

Amateur Radio

LEVEL 1 TECHNICIAN LICENSE SYLLABUS

For the **2026 to 2030** Question Pool

Valid on July 1, 2026

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Technician License Class Syllabus

Written by Jack Tiley AD7FO

All 409 possible questions are shown exactly as they will appear in the exam with only the correct answer shown (in underlined green bold text). Question numbers have been included so you can go to the ARRL General Class License Manual, or the question pool itself at <https://ncvec.org/index.php/2026-2030-technician-question-pool> to see the additional choices in the exam for each question.

This material is based on the published 2026 Technician Class License question pool, effective July 1, 2026, with additional information added by the author *(in italicized blue text)*.

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If you wish to post this document on another site it is asked that you post the author's website address www.ad7fo.com which will always have the latest revision instead of the document itself. Web site revisions will be made to correct errors, and any changes made to the question pool. This will prevent out of date versions from being circulated.

Additional information and resources to help you study for the Technician Class License can be found on the ARRL web site (<http://www.arrl.org>). The ARRL web site has articles, resources, and reference materials on all aspects of the exam questions and Amateur Radio in general.

You should have a copy of the ARRL Band Plan available to use with this syllabus. You can download and print a copy from the ARRL Web site at <https://www.arrl.org/files/file/Regulatory/Band%20Chart/OTAbands.pdf>

The ARRL Handbook is your complete guide to wireless technology experimentation, practice, and development. It covers radio, electronics, circuit design, digital modulation techniques, equipment construction and much more. At a cost of approximately \$55 from ARRL. You can frequently find used copies for \$15 to \$30 at hamfests and used bookstores. Not a lot of technical content changes from year to year so a copy that is a few years old should be sufficient. The Handbook will cover most your technical needs for all three license levels (Technician, General and Extra).



Syllabus Overview

This Syllabus is copyrighted by the author.

The Syllabus is intended either as a classroom text or for self-study in pursuit of the Amateur Radio Technician License. It may be distributed freely if no charge for the material is made. Reproduction costs associated with delivering paper or electronic copies on CD-ROM's may be charged and **the note of copyright permission on page 2 is not removed.**

Any modified copies must contain a note that the original material by the author has been modified and contain the name and contact information of the person making the changes. An MS Word version is available on the web site for instructors who wish to customize this material for their class.

Question numbers are shown in bold text like this, **T1A03** so you can go to the question pool or the ARRL Technician Class License Manual to see the actual questions and other answer choices that will be in the exam. If there is an FCC (Federal Communications Commission) **Part 97 rule** relating to the answer it is shown following the question number. The FCC regulations reference number for example **T1A07 [97.3(a)(45)]**

All questions are shown with only the correct answer **in bold underlined green text**, which in the author's view makes it easier when you see the other choices in your exam to identify the correct answer. Note that the letter designations of the answer choices in the exam will be different than that in the question pool.

Additional information has been added by the author (*in italicized blue text*) to some of the questions to further explain the answer or show calculations. In addition, some graphics have also been added for additional clarification.

You do not need a copy of the ARRL Technician Class License Manual or any other study guide. Everything you need to study for your license exam is in this syllabus.

While every effort was made to ensure the accuracy of this syllabus, this material was prepared by an ordinary human being and it is likely that a few typographical or other errors remain. The author welcomes corrections and can be contacted at ad7fo@arrl.net

Go to the author's web site www.ad7fo.com to be sure you have the latest revision of the syllabus. There is word document version of this syllabus available for instructors who want to customize this material for their own use and also a PDF file for those who do not have Microsoft word.



About the Author

Education:

Electrical Engineering, Pennsylvania State University

Work Experience:

Hewlett Packard: Thirty-four years filling various positions (retired in 2004)

- RF Products Division in Spokane WA – 1981 to 2004 - Regional Sales Support, Application Engineering, Military sales management, Worldwide Sales Management, Systems Development and Product Management
- Valley Forge PA - from 1969 until 1981 - Engineering Technical Support, Technical Customer Training and Field Sales Engineer

American Electronics Laboratories:

- Nine years working in and managing a Metrology (Calibration Standards) Laboratory in Colmar PA. Responsible for managing a Metrology lab and team of Technicians and engineers that maintained a wide range precision electronic and mechanical measuring instruments and standards with documented calibration traceability to the National Bureau of Standards (**NBS**) [now the National Institute of Standards and Technology (**NIST**)] in accordance with MIL STD 45662A.

Jerrold Electronics:

- Two years as a Technician at the Jerrold Electronics R&D Laboratory in Hatboro, PA working on Cable TV Products and RF test equipment.

Hobbies:

- Amateur Radio
- Test Equipment
- Electronics in general.

Amateur Radio Activities:

- Amateur radio teaching and mentoring
- Writing and presenting many short (30-60 minute) technical talks for local ham radio clubs (Available from the Authors web page www.ad7fo.com).
- Attending many Pacific Northwest Hamfest's
- Attended Hamvention in Dayton Ohio every year from 1991 thru 2017.

ARRL Appointments:

- ARRL Technical Specialist Eastern Washington Section
- ARRL VE (Volunteer Examiner)
- ARRL Registered Instructor

Other:

- Member of the Inland Empire VHF Club

Class Requirements for Students attending person classes

1. You will need a copy of this syllabus (printed or online) for study prior to the class. The Classes will be taught from a PowerPoint version of this syllabus. The syllabus can be downloaded from the Authors Web Page at www.ad7fo.com. All the possible questions and the correct answers in the license exam are covered in this syllabus.
2. A copy of Part 97 of the FCC rules is recommended and can be downloaded for free from the ARRL website at <http://www.arrl.org/part-97-amateur-radio> or purchased in printed form from amateur radio stores or Amazon. The FCC rules require that you have access to a copy of the part 97 rules (a printed copy or online) when you receive your license.
3. You will need a basic scientific calculator that you are familiar with operating that is capable of normal math functions, square roots, trigonometry, and Base 10 Log functions (all basic scientific calculators have these functions). Scientific calculators like the Texas Instruments TI30 or similar are available from office supply stores for around \$20 or less if you do not already have one. **It is recommended you do not purchase a programmable calculator as it will not be allowed in the test session because they can store information and equations. Cellular phone calculators and cell phones are never allowed in test sessions.**
4. Come with a desire to learn and to ask questions. If you do not understand something that is being taught, be sure you ask the instructor(s) to explain further.
5. To obtain your license you must take and pass the Technician Class written exam (element 2)
 - There are 35 questions on the exam. All questions are multiple choice (4 choices), only the correct answer is shown in this syllabus.
 - Questions can only come from the published Question Pool (all possible questions are covered in this syllabus).
 - The number of possible questions for each topic area is fixed and shown for each question group in the test.
 - You must have 26 correct answers to pass the exam (no more than 9 incorrect answers).
 - There are online sites with the actual test questions where you can take practice exams. Listed below are a few of the sites where you can find practice exams (**all sites verified 12/27/25**) :
 - <http://aa9pw.com/radio/>
<http://www.arrl.org/exam-practice>
<http://www.eham.net/exams>
<http://www.qrz.com/hamtest>
<http://www.hamexam.org>
<http://www.hamstudy.org>
<http://www.hamradiolicenseexam.com>
6. You are encouraged to read through this syllabus before the class. You are not expected to learn and understand everything you read, but by being familiar with what will be covered you can identify those areas where you need to focus on and/or bring up questions during the class. Do not be intimidated. The material will be made easy to understand by your instructor(s). You can check Ham Radio clubs in your area for local Ham's (known as Elmer's) that can help you or the go to the ARRL web site to find a local ARRL Technical Specialist.

7. You do not need to purchase a copy of the current ARRL Technician Class License Manual. Everything you need to study for your license exam is in this syllabus.

Class Outline:

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

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

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

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

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

SUBELEMENT T6 - ELECTRONIC AND ELECTRICAL COMPONENTS [4 Exam Questions - 4 Groups]

SUBELEMENT T7 - PRACTICAL CIRCUITS [4 Exam Questions - 4 Groups]

SUBELEMENT T8 - SIGNALS AND EMISSIONS [4 Exam Questions - 4 Groups]

SUBELEMENT T9 - ANTENNAS AND FEED LINES [2 Exam Questions - 2 Groups]

SUBELEMENT T0 - SAFETY [3 Exam Questions - 3 Groups]

There are 10 Sub Elements (1 thru 0). Each Element has a number of groups for a total of 35 groups. Each group has 10 or more question. The exam is made up of only one question from each of the 35 groups. If there are some groups you are having difficulty with, concentrate on those you understand. There are 35 questions in the exam and you need a minimum of 26 correct answers to pass.

ELECTRICAL AND ELECTRONIC BASICS

Background information for the technical questions in the Exam

Metric system prefixes and suffixes used in Ham Radio

Giga **XXXX** = 1,000,000,000 (one thousand million times)

Mega **XXXX** = 1,000,000 (one million times)

Kilo **XXXX** = 1,000 (one thousand times)

Centi **XXXX** = 1/100 (one hundredth)

Milli **XXXX** = 1/1,000 (one thousandth)

Micro **XXXX** = 1/1,000,000 (one millionth)

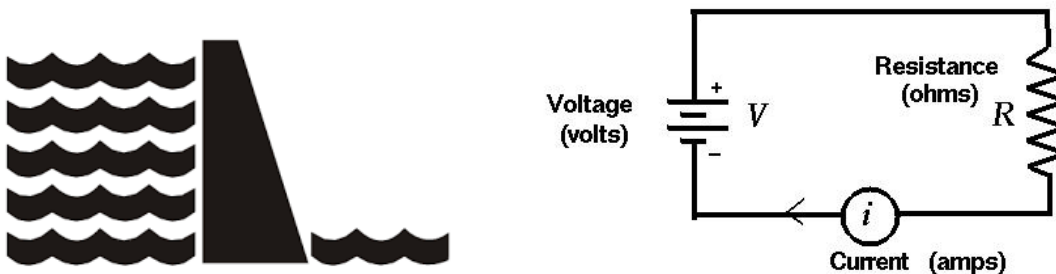
Nano **XXXX** = 1/1,000,000,000 (one thousandth of a Micro)

Pico **XXXX** = 1/1,000,000,000,000 (one millionth of a millionth)

Example: **XXXX** is the value you are expressing such as Volts, Amperes, Ohms, Watts, etc. One Kilo**volt** would be 1,000 Volts, one mega**ohm** would be 1,000,000 ohms, one milli**volt** would be 0.001 volts

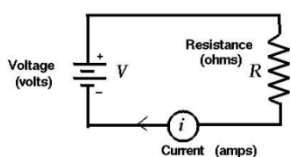
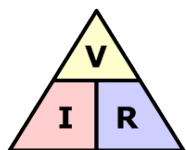
Voltage, Resistance and Current Flow:

Everything we use in our amateur station requires a power source that delivers a specific Voltage and Current. *Voltage* is commonly referred to in Physics as **Electro Motive Force (EMF)** instead of volts. This is like the water pressure at the bottom of a dam. The higher the water in the dam, the more pressure at the bottom of the dam. Current, the flow of electricity, is measured in *Amperes* and is commonly represented by the letter *I*. This is like the flow of water in a pipe at the bottom of the dam. The amount of water flowing would be limited by the diameter of the pipe and the pressure exerted by the height of the water in the dam. In an electronic circuit the current flow would be limited by the **EMF** (*voltage*) and the resistance to current flow measured in Ohms.



If we know the voltage and the resistance in a circuit, we can calculate the current that would be flowing using Ohms Law :

Current in amperes (I) is equal to the EMF in volts (E) divided by the resistance in ohms (R).

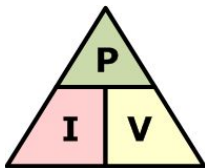


This Triangle can help you solve for Current, Voltage and Resistance in a circuit. For example: if you have a 12-volt battery connected across a 6-ohm resistor the current flowing would be 2 amperes. You can determine this by covering the value you want to find with your thumb to see what you need to do to find the answer. Cover the I and you will see that it is V (Voltage) divided by R (Resistance) therefore:

Current = 12 volts ÷ 6 Ohms or Current = 2 Amperes

Power

Power is work done by electricity and is defined as the voltage across a circuit multiplied by the current flowing through the circuit.



This Triangle can help you solve for Power (in watts) if Voltage and voltage and Current are known. You can determine by covering the P with your thumb to see it is equal to the current (I) times the voltage (V) . Here are a couple of examples:

A circuit connected to 120-volt power outlet that draws 10 amperes would be consuming how many watts.

Power = voltage times the current or Power = 120 x 10 or 1200 watts

A circuit powered by a 12-volt battery that draws 200 milliamperes (0.2Amperes) would consume 2.4 watts.

Power = voltage times the current or Power = 12 x 0.20 or 2.4 watts

Current Sources:

In the electronic world we have two kinds of commonly encountered sources of electric power:

Direct Current:

Direct Current (DC) is a voltage that has two terminals, one positive and one negative. Typically, DC power is available from batteries, accessory jacks in vehicles, and plug-in power supplies

Some commonly used batteries for amateur radio applications include the following:

Alkaline and Zinc Carbon cells that produce 1.5 V – Commonly available in AAA, AA, C and D cells.

These batteries are not rechargeable.



Lithium batteries that produce 1.5 or 3 volts. A typical example would be AAA, AA and coin cells.

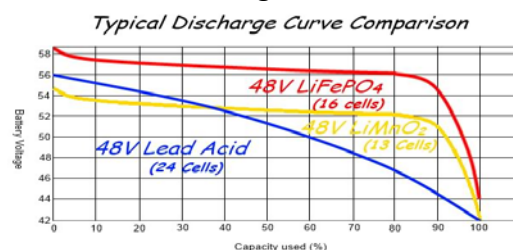
These batteries are not rechargeable.



Nickel Cadmium (NICAD) and Nickel Metal Hydride (NIMH) produce 1.2 volts, and are commonly available in AAA, AA, C, D cells, and custom shapes. These batteries are rechargeable.



LiFePO₄, Lithium Iron Phosphate Batteries are a newer Light weight , longer life rechargeable batteries with flatter discharge voltage characteristic, but the initial cost is higher.



Flooded Lead Acid batteries that produce 12 volts. Examples are automotive batteries and deep cycle marine batteries. These contain a liquid electrolyte (Sulphuric acid) and must be operated in an upright position. These batteries are rechargeable. These batteries release Hydrogen gas while charging so ventilation is required.



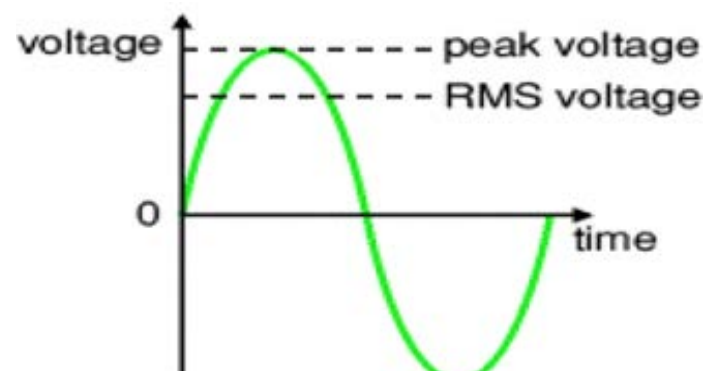
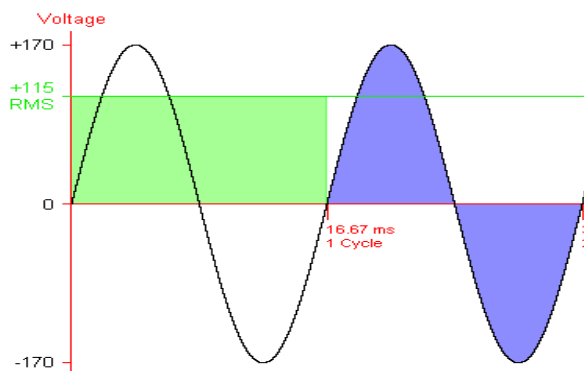
Sealed Lead Acid batteries, Gel Cells and AGM (Absorbed Glass Mat) batteries that are commonly available in 6-volt and 12-volt versions. They are sealed and use a “gelled” electrolyte. They have high current ratings ranging from smaller ones with a 1 ampere hour rating up to 80 ampere hours and more. These batteries are rechargeable.

Most Gel Cell Sealed Lead Acid Batteries can be installed in any position including inverted.

Alternating Current

Alternating current is a voltage that alternates between equal positive and negative values. This is what is available from the 120 VAC wall outlet in your home.

The 120 Volts we normally associate with the outlets in our home is the equivalent of a DC value that would provide the same heating effect (or work) as a 120-volt DC voltage. This is known as the RMS value of the AC voltage. The heating effect of AC is less than the peak value because the voltage is continuously changing over the time for each cycle. The peak value of an AC voltage is **1.414 times the RMS value**. Therefore the peak voltage for a 120 Volt RMS coming from the outlet in our homes would be 1.414 times 120 volts or **169.68 volts Peak** or **339.36 volts peak to peak** (measured from the positive peak to the negative peak).



For a pure AC sine wave the equivalent RMS value is 0.707 times the peak value. Conversely the peak voltage can be calculated as 1.414 times the RMS Value.

Examples:

The peak voltage present in standard 120V RMS AC line voltage is $1.414 \times 120\text{V}$ or approx. 170 volts peak. The peak to peak (maximum negative to maximum positive peaks) would be two times the peak voltage or approx. 340 V Peak to Peak.

$$PP = 2 \times \text{Peak} \text{ or } PP = 2 \times (120 \times 1.414) \text{ or } PP = 2 \times 169.7 \text{ or } PP = 339.4 \text{ Volts}$$

An AC voltage that reads 65 volts on an RMS meter will have a peak to peak voltage of 184 Volts.

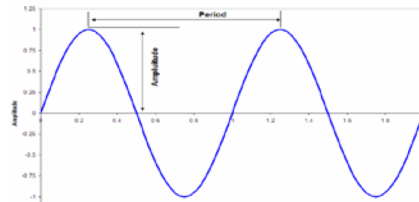
$$\text{Peak to peak Voltage} = 2 \times \text{RMS} \times 1.414 \text{ or } PP = 2 \times 65 \times 1.414 \text{ or } PP = 183.8 \text{ V PP}$$

FREQUENCY:

If we start at the first positive peak to the next positive peak of one cycle of our sine wave you will observe that it crosses through Zero twice in the cycle. The time it takes for one cycle of a sine wave is the period of the sine wave. A 100 Hz sine wave has a period of .01 Seconds (or 10 milliseconds).

$$\text{Period} = 1/100 \text{ or Period} = .01 \text{ Seconds}$$

Frequency is the number of times that an event happens in one second of time. Shown below is a single cycle of a sine wave, as it would be displayed on an oscilloscope. To determine its frequency, you would divide the time in seconds for one cycle into 1.00.



Examples:

What is the frequency of a sine wave with a 16 ms (millisecond) period for one cycle?

$$F = 1 \div \text{time} \text{ or } F = 1 \div 0.016 \text{ or } F = 60.2 \text{ Hz}$$

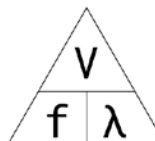
What is the frequency of a sine wave with a 1 μs (microsecond) period for one cycle?

$$F = 1 \div \text{time} \text{ or } F = 1 \div 0.000001 \text{ or } F = 1,000,000 \text{ Hz or } 1 \text{ MHz}$$

Wavelength:

Wavelength is the physical distance a wave will travel during one cycle usually expressed in meters. Radio waves in free space travel at the speed of light. Light travels at a speed of approximately 300 million meters per second (*actual speed of light is 299,792,458 meters every second*) in free space. Wavelength is important in amateur radio when designing and building antennas.

V = Velocity (speed of Light)
F = Frequency (in Hertz)
λ = Wavelength (in Meters)



We frequently refer to the frequency bands in amateur radio by their wavelength in meters.

This is important triangle to remember since there are questions in the exam relating to wavelength for a specific frequency or the frequency for a given wavelength.

In amateur radio we frequently refer to our frequencies in terms of approximate wavelength. Since we are frequently operating in the Megahertz frequency range, we can simplify our conversion to wavelength by dividing the frequency in megahertz (MHz) into 300. For example:

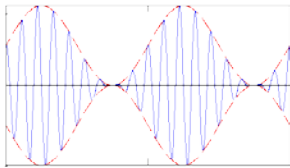
A 146 MHz signal would be in the 2 meter band --- $300 \div 146 = 2.054\text{-meters}$

A 4.0 MHz signal would be in the 75 meter band --- $300 \div 4 = 75\text{-meters}$

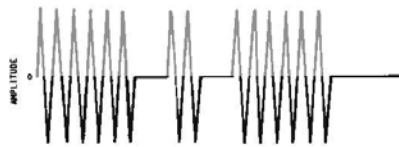
RF Signals and Modulation

Radio frequencies are simply sine waves like we see coming out of the outlet at home except at a much higher Repetition rate (frequency) Radio signals in the AM Broadcast band operate from 500,000 hertz to 1,700,000 Hertz. This frequency range can be expressed in kilohertz (thousands of hertz) as 500 KHz to 1,700 KHz, or in megahertz (millions of hertz) as 0.500 MHz to 1.700 MHz

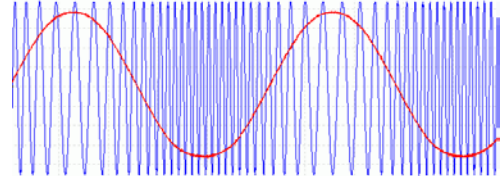
The frequency of a signal is just the carrier frequency, that is the frequency with no information applied. When we add voice or data to the carrier we are “modulating” or adding information. Simple modulation can be accomplished by varying the frequency of the carrier (Frequency Modulation or FM) or varying the amplitude of the carrier amplitude (Amplitude Modulation or AM).



Amplitude Modulation



CW Morse Code



Frequency Modulation

2026 to 2030 Element 2 (Technician License)

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

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; Beacon

T1A01 [97.1]

Which of the following is part of the Basis and Purpose of the Amateur Radio Service?

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

T1A02 [97.1]

Which agency regulates and enforces the rules for the Amateur Radio Service in the United States?

The FCC



T1A03 [97.119(b)(2)]

What do the FCC rules state regarding the use of a phonetic alphabet for station identification in the Amateur Radio Service?

It is encouraged when using phone emissions

Phonetic Alphabet

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

T1A04 [97.23]

How do you receive official notification of your new license and call sign after passing the exam?

Email from the FCC with a link to download the license grant

T1A05 [97.7]

What proves that the FCC has issued an operator/primary license grant?

The license appears in the FCC ULS database

FCC ULS is the Federal Communications Commission Universal Licensing System

T1A06 [97.203(d)]

On which of the following HF frequencies can automatically controlled amateur propagation beacons be found?

On ten meters, between 28.200 MHz and 28.300 MHz

See ARRL Band Plan

T1A07 [97.3(a)(41)]

What is the FCC Part 97 definition of a space station?

An amateur station located more than 50 km above Earth's surface

T1A08 [97.3(a)(22)]

Who recommends transmit/receive channels for repeater and auxiliary stations?

A Volunteer Frequency Coordinator recognized by local amateurs

The frequency coordinator for Eastern Washington state is Ken Rau email- IACC.COORDINATOR@nwi.net

T1A09 [97.3(a)(22)]

Who selects a Frequency Coordinator?

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

T1A10 [97.407(a)]

Besides an FCC-issued amateur operator license, what is required to be the control operator of a Radio Amateur Civil Emergency Service (RACES) Station?

Certification of current enrollment by a civil defense organization

T1A11 [97.101(d)]

Which of the following is prohibited?

Willful or malicious interference

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

T1B01 [97.301(e)]

Which of the following frequency ranges are available for phone operation by Technician licensees?

28.300 MHz to 28.500 MHz

See ARRL Band Plan

T1B02 [97.301, 97.207(c)]

Which of the following U.S. amateur radio operators are allowed to contact the International Space Station (ISS) on VHF bands?

Any amateur with a Technician class or higher license

The contact frequency for the ISS in the US is primarily on the 2-meter band and Voice Downlink is 145.80 MHz for ITU Regions 2 and 3 .

T1B03 [97.301(a)]

Which frequency is in the 6-meter amateur band?

52.525 MHz

Actual Wavelength is $300 \div 52.525$ or 5.71 Meters.

T1B04 [97.301(a)]

Which amateur band includes 146.52 MHz?

2 meters

See ARRL Band Plan

T1B05 [97.301, 97.305]

Which of the following bands include frequencies where Technicians are authorized to use digital modes such as FT8?

A. 10 meters

B. 6 meters

C. 2 meters

D. All these choices are correct

See ARRL Band Plan

T1B06 [97.301(e), 97.305]

On which HF bands does a Technician class operator have phone privileges?

10-meter band only

See ARRL Band Plan

T1B07 [97.305(a), (c)]

Which of the following VHF/UHF band segments are limited to CW only?

50.0 MHz to 50.1 MHz and 144.0 MHz to 144.1 MHz

See ARRL Band Plan

T1B08 [97.303]

How are US amateurs restricted in segments of bands where the Amateur Radio Service is secondary?

U.S. amateurs may find non-amateur stations in those segments, and must avoid interfering with them

T1B09 [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 these choices are correct

T1B10 [97.305(c)]

Where may SSB phone be used in amateur bands above 50 MHz?

In at least some segment of all these bands

See ARRL Band Plan

T1B11 [97.313]

What is the maximum peak envelope power output for Technician class operators in their HF band segments?

200 watts

See ARRL Band Plan

T1B12 [97.313(b)]

Except for some specific restrictions, what is the maximum peak envelope power output for Technician class operators using frequencies above 30 MHz? 1500 watts

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)]

Which amateur license classes are currently issued by the FCC?

Technician, General, Amateur Extra

T1C02 [97.19]

Who may select a desired call sign under the vanity call sign rules?

Any licensed amateur

T1C03 [97.117]

What types of international communications are FCC-licensed amateur radio stations permitted to make?

Communications incidental to the purposes of the Amateur Radio Service and remarks of a personal character

T1C04 [97.23]

What may happen if the FCC is unable to reach you by e-mail?

Revocation of the station license or suspension of the operator license

T1C05

Which of the following is a valid Group D call sign format for Technician class?

KF1XXX

The group D call sign format for amateur radio operators in the united states is a 2-by3 Call sign, which consists of a prefix, a number, a suffix of 2 to 3 letters. Technician licenses all have a three letter suffix. 1 or 2 letter Suffixes are limited to limited to extra class operators

T1C06 [97.5(a)(2), 97.11(a)]

Which of the following statements is true about using your amateur radio license when operating aboard a vessel or craft in international waters?

You may operate from a US-documented vessel with the master's permission

You will need approval by the ships captain if that is not you

T1C07 [97.21, 1.949]

How long before the expiration date may an amateur radio license renewal be requested?

90 days

T1C08 [97.25]

What is the normal term for an FCC-issued amateur radio license?

Ten years

T1C09 [97.21(a)(b)]

What is the grace period for renewal if an amateur license expires?

Two years

T1C10 [97.5a]

How soon 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, may you continue to transmit on the amateur radio bands?

No, you must wait until the license has been renewed

T1D Authorized and prohibited transmissions; Sale of equipment

T1D01 [97.111(a)(1)]

With which countries are FCC-licensed amateur radio stations prohibited from exchanging communications?

Any country whose administration has notified the International Telecommunication Union (ITU) that it objects to such communications

Yemen and North Korea currently do not allow ham radio operation by its citizens

T1D02 [97.113(b), 97.111(b)]

Under which of the following circumstances are one-way transmissions by an amateur station prohibited?

Broadcasting

Broadcasting is the electronic transmission of radio and television signals that are intended for general public reception, as distinguished from private signals that are directed to specific individual receivers.

T1D03 [97.211(b), 97.215(b), 97.113(a)(4)]

When is it permissible to transmit messages encoded to obscure their meaning?

Only when transmitting control commands to space stations or model craft

T1D04 [97.113(a)(4), 97.113(c)]

Under what conditions is an amateur station authorized to transmit music using a phone emission?

When incidental to an authorized retransmission of manned spacecraft communications

T1D05 [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?

When selling amateur radio equipment and not on a regular basis

T1D06 [97.113(a)(4)]

What, if any, are the restrictions concerning transmission of language that may be considered indecent or obscene?

Any such language is prohibited

T1D07 [97.113(d), 97.201(e)]

Which of the following is an example of an auxiliary station?

A station sending one-way transmissions between a remote repeater receiver and the main repeater transmitter

T1D08 [97.113(a)(3)(iii)]

In which of the following circumstances may the control operator of an amateur station receive compensation for operating that station?

When the communication is a part of classroom instruction at an educational institution

T1D09 [97.113(5)(b)]

When may amateur stations transmit information in support of broadcasting, program production, or news gathering, assuming no other means is available?

When such communications are directly related to the immediate safety of human life or protection of property

T1D10 [97.3(a)(10)]

How does the FCC define broadcasting for the Amateur Radio Service?

Transmissions intended for reception by the general public

T1D11 [97.215]

When may an amateur station transmit without identifying on the air?

When transmitting signals to control model craft

Model craft transmitters must have a copy of the operator's license attached.

T1D12 [97.119(a)]

Which of the following is required when making on-the-air test transmissions?

Identify the transmitting station

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

T1E01 [97.7(a)]

When may an amateur station transmit without a control operator?

Never

T1E02 [97.301, 97.207(c)]

Who may be the control operator of a station communicating through an amateur satellite or space station?

Any amateur allowed to transmit on the satellite uplink frequency

T1E03 [97.103(b)]

Who must designate the station control operator?

The station licensee

T1E04 [97.103(b)]

What determines the transmitting frequency privileges of an amateur station?

The class of operator license held by the control operator

T1E05 [97.3(a)(14)]

What is an amateur station's control point?

The location at which the control operator function is performed

T1E06 [97.301]

When, other than during an emergency, may a Technician class licensee be the control operator of a station operating in an Amateur Extra Class band segment?

At no time

T1E07 [97.103(a)]

When the control operator is not the station licensee, who is responsible for the proper operation of the station?

The control operator and the station licensee

T1E08 [97.3(a)(6), 97.205(d)]

Which of the following is an example of automatic control?

Repeater operation

A Repeater automatically re-transmits the received signal on another frequency

T1E09 [97.109(c)]

Which amateur stations may be remotely controlled?

Any station

T1E10 [97.3(a)(39)]

Which of the following is an example of remote control as defined in Part 97?

Operating the station over the internet

T1E11 [97.3(a)(13)]

What is a control operator as defined in Part 97?

An amateur operator designated by the licensee of a station to be responsible for transmissions and FCC rules compliance at that station

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

T1F01 [97.103(c)]

When must the station licensee make the station and the station records available for inspection?

At any time upon request by an FCC representative

T1F02 [97.119(a)]

How often must you identify with your FCC-assigned call sign when using tactical call signs such as "Race Headquarters"?

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

T1F03 [97.119(a)]

When are 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)]

What language must you use for identification when using a phone emission?

English

T1F05 [97.119(b)(2)]

What method of call sign identification is required for a station transmitting phone signals?

Send the call sign using a CW or phone emission

T1F06 [97.119(c)]

Which of the following self-assigned indicators are acceptable when using a phone transmission?

A. KL7CC stroke W3

B. KL7CC slant W3

C. KL7CC slash W3

D. All these choices are correct

T1F07 [97.115(a)(2)]

Which of the following restrictions apply when a non-licensed person speaks to a foreign amateur radio station via a station under the control of an FCC-licensed amateur radio operator?

The foreign station must be in a country with which the U.S. has a third-party agreement

T1F08 [97.3(a)(47)] sa

What is the definition of third-party communications?

A message from a control operator to another amateur station control operator on behalf of another person

T1F09 [97.3(a)(40)]

What type of amateur station simultaneously retransmits the signal of another amateur station on a different channel or channels?

Repeater station

T1F10 [97.205(g)]

Who is accountable if a repeater inadvertently retransmits communications that violate the FCC rules?

The control operator of the originating station

T1F11 [97.5(b)(2)]

Which of the following is a requirement for the issuance of a club station license grant?

The club must have at least four members

SUBELEMENT T2 - OPERATING PROCEDURES

[3 Exam Questions - 3 Groups]

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

T2A01

What is a common repeater frequency offset in the 2-meter band?

Plus or minus 600 kHz

Repeater offset is the difference between the repeaters listen and transmit frequency

T2A02

What is the national calling frequency for FM simplex operations in the 2-meter band?

146.520 MHz

A calling frequency is one that many operators monitor on a band. If you are in a new area or on the road calling on this frequency has a high probability of making a contact

T2A03

What is a common repeater frequency offset in the 70-centimeter band?

Plus or minus 5 MHz

T2A04

What is an appropriate way to call another station on a repeater if you know the other station's call sign?

Say the station's call sign, then identify with your call sign

Example: W3JIN this is AD7FO

T2A05

How should you respond to a station calling CQ?

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

Example: W3JIN this is AD7FO or W3JIN AD7FO

T2A06

What is an effective way to seek a call from any phone station when not using a repeater?

Repeat "CQ" a few times, followed by "this is," and your call sign, then pause to listen; repeat as necessary

T2A07

What does the term "repeater offset" mean?

The difference between a repeater's transmit and receive frequencies

T2A08

What is the meaning of the procedural signal "CQ"?

Calling any station

Procedure signs or prosigns are shorthand signals originally used in Morse code transmissions for the purpose of simplifying and standardizing radio communication protocol. They are several from Morse code abbreviations, which consist mainly of brevity codes that convey messages to other parties with greater speed and accuracy.

T2A09

Which of the following is a customary way to indicate a station is listening on a repeater and looking for a contact?

The station's call sign followed by the word "listening"

T2A10

What is a band plan, beyond the privileges established by the FCC?

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

T2A11

What term describes an amateur station that is transmitting and receiving on the same frequency?

Simplex

Think, simple communication where both parties use the same frequency, and no repeater is involved

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

T2B01

What is the purpose of the reverse function on a VHF/UHF transceiver?

To listen on a repeater's input frequency

T2B02

What term describes the use of a sub-audible tone transmitted along with normal voice audio to open the squelch of a receiver?

CTCSS

Continuous Tone Coded Squelch System or CTCSS is a type of in band signaling that is used to reduce the annoyance of listening to other users on a shared two way radio communications channel and to tell the receiving station that this the correct signal that you want to hear, The tone frequencies used are between 67 and 257 Hz.

T2B03

Which of the following describes a linked repeater network?

A network of repeaters in which signals received by one repeater are transmitted by all the repeaters in the network

T2B04

Which of the following could be the reason you are unable to access a repeater whose output you can hear?

- A. Improper transceiver offset
- B. You are using the wrong CTCSS tone
- C. You are using the wrong DCS code

D. All these choices are correct

Digital Code Squelch (DCS) is a digital code similar to the purpose of the continuous tone-coded squelch system or CTCSS. It uses a slow-speed, binary data stream passed as sub-audible data along with the transmission. You need the correct Digital password in the transmitter and the receiver to receive the signal.

T2B05

Which of the following would cause your FM transmission audio to drop out on voice peaks?

You are talking too loudly

Speaking loudly may cause the transmitter to overmodulate and internal circuits will clip the audio peaks to limit the deviation.

T2B06

What type of signaling to a repeater uses two simultaneous audio tones?

DTMF

DTMF stands for “Dual Tone Multiple Frequency”. This is the Dual Tones generated of by key press on a telephone key pad.

DTMF keypad frequencies								
	1209 Hz	1336 Hz	1477 Hz	1633 Hz	1	2	3	A
697 Hz	1	2	3	A	4	5	6	B
770 Hz	4	5	6	B	7	8	9	C
852 Hz	7	8	9	C	*	0	#	D
941 Hz	*	0	#	D				

T2B07

How can you join a digital repeater’s “talkgroup”?

Program your radio with the group’s ID or code

A talkgroup ID is a unique identifier for a specific communication group in digital radio systems. It allows multiple users to communicate on the same frequency without interference. Talkgroup IDs are commonly used in systems like DMR (Digital Mobile Radio) and P25 (Project 25). Each ID corresponds to a specific group, such as emergency services or community organizations. Users must select the correct talkgroup ID to join the desired conversation.

T2B08

Which of the following applies when two stations transmitting on the same frequency interfere with each other?

The stations should negotiate continued use of the frequency

T2B09

Why are simplex channels designated in the VHF/UHF band plans?

So stations within range of each other can communicate without tying up a repeater

T2B10

Which Q signal indicates that you are receiving interference from other stations?

QRM

Q signals are procedurals used originally for CW (Morse Code) to reduce the number of words needed to communicate a message.

T2B11

Which Q signal indicates that you are changing frequency?

QSY

T2B12

What is the digital color code used on DMR repeater systems?

An access code which must be programmed into a DMR transmitter to access a specific repeater

A Color Code for a DMR repeater functions like a PL tone for an analog repeater. There are 16 color codes (0–15). To access the repeater, your radio must be programmed with the correct color code.

T2B13

What is the purpose of a squelch function?

Mute the receiver audio when a signal is not present

T2B14

Which of the following is a “talkgroup”?

An identifier used by DMR to organize radio traffic so that those who want to hear the group aren’t bothered by other radio traffic

See answer for T2B07

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)]

When do the FCC Part 97 Amateur Radio Service rules NOT apply to the operation of an amateur station?

FCC rules always apply

T2C02

Which of the following are typical duties of a Net Control Station?

Call the net to order and direct communications between stations checking in

T2C03

What technique is used to ensure that voice messages containing unusual words are received correctly?

Spell the words using a standard phonetic alphabet

The Standard phonetic alphabet (see answer to T1A03) used in Amateur radio worldwide is the Military / NATO phonetic alphabet.

T2C04

What is RACES?

An FCC Part 97 amateur radio service for civil defense communications during national emergencies

The local Civil Defense Agency may be known as the Department Of Emergency Management



T2C05

What does the term “traffic” refer to in net operation?

Formal messages exchanged by net stations

T2C06

What is the Amateur Radio Emergency Service (ARES)?

A group of licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service



T2C07

Which of the following is standard practice when you participate in a net?

Unless you are reporting an emergency, transmit only when directed by the net control station

Once you are checked in the net control operator assumes you are there and listening unless you inform him or her you are leaving the net.

T2C08

Which of the following relays messages using email addresses based on amateur callsigns?

Winlink

T2C09

Are amateur station control operators ever permitted to operate outside the frequency privileges of their license class?

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

T2C10

What information is contained in the preamble of a formal traffic message?

Information needed to track the message

T2C11

What is meant by "check" in a radiogram header?

The number of words or word equivalents in the text portion of the message

THE AMERICAN RADIO RELAY LEAGUE
RADIOGRAM
TO AMATEUR RADIO

NUMBER	PRECEDENCE	HR	STATION OF ORIGIN	CHECK	PLACE OF ORIGIN	TIME FILED	DATE
1	R	G	K4IWW	12	CARY NC		DEC 20

TO
JOHN Q PUBLIC
1234 MAPLE AVE
ANYTOWN NC 27000

TELEPHONE NUMBER 919 555 1234

ARRIVE 7PM
LOOKING FORWARD
X LOVE

THIS RADIO MESSAGE WAS RECEIVED AT
AMATEUR STATION _____ PHONE _____
NAME _____
STREET ADDRESS _____
CITY AND STATE _____

24 X
SEEKING YOU

BETTY M PUBLIC

REC'D FROM DATE TIME SENT TO DATE TIME

Form: Copyright 1995, American Radio Relay League. Used with permission

T2C12

Which of the following requires certification by a civil defense agency?

RACES

SUBELEMENT T3 - RADIO WAVE PROPAGATION

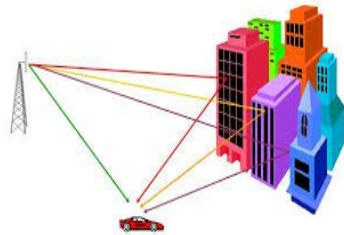
[3 Exam Questions - 3 Groups]

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

T3A01

Why do VHF signal strengths sometimes vary greatly when the antenna is moved only a few feet?

Multipath propagation cancels or reinforces signals



Signals arriving from multiple paths caused by reflections will take longer transit times. These reflected signals may arrive in phase where they will reinforce the received signal or out of phase where they will weaken and may cancel the received frequency.

T3A02

How does vegetation affect UHF and microwave signals?

Absorbs signals, leading to poor reception of weak signals

In the winter VHF and UHF signals may go farther when the trees do not have leaves.

T3A03

What antenna polarization is normally used for long-distance CW and SSB contacts on the VHF and UHF bands?

Horizontal

T3A04

What is the effect of antenna cross-polarization over a line-of-sight VHF or UHF path?

Received signal strength is reduced

Received signals may be reduced by as much as 20 dB (a factor of 100)

T3A05

When using a directional antenna, how might your station be able to communicate with a distant repeater if buildings or obstructions are blocking the direct line of sight path?

Try to find a path that reflects signals to the repeater

T3A06

What is the meaning of the term “picket fencing”?

Rapid flutter on mobile signals due to multipath propagation

T3A07

What weather condition might decrease range at microwave frequencies?

Precipitation

T3A08

What is a likely cause of irregular fading of signals propagated by the ionosphere?

Random combining of signals arriving via different paths

T3A09

Which of the following results from the fact that signals propagated by the ionosphere are elliptically polarized?

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

T3A10

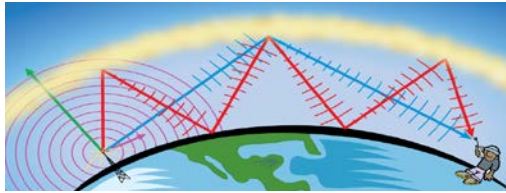
What effect does multi-path propagation have on data transmissions?

Error rates are likely to increase

T3A11

Which region of the atmosphere can reflect HF radio waves?

The ionosphere



T3A12

What effect does fog or rain have on 10-meter and 6-meter band signals?

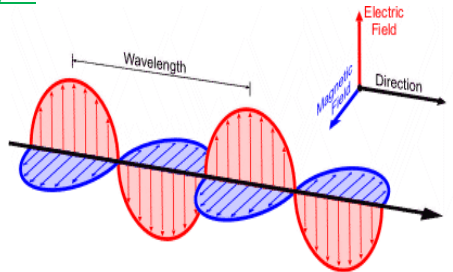
Little effect

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

What is the relationship between the electric and magnetic fields of an electromagnetic wave?

They are at right angles



T3B02

What property of a radio wave defines its polarization?

The orientation of the electric field

T3B03

What are the two components of a radio wave?

Electric and magnetic fields

T3B04

What is the velocity of a radio wave traveling through free space?

Speed of light

Approximately 300 million meters per second

T3B05

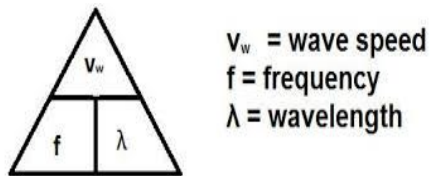
What is the relationship between wavelength and frequency?

Wavelength gets shorter as frequency increases

T3B06

What is the formula for converting frequency to approximate wavelength in meters?

Wavelength in meters equals 300 divided by frequency in megahertz



T3B07

In addition to frequency, which of the following is used to identify amateur radio bands?

The approximate wavelength in meters

T3B08

What frequency range is referred to as VHF?

30 MHz to 300 MHz

VHF is Very High Frequency



T3B09

What frequency range is referred to as UHF?

300 to 3000 MHz

UHF is Ultra High Frequency

T3B10

What frequency range is referred to as HF?

3 to 30 MHz

HF is High Frequency

T3B11

What is the approximate velocity of a radio wave in free space?

300,000,000 meters per second

T3B12

Which of these frequencies travels at the highest velocity in free space?

All radio frequencies travel at the same velocity

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

T3C01

Why are simplex UHF signals rarely heard beyond their radio horizon?

UHF signals are usually not propagated by the ionosphere

UHF signals are usually not refracted by our atmosphere. They simply absorbed or continue beyond our atmosphere.

T3C02

What is a characteristic of HF communication compared with communications on VHF and higher frequencies?

Long-distance ionospheric propagation is far more common on HF

T3C03

What is one characteristic of VHF signals received via auroral backscatter?

They are distorted, with a characteristic raspy sound

T3C04

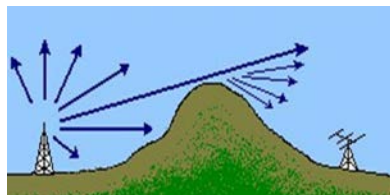
Which of the following types of propagation is most commonly associated with occasional strong signals on the 10-, 6-, and 2-meter bands from beyond the radio horizon?

Sporadic E

T3C05

Which of the following effects may allow radio signals to travel beyond obstructions between the transmitting and receiving stations?

Knife-edge diffraction

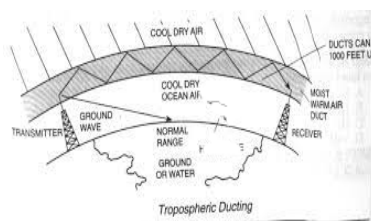


T3C06

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?

Tropospheric ducting

The troposphere is Earth's lowest atmospheric layer, and it plays a vital role in regulating the planet's climate.



T3C07

What band is best suited for communicating via meteor scatter?

6 meters

T3C08

What causes tropospheric ducting?

Temperature inversions in the atmosphere

T3C09

What is generally the best time for long-distance 10-meter band propagation via the F region?

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

T3C10

Which of the following bands may provide long-distance communications via the ionosphere's F region during the peak of the sunspot cycle?

6 and 10 meters

T3C11

Why is the radio horizon for VHF and UHF signals more distant than the visual horizon?

The atmosphere refracts radio waves slightly

SUBELEMENT T4 - AMATEUR RADIO PRACTICES

[2 Exam Questions - 2 Groups]

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

T4A01

Which of the following is an appropriate power supply rating for a typical 50-watt output mobile FM transceiver?

13.8 volts at 12 amperes

This is 165 watts ($P=13.8 \times 12$). This is because the final output amplifier is not 100% efficient and additional power is consumed by the audio amplifier and modulation circuits.

T4A02

Which of the following should be considered when selecting an accessory SWR meter?

The frequency and power level at which the measurements will be made

AN SWR (VSWR) meter indicates the forward and reverse power flowing on your transmission line and an indication of how well your antenna is matched to the transmitter output impedance.

T4A03

Why are short, heavy-gauge wires used for a transceiver's DC power connection?

To minimize voltage drop when transmitting

T4A04

How are the audio input and output of a transceiver connected in a station configured to operate using FT8?

To the audio output and input of a computer running FT8 software

T4A05

Where should an RF power meter be installed?

In the feed line, between the transmitter and antenna



T4A06

What signals are used in a computer-radio interface for digital mode operation?

Receive audio, transmit audio, and transmitter keying

T4A07

Which of the following is one of the connections required between a computer and a transceiver to operate digital modes?

Computer "line in" to transceiver speaker connector

T4A08

Which of the following conductors is preferred for bonding at RF?

Flat copper strap

Since RF Current flows on the skin of a conductor using a thin flat conductor will provide more conducting surface and be a better RF conductor,



T4A09

How can you determine the length of time that equipment can be powered from a battery?

Divide the battery ampere-hour rating by the average current draw of the equipment

T4A10

What function does a digital mode hotspot perform for nearby transceivers?

Communication with a digital voice or data network

T4A11

Where should the negative power return of a mobile transceiver be connected in a vehicle?

At the 12-volt battery chassis ground

T4A12

What is an electronic keyer?

A device that assists in manual sending of Morse code



The keyers above are examples of external keyers with the “paddles” attached. Today many modern HF Transceivers have internal keyer circuitry. When the left or right keys are pressed the transmitter is keyed to provide a dot or Dash. Pressing the opposite key will produce a dash. The duration of the dot and dash will each be in a uniform proportion in lengths based on your selected code speed,

T4B Operating controls: frequency tuning, use of filters, squelch function, AGC, memory channels, noise blanker, microphone gain, receiver incremental tuning (RIT), bandwidth selection, scanning function; Digital transceiver configuration; DMR code plugs and talk groups

T4B01

What is the effect of excessive microphone gain on SSB transmissions?

Distorted transmitted audio

T4B02

Which of the following can be used to enter a transceiver's operating frequency?

The keypad or VFO knob

VFO Variable Frequency Oscillator. In early days of Amateur Radio the transmit frequency was controlled by quartz crystals. Changing frequency meant changing the crystal. Replacing the crystal oscillator circuit with a variable frequency oscillator circuit greatly improved the process of switching transmit frequencies.



T4B03

How is squelch adjusted so that a weak FM signal can be heard?

Set the squelch threshold so that receiver output audio is on all the time

T4B04

What does an FM signal sound like when received slightly off frequency?

The audio becomes distorted

T4B05

What does the scanning function of an FM transceiver do?

Tunes through a range of frequencies to check for activity

T4B06

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?

The RIT or Clarifier

This control can be thought of as a fine frequency tuning control

T4B07

What is a DMR "code plug"?

Configuration data loaded onto your radio to access repeaters and talkgroups

A DMR (Digital Mobile Radio) codeplug is essentially a configuration file used in DMR radios, which contains all the settings and information required for the radio to operate correctly within a DMR network. This includes frequencies, talk groups, channels, zones, contacts, and various other settings that are necessary for the radio to communicate effectively on the DMR system.

T4B08

What is the advantage of having a choice of receiver filter bandwidths in a multimode transceiver?

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

T4B09

How is a specific group of stations selected on a DMR digital voice transceiver?

By entering the group's identification code

T4B10

Which of the following receiver filter bandwidths provides the best signal-to-noise ratio for SSB reception?

2400 Hz

Or can be stated as 2.400 kilohertz.

T4B11

Which of the following must be programmed into a D-STAR digital transceiver before transmitting?

Your call sign

SUBELEMENT T5 - ELECTRICAL PRINCIPLES

[4 Exam Questions - 4 Groups]

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

T5A01

Electrical current is measured in which of the following units?

Amperes

T5A02

Electrical power is measured in which of the following units?

Watts

T5A03

What is the term for the flow of electrons in an electric circuit?

Current

T5A04

What term describes the number of times per second that an alternating current makes a complete cycle?

Frequency

T5A05

What is the electrical term for the force that causes electron flow?

Voltage

T5A06

What is the unit of frequency?

Hertz

T5A07

Why are metals generally good conductors of electricity?

They have many free electrons

T5A08

Which of the following is a good electrical insulator?

Glass

T5A09

Which of the following describes alternating current?

Current that alternates between positive and negative directions

T5A10

Which term describes the rate at which electrical energy is used?

Power

T5A11

What type of current flow is opposed by resistance?

- A. Direct current
- B. Alternating current
- C. RF current

D. All these choices are correct

T5B Math for electronics: conversion of electrical units, decibels**T5B01**

How many milliamperes is 1.5 amperes?

1500 milliamperes

T5B02

Which is equal to 1,500,000 hertz?

1500 kHz

T5B03

Which is equal to one kilovolt?

One thousand volts

T5B04

Which is equal to one microvolt?

One one-millionth of a volt

T5B05

Which is equal to 500 milliwatts?

0.5 watts

T5B06

Which is equal to 3000 milliamperes?

3 amperes

T5B07

Which is equal to 3.525 MHz?

3525 kHz

T5B08

Which is equal to 1,000,000 picofarads?

1 microfarad

The Decibel Background

The **decibel** (symbol dB) is a relative unit of measurement. It expresses the ratio of two values of a power quantity on a logarithmic scale.

The strict original usage above only expresses a relative change. However, the word decibel has since also been used for expressing an absolute value that is relative to some fixed reference value, in which case the dB symbol is often suffixed with letter codes that indicate the reference value. For example dBm for power relative to one milliwatt, dBw for power relative to one watt. dBi is used for antenna gain relative to a theoretical point signal source and dBd for antenna gain relative to a dipole antenna.

T5B09

Which decibel value most closely represents a power increase from 5 watts to 10 watts?

3 dB

A simple way to remember this is that a + 2 times change is +3 dB and a change of 1 half is -3dB therefore the change from 5 to 10 watts is a + two times change or +3dB

Plus (+)	dB Change	Minus (-)
2 times	3	one half
4 times	6	one quarter
10 times	10	one tenth

The actual change can be calculated using the following equation:

$$dB = 10 \times \log_{10} (\text{Power (1)}) \div (\text{Power (2)}) \text{ or } dB = 10 \times \log_{10} (10) \div (5) \text{ or } dB = 10(.301) \text{ or } dB = 3.01$$

T5B10

Which decibel value most closely represents a power decrease from 12 watts to 3 watts?

-6 dB

A simple way to remember this is that a change of 2 times is +3 dB and a change of 1 half is -3dB therefore a change from 12 to 6 watts is one half or change is -3dB an additional change from 6 to 3 watts is again one half the change is an additional change of -3dB for a total change of -6dB

The actual change can be calculated using the following equation:

$$dB = 10 \times \log_{10} (\text{Power (1)}) \div (\text{Power (2)}) \text{ or } dB = 10 \times \log_{10} (12) \div (3) \text{ or } dB = 10(.602) \text{ or } dB = 6.02$$

T5B11

Which decibel value represents a power increase from 20 watts to 200 watts?

10 dB

A simple way to remember this is that a change of 10 times is +10 dB and a change of one tenth is -10 dB therefore the change from 20 to 200 watts is change of 10 times or a +10 dB change

The actual change can be calculated using the following equation:

$dB = 10 \times \log_{10} (\text{Power (1)} \div \text{Power (2)})$ or $dB = 10 \times \log (200) \div (10)$ or $dB = (10)(1)$ or $dB = +10$

T5B12

Which is equal to 28400 kHz?

28.400 MHz

T5B13

Which is equal to 2425 MHz?

2.425 GHz

T5C Capacitance and inductance terminology and units; Radio frequency definition and units; Impedance definition and units; Calculating power

T5C01

What describes the ability to store energy in an electric field?

Capacitance

T5C02

What is the unit of capacitance?

Farad

T5C03

What describes the ability to store energy in a magnetic field?

Inductance

T5C04

What is the unit of inductance?

Henry

T5C05

What is the unit of impedance?

Ohm

T5C06

What is the abbreviation for kilohertz?

kHz

T5C07

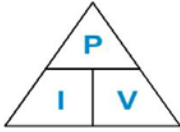
What is the abbreviation for megahertz?

MHz

T5C08

What formula is used to calculate electrical power (P) in a DC circuit?

$P = I \times E$



P= Power in Watts
I= Current in Amperes
V= Voltage in Volts

T5C09

How much power is delivered by a voltage of 13.8 volts DC and a current of 10 amperes?

138 watts

$Power = E \text{ (Voltage)} \times I \text{ (current)}$ or $P = 13.8 \times 10$ or $P = 138 \text{ watts}$

T5C10

How much power is delivered by a voltage of 12 volts DC and a current of 2.5 amperes?

30 watts

$Power = E \text{ (Voltage)} \times I \text{ (current)}$ or $P = 12 \times 2.5$ or $Power = 30 \text{ Watts}$

T5C11

How much current is required to deliver 120 watts at a voltage of 12 volts DC?

10 amperes

$Power = E \text{ (Voltage)} \times I \text{ (current)}$ or $120 = 12 \times I \text{ (current)}$ or $120 \div 12 = I \text{ (current)}$ or $10 = I \text{ (current)}$

T5C12

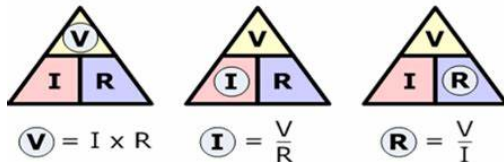
What is impedance?

The opposition to AC current flow

T5D Ohm's Law; Series and parallel circuits**T5D01**

What formula is used to calculate current in a circuit?

$I = E / R$

**T5D02**

What formula is used to calculate voltage in a circuit?

$E = I \times R$

T5D03

What formula is used to calculate resistance in a circuit?

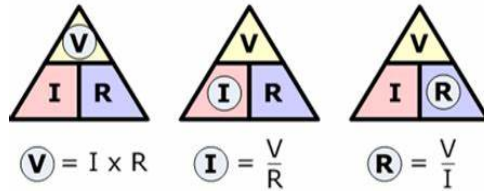
$R = E / I$

T5D04

What is the resistance of a circuit in which a current of 3 amperes flows when connected to 90 volts?

30 ohms

$R = E / I$ or $R = 90 \div 3$ or $R = 30 \text{ Ohms}$



T5D05

What is the resistance of a circuit for which the applied voltage is 12 volts and the current flow is 1.5 amperes?

8 ohms

$$R = E / I \text{ or } R = 12 \div 1.5 \text{ or } R = 8 \text{ Ohms}$$

T5D06

What is the resistance of a circuit that draws 4 amperes from a 12-volt source?

A. 3 ohms

$$R = E / I \text{ or } R = 12 \div 4 \text{ or } R = 3 \text{ Ohms}$$

T5D07

What is the current in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms?

1.5 amperes

$$I = E / R \text{ or } I = 120 \div 80 \text{ or } I = 1.5 \text{ Amperes}$$

T5D08

What is the current through a 100-ohm resistor connected across 200 volts?

2 amperes

$$I = E / R \text{ or } I = 200 \div 100 \text{ or } I = 2 \text{ Amperes}$$

T5D09

What is the current through a 24-ohm resistor connected across 240 volts?

10 amperes

$$I = E / R \text{ or } I = 240 \div 24 \text{ or } I = 10 \text{ Amperes}$$

T5D10

What is the voltage across a 2-ohm resistor if a current of 0.5 amperes flows through it?

1 volt

$$E = I \times R \text{ or } E = 0.5 \times 2 \text{ or } 1 \text{ Volts}$$

T5D11

What is the voltage across a 10-ohm resistor if a current of 1 ampere flows through it?

10 volts

$$E = I \times R \text{ or } E = 1 \times 10 \text{ or } 10 \text{ Volts}$$

T5D12

What is the voltage across a 10-ohm resistor if a current of 2 amperes flows through it?

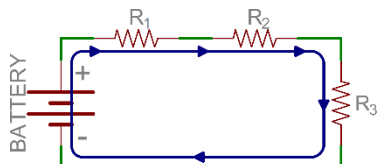
20 volts

$$E = I \times R \text{ or } E = 2 \times 10 \text{ or } 20 \text{ Volts}$$

T5D13

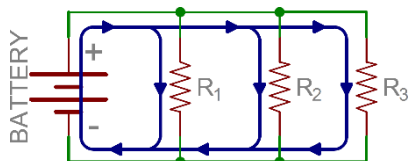
In which type of circuit is the current always the same through all components?

Series

**T5D14**

In which type of circuit is the voltage always the same across all components?

Parallel



SUBELEMENT T6 - ELECTRONIC AND ELECTRICAL COMPONENTS

[4 Exam Questions - 4 Groups]

T6A Fixed and variable resistors; Capacitors; Inductors; Fuses; Switches; Batteries

T6A01

What electrical component opposes the flow of current in a DC circuit?

Resistor



T6A02

What type of component is often used as an adjustable volume control?

Potentiometer



T6A03

What electrical parameter is controlled by a potentiometer?

Resistance

T6A04

What electrical component stores energy in an electric field?

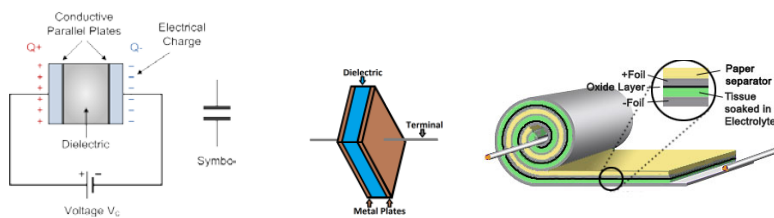
Capacitor



T6A05

What type of electrical component consists of conductive surfaces separated by an insulator?

Capacitor



T6A06

What type of electrical component stores energy in a magnetic field?

Inductor

T6A07

What electrical component is typically constructed as a coil of wire?

Inductor

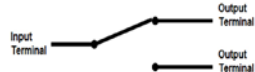


T6A08

What is the function of an SPDT switch?

A single circuit is switched between one of two other circuits

Single Pole Double Throw Switch



T6A09

What type of switch is represented by component 3 in figure T-2?

Single-pole single-throw

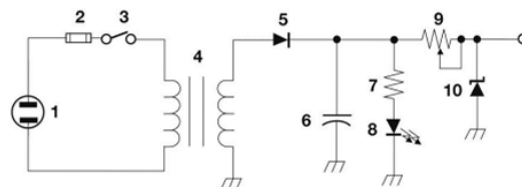


Figure T-2

T6A10

Which of the following battery chemistries is rechargeable?

- A. Nickel-metal hydride
- B. Lithium-ion
- C. Lead-acid

D. All these choices are correct

T6A11

Which of the following battery chemistries is not rechargeable?

Carbon-zinc

T6B Semiconductors: basic principles and applications of solid-state devices, diodes and transistors; Gain

T6B01

Which is true about forward voltage drop in a diode?

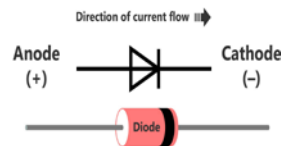
It is lower in some diode types than in others

Germanium diodes have a 0.5 volt forward voltage drop and Silicone diodes have a 0.7 volt forward voltage drop

T6B02

What electronic component allows current to flow in only one direction?

Diode



T6B03

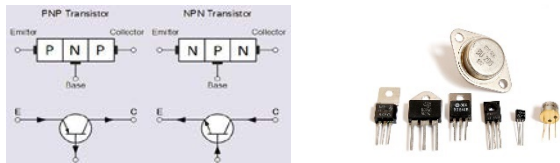
Which of these components can be used as an electronic switch?

Transistor

T6B04

Which of the following components can consist of three regions of semiconductor material?

Transistor



T6B05

What type of transistor has a gate, drain, and source?

Field-effect

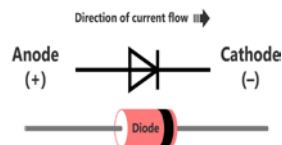


The field-effect transistor (FET) is a type of Transistor that uses an electric field to control the current through a semiconductor. FETs have three terminals: source, gate, and drain. FETs control the current by the application of a voltage to the gate (no current flows thru the gate which means no power is dissipated while controlling the source to drain current).

T6B06

How is the cathode lead of a semiconductor diode often marked on the package?

With a stripe



T6B07

What causes a light-emitting diode (LED) to emit light?

Forward current

T6B08

What does the abbreviation FET stand for?

Field Effect Transistor

T6B09

What are the names for the electrodes of a diode?

Anode and cathode

T6B10

Which of the following can provide power gain?

Transistor

T6B11

What does the term gain mean in amplifiers?

- A. The output signal voltage relative to the input signal voltage
- B. The output signal current relative to the input signal current
- C. The output signal power relative to the input signal power

D. All these choices are correct

T6B12

What are the names of the electrodes of a bipolar junction transistor?

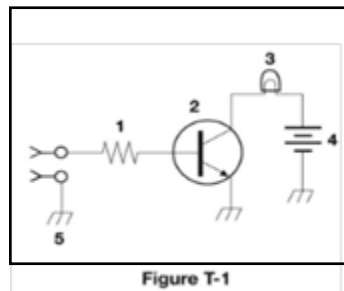
Emitter, base, collector

T6C Circuit diagrams: use of schematics, basic structure; Schematic symbols of basic components

T6C01

What is an electrical diagram using standard component symbols called?

Schematic



T6C02

What is component 1 in figure T-1?

Resistor

T6C03

What is component 2 in figure T-1?

Transistor

T6C04

What is component 3 in figure T-1?

Lamp

T6C05

What is component 4 in figure T-1?

Battery

T6C06

What is component 6 in figure T-2?

Capacitor

T6C07

What is component 8 in figure T-2?

Light emitting diode

T6C08

What is component 9 in figure T-2?

Variable resistor

T6C09

What is component 4 in figure T-2?

Transformer

T6C10

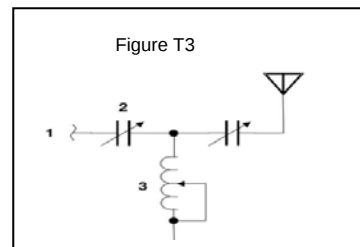
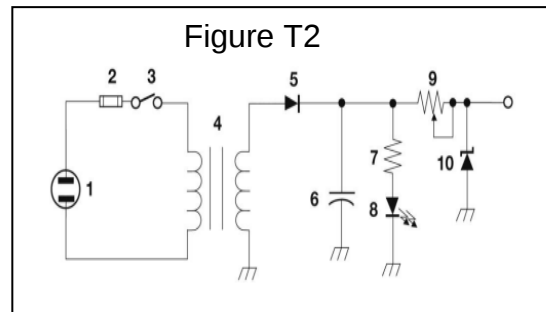
What is component 3 in figure T-3?

Variable inductor

T6C11

What is component 4 in figure T-3?

Antenna



T6C12

Which of the following is accurately represented in electrical schematics?

Component connections

T6D Component functions: rectifiers, relays, voltage regulators, meters, indicators, integrated circuits, transformers; Resonant circuit; Shielding

T6D01

Which of the following devices or circuits changes an alternating current into a varying direct current signal?

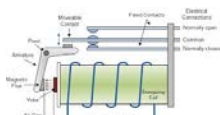
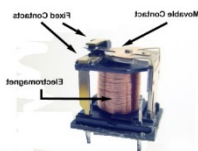
Rectifier

Rectifier is another name for a diode when used in a power supply

T6D02

What is a relay?

An electrically-controlled switch



T6D03

Which of the following is a reason to use shielded wire?

To prevent coupling of unwanted signals to or from the wire



T6D04

Which of the following displays an electrical quantity as a numeric value?

Meter



T6D05

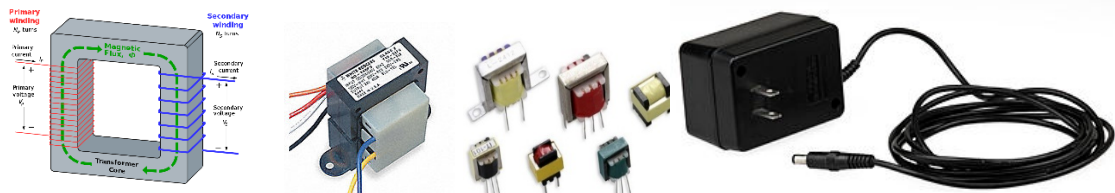
What type of circuit controls the amount of voltage from a power supply?

Regulator

T6D06

What component changes 120 V AC power to a lower AC voltage for other uses?

Transformer



T6D07

Which of the following is commonly used as a visual indicator?

LED

Light Emitting Diode



T6D08

Which of the following is combined with an inductor to make a resonant circuit?

Capacitor

T6D09

What is the name of a device that combines several semiconductors and other components into one package?

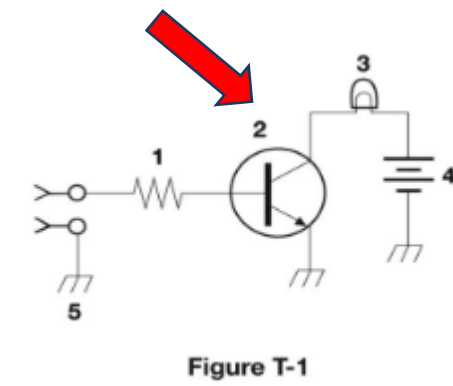
Integrated circuit



T6D10

What is the function of component 2 in figure T-1?

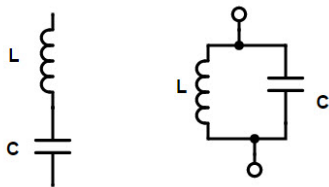
Control the flow of current



T6D11

Which of the following is a resonant or tuned circuit?

An inductor and a capacitor in series or parallel



SUBELEMENT T7 - PRACTICAL CIRCUITS

[4 Exam Questions - 4 Groups]

T7A Station equipment: receivers, transceivers, transmitter amplifiers, RF preamplifiers, transverters; Basic radio circuit concepts and terminology: sensitivity, selectivity, mixers, oscillators, Push-To-Talk (PTT), VFO, modulation

T7A01

Which term describes the ability of a receiver to detect the presence of a signal?

Sensitivity

T7A02

What is a transceiver?

A device that combines a receiver and transmitter



T7A03

Which of the following is used to convert a signal from one frequency to another?

Mixer

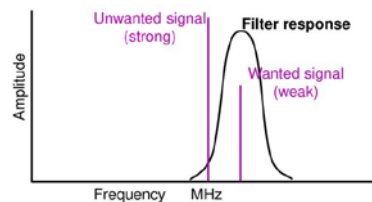


T7A04

Which term describes the ability of a receiver to discriminate between multiple signals?

Selectivity

Selectivity is the ability to separate the wanted signal from nearby unwanted signals (other stations)



T7A05

What is the name of a circuit that generates a signal at a specific frequency?

Oscillator

T7A06

What device converts the RF input and output of a transceiver to another band?

Transverter



T7A07

What is the function of a transceiver's PTT input?

Switches transceiver from receive to transmit when grounded

T7A08

Which of the following describes combining speech with an RF carrier signal?

Modulation



T7A09

What is the function of the switch which selects either SSB or CW-FM on a VHF power amplifier?

Set the amplifier for proper operation in the selected mode

T7A10

What can be added to the output of a transceiver to increase the transmitted output power?

An RF power amplifier



T7A11

What is the function of the Variable Frequency Oscillator (VFO) circuit in a transceiver?

Set the receive and transmit frequency

T7B Symptoms, causes, and cures of common transmitter and receiver problems: overload and overdrive, distortion, interference and consumer electronics, RF feedback

T7B01

What can you do if you are told your FM handheld or mobile transceiver is over-deviating?

Talk farther away from the microphone

T7B02

What would cause a broadcast AM or FM radio to receive an amateur radio transmission unintentionally? The receiver is unable to reject strong signals outside the AM or FM band

T7B03

Which of the following can cause radio frequency interference?

- A. Fundamental overload
- B. Harmonics
- C. Spurious emissions

D. All these choices are correct

T7B04

Which of the following might be the cause of low RF power output from a solid-state transceiver?

High SWR

T7B05

Which of the following might reduce interference by an amateur station to a non-amateur over-the-air radio receiver?

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?

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

Which of the following can reduce interference to a 2-meter band transceiver from a nearby commercial FM station?

Installing a band-reject filter

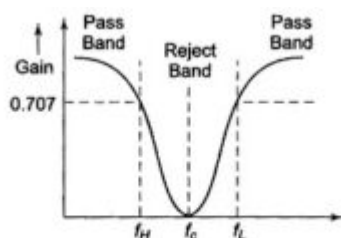


Fig. 15.20 (b) Frequency Response of a Wide Band Reject Filter

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 that FCC rules prohibit the use of devices that cause interference
- C. Make sure your station meets the standards of good amateur practice

All these choices are correct

T7B09

What should be the first step to resolve non-fiber optic cable TV interference caused by your amateur radio transmission?

Be sure all TV feed line coaxial connectors are installed properly

T7B10

What might be a problem if you receive a report that your audio signal through an FM repeater is distorted or unintelligible?

- A. Your transmitter is slightly off frequency
- B. You are speaking too loudly or too close to the microphone
- C. You are in a bad location

D. All these choices are correct

T7B11

Which of the following can eliminate distorted voice transmissions?

Adding a clip-on ferrite "choke" to the microphone cable to prevent the transmitted signal from feeding back into the transmitter



T7C Antenna and transmission line measurements and troubleshooting: measuring SWR, effects of high SWR, causes of feed line failures; Basic coaxial cable characteristics; Use of dummy loads when testing

T7C01

What is the primary purpose of a dummy load?

To prevent transmitting signals over the air when making tests



T7C02

Which of the following is used to determine if an antenna is resonant at the desired operating frequency?

[An antenna analyzer](#)



T7C03

What does a typical RF dummy load consist of?

[A 50-ohm non-inductive resistor mounted on a heat sink](#)

T7C04

What reading on an SWR meter indicates a perfect impedance match between the antenna and the feed line?

[1:1](#)

T7C03

What does a typical RF dummy load consist of?

[A 50-ohm non-inductive resistor mounted on a heat sink](#)

T7C04

What reading on an SWR meter indicates a perfect impedance match between the antenna and the feed line?

[1:1](#)

T7C08

Which instrument can be used to determine SWR?

[Directional wattmeter](#)



T7C09

Which of the following causes failure of coaxial cables?

[Moisture contamination](#)

T7C10

Why should the outer jacket of coaxial cable be resistant to ultraviolet light?

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

T7C11

What is an advantage of foam-dielectric versus solid-dielectric coaxial cable?

It has less loss per foot

T7D Using basic test instruments: voltmeter, ammeter, and ohmmeter; Soldering

T7D01

Which instrument would you use to measure electric potential?

A voltmeter

T7D02

How is a voltmeter connected to a component to measure applied voltage?

In parallel

T7D03

When configured to measure current, how is a multimeter connected to a component?

In series

T7D04

Which instrument is used to measure electric current?

An ammeter

T7D05

How does an ohmmeter measure the resistance of a circuit or component?

By applying a small current and measuring the resulting voltage

T7D06

Which of the following can damage a multimeter?

Attempting to measure voltage when using the resistance setting

T7D07

Which of the following measurements are made using a multimeter?

Voltage and resistance

T7D08

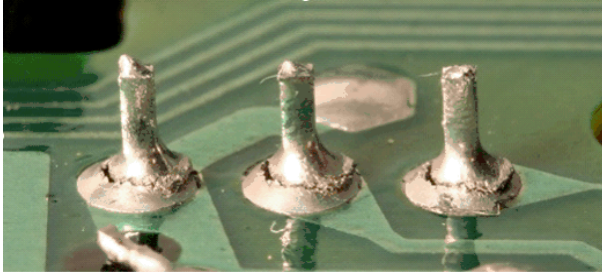
Which of the following types of solder should not be used for radio and electronic applications?

Acid-core solder

T7D09

What is the characteristic appearance of a cold tin-lead solder joint?

A rough or lumpy surface



T7D10

What reading indicates that an ohmmeter is connected across a large, discharged capacitor?

Increasing resistance with time

This is because the ohmmeter current is charging the circuit capacitor(s). It will stop increasing as the circuit capacitance stops charging then the resistance reading will be correct.

T7D11

Which of the following precautions should be taken when measuring in-circuit resistance with an ohmmeter?

Ensure that the circuit is not powered

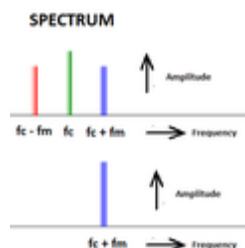
SUBELEMENT T8 - SIGNALS AND EMISSIONS

[4 Exam Questions - 4 Groups]

T8A Basic characteristics of FM and SSB; Bandwidth of various modulation modes: CW, SSB, FM, fast-scan TV; Choice of emission type: selection of USB vs LSB, use of SSB for weak signal work, use of FM for VHF packet and repeaters

Brief SSB (single sideband) modulation tutorial

In the process of Amplitude Modulation, the modulated wave consists of the carrier wave and two sidebands. The Graphic below shows a representation of an amplitude modulated signal in the frequency domain with the carrier and its two sidebands. The carrier makes up 50% of the transmitted signal power and each sideband has 25% of the power making up the total 100%. Both the sidebands contain the same information. So it is only necessary to send one of them and since the carrier does not contain any information it can also be eliminated. Doing this reduces the transmit power requirement by 75%. The disadvantage is a more complex recovery process in the receiver and a requirement for very stable Transmit frequency and receiver frequency stability.



T8A01

Which of the following is a form of amplitude modulation?

Single sideband

T8A02

What type of modulation is commonly used for VHF packet radio transmissions?

FM or PM

T8A03

Which type of voice mode is often used for long-distance (weak signal) contacts on the VHF and UHF bands?

SSB

T8A04

Which type of modulation is commonly used for VHF and UHF voice repeaters?

FM or PM

T8A05

Which of the following signal types has the narrowest bandwidth?

CW

Morse Code (CW) takes up approx. 150 Hz of spectrum and a receive bandwidth of 300 to 500 Hz is sufficient to receive it.

T8A06

Which sideband is normally used for 10-meter HF, VHF, and UHF single-sideband communications?

Upper sideband

Upper sideband is normally used for all frequencies above 10 MHz. 10 meters is 28 to 28.8 MHz therefore upper sideband is used.

T8A07

What is one characteristic of single sideband (SSB) compared to FM?

SSB signals have narrower bandwidth

FM transmissions requires 15 KHz of spectrum and SSB signal requires 3 KHz of spectrum . Five SSB transmissions can fit in the spectrum needed for a single FM Transmission.

T8A08

What is the approximate bandwidth of a typical single sideband (SSB) voice signal?

3 kHz

T8A09

What is the approximate bandwidth of an FM voice signal on VHF repeaters?

Between 10 and 15 kHz

T8A10

What is the approximate bandwidth of AM fast-scan TV transmissions?

About 6 MHz

Fast scan TV is the old Analog NTSC (National Television Standards Committee) format.

T8A11

What is the approximate bandwidth required to transmit a CW signal?

150 Hz

T8A12

Which of the following is a disadvantage of FM compared with single sideband?

Only one signal can be received at a time

A disadvantage of FM compared to single sideband is that only one signal can be received at a time, even when two signals are on the same frequency. This is due to the "capture effect". Capture Effect is when two stations transmit at the same time on the same frequency, the strongest signal wins. You will usually only hear the stronger one unless they are close in signal strength in which case you may hear garbled audio, or nothing at all.

T8B Amateur satellite operation: Doppler shift, basic orbits, operating protocols, modulation mode selection, transmitter power considerations, telemetry, satellite tracking programs, beacons, uplink and downlink mode definitions, spin fading, definition of "LEO", setting uplink power

T8B01

What telemetry information is typically transmitted by satellite beacons?

Health and status of the satellite

Examples of satellite Health are Status indicators such as battery voltage, temperature and data on the operational state of the satellite's transmitters.

T8B02

What is the impact of using excessive effective radiated power on a satellite uplink?

Blocking access by other users

If your uplink power is too high you could "blind" the satellite to other signals, blocking them from using it because the satellite receiver will AGC (automatic gain control) to prevent overload therefore reducing the sensitivity to other received signals.

T8B03

Which of the following are provided by satellite tracking programs?

- A. Maps showing the real-time position of the satellite track over 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 these choices are correct

T8B04

What mode of transmission is commonly used by amateur radio satellites?

- A. SSB
- B. FM
- C. CW/data

D. All these choices are correct

T8B05

What is a satellite beacon?

A transmission from a satellite that contains status information

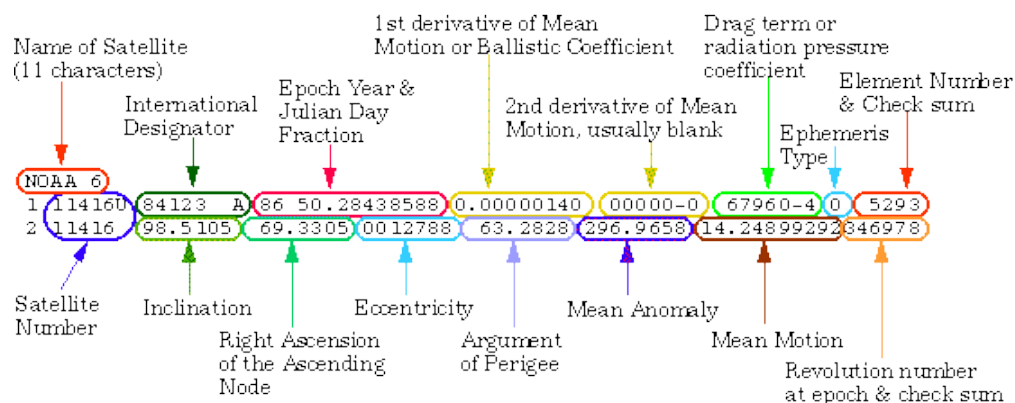
T8B06

Which of the following are inputs to a satellite tracking program?

The Keplerian elements

Satellite Orbital Elements are numbers that tell us the orbit of each satellite. Elements for common satellites are distributed through amateur radio bulletin boards, and other means.

Below is an example set of Keplerian elements



T8B07

What is Doppler shift in reference to satellite communications?

An observed change in signal frequency caused by relative motion between the satellite and Earth station



T8B08

What does it mean if a satellite is operating in U/V mode?

The satellite uplink is in the 70-centimeter band and the downlink is in the 2-meter band

The satellite uplink is the UHF band and the downlink is the VHF band

T8B09

What causes spin fading of satellite signals?

Rotation of the satellite and its antennas

T8B10

What does the term LEO mean in reference to communication satellites?

Low Earth Orbit, which has a period of around 100 minutes

A low Earth orbit (LEO) is an orbit around Earth with an altitude of 2,000 kilometers (1,200 mi) or less, and an orbital period of between about 84 and 127 minutes. Objects below approximately 160 kilometers (99 mi) will experience very rapid orbital decay and altitude loss due to atmospheric drag

T8B11

Who is permitted to receive telemetry from an amateur radio satellite?

Anyone

T8B12

Which of the following is a way to determine whether your satellite uplink power into a linear transponder satellite is neither too low nor too high?

Your signal strength on the downlink should be about the same as the beacon

T8C Operating activities: radio direction finding, contests, linking over the internet, exchanging grid locators

T8C01

Which of the following methods is used to locate sources of noise interference or jamming?

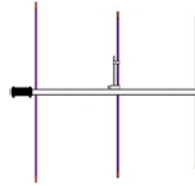
Radio direction finding

T8C02

Which of these items would be useful for a hidden transmitter hunt?

A directional antenna

This activity is frequently referred to as a fox hunt.



T8C03

What operating activity involves contacting as many stations as possible during a specified period?

Contesting

T8C04

Which of the following is good practice when contacting another station in a contest?

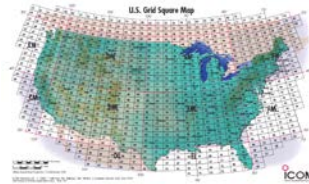
Sending only the minimum information needed for proper identification and the contest exchange

T8C05

What is a grid locator?

A letter-number designator assigned to a geographic location

Spokane Washington in
located in Grid Square
DN17



T8C06

How is over the air access to Internet Radio Linking Project (IRLP) nodes accomplished?

By using Dual-Tone Multi-Frequency (DTMF) signals

IRLP is the Internet Radio Linking Project. The aim of this project is to link amateur radio systems reliably and inexpensively without the use of RF links, leased lines, or satellites. The IRLP uses Voice-Over-IP (VoIP) custom software and hardware. Coupled with the power of the Internet, IRLP will link your repeater site or simplex station to the world in a simple and cost effective way.

T8C07

What is Voice Over Internet Protocol (VoIP)?

A method of delivering voice communications over the internet using digital techniques

T8C08

What is the Internet Radio Linking Project (IRLP)?

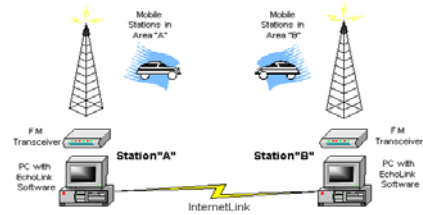
A technique to connect amateur radio systems, such as repeaters, via the internet

T8C09

Which of the following protocols enables an amateur station to transmit through a repeater without using a radio to initiate the transmission?

EchoLink

EchoLink® software allows licensed Amateur Radio stations to communicate with one another over the Internet, using streaming-audio technology. The program allows worldwide connections to be made between stations, or from computer to station, greatly enhancing Amateur Radio's communications capabilities.



T8C10

What is required before using the EchoLink system?

Register your call sign and provide proof of license

T8C11

What is an amateur radio station that connects other amateur stations to the internet?

A gateway

T8D Non-voice and digital communications: image signals and definition of NTSC, CW, packet radio, PSK, APRS, error detection and correction, amateur radio networking, DMR, WSJT modes, Broadband-Hamnet

T8D01

Which of the following is a digital communications mode?

- A. Packet radio
- B. IEEE 802.11
- C. FT8

D. All these choices are correct

T8D02

What is FT8?

A digital mode capable of low signal-to-noise operation

FT8 lets amateur radio operators make reliable contacts even if signals are too weak to hear. It uses efficient encoding and precise timing to send tiny bits of data over long distances. Operators often manage this with minimal power and pretty basic antennas.

T8D03

What kind of data can be transmitted by APRS?

- A. GPS position data
- B. Text messages
- C. Weather data

D. All these choices are correct

T8D04

What is meant by the term "NTSC?"

An analog fast-scan color TV signal

NTSC is the National Television Standards Committee, the old analog TV system.

T8D05

Which of the following is an application of APRS?

Providing real-time tactical digital communications in conjunction with a map showing the locations of stations

T8D06

What does the abbreviation "PSK" mean?

Phase Shift Keying

T8D07

Which of the following describes DMR?

A technique for time-multiplexing two digital voice signals on a single 12.5 kHz repeater channel

DMR stands for Digital Mobile Radio and is an international standard that has been defined for two-way radios. The DMR standard allows equipment developed by different manufacturers to operate together on the same network for all the functions defined within the standard.

T8D08

Which of the following is included in packet radio transmissions?

- A. A checksum that permits error detection
- B. A header that contains the call sign of the station to which the information is being sent
- C. Automatic repeat request in case of error

D. All these choices are correct

T8D09

What is CW?

Another name for a Morse code transmission

T8D10

Which of the following operating activities is supported by digital mode software in the WSJT-X software suite?

- A. Earth-Moon-Earth
- B. Weak signal propagation beacons
- C. Meteor scatter

D. All these choices are correct

WSJT software facilitates basic digital communication using protocols explicitly optimized for a number of different propagation modes:

JTMS, FSK441 for meteor scatter

ISCAT, JT6M for ionospheric scatter

JT65 for EME at VHF/UHF, and for QRP operation at MF/HF

JT4: for EME on the microwave bands

T8D11

What is the role of ARQ in a transmission system?

An error correction method in which the receiving station detects errors and sends a request for retransmission

Automatic Repeat ReQuest (ARQ) is a group of error – control protocols for transmission of data over noisy or unreliable communication network. They are named so because they provide for automatic retransmission of frames that are corrupted or lost during transmission.

T8D12

Which of the following best describes an amateur radio mesh network?

An amateur-radio data network using commercial Wi-Fi equipment with modified firmware

Simply, it's hams using our radio privileges to operate a private, self-contained wireless computer network. Anything that can be done on a regular network/internet can be done on this private Wi-Fi network. The HAM Mesh Network uses off-the-shelf Wi-Fi equipment that has been modified to permit equipment to be used on HAM frequencies under Part 97 rules. Links between nodes can be achieved for miles limited by line-of-site.

SUBELEMENT T9 - ANTENNAS AND FEED LINES

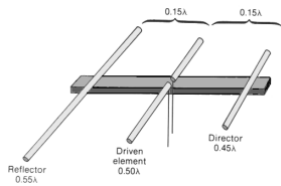
[2 Exam Questions - 2 Groups]

T9A Antennas: vertical and horizontal polarization, concept of antenna gain, definition and types of beam antennas, antenna loading, common portable and mobile antennas, relationships between resonant length and frequency, dipole pattern

T9A01

What is a beam antenna?

An antenna that concentrates signals in one direction



T9A02

Which of the following describes a type of antenna loading?

Electrically lengthening by inserting inductors in radiating elements



T9A03

How is the polarization of an antenna described?

By the orientation of the electric field

T9A04

What is a disadvantage of a handheld radio transceiver's short flexible antenna compared to a full-sized quarter-wave antenna?

It has low efficiency

T9A05

Which of the following increases the resonant frequency of a dipole antenna?

Shortening it

T9A06

Which of the following types of antennas offers the greatest gain?

Yagi



T9A07

What is a potential drawback of using a handheld VHF transceiver inside a vehicle that lacks an externally mounted antenna?

Signal strength is reduced due to the shielding effect of the vehicle

T9A08

Why is a 19-inch-long vertical antenna often used on 2 meters?

It is a resonant quarter-wave

$WL = ((300 \div 146) \div 4)$ or $(2.05 \div 4)$ or .5134 meters or 51.34 cm

Divide cm by 2.54 to get inches or $51.34 \div 2.54$ or 20.2 Inches, the closest answer is 19 inches

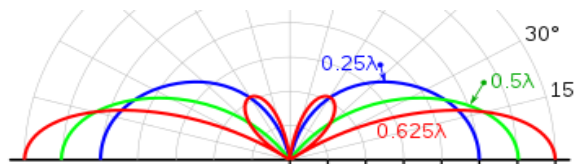
Directly in inches:

$\frac{1}{4} WL = ((492 \div 146) \div 2)$ or $3.369 \div 2$ or 1.684 FT or in inches $1.684 \text{ FT} \times 12$ or 20.21 inches. 19 is the closest answer show in the choices.

T9A09

What is an advantage of a 5/8-wavelength whip antenna for VHF or UHF mobile service compared to a 1/4-wave antenna?

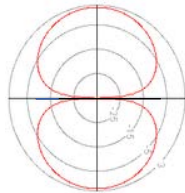
It has more gain



T9A10

In which direction does a half-wave dipole antenna radiate the strongest signal?

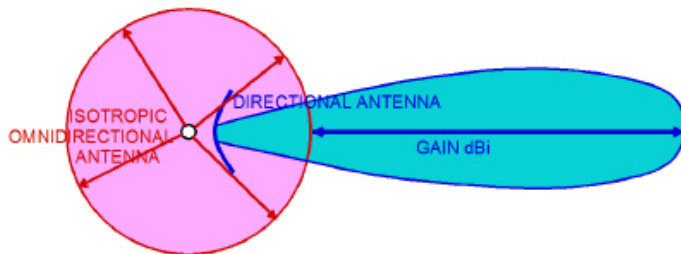
Broadside to the antenna



T9A11

What is antenna gain?

The increase in signal strength in a specified direction compared to a reference antenna



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

T9B01

Which of the following connectors should be carefully taped for weather protection when used outdoors?

- A. PL259
- B. BNC
- C. Type N

D. All these choices are correct

T9B02

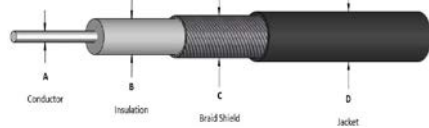
What is the most common impedance of coaxial cables used in amateur radio?

50 ohms

T9B03

Why is coaxial cable the most common feed line for amateur radio antenna systems?

It is easy to use and requires few special installation considerations



T9B04

What is the major function of an antenna tuner (antenna coupler)?

It matches the antenna system impedance to the transceiver's output impedance



T9B05

What happens as the frequency of a signal in coaxial cable is increased?

The loss increases

T9B06

Which of the following connector types is most suitable as an RF connector for frequencies above 400 MHz?

Type N



T9B07

Which of the following is true of PL-259 type coax connectors?

They are commonly used at HF and VHF frequencies

**T9B08**

Which of the following is a source of loss in coaxial feed line?

- A. Water intrusion into coaxial connectors
- B. High SWR
- C. Multiple connectors in the line

D. All these choices are correct

T9B09

What can cause erratic changes in SWR?

Loose connection in the antenna or feed line

T9B10

What is the electrical difference between RG-58 and RG-213 coaxial cable?

RG-213 cable has less loss at a given frequency

Coax Cable Signal Loss (Attenuation) in dB per 100ft								
Loss*	RG-174	RG-58	RG-8X	RG-213	RG-6	RG-11	RF-9914	RF-9913
1MHz	1.9dB	0.4dB	0.5dB	0.2dB	0.2dB	0.2dB	0.3dB	0.2dB
10MHz	3.3dB	1.4dB	1.0dB	0.6dB	0.6dB	0.4dB	0.5dB	0.4dB
50MHz	6.6dB	3.3dB	2.5dB	1.6dB	1.4dB	1.0dB	1.1dB	0.9dB
100MHz	8.9dB	4.9dB	3.6dB	2.2dB	2.0dB	1.6dB	1.5dB	1.4dB
200MHz	11.9dB	7.3dB	5.4dB	3.3dB	2.8dB	2.3dB	2.0dB	1.8dB
400MHz	17.3 dB	11.2dB	7.9dB	4.8dB	4.3dB	3.5dB	2.9dB	2.6dB
700MHz	26.0dB	16.9dB	11.0dB	6.6dB	5.6dB	4.7dB	3.8dB	3.6dB
900MHz	27.9 dB	20.1dB	12.6dB	7.7dB	6.0dB	5.4dB	4.9dB	4.2dB
1GHz	32.0dB	21.5dB	13.5dB	8.3dB	6.1dB	5.6dB	5.3dB	4.5dB

T9B11

Which of the following types of feed line has the lowest loss?

Air-insulated hardline

**T9B12**

What is standing wave ratio (SWR)?

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

SUBELEMENT T0 - SAFETY

[3 Exam Questions - 3 Groups]

T0A Power circuits and hazards: hazardous voltages, fuses and circuit breakers, grounding, electrical code compliance; Lightning protection; Battery safety

T0A01

Which of the following is a safety hazard of a 12-volt storage battery that lacks internal protection circuitry?

Shorting the terminals can cause burns, fire, or an explosion



T0A02

What health hazard is posed by electrical current flowing through the body?

- A. It may cause injury by heating body tissue
- B. It may disrupt the electrical functions of cells
- C. It may cause involuntary muscle contractions

D. All these choices are correct



T0A03

In the United States, what circuit does black wire insulation indicate in a three-wire 120 V AC cable?

Hot

Keep in mind that in DC Circuits black is minus or ground and red is hot. In AC wiring black is the HOT line, White in neutral and green is ground

T0A04

What is the purpose of a fuse in an electrical circuit?

To remove power in case of an overload



T0A05

Why should a 5-ampere fuse never be replaced with a 20-ampere fuse?

Excessive current could cause a fire

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. Ensure all capacitors used for high-voltage DC are fully discharged before working inside equipment

All these choices are correct

T0A07

Where should a lightning arrester be installed in a coaxial feed line?

On a grounded panel near where feed lines enter the building



T0A08

Where should a fuse or circuit breaker be installed in a 120V AC power circuit?

In series with the hot conductor only

T0A09

What should be done to all external ground rods or earth connections?

Bond them together with heavy wire or conductive strap

T0A10

What hazard occurs when rapidly charging or discharging an unprotected battery?

Overheating or out-gassing

The gas generated is hydrogen and if the battery is in a closed space the Hydrogen gas can accumulate creating an explosion hazard

T0A11

What hazard exists in a power supply immediately after turning it off?

Charge stored in filter capacitors

T0A12

Which of the following precautions should be taken when measuring high voltages with a voltmeter?

Ensure that the voltmeter and its leads are rated for use at the voltages being measured

T0B Antenna safety: tower safety and grounding, installing antennas, antenna supports

Ensure that connections are short and direct

T0B01

Which of the following is good practice when installing ground wires on a tower for lightning protection?

T0B02

What is required when climbing an antenna tower?

- A. Have sufficient training on safe tower climbing techniques
- B. Use appropriate tie-off to the tower at all times
- C. Always wear an approved climbing harness

D. All these choices are correct

T0B03

Under what circumstances is it safe to climb a tower without a helper or observer?

Never

T0B04

Which of the following is an important safety precaution to observe when putting up an antenna tower?

Look for and stay clear of any overhead electrical wires

T0B05

What is the purpose of a safety wire through a turnbuckle used to tension guy lines?

Prevent loosening of the turnbuckle from vibration

T0B06

What is the minimum safe distance from a power line to allow when installing an antenna?

Enough so that if the antenna falls, no part of it can come within 10 feet of the power wires

T0B07

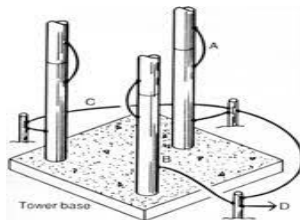
Which of the following is an important safety rule to remember when using a crank-up tower?

This type of tower must not be climbed unless it is retracted, or mechanical safety locking devices have been installed

T0B08

Which is a proper grounding method for a tower?

Separate eight-foot ground rods for each tower leg, bonded to the tower and each other



T0B10

Which of the following is true when installing grounding conductors used for lightning protection?

Sharp bends must be avoided

T0B11

Which of the following establishes grounding requirements for an amateur radio tower or antenna?

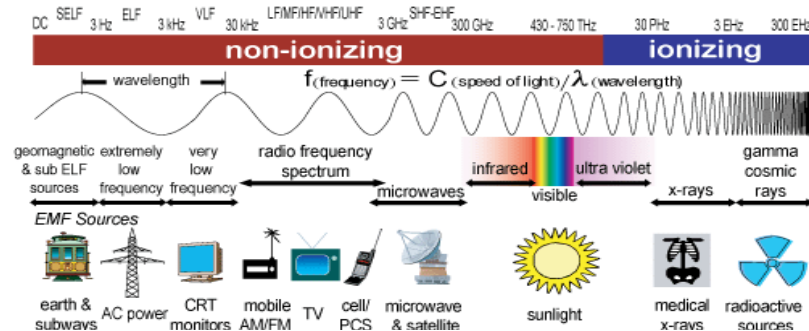
Local electrical codes

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

T0C01

What type of radiation are radio signals?

Non-ionizing radiation



T0C02

Which of the following bands has the lowest maximum permissible exposure for RF safety?

50 MHz

Band	Power (W) into Antenna
160-meters	500
80-meters	500
40-meters	500
30-meters	425
20-meters	225
17-meters	125
15-meters	100
12-meters	75
10-meters	50
6-meters	50
2-meters	50
1.25-meters	50
70-centimeters	70
33-centimeters	150
23-centimeters	200
13-centimeters	250
SHF (all bands)	250
EHF (all bands)	250

T0C03

How does the allowable power density for RF safety change if duty cycle changes from 100 percent to 50 percent?

It increases by a factor of 2

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 these choices are correct

T0C05

Why do exposure limits vary with frequency?

The human body absorbs more RF energy at some frequencies than at others

T0C06

Which of the following is an acceptable method to determine whether 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 these choices are correct

T0C07

What hazard is created by touching an antenna during a transmission?

RF burn to skin

T0C08

Which of the following actions can reduce exposure to RF radiation?

Relocate antennas

T0C09

How can you make sure your station stays in compliance with RF safety regulations?

By re-evaluating the station whenever an item in the transmitter or antenna system is changed

T0C10

Why is duty cycle one of the factors used to determine safe RF radiation exposure levels?

It affects the average exposure to radiation

T0C11

What is the definition of duty cycle during the averaging time for RF exposure?

The percentage of time that a transmitter is transmitting

T0C12

How does RF radiation differ from ionizing radiation (radioactivity)?

RF radiation does not have sufficient energy to cause chemical changes in cells and damage DNA

T0C13

Who is responsible for ensuring that no person is exposed to RF energy above the FCC exposure limits?

The station licensee

