formulas and usage; components in series and parallel

T5D01
The formula used to calculate current in a circuit is current (I) equals voltage (E) divided by resistance (R).

T5D02
The formula used to calculate voltage in a circuit is voltage (E) equals current (I) multiplied by resistance (R).

T5D03
The formula used to calculate resistance in a circuit is resistance (R) equals voltage (E) divided by current (I).

T5D04
In a circuit having a current of 3 Amperes flowing through a resistor connected to 90 Volts, the resistance is 30 Ohms.

T5D05
In a circuit for which the applied voltage is 12 Volts and the current flow is 1.5 Amperes, the resistance is 8 Ohms.

T5D06
The resistance of a circuit that draws 4 Amperes from a 12-Volt source is 3 Ohms.

T5D07
The current in a circuit with an applied voltage of 120 Volts and a resistance of 80 Ohms is 1.5 Amperes.

T5D08
The current through a 100-Ohm resistor connected across 200 Volts is 2 Amperes.

T5D09
The current through a 24-Ohm resistor connected across 240 Volts is 10 Amperes.

T5D10
The voltage across a 2-Ohm resistor if a current of 0.5 Amperes flows through it is 1 Volt.

T5D11
The voltage across a 10-Ohm resistor if a current of 1 Ampere flows through it is 10 Volts.

T5D12
The voltage across a 10-Ohm resistor if a current of 2 Amperes flows through it is 20 Volts.

T5D13
Current at the junction of two components in series is unchanged.

T5D14
Current at the junction of two components in parallel divides between them dependent on the value of the components.

T5D15
The voltage across each of two components in series with a voltage source is determined by the type and value of the components.

T5D16
The voltage across each of two components in parallel with a voltage source is the same voltage as the source.

SUBELEMENT T6 – Electrical components; circuit diagrams; component functions – [4 Exam Questions - 4 Groups]

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

T6A01
The electrical component which opposes the flow of current in a DC circuit is the resistor.

T6A02
The component often used as an adjustable volume control is the potentiometer.

T6A03
The electrical parameter controlled by a potentiometer is resistance.

T6A04
The electrical component which stores energy in an electric field is the capacitor.

T6A05
The electrical component which consists of two or more conductive surfaces separated by an insulator is the capacitor.

T6A06
The electrical component which stores energy in a magnetic field is the inductor.

T6A07
The component usually constructed as a coil of wire is the inductor.

T6A08
The component used to connect or disconnect electrical circuits is the switch.

T6A09
The component used to protect other circuit components from current overloads is the fuse.

T6A10
Nickel-metal hydride (NiMH), Lithium-ion (Li-Ion), and Lead-acid gel-cell batteries are all rechargeable.

T6A11
Carbon-zinc batteries are not rechargeable.

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

T6B01
Transistors are a class of electronic components using a voltage or current signal to control current flow.

T6B02
A diode is an electronic component which allows current to flow in only one direction.

T6B03
A transistor can be used as an electronic switch or amplifier.

T6B04
A transistor can consist of three layers of semiconductor material.

T6B05
A transistor is an electronic component which can amplify signals.

T6B06
The cathode lead of a semiconductor diode is often marked on the package with a stripe.

T6B07
The abbreviation LED stands for Light Emitting Diode.

T6B08
The abbreviation FET stands for Field Effect Transistor.

T6B09
The names of the two electrodes of a diode are anode and cathode.

T6B10
A transistor could be the primary gain-producing component in an RF power amplifier.

T6B11
Gain is the term that describes a device's ability to amplify a signal.

T6C - Circuit diagrams; schematic symbols

T6C01
Schematic is the name of an electrical wiring diagram that uses standard component symbols.

T6C02
Component 1 in figure T-1 is a resistor. 

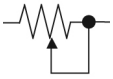
T6C03
Component 2 in figure T-1 is a transistor. 

T6C04
Component 3 in figure T-1 is a lamp. 

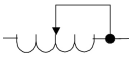
T6C05
Component 4 in figure T-1 is a battery. 

T6C06
Component 6 in figure T-2 is a capacitor. 

T6C07
Component 8 in figure T-2 is a light emitting diode. 

T6C08
Component 9 in figure T-2 is a variable resistor. 

T6C09
Component 4 in figure T-2 is a transformer. 

T6C10
Component 3 in figure T-3 is a variable inductor. 

T6C11
Component 4 in figure T-3 is an antenna. 

T6C12
The symbols on an electrical schematic represent electrical components.

T6C13
Electrical schematics accurately represent the way components are interconnected.

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

T6D01
A rectifier is a device or circuit which changes an alternating current into a varying direct current signal.

T6D02
A relay is an electrically-controlled switch.

T6D03
A single-pole single-throw (SPST) switch is represented by component 3 in figure T2.

T6D04
A meter displays an electrical quantity as a numeric value.

T6D05
A regulator controls the amount of voltage from a power supply.

T6D06
A transformer is commonly used to change 120V AC house current to a lower AC voltage for other uses.

T6D07
An LED is commonly used as a visual indicator.

T6D08
A capacitor is combined with an inductor to make a tuned circuit.

T6D09
The name of a device that combines several semiconductors and other components into one package is integrated circuit.

T6D10
The function of component 2 in Figure T1 is to control the flow of current.

T6D11
A resonant or tuned circuit is an inductor and a capacitor connected in series or parallel to form a filter.

T6D12
A common reason to use shielded wire is 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; transmit and receive amplifiers

T7A01
The term sensitivity describes the ability of a receiver to detect the presence of a signal.

T7A02
A transceiver is a unit combining the functions of a transmitter and a receiver.

T7A03
A mixer is used to convert a radio signal from one frequency to another.

T7A04
The term selectivity describes the ability of a receiver to discriminate between multiple signals.

T7A05
The name of a circuit that generates a signal at a specific frequency is an oscillator.

T7A06
A transverter is a device that converts the RF input and output of a transceiver to another band.

T7A07
“PTT” means the push-to-talk function that switches between receive and transmit.

T7A08
Modulation describes combining speech with an RF carrier signal.?

T7A09
The function of the SSB/CW-FM switch on a VHF power amplifier is to set the amplifier for proper operation in the selected mode.

T7A10

An RF power amplifier increases the low-power output from a handheld transceiver.

T7A11
An RF preamplifier installed is installed 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-modulation; RF feedback; off frequency signals

T7B01
If you are told your FM handheld or mobile transceiver is over-deviating you can talk farther away from the microphone.

T7B02
A broadcast AM or FM radio might receive an amateur radio transmission unintentionally because the receiver is unable to reject strong signals outside the AM or FM band.

T7B03
Harmonics, Spurious emissions, and Fundamental overload can all cause radio frequency interference.

T7B04
One way to reduce or eliminate interference from an amateur transmitter to a nearby telephone is to put an RF filter on the telephone.

T7B05
Overload of a non-amateur radio or TV receiver by an amateur signal might be reduced or eliminated by blocking the amateur signal with a filter at the antenna input of the affected receiver.

T7B06
If a neighbor tells you that your station’s transmissions are interfering with their radio or TV reception you should first 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
A band-reject filter can reduce overload to a VHF transceiver from a nearby FM broadcast station.

T7B08
If something in a neighbor’s home is causing harmful interference to your amateur station, you should check your station and make sure it meets the standards of good amateur practice, work with your neighbor to identify the offending device, and politely inform your neighbor about the rules that prohibit the use of devices that cause interference.

T7B09
A Part 15 device is an unlicensed device that may emit low-powered radio signals on frequencies used by a licensed service.

T7B10
If you receive a report that your audio signal through the repeater is distorted or unintelligible, the problem might be you are in a bad location, you are slightly off frequency, or your batteries are running low.

T7B11
A symptom of RF feedback in a transmitter or transceiver might be reports of garbled, distorted, or unintelligible voice transmissions.

T7B12
The first step to resolving cable TV interference from your ham radio transmission would be to be sure all TV coaxial connectors are installed properly.

T7C — Antenna measurements and troubleshooting: measuring SWR; dummy loads; coaxial cables; causes of feed line failures

T7C01
The primary purpose of a dummy load is to prevent transmitting signals over the air when making tests.

T7C02
An antenna analyzer can be used to determine if an antenna is resonant at the desired operating frequency.

T7C03
In general terms, standing wave ratio (SWR) is a measure of how well a load is matched to a transmission line.

T7C04
An SWR meter reading of 1 to 1 indicates a perfect impedance match between the antenna and the feed line.

T7C05
Most solid-state amateur radio transmitters reduce output power as SWR increases to protect the output amplifier transistors.

T7C06
An SWR reading of 4:1 indicates an impedance mismatch.

T7C07
Power lost in a feed line is converted into heat.

T7C08
Other than an SWR meter, you could use a directional wattmeter to determine if a feed line and antenna are properly matched.

T7C09
Moisture contamination is the most common cause for failure of coaxial cables.

T7C10
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.

T7C11
When compared to foam or solid dielectric types, a disadvantage of air core coaxial cable is that it requires special techniques to prevent water absorption.

T7C12
A dummy load consists of 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
You would use a voltmeter to measure electric potential or electromotive force.

T7D02
The correct way to connect a voltmeter to a circuit is in parallel with the circuit.

T7D03
A simple ammeter is connected in series with the circuit.

T7D04
An ammeter is used to measure electric current.

T7D05
An ohmmeter is used to measure resistance.

T7D06
Attempting to measure voltage when using the resistance setting might damage a multimeter.

T7D07
Voltage and resistance measurements are commonly made using a multimeter.

T7D08
Rosin-core solder is best for radio and electronic use when compared to acid core solder, silver solder, and aluminum solder.

T7D09
The characteristic appearance of a cold solder joint is a grainy or dull surface.

T7D10
When an ohmmeter, connected across an unpowered circuit, initially indicates a low resistance and then shows increasing resistance with time the circuit likely contains a large capacitor.

T7D11
When measuring circuit resistance with an ohmmeter, you should take the precaution of ensuring the circuit is not powered.

T7D12
When measuring high voltages with a voltmeter, you should take the precaution of ensuring 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 and digital communications – [4 Exam Questions - 4 Groups]

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

T8A01
Single sideband (SSB) is a form of amplitude modulation.

T8A02
FM is most commonly used for VHF packet radio transmissions.

T8A03
SSB voice mode is most often used for long-distance (weak signal) contacts on the VHF and UHF bands.

T8A04
FM is most commonly used for VHF and UHF voice repeaters.

T8A05
CW emission has the narrowest bandwidth when compared to FM Voice, SSB Voice or slow-scan television.

T8A06
Upper sideband (USB) is normally used for 10 meter HF, VHF, and UHF single-sideband communications.

T8A07
An advantage of single sideband (SSB) over FM for voice transmissions is that SSB signals have narrower bandwidth.

T8A08
The approximate bandwidth of a single sideband (SSB) voice signal is 3 kHz.

T8A09
The approximate bandwidth of a VHF repeater FM phone signal is between 10 and 15 kHz.

T8A10
The typical bandwidth of analog fast-scan TV transmissions on the 70 centimeter band is about 6 MHz.

T8A11
The approximate maximum bandwidth required to transmit a CW signal is 150 Hz.

T8B - Amateur satellite operation; Doppler shift; basic orbits; operating protocols; transmitter power considerations; telemetry and telecommand; satellite tracking

T8B01
Telemetry information typically transmitted by satellite beacons is health and status of the satellite.

T8B02
The impact of using too much effective radiated power on a satellite uplink is blocking access by other users.

T8B03
Satellite tracking programs provide 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, and the apparent frequency of the satellite transmission, including effects of Doppler shift.

T8B04
Satellite beacons use RTTY, CW, and packet.

T8B05
A satellite beaconis a transmission from a satellite that contains status information.

T8B06
The Keplerian elements are inputs to a satellite tracking program.

T8B07
With regard to satellite communications, Doppler shift is an observed change in signal frequency caused by relative motion between the satellite and the earth station.

T8B08
The statement that a satellite is operating in mode U/V means the satellite uplink is in the 70 centimeter band and the downlink is in the 2 meter band.

T8B09
Spin fading of satellite signals is caused by rotation of the satellite and its antennas.

T8B10
The initials LEO tells you the satellite is in a Low Earth Orbit.

T8B11
Anyone who can receive the telemetry signal from a space station.

T8B12
A good way to judge whether your uplink power is neither too low nor too high is that your signal strength on the downlink should be about the same as the beacon.

T8C — Operating activities: radio direction finding; radio control; contests; linking over the internet; grid locators

T8C01
Radio direction finding is a method used to locate sources of noise interference or jamming.

T8C02
A directional antenna would be more useful for a hidden transmitter hunt than a calibrated SWR meter, or a calibrated noise bridge.

T8C03
Contesting is an operating activity involving contacting as many stations as possible during a specified period.

T8C04
When contacting another station in a radio contest, good procedure is to send only the minimum information needed for proper identification and the contest exchange.

T8C05
A grid locator is a letter-number designator assigned to a geographic location.

T8C06
Access to some IRLP nodes is accomplished by using DTMF signals.

T8C07
Voice Over Internet Protocol (VoIP) as used in amateur radio means a method of delivering voice communications over the internet using digital techniques.

T8C08
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 (VoIP).

T8C09
You might obtain a list of active nodes that use VoIP by subscribing to an on line service, from on line repeater lists maintained by the local repeater frequency coordinator, or from a repeater directory.

T8C10B
Before you may use the Echolink system to communicate using a repeater you must register your call sign and provide proof of license.

T8C11
A gateway is the name given to an amateur radio station that is used to connect other amateur stations to the internet.

T8D — Non-voice and digital communications: image signals; digital modes; CW; packet radio; PSK31; APRS; error detection and correction; NTSC; amateur radio networking; Digital Mobile/Migration Radio

T8D01
Packet radio, IEEE 802.11, and JT65 are all digital communications modes.

T8D02
The term “APRS” mean automatic Packet Reporting System.

T8D03
A Global Positioning System receiver is used to provide data to the transmitter when sending automatic position reports from a mobile amateur radio station.

T8D04
The term "NTSC" indicates an analog fast scan color TV signal.

T8D05
An application of APRS (Automatic Packet Reporting System) is providing real-time tactical digital communications in conjunction with a map showing the locations of stations.

T8D06
The abbreviation "PSK" means Phase Shift Keying.

T8D07
DMR (Digital Mobile Radio or Digital Migration Radio) means a technique for time-multiplexing two digital voice signals on a single 12.5 kHz repeater channel.

T8D08
Packet transmissions may include a check sum that permits error detection, a header that contains the call sign of the station to which the information is being sent, or automatic repeat request in case of error.

T8D09
When sending CW in the amateur bands the code used is International Morse.

T8D10
The WSJT suite of digital mode software supports Moonbounce or Earth-Moon-Earth, Weak-signal propagation beacons, and meteor scatter.

T8D11
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.

T8D12
Broadband-Hamnet(TM), also referred to as a high-speed multi-media network is best described as an amateur-radio-based data network using commercial Wi-Fi gear with modified firmware.

T8D13
FT8 is a digital mode capable of operating in low signal-to-noise conditions that transmits on 15-second intervals.

T8D14
An electronic keyer is a device that assists in manual sending of Morse code.

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 resonant length and frequency; concept of dipole antennas

T9A01

A beam antenna is an antenna that concentrates signals in one direction.

T9A02
Inserting an inductor in the radiating portion of the antenna to make it electrically longer is a type of antenna loading.

T9A03
A simple dipole oriented parallel to the Earth's surface is a horizontally polarized antenna.

T9A04
When compared to a full-sized quarter-wave antenna, a disadvantage of the “rubber duck” antenna supplied with most handheld radio transceivers is that it does not transmit or receive as effectively.

T9A05
You would shorten a dipole antenna to make it resonant on a higher frequency.

T9A06
The quad, Yagi, and dish are directional antennas.

T9A07
A disadvantage of using a handheld VHF transceiver, with its integral antenna, inside a vehicle is that signals might not propagate well due to the shielding effect of the vehicle.

T9A08
The approximate length of a quarter-wavelength vertical antenna for 146 MHz is 19 inches.

T9A09
The approximate length of a half-wavelength 6 meter dipole antenna is 112 inches.

T9A10
A half-wave dipole antenna radiates the strongest signal broadside to the antenna.

T9A11
The gain of an antenna is the increase in signal strength in a specified direction compared to a reference antenna.

T9A12
An advantage of using a properly mounted 5/8 wavelength antenna for VHF or UHF mobile service is that it has a lower radiation angle and more gain than a 1/4 wavelength antenna.

T9B – Feed lines: types, attenuation vs frequency, selecting; SWR concepts; Antenna tuners (couplers); RF Connectors: selecting, weather protection

T9B01
It is important to have low SWR when using coaxial cable feed line to reduce signal loss.

T9B02
The impedance of most coaxial cables used in amateur radio installations is 50 ohms.

T9B03
Coaxial cable is the most common feed line selected for amateur radio antenna systems because it is easy to use and requires few special installation considerations.

T9B04
The major function of an antenna tuner (antenna coupler) is to match the antenna system impedance to the transceiver's output impedance.

T9B05
In general, as the frequency of a signal passing through coaxial cable is increased the loss increases.

T9B06
A Type N connector is most suitable for frequencies above 400 MHz.

T9B07
PL-259 type coax connectors are commonly used at HF frequencies.

T9B08
Coax connectors exposed to the weather should be sealed against water intrusion to prevent an increase in feed line loss.

T9B09
A loose connection in an antenna or a feed line can cause erratic changes in SWR readings.

T9B10
The electrical difference between RG-58 and RG-8 coaxial cable is that RG-8 cable has less loss at a given frequency.

T9B11
Air-insulated hard line has the lowest loss at VHF and UHF.

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
A safety hazard of a 12-volt storage battery is that shorting the terminals can cause burns, fire, or an explosion.

T0A02
Electrical current flowing through the body can cause injury by heating tissue, may disrupt the electrical functions of cells, and may cause involuntary muscle contractions.

T0A03
In the United States, the equipment ground is connected to the green wire in a three-wire electrical AC plug.

T0A04
The purpose of a fuse in an electrical circuit is to interrupt power in case of overload.

T0A05
It is unwise to install a 20-ampere fuse in the place of a 5-ampere fuse because excessive current could cause a fire.

T0A06
Good ways to guard against electrical shock at your station are to use three-wire cords and plugs for all AC powered equipment, connect all AC powered station equipment to a common safety ground, and use a circuit protected by a ground-fault interrupter.

T0A07
Mount all of the protectors on a metal plate that is in turn connected to an external ground rod is a precaution that should be taken when installing devices for lightning protection in a coaxial cable feed line.

T0A08
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.

T0A09
All external ground rods or earth connections should be bonded together with heavy wire or conductive strap.

T0A10
If a lead-acid storage battery is charged or discharged too quickly, the battery could overheat, give off flammable gas, or explode.

T0A11
A power supply may produce an electric shock from the charge stored in large capacitors even when it is turned off and disconnected.

T0B – Antenna safety: tower safety and grounding; erecting an antenna support; safely installing an antenna

T0B01
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.

T0B02
A good precaution to observe before climbing an antenna tower is to put on a carefully inspected climbing harness (fall arrester) and safety glasses.

T0B03
It is never safe to climb a tower without a helper or observer.

T0B04
An important safety precaution to observe when putting up an antenna tower is to look for and stay clear of any overhead electrical wires.

T0B05
The purpose of a gin pole is to lift tower sections or antennas.

T0B06
The minimum safe distance from a power line to allow when installing an antenna is enough so that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires.

T0B07
An important safety rule to remember when using a crank-up tower is that this type of tower must not be climbed unless retracted or mechanical safety locking devices have been installed.

T0B08
A proper grounding method for a tower is to use separate eight-foot long ground rods for each tower leg, bonded to the tower and each other.

T0B09
You should avoid attaching an antenna to a utility pole because the antenna could contact high-voltage power lines.

T0B10
When installing grounding conductors used for lightning protection sharp bends must be avoided.

T0B11
Local electrical codes establish grounding requirements for an amateur radio tower or antenna.

T0B12
Good practice when installing ground wires on a tower for lightning protection is to ensure that connections are short and direct.

T0B13
The purpose of a safety wire through a turnbuckle used to tension guy lines is to prevent loosening of the guy line from vibration.

T0C - RF hazards: radiation exposure; proximity to antennas; recognized safe power levels; exposure to others; radiation types; duty cycle

T0C01
VHF and UHF radio signals are non-ionizing radiation.

T0C02
50 MHz has a lower value for Maximum Permissible Exposure limit than 3.5 MHz, 440 MHz, or 1296 MHz.

T0C03
The maximum power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required is 50 watts PEP at the antenna.

T0C04 (D)
Factors affecting the RF exposure of people near an amateur station antenna are frequency and power level of the RF field, distance from the antenna to a person, and the radiation pattern of the antenna.

T0C05
Exposure limits vary with frequency because the human body absorbs more RF energy at some frequencies than at others.

T0C06
Acceptable methods to determine that your station complies with FCC RF exposure regulations are by calculation based on FCC OET Bulletin 65, by calculation based on computer modeling, and by measurement of field strength using calibrated equipment.

T0C07
If a person accidentally touched your antenna while you were transmitting, they might receive a painful RF burn.

T0C08
To prevent exposure to RF radiation in excess of FCC-supplied limits, an amateur operator might relocate antennas.

T0C09
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.

T0C10
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.

T0C11
The definition of duty cycle during the averaging time for RF exposure is the percentage of time that a transmitter is transmitting.

T0C12
RF radiation differs from ionizing radiation (radioactivity) because RF radiation does not have sufficient energy to cause genetic damage.

T0C13
If the averaging time for exposure is 6 minutes, 2 times as 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.

END OF Questions

3 Diagrams required for examinations on the following pages

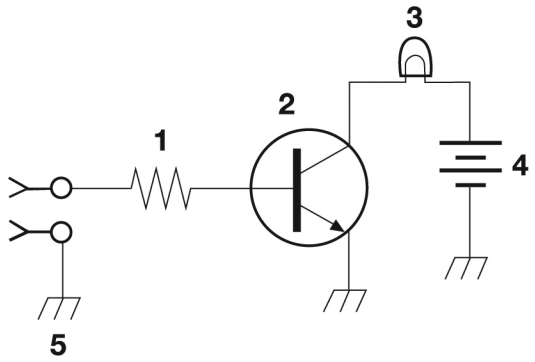


Figure T-1

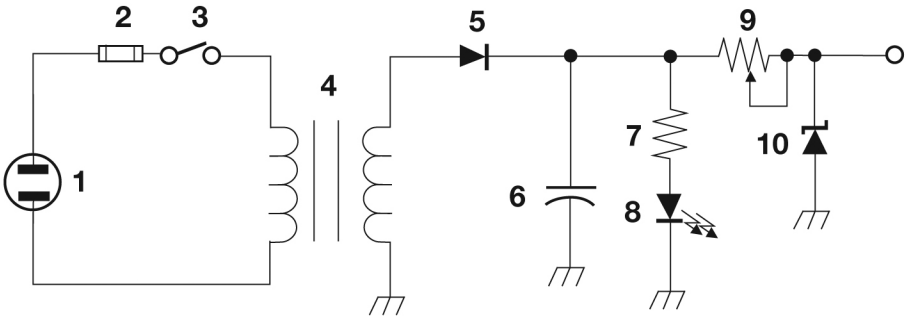


Figure T-2

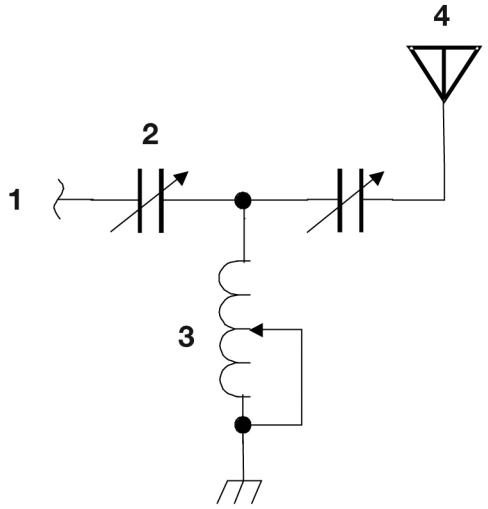


Figure T-3