

Amateur Radio (Ham) Technician Study Guide

FCC Element 2: Questions & Answers

Until June 2026



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221108

Amateur Radio (Ham) Technician Study Guide

with exact questions & answers

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My complete, high-performance VHF/UHF antenna system:

Ham-built counterpoise, Compactenna, RG-213/U coax, ferrite beads, Polyphaser protector, workbench by Jason.

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We added explanatory material to aid in study for the Amateur radio exams. This is to support and assist the Amateur community. Please give credit for any information used.

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The exam has one question from each category under a sub-element.

HOW TO USE THE STUDY GUIDE

Please read before you start study. You will thank us, if you do.

How many people do you know who wanted to be a ham, at one time?

In early days, Morse Code kept many from pursuing their interest, but Code is no longer required. Then the prospect of not knowing what, how, and where leaves countless unfulfilled.

We want to help you become a ham in 4-weeks.

We have done it with hundreds from 85-year-old great-grandfather to stay-at-home moms, from college students to truck-drivers, from engineers to social workers.

We know who passes the exams, everyone who diligently follows the directions.

In cyber-space, there is almost as much study material, books, and web-sites as there are questions on the exam, but it is less than effective because non-technical people become really intimidated.

We found one of two problems with most study plans.

One, too much material makes prep long, difficult, and overwhelming.

Two, not enough material restricts understanding. Practice tests are of little use, until just before your exam.

At the end of the day, the **ONLY** thing that matters is 'the questions with the correct answer.'

This guide prepares you, with that in mind.

It is exactly like taking the driver's license exam.

The precise questions are given.

The correct answer is highlighted.

The distractors are included for form, but do not read them.

Succinct hints really aid in memorization.

Repeat a few times.

You are now a ham.

Ham exams are not to show what you know, they are to help you learn.

After the questions, several helpful concise articles reside at the back for your reference with technical made non-technical and your first radio set-up.

Dr. Marcus O. Durham is an Amateur Extra. His career spans industry, academia, and entrepreneurship. He and Rosemary live on a fabulous ranch, which houses his research lab. He is Professor Emeritus of Electrical Engineering. His education includes a PhD in Engineering. Then he earned a second PhD in Theology with a heavy dose of history and archaeology.

Rosemary Durham is an Amateur (Ham) radio operator. Her career includes business owner, ranch operator, and grandmother. She is a Certified Fire Investigator, Certified Vehicle Fire Investigator, and Certified Color Analyst.

Dr. Marc and Rosemary have written 24 books. He has published over 200 peer-reviewed engineering papers and articles. They co-author a weekly history column for the newspaper. They co-author a weekly article on amateur for their local organization. Several of the articles are in the back.

They know how to do, teach, and write, so you can prep for the exam in the easiest possible way.

Special thanks to Lt. Col. Dan, K5CAY, for suggestions, discussions, and review.



**SKIP THIS SECTION
IT IS HEADERS FOR EACH CHAPTER**

NCVEC Public Domain

**FCC Exam Element 2 Question Pool for Technician Class
Effective 7/01/2018-6/30/2022**

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SUBELEMENT T4 – AMATEUR RADIO PRACTICES – [2 Exam Questions - 2 Groups] 24 Questions

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

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

SUBELEMENT T5 – ELECTRICAL PRINCIPLES – [4 Exam Questions - 4 Groups] 52 Questions

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

T5B - Math for electronics: conversion of electrical units, decibels

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

T5D – Ohm’s Law; Series and parallel circuits

SUBELEMENT T6 – ELECTRONIC AND ELECTRICAL COMPONENTS – [4 Exam Questions - 4 Groups] 47 Questions

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

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

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

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

SUBELEMENT T7 – PRACTICAL CIRCUITS – [4 Exam Questions - 4 Groups] 44 Questions

T7A – Station equipment: receivers, transceivers, transmitter amplifiers, receive amplifiers, transverters; Basic radio circuit concepts and terminology: sensitivity, selectivity, mixers, oscillators, PTT, modulation

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

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

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

SUBELEMENT T8 – SIGNALS AND EMISSIONS – [4 Exam Questions - 4 Groups] 48 Questions

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

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

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

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

SUBELEMENT T9 – ANTENNAS AND FEED LINES - [2 Exam Questions - 2 Groups] 24 Questions

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

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

SUBELEMENT T0 – SAFETY – [3 Exam Questions - 3 Groups] 36 Questions

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

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

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

END SKIP

By: Dr. Marc and Rosemary

**2022-2026 Technician Class
FCC Element 2 Question Pool
Effective 7/01/2022 – 6/30/2026**

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

T1A01 (C) [97.1]

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

- A. Providing personal radio communications for as many citizens as possible
- B. Providing communications for international non-profit organizations
- C. Advancing skills in the technical and communication phases of the radio art
- D. All these choices are correct

Purpose = skills

~~

T1A02 (C) [97.1]

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

- A. FEMA
- B. Homeland Security
- C. The FCC
- D. All these choices are correct

Radio = Federal COMMUNICATIONS Commission (FCC)

~~

T1A03 (B) [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?

- A. It is required when transmitting emergency messages
- B. It is encouraged
- C. It is required when in contact with foreign stations
- D. All these choices are correct

Phonetics = encouraged

~~

T1A04 (A) [97.5(b)(1)]

How many operator/primary station license grants may be held by any one person?

- A. One
- B. No more than two
- C. One for each band on which the person plans to operate
- D. One for each permanent station location from which the person plans to operate

one person = one license

~~

T1A05 (C) [97.7]

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

- A. A printed copy of the certificate of successful completion of examination
- B. An email notification from the NCVETC granting the license
- C. The license appears in the FCC ULS database
- D. All these choices are correct

Proof = database

~~

T1A06 (D) [97.3(a)(9)]

What is the FCC Part 97 definition of a beacon?

- A. A government transmitter marking the amateur radio band edges
- B. A bulletin sent by the FCC to announce a national emergency
- C. A continuous transmission of weather information authorized in the amateur bands by the National Weather Service
- D. An amateur station transmitting communications for the purposes of observing propagation or related experimental activities

Beacon = observing

~~

T1A07 (C) [97.3(a)(41)]

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

- A. Any satellite orbiting Earth
- B. A manned satellite orbiting Earth
- C. An amateur station located more than 50 km above Earth's surface
- D. An amateur station using amateur radio satellites for relay of signals

Space station = station > 50

~~

T1A08 (B) [97.3(a)(22)]

Which of the following entities recommends transmit/receive channels and other parameters for auxiliary and repeater stations?

- A. Frequency Spectrum Manager appointed by the FCC
- B. Volunteer Frequency Coordinator recognized by local amateurs
- C. FCC Regional Field Office
- D. International Telecommunication Union

Recommend = volunteer

~~

T1A09 (C) [97.3(a)(22)]

Who selects a Frequency Coordinator?

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

Selects = eligible stations

~~

T1A10 (D) [97.3(a)(38), 97.407]

What is the Radio Amateur Civil Emergency Service (RACES)?

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

Emergency = all in

~~

T1A11 (B) [97.101 (d)]

When is willful interference to other amateur radio stations permitted?

- A. To stop another amateur station that is breaking the FCC rules
- B. At no time
- C. When making short test transmissions
- D. At any time, stations in the Amateur Radio Service are not protected from willful interference

Willful = never

~~

T1B - Frequency allocations;

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

T1B01 (C) [97.301 (e)]

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

- A. 28.050 MHz to 28.150 MHz
- B. 28.100 MHz to 28.300 MHz
- C. 28.300 MHz to 28.500 MHz
- D. 28.500 MHz to 28.600 MHz

Tech = edge pf 10 m, just memorize

~~

T1B02 (B) [97.301, 97.207(c)]

Which amateurs may contact the International Space Station (ISS) on VHF bands?

- A. Any amateur holding a General class or higher license
- B. Any amateur holding a Technician class or higher license
- C. Any amateur holding a General class or higher license who has applied for and received approval from NASA
- D. Any amateur holding a Technician class or higher license who has applied for and received approval from NASA

ISS = any license, think kids in classroom

~~

T1B03 (B) [97.301(a)]

Which frequency is in the 6 meter amateur band?

- A. 49.00 MHz
- B. 52.525 MHz
- C. 28.50 MHz
- D. 222.15 MHz

*Freq * band = 300; so 300/6 ≈ 50 Mhz*

~~

T1B04 (D) [97.301(a)]

Which amateur band includes 146.52 MHz?

- A. 6 meters
- B. 20 meters
- C. 70 centimeters
- D. 2 meters

*Freq * band = 300; so 300/~150 = 2 meter*

~~

T1B05 (D) [97.305(c)]

How may amateurs use the 219 to 220 MHz segment of 1.25 meter band?

- A. Spread spectrum only
- B. Fast-scan television only
- C. Emergency traffic only
- D. Fixed digital message forwarding systems only

1 MHz = skinny, so fixed

~~

T1B06 (B) [97.301(e), 97.305]

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

- A. None
- B. 10 meter band only
- C. 80 meter, 40 meter, 15 meter, and 10 meter bands
- D. 30 meter band only

Tech phone = highest freq

~~

T1B07 (A) [97.305(a), (c)]

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

- A. 50.0 MHz to 50.1 MHz and 144.0 MHz to 144.1 MHz
- B. 219 MHz to 220 MHz and 420.0 MHz to 420.1 MHz
- C. 902.0 MHz to 902.1 MHz
- D. All these choices are correct

VHF/UHF = 50 MHz & 144 MHz, only VHF choice

~~

T1B08 (A) [97.303]

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

- A. U.S. amateurs may find non-amateur stations in those segments, and must avoid interfering with them
- B. U.S. amateurs must give foreign amateur stations priority in those segments
- C. International communications are not permitted in those segments
- D. Digital transmissions are not permitted in those segments

Secondary = non-ham

~~

T1B09 (D) [97.101(a), 97.301(a-e)]

Why should you not set your transmit frequency to be exactly at the edge of an amateur band or sub-band?

- A. To allow for calibration error in the transmitter frequency display
- B. So that modulation sidebands do not extend beyond the band edge
- C. To allow for transmitter frequency drift
- D. All these choices are correct

Edge = all fall-off if anything wrong

~~

T1B10 (C) [97.305(c)]

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

- A. Only in sub-bands allocated to General class or higher licensees
- B. Only on repeaters
- C. In at least some segment of all these bands

D. On any band if the power is limited to 25 watts

>50 MHz = some of all

~~

T1B11 (A) [97.313]

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

A. 200 watts

B. 100 watts

C. 50 watts

D. 10 watts

Max = 200, the max option

~~

T1B12 (D) [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?

A. 50 watts

B. 100 watts

C. 500 watts

D. 1500 watts

Max = 1500, the max option

~~

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 (D) [97.9(a), 97.17(a)]

For which license classes are new licenses currently available from the FCC?

A. Novice, Technician, General, Amateur Extra

B. Technician, Technician Plus, General, Amateur Extra

C. Novice, Technician Plus, General, Advanced

D. Technician, General, Amateur Extra

New = only three

~~

T1C02 (D) [97.19]

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

A. Only a licensed amateur with a General or Amateur Extra Class license

B. Only a licensed amateur with an Amateur Extra Class license

C. Only a licensed amateur who has been licensed continuously for more than 10 years

D. Any licensed amateur

Vanity = anyone

~~

T1C03 (A) [97.117]

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

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

B. Communications incidental to conducting business or remarks of a personal nature

- C. Only communications incidental to contest exchanges; all other communications are prohibited
- D. Any communications that would be permitted by an international broadcast station

Amateur = amateur

~~

T1C04 (B) [97.23]

What may happen if the FCC is unable to reach you by email?

- A. Fine and suspension of operator license
- B. Revocation of the station license or suspension of the operator license
- C. Revocation of access to the license record in the FCC system
- D. Nothing; there is no such requirement

Undeliverable = revoked

~~

T1C05 (A)

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

- A. KF1XXX
- B. KA1X
- C. W1XX
- D. All these choices are correct

Tech = xxx, three letters at end

~~

T1C06 (D) [97.5(a)(2)]

From which of the following locations may an FCC-licensed amateur station transmit?

- A. From within any country that belongs to the International Telecommunication Union
- B. From within any country that is a member of the United Nations
- C. From anywhere within International Telecommunication Union (ITU) Regions 2 and 3
- D. From any vessel or craft located in international waters and documented or registered in the United States

FCC (Federal Communication Commission) = United States

~~

T1C07 (B) [97.23]

Which of the following can result in revocation of the station license or suspension of the operator license?

- A. Failure to inform the FCC of any changes in the amateur station following performance of an RF safety environmental evaluation
- B. Failure to provide and maintain a correct email address with the FCC
- C. Failure to obtain FCC type acceptance prior to using a home-built transmitter
- D. Failure to have a copy of your license available at your station

Revocation = no email

~~

T1C08 (C) [97.25]

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

- A. Five years
- B. Life
- C. Ten years
- D. Eight years

Te-rm = te-n

~~

T1C09 (A) [97.21(a)(b)]

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

- A. Two years
- B. Three years
- C. Five years
- D. Ten years

grace = minimum, 2

~~

T1C10 (C) [97.5a]

How soon after passing the examination for your first amateur radio license may you transmit on the amateur radio bands?

- A. Immediately on receiving your Certificate of Successful Completion of Examination (CSCE)
- B. As soon as your operator/station license grant appears on the ARRL website
- C. As soon as your operator/station license grant appears in the FCC's license database
- D. As soon as you receive your license in the mail from the FCC

Operate = in database

~~

T1C11 (D) [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?

- A. Yes, for up to two years
- B. Yes, as soon as you apply for renewal
- C. Yes, for up to one year
- D. No, you must wait until the license has been renewed

Operate = in database

~~

T1D - Authorized and prohibited transmissions:

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

T1D01 (A) [97.111(a)(1)]

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

- A. Any country whose administration has notified the International Telecommunication Union (ITU) that it objects to such communications
- B. Any country whose administration has notified the American Radio Relay League (ARRL) that it objects to such communications
- C. Any country banned from such communications by the International Amateur Radio Union (IARU)
- D. Any country banned from making such communications by the American Radio Relay League (ARRL)

Prohibited country = international objection

~~

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

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

- A. In all circumstances
- B. Broadcasting
- C. International Morse Code Practice
- D. Telecommand or transmissions of telemetry

Prohibited = broadcasting (no one in particular)

~~

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

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

- A. Only during contests
- B. Only when transmitting certain approved digital codes
- C. Only when transmitting control commands to space stations or radio control craft
- D. Never

Encoded = control

~~

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

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

- A. When incidental to an authorized retransmission of manned spacecraft communications
- B. When the music produces no spurious emissions
- C. When transmissions are limited to less than three minutes per hour
- D. When the music is transmitted above 1280 MHz

Music = retransmit spacecraft

~~

T1D05 (D) [97.113(a)(3)(ii)]

When may amateur radio operators use their stations to notify other amateurs of the availability of equipment for sale or trade?

- A. Never
- B. When the equipment is not the personal property of either the station licensee, or the control operator, or their close relatives
- C. When no profit is made on the sale
- D. When selling amateur radio equipment and not on a regular basis

Amateur sale = amateur stuff

~~

T1D06 (B) [97.113(a)(4)]

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

- A. The FCC maintains a list of words that are not permitted to be used on amateur frequencies
- B. Any such language is prohibited
- C. The ITU maintains a list of words that are not permitted to be used on amateur frequencies
- D. There is no such prohibition

Obscene = prohibited

~~

T1D07 (D) [97.113(d)]

What types of amateur stations can automatically retransmit the signals of other amateur stations?

- A. Auxiliary, beacon, or Earth stations
- B. Earth, repeater, or space stations
- C. Beacon, repeater, or space stations
- D. Repeater, auxiliary, or space stations

Automatically retransmit = repeater, auxiliary

~~

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

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

- A. When the communication is related to the sale of amateur equipment by the control operator's employer
- B. When the communication is incidental to classroom instruction at an educational institution
- C. When the communication is made to obtain emergency information for a local broadcast station
- D. All these choices are correct

Compensation = teachers

~~

T1D09 (A) [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?

- A. When such communications are directly related to the immediate safety of human life or protection of property
- B. When broadcasting communications to or from the space shuttle
- C. Where noncommercial programming is gathered and supplied exclusively to the National Public Radio network
- D. Never

Broadcasting program = immediate safety

~~

T1D10 (D) [97.3(a)(10)]

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

- A. Two-way transmissions by amateur stations
- B. Any transmission made by the licensed station
- C. Transmission of messages directed only to amateur operators
- D. Transmissions intended for reception by the general public

Broadcasting = general public

~~

T1D11 (D) [97.119(a)]

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

- A. When the transmissions are of a brief nature to make station adjustments
- B. When the transmissions are unmodulated
- C. When the transmitted power level is below 1 watt
- D. When transmitting signals to control model craft

Without id = to control models

~~

T1E - Control operator:

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

T1E01 (D) [97.7(a)]

When may an amateur station transmit without a control operator?

- A. When using automatic control, such as in the case of a repeater
- B. When the station licensee is away and another licensed amateur is using the station
- C. When the transmitting station is an auxiliary station
- D. Never

Without control operator = never

~~

T1E02 (D) [97.301, 97.207(c)]

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

- A. Only an Amateur Extra Class operator
- B. A General class or higher licensee with a satellite operator certification

C. Only an Amateur Extra Class operator who is also an AMSAT member

D. Any amateur allowed to transmit on the satellite uplink frequency

Control through space = any ham

~~

T1E03 (A) [97.103(b)]

Who must designate the station control operator?

A. The station licensee

B. The FCC

C. The frequency coordinator

D. Any licensed operator

Who designate = who licensee

~~

T1E04 (D) [97.103(b)]

What determines the transmitting frequency privileges of an amateur station?

A. The frequency authorized by the frequency coordinator

B. The frequencies printed on the license grant

C. The highest class of operator license held by anyone on the premises

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

Privileges = class of operator

~~

T1E05 (C) [97.3(a)(14)]

What is an amateur station's control point?

A. The location of the station's transmitting antenna

B. The location of the station's transmitting apparatus

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

D. The mailing address of the station licensee

Control point = location control performed

~~

T1E06 (A) [97.301]

When, under normal circumstances, may a Technician class licensee be the control operator of a station operating in an Amateur Extra Class band segment?

A. At no time

B. When designated as the control operator by an Amateur Extra Class licensee

C. As part of a multi-operator contest team

D. When using a club station whose trustee holds an Amateur Extra Class license

Technician can be amateur extra = no time

~~

T1E07 (D) [97.103(a)]

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

A. All licensed amateurs who are present at the operation

B. Only the station licensee

C. Only the control operator

D. The control operator and the station licensee

operator is not licensee = both responsible

~~

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

Which of the following is an example of automatic control?

- A. Repeater operation
 - B. Controlling a station over the internet
 - C. Using a computer or other device to send CW automatically
 - D. Using a computer or other device to identify automatically
- Automatic control = repeater*

~~

T1E09 (D) [97.109(c)]

Which of the following are required for remote control operation?

- A. The control operator must be at the control point
- B. A control operator is required at all times
- C. The control operator must indirectly manipulate the controls
- D. All these choices are correct

Remote control operation = all places, all times

~~

T1E10 (B) [97.3(a)(39)]

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

- A. Repeater operation
- B. Operating the station over the internet
- C. Controlling a model aircraft, boat, or car by amateur radio
- D. All these choices are correct

Remote control example = over internet

~~

T1E11 (D) [97.103(a)]

Who does the FCC presume to be the control operator of an amateur station, unless documentation to the contrary is in the station records?

- A. The station custodian
- B. The third party participant
- C. The person operating the station equipment
- D. The station licensee

Control operator = licensee, got to be licensed

~~

T1F - Station identification;

Repeaters; Third party communications; Club stations; FCC inspection

T1F01 (B) [97.103(c)]

When must the station and its records be available for FCC inspection?

- A. At any time ten days after notification by the FCC of such an inspection
- B. At any time upon request by an FCC representative
- C. At any time after written notification by the FCC of such inspection
- D. Only when presented with a valid warrant by an FCC official or government agent

Records available = upon request

~~

T1F02 (C) [97.119 (a)]

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

- A. Never, the tactical call is sufficient
- B. Once during every hour
- C. At the end of each communication and every ten minutes during a communication
- D. At the end of every transmission

Identification = ten minutes & end

~~

T1F03 (D) [97.119(a)]

When are you required to transmit your assigned call sign?

- A. At the beginning of each contact, and every 10 minutes thereafter
- B. At least once during each transmission
- C. At least every 15 minutes during and at the end of a communication
- D. At least every 10 minutes during and at the end of a communication

Identification = ten minutes & end

~~

T1F04 (C) [97.119(b)(2)]

What language may you use for identification when operating in a phone sub-band?

- A. Any language recognized by the United Nations
- B. Any language recognized by the ITU
- C. English
- D. English, French, or Spanish

Phone = English

~~

T1F05 (B) [97.119(b)(2)]

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

- A. Send the call sign followed by the indicator RPT
- B. Send the call sign using a CW or phone emission
- C. Send the call sign followed by the indicator R
- D. Send the call sign using only a phone emission

Phone identification = phone or morse code (CW)

~~

T1F06 (D) [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

self-assigned = all, whatever you want

~~

T1F07 (B) [97.115(a)(2)]

Which of the following restrictions apply when a non-licensed person is allowed to speak to a foreign station using a station under the control of a licensed amateur operator?

- A. The person must be a U.S. citizen
- B. The foreign station must be in a country with which the U.S. has a third party agreement
- C. The licensed control operator must do the station identification
- D. All these choices are correct

Foreign station = agreement

~~

T1F08 (A) [97.3(a)(47)]

What is the definition of third party communications?

- A. A message from a control operator to another amateur station control operator on behalf of another person
- B. Amateur radio communications where three stations are in communications with one another
- C. Operation when the transmitting equipment is licensed to a person other than the control operator
- D. Temporary authorization for an unlicensed person to transmit on the amateur bands for technical experiments

Third party = message for another person

~~

T1F09 (C) [97.3(a)(40)]

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

- A. Beacon station
- B. Earth station
- C. Repeater station
- D. Message forwarding station

Re-transmits on different channel = re-peater

~~

T1F10 (A) [97.205(g)]

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

- A. The control operator of the originating station
- B. The control operator of the repeater
- C. The owner of the repeater
- D. Both the originating station and the repeater owner

Responsible = original who dunit

~~

T1F11 (B) [97.5(b)(2)]

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

- A. The trustee must have an Amateur Extra Class operator license grant
- B. The club must have at least four members
- C. The club must be registered with the American Radio Relay League
- D. All these choices are correct

Club = 4 or more

~~

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 (B)

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

- A. Plus or minus 5 MHz
- B. Plus or minus 600 kHz
- C. Plus or minus 500 kHz
- D. Plus or minus 1 MHz

2 meter = ±600, just memorize it (only one not 1 or 5)

~~

T2A02 (A)

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

- A. 146.520 MHz
- B. 145.000 MHz
- C. 432.100 MHz
- D. 446.000 MHz

2 meter calling = highest 2 meter option

~~

T2A03 (A)

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

- A. Plus or minus 5 MHz
- B. Plus or minus 600 kHz
- C. Plus or minus 500 kHz
- D. Plus or minus 1 MHz

70 cm = most bandwidth

~~

T2A04 (B)

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

- A. Say "break, break," then say the station's call sign
- B. Say the station's call sign, then identify with your call sign
- C. Say "CQ" three times, then the other station's call sign
- D. Wait for the station to call CQ, then answer

If you know it = say it. Then say yours

~~

T2A05 (C)

How should you respond to a station calling CQ?

- A. Transmit "CQ" followed by the other station's call sign
- B. Transmit your call sign followed by the other station's call sign
- C. Transmit the other station's call sign followed by your call sign
- D. Transmit a signal report followed by your call sign

If you know it = say it. Then say yours

~~

T2A06 (A)

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

- A. Identify the transmitting station
- B. Conduct tests only between 10 p.m. and 6 a.m. local time
- C. Notify the FCC of the transmissions
- D. All these choices are correct

Making transmission = identify

~~

T2A07 (A)

What is meant by "repeater offset"?

- A. The difference between a repeater's transmit and receive frequencies
- B. The repeater has a time delay to prevent interference
- C. The repeater station identification is done on a separate frequency
- D. The number of simultaneous transmit frequencies used by a repeater

Offset = difference

~~

T2A08 (D)

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

- A. Call on the quarter hour
- B. Test transmission, no reply expected
- C. Only the called station should transmit
- D. Calling any station

CQ = calling I don't know who

~~

T2A09 (B)

Which of the following indicates that a station is listening on a repeater and looking for a contact?

- A. "CQ CQ" followed by the repeater's call sign
- B. The station's call sign followed by the word "monitoring"
- C. The repeater call sign followed by the station's call sign
- D. "QSY" followed by your call sign

Repeater = just say call sign. Every one using the repeater knows rest of stuff

~~

T2A10 (A)

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

- A. A voluntary guideline for using different modes or activities within an amateur band
- B. A list of operating schedules
- C. A list of available net frequencies
- D. A plan devised by a club to indicate frequency band usage

Band plan = voluntary guide

~~

T2A11 (C)

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

- A. Full duplex
- B. Diplex
- C. Simplex
- D. Multiplex

Same frequency = simple

~~

T2A12 (D)

What should you do before calling CQ?

- A. Listen first to be sure that no one else is using the frequency
- B. Ask if the frequency is in use
- C. Make sure you are authorized to use that frequency
- D. All these choices are correct

Calling CQ = all, to make sure frequency is not in use

~~

T2B – VHF/UHF operating practices:

FM repeater, simplex, reverse splits; Access tones: CTCSS, DTMF; DMR operation; Resolving operational problems; Q signals

T2B01 (C)

How is a VHF/UHF transceiver's "reverse" function used?

- A. To reduce power output
- B. To increase power output
- C. To listen on a repeater's input frequency
- D. To listen on a repeater's output frequency

Reverse split = listen to what repeater is listening

~~

T2B02 (D)

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

- A. Carrier squelch
- B. Tone burst
- C. DTMF
- D. CTCSS

Sub audible = Continuous Tone Coded Squelch System (CTCSS)

~~

T2B03 (A)

Which of the following describes a linked repeater network?

- A. A network of repeaters in which signals received by one repeater are transmitted by all the repeaters in the network
- B. A single repeater with more than one receiver
- C. Multiple repeaters with the same control operator
- D. A system of repeaters linked by APRS

Linked = network. One for all

~~

T2B04 (D)

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

Unable to access = lotta reasons, all

~~

T2B05 (C)

What would cause your FM transmission audio to be distorted on voice peaks?

- A. Your repeater offset is inverted
- B. You need to talk louder
- C. You are talking too loudly
- D. Your transmit power is too high

On voice peaks = you are yelling

~~

T2B06 (A)

What type of signaling uses pairs of audio tones?

- A. DTMF
- B. CTCSS
- C. GPRS
- D. D-STAR

Pairs of tones = telephone keypad, Dual Tone Multi-Frequency, DTMF

~~

T2B07 (C)

How can you join a digital repeater's "talkgroup"?

- A. Register your radio with the local FCC office
- B. Join the repeater owner's club
- C. Program your radio with the group's ID or code
- D. Sign your call after the courtesy tone

join talk group = program your radio

~~

T2B08 (A)

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

- A. The stations should negotiate continued use of the frequency
- B. Both stations should choose another frequency to avoid conflict
- C. Interference is inevitable, so no action is required
- D. Use subaudible tones so both stations can share the frequency

Interfere = negotiate

~~

T2B09 (A)

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

- A. So stations within range of each other can communicate without tying up a repeater
- B. For contest operation
- C. For working DX only
- D. So stations with simple transmitters can access the repeater without automated offset

Simple = without repeater

~~

T2B10 (A)

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

- A. QRM
- B. QRN
- C. QTH

D. QSB

Q abbreviation for interference = QRM, Q R(adio) M(ess)

~~

T2B11 (B)

Which Q signal indicates that you are changing frequency?

A. QRU

B. QSY

C. QSL

D. QRZ

Q abbreviation for changing frequency = QSY, Q S(ignal) (frequenc)Y

~~

T2B12 (A)

What is the purpose of the color code used on DMR repeater systems?

A. Must match the repeater color code for access

B. Defines the frequency pair to use

C. Identifies the codec used

D. Defines the minimum signal level required for access

Color code = must match

~~

T2B13 (B)

What is the purpose of a squelch function?

A. Reduce a CW transmitter's key clicks

B. Mute the receiver audio when a signal is not present

C. Eliminate parasitic oscillations in an RF amplifier

D. Reduce interference from impulse noise

Squelch = mute

~~

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 (D) [97.103(a)]

When do FCC rules NOT apply to the operation of an amateur station?

A. When operating a RACES station

B. When operating under special FEMA rules

C. When operating under special ARES rules

D. FCC rules always apply

FCC not apply = never

~~

T2C02 (C)

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

A. Choose the regular net meeting time and frequency

B. Ensure that all stations checking into the net are properly licensed for operation on the net frequency

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

D. All these choices are correct

Net control = net order

~~

T2C03 (C)

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

- A. Send the words by voice and Morse code
- B. Speak very loudly into the microphone
- C. Spell the words using a standard phonetic alphabet
- D. All these choices are correct

Unusual words = spell phonetically

~~

T2C04 (D)

What is RACES?

- A. An emergency organization combining amateur radio and citizens band operators and frequencies
- B. An international radio experimentation society
- C. A radio contest held in a short period, sometimes called a "sprint"
- D. An FCC part 97 amateur radio service for civil defense communications during national emergencies

RACES = Radio Amateur Civil Emergency Service

~~

T2C05 (A)

What does the term "traffic" refer to in net operation?

- A. Messages exchanged by net stations
- B. The number of stations checking in and out of a net
- C. Operation by mobile or portable stations
- D. Requests to activate the net by a served agency

Traffic = message, something to say

~~

T2C06 (A)

What is the Amateur Radio Emergency Service (ARES)?

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

ARES = public service

~~

T2C07 (C)

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

- A. When first responding to the net control station, transmit your call sign, name, and address as in the FCC database
- B. Record the time of each of your transmissions
- C. Unless you are reporting an emergency, transmit only when directed by the net control station
- D. All these choices are correct

Net = speak (transmit) only when spoken to

~~

T2C08 (A)

Which of the following is a characteristic of good traffic handling?

- A. Passing messages exactly as received
- B. Making decisions as to whether messages are worthy of relay or delivery
- C. Ensuring that any newsworthy messages are relayed to the news media
- D. All these choices are correct

Good handling = exactly as received

~~

T2C09 (D)

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

- A. No
- B. Yes, but only when part of a FEMA emergency plan
- C. Yes, but only when part of a RACES emergency plan
- D. Yes, but only in situations involving the immediate safety of human life or protection of property

Operate outside privileges = in immediate emergency ~~

T2C10 (D)

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

- A. The email address of the originating station
- B. The address of the intended recipient
- C. The telephone number of the addressee
- D. Information needed to track the message

Preamble to message = tracking info

~~

T2C11 (A)

What is meant by “check” in a radiogram header?

- A. The number of words or word equivalents in the text portion of the message
- B. The call sign of the originating station
- C. A list of stations that have relayed the message
- D. A box on the message form that indicates that the message was received and/or relayed

Check = number, just like checksum

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 (C)

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

- A. The signal path encounters different concentrations of water vapor
 - B. VHF ionospheric propagation is very sensitive to path length
 - C. Multipath propagation cancels or reinforces signals
 - D. All these choices are correct
- varies = multiple paths*

~~

T3A02 (B)

What is the effect of vegetation on UHF and microwave signals?

- A. Knife-edge diffraction
 - B. Absorption
 - C. Amplification
 - D. Polarization rotation
- vegetation = absorbs*

~~

T3A03 (C)

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

- A. Right-hand circular
 - B. Left-hand circular
 - C. Horizontal
 - D. Vertical
- Polarization (orientation) = horizontal, long distance*

~~

T3A04 (B)

What happens when antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization?

- A. The modulation sidebands might become inverted
 - B. Received signal strength is reduced
 - C. Signals have an echo effect
 - D. Nothing significant will happen
- Not same = reduce*

~~

T3A05 (B)

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?

- A. Change from vertical to horizontal polarization
 - B. Try to find a path that reflects signals to the repeater
 - C. Try the long path
 - D. Increase the antenna SWR
- If obstruction = use reflection*

~~

T3A06 (B)

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

- A. Alternating transmissions during a net operation
- B. Rapid flutter on mobile signals due to multipath propagation
- C. A type of ground system used with vertical antennas
- D. Local vs long-distance communications

picket fencing = flutter

~~

T3A07 (C)

What weather condition might decrease range at microwave frequencies?

- A. High winds
- B. Low barometric pressure
- C. Precipitation
- D. Colder temperatures

Decrease range = precipitation (water drops) blocks signal

~~

T3A08 (D)

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

- A. Frequency shift due to Faraday rotation
- B. Interference from thunderstorms
- C. Intermodulation distortion
- D. Random combining of signals arriving via different paths

irregular = random

~~

T3A09 (B)

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

- A. Digital modes are unusable
- B. Either vertically or horizontally polarized antennas may be used for transmission or reception
- C. FM voice is unusable
- D. Both the transmitting and receiving antennas must be of the same polarization

Elliptical = vertical and horizontal

~~

T3A10 (D)

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

- A. Transmission rates must be increased by a factor equal to the number of separate paths observed
- B. Transmission rates must be decreased by a factor equal to the number of separate paths observed
- C. No significant changes will occur if the signals are transmitted using FM
- D. Error rates are likely to increase

Multiple paths = errors

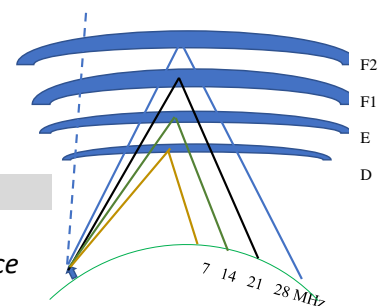
~~

T3A11 (C)

Which region of the atmosphere can refract or bend HF and VHF radio waves?

- A. The stratosphere
- B. The troposphere
- C. The ionosphere
- D. The mesosphere

Atmosphere that refract = ionosphere between the near earth and outer space



T3A12 (B)

What is the effect of fog and rain on signals in the 10 meter and 6 meter bands?

- A. Absorption
- B. There is little effect
- C. Deflection
- D. Range increase

Fog and rain on HF = little

~~

T3B - Electromagnetic wave properties:

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

T3B01 (D)

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

- A. They travel at different speeds
- B. They are in parallel
- C. They revolve in opposite directions
- D. They are at right angles

Electric + magnetic = right

~~

T3B02 (A)

What property of a radio wave defines its polarization?

- A. The orientation of the electric field
- B. The orientation of the magnetic field
- C. The ratio of the energy in the magnetic field to the energy in the electric field
- D. The ratio of the velocity to the wavelength

Polarization = electric field. What you see.

~~

T3B03 (C)

What are the two components of a radio wave?

- A. Impedance and reactance
- B. Voltage and current
- C. Electric and magnetic fields
- D. Ionizing and non-ionizing radiation

Radio = electric + magnetic

~~

T3B04 (A)

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

- A. Speed of light
- B. Speed of sound
- C. Speed inversely proportional to its wavelength
- D. Speed that increases as the frequency increases

Radio = light

~~

Frequency * wavelength = light speed (300,000,000 m/s)
MHz * wavelength = 300 m/s

T3B05 (B)

What is the relationship between wavelength and frequency?

- A. Wavelength gets longer as frequency increases
 - B. Wavelength gets shorter as frequency increases
 - C. Wavelength and frequency are unrelated
 - D. Wavelength and frequency increase as path length increases
- Frequency * wavelength = fixed. If one increases other decreases*

~~

T3B06 (D)

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

- A. Wavelength in meters equals frequency in hertz multiplied by 300
- B. Wavelength in meters equals frequency in hertz divided by 300
- C. Wavelength in meters equals frequency in megahertz divided by 300
- D. Wavelength in meters equals 300 divided by frequency in megahertz

$MHz * wavelength = 300 \text{ m/s}$

Wavelength = 300 / MHz

~~

T3B07 (A)

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

- A. The approximate wavelength in meters
- B. Traditional letter/number designators
- C. Channel numbers
- D. All these choices are correct

Bands = frequency and/or wavelength

~~

T3B08 (B)

What frequency range is referred to as VHF?

- A. 30 kHz to 300 kHz
- B. 30 MHz to 300 MHz
- C. 300 kHz to 3000 kHz
- D. 300 MHz to 3000 MHz

Very = 30

~~

UHF (ultra) = 300 – 3000 MHz
VHF (very) = 30 – 300 MHz
HF (high) = 3 – 30 MHz

T3B09 (D)

What frequency range is referred to as UHF?

- A. 30 to 300 kHz
- B. 30 to 300 MHz
- C. 300 to 3000 kHz
- D. 300 to 3000 MHz

Ultra = 300

~~

T3B10 (C)

What frequency range is referred to as HF?

- A. 300 to 3000 MHz
- B. 30 to 300 MHz
- C. 3 to 30 MHz
- D. 300 to 3000 kHz

High = 3

~~

T3B11 (B)

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

- A. 150,000 meters per second
- B. 300,000,000 meters per second
- C. 300,000,000 miles per hour
- D. 150,000 miles per hour

Radio velocity = always a 3 and metric

~~

T3C - Propagation modes:

sporadic E, meteor scatter, auroral propagation, tropospheric ducting; F region skip; Line of sight and radio horizon

T3C01 (C)

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

- A. They are too weak to go very far
- B. FCC regulations prohibit them from going more than 50 miles
- C. UHF signals are usually not propagated by the ionosphere
- D. UHF signals are absorbed by the ionospheric D region

Ultra High Frequency (UHF) = not ionosphere, but line-of-sight

~~

T3C02 (C)

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

- A. HF antennas are generally smaller
- B. HF accommodates wider bandwidth signals
- C. Long-distance ionospheric propagation is far more common on HF
- D. There is less atmospheric interference (static) on HF

High Frequency = ionosphere

~~

T3C03 (B)

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

- A. They are often received from 10,000 miles or more
- B. They are distorted and signal strength varies considerably
- C. They occur only during winter nighttime hours
- D. They are generally strongest when your antenna is aimed west

Aurora backscatter (reflection) = billowing fluctuations (varies)

~~

T3C04 (B)

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

- A. Backscatter
- B. Sporadic E
- C. D region absorption
- D. Gray-line propagation

Occasional strong = sporadic

~~

T3C05 (A)

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

- A. Knife-edge diffraction
- B. Faraday rotation
- C. Quantum tunneling
- D. Doppler shift

Despite obstruction = diffraction

~~

T3C06 (A)

What type of propagation is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis?

- A. Tropospheric ducting
- B. D region refraction
- C. F2 region refraction
- D. Faraday rotation

Regular path = duct

~~

T3C07 (B)

What band is best suited for communicating via meteor scatter?

- A. 33 centimeters
- B. 6 meters
- C. 2 meters
- D. 70 centimeters

Meteor = 6 meters, it is called the Magic Band, where Mother Nature pulls your chain

~~

T3C08 (D)

What causes tropospheric ducting?

- A. Discharges of lightning during electrical storms
- B. Sunspots and solar flares
- C. Updrafts from hurricanes and tornadoes
- D. Temperature inversions in the atmosphere

Ducting = tunnel caused by temperature layer

~~

T3C09 (A)

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

- A. From dawn to shortly after sunset during periods of high sunspot activity
- B. From shortly after sunset to dawn during periods of high sunspot activity
- C. From dawn to shortly after sunset during periods of low sunspot activity
- D. From shortly after sunset to dawn during periods of low sunspot activity

f-layer = fine during daylight during high sunspot

~~

T3C10 (A)

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

- A. 6 and 10 meters
- B. 23 centimeters
- C. 70 centimeters and 1.25 meters

Sunspot increasing now
Improving HF

D. All these choices are correct

Peak sunspot = edge of high frequency, 10 meters

~~

T3C11 (C)

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

A. Radio signals move somewhat faster than the speed of light

B. Radio waves are not blocked by dust particles

C. The atmosphere refracts radio waves slightly

D. Radio waves are blocked by dust particles

Radio further than line of sight = follows earth curvature

~~

SUBELEMENT T4 – AMATEUR RADIO PRACTICES

– [2 Exam Questions - 2 Groups]

T4A – Station setup:

connecting a microphone, a power source, a computer, digital equipment, an SWR meter; bonding; Mobile radio installation

T4A01 (D)

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

- A. 24.0 volts at 4 amperes
- B. 13.8 volts at 4 amperes
- C. 24.0 volts at 12 amperes
- D. 13.8 volts at 12 amperes

$$50 = 13.8 * \text{reserve of } 12$$

~~

$$S = V * I$$

Power = multiply

Normal battery = 13.8 V
Needs reserve (bigger)

T4A02 (A)

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

- A. The frequency and power level at which the measurements will be made
- B. The distance that the meter will be located from the antenna
- C. The types of modulation being used at the station
- D. All these choices are correct

$$SWR (\text{standing wave ratio}) = \text{Frequency}$$

~~

T4A03 (A)

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

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

$$\text{Short} = \text{minimize}$$

~~

T4A04 (B)

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

- A. To a computer running a terminal program and connected to a terminal node controller unit
- B. To the audio input and output of a computer running WSJT-X software
- C. To an FT8 conversion unit, a keyboard, and a computer monitor
- D. To a computer connected to the FT8converter.com website

$$FT8 (\text{digital, ie computer}) = \text{invented by Joe Taylor (wsJT)}$$

~~

T4A05 (A)

Where should an RF power meter be installed?

- A. In the feed line, between the transmitter and antenna
- B. At the power supply output
- C. In parallel with the push-to-talk line and the antenna
- D. In the power supply cable, as close as possible to the radio

$$RF \text{ power} = \text{transmitted}$$

~~

T4A06 (C)

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

- A. Receive and transmit mode, status, and location
- B. Antenna and RF power
- C. Receive audio, transmit audio, and transmitter keying
- D. NMEA GPS location and DC power

Computer to radio = audio & keying (Switching)

~~

T4A07 (C)

Which of the following connections is made between a computer and a transceiver to use computer software when operating digital modes?

- A. Computer "line out" to transceiver push-to-talk
- B. Computer "line in" to transceiver push-to-talk
- C. Computer "line in" to transceiver speaker connector
- D. Computer "line out" to transceiver speaker connector

Input to computer = output from radio (speaker)

~~

T4A08 (D)

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

Conductor = copper

- A. Copper braid removed from coaxial cable
- B. Steel wire
- C. Twisted-pair cable
- D. Flat copper strap

RF bond = flat copper

~~

T4A09 (B)

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

- A. Divide the watt-hour rating of the battery by the peak power consumption of the equipment
- B. Divide the battery ampere-hour rating by the average current draw of the equipment
- C. Multiply the watts per hour consumed by the equipment by the battery power rating
- D. Multiply the square of the current rating of the battery by the input resistance of the equipment

Time = Ampere-hour / Ampere

~~

T4A10 (A)

What function is performed with a transceiver and a digital mode hot spot?

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

Radio + hot-spot = communication + internet

~~

T4A11 (A)

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

- A. At the 12 volt battery chassis ground
- B. At the antenna mount
- C. To any metal part of the vehicle
- D. Through the transceiver's mounting bracket

Negative return = battery ground

~~

T4A12 (C)

What is an electronic keyer?

- A. A device for switching antennas from transmit to receive
- B. A device for voice activated switching from receive to transmit
- C. A device that assists in manual sending of Morse code
- D. An interlock to prevent unauthorized use of a radio

Keyer = manual Morse Code

~~

T4B - Operating controls:

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

T4B01 (B)

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

- A. Frequency instability
- B. Distorted transmitted audio
- C. Increased SWR
- D. All these choices are correct

Too high gain = distort normal sound, like yelling

~~

T4B02 (A)

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

- A. The keypad or VFO knob
- B. The CTCSS or DTMF encoder
- C. The Automatic Frequency Control
- D. All these choices are correct

Enter frequency numbers = keypad or (Variable Frequency Oscillator) knob

~~

T4B03 (A)

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

- A. Set the squelch threshold so that receiver output audio is on all the time
- B. Turn up the audio level until it overcomes the squelch threshold
- C. Turn on the anti-squelch function
- D. Enable squelch enhancement

Weak = set squelch for noise all the time.

~~

T4B04 (B)

What is a way to enable quick access to a favorite frequency or channel on your transceiver?

- A. Enable the frequency offset
- B. Store it in a memory channel
- C. Enable the VOX
- D. Use the scan mode to select the desired frequency

Quick access to favorite = memory

~~

T4B05 (C)

What does the scanning function of an FM transceiver do?

- A. Checks incoming signal deviation
- B. Prevents interference to nearby repeaters
- C. Tunes through a range of frequencies to check for activity
- D. Checks for messages left on a digital bulletin board

Scan function = scan frequencies

~~

T4B06 (D)

Which of the following controls could be used if the voice pitch of a single-sideband signal returning to your CQ call seems too high or low?

- A. The AGC or limiter
- B. The bandwidth selection
- C. The tone squelch
- D. The RIT or Clarifier

Voice pitch is a little off = Receiver Incremental Tuning (tweaking)

~~

T4B07 (B)

What does a DMR “code plug” contain?

- A. Your call sign in CW for automatic identification
- B. Access information for repeaters and talkgroups
- C. The codec for digitizing audio
- D. The DMR software version

DMR (Digital Mobile Radio) code plug = info for repeaters

~~

T4B08 (B)

What is the advantage of having multiple receive bandwidth choices on a multimode transceiver?

- A. Permits monitoring several modes at once by selecting a separate filter for each mode
- B. Permits noise or interference reduction by selecting a bandwidth matching the mode
- C. Increases the number of frequencies that can be stored in memory
- D. Increases the amount of offset between receive and transmit frequencies

Multiple bandwidth = permit selecting bandwidth

~~

T4B09 (C)

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

- A. By retrieving the frequencies from transceiver memory
- B. By enabling the group’s CTCSS tone
- C. By entering the group’s identification code
- D. By activating automatic identification

Select specific group = enter group code

~~

T4B10 (C)

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

- A. 500 Hz
- B. 1000 Hz
- C. 2400 Hz

D. 5000 Hz

Single side band (SSB) = uses medium bandwidth, 2400 Hz. (SSB sounds like Donald Duck since not both sides.)

~~

T4B11 (A)

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

A. Your call sign

B. Your output power

C. The codec type being used

D. All these choices are correct

D-Star (Icom) digital = call sign

~~

T4B12 (D)

What is the result of tuning an FM receiver above or below a signal's frequency?

A. Change in audio pitch

B. Sideband inversion

C. Generation of a heterodyne tone

D. Distortion of the signal's audio

Above or below = distortion

~~

SUBELEMENT T5 – ELECTRICAL PRINCIPLES

– [4 Exam Questions - 4 Groups]

T5A – Current and voltage:

terminology and units, conductors and insulators, alternating and direct current

T5A01 (D)

Electrical current is measured in which of the following units?

- A. Volts
- B. Watts
- C. Ohms
- D. Amperes

Current flow = Ampere; named for French dude whose name is on Eiffel Tower

~~

3 Fundamental
Voltage (V) = Volts
Current (I) = Amps
Time (t) = seconds

T5A02 (B)

Electrical power is measured in which of the following units?

- A. Volts
- B. Watts
- C. Watt-hours
- D. Amperes

Power = Watts; named for steam engine dude

~~

3 Calculated
Power (S or P) = multiply = $V * I$ = Watts
Impedance (Z or R) = divide = V / I = Ohms
Time shift = difference = SWR or phase

T5A03 (D)

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

- A. Voltage
- B. Resistance
- C. Capacitance
- D. Current

Flow of electrons per second = current

~~

T5A04 (C)

What are the units of electrical resistance?

- A. Siemens
- B. Mhos
- C. Ohms
- D. Coulombs

Resistance = Ohms; named for German dude, Georg Ohm, who was high school teacher

~~

T5A05 (A)

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

- A. Voltage
- B. Ampere-hours
- C. Capacitance
- D. Inductance

Electrical motive force (emf) = Voltage; named for Italian dude, a cleric-scientist, inventor of the pile

~~

T5A06 (A)

What is the unit of frequency?

- A. Hertz
- B. Henry
- C. Farad
- D. Tesla

Frequency (cycles per second) = Hertz, named for German physics, not the frequent renter car company

~~

T5A07 (B)

Why are metals generally good conductors of electricity?

- A. They have relatively high density
- B. They have many free electrons
- C. They have many free protons
- D. All these choices are correct

Metal conductor = free electrons. You do not have to buy them.

~~

T5A08 (B)

Which of the following is a good electrical insulator?

- A. Copper
- B. Glass
- C. Aluminum
- D. Mercury

Insulator = glass

~~

T5A09 (C)

Which of the following describes alternating current?

- A. Current that alternates between a positive direction and zero
- B. Current that alternates between a negative direction and zero
- C. Current that alternates between positive and negative directions
- D. All these answers are correct

Alternating = reverse direction between positive and negative

~~

T5A10 (C)

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

- A. Resistance
- B. Current
- C. Power
- D. Voltage

Rate of energy = power, named for steam dude

~~

$$S = V * I$$

$$Z = V / I$$

T5A11 (D)

What type of current flow is opposed by resistance?

- A. Direct current
- B. Alternating current
- C. RF current
- D. All these choices are correct

Resistance = opposition to all current

~~

T5A12 (D)

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

- A. Pulse rate
- B. Speed
- C. Wavelength
- D. Frequency

Times per second = frequency or how often

~~

T5B - Math for electronics:

conversion of electrical units, decibels

T5B01 (C)

How many milliamperes is 1.5 amperes?

- A. 15 milliamperes
- B. 150 milliamperes
- C. 1500 milliamperes
- D. 15,000 milliamperes

*1.5 Amps * 1000 milliamps per amp = 1500 milliamps*

~~

Little
milli = 1 thousandth
micro = 1 millionth
pico = 1 thousand millionth

T5B02 (A)

Which is equal to 1,500,000 hertz?

- A. 1500 kHz
- B. 1500 MHz
- C. 15 GHz
- D. 150 kHz

1,500,000 / 1000 Hz per kHz = 1500 kHz

~~

Big
kilo = 1000
mega = million
giga = thousand million

T5B03 (C)

Which is equal to one kilovolt?

- A. One one-thousandth of a volt
- B. One hundred volts
- C. One thousand volts
- D. One million volts

*1 kV * 1000 volts / kilovolt = 1000*

~~

T5B04 (A)

Which is equal to one microvolt?

- A. One one-millionth of a volt
- B. One million volts
- C. One thousand kilovolts
- D. One one-thousandth of a volt

1 microvolt / 1,000,000 microvolts per volt = 1 millionth

~~

T5B05 (B)

Which is equal to 500 milliwatts?

- A. 0.02 watts

- B. 0.5 watts
- C. 5 watts
- D. 50 watts

$500 \text{ milliwatts} / 1000 \text{ milliwatts per watt} = 500/1000 = 0.5$

~~

T5B06 (D)

Which is equal to 3000 milliamperes?

- A. 0.003 amperes
- B. 0.3 amperes
- C. 3,000,000 amperes
- D. 3 amperes

$3000 \text{ milliamperes} / 1000 \text{ milliamperes per amp} = 3 \text{ amps}$

~~

T5B07 (C)

Which is equal to 3.525 MHz?

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

$3.525 \text{ Mhz} * 1000 \text{ kilohertz per Megahertz} = 3525 \text{ kHz}$

~~

T5B08 (B)

Which is equal to 1,000,000 picofarads?

- A. 0.001 microfarads
- B. 1 microfarad
- C. 1000 microfarads
- D. 1,000,000,000 microfarads

$1,000,000 \text{ picofarads} / 1,000,000 \text{ picofarads per microfarad} = 1 \text{ microfarad}$

~~

T5B09 (B)

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

- A. 2 dB
- B. 3 dB
- C. 5 dB
- D. 10 dB

Power times	dB
2	3
10	10

$10 / 5 = 2 \text{ times power} = 3 \text{ db, increase is positive}$

~~

T5B10 (C)

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

- A. -1 dB
- B. -3 dB
- C. -6 dB
- D. -9 dB

$12 / 3 = 4 \text{ times power} = [2] * 2 \text{ times} = [2] * 3\text{db} = 6 \text{ dB, decrease is negative}$

~~

Memorize those two
Anything else =
multiply by one of these

T5B11 (A)

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

- A. 10 dB
- B. 12 dB
- C. 18 dB
- D. 28 dB

$200 / 20 = 10$ times power = 10 dB; that is how deciBel is defined.

~~

T5B12 (D)

Which is equal to 28400 kHz?

- A. 28.400 kHz
- B. 2.800 MHz
- C. 284.00 MHz
- D. 28.400 MHz

$28,400 \text{ kHz} / 1000 \text{ kHz per MHz} = 28.4 \text{ MHz}$

~~

T5B13 (C)

Which is equal to 2425 MHz?

- A. 0.002425 GHz
- B. 24.25 GHz
- C. 2.425 GHz
- D. 2425 GHz

$2425 \text{ MHz} / 1000 \text{ MHz per GHz} = 2.425 \text{ GHz}$

That is all. Not too bad. You can do those.

T5C – Electronic principles, definition and units:

Capacitance and inductance; Radio frequency; Impedance; Calculating power

T5C01 (D)

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

- A. Inductance
- B. Resistance
- C. Tolerance
- D. Capacitance

Store ELECTRIC energy = capacitance or capacity

~~

T5C02 (A)

What is the unit of capacitance?

- A. The farad
- B. The ohm
- C. The volt
- D. The henry

Capacitance = Farad, named for dude from London with little education, but smart

~~

T5C03 (D)

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

- A. Admittance
- B. Capacitance
- C. Resistance

D. Inductance

Store MAGNETIC energy = Inductance or induced from magnet

~~

T5C04 (C)

What is the unit of inductance?

- A. The coulomb
- B. The farad
- C. The henry
- D. The ohm

Inductance = Henry, named for 1800 American dude that played with magnets

~~

T5C05 (D)

What is the unit of impedance?

- A. The volt
- B. The ampere
- C. The coulomb
- D. The ohm

Impedance or resistance = Ohm, named for the German high school teacher dude

~~

T5C06 (A)

What does the abbreviation "RF" mean?

- A. Radio frequency signals of all types
- B. The resonant frequency of a tuned circuit
- C. The real frequency transmitted as opposed to the apparent frequency
- D. Reflective force in antenna transmission lines

RF = radio frequency. That is a free question

~~

T5C07 (D)

What is the abbreviation for megahertz?

- A. MH
- B. mh
- C. Mhz
- D. MHz

Abbreviation = MHz, capital M for Mega to separate from milli, capital H for dudes name.

~~

T5C08 (A)

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

- A. $P = I \times E$
- B. $P = E / I$
- C. $P = E - I$
- D. $P = I + E$

More power = multiply

~~

$$S = V * I$$

$$Z = V / I$$

T5C09 (A)

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

- A. 138 watts

- B. 0.7 watts
- C. 23.8 watts
- D. 3.8 watts

*Power = multiply; 13.8 * 10 = 138*

~~

T5C10 (B)

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

- A. 4.8 watts
- B. 30 watts
- C. 14.5 watts
- D. 0.208 watts

*Power = multiply; 12 * 2.5 = 30*

~~

T5C11 (B)

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

- A. 0.1 amperes
- B. 10 amperes
- C. 12 amperes
- D. 132 amperes

Power = multiply. So, if start with power then divide; 120 / 12 = 10

~~

T5C12 (A)

What is impedance?

- A. The opposition to AC current flow
- B. The inverse of resistance
- C. The Q or Quality Factor of a component
- D. The power handling capability of a component

Impedance = impede or opposition. Resistance is one kind

~~

T5C13 (D)

What is the abbreviation for kilohertz?

- A. KHZ
- B. khz
- C. khZ
- D. kHz

Frequency = kHz, capitized for dudes name

~~

<p>Symbols</p> <p>Different based on alternating or DC</p> <p>Volt = V or E</p> <p>Impedance (resistance) = Z or R</p> <p>Power = S or P</p>

T5D – Ohm’s Law;
Series and parallel circuits

T5D01 (B)

What formula is used to calculate current in a circuit?

- A. $I = E \times R$
- B. $I = E / R$
- C. $I = E + R$

<p>$Z = V / I$</p> <p>so</p> <p>$I = V / Z$</p> <p>or</p> <p>$V = I * Z$</p>

D. $I = E - R$

Current = divide by resistance

~~

T5D02 (A)

What formula is used to calculate voltage in a circuit?

A. $E = I \times R$

B. $E = I / R$

C. $E = I + R$

D. $E = I - R$

Voltage = multiply by resistance

~~

T5D03 (B)

What formula is used to calculate resistance in a circuit?

A. $R = E \times I$

B. $R = E / I$

C. $R = E + I$

D. $R = E - I$

Resistance (opposition) = divide by current

~~

T5D04 (B)

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

A. 3 ohms

B. 30 ohms

C. 93 ohms

D. 270 ohms

Resistance = divide by current; $90 / 3 = 30$

~~

T5D05 (C)

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

A. 18 ohms

B. 0.125 ohms

C. 8 ohms

D. 13.5 ohms

Resistance = divide by current; $12 / 1.5 = 8$

~~

T5D06 (A)

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

A. 3 ohms

B. 16 ohms

C. 48 ohms

D. 8 ohms

Resistance = divide by current; $12 / 4 = 3$

~~

T5D07 (D)

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

A. 9600 amperes

- B. 200 amperes
- C. 0.667 amperes
- D. 1.5 amperes

Current = divide by resistance; $120 / 80 = 1.5$

~~

T5D08 (C)

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

- A. 20,000 amperes
- B. 0.5 amperes
- C. 2 amperes
- D. 100 amperes

Current = divide by resistance; $200 / 100 = 2$

~~

T5D09 (C)

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

- A. 24,000 amperes
- B. 0.1 amperes
- C. 10 amperes
- D. 216 amperes

Current = divide by resistance; $240 / 24 = 10$

~~

T5D10 (A)

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

- A. 1 volt
- B. 0.25 volts
- C. 2.5 volts
- D. 1.5 volts

*Voltage = multiply; $.5 * 2 = 1$*

~~

T5D11 (B)

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

- A. 1 volt
- B. 10 volts
- C. 11 volts
- D. 9 volts

*Voltage = multiply; $1 * 10 = 10$*

~~

T5D12 (D)

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

- A. 8 volts
- B. 0.2 volts
- C. 12 volts
- D. 20 volts

*Voltage = multiply; $2 * 10 = 20$*

~~

T5D13 (A)

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



- A. Series
- B. Parallel
- C. Resonant
- D. Branch

Current = through, series

~~

T5D14 (B)

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

- A. Series
- B. Parallel
- C. Resonant
- D. Branch

Voltage = across, parallel

~~



SUBELEMENT T6 – ELECTRONIC COMPONENTS

AND ELECTRICAL – [4 Exam Questions - 4 Groups]

T6A - Fixed and variable resistors

; Capacitors; Inductors; Fuses; Switches; Batteries

T6A01 (B)

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

- A. Inductor
- B. Resistor
- C. Inverter
- D. Transformer

Oppose = resist

~~

T6A02 (C)

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

- A. Fixed resistor
- B. Power resistor
- C. Potentiometer
- D. Transformer

Volume control = pot, a variable resistor

~~

T6A03 (B)

What electrical parameter is controlled by a potentiometer?

- A. Inductance
- B. Resistance
- C. Capacitance
- D. Field strength

Potentiometer = variable resistor

~~

T6A04 (B)

What electrical component stores energy in an electric field?

- A. Varistor
- B. Capacitor
- C. Inductor
- D. Diode

store in electric field = capacity (capacitor)

~~

T6A05 (D)

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

- A. Resistor
- B. Potentiometer
- C. Oscillator
- D. Capacitor

metal + insulator + metal = capacitor

~~

T6A06 (C)

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

- A. Varistor
- B. Capacitor
- C. Inductor
- D. Diode

Store in magnetic field = induce (inductor)

T6A07 (D)

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

- A. Switch
- B. Capacitor
- C. Diode
- D. Inductor

wire coil = inductor, also called electro-magnet

~~

T6A08 (C)

What is the function of an SPDT switch?

- A. A single circuit is opened or closed
- B. Two circuits are opened or closed
- C. A single circuit is switched between one of two other circuits
- D. Two circuits are each switched between one of two other circuits

SPDT = single pole (circuit connection) double throw (2 positions)

~~

T6A09 (A)

What electrical component is used to protect other circuit components from current overloads?

- A. Fuse
- B. Thyatron
- C. Varactor
- D. All these choices are correct

Overload = blow a fuse

~~

T6A10 (D)

Which of the following battery chemistries is rechargeable?

- A. Nickel-metal hydride
- B. Lithium-ion
- C. Lead-acid
- D. All these choices are correct

Rechargeable battery = all these

~~

T6A11 (B)

Which of the following battery chemistries is not rechargeable?

- A. Nickel-cadmium
- B. Carbon-zinc
- C. Lead-acid
- D. Lithium-ion

Not rechargeable = carbon- zinc, like flashlight

~~

T6A12(A)

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

- A. Single-pole single-throw
- B. Single-pole double-throw
- C. Double-pole single-throw
- D. Double-pole double-throw

One position switch = single pole (circuit) single throw (one or off)

~~

T6B – Semiconductors:

basic principles and applications of solid state devices, diodes and transistors

T6B01 (A)

Which is true about forward voltage drop in a diode?

- A. It is lower in some diode types than in others
- B. It is proportional to peak inverse voltage
- C. It indicates that the diode is defective
- D. It has no impact on the voltage delivered to the load

Forward voltage drop = all diodes have, but some are lower

~~

T6B02 (C)

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

- A. Resistor
- B. Fuse
- C. Diode
- D. Driven element

one-way = diode

~~

T6B03 (C)

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

- A. Varistor
- B. Potentiometer
- C. Transistor
- D. Thermistor

Switch = transistor, it can conduct or be switched off

~~

T6B04 (B)

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

- A. Alternator
- B. Transistor
- C. Triode
- D. Pentagrid converter

3-layers semiconductor = transistor

~~

T6B05 (B)

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

- A. Varistor
- B. Field-effect

- C. Tesla-effect
- D. Bipolar junction

Transistor has 3 terminals. Called gate, drain, source = FET (field effect transistor)

~~

T6B06 (B)

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

- A. With the word "cathode"
- B. With a stripe
- C. With the letter C
- D. With the letter K

Cathode = stripe, negative, minus

~~

T6B07 (A)

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

- A. Forward current
- B. Reverse current
- C. Capacitively-coupled RF signal
- D. Inductively-coupled RF signal

LED = forward current, means it is on

~~

T6B08 (D)

What does the abbreviation FET stand for?

- A. Frequency Emission Transmitter
- B. Fast Electron Transistor
- C. Free Electron Transmitter
- D. Field Effect Transistor

FET = Field Effect Transistor (for signal control)

~~

T6B09 (C)

What are the names for the electrodes of a diode?

- A. Plus and minus
- B. Source and drain
- C. Anode and cathode
- D. Gate and base

Two electrodes = anode & cathode, sounds more technical than plus (+) & minus (-)

~~

T6B10 (B)

Which of the following can provide power gain?

- A. Transformer
- B. Transistor
- C. Reactor
- D. Resistor

Gain (amplification or control) = transistor

~~

T6B11 (A)

What is the term that describes a device's ability to amplify a signal?

- A. Gain
- B. Forward resistance
- C. Forward voltage drop
- D. On resistance

Amplify = gain

~~

T6B12 (B)

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

- A. Signal, bias, power
- B. Emitter, base, collector
- C. Input, output, supply
- D. Pole one, pole two, output

Transistor has 3 terminals. BJT = emitter, base collector

~~

T6C - Circuit diagrams:

use of schematics, basic structure; Schematic symbols of basic components

T6C01 (C)

What is the name of an electrical wiring diagram that uses standard component symbols?

- A. Bill of materials
- B. Connector pinout
- C. Schematic
- D. Flow chart

Diagram = schematic (a scheme)

~~

T6C02 (A)

What is component 1 in figure T-1?

- A. Resistor
- B. Transistor
- C. Battery
- D. Connector

Jiggle lines = more resistor

~~

T6C03 (B)

What is component 2 in figure T-1?

- A. Resistor
- B. Transistor
- C. Indicator lamp
- D. Connector

Three layers (lines) = transistor

~~

T6C04 (C)

What is component 3 in figure T-1?

- A. Resistor
- B. Transistor

C. Lamp

D. Ground symbol

Loop = lamp = light

~~

T6C05 (D)

What is component 4 in figure T-1?

A. Resistor

B. Transistor

C. Ground symbol

D. Battery

Long & short = battery

~~

T6C06 (B)

What is component 6 in figure T-2?

A. Resistor

B. Capacitor

C. Regulator IC

D. Transistor

Metal + insulator space + bent metal = capacitor

~~

T6C07 (D)

What is component 8 in figure T-2?

A. Resistor

B. Inductor

C. Regulator IC

D. Light emitting diode

Lightning bolt = Light emitting diode (LED)

~~

T6C08 (C)

What is component 9 in figure T-2?

A. Variable capacitor

B. Variable inductor

C. Variable resistor

D. Variable transformer

Jiggle lines with arrow to it = resistor variable

~~

T6C09 (D)

What is component 4 in figure T-2?

A. Variable inductor

B. Double-pole switch

C. Potentiometer

D. Transformer

Two coils on metal bars = transformer

~~

T6C10 (D)

What is component 3 in figure T-3?

- A. Connector
- B. Meter
- C. Variable capacitor
- D. Variable inductor

a coil with arrow to it = inductor variable

~~

T6C11 (A)

What is component 4 in figure T-3?

- A. Antenna
- B. Transmitter
- C. Dummy load
- D. Ground

Triangle up in air = antenna

~~

T6C12 (C)

Which of the following is accurately represented in electrical schematics?

- A. Wire lengths
- B. Physical appearance of components
- C. Component connections
- D. All these choices are correct

Schematics accurately represent = component connections

~~

T6D - Component functions:

rectifiers, relays, voltage regulators, meters, indicators, integrated circuits, transformers; Resonant circuit; Shielding

T6D01 (B)

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

- A. Transformer
- B. Rectifier
- C. Amplifier
- D. Reflector

Changes AC to DC = rectifier

~~

T6D02 (A)

What is a relay?

- A. An electrically-controlled switch
- B. A current controlled amplifier
- C. An inverting amplifier
- D. A pass transistor

Relay = controlled switch

~~

T6D03 (C)

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

- A. To decrease the resistance of DC power connections
- B. To increase the current carrying capability of the wire

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

D. To couple the wire to other signals

Shield = prevent unwanted

~~

T6D04 (C)

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

A. Potentiometer

B. Transistor

C. Meter

D. Relay

Display numeric = meter

~~

T6D05 (A)

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

A. Regulator

B. Oscillator

C. Filter

D. Phase inverter

Controls from power supply = regulator

~~

T6D06 (B)

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

A. Variable capacitor

B. Transformer

C. Transistor

D. Diode

Change AC high to low = transform

~~

T6D07 (A)

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

A. LED

B. FET

C. Zener diode

D. Bipolar transistor

Visual indicator = LED (Light Emitting Diode)

~~

T6D08 (D)

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

A. Resistor

B. Zener diode

C. Potentiometer

D. Capacitor

Tuned = inductor + capacitor (a tuner adjusts one of them, filters out unwanted)

~~

T6D09 (C)

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

- A. Transducer
- B. Multi-pole relay
- C. Integrated circuit
- D. Transformer

Combine several into one = integrate

~~

T6D10 (C)

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

- A. Give off light when current flows through it
- B. Supply electrical energy
- C. Control the flow of current
- D. Convert electrical energy into radio waves

Transistor = control signal

~~

T6D11 (A)

Which of the following is a resonant or tuned circuit?

- A. An inductor and a capacitor in series or parallel
- B. A linear voltage regulator
- C. A resistor circuit used for reducing standing wave ratio
- D. A circuit designed to provide high-fidelity audio

Tuned = inductor + capacitor

~~

SUBELEMENT T7 – PRACTICAL CIRCUITS

– [4 Exam Questions - 4 Groups]

T7A – Station equipment:

receivers, transceivers, transmitter amplifiers, receive amplifiers, transverters; Basic radio circuit concepts and terminology: sensitivity, selectivity, mixers, oscillators, PTT, modulation

T7A01 (B)

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

- A. Linearity
- B. Sensitivity
- C. Selectivity
- D. Total Harmonic Distortion

Ability to detect = sensitivity (how sensitive are you?)

~~

T7A02 (A)

What is a transceiver?

- A. A device that combines a receiver and transmitter
- B. A device for matching feed line impedance to 50 ohms
- C. A device for automatically sending and decoding Morse code
- D. A device for converting receiver and transmitter frequencies to another band

Transceiver = transmitter + receiver

~~

T7A03 (B)

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

- A. Phase splitter
- B. Mixer
- C. Inverter
- D. Amplifier

Convert one frequency to another = mix

~~

T7A04 (C)

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

- A. Discrimination ratio
- B. Sensitivity
- C. Selectivity
- D. Harmonic distortion

Ability to discriminate = select

~~

T7A05 (D)

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

- A. Reactance modulator
- B. Phase modulator
- C. Low-pass filter
- D. Oscillator

A specific frequency = oscillates

~~

T7A06 (C)

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

- A. High-pass filter
- B. Low-pass filter
- C. Transverter
- D. Phase converter

Converts transceiver band = transverter

~~

T7A07 (B)

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

- A. Input for a key used to send CW
- B. Switches transceiver from receive to transmit when grounded
- C. Provides a transmit tuning tone when grounded
- D. Input for a preamplifier tuning tone

PTT = Push To Talk (microphone switch) makes grounded

~~

T7A08 (C)

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

- A. Impedance matching
- B. Oscillation
- C. Modulation
- D. Low-pass filtering

Combining audio speech with radio signal = modulation

~~

T7A09 (B)

What is the function of the SSB/CW-FM switch on a VHF power amplifier?

- A. Change the mode of the transmitted signal
- B. Set the amplifier for proper operation in the selected mode
- C. Change the frequency range of the amplifier to operate in the proper segment of the band
- D. Reduce the received signal noise

SSB/CW-FM switch = set up in selected mode

~~

T7A10 (B)

What device increases the transmitted output power from a transceiver?

- A. A voltage divider
- B. An RF power amplifier
- C. An impedance network
- D. All these choices are correct

Increase power = amplifier

~~

T7A11 (A)

Where is an RF preamplifier installed?

- A. Between the antenna and receiver
- B. At the output of the transmitter power amplifier
- C. Between the transmitter and the antenna tuner
- D. At the output of the receiver audio amplifier

Preamplifier = between antenna before (pre) RECEIVER

~~

T7B – Symptoms, causes, and cures

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

T7B01 (D)

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

- A. Talk louder into the microphone
- B. Let the transceiver cool off
- C. Change to a higher power level
- D. Talk farther away from the microphone

Over-deviating = yelling, talk farther from mike

~~

T7B02 (A)

What would cause a broadcast AM or FM radio to receive an amateur radio transmission unintentionally?

- A. The receiver is unable to reject strong signals outside the AM or FM band
- B. The microphone gain of the transmitter is turned up too high
- C. The audio amplifier of the transmitter is overloaded
- D. The deviation of an FM transmitter is set too low

Broadcast radio receives ham = receiver unable to reject strong (cheap AM radio)

~~

T7B03 (D)

Which of the following can cause radio frequency interference?

- A. Fundamental overload
- B. Harmonics
- C. Spurious emissions
- D. All these choices are correct

Interference = all, everything

~~

T7B04 (D)

Which of the following could you use to cure distorted audio caused by RF current on the shield of a microphone cable?

- A. Band-pass filter
- B. Low-pass filter
- C. Preamplifier
- D. Ferrite choke

Cure stray RF = ferrite (iron) chokes or blocks

~~

T7B05 (A)

How can fundamental overload of a non-amateur radio or TV receiver by an amateur signal be reduced or eliminated?

- A. Block the amateur signal with a filter at the antenna input of the affected receiver
- B. Block the interfering signal with a filter on the amateur transmitter
- C. Switch the transmitter from FM to SSB
- D. Switch the transmitter to a narrow-band mode

Overload of non-ham by ham = block with filter on NON-HAM

~~

T7B06 (A)

Which of the following actions should you take if a neighbor tells you that your station's transmissions are interfering with their radio or TV reception?

- A. Make sure that your station is functioning properly and that it does not cause interference to your own radio or television when it is tuned to the same channel
- B. Immediately turn off your transmitter and contact the nearest FCC office for assistance
- C. Install a harmonic doubler on the output of your transmitter and tune it until the interference is eliminated
- D. All these choices are correct

Neighbor complains ham interference = make sure not to your own radio / TV

~~

T7B07 (D)

Which of the following can reduce overload of a VHF transceiver by a nearby commercial FM station?

- A. Installing an RF preamplifier
- B. Using double-shielded coaxial cable
- C. Installing bypass capacitors on the microphone cable
- D. Installing a band-reject filter

Overload from FM broadcast = Band- Reject filter

~~

T7B08 (D)

What should you do if something in a neighbor's home is causing harmful interference to your amateur station?

- A. Work with your neighbor to identify the offending device
- B. Politely inform your neighbor that FCC rules prohibit the use of devices that cause interference
- C. Make sure your station meets the standards of good amateur practice
- D. All these choices are correct

Neighbor causing interference = all, everything

~~

T7B09 (D)

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

- A. Add a low-pass filter to the TV antenna input
- B. Add a high-pass filter to the TV antenna input
- C. Add a preamplifier to the TV antenna input
- D. Be sure all TV feed line coaxial connectors are installed properly

Non-fiber is coax = connectors installed properly

~~

T7B10 (D)

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. Your batteries are running low
- C. You are in a bad location
- D. All these choices are correct

Distorted = all, lot of causes

~~

T7B11 (C)

What is a symptom of RF feedback in a transmitter or transceiver?

- A. Excessive SWR at the antenna connection
- B. The transmitter will not stay on the desired frequency
- C. Reports of garbled, distorted, or unintelligible voice transmissions
- D. Frequent blowing of power supply fuses

Symptom of feedback = reports of garble

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 (A)

What is the primary purpose of a dummy load?

- A. To prevent transmitting signals over the air when making tests
- B. To prevent over-modulation of a transmitter
- C. To improve the efficiency of an antenna
- D. To improve the signal-to-noise ratio of a receiver

Dummy load = alternate antenna to prevent transmitting

~~

T7C02 (B)

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

- A. A VTVM
- B. An antenna analyzer
- C. A Q meter
- D. A frequency counter

If antenna resonant = antenna analyzer

~~

T7C03 (B)

What does a dummy load consist of?

- A. A high-gain amplifier and a TR switch
- B. A non-inductive resistor mounted on a heat sink
- C. A low-voltage power supply and a DC relay
- D. A 50-ohm reactance used to terminate a transmission line

Dummy load = non-inductive resistor, No I did not say it

~~

T7C04 (C)

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

- A. 50:50
- B. Zero
- C. 1:1
- D. Full Scale

SWR perfect = 1 to 1 (1:1)

~~

T7C05 (A)

Why do most solid-state transmitters reduce output power as SWR increases beyond a certain level?

- A. To protect the output amplifier transistors
- B. To comply with FCC rules on spectral purity
- C. Because power supplies cannot supply enough current at high SWR
- D. To lower the SWR on the transmission line

Reduce power = to protect

~~

T7C06 (D)

What does an SWR reading of 4:1 indicate?

- A. Loss of -4 dB

- B. Good impedance match
- C. Gain of +4 dB
- D. Impedance mismatch

SWR not 1:1 = mismatch

~~

T7C07 (C)

What happens to power lost in a feed line?

- A. It increases the SWR
- B. It is radiated as harmonics
- C. It is converted into heat
- D. It distorts the signal

Power loss = heat

~~

T7C08 (D)

Which instrument can be used to determine SWR?

- A. Voltmeter
- B. Ohmmeter
- C. Iambic pentameter
- D. Directional wattmeter

Proper match = directional wattmeter (how much power in which direction)

~~

T7C09 (A)

Which of the following causes failure of coaxial cables?

- A. Moisture contamination
- B. Solder flux contamination
- C. Rapid fluctuation in transmitter output power
- D. Operation at 100% duty cycle for an extended period

COMMON coax failure = moisture (wet)

~~

T7C10 (D)

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

- A. Ultraviolet resistant jackets prevent harmonic radiation
- B. Ultraviolet light can increase losses in the cable's jacket
- C. Ultraviolet and RF signals can mix, causing interference
- D. Ultraviolet light can damage the jacket and allow water to enter the cable

Resistant to UV = UV damages jacket, just like skin

~~

T7C11 (C)

What is a disadvantage of air core coaxial cable when compared to foam or solid dielectric types?

- A. It has more loss per foot
- B. It cannot be used for VHF or UHF antennas
- C. It requires special techniques to prevent moisture in the cable
- D. It cannot be used at below freezing temperatures

Disadvantage of air verses solid core = requires special handling

~~

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

T7D01 (B)

Which instrument would you use to measure electric potential?

- A. An ammeter
- B. A voltmeter
- C. A wavemeter
- D. An ohmmeter

Potential (voltage, electromotive force) = Volt measure

~~

T7D02 (B)

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

- A. In series
- B. In parallel
- C. In quadrature
- D. In phase

Connect voltmeter = parallel (across), like a household receptacle

~~



T7D03 (A)

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

- A. In series
- B. In parallel
- C. In quadrature
- D. In phase

Connect ammeter = series (in-line, through)

~~



T7D04 (D)

Which instrument is used to measure electric current?

- A. An ohmmeter
- B. An electrometer
- C. A voltmeter
- D. An ammeter

current measure = amp measure

~~

T7D05 Question Removed (section not renumbered)

T7D06 (C)

Which of the following can damage a multimeter?

- A. Attempting to measure resistance using the voltage setting
- B. Failing to connect one of the probes to ground
- C. Attempting to measure voltage when using the resistance setting
- D. Not allowing it to warm up properly

Damage MULTI-meter = attempting voltage on resistance setting

~~

T7D07 (C)

Which of the following measurements are made using a multimeter?

- A. Signal strength and noise
- B. Impedance and reactance
- C. Voltage and resistance
- D. All these choices are correct

COMMON with MULTI meter = voltage and resistance

~~

T7D08 (A)

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

- A. Acid-core solder
- B. Lead-tin solder
- C. Rosin-core solder
- D. Tin-copper solder

Not use = acid, it erodes

~~

T7D09 (C)

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

- A. Dark black spots
- B. A bright or shiny surface
- C. A rough or lumpy surface
- D. Excessive solder

Cold solder = rough, dull, just plain bad

~~

T7D10 (A)

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

- A. Increasing resistance with time
- B. Decreasing resistance with time
- C. Steady full-scale reading
- D. Alternating between open and short circuit

Ohmmeter across large, undischarged capacitor = resistance reading increasing from capacitor charge

~~

T7D11 (B)

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

- A. Ensure that the applied voltages are correct
- B. Ensure that the circuit is not powered
- C. Ensure that the circuit is grounded
- D. Ensure that the circuit is operating at the correct frequency

Precautions for measure Resistance = unpowered

~~

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

T8A01 (C)

Which of the following is a form of amplitude modulation?

- A. Spread spectrum
- B. Packet radio
- C. Single sideband
- D. Phase shift keying (PSK)

Amplitude modulation (voice add to RF) = Single Side Band (SSB)

~~

T8A02 (A)

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

- A. FM or PM
- B. SSB
- C. AM
- D. PSK

Modulation for VHF = FM (Frequency Modulation, hi quality voice or data)

~~

T8A03 (C)

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

- A. FM
- B. DRM
- C. SSB
- D. PM

Voice mode for weak signal = SSB (Single Side Band, lower quality)

~~

T8A04 (D)

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

- A. AM
- B. SSB
- C. PSK
- D. FM or PM

VHF & UHF = FM (Frequency Modulation, hi quality voice)

~~

T8A05 (C)

Which of the following types of signal has the narrowest bandwidth?

- A. FM voice
- B. SSB voice
- C. CW
- D. Slow-scan TV

Narrowest bandwidth = CW (continuous wave, morse code), just on or off

~~

T8A06 (A)

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

- A. Upper sideband
- B. Lower sideband
- C. Suppressed sideband
- D. Inverted sideband

HF, higher frequency = Upper sideband

~~

T8A07 (C)

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

- A. SSB signals are easier to tune in correctly
- B. SSB signals are less susceptible to interference
- C. SSB signals have narrower bandwidth
- D. All these choices are correct

Advantage of SSB = narrower bandwidth (lower quality)

~~

T8A08 (B)

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

- A. 1 kHz
- B. 3 kHz
- C. 6 kHz
- D. 15 kHz

SSB bandwidth = 3 kHz (lo-quality voice)

~~

T8A09 (C)

What is the approximate bandwidth of a VHF repeater FM voice signal?

- A. Less than 500 Hz
- B. About 150 kHz
- C. Between 10 and 15 kHz
- D. Between 50 and 125 kHz

FM = 10 – 15 kHz (hi quality voice)

~~

T8A10 (B)

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

- A. More than 10 MHz
- B. About 6 MHz
- C. About 3 MHz
- D. About 1 MHz

TV = 6 MHz (hi-quality voice plus video. Remember TV6)

~~

T8A11 (B)

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

- A. 2.4 kHz
- B. 150 Hz
- C. 1000 Hz
- D. 15 kHz

CW bandwidth = 150 Hz (just a flat line, morse code)

~~

T8A12 (B)

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

- A. Voice quality is poorer
- B. Only one signal can be received at a time
- C. FM signals are harder to tune
- D. All these choices are correct

FM disadvantage = wide bandwidth, so only one signal at time.

~~

T8B - Amateur satellite operation:

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

T8B01 (C)

What telemetry information is typically transmitted by satellite beacons?

- A. The signal strength of received signals
- B. Time of day accurate to plus or minus 1/10 second
- C. Health and status of the satellite
- D. All these choices are correct

satellite beacon = satellite status

~~

T8B02 (B)

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

- A. Possibility of commanding the satellite to an improper mode
- B. Blocking access by other users
- C. Overloading the satellite batteries
- D. Possibility of rebooting the satellite control computer

Too much power = block others

~~

T8B03 (D)

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

Tracking programs = all sorts of stuff

~~

T8B04 (D)

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

- A. SSB
- B. FM
- C. CW/data
- D. All these choices are correct

ham satellite mode = all modes

~~

T8B05 (D)

What is a satellite beacon?

- A. The primary transmit antenna on the satellite
- B. An indicator light that shows where to point your antenna
- C. A reflective surface on the satellite
- D. A transmission from a satellite that contains status information

satellite beacon = satellite status

~~

T8B06 (B)

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

- A. The satellite transmitted power
- B. The Keplerian elements
- C. The last observed time of zero Doppler shift
- D. All these choices are correct

Tracking inputs = Keplerian elements, (German dude Kepler in 1600 AD gave 3 laws for planetary motion)

~~

T8B07 (C)

What is Doppler shift in reference to satellite communications?

- A. A change in the satellite orbit
- B. A mode where the satellite receives signals on one band and transmits on another
- C. An observed change in signal frequency caused by relative motion between the satellite and Earth station
- D. A special digital communications mode for some satellites

Doppler shift = change in frequency caused by motion

~~

T8B08 (B)

What is meant by the statement that a satellite is operating in U/V mode?

- A. The satellite uplink is in the 15 meter band and the downlink is in the 10 meter band
- B. The satellite uplink is in the 70 centimeter band and the downlink is in the 2 meter band
- C. The satellite operates using ultraviolet frequencies
- D. The satellite frequencies are usually variable

Mode U/V = UHF (70cm) up and VHF (2m) down

~~

T8B09 (B)

What causes spin fading of satellite signals?

- A. Circular polarized noise interference radiated from the sun
- B. Rotation of the satellite and its antennas
- C. Doppler shift of the received signal
- D. Interfering signals within the satellite uplink band

Spin fading = rotation

~~

T8B10 (D)

What is a LEO satellite?

- A. A sun synchronous satellite
- B. A highly elliptical orbit satellite
- C. A satellite in low energy operation mode
- D. A satellite in low earth orbit

LEO = Low Earth Orbit, where Elon Musk has made billions

~~

T8B11 (A)

Who may receive telemetry from a space station?

- A. Anyone
- B. A licensed radio amateur with a transmitter equipped for interrogating the satellite
- C. A licensed radio amateur who has been certified by the protocol developer
- D. A licensed radio amateur who has registered for an access code from AMSAT

Receive = anyone

~~

T8B12 (C)

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

- A. Check your signal strength report in the telemetry data
- B. Listen for distortion on your downlink signal
- C. Your signal strength on the downlink should be about the same as the beacon
- D. All these choices are correct

Judge uplink power = your signal strength down is similar to status beacon

~~

T8C – Operating activities:

radio direction finding, contests, linking over the internet, exchanging grid locators

T8C01 (C)

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

- A. Echolocation
- B. Doppler radar
- C. Radio direction finding
- D. Phase locking

Locate radio noise = radio direction

~~

T8C02 (B)

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

- A. Calibrated SWR meter
- B. A directional antenna
- C. A calibrated noise bridge
- D. All these choices are correct

Hidden transmitter = direction antenna

~~

T8C03 (D)

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

- A. Simulated emergency exercises
- B. Net operations
- C. Public service events
- D. Contesting

Contact as many as possible = contesting

~~

T8C04 (C)

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

- A. Sign only the last two letters of your call if there are many other stations calling
- B. Contact the station twice to be sure that you are in his log
- C. Send only the minimum information needed for proper identification and the contest exchange
- D. All these choices are correct

Good procedure in contest = send minimum

~~

T8C05 (A)

What is a grid locator?

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

Grid locator = letter number for geographic, i.e. a map location

~~

T8C06 (B)

How is over the air access to IRLP nodes accomplished?

- A. By obtaining a password that is sent via voice to the node
- B. By using DTMF signals
- C. By entering the proper internet password
- D. By using CTCSS tone codes

Access (Internet Radio Linking Project) IRLP = DTMF (Dual Tone Multi Frequency) a telephone keypad

~~

T8C07 (D)

What is Voice Over Internet Protocol (VoIP)?

- A. A set of rules specifying how to identify your station when linked over the internet to another station
- B. A technique employed to "spot" DX stations via the internet
- C. A technique for measuring the modulation quality of a transmitter using remote sites monitored via the internet
- D. A method of delivering voice communications over the internet using digital techniques

VoIP = voice communication over Internet

~~

T8C08 (A)

What is the Internet Radio Linking Project (IRLP)?

- A. A technique to connect amateur radio systems, such as repeaters, via the internet using Voice Over Internet Protocol (VoIP)
- B. A system for providing access to websites via amateur radio
- C. A system for informing amateurs in real time of the frequency of active DX stations
- D. A technique for measuring signal strength of an amateur transmitter via the internet

Internet Radio Linking Project = technique to connect hams using VoIP

~~

T8C09 (D)

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

- A. IRLP
- B. D-STAR

C. DMR

D. EchoLink

Transmit without a radio = EchoLink. Part of Evergreen weekly net.

~~

T8C10 (C)

What is required before using the EchoLink system?

- A. Complete the required EchoLink training
- B. Purchase a license to use the EchoLink software
- C. Register your call sign and provide proof of license
- D. All these choices are correct

Before use EchoLink = must register. Do it!

~~

T8C11 (A)

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

- A. A gateway
- B. A repeater
- C. A digipeater
- D. A beacon

Station that connects others = gateway (the gate). Tulsa Amateur (TARC) gateway links to 16 other stations.

~~

T8D – Non-voice and digital communications:

image signals and definition of NTSC, CW, packet radio, PSK, APRS, error detection and correction, amateur radio networking, Digital Mobile Radio, WSJT modes, Broadband-Hamnet

T8D01 (D)

Which of the following is a digital communications mode?

- A. Packet radio
- B. IEEE 802.11
- C. FT8
- D. All these choices are correct

Digital communications modes = all these, and then some more

~~

T8D02 (B)

What is a “talkgroup” on a DMR repeater?

- A. A group of operators sharing common interests
- B. A way for groups of users to share a channel at different times without hearing other users on the channel
- C. A protocol that increases the signal-to-noise ratio when multiple repeaters are linked together
- D. A net that meets at a specified time

Talk group on digital mobile radio (DMR) = a way to group calls to share channels

~~

T8D03 (D)

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

APRS = Automatic Packet Reporting System gives position reports for mobile hams

~~

T8D04 (C)

What type of transmission is indicated by the term "NTSC?"

A. A Normal Transmission mode in Static Circuit

B. A special mode for satellite uplink

C. An analog fast-scan color TV signal

D. A frame compression scheme for TV signals

NTSC = National Television System Committee, old style analog color TV

~~

T8D05 (A)

Which of the following is an application of APRS?

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

B. Showing automatically the number of packets transmitted via PACTOR during a specific time interval

C. Providing voice over internet connection between repeaters

D. Providing information on the number of stations signed into a repeater

Application of APRS = provide real time automatic position location

~~

T8D06 (B)

What does the abbreviation "PSK" mean?

A. Pulse Shift Keying

B. Phase Shift Keying

C. Packet Short Keying

D. Phased Slide Keying

PSK= Phase Shift Keying modulates phase of CW (digital morse code)

~~

T8D07 (A)

Which of the following describes DMR?

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

B. An automatic position tracking mode for FM mobiles communicating through repeaters

C. An automatic computer logging technique for hands-off logging when communicating while operating a vehicle

D. A digital technique for transmitting on two repeater inputs simultaneously for automatic error correction

Digital Mobile Radio = technique to multiplex 2 digital signals on one repeater

~~

T8D08 (D)

Which of the following is included in packet radio transmissions?

A. A check sum 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

Included in packet = all, everything

~~

T8D09 (D)

What is CW?

A. A type of electromagnetic propagation

- B. A digital mode used primarily on 2 meter FM
- C. A technique for coil winding
- D. Another name for a Morse code transmission

CW (continuous wave, switched on and off) = international Morse code

~~

T8D10 (D)

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

Activities in digital WSJT software = all these and more. The JT is Dr. Joe Taylor a ham Nobel Laureate.

~~

T8D11 (C)

What is an ARQ transmission system?

- A. A special transmission format limited to video signals
- B. A system used to encrypt command signals to an amateur radio satellite
- C. An error correction method in which the receiving station detects errors and sends a request for retransmission
- D. A method of compressing data using autonomous reiterative Q codes prior to final encoding

ARQ = Automatic Repeat Query, scheme to retransmit if errors

~~

T8D12 (A)

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

- A. An amateur-radio based data network using commercial Wi-Fi equipment with modified firmware
- B. A wide-bandwidth digital voice mode employing DMR protocols
- C. A satellite communications network using modified commercial satellite TV hardware
- D. An internet linking protocol used to network repeaters

Amateur mesh net = amateur radio using commercial WiFi

~~

T8D13 (B)

What is FT8?

- A. A wideband FM voice mode
- B. A digital mode capable of low signal-to-noise operation
- C. An eight channel multiplex mode for FM repeaters
- D. A digital slow-scan TV mode with forward error correction and automatic color compensation

FT8 = Franke-Taylor 8 digital mode for low signal in noise. Yep the same Dr. Joe Taylor, the guru of digital ham

~~

SUBELEMENT T9 – ANTENNAS AND FEED LINES

- [2 Exam Questions - 2 Groups]

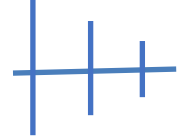
T9A – Antennas:

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 (C)

What is a beam antenna?

- A. An antenna built from aluminum I-beams
 - B. An omnidirectional antenna invented by Clarence Beam
 - C. An antenna that concentrates signals in one direction
 - D. An antenna that reverses the phase of received signals
- Beam antenna = antenna to concentrate (like old time TV antenna)*



T9A02 (A)

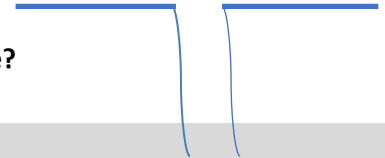
Which of the following describes a type of antenna loading?

- A. Electrically lengthening by inserting inductors in radiating elements
 - B. Inserting a resistor in the radiating portion of the antenna to make it resonant
 - C. Installing a spring in the base of a mobile vertical antenna to make it more flexible
 - D. Strengthening the radiating elements of a beam antenna to better resist wind damage
- Antenna loading = inserting inductor (coil) to act longer*

T9A03 (B)

Which of the following describes a simple dipole oriented parallel to Earth's surface?

- A. A ground-wave antenna
 - B. A horizontally polarized antenna
 - C. A travelling-wave antenna
 - D. A vertically polarized antenna
- Oriented parallel to earth = horizontal polarized*



T9A04 (A)

What is a disadvantage of the short, flexible antenna supplied with most handheld radio transceivers, compared to a full-sized quarter-wave antenna?

- A. It has low efficiency
 - B. It transmits only circularly polarized signals
 - C. It is mechanically fragile
 - D. All these choices are correct
- Rubber duck = does not work as well*



T9A05 (C)

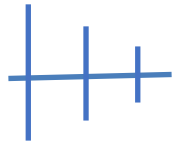
Which of the following increases the resonant frequency of a dipole antenna?

- A. Lengthening it
 - B. Inserting coils in series with radiating wires
 - C. Shortening it
 - D. Adding capacitive loading to the ends of the radiating wires
- to resonate higher = shorten (higher freq = shorter wavelength, remember?)*

T9A06 (D)

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

- A. 5/8 wave vertical
- B. Isotropic
- C. J pole
- D. Yagi



Greatest gain = Yagi

~~

T9A07 (A)

What is a disadvantage of using a handheld VHF transceiver with a flexible antenna inside a vehicle?

- A. Signal strength is reduced due to the shielding effect of the vehicle
- B. The bandwidth of the antenna will decrease, increasing SWR
- C. The SWR might decrease, decreasing the signal strength
- D. All these choices are correct

Disadvantage of radio inside metal vehicle = signal not propagate well

~~

T9A08 (C)

What is the approximate length, in inches, of a quarter-wavelength vertical antenna for 146 MHz?

- A. 112
- B. 50
- C. 19
- D. 12

*one-quarter wave on 146 MHz = on 2 meter (1 meter ~ 38", so $2 * 38 * 1/4 = 19$ ")*

~~

T9A09 (C)

What is the approximate length, in inches, of a half-wavelength 6 meter dipole antenna?

- A. 6
- B. 50
- C. 112
- D. 236

*One-halfwave on 6-meter = $(6 * 38" * 1/2) = 114$ or approx. 112*

~~

T9A10 (D)

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

- A. Equally in all directions
- B. Off the ends of the antenna
- C. In the direction of the feed line
- D. Broadside to the antenna

Direction of dipole = broadside (most is exposed)

~~

T9A11 (C)

What is antenna gain?

- A. The additional power that is added to the transmitter power
- B. The additional power that is required in the antenna when transmitting on a higher frequency
- C. The increase in signal strength in a specified direction compared to a reference antenna
- D. The increase in impedance on receive or transmit compared to a reference antenna

Gain = increase in signal in a direction

~~

T9A12 (A)

What is an advantage of a 5/8 wavelength whip antenna for VHF or UHF mobile service?

- A. It has more gain than a 1/4-wavelength antenna
- B. It radiates at a very high angle
- C. It eliminates distortion caused by reflected signals
- D. It has 10 times the power gain of a 1/4 wavelength whip

Advantage of 5/8 wavelength = more gain than 1/4; gets tip higher

~~

T9B – Feed lines

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

T9B01 (B)

What is a benefit of low SWR?

- A. Reduced television interference
- B. Reduced signal loss
- C. Less antenna wear
- D. All these choices are correct

Low SWR = reduce loss (less heat)

~~

T9B02 (B)

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

- A. 8 ohms
- B. 50 ohms
- C. 600 ohms
- D. 12 ohms

Impedance of ham coax = 50 Ohm (the way it is made. Have to memorize this one)

~~

T9B03 (A)

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

- A. It is easy to use and requires few special installation considerations
- B. It has less loss than any other type of feed line
- C. It can handle more power than any other type of feed line
- D. It is less expensive than any other type of feed line

Why coax = easy to use, nothing special

~~

T9B04 (A)

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

- A. It matches the antenna system impedance to the transceiver's output impedance
- B. It helps a receiver automatically tune in weak stations
- C. It allows an antenna to be used on both transmit and receive
- D. It automatically selects the proper antenna for the frequency band being used

Antenna tuner = match antenna to transceiver

~~

T9B05 (D)

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

- A. The characteristic impedance decreases
- B. The loss decreases
- C. The characteristic impedance increases
- D. The loss increases

Frequency increase = loss increase (more heat)

~~



T9B06 (B)

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

- A. UHF (PL-259/SO-239)
- B. Type N
- C. RS-213
- D. DB-25

Connector above 400 MHz (UHF) = type N, simplest answer

~~



T9B07 (C)

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

- A. They are preferred for microwave operation
- B. They are watertight
- C. They are commonly used at HF and VHF frequencies
- D. They are a bayonet-type connector

PL-259 connector = most common

~~



T9B08 (D)

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

Loss = all sorts of things

~

T9B09 (B)

What can cause erratic changes in SWR?

- A. Local thunderstorm
- B. Loose connection in the antenna or feed line
- C. Over-modulation
- D. Overload from a strong local station

Erratic = loose

~~

T9B10 (C)

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

- A. There is no significant difference between the two types
- B. RG-58 cable has two shields
- C. RG-213 cable has less loss at a given frequency

D. RG-58 cable can handle higher power levels
Difference in 58 & 213 = less loss in 213

~~

T9B11 (C)

Which of the following types of feed line has the lowest loss at VHF and UHF?

- A. 50-ohm flexible coax
- B. Multi-conductor unbalanced cable
- C. Air-insulated hardline
- D. 75-ohm flexible coax

Lowest loss feed = air insulated hardline (a wire in the air)

~~

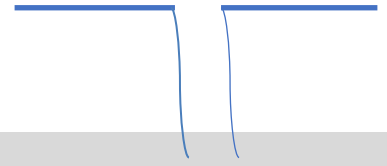
T9B12 (A)

What is standing wave ratio (SWR)?

- A. A measure of how well a load is matched to a transmission line
- B. The ratio of amplifier power output to input
- C. The transmitter efficiency ratio
- D. An indication of the quality of your station's ground connection

standing wave = how well match

~~



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 (B)

Which of the following is a safety hazard of a 12-volt storage battery?

- A. Touching both terminals with the hands can cause electrical shock
- B. Shorting the terminals can cause burns, fire, or an explosion
- C. RF emissions from a nearby transmitter can cause the electrolyte to emit poison gas
- D. All these choices are correct

Battery safety hazard = shorting the terminals

~~

T0A02 (D)

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

- A. It may cause injury by heating tissue
- B. It may disrupt the electrical functions of cells
- C. It may cause involuntary muscle contractions
- D. All these choices are correct

Health hazard of current = all are ways to die

~~

T0A03 (B)

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

- A. Neutral
- B. Hot
- C. Equipment ground
- D. Black insulation is never used

Black = hot

~~

T0A04 (B)

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

- A. To prevent power supply ripple from damaging a component
- B. To remove power in case of overload
- C. To limit current to prevent shocks
- D. All these choices are correct

Fuse = interrupt overload

~~

T0A05 (C)

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

- A. The larger fuse would be likely to blow because it is rated for higher current
- B. The power supply ripple would greatly increase
- C. Excessive current could cause a fire
- D. All these choices are correct

over-fuse = permits excessive current causing fire

~~

T0A06 (D)

What is a good way to guard against electrical shock at your station?

- A. Use three-wire cords and plugs for all AC powered equipment
- B. Connect all AC powered station equipment to a common safety ground
- C. Install mechanical interlocks in high-voltage circuits
- D. All these choices are correct

Guard against shock = all you can do

~~

T0A07 (D)

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

- A. At the output connector of a transceiver
- B. At the antenna feed point
- C. At the ac power service panel
- D. On a grounded panel near where feed lines enter the building

lightning protection = mount on metal, connected to earth, near entrance

~~

T0A08 (A)

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

- A. In series with the hot conductor only
- B. In series with the hot and neutral conductors
- C. In parallel with the hot conductor only
- D. In parallel with the hot and neutral conductors

Fuse for 120VAC = in line (series) hot (black) only

~~

T0A09 (C)

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

- A. Waterproof them with silicone caulk or electrical tape
- B. Keep them as far apart as possible
- C. Bond them together with heavy wire or conductive strap
- D. Tune them for resonance on the lowest frequency of operation

All ground rods = bond together

~~

T0A10 (A)

What hazard is caused by charging or discharging a battery too quickly?

- A. Overheating or out-gassing
- B. Excess output ripple
- C. Half-wave rectification
- D. Inverse memory effect

If use too fast = overheat, ka-boom

~~

T0A11 (D)

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

- A. Circulating currents in the dc filter
- B. Leakage flux in the power transformer
- C. Voltage transients from kickback diodes
- D. Charge stored in filter capacitors

Hazard from disconnected power supply = get shock from capacitors (been there, done that, it sucks)

~~

T0A12 (B)

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

- A. Ensure that the voltmeter has very low impedance
- B. Ensure that the voltmeter and leads are rated for use at the voltages to be measured
- C. Ensure that the circuit is grounded through the voltmeter
- D. Ensure that the voltmeter is set to the correct frequency

Precaution = use rated meter

~~

TOB – Antenna safety:

tower safety and grounding, installing antennas, antenna supports

TOB01 (C)

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

- A. Put a drip loop in the ground connection to prevent water damage to the ground system
- B. Make sure all ground wire bends are right angles
- C. Ensure that connections are short and direct
- D. All these choices are correct

Ground wires = short & sweet

TOB02 (D)

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

Required climbing = all safety

~~

TOB03 (D)

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

- A. When no electrical work is being performed
- B. When no mechanical work is being performed
- C. When the work being done is not more than 20 feet above the ground
- D. Never

When safe to climb without helper = never, not ever

~~

TOB04 (C)

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

- A. Wear a ground strap connected to your wrist at all times
- B. Insulate the base of the tower to avoid lightning strikes
- C. Look for and stay clear of any overhead electrical wires
- D. All these choices are correct

Safety putting up tower = look for and clear of overhead electric

~~

TOB05 (B)

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

- A. Secure the guy line if the turnbuckle breaks
- B. Prevent loosening of the turnbuckle from vibration
- C. Provide a ground path for lightning strikes
- D. Provide an ability to measure for proper tensioning

Safety wire = prevent loosening

~~

TOB06 (D)

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

- A. Add the height of the antenna to the height of the power line and multiply by a factor of 1.5
- B. The height of the power line above ground
- C. 1/2 wavelength at the operating frequency
- D. Enough so that if the antenna falls, no part of it can come closer than 10 feet to the power wires

Safe distance from power line = enough so no part closer than 10'; DUH

~~

TOB07 (C)

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

- A. This type of tower must never be painted
- B. This type of tower must never be grounded
- C. This type of tower must not be climbed unless it is retracted, or mechanical safety locking devices have been installed
- D. All these choices are correct

crank-up tower = must not climb

~~

TOB08 (D)

Which is a proper grounding method for a tower?

- A. A single four-foot ground rod, driven into the ground no more than 12 inches from the base
- B. A ferrite-core RF choke connected between the tower and ground
- C. A connection between the tower base and a cold water pipe
- D. Separate eight-foot ground rods for each tower leg, bonded to the tower and each other

Proper grounding for tower = Separate ground rod for each leg, all bonded together

~~

TOB09 (C)

Why should you avoid attaching an antenna to a utility pole?

- A. The antenna will not work properly because of induced voltages
- B. The 60 Hz radiations from the feed line may increase the SWR
- C. The antenna could contact high-voltage power lines
- D. All these choices are correct

Avoid antenna to utility pole = antenna could contact high voltage

~~

TOB10 (C)

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

- A. Use only non-insulated wire
- B. Wires must be carefully routed with precise right-angle bends
- C. Sharp bends must be avoided
- D. Common grounds must be avoided

Ground conductor for lightning = sharp bends verboten

~~

TOB11 (B)

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

- A. FCC Part 97 rules
- B. Local electrical codes
- C. FAA tower lighting regulations
- D. UL recommended practices

Establishes grounding requirements = local electrical codes

~~

T0C - RF hazards:

radiation exposure, proximity to antennas, recognized safe power levels, radiation types, duty cycle

T0C01 (D)

What type of radiation are radio signals?

- A. Gamma radiation
- B. Ionizing radiation
- C. Alpha radiation
- D. Non-ionizing radiation

VHF/UHF radio = non-ionizing radiation. (Not enough energy to change molecules.)

~~

T0C02 (B)

At which of the following frequencies does maximum permissible exposure have the lowest value?

- A. 3.5 MHz
- B. 50 MHz
- C. 440 MHz
- D. 1296 MHz

Lowest Maximum Permissible Exposure = 50 MHz (VHF absorbed easiest by body, this is only VHF)

~~

T0C03 (C)

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

- A. It increases by a factor of 3
- B. It decreases by 50 percent
- C. It increases by a factor of 2
- D. There is no adjustment allowed for lower duty cycle

Averaging power = 50% duty cycle allows 2 times the power

~~

T0C04 (D)

What factors affect the RF exposure of people near an amateur station antenna?

- A. Frequency and power level of the RF field
- B. Distance from the antenna to a person
- C. Radiation pattern of the antenna
- D. All these choices are correct

affect RF exposure = all, lots of things

~~

T0C05 (D)

Why do exposure limits vary with frequency?

- A. Lower frequency RF fields have more energy than higher frequency fields
- B. Lower frequency RF fields do not penetrate the human body
- C. Higher frequency RF fields are transient in nature
- D. The human body absorbs more RF energy at some frequencies than at others

Why exposure limits vary = human body absorbs different frequencies

~~

TOC06 (D)

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

Methods for rf calculation = all are acceptable

~~

TOC07 (B)

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

- A. Electrocution
- B. RF burn to skin
- C. Radiation poisoning
- D. All these choices are correct

Touch antenna transmitting = painful RF burn (been there, done that, don't do it)

~~

TOC08 (A)

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

- A. Relocate antennas
- B. Relocate the transmitter
- C. Increase the duty cycle
- D. All these choices are correct

Prevent exposure to RF = relocate ANTENNA

~~

TOC09 (B)

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

- A. By informing the FCC of any changes made in your station
- B. By re-evaluating the station whenever an item in the transmitter or antenna system is changed
- C. By making sure your antennas have low SWR
- D. All these choices are correct

Stay in compliance = re-evaluating

~~

TOC10 (A)

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

- A. It affects the average exposure to radiation
- B. It affects the peak exposure to radiation
- C. It takes into account the antenna feed line loss
- D. It takes into account the thermal effects of the final amplifier

duty cycle = affects the average

~~

TOC11 (C)

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

- A. The difference between the lowest power output and the highest power output of a transmitter
- B. The difference between the PEP and average power output of a transmitter
- C. The percentage of time that a transmitter is transmitting
- D. The percentage of time that a transmitter is not transmitting

Duty cycle = percentage of time TRANSMITTING

~~

TOC12 (A)

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

- A. RF radiation does not have sufficient energy to cause chemical changes in cells and damage DNA
- B. RF radiation can only be detected with an RF dosimeter
- C. RF radiation is limited in range to a few feet
- D. RF radiation is perfectly safe

RF vs. radioactive = not sufficient energy for genetic damage

~~

TOC13 (B)

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

- A. The FCC
- B. The station licensee
- C. Anyone who is near an antenna
- D. The local zoning board

Responsible party = station licensee, who dun it

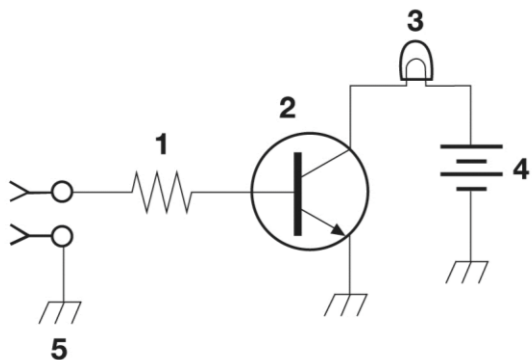
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~~~~END of question pool text~~~~



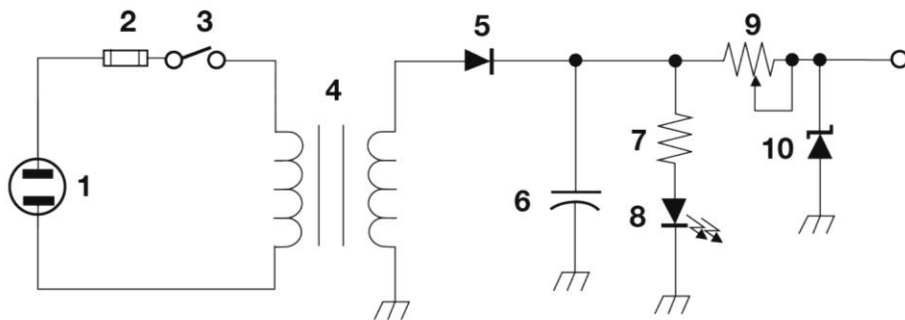
**3 DIAGRAMS REQUIRED**

For questions in section T6C, about pages 50 - 53



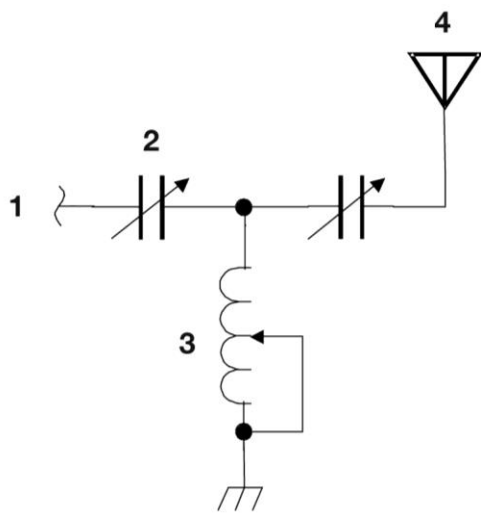
|   |            |
|---|------------|
| 1 | resistor   |
| 2 | transistor |
| 3 | lamp       |
| 4 | battery    |
| 5 | ground     |

**Figure T-1**



|    |                   |
|----|-------------------|
| 1  | connector plug    |
| 2  | fuse              |
| 3  | SPST switch       |
| 4  | transformer       |
| 5  | diode             |
| 6  | capacitor         |
| 7  | resistor          |
| 8  | led               |
| 9  | variable resistor |
| 10 | zener diode       |

**Figure T-2**



|   |                    |
|---|--------------------|
| 1 | connector          |
| 2 | variable capacitor |
| 3 | variable inductor  |
| 4 | antenna            |

**Figure T-3**

***That's All Folks***



## ARTICLES SUPPLEMENTAL

MOD – Valuable, but not part of exam:

### **⚠ WARNING**

*The skill level of each user and installer is different. The location and equipment are different. Interpretation and application are different. Use this information at your discretion. We cannot be responsible for what you or others do*

These articles are supplemental and are not part of the exam. They do contain valuable information.

Article Ham 3, 4, 6, 7, are beneficial aids for preparing for the license exam. Read once or twice.

Ham 9A tells how to navigate the FCC before your exam session, while 9B tells what to do after your exam.

The remaining articles Ham 10A, 10B, 10C, 11, 30, 54, 60, 61, 64 are aids to getting on the air.

Article 18 is just for fun and part of the lore.



**Ham 2 - Intro Class Agenda**  
Dr. Marc & Rosemary 220404

1. Material for students
  - a. Ham 1 – Ham Technician Study Guide Questions Pool
  - b. Ham 2 - Agenda handout
  - c. Ham 3, 4
  - d. Ham 6, 7, 8, 9
2. Welcome
  - a. Your time is valuable. So, this session will be about 2 hours.
  - b. Then you can go work at your own pace, with a definite end-time for review.
  - c. You can do this. You will see why I know that.
3. Introduce us
  - a. Rosemary, KE5CMS mostly called Gramm, totally non-math, but very smart and intuitive. Evaluates my material.
  - b. Dr. Marc, NM0D, TU Professor Emeritus, both Commercial & Ham Extra Class licenses, Elmer for hundreds.
  - c. Depending on the week, other Elmers volunteer to help you.
4. Tell us about you
  - a. Name
  - b. What do you know about ham radio?
  - c. What got you interested or what do you want to do with it?
5. Transfer material
  - a. Make sure everyone is checked-in.
  - b. Get their email address. That is how you get material.
  - c. Give them network access. Network name, pass
  - d. Send files.
  - e. Make sure they received and open first one, Ham 2 - Agenda.
6. Ham 2 - Agenda
  - a. Ham 3 - What is Ham
  - b. Ham 4 - Differences, show Handi, from about \$30 on Amazon to as much as you want to spend.
  - c. Break
  - d. Ham 1 – Ham Technician Study Guide
    - i. TOC
    - ii. What Is This
    - iii. SubElement T1 & T2 go over to illustrate
      1. **Read BOLD question**
      2. Study **HIGHLIGHT** answer
      3. Analyze *ITALIC* hint: *question = answer*
7. That is all.
  - a. Stay positive. Ignore distractor answers and anything else about the question, such as numbers and references.
  - b. It is as simple as 1,2,3.
  - c. Repeat for all the questions.
8. Other references for next session.
  - a. Ham 6 – Electric principles
  - b. Ham 7 – Moving zeroes
  - c. Ham 8 – You can do it.
9. Follow-up
  - a. We will see you in two-weeks. Same Bat-time, same Bat-channel.
  - b. During study, write down questions, qualms, and not sure abouts. Bring them.
  - c. An old professor once said, “If you do not understand, likely someone else does not either. So, help them out.”
  - d. By going over everyone’s questions, you will grasp a new perspective.
10. Ham 9 - Schedule to take the exam
  - a. Goal is 4 - 5 weeks for optimal capture of your memory. If you delay, more time is required to refresh.
  - b. You can do it. All my students who persevered have passed.
  - c. A month and done. Cool! Very cool!



**Ham 3 - What Is a Ham**  
Dr. Marc & Rosemary 220404

1. First, let's talk about golf.
  - a. *Pro* is a golfer who is skilled and paid for his golfing abilities.
  - b. *Amateur* is skilled enough to play with pros, but is unpaid as a golfer.
  - c. *Duffer* is someone who has a golf club, may know where the course is, but is not allowed with the big boys.
2. Now, let's talk radio communications.
  - a. *Commercial* is radio for general use like FM, TV, cellphone tower, which is installed, operated, and maintained by PAID qualified, licensed, professionals. Frequencies are allocated and activity is controlled by the FCC.
  - b. *Amateur* is radio on all the same bands, for experimental use (trying different things), which is installed, operated, and maintained by UNPAID qualified, licensed, professionals. That is a paraphrase of the FCC law.
  - c. *Personal* is low-powered, two-way, short-distance voice communications service for personal or business activities of the general-public, like CB, GMRS, FRS, or MURS walkie-talkies. These do not require an examination license, since any screw-up is unlikely to be more than a minor, local nuisance.
3. What is radio spectrum?
  - a. Radio spectrum includes that part of nature, which humans use to send information at some distance.
  - b. The spectrum includes light, which is electrical and magnetic in nature, on the high end and hearing on the low.
  - c. Everything in nature vibrates at a frequency, usually multiple frequencies.
  - d. Number of vibrations per second is a Hertz (Hz). 1000 is kiloHertz (kHz). 1,000,000 is megaHertz (MHz).
  - e. For convenience, a group of frequencies are called a band, which is determined by the length of the radio wave.
  - f. *Frequency \* wavelength = the speed of light* (300,000,000 meters per second).
  - g. Quicker is ***Frequency in MHz \* wavelength = 300***.
  - h. Commercial FM radio is about 100 MHz, so its wavelength or band is 3 meters (Very High Frequency, VHF).
  - i. Commercial AM radio is about 1000 kHz, so its wavelength or band is about 300 meters. (Medium wave, MW).
4. Unit abbreviations are two letters. If it is honorary name for someone, the first letter is always capital.
  - a. Because of the size of some numbers, it is easier to get rid of three-zeroes and apply a different prefix.
5. Who gets to use the spectrum?
  - a. Since radio transmission is not limited by borders, international agreements decide who can use what part of the radio spectrum. In the United States these agreements are managed by the Federal Communications Commission.
  - b. Commercial radio stations (TV, Wi-Fi, cellphones, GPS, radar) broadcast on a single, well-regulated frequency within a band, so others can know where to find the radio signal and information.
  - c. Since the first days of radio, part of each band grouping has been reserved for Amateur (ham) use, so that different things can be tried (experimentation).
  - d. No two ham stations are the same. Almost every communication includes how well the signal is received.
  - e. Because of this experimenting (my wife calls it playing around), much of radio technology has developed and advanced by hams, but non-hams are not aware of the contribution to their lifestyle.
  - f. If something works, then its usage expands.
6. What about emergency comms?
  - a. When an emergency strikes, whether weather or whatever, what communications is always there? Why?
  - b. How do storm-chasers and storm-spotters communicate? Storm spotter classes are in February and March.
  - c. Who operates and pays for amateur radio? *Individuals*, not government nor organizations.
  - d. The innovation, creativity, & energy of multiple, independent people distributed around is unlikely to be stopped.
  - e. A few notable hams include Dick Rutan, Priscilla Presley, Joe Walsh, [www.qsl.net/w5www/famous.html](http://www.qsl.net/w5www/famous.html).
  - f. Ham experience, experimentation, and exigency provides communication service when no one else can.

*Consider this. The grid goes down and limits travel. No internet. No phones. Suddenly, anyone beyond walking distance is now someone you used to know. Your ability to exchange information with the world is non-existent. Who can change that? What backup communication system is there in emergencies? Let's get you up and running.*

*Most everyone uses a cellphone, and listens to Travis' weather on TV. But, if it all went down tomorrow, How would you stay informed? How would you give help or get help? What is the backup communication system that is there in every emergency?*

7. Hams are UNPAID, qualified, licensed, professionals. Unlike any other radio service, hams are encouraged to experiment (try things). We all become hams because of an Elmer. An Elmer steps-up to help other hams.
8. Amateur radio has three aspects: technology, mental exercise, and lifestyle. What you do is up to you.



## Ham 4 - Differences in Ham Privileges and Radios

Dr. Marc & Rosemary 221108

1. History. Amateur radio is very much about tradition, trying things, and being prepared.
  - a. In 1873, Dr. James Clerk Maxwell, FRS, presented the theory of electromagnetic waves in Edinburgh.
    - i. He was a devout, conservative Christian, who believed that science and religion are very harmonious.
    - ii. James was homeschooled by his mother, who encouraged him to “look up through Nature to Nature’s God.”
    - iii. According to Maxwell’s biographer, “His knowledge of Scripture, from his earliest boyhood, was extraordinarily extensive and minute....These things were not known merely by rote. They occupied his imagination, and sank deeper than anybody knew.”
  - b. In 1901, Guglielmo Marconi created a spark-gap radio and a huge antenna farm to transmit radio across the ocean.
    - i. A Nobel physicist, he asserted “I am proud to be a Christian.” One of his radio patent numbers was 7777.
    - ii. “I believe not only as a Christian, but as a scientist as well.”
    - iii. “A wireless device can deliver a message through the wilderness. In prayer the human spirit can send invisible waves to eternity, waves that achieve their goal in front of God.”
  - c. The unknowing have tried to hijack science by rejecting the Creator that designed nature and nature’s laws..
  - d. Congress passed the Radio Act of 1912, requiring amateur licensing to prevent interference with commercial.
  - e. Then in 1914, Hiram Percy Maxim started the Amateur Radio Relay League (ARRL) to coordinate transmitters.
2. Throughout the short history of radio, Amateurs have had a spectrum in each band to experiment.
  - a. Not all are equally skilled, so three licenses are now available. These have a 10-year term.
  - b. *Technician* (T) is the entry level and can transmit in a slice of 10 meters, 6 meters, and most higher frequencies.
  - c. *General* (G) is more flexible and technical allowing transmission on parts of all bands.
  - d. *Extra* (E) is more advanced, allowing any ham activity. The license is much more complex than the Commercial.
3. Let’s talk bands, which hams can use.
  - a. As you may know, *Frequency in MHz\* wavelength = 300 meters/second*).
  - b. Based on this relationship, the radio spectrum breaks into logical segments.

| Band | Spectrum             | Frequencies  | Wavelength   | Major Users                       | Band Plan |
|------|----------------------|--------------|--------------|-----------------------------------|-----------|
| LF   | low frequency        | 30-300 kHz   | 10 km – 1 km | Navy                              | E, G      |
| MW   | medium wave          | 300-3000 kHz | 1000 – 100 m | Commercial AM                     | E, G      |
| HF   | high frequency       | 3-30 MHz     | 100 – 10 m   | Shortwave                         | E, G      |
| VHF  | very high frequency  | 30-300 MHz   | 10 – 1 m     | Com’l FM, business, fixed digital | E, G, T   |
| UHF  | ultrahigh frequency  | 300-3000 MHz | 100 – 10 cm  | Gov’t, cell, WiFi                 | E, G, T   |
| EHF  | extra high frequency | 3-30 GHz     | 10 – 1 cm    | Cell, WiFi, radar                 | E, G, T   |
|      | And so on            |              |              | Wide data BW                      | E, G, T   |

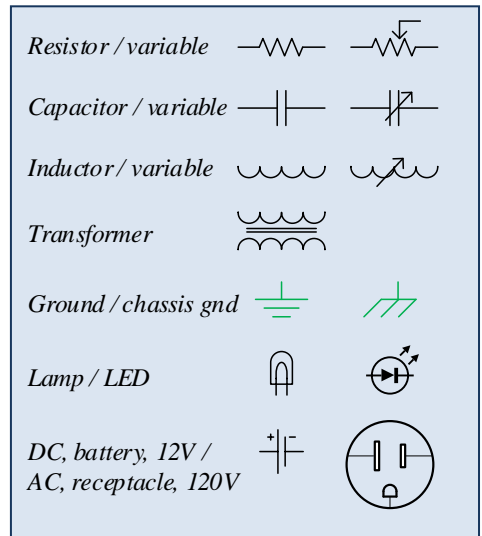
- c. Technician has limited access for CW on 80, 40, 15 meters with phone, rtty, data on 10 meters.
  - d. Isn’t it amazing? Hams have privileges across the spectrum without FCC telling us how to or which channel.
4. VHF and above is open to everyone, but is primarily local communications.
  - a. Communications is near line-of-sight, with higher frequency disturbed by smaller things like raindrops and dust.
  - b. More-power decides if you will be able to talk or not. You can legally use 1500-Watts, but 50 is more common.
  - c. A mobile/base is the most reliable in emergency communications, with 50-Watts simplex direct between radios.
  - d. A Handi-Talkie operating at 5-Watts has very limited range. Cost starts at \$28. Makes a great don’t care radio.
  - e. To get more range, a base-repeater receives from one radio, amplifies the signal, and retransmits to another radio.
  - f. With low-power, in hilly or urban terrain, a handi- may not be able to see the repeater base.
  - g. All radios should be capable of battery operation, to permit emergency communications.
  - h. Signal strength can come from the antenna or out of the wall.
  - i. A taller, matched antenna enhances signal strength, which improves getting the signal out, even for handi-.
  - j. Specialty antennas provide moon-bounce, skip, and other ideas. But in most cases, these are very limited use.
5. HF communications provides local to around the world communications.
  - k. The spectrum is for General and Extra class.
  - l. Elegant communications include voice, cw (continuous wave, Morse code), and digital.
  - m. Many stations are a 100-Watt transceiver with band access to everything and all modes.
  - n. The antenna is the biggest problem, the most opportunity to experiment, and most critical to success.
  - o. Radios have made fantastic electronic and computer progress, leaving Marconi’s spark gap in the dust.
  - p. However, antenna technology is not far from his old antenna farm. Antennas are still bulky and high.



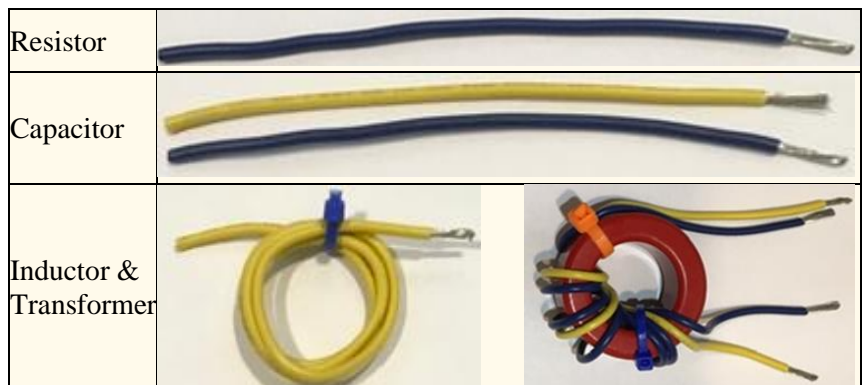
**Ham 6 - Electrical Principles**  
 Dr. Marc & Rosemary 221108

1. Only three things can be measured.
  - a. *Voltage (V)* - measured as Volts - is the potential force or pressure in a circuit. It exists whether anything is connected or not. Voltage is measured across, or as the difference between, two points. Voltage is similar to pounds per square inch (psi) on a water line.
  - b. *Current (I)* - measured as Amps - is the rate or quantity of flow through a path. Current can be measured only if a load or fault is connected and operating. An Amp is a quantity of electrons per second. Current is similar to gallons per minute on a water line.
  - c. *Time event (t)* - measured in seconds - is the elapsed time between events. The reciprocal of time is the frequency (f), which is measured in oscillations or cycles per second called Hertz (Hz).
2. Only three things can be calculated.
  - a. *Power (S)* - expressed in Volt-Amps - is the product of voltage and current. Power is energy or work that occurs over some period of time. The asterisk simply notes a time change on the current.  $S = V \times I'$
  - b. *Real or DC power (P)* - is expressed in Watts.
  - c. *Impedance (Z)* - expressed in Ohms - is the ratio of voltage to current (Volts per Amp). Impedance is the opposition to current flow. The relationship is called Ohm's Law.  $Z = V / I$
  - d. *Delay (ta)* - is the difference in the time or phase shift between voltage and current being at maximum. It may be expressed in seconds, in angular terms, or Standing Wave Ratio (SWR).  $Optimum\ SWR = 1:1$

3. Only 3 components of Impedance.
  - a. *Resistance (R)* is natural opposition of any conductor. Most conductors are wires made of copper or aluminum. Resistance is the friction in a conductor. A resistor *converts electrical energy* into mechanical energy in the form of heat. Basic unit is Ohm.
  - b. *Inductance (L)* results from a conductor being bent into a coil. A coil converts electrical energy into a magnet. A coil *stores magnetic energy*. Coils are used to make relays, motors, and transformers. Unit is Henry.
  - c. *Capacitance (C)* results from two conductors or plates being close to each other. A capacitor *stores electrical energy*. A capacitor smooths out the electrical energy. Capacitors are used in electronic circuits and to reduce the effect of time delay from a coil. Basic unit is Farad.
4. Variable resistor, inductor and capacitor have an arrow added to the diagram.
  - a. *Variable resistor (R)* is a potentiometer (pot) or volume control.
  - b. *Variable inductor (L)* is a coil used to tune a frequency.
  - c. *Variable capacitor (C)* is a condenser used to tune a frequency.



5. *Transformer* is two coils of wire wrapped around a common iron-type material.
  - a. The number of turns are adjusted to change the impedance, for example to an antenna.
  - b. A transformer can change 120 VAC to lower voltage.



6. Series / Parallel
  - a. *Series* has components connected end to end, with same current through all components. The voltage is split by components. Old Christmas tree lights were series, when one goes out all are out. Connect ammeter in series.
  - b. *Parallel* has components side by side with same voltage across all components. Wall receptacles are parallel, with all measuring 120 VAC. Connect voltmeter in parallel.
7. A *Meter* displays an electrical quantity as a numeric value or with a swinging needle. Think SWR or wattmeter.
  - a. A multi-meter measures voltage and resistance. Damage occurs if meter is set to Ohm but connected to voltage.





**Ham 7 – Moving Zeroes**  
Dr. Marc & Rosemary 221108

1. Unit abbreviations are two letters. If it is honorary name for someone, the first letter is always capital.  
a. Because of the size of some numbers, it is easier to get rid of three-zeroes and apply a different prefix.

|                                  |   |                                               |   |
|----------------------------------|---|-----------------------------------------------|---|
| kilo = 1,000 = 1 thousand        | k | milli = .001 = 1 thousandth                   | m |
| Mega = 1,000,000 = 1 million     | M | micro = .000 001 = 1 millionth                | μ |
| giga = 1,000,000,000 = 1 billion | g | pico = .000 000 000 001 = 1 million millionth | p |

b.  $25.1 \text{ MHz} = 25,100 \text{ kHz} = 25,100,000 \text{ Hz}$        $1,000,000 \text{ pF} = 1 \text{ μF} = .001$

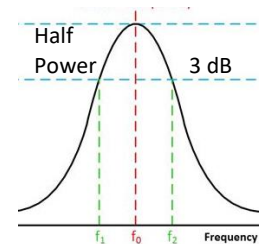
2. Human hearing can detect whispers to explosions. To prevent damage at extremely high levels, the ear is designed to attenuate large noise at a natural rate called a logarithmic scale.

- a. We define decibels (dB) to represent the sound level without using huge numbers.  
b. For the exam, you only need to use the power ratio for 3 dB or 10 dB.  
c. power ratio of 2 = 3 dB  
d. power ratio of 10 = 10 dB  
e. Increase of power is positive dB, decrease of power is negative dB.

$$dB = 10 \log_{10} (P_{out}/P_{in})$$








| Power ratio | dB |
|-------------|----|
| 2           | 3  |
| 10          | 10 |

Example: Power decrease from 12 to 3 watts  
 $12/3 = 4 \text{ times} = [2] * 2 \text{ times} = [2] * 3\text{dB} = 6\text{dB}$



3. Protection removes power.  
a. *Switch* turns electric devices on and off and is commonly marked by (1/0). The switch can be manual, a relay, or a transistor.  
b. *Fuse* protects other components from overloads.  
c. A schematic (scheme) is an electrical wiring diagram that uses standard symbols to show connection of components.

4. Solid State electronics are made of semi-conductors, which are a part-time conductor and part insulator (glass).  
a. *Diode* has two terminals or electrodes. The cathode (bar) is negative & shorter leg. The anode (arrow) is positive. Current flows in the direction of the arrow, but is blocked by the bar. A diode is a rectifier making DC from AC.  
b. *Transistor* has three layers (terminals). One terminal switches the diode on or off. A transistor can be a switch to control current flow or an amplifier by controlling current to increase *gain*. Field Effect Transistor (FET), Metal Oxide Semiconductor (MOS), and bipolar are types of transistors.

|                      |                                                                                       |                                                                                       |
|----------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Switch SPST / DPST   |  |  |
| Fuse                 |  |                                                                                       |
| Diode / LED          |  |  |
| Transistor / Antenna |  |  |

5. AC / DC  
a. *Direct Current (DC)* flows in one direction. The source is batteries. DC is used for portable power. The most common mobile source is 12 VDC.  
b. *Alternating Current (AC)* reverses direction many cycles per second called the frequency. Common AC power is 120 VAC, 60 Hz from the wall outlet.  
c. *Rectifier* also called a diode, converts AC to varying DC. These are in a power supply.  
d. *Regulator* controls the voltage from a power supply.  
e. Rechargeable batteries are lead-acid (vehicle), gel-cell (alarm), ni-cad, nickel metal hydride, or lithium ion.  
f. Non-rechargeable are carbon-zinc (flashlight and alkaline).

6. *Radio Frequency (RF)* is alternating current operating at higher frequencies.  
a. Frequency is kiloHertz, megaHertz or greater. The wave is both electric & magnetic (electromagnetic) fields.  
b. A field is energy operating in space. For example, a magnetic does not have to touch to move an iron object.  
c. In general, the orientation of the antenna describes the polarization.  
d. Horizontal polarization is parallel to the earth surface. Vertical is perpendicular.  
e. The electric field from the antenna defines the polarization or direction of movement around the earth.  
f. Magnetic field is the opposite (perpendicular) polarization.  
g. Horizontal polarization hugs the earth, so it is better for long-distance, weak signals.  
h. Vertical polarization works best for portable and mobile, short range.  
i. Receiving antenna opposite from the transmitting antenna results in about 18 dB signal loss.  
j. Because of antennas, VHF/UHF FM (voice) are usually vertical while SSB/CW are horizontal.  
k. Vertical is different around the globe. A vertical antenna over the horizon is not parallel to local, not line-of-sight.



## Ham 8 – A Little Practice & Practical Theology

Dr. Marc & Rosemary 220404

1. First the disclaimer. The limited number of questions make practice exams an ineffective “teaching” tool and they are not a substitute for study. They only ask 35 questions out of about 420. They put 3 times the emphasis on wrong answers as the correct one. Unfortunately most slick vehicles have the same issues.
2. Over the years with hundreds of successful ham preparations, we have found for most people the fastest, simplest method.

Read the questions.  
Learn the correct answer.  
Pass exam.

3. That is the shortcut everyone seeks.
4. Focus only on the correct answers. Your mind does not need the negative from the distractors. This is not a cram course, but an emphasis on learning by only positive input.

Do the right thing.

5. Different personalities use various learning styles. For those who like to take exams, ARRL and numerous other sites offer multiple practice exams. Because the actual proficiency assessments are well guarded, the practice exams will not be the real deal, except in form.

<https://www.arrl.org/exam-practice> > ARRL Exam Review for Ham Radio >  
<https://arrlexamreview.appspot.com/>

6. We would suggest the on-line practice tests only as a final check-up measurement, after you have adequately prepared and are reasonably comfortable you have the fundamentals and are about ready to go.
7. REMEMBER: Poetry in motion, with a nod to Dad.  
Perfection is not required, suggested, or on the menu.  
When you pass, who cares, if you missed a few?

You've  
Got  
This!

*I can do all this through Him who gives me strength.* – Philippians 4:13 NIV



**Ham 9 – FCC & VEC, before the Exam**  
Dr. Marc & Rosemary    Review: Lt.Col. Dan 220404

1. **Obtain an FCC registration number (FRN) from CORES** (COMmission REGistration System).
  - a. The FCC no longer accepts SSN.
  - b. <https://apps.fcc.gov/coresWeb/publicHome.do>
  - c. Register on the website and receive FRN.
  - d. A valid email is required. Your password must be 12-15 characters, with capital, lower, number & special.
2. Find a Volunteer Examiner (VE) testing location from these Volunteer Examiner Coordinators (VEC).  
[www.arrl.com](http://www.arrl.com) or [www.w5yi.org](http://www.w5yi.org)
3. I recommend searching locally.
  - a. Evergreen VE team > Contact: Dan B. Belcher, danbelcher1@cox.net.
  - b. Tulsa Amateur Radio Club (TARC) > Testing: <http://w5ias.com/testing/>
  - c. Tulsa Repeater Organization (TRO) > Testing: [http://tulsahamradio.org/Area\\_Testing.htm](http://tulsahamradio.org/Area_Testing.htm)
  - d. Reach out to your preferred VE group for confirmation of date and time and your intention.
4. What to bring?
  - a. Exam fee is currently \$15, cash only. This goes to ARRL for developing and printing.
  - b. Personal photo ID, such as driver's license, student ID, or tribal enrollment.
  - c. Sharp #2 pencils and fine tip pen, with back-up. The VE may have their own, but yours will be easier.
  - d. Calculator without memory storage, if needed.
  - e. Ham license or CSCE for credit on prior completed element testing.
5. When you arrive.
  - a. Check in at VE table.
  - b. Complete the registration application, NCVEC-Form 605
  - c. You will need your FRN, Permanent home address, Permanent email, Daytime phone, Previous license.
  - d. After you complete the exam, VE sends it with this Form 605 to the VEC to verify all blocks are checked.
  - e. Then the VEC sends the info to the FCC to put in database.
6. Basic Qualifying Question.
  - a. Have you been convicted of a felony?
  - b. If yes, then submit court documents within 14-days of your app being submitted to FCC. You can take the exam.
7. Section 2 of the Form 605 is completed by a VE. This is a government operation, so everything is very tedious.
8. Take the exam!
  - a. One of the VEs will give you one of 4 exam versions and an answer sheet.
  - b. Put your name, date, and exam version on the provided answer sheet.
  - c. There are 35-questions on Technician and General with 50 questions on Extra Class.
  - d. There will be No surprises. The exam is word matched, just like the test pool.
  - e. Take your time. Complete the exam. There is no rush.
  - f. Then check to make sure things match.
  - g. Turn in to VE table.
9. They will check all paper work, again.
  - a. Three VEs will grade the exam to make sure they did it right. Bring snacks, something to while away 15 minutes.
  - b. After checking your answers, they will smile, congratulate you, and ask if you want to try the General at no fee.
  - c. You will receive a Certificate of Successful Completion of Examination. Sign it and hold on to it just in case.
  - d. If you miss too many they will ask if you want to try again for an additional fee. It will be different questions. So, you have a high probability of making it that time.
10. It will take a few days for everything to get through the system.
  - a. FCC will email your license info in a few days.
  - b. Then you will go to the FCC website to pay the government fee of \$35.
  - c. Then they will post your license call-sign. This may take up to 10 days.
  - d. Universal Licensing System: <https://wireless2.fcc.gov/UlsApp/UlsSearch/searchLicense.jsp>
11. Ham 10, First Radio guide shows you how to program the radio, what are local frequencies, and how to talk.
12. While you are fresh, begin studying for your next license, the same way. The General is still 35 questions.
  - a. The General is no more difficult, but a little more technical definitions.
13. Relax, enjoy, Life Is Good!





These are sample illustrations only. Not for filling out.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |                                                                                                                                                    |                                                                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>American Radio Relay League VEC</b><br><b>Certificate of Successful Completion of Examination</b>                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |  <b>ARRL</b> The national association for<br><b>AMATEUR RADIO</b> | <b>NOTE TO VEC TEAM:</b><br><b>COMPLETELY CROSS OUT ALL BOXES BELOW THAT DO NOT APPLY TO THIS CANDIDATE.</b>                                                                                   |
| Test Site (City/State): _____ Test Date: _____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                                                                                                                                    | The applicant named herein has presented valid proof for the exam element credit(s) indicated below.<br>Element 3 credit <input type="checkbox"/><br>Element 4 credit <input type="checkbox"/> |
| <b>CREDIT for ELEMENTS PASSED VALID FOR 365 DAYS</b><br>You have passed the written element(s) indicated at right. You will be given credit for the appropriate examination element(s), for up to 365 days from the date shown at the top of this certificate.                                                                                                                                                                                                                                                                                 |  |                                                                                                                                                    | <b>EXAM ELEMENTS EARNED</b><br>Passed written Element 2 <input type="checkbox"/><br>Passed written Element 3 <input type="checkbox"/><br>Passed written Element 4 <input type="checkbox"/>     |
| <b>LICENSE UPGRADE NOTICE</b><br>If you also hold a valid FCC-issued Amateur radio license grant, this Certificate validates temporary operation with the <u>operating privileges</u> of your new operator class (see Section 97.9[b] of the FCC's Rules) until you are granted the license for your new operator class, or for a period of 365 days from the test date stated above on this certificate, whichever comes first.                                                                                                               |  |                                                                                                                                                    | <b>NEW LICENSE CLASS EARNED</b><br>TECHNICIAN <input checked="" type="radio"/><br>GENERAL <input type="radio"/><br>EXTRA <input type="radio"/><br>NONE <input type="radio"/>                   |
| <b>LICENSE STATUS INQUIRIES</b><br>You can find out if a new license or upgrade has been "granted" by the FCC. For on-line inquiries see the FCC Web at <a href="http://wireless.fcc.gov/uls/">http://wireless.fcc.gov/uls/</a> ("Click on Search Licenses" button), or see the ARRL Web at <a href="http://www.arrl.org/fcc/search">http://www.arrl.org/fcc/search</a> ; or by calling FCC toll free at 888-225-5322; or by calling the ARRL at 1-860-594-0300 during business hours. <b>Allow 15 days from the test date before calling.</b> |  |                                                                                                                                                    |                                                                                                                                                                                                |
| <b>THIS CERTIFICATE IS NOT A LICENSE, PERMIT, OR ANY OTHER KIND OF OPERATING AUTHORITY IN AND OF ITSELF. THE ELEMENT CREDITS AND/OR OPERATING PRIVILEGES THAT MAY BE INDICATED IN THE LICENSE UPGRADE NOTICE ARE VALID FOR 365 DAYS FROM THE TEST DATE. THE HOLDER NAMED HEREON MUST ALSO HAVE BEEN GRANTED AN AMATEUR RADIO LICENSE ISSUED BY THE FCC TO OPERATE ON THE AIR.</b>                                                                                                                                                              |  |                                                                                                                                                    |                                                                                                                                                                                                |
| Candidate's Signature _____ Call Sign _____<br>(If none, write none)                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  | VE #1 _____<br>Signature _____ Call Sign _____                                                                                                     |                                                                                                                                                                                                |
| Candidate's Name _____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  | VE #2 _____<br>Signature _____ Call Sign _____                                                                                                     |                                                                                                                                                                                                |
| Address _____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | VE #3 _____<br>Signature _____ Call Sign _____                                                                                                     |                                                                                                                                                                                                |
| City _____ State _____ ZIP _____                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  | COPIES: WHITE-Candidate, YELLOW-VE Team, PINK-ARRL VEC<br>MVE 03/2020                                                                              |                                                                                                                                                                                                |

**NCVEC QUICK-FORM 605 APPLICATION  
 AMATEUR OPERATOR/PRIMARY STATION LICENSE**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                              |                                                                            |                                        |                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----------------------------------------------------------------------------|----------------------------------------|--------------------------------------------------------------------------------|
| <b>SECTION 1 - TO BE COMPLETED BY APPLICANT</b>                                                                                                                                                                                                                                                                                                                                                                                                     |                              |                                                                            |                                        | <b>PLEASE PRINT LEGIBLY!</b>                                                   |
| PRINT LAST NAME                                                                                                                                                                                                                                                                                                                                                                                                                                     | SUFFIX (Jr., Sr.)            | FIRST NAME                                                                 | M.I.                                   | STATION CALL SIGN (IF ANY)                                                     |
| MAILING ADDRESS (Number and Street or P.O. Box)                                                                                                                                                                                                                                                                                                                                                                                                     |                              |                                                                            |                                        | FEDERAL REGISTRATION NUMBER (FRN) - IF NONE, THEN SOCIAL SECURITY NUMBER (SSN) |
| CITY                                                                                                                                                                                                                                                                                                                                                                                                                                                | STATE CODE                   | ZIP CODE (5 or 9 Numbers)                                                  |                                        |                                                                                |
| DAYTIME TELEPHONE NUMBER (include Area Code)                                                                                                                                                                                                                                                                                                                                                                                                        |                              | E-MAIL ADDRESS (MANDATORY TO RECEIVE LICENSE NOTIFICATION EMAIL FROM FCC)  |                                        |                                                                                |
| <b>Basic Qualification Question: *ANSWER REQUIRED IN ORDER TO PROCESS YOUR APPLICATION*</b><br>Has the Applicant or any party to this application, or any party directly or indirectly controlling the Applicant, ever been convicted of a felony by any state or federal court? <input type="checkbox"/> YES <input type="checkbox"/> NO<br>If "YES", see "FCC BASIC QUALIFICATION QUESTION INSTRUCTIONS AND PROCEDURES" on the back of this form. |                              |                                                                            |                                        |                                                                                |
| I HEREBY APPLY FOR (Make an X in the appropriate box(es)):                                                                                                                                                                                                                                                                                                                                                                                          |                              |                                                                            |                                        |                                                                                |
| <input type="checkbox"/> EXAMINATION for a new license grant                                                                                                                                                                                                                                                                                                                                                                                        |                              | <input type="checkbox"/> CHANGE my mailing address to <b>above</b> address |                                        |                                                                                |
| <input type="checkbox"/> EXAMINATION for upgrade of my license class                                                                                                                                                                                                                                                                                                                                                                                |                              | <input type="checkbox"/> CHANGE my station call sign systematically        |                                        |                                                                                |
| <input type="checkbox"/> CHANGE my name on my license to my new name                                                                                                                                                                                                                                                                                                                                                                                |                              | Applicant's Initials: To confirm _____                                     |                                        |                                                                                |
| Former Name: _____<br>(Last name) (Suffix) (First name) (MI)                                                                                                                                                                                                                                                                                                                                                                                        |                              | <input type="checkbox"/> RENEWAL of my license grant                       |                                        |                                                                                |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                              | Exp. Date: _____                                                           |                                        |                                                                                |
| Do you have another license application on file with the FCC which has not been acted upon?                                                                                                                                                                                                                                                                                                                                                         | PURPOSE OF OTHER APPLICATION |                                                                            | PENDING FILE NUMBER (FOR VEC USE ONLY) |                                                                                |

**I certify that:**

- I waive any claim to the use of any particular frequency regardless of prior use by license or otherwise;
- All statements and attachments are true, complete and correct to the best of my knowledge and belief and are made in good faith;
- I am not a representative of a foreign government;
- I am not subject to a denial of Federal benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. § 862;
- The construction of my station will NOT be an action which is likely to have a significant environmental effect (See 47 CFR Sections 1.1301-1.1319 and Section 97.13(a));
- I have read and WILL COMPLY with Section 97.13(c) of the Commission's Rules regarding RADIOFREQUENCY (RF) RADIATION SAFETY and the amateur service section of OST/OET Bulletin Number 65.

Signature of Applicant:

**X** \_\_\_\_\_ Date Signed: \_\_\_\_\_

**Ham 9B – FCC after the Exam**  
Dr. Marc & Rosemary 220528

1. When you register, it is crucial that you make notes. The FCC website is intolerant of any deviation.
  - a. Record USERNAME.
  - b. Record PASSWORD. Your password must be 12-15 characters, with capital, lower, number & special.
  - c. Record EMAIL. This is your only access. You cannot believe the number of problems with improper emails.
  - d. Record FRN.
2. After the exam.
  - a. The VE Liaison turns in the data to the VEC, ARRL.
  - b. ARRL records to FCC.
  - c. FCC sends you an email, generally within a couple of days.
3. Follow the email and web instructions meticulously.
  - a. The process can be made 'long and convoluted' or 'short and sweet'.
  - b. About 25% do something incorrect, then, must get help to resurrect their file.
  - c. Please, please, please be very careful on what you click.
  - d. If done properly, you are a few clicks from being licensed.
4. This is the email. The links in this PDF work.

Applicant Name: Last, First  
FRN: 0011111111  
File Number: 0010051444  
Receipt Date: 05/16/2022  
Call Sign: N/A

This email is to notify you that the application for Last, First, located under FCC file number 0010051444, was submitted to the FCC on 05/16/2022 by ARRL/VEC. Payment for this application must be received within 10 days of 05/16/2022 to avoid application dismissal.

The [FCC Pay Fees System](#) link below provides for electronic payment of required fees by credit card. Login to Pay Fees using your Username and password and follow the on-screen prompts.

[https://apps2.fcc.gov/Batch\\_Filer/login.cfm](https://apps2.fcc.gov/Batch_Filer/login.cfm)

If you require assistance with the fee payment process or have questions regarding this application, please contact the ULS Licensing Support Center at (877) 480-3201, Option 2; TTY (717) 338-2824, or via the web at <https://esupport.fcc.gov/request.htm>.

Please do not respond to this e-mail, as this mailbox is not regularly monitored.

Regards,  
Federal Communications Commission

5. Heed the CORES message. Use of USER NAME is the way to enter.
  - a. Websites change, so it may be some different from these notes. 'Follow-the-money' links.
  - b. Two choices are given to login.
  - c. Use your User Name to login.
6. When you arrive at User Home page, carefully follow only the 'pay' leads.
  - a. **User Home:** > Manage Existing FRN / FRN Financial / Bills and Fees
  - b. **Manage Existing FRN:** > FRN Financial
  - c. **FRN Financial:** > View / Make Payments
  - d. Again **FRN Financial:** > Open Bill (or appropriate tab). PAY.
7. When done properly, you will get a green light. An email granting your license is sent usually within 24 hours.

This email is to notify you of the recent grant of your application(s).....This link will remain active for 30 days.

[Authorization Link](#)

If you cannot access your authorization(s) using the link, you may download the authorization(s) from [License Manager](#) by following the instructions available at <https://www.fcc.gov/how-obtain-official-authorizations-uls>. If you have any questions you may contact the Licensing Support Center at (877) 480-3201, Option 4; TTY (717) 338-2824, or via the web at <https://esupport.fcc.gov/request.htm>.

8. Save a copy of your license.
9. Relax, enjoy, Life Is Good!



## Ham 10A – First Radio: Simplex for Real

Dr. Marc & Rosemary 221108

1. So now you are a Ham. You observed on the FCC database that your license is online. What do you do now?
2. Which radio you choose depends on your expected use, which will likely change. Perhaps most people pursue ham radio for emergency capabilities. Our recommendations orient to reliable, always-available communications.
3. Before deciding on a radio, we need to address Simplex and Duplex.  
Simplex is just what it sounds like, Simple: It is one radio talking directly to another radio on the same frequency.  
Duplex is one radio talking through a repeater system to another radio, using different transmit and receive signals.
4. Emergency communications must occur regardless of outside circumstances. So, Simplex is the only dependable mode, when disaster or a situation outside your control happens. (\$tuff hits the fan, \$htf.) (Keep it simple Sam, Kiss)
5. **Radio:** The transceiver category is mobile/base, since it operates from 12 Vdc. One can operate fixed or mobile. The unit should be a minimum of 50-Watts to operate in our urban, hilly terrain. Select both VHF/UHF to communicate with Nets, SuperLink and weather. Icom and Yaesu are highly reputable. Anytone, BTech and TFT have a following. Costs about \$200-300.
6. **Power:** To obtain 12 Vdc, a power supply converts from 120 Vac wall power. Output current should exceed 15 Amp or whatever your radio requires. Variable can destroy a radio. MFJ is most common. Costs about \$100.
7. **Antenna:** To get the signal into the air, use a quality antenna with gain and elevation. If space is limited or you are behind a hill, a Not-Line-Of-Sight (NLOS) Compactenna works fine. J-pole is great on VHF, a dual band J-pole also works UHF. Colinear improves gain. Keep antenna in attic to protect from lightning and HOA. Diamond, Comet, & Tram make conventional. I use Compactenna 9", Diamond X-50, dual-band J-pole. Costs about \$100.
8. **Coax** connects the antenna to radio. Lower loss is better. Keep length as short as possible. RG-213/U is lower loss and better but larger and stiffer. RG-8X is much smaller and more flexible, but use in a high noise, low signal area is marginal. Cost about \$25.
9. **Emergency power:** This depends on your unique needs, desires, and budget. The minimum is a back-up battery like an alarm battery. A charger is highly-desirable. Solar panels are off-the-grid. Generators (Honda EU2200i) provide other support. Costs depend on size of credit card.
10. Plug it in, hook up antenna. Switch to Frequency mode (VFO) and you can talk to most anyone around the county.  
More power with a specialty, higher antenna can reach over 100 miles.
11. National calling simplex frequency for VHF = 146.52 or UHF = 446.0 Mhz. Then move to another such as 146.470.  
More commonly, we monitor a frequency our network group selects to use.
12. **Hand-held:** A handi-talkie is inexpensive, but not only radio.  
It is often the first investment, because of the incredibly low price for Baofeng about \$28.  
I have a couple. They are convenient for a carry radio. The cheapy Baofeng causes no tears if lost or damaged.  
Their power rating is only 4 – 8 Watts, which is similar to FRS, GMRS, or CB hand-talkies from big-box stores.  
Their performance improves somewhat by connecting to a better antenna, like the base described above.  
Caution: Because of low power, they almost require a remote repeater. Even then, communication is not assured.  
From our group experience, they are not suitable or dependable for an emergency communication radio.
13. How to talk.
  - a. Select appropriate frequency.
  - b. If hand-held, hold antenna as vertical as possible to match vertical polarization of others.
  - c. Press PTT. Speak in normal voice. Microphone is small 1/16" hole on front. Space 1 – 2" to side of mouth.
  - d. I am available to talk to anyone: My call-sign (NM0D) monitoring.
  - e. Calling specific person: K5CAY this is (de) NM0D.
  - f. Answering: My call-sign, their call-sign (K5CAY), go ahead Fred.
  - g. Discussion: Genteel. Whatever you want, like a good neighbor. No music.
  - h. Ending call: 73 (goodbye, best wishes, etc) NM0D. If no answer, just say: NM0D.
  - i. Relax: Just be yourself. If you miss something, so what? Go with the flow.
  - j. AVOID: Anything that sounds like CB, the hangout of unqualified & unskilled.
14. Welcome to real radio, where you can experiment, aid, or just chat. The radio which works.



**Ham 10B – First Radio: Duplex to Reach Out**  
Dr. Marc & Rosemary 221108

1. Duplex allows a radio to talk via a repeater. A repeater is a remote base radio, which can hear your radio, boost the signal, then retransmit to another radio. A repeater may work up to 30-mile or so radius from the station. In our area, most do not do that well, because of terrain and older equipment.
  2. Repeater links can expand from Kansas to North Texas, using Tulsa Amateur Radio Club (TARC) network.
  3. Echolink uses the Internet to extend radio range even further around the world.
  4. Analog radios use traditional electronics and are more reliable in an emergency. Digital offers more features and can link around the world.
  5. Your radio must be programmed to talk on the correct frequencies in the proper way.  
What do I need before programming?
  6. Go on the web to find frequencies for the repeater you want, such as Tulsa Amateur Radio Club. RepeaterBook.com is a common source.
  7. Receive, RX, downlink, repeater output: *The receive frequency displays on your radio screen.*  
Transmit, TX, uplink, repeater input: *The transmit frequency is what the repeater hears.*  
Offset, sometimes used instead of Transmit: *Offset is the difference between the receive and transmit.*  
CTCSS, Continuous tone-coded squelch system: *Sub-audible tone allows multiple groups on freq w/o hearing*
  8. Think about the meaning of offset. That is the separation the transmitter must be from receiver to stay within the band.  
+ means add the offset to the RX frequency to get the TX frequency.  
VHF offset is normally 0.6 MHz, UHF is normally 5.0 MHz.
  9. Program a channel with your first frequency. I use channel 2, so I have channels 0 and 1 for simplex.  
Repeater example: RX, +offset, CTCSS      RX, TX, CTCSS  
Tulsa Repeater Org: 146.805, -0.6 MHz, 88.5      146.805, 146.205, 88.5  
Tulsa Amateur RC: 443.85, +5 MHz, 88.5      443.850, 448.850, 88.5
- CTCSS also called PL  
for Private Line
10. To operate duplex, switch your radio to Channel Mode (Memory Recall, MR).
  11. A word about VHF & UHF. In our region, you want and need both.
    - a. Most local communications and Nets operate on VHF.
    - b. However, the TARC SuperLink of repeaters from Kansas to Oklahoma, Arkansas, and Texas uses UHF.
    - c. The National Weather Service operates emergency weather Nets on the SuperLink UHF gateway. Without UHF, you cannot talk or listen.
    - d. My Icom 2730, and some others, has two separate receivers. This allows cross band operations when one is set for VHF and one for UHF. Not frequently used, it does occasionally come in beneficial in remote situations.
  12. Remote programming.
    - a. Obviously entering more than one or two frequencies with tones would be a pain in the laticibles.
    - b. Obtain a programming cable for your radio.
    - c. Obtain CHIRP software for your computer.
    - d. Program the channels you want to use on the computer.
    - e. Download the files to your radio.
    - f. It is still beneficial to know how to manually do a channel, when something different arises in the field.
  13. We have a complete article on how to do Chirp.





## Ham 10C - First Not Only Radio: Setup

Dr. Marc & Rosemary 221108

1. For dependable, emergency communications, you must have a more powerful mobile/base radio of about 50W.
2. The most common radio is a throw away Handi-Talkie. The cheapest is a Baofeng UV-5R series, at about \$28. The better choice is the GT-5R upgraded by Radioddity, still with the Baofeng label. Buy through Baofeng Tech (BTech) store, since they are a company in the US that will assist you on problems. The step-up 8-watt is an even better choice at about \$70. At that price buy a real Icom or Yaesu.

3. The instructions are for the Baofeng / Radioddity series of inexpensive radios.

4. Charge radio before you turn on the first time.

To turn on: Rotate top knob clockwise, rotation increases volume

5. [PTT] Transmit while holding button down, receive when release.

[VFO/MR]: Switches between Frequency (variable frequency oscillator) and Channel (memory recall) modes.

[A/B] Switches between upper and lower display for RX.

[▲][▼] Scroll up / down.

[MENU] Enter menu mode. Then confirms and save entry.

[EXIT] Change between menu steps. Quit current operation.

If you screw up, hit exit, and start over.

6. Use Simplex channel:

- a. Set to Frequency mode: Press [VFO/MR]. Channel # on right disappears.
- b. Enter RX/TX frequency, no decimal: 146.520
- c. Ready to talk.

7. Program a channel:

- a. Switch to upper display: Press [A/B] until get arrow on left of upper line.
- b. Set to Frequency mode: Press [VFO/MR] until channel # on right disappears.
- c. Delete prior data (menu28), e.g. chan 2: [MENU]...[2][8][MENU]...[2][MENU]...[EXIT]
- d. Set TX CTCSS tone (menu13): [MENU]...[1][3][MENU]...88.5[MENU]...[EXIT]
- e. Enter RX frequency, 6 digits: 443850
- f. Store RX (menu27), e.g. chan 2: [MENU]...[2][7][MENU]...[2][MENU]...[EXIT]
- g. Enter TX frequency, 6 digits: 448850
- h. Store TX, e.g. chan 2: [MENU]...[2][7][MENU]...[2][MENU]...[EXIT]
- i. Set to Channel (Memory recall) mode: Press [VFO/MR]. Channel # on appears on right.

8. Program a simplex channel:

- a. Follow above steps to program: Substitute new channel in step c.
- b. If CTCSS: Follow step d. If no tone, ignore d.
- c. Continue: Substitute new frequency and channel in e, f, i. Ignore g.

9. Program a repeater:

- a. Set to Frequency mode: Press [VFO/MR]. Channel # on right disappears.
- b. Enter repeater out, your receive: Press [▲][▼] or enter frequency from keyboard.
- c. Set frequency offset, 0.600 or 5.000 [MENU]...[2][6][MENU]...600[MENU]
- d. Set direction, [▲][▼] for +/-: [2][5]...[▲][MENU]...[EXIT]
- e. To save to memory channel: see manual program a channel.

10. Use Menu shortcuts:

- a. Set desired value, e.g. squelch: [MENU] [0][MENU] [▲] / keypad [MENU saves] or [EXIT cancels]
- b. Keys are labelled with first 10 menus: 0=squelch, 1=freq step, 2=TX power hi/lo, 3=save bat, 4=VOX, etc

11. Other fun keys.

- a. [CALL] Switch to FM receive. Long= alarm. Press again to turn off.
- b. [MON] Turn on flashlight. Again= flash. Press again to turn off.
- c. [BAND] Switch bands. Changes depending on mode.
- d. [MENU][7] TDR, turn on dual receive for both A and B.
- e. [MENU][22] MDF-B, display name for channel B.

12. Life is good. Enjoy



**Ham 11 – More First Radio**  
Dr. Marc & Rosemary 221108

1. For dependable, emergency communications, you will need a VHF/UHF mobile-base transceiver with power supply and antenna, capable of operating Simplex. We usually end up with more than one radio for different purposes.
2. First the disclaimer. Baofeng radios by definition are cheap. They do not compare to the high-end units like Icom or Yaesu. We cannot compare the two in performance or price.
3. The cheap price has made the Baofeng by far the most popular hand-held HT ham radio for VHF/UHF use. The cheapy Baofeng UV-5R is \$28. It works ok as a carry. It is what I use as a ‘don’t care if it gets damaged’ unit when in the woods or other harsh environments.
4. If you want a little more power and a step up, Baofeng BF-F8HP has a theoretical 8-watts. Actual power measure is a little less. This model has interchangeable parts with the UV-5R. Cost is about \$70.
5. For more power they have UV-9R. But now you are approaching the price of lower end, higher quality Icom and Yaesu.
6. Like Tim Allen said, “mo’ power is better.”
7. One thing that is very helpful is a better, longer antenna. Replace the stubby rubber duck antenna with a longer, better radiator like Comet or Shengda. We have tested antennas and the highly touted Nagoya NA-771 just does not stand-up. Even better is a short coax to a mobile or base antenna.
8. You will need a programming cable if you fiddle much with configuring channels. Use only the FTDI chipset programming cable. Several Elmers have a cable, so purchase is not necessary now. They will likely help you get setup. We will have a separate memo on programming.
9. Only buy Baofeng from the BTech store on Amazon. They are the official US distributor who provides product support. Unfortunately, on Amazon, some of the other Baofeng sellers are knockoffs.
10. If your credit card has room, Icom and Yaesu make some tremendous units with super features. Although I have several other rigs, my personal all-around favorite is the *Icom 2730*, for effectiveness, ease of use, and mounting flexibility.
11. When you decide on which radio and receive it, we can get together to make it work for you.
12. Remember, ham radio is about people. Virtually everyone will be happy to be an Elmer to you. Before you invest big bucks, talk to two or three Elmers. We are an opinionated lot, and our set-in-ways may be different from your needs. Seldom do two of us agree on equipment or mode of communications, but we are still hams.
13. If you are looking to purchase a higher quality radio, I have had good results with these sellers: Main Trading Company in Paris, TX is a small personal store with lots of stuff. Ham Radio Outlet with numerous stores is the big league. Universal Radio is a little eclectic. GigaParts is a broader category amateur and computer group.
14. Where you buy becomes even more crucial for components. I seldom buy components from Amazon because of knock-offs. On things like coax and connectors, it is hard to tell if they are worthless. Besides these distribution companies, the following provide quality component support: DX Engineering, Palomar Engineers, and LDG.
15. The big gorilla in equipment is MFJ Enterprises. I would like to like them even better than I do. Although they ‘make’ one of about everything, and they are a U.S. company, often their performance is a small notch below the competition. But there is a large marketplace for their equipment and I still buy from them. Always the trade-off for higher performance is greater cost. Their advertised prices in magazines are seldom what vendors have in stock.
16. All the vendors noted have websites, with all transactions done on-line. Most of these I have talked to a real live person, who speaks English as a first language, when I had a question. At my hearing level, that is crucial.
17. I am a firm believer Amateur Radio needs lobbyists and an advocate in D.C. Although not perfect, the biggest, oldest, most influential ham group is ARRL. Join them. They have a number of different magazine choices, one just for new hams. There are other excellent groups, and I have former students who are editors, like CQ.
18. You do not need everything or the best today. As experimenters we are always looking for better.
19. Life is good. Enjoy.



## Ham 18 – Elmer the Elder – Just for fun traditions

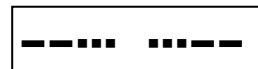
Dr. Marc 221108

1. *What or who is Elmer?*
2. You can believe everything on the internet, right? The web says the term started in an article a few years ago. “The term “Elmer”--meaning someone who provides personal guidance and assistance to would-be hams--first appeared in *QST* in a March 1971.”
3. The internet opinion would not be entirely correct. The term may have first appeared in an article then, but that was not the first use.
4. We are considerably older than the date of the article and Elmer has been around at least since the 1950s from my personal experience. I realized today that I have been around doing this stuff for half-as-long as ham radio has been around. Because of the way math works, few younger than us will ever be able to say that. Whoa, but I digress.
5. Elmer appears to be an outgrowth of World War II, when a generation of young electronics whizzes came out of the military.
6. Traditionally, older, experienced guys are called ‘Elder’ in religion and many cultures around the world. But young experienced guys resented the implications of being knowledgeable required the meaning of older, when they were 23 years of age. Besides, Elder carries too religious of a context. In addition, note, the British tradition below.
7. So, the morphology is that Elder became Elmer in the radio world. Elder → Elmer
8. For any gentleman, those associated with British and Northeastern radio often use the abbreviation *OM* for *Old Man*.
9. What would be the fairer gender? *YL* for *Young Lady*. In keeping with tradition, *wife* is *XYL*. Why? *Ex-Young-Lady*.

10. Now you know.

11. *What is 73?*

73



12. The term means something to the effect of “Best Regards” or “Be well.”
13. The term dates to the earliest days of telegraph when the Old West operator was sending the same messages over and over. Since telegraphers were working for the railroads and Western Union, they were a tight knit group, who developed standardized practices to make their job easier, with less likelihood of mistakes.
14. Number codes were well defined by 1857 and published in the telegraphers training manual. Western Union accepted and solidified the numeric assignments in 1859 as the “92 Code” reflecting the then highest number.
15. The code 73 made a slight morph from its original meaning of “My love to you.” The operators on opposite ends of the line moved the sentiment to the equivalent of “Goodbye.” That easily transitioned to the current idea of “Best Regards.”

88



16. There is a code for the more emotive. Code 88 translates as ‘Love and Kisses.’
17. As an interesting side-note, one of my first-cousins and his wife were professional telegraphers for the railroad from the 1950s into the 1980s. The technology has not been gone that long.
18. That is the story of how language morphs over time to take on a seemingly unrelated meaning.
19. *What is a common tool today which came out of the telegraph industry in 1857?*

20. Mathias Klein, now some of you know the answer.

21. Mathias Klein emigrated from Germany to Chicago as a blacksmith. His first job was to repair a broken arm of a side cutter pliers for a telegraph lineman in the nascent communications business. Shortly afterward, the communications installer returned with the other side broken. Klein had made his first pair of pliers.

22. Through forging, materials, and sharpening, the Klein lineman is the undisputed premier pliers today. They are a hammer, steel cutter, and copper twister for electrical and iron workers. They are so well-respected that the design is commonly referred to simply as Kleins.

23. Their logo reflects the heritage.

24. Life is good. Enjoy.



God said:

*Let there be light,  
And created the electrical  
trade.*

It is a family thing.  
My dad, me, my son, grandson.  
Father-in-law, brother-in-law,  
his son



**Ham 30 – Why General or Extra**  
 Dr. Marc & Rosemary 221108

1. You have just earned your Technician license. Out of curiosity, you may have tried the General test, after successfully passing Tech. Elmers, who are General or Extra class, encourage you to get your General ticket. Why would you want to?

2. Because you can!

3. The Tech ticket is the entry platform and allows you some awesome abilities. Even if you are still building your first station or your dream station, the General moves your training, education, and experience along. Extra gives you all privileges

4. In our ham world, “braggin’ rights” are encouraged, mostly because it encourages your confidence in your capabilities.

5. Second, the license makes you an Elmer, because you have experience to share and to reassure others.

6. Administration of ham exams is by General or Extra class licensees. Get your General. Contact ARRL to take the open-book Volunteer Examiner (VE) quiz. Then you are qualified to administer exams to Techs, which helps others into our fold. Extra can administer all exams.

7. The General exam looks just like the Tech, but with a different set of questions. The pool is about 400 questions and your exam is 35 of those, one from each category. Sound familiar? Since you passed the Tech, we know with certainty that you can pass the General, even if you only managed 5 correct on the curiosity exam after the Tech.

8. We have prepared a General License Study Guide which follows the proven and effective Technician License format.

9. The Technician license, because of frequency allowances and nature’s impact, makes it a local communication vehicle, although a critical one during emergencies.

10. The General opens the high-frequency (HF) bands, allowing the famous around-the-world communication ability for which hams are legendary. You can operate on radio frequencies from near DC to daylight.

11. Where Technician class activity is pretty well-defined in terms of radios, antennas, and equipment, the General opens-up the role of creativity. No two antenna installations are the same.

12. Elecraft, TenTec, and FlexRadio are top-flight radios designed and manufactured with USA technology. The same international vendors that make VHF/UHF make HF. Unlike VHF/UHF, new radio designs still come along, thanks to Software Defined Radio (SDR) technology. Digital and computers play a significant role in modern HF ham communication.

13. My HF rig is an Icom 7300, compact, software defined, touch-screen, waterfall, premium audio, *most sold HF-transceiver in the history* of ham radio. It is near the low-end price. It is very nice. No, it is excellent.

14. But, when there is three-times the money in the bank, I would love an Elecraft KX3, ultra-compact, 160 : 2-meter take-anywhere transceiver, weighing in at 18 ounces and the size of a 7½” long 2x4. Dreaming is cool and can be very expensive.

15. You can build a software defined receiver with a Raspberry Pi, a dongle, and on-line software. Oh, the options that await you.

16. Meteorology, weather, and ionosphere play a key role in successful contacts. So, terms like sun-spots and meteor-showers take on new significance.

17. Let’s go, General.

18. Life is good. Enjoy.



**Icom 7300, HF SDR**



**Elecraft KX3**



**20M – VHF – UHF  
COMPACTenna**

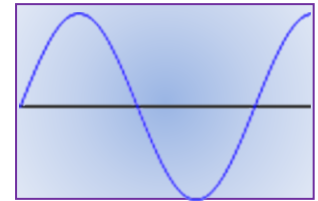




## Ham 54 – Counterpoise and Dual-Band Antenna, Ham Brew

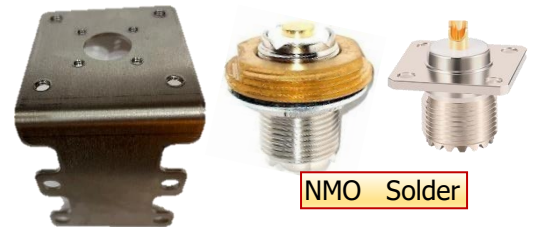
Dr. Marc & Rosemary 221108

1. An antenna is radiating into the air around the earth. Therefore, the ground is part of the circuit. How does it couple to the earth?
2. A counterpoise, sometimes called a ground-plane, completes the antenna path. The counterpoise is simply a conductive metal surface. The impedance coupling depends on the metal length, surface area, height above ground, and earth characteristics. Tuning to 'match' is simply shortening lengths.
3. First, the physics. For the Tech exam, you learned to do this in your head. Frequency in MHz \* wavelength in meters = 300. For 150 MHz, the wavelength is 2 meters or 78.7".
4. To get peak energy transfer, one-quarter wavelength is optimum as seen on the figure. The 2-meter VHF band is 144-148 MHz. For the center frequency, wavelength is 80.9". One-quarter length (a) is 20.22". For 435 MHz UHF, length (b) is 6.8".
5. Bend the two sides from a continuous rod. Separate (c) by about 10 mm. Since this is in near-field, it is not critical to radiation. Solder to the SO-239.
6. What is a counterpoise? It is simply a metal base for mounting 3 items.
  - a. Attachment to a mast or support. Use hose clamps or u-bolt.
  - b. A connector between the antenna and coax (feedline).
  - c. Radials for coupling to ground.
7. Radials are extensions to improve the impedance coupling. On a portable radio, a single conductor may comprise the counterpoise, called a tiger-tail. A minimal fixed operation uses 3 radials. These were typical in old CB set-ups. A better system uses four, which provide symmetry to the radiation pattern.
8. How long should the radials be? One-quarter wave or 20.22" for resonance. A dipole is a quarter wave antenna with one radial. Distance is measured from the antenna. The photo is 18" rods. With the connector and bracket, the length is about right. Shorter does not critically affect SWR.
9. Few antennas have a good SWR match with the earth. The impedance, and resulting SWR of the antenna, is influenced by the coupling of the radials. Some manufacturers use horizontal radials. A drop of 45 degrees lowers impedance and SWR.
10. Dissimilar metals are problematic. Stainless steel is the preferred mount. Only connect bronze or copper to the stainless. Other materials corrode more, which will cause a potential difference in the metals and crackling in the signal over time. Aluminum can connect to aluminum. Aluminum should never be in contact with steel or copper.
11. The RF-connector depends on the antenna. The mounting hole is 5/8". Two types are common with SO-239 on the bottom for coax connection. The difference is the top, antenna connection. One is a solder connection for panel mount. The other is a mobile mount NMO (New MOtorola). Many NMO connectors come with coax pre-installed, requiring a larger mounting hole.
12. Now the challenge. Come up with a configuration that anyone can build.
  - a. Parts must be readily available, like Home Depot or Amazon.
  - b. Cost must be low.
  - c. Performance must be SWR <2.0
  - d. Device must be rugged, not easily damaged and looks reasonable.
13. Build time is less than two-hours with SWR 1.3. These are the parts.
  - a. Mount: L-bracket with 5/8" hole for RF, 4 threaded holes for radials, 4 threaded holes for SO-239. Brett, KI5TAX has a custom design.
  - b. Radials: 4: 18" x 1/8" rods or 1/4" tubing. *Lowes*.
  - c. Connector: 4: Spade lugs for #12 AWG, crimp to rods, then solder.
  - d. RF: SO-239 or NMO to match antenna. *Amazon*.  
Leave >1.5" circle clear in the middle for NMO-type antennas.
  - e. Bolts: 4: 10-32 x 3/8" with washers for radials.  
2: 6-32 x 1/4" for SO-239 mount.
  - f. Coax: RG-213U is important. RG-8X does not work well for VHF/UHF.
14. Life is good. Enjoy!

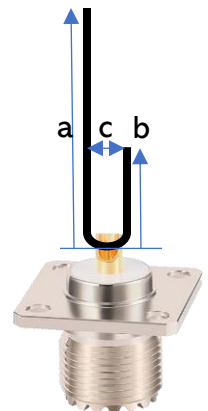


$$\lambda(m) * f(\text{MHz}) = 300$$

Fun project  
Partially fill a cup with water.  
Put 2 different metals in water.  
Use a dc voltmeter to measure  
voltage between the metals.  
That potential is causing  
corrosion.



NMO Solder



## Ham 60 – VHF/UHF Station Checklist

Dr. Marc & Rosemary 221108

1. You are following the ham advice of *Be Prepared: Get licensed, Get a real-radio, Get radio-active.*
2. You have the license, but need a station to exercise your privileges. All the info can be overwhelming. This is a simple check list.

| <input checked="" type="checkbox"/> | id | Component                   | Basic                             | Optimal                                   |
|-------------------------------------|----|-----------------------------|-----------------------------------|-------------------------------------------|
|                                     | a. | Antenna                     | 1/4 wave ham-brew                 | Not-line-of-sight (Compactenna 9" or 7")  |
|                                     | b. | Counterpoise                | Ham-brew stainless                |                                           |
|                                     | c. | Location                    | In top of attic                   | Move a few inches to solve problems       |
|                                     | d. | Coax                        | RG-213/U w/ PL259 ends            |                                           |
|                                     | e. | Mast                        | 1" or 1-1/4" PVC                  | 1" EMT thin conduit does not flex in heat |
|                                     | f. | Mounting base               | Pipe flange mount                 |                                           |
|                                     | g. | Coax flex hook-up           | 3' RG-8X                          | RG-213/U                                  |
|                                     | h. | Connector                   | Barrel connector w/ SO-239        |                                           |
|                                     | i. | Ferrite beads, if needed    | 4 or 5 are minimum                | 4 or 5 Mix-31 snap-on                     |
|                                     | j. | Ground bar & connectors     | Copper, bronze, stainless         |                                           |
|                                     | k. | Bar bonding conductor, #10  | Connect bar to rod or intersystem |                                           |
|                                     | l. | Ground rod & clamp          | 8' copper clad in flower bed      |                                           |
|                                     | m. | Rod bonding conductor, #6   | Connect rod to utility ground     |                                           |
|                                     | n. | Antenna discharge unit, #14 | Connect coax to ground bar        | PolyPhaser IS-50UX-C0                     |
|                                     | o. | VHF/UHF radio               | TYT TH-7800                       | Icom 2730                                 |
|                                     | p. | Power supply 13.8 VDC       | TekPower TP30SWI                  | Astron SL-15R                             |

3. The Icom 2730 gives the best performance to cost ratio with VHF/UHF, cross-band, two receivers, large crisp brighter numbers, ease of controls, better mic audio, and decent power at 50 Watts.
4. A quick primer introduces signal (S) to noise (N) ratio (S/N). If the noise is high, a weak signal may not be above the noise and becomes unhearable. Many factors influence one or the other.
5. Some switch-mode power supplies may add 2-bars of noise when there is no signal. If that blocks low level signals, replace with a linear power supply.
6. If you have noise, crackle, cannot hit repeater, or cannot hear, several things are critical to squeeze the last bit of signal. Earth is the other-half of the antenna system. Different from a power (60 Hz) ground, a radio-frequency (RF) ground network requires a ground rod, single-point ground bar, bonding all-metal, and bonding coax. Then, add ferrite beads to coax. Next, use 'not line-of-sight' antenna. If still noise issue, add ferrite beads to power cords. A *properly installed* radio can still be used in inclement weather, when you need it most. Ours stay on. So does Channel 7 (Wx5TUL) and TV 6.
7. For weak signals, RG-213/U is necessary. If you are in a strong signal, RG-8X may work for a few feet.
8. An elliptical polarization, NLOS antenna can get through where a vertical polarization may suffer. Generally, the 9" Compactenna is better. But the 7" has lower gain, making take-off angles different, which counteracts some RF noise resulting in better S/N (signal to noise ratio) performance.
9. A story always makes the illustration more relatable. This week, another ham got his station working. He lives behind a big hill. Expectedly, he was having normal difficulty communicating. So, he went through the steps. First, he obtained the top-notch Icom 2730 radio which assures reliable, easy to see, easy to use operation. He made a ham-brew counter-poise and added the 'not-line-of-sight' 9" Compactenna. With the antenna on his table, he could hear and talk to some stations. He added 4 ferrite beads and much of the background noise was gone. He installed the antenna in the top of the attic. He could hit several repeaters, but not Evergreen. Then he installed a RF single-point ground bar, connected it to a ground rod, and bonded his coax to further quieten. His story repeats often.
10. Relax. You are not unique if you do not understand everything.  
*Everyone, yep everyone, is still trying to figure what works best for their location. Talk to an Elmer.*
11. For newcomers, it is difficult to believe that other hams will actually help you. 'Ham Rescue' will even help with your install, at no charge. They made our initial repeater installation at Evergreen. Why? With more radios on, there are more options to connect with in an emergency. It is the culture, communications, and camaraderie.
12. If you want more details or additional info, you can find most anything from our numerous other articles.
13. Life is good. Enjoy!



**Ham 61 – Battery, Maintainer, Solar**  
 Dr. Marc & Rosemary 221108

1. You are following the ham advice of *Be Prepared: Get licensed, Get a real-radio, Get radio-active.*
2. What is the number one stated purpose for why most people get their ham license? Be prepared for emergency operations. That covers a lot of options from power outage, to cell outage, to weather, to other disturbances.
3. Too many get their license, but are not radio-active, so the radio is unusable when wanted.
  - a. Ham is not like CB; there is no Channel 19 to call your local trucker, when you want to know the road ahead.
  - b. If you are not radio-active on a Net, there is no one to talk to in an emergency.
  - c. A Net comprises three crucial things.
    - i. Who: The people with whom you can talk.
    - ii. Where: The frequency on which you talk.
    - iii. When: The time that someone will be there.
4. To be radio-active, there must be a real-radio, that is working.  
 So, back-up power becomes necessary regardless of the infrastructure.



| Radio Specs                        | Receive             | Transmit           | Total  |
|------------------------------------|---------------------|--------------------|--------|
| Current, 12V full charge           | 1.4 A               | 10 A               |        |
| Current, 7.4V drained              | 1.7 A               | 13 A               |        |
| Typical operating day              | 8 hr                | 20%                |        |
| Amp-hours battery capacity for day | 1.4A * 8h = 11.2 Ah | 10A * 1.6h = 16 Ah | 27 Ah  |
| Watt-hours = Ah * 12V              | 136 Wh              | 192 Wh             | 328 Wh |
| How long will 7 Ah battery operate | 7Ah / 1.4A = 5 h    | 7Ah / 10A = 0.7 h  |        |



5. **BATTERY Emergency:** Select a 12 Vdc rated battery, that is sealed and does not vent.
  - a. Gel-cell used for alarms is a good choice. Deep cycle is a necessary idea.
  - b. LiFePO4 (Lithium Iron Phosphate) is smaller with greater energy density and greater cost.
  - c. Radio power demand stays constant, so as battery voltage runs down, the current draw by the radio goes up.
  - d. The battery size is determined by how long you intend to operate and other added devices.
6. **BATTERY Size:** Size is total Amp-hour (Ah). How big do you need \_\_\_\_? 35 Ah ~\$80.
7. **MAINTAINER Wall-wart:** A maintainer is just to keep an unused battery charged.
  - a. The maintainer **MUST** be rated for the chemical type battery you are using, whether lead-acid or LiFePO4 (lithium-ion). The battery charging is very different. Wrong charger will cause a fire.
  - b. Two quality devices stand out as acceptable. Larger versions of both are available.
  - c. *Noco Genius* is preferred choice. It is suitable for lead-acid & LiFePO4. It has top safety features. Genius1= 1 A, 15W, up to 30Ah battery. Genius2= 40Ah, Genius5= 120Ah. Genius1= \$30.
  - d. *Deltran Battery Tender Jr'* is for lead-acid only. ~\$39.



8. **MAINTAINER Solar:** A small solar system controller is a viable alternative.
  - a. *Suner Power BC-6W* delivers 6W, ~\$40.
9. **SOLAR Background:** Continuous operation without infrastructure requires much larger solar & battery.
  - a. Size in Watts \* peak sun hours = daily Watt-hour energy available.
  - b. Ratings at max (peak sun) include power (Pmx), current (Ipm), and voltage (Vpm) ~ 17V.
  - c. Voltage and resulting power vary with sun level, so a controller is required.
  - d. Average peak OK sun is 4.5 hours / day, with more in summer and less in winter.

| Typical Photovoltaic Solar Specs |            |
|----------------------------------|------------|
| Max Power P (Pmx)                | 100 Watts  |
| Max Power V (Vmp)                | 18.1 Volts |
| Max Power I (Imp)                | 5.5 Amps   |

10. **SOLAR Panel:** Select panel size (Watts) to supply the current (A) desired.
  - a. 100-Watt panel typically delivers about 5 A at maximum sun.
  - b. 8 hours of summer sun yields (5A \* 8hr) = 40 Ah. Winter is one-half that.
  - c. In summer, this panel restores all power used. Winter requires two panels for full power.
  - d. *Renogy 100 W* solar panel is adequate, depending on sun. ~\$100.
  - e. *Dokio* portable units are foldable and come with a controller. Same price range.
11. **SOLAR Controller:** Controller manages battery charging.
  - a. PWM is inexpensive. Pricy MPPT (maximum power point) optimizes voltage.
  - b. The controller size is the current put in the battery.
  - c. *Renogy Wanderer 10 Amp, 12V, PWM* is adequate, ~\$20.



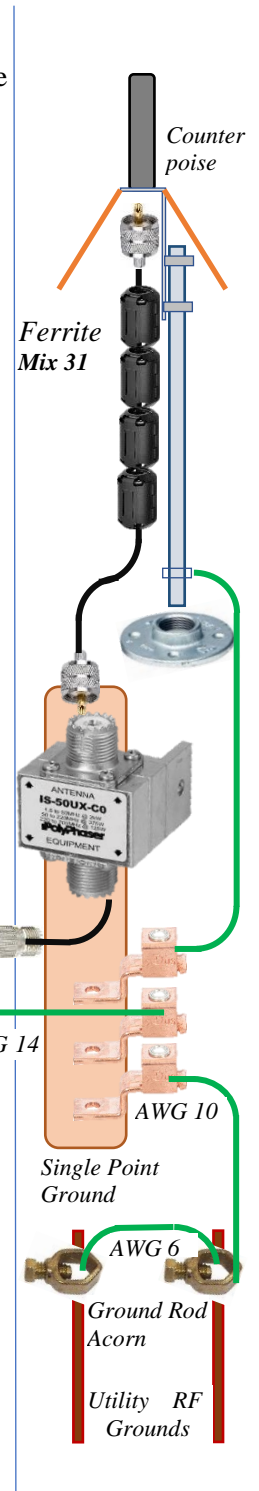
12. Life is good. Enjoy!



# Ham 64 – Antenna, SPG, & Earth Diagram

Dr. Marc & Rosemary 221108

1. Rule #1: Everyone has antenna issues and they are all different. Every installation is about optimizing for that location! There are no short-cuts. Optimization involves trying many different alternatives, and accepting the trade-offs. Simply moving the antenna element 2 feet has a dramatic effect.
2. This article shows the minimum installation diagram. If you do not have every one of these items installed, your installation is vulnerable and less than effective. Just saying.
3. Noise is the reason you cannot receive. The three sources of noise are atmospheric through antenna, power through supply, and electronic devices nearby like LED lamps and WiFi. Each noise source handles differently. Antenna ferrite will not fix electronics noise, but you still need both.
4. Several previous articles address not-line-of-sight, noise, and alternative installs. Each one of these has different info to address a specific problem. When you have challenges, you must go through the sometimes-tedious process to find the root reason. If you do not find the source of the noise, you cannot fix it. This is amateur radio, making communications work when nothing else does.
5. Every component is specifically chosen to increase the signal (antenna), radials (counterpoise) to complete the ground circuit, mitigate loss (coax), eliminate noise (ferrite), increase safety (protector), and provide a noise path out (ground). A separate RF ground rod should be driven within 20', then it must be bonded back to the utility ground.



6. Life is good. Enjoy!



**The End**

