

Technician and General Class Amateur Radio & Satellite Stuff

Anthony Odenthal, KE7OSN Amateur Extra

December 4, 2013

Welcome

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenhal,
KE7OSN
Amateur Extra

Welcome, over the next several sessions we will cover a substantial amount of information. please ask questions and slow me down.

The goals are:

- To introduce you to Amateur Radio

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Welcome, over the next several sessions we will cover a substantial amount of information. please ask questions and slow me down.

The goals are:

- To introduce you to Amateur Radio
- Prepare you to take (and pass) the technician and general exams

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Welcome, over the next several sessions we will cover a substantial amount of information. please ask questions and slow me down.

The goals are:

- To introduce you to Amateur Radio
- Prepare you to take (and pass) the technician and general exams
- Introduce you to satellite communications.

A little about myself

Technician and
General Class
Amateur Radio
& Satellite Stuff

Anthony
Odenhal,
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- Passed Tech Sept 2007
- Passed Gen Oct 2007
- Joined Benton County ARES April 2012
- Passed Extra April 2012
- Became a VE in June 2012

What is Amateur Radio?

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Amateur radio are people and activities that are regulated and encouraged, in the US and abroad, that allow licensed individuals to play around with radio waves, electronics, software, techniques, practices, and equipment to do all sorts of really cool stuff. Radio Amateurs are some of the least restricted users of radio spectrum, and with that freedom they have proven time and time again their worth. The term Amateur refers to someone who does something as a pastime rather than a profession.

Some useful tools

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Some things you may want to look into as useful for studying

- AA9PW practice exams <http://aa9pw.com>
- ARRL license Manuals <http://www.arrl.org/shop/Licensing-Education-and-Training/>

About the test

Technician and
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Anthony
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- 35 questions

About the test

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- 35 questions
- Multiple Choice

About the test

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- 35 questions
- Multiple Choice
- No time limit

About the test

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- 35 questions
- Multiple Choice
- No time limit
- 396 questions in the tech pool, 457 in the general

About the test

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- 35 questions
- Multiple Choice
- No time limit
- 396 questions in the tech pool, 457 in the general
- Need a 75% to pass

Shal we begin?

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Remember if I go too fast or you have questions, let me know.

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International Telecommunications Union (ITU)

- Worldwide, treaty-based organization that allocates frequencies for specific uses.
- Primary Users - first "rights" to a frequency
- Secondary Users - permitted to use a frequency but must not interfere with a primary user
- World divided into 3 regions, US is in Region 2
- Creates "bands" - sections of spectrum allocated for amateur radio use.

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Federal Communications Commission (FCC)

- Promulgates rules for non-federal radio users within ITU spec
- Divides amateur bands into mode-specific sub-bands
- Rules for telecommunications are in the Code of Federal Regulations, Chapter 47
- Rules for amateur radio are in Part 97 of Chapter 47 (47 CFR 97)

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Frequency Coordinator

- FCC recognized regional groups that coordinate the use of bands between large number of users

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Frequency Coordinator

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- Appointed by amateurs for amateurs

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Frequency Coordinator

- FCC recognized regional groups that coordinate the use of bands between large number of users
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- Intended to help reduce and allow resolution of interference issues

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- Appointed by amateurs for amateurs
- Intended to help reduce and allow resolution of interference issues
- Voluntary rules unless there is interference, then the coordinated user "wins"

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- Intended to help reduce and allow resolution of interference issues
- Voluntary rules unless there is interference, then the coordinated user "wins"
- Gentleman's agreement

FCC allocations

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UNITED STATES FREQUENCY ALLOCATIONS



SERVICE	EXEMPT	DESCRIPTION
Priority	None	Capital letters
Nonpriority	None	Not limited with regard to content



U.S. DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Office of Spectrum Management
Created: 2006

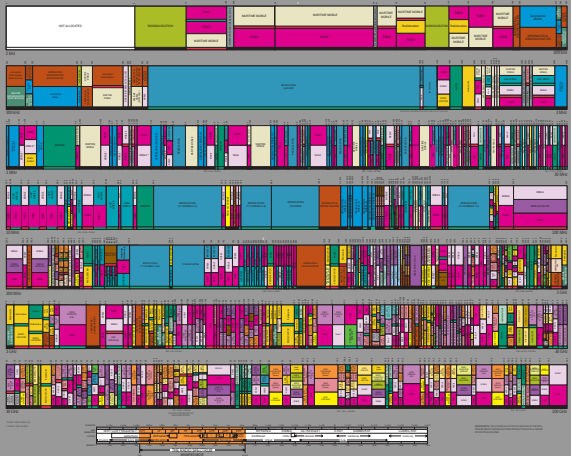


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47 CRF 97.1 Basic Purpose

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The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles:

- A Recognition and enhancement of the value of the amateur service to the public as a *voluntary noncommercial communication service*, particularly with respect to providing emergency communications.

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- A Recognition and enhancement of the value of the amateur service to the public as a *voluntary noncommercial communication service*, particularly with respect to providing emergency communications.
- B Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.

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- C Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art.

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- C Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art.
- D Expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronics experts.

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- C Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art.
- D Expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronics experts.
- E Continuation and extension of the amateur's unique ability to enhance international goodwill.

Keyphrase

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*...a voluntary noncommercial
communications service...*

This phrase sums up almost every rule and tenant of amateur radio.

A voluntary noncommercial communications service

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Noncommercial means no "pecuniary interest". It is illegal to profit from the use of amateur radio.

As with almost any rule there are exceptions"

- Teachers may use ham radio in the classroom as a teaching aid
- "Code practice" transmissions
- Disaster Drills

More basic rules

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- No Music - expect transmission or re-transmission of a signal from a space station
- No Broadcasting
- No commercial traffic
- No profanity
- No codes or ciphers intended to hide content
- No international third party traffic unless treaty-approved

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A license is valid for ten years, with a two year grace period.
Upgrades don't count as renewals. Basic renewals are free!
There are five classes.

- *Novice
- Technician
- General
- *Advanced
- Extra

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There are four kinds of licenses, Individual hams hold both a "Station" and "Operator"

- Station
- Operator
- Club - W7OSU, K7CVO, W1AW
- Special Event - A7W

Clubs can get a "club callsign", and events can get an event callsign.

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- US callsigns start with A,K,N, or W
- The format is one or two letters, a number, and one to three letters.
- New callsigns are assigned in sequential order - number indicates the region in the US
- Shorter callsigns are reserved for higher license classes
- 1X1 for special events only

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- N8GFO

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- N8GFO -Yep

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- VE6GLW

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- VE6GLW -That's Canadian, eh
- KLOO -That's a commercial station
- WSJ509

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- VE6GLW -That's Canadian, eh
- KLOO -That's a commercial station
- WSJ509 -Land Mobile, Benton County Sheriff

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- VE6GLW -That's Canadian, eh
- KLOO -That's a commercial station
- WSJ509 -Land Mobile, Benton County Sheriff
- Mission Base

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- VE6GLW -That's Canadian, eh
- KLOO -That's a commercial station
- WSJ509 -Land Mobile, Benton County Sheriff
- Mission Base -What is known as a "tactical callsign"

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Who "operates" an amateur station?

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Who "operates" an amateur station?

The control operator, who is designated by the station licensee, and determines the privileges of operation.

e.g. if you are at a radio that can operate outside your privileges, you still can only use what you are licensed to.

Your Callsign

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A station must transmit its callsign at least every ten minutes and at the end of every communication.

Special situations have special rules

- Control operator working outside of a station licensee privileges.
- Special event station control operator
- Control operator using new privileges prior to FCC database update

The Uniform Licensing System

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The ULS is an online database of FCC license information. A new licensee may use their privileges as soon as their information appears in the ULS. When you upgrade you may use your new privileges as soon as you pass the test.

Typical uses of a callsign

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- W7OSU This is KE7OSN

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- Net Control This is KE7OSN

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- W7OSU This is KE7OSN
- Net Control This is KE7OSN
- This is W7OSU (Go Ahead)

Typical uses of a callsign

Technician and
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- W7OSU This is KE7OSN
- Net Control This is KE7OSN
- This is W7OSU (Go Ahead)
- CQ CQ CQ this is KE7OSN

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- W7OSU This is KE7OSN
- Net Control This is KE7OSN
- This is W7OSU (Go Ahead)
- CQ CQ CQ this is KE7OSN
- KE7OSN monitoring

Typical uses of a callsign

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- W7OSU This is KE7OSN
- Net Control This is KE7OSN
- This is W7OSU (Go Ahead)
- CQ CQ CQ this is KE7OSN
- KE7OSN monitoring
- This is KF7FGE stroke (/) KE7OSN

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- W7OSU This is KE7OSN
- Net Control This is KE7OSN
- This is W7OSU (Go Ahead)
- CQ CQ CQ this is KE7OSN
- KE7OSN monitoring
- This is KF7FGE stroke (/) KE7OSN
- Hey Bob, you around?

Hey bob, you around

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Hey bob you around?
Legal?

Hey bob, you around

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Hey bob you around?

Legal?

Yes, as long as you keep to the every ten minutes and the end of every communication.

Hey bob, you around

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Hey bob you around?

Legal?

Yes, as long as you keep to the every ten minutes and the end of every communication.

What if Bob isn't there?

Hey bob, you around

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Hey bob you around?

Legal?

Yes, as long as you keep to the every ten minutes and the end of every communication.

What if Bob isn't there?

KE7OSN clear

Types of stations

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- Club – at least four people, one of which accepts responsibility and is the “trustee”.
- Space – at least 50km above the surface.
- Beacon – transmits a low-level signal for propagation studies
- Repeater – retransmits a signal heard on one frequency on another frequency.
- Auxillary – a secondary receiver that feeds a repeater station.

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US Amateur Radio Bands

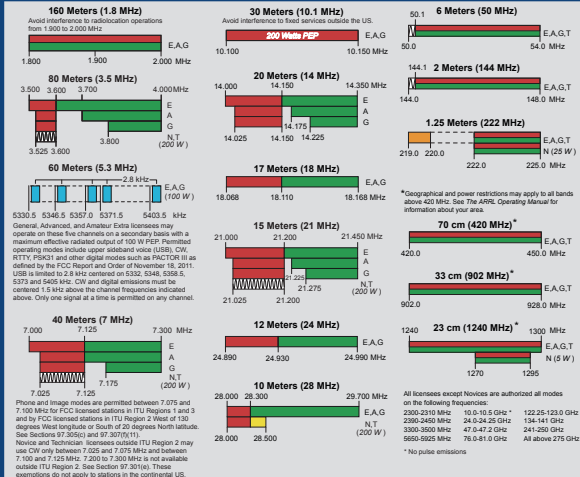
US AMATEUR POWER LIMITS

FCC 97.313 An amateur station must use the minimum transmitter power necessary to carry out the desired communications. (b) No station may transmit with a transmitter power exceeding 1.5 kW PEP.

Effective Date
March 5, 2012

Published by:
ARRL The national association for
AMATEUR RADIO®
www.arrl.org

225 Main Street, Newington, CT USA 06111-1494



ITU Band Names

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- MF - Medium Frequency 300KHz to 3MHz
- HF - High Frequency 3MHz to 30 MHz
- VHF - Very High Frequency 30MHz to 300MHz
- UHF - Ultra High Frequency 300MHz to 3GHz
- SHF - Super High Frequency 3GHz to 30GHz
- EHF - Extremely High Frequency - 30GHz to 300GHz
- THF - Tremendously High Frequency - 300GHz to 3THz

HF 3-30MHz

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- 80 Meters
 - 3.525-3.600MHz: CW Only
- 40 Meters
 - 7.025-7.125MHz: CW Only
- 15 Meters
 - 21.025-21.200MHz: CW Only
- 10 Meters
 - 28.000-28.300MHz: CW, RTTY/Data 200 watts PEP max
 - 28.300-28.500MHz: CW, Phone 200 watts PEP max

VHF 30-300MHz

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- 6 Meters
 - 50.0-50.1MHz CW Only
 - 50.1-54.0MHz All modes
- 2 Meters
 - 144.0-144.1MHz CW Only
 - 144.1-148.0MHz All modes
- 1.25 Meters
 - 222.00-225.00MHz All modes

UHF 300-3000MHz (3GHz)

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- 70 Centimeters
 - 420.0-450.0MHz All Modes
- 33 Centimeters
 - 902.0-928.0MHz All Modes
- 23 Centimeters
 - 1240-1300MHz All Modes
- 2.4GHz
 - 2.3-2.31GHz
 - 2.39-2.45GHz *

2.4GHz

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We share the 2390-2450MHz band with: 802.11 networks, cordless phones, video cameras, zigbee, etc.

We are PRIMARY users. We have first "rights". Secondary users must not cause us interference and must accept interference from our operations.

SHF 3GHz-30GHz and up

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- 3.3-3.5GHz
- 5.65-5.925GHz
- 10.0-10.5GHz
- 24.0-24.25GHz
- 47.0-47.2GHz
- 76.0-81.9GHz
- 119.98-120.02GHz
- 142-149GHz
- 241-250GHz
- Everything above 300GHz

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

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C. That which seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations
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D. An amateur station located more than 50 km above the Earth's surface
- **T1A06 What is the FCC Part 97 definition of telecommand?**
C. A one-way transmission to initiate, modify or terminate functions of a device at a distance

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- **T1A06 What is the FCC Part 97 definition of telecommand?**
C. A one-way transmission to initiate, modify or terminate functions of a device at a distance
- **T1A07 What is the FCC Part 97 definition of telemetry?**
C. A one-way transmission of measurements at a distance from the measuring instrument

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C. A one-way transmission of measurements at a distance from the measuring instrument
- **T1A08 Which of the following entities recommends transmit/receive channels and other parameters for auxiliary and repeater stations?**
B. Frequency Coordinator

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B. Frequency Coordinator
- **T1A09 Who selects a Frequency Coordinator?**
C. Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations

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- **T1A10 What is the FCC Part 97 definition of an amateur station?**
A. A station in an Amateur Radio Service consisting of the apparatus necessary for carrying on radio communications

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- **T1A09 Who selects a Frequency Coordinator?**
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- **T1A11 Which of the following stations transmits signals over the air from a remotereceive site to a repeater for retransmission?**
C. Auxiliary station

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

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- **T1B02 North American amateur stations are located in which ITU region?**
B. Region 2

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- **T1B02 North American amateur stations are located in which ITU region?**
B. Region 2
- **T1B03 Which frequency is within the 6 meter band?**
B. 52.525 MHz

T1B 6 Questions from T1

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- **T1B02 North American amateur stations are located in which ITU region?**
B. Region 2
- **T1B03 Which frequency is within the 6 meter band?**
B. 52.525 MHz
- **T1B04 Which amateur band are you using when your station is transmitting on 146.52MHz?**
A. 2 meter band

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- ☐ **T1B02 North American amateur stations are located in which ITU region?**
B. Region 2
- ☐ **T1B03 Which frequency is within the 6 meter band?**
B. 52.525 MHz
- ☐ **T1B04 Which amateur band are you using when your station is transmitting on 146.52MHz?**
A. 2 meter band
- ☐ **T1B05 Which 70 cm frequency is authorized to a Technician Class license holder operating in ITU Region 2?**
C. 443.350 MHz

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- **T1B02 North American amateur stations are located in which ITU region?**
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- **T1B03 Which frequency is within the 6 meter band?**
B. 52.525 MHz
- **T1B04 Which amateur band are you using when your station is transmitting on 146.52MHz?**
A. 2 meter band
- **T1B05 Which 70 cm frequency is authorized to a Technician Class license holder operating in ITU Region 2?**
C. 443.350 MHz
- **T1B06 Which 23 cm frequency is authorized to a Technician Class operator license?**
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- ☐ **T1B01 What is the ITU?**
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C. Amateurs may not cause harmful interference to primary users

T1B 6 Questions from T1

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C. Amateurs may not cause harmful interference to primary users
- T1B09** Why should you not set your transmit frequency to be exactly at the edge of an amateur band or sub-band?

A. To allow for calibration error in the transmitter frequency display
B. So that modulation sidebands do not extend beyond the band edge
C. To allow for transmitter frequency drift
D. All of these choices are correct
- T1B10** Which of the bands available to Technician Class operators have mode-restricted sub-bands?

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

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- **T1C08 What is the normal term for an FCC-issued primary station/operator license grant?**
C. Ten years

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C. As soon as your name and call sign appear in the FCC's ULS database

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C. As soon as your name and call sign appear in the FCC's ULS database
- **T1C11 If your license has expired and is still within the allowable grace period, may you continue to operate a transmitter on amateur service frequencies?**
A. No, transmitting is not allowed until the ULS database shows that the license has been renewed

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D. Transmissions intended for reception by the general public

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- **T1D11 Which of the following types of communications are permitted in the Amateur Radio Service?**
A. Brief transmissions to make station adjustments

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B. Remote

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D. The station licensee

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A. Tactical call

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A. Any station whose government permits such communications

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B. At least 4

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- **T1F08** When may a Technician Class licensee be the control operator of a station operating in an exclusive Extra Class operator segment of the amateur bands?
A. Never
- **T1F09** What type of amateur station simultaneously retransmits the signal of another amateur station on a different channel or channels?
C. Repeater station
- **T1F10** Who is accountable should a repeater inadvertently retransmit communications that violate the FCC rules?
A. The control operator of the originating station
- **T1F11** To which foreign stations do the FCC rules authorize the transmission of non-emergency third party communications?
A. Any station whose government permits such communications
- **T1F12** How many persons are required to be members of a club for a club station license to be issued by the FCC?
B. At least 4
- **T1F13** When must the station licensee make the station and its records available for FCC inspection?
B. Any time upon request by an FCC representative

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97.403 Safety of life and protection of property

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No provision of these rules prevents the use by an amateur station of any means of radio communication at its disposal to provide essential communication needs in connection with the immediate safety of human life and immediate protection of property when normal communication systems are not available.

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No provision of these rules prevents the use by an amateur station of any means of radio communication at its disposal to provide essential communication needs in connection with the immediate safety of human life and immediate protection of property **when normal communication systems are not available.**

ARES

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ARES – **A**mateur **R**adio **E**mergency **S**ervice

- Organized and run by ARRL
- Supports governmental and NGO groups.
- Most groups are organized at the county level
- “EC” – Emergency Coordinator

RACES

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RACES – **R**adio **A**mateur **C**ivil **E**mergency **S**ervice

- Defined by the FCC
- Supports governmental agencies **ONLY**.
- Operators are registered with the controlling agency.
- RACES Officer
- Activated by federal declaration of emergency.
- In Oregon, ARES members are also registered in RACES

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Disaster == Organized Chaos

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To keep some organization to the use of frequencies and communications, groups are organized into “nets”.

A “net” is a group of stations that are cooperating in the use of a frequency. The “net control” is responsible for deciding who gets to talk.

Disaster == Organized Chaos

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There are two kinds of nets:

Directed - the net control is strict in controlling who talks to whom. Stations tell net control they have a message for another station, and the net control directs them to call that station and pass the message.

Free - the net control allows stations to contact each other as they need to.

Disaster == Organized Chaos

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There are three types of messages

Formal - written messages.

Informal - unwritten messages.

Administrative - station to station housekeeping.

Written Messages – Formal Traffic

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ARES and RACES have adopted the NIMS/ICS system for written traffic. I.e., ICS-213 message forms, in either digital or transcribed versions.

Written Messages – Formal Traffic

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ARES and RACES have adopted the NIMS/ICS system for written traffic. I.e., ICS-213 message forms, in either digital or transcribed versions.

The TEST doesn't ask you about that. The TEST deals with the National Traffic System message form.

Written Messages – Formal Traffic

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The National Traffic System (NTS) is a system organized by ARRL to transmit messages in a standard format, usually concerning “Health and Welfare”. For example: “Aunt Martha arrived home safely. Have a happy birthday.” Or “welcome to Ham radio”. These messages use the NTS RadioGram form. The process is described in depth in the Message Processing Guidelines (MPG).

NTS RadioGram Form

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The American Radio Relay League RADIOGRAM Via Amateur Radio

Number	Precedence	HX	Station of Origin	Check	Place of Origin	Time Filed	Date
--------	------------	----	-------------------	-------	-----------------	------------	------

To:

This Radio Message was received at:

Amateur Station _____ Date _____
Name _____
Street Address _____
City, State, Zip _____

Telephone Number:

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

REC'D	From	Date	Time	SENT	To	Date	Time
-------	------	------	------	------	----	------	------

A licensed Amateur Radio Operator, whose address is shown above, handled this message free of charge. As such messages are handled solely for the pleasure of operating, a "Ham" Operator can accept no compensation. A return message may be filed with the "Ham" delivering this message to you. Further information on Amateur Radio may be obtained from ARRL Headquarters, 225, Main Street, Newington, CT 06111.

The American Radio Relay League, Inc. is the National Membership Society of licensed radio amateurs and the publisher of QST Magazine. One of its functions is promotion of public service communication among Amateur Operators. To that end, The League has organized the National Traffic System for daily nationwide message handling.

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Types of radio short-hand

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Amateur radio has its own codes, and slang. Much like 1337 or txt, this "shared language" makes it easier to communicate quickly, and efficiently. Much of it comes from the days of telegraph and Morse Code.

Q Codes - Three letter codes beginning with Q

Number codes - Codes sent as numbers, we really only use 73

Pro-words - Standardized ways of saying things in a clear and concise fashion

Phonetics - Words for letters, try saying BCDEZGT five times fast.

Q-Codes

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Q codes are three letter codes that begin with Q and not QU and can be sent as either a question or a response. Really useful when using Morse Code as the codes are much shorter than what they represent. Some common Q codes are listed below.

QSY Change frequency

QRT Stop transmitting

QRZ I'm calling

QRM Man made interference

QRN Natural interference or Noise

QSL Acknowledge

QST Message to all amateurs

Q-Codes

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Q codes are three letter codes that begin with Q and not QU and can be sent as either a question or a response. Really useful when using Morse Code as the codes are much shorter than what they represent. Some common Q codes are listed below.

QSY Change frequency

QRT Stop transmitting

QRZ I'm calling

QRM **M**an made interference

QRN **N**atural interference or **N**oise

QSL Acknowledge

QST Message to all amateurs

Pro-words

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Pro or Professional words are used as shorthand, and because they prevent confusion. Yea and Nah kinda sound the same.

Roger Received

WilCO Will Comply

Over I'm done talking for now

Out I'm done talking to you

This Is I'm going to say my callsign now

Wait Hold on for a while

Affirmative Yes

Negative No

Phonetics

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In amateur radio we use ITU phonetics, this helps us reduce the potential of confusion over letters that sound the same

A - Alfa "AL-FAH"	N - November "NO-VEM-BER"	0 "ZEE-RO"
B - Bravo "BRAH-VOH"	O - Oscar "OSS-CAH"	1 "WUN"
C - Charlie "CHAR-LEE"	P - Papa "PAH-PAH"	2 "TOO"
D - Delta "DELL-TAH"	Q - Quebec "KEH-BECK"	3 "TH-UH-REE"
E - Echo "ECK-OH"	R - Romeo "ROW-ME-OH"	4 "FOW-ER"
F - Foxtrot "FOKS-TROT"	S - Sierra "SEE-AIR-RAH"	5 "FI-IV" OR "FIFE"
G - Golf "GOLF"	T - Tango "TANG-GO"	6 "SIX"
H - Hotel "HOH-TELL"	U - Uniform "YOU-NEE-FORM"	7 "SEV-EN"
I - India "IN-DEE-AH"	V - Victor "VIK-TAH"	8 "ATE"
J - Juliett "JEW-LEE-ETT"	W - Whiskey "WISS-KEY"	9 "NIN-ER"
K - Kilo "KEE-LOH"	X - X-Ray "ECKS-RAY"	
L - Lima "LEE-MAH"	Y - Yankee "YANG-KEY"	
M - Mike "MIKE"	Z - Zulu "ZOO-LOO"	

W7QH becomes "Whiskey 7 Quebec Hotel"

CQ and 73

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There are two other special cases.

- CQ is the standard calling call. Think of it as Seek You, though no one really knows where it comes from. It is common to add extra stuff depending on the situation. You might hear CQ JOTA, CQ Field Day, CQ Contest, CQ DX, CQ Oregon. This lets people pick who they are looking for. A common general CQ would sound like "CQ CQ CQ this is KE7OSN calling CQ CQ CQ"
- The other thing that comes up is the number 73, this goes back to the old Western Union Telegraph 92 codes, these were numbers that could be used in place of certain phrases, most of them dealing with packages or trains. 73 means "Beast Regards" and is generally used as "goodbye"

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Power

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In most amateur bands the maximum legal limit for power output is 1500 Watts, PEP. PEP - Peak Envelope Power is the largest amplitude of a signal. On some bands the limit is lower, for each band there is also a point at which you have to do a safety evaluation of your station to avoid unsafe exposure. You should always use the minimal power required to do what you need to do.

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- ☐ **T2A01 What is the most common repeater frequency offset in the 2 meter band?**
B. plus or minus 600 kHz

79 of 396 19.9%

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- ☐ **T2A01 What is the most common repeater frequency offset in the 2 meter band?**
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- ☐ **T2A02 What is the national calling frequency for FM simplex operations in the 70 cm band?**
D. 446.000 MHz

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B. plus or minus 600 kHz
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D. 446.000 MHz
- ☐ **T2A03** What is a common repeater frequency offset in the 70 cm band?
A. Plus or minus 5 MHz

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A. Plus or minus 5 MHz
- ☐ **T2A04** What is an appropriate way to call another station on a repeater if you know the other station's call sign?
B. Say the station's call sign then identify with your call sign

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- ☐ **T2A04** What is an appropriate way to call another station on a repeater if you know the other station's call sign?
B. Say the station's call sign then identify with your call sign
- ☐ **T2A05** What should you transmit when responding to a call of CQ?
C. The other station's call sign followed by your call sign

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B. Say the station's call sign then identify with your call sign
- ☐ **T2A05** What should you transmit when responding to a call of CQ?
C. The other station's call sign followed by your call sign
- ☐ **T2A06** What must an amateur operator do when making on-air transmissions to test equipment or antennas?
A. Properly identify the transmitting station

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B. Say the station's call sign then identify with your call sign
- ☐ T2A05 What should you transmit when responding to a call of CQ?
C. The other station's call sign followed by your call sign
- ☐ T2A06 What must an amateur operator do when making on-air transmissions to test equipment or antennas?
A. Properly identify the transmitting station
- ☐ T2A07 Which of the following is true when making a test transmission?
D. Station identification is required at least every ten minutes during the test and at the end

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- **T2A05 What should you transmit when responding to a call of CQ?**
C. The other station's call sign followed by your call sign
- **T2A06 What must an amateur operator do when making on-air transmissions to test equipment or antennas?**
A. Properly identify the transmitting station
- **T2A07 Which of the following is true when making a test transmission?**
D. Station identification is required at least every ten minutes during the test and at the end
- **T2A08 What is the meaning of the procedural signal "CQ"?**
D. Calling any station
- **T2A09 What brief statement is often used in place of "CQ" to indicate that you are listening on a repeater?**
B. Say your call sign

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B. Say your call sign
- **T2A10** What is a band plan, beyond the privileges established by the FCC?
A. A voluntary guideline for using different modes or activities within an amateur band

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B. Say your call sign
- **T2A10** What is a band plan, beyond the privileges established by the FCC?
A. A voluntary guideline for using different modes or activities within an amateur band
- **T2A11** What are the FCC rules regarding power levels used in the amateur bands?
D. An amateur must use the minimum transmitter power necessary to carry out the desired communication

T2B 3 questions from T2

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T2B

- T2B01** What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?
- C. Simplex communication

T2B 3 questions from T2

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T2B

- ☐ T2B01 What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?
C. Simplex communication
- ☒ T2B02 What is the term used to describe the use of a sub-audible tone transmitted with normal voice audio to open the squelch of a receiver?
D. CTCSS

T2B 3 questions from T2

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- ☐ T2B01 What is the term used to describe an amateur station that is transmitting and receiving on the same frequency?
C. Simplex communication
- ☐ T2B02 What is the term used to describe the use of a sub-audible tone transmitted with normal voice audio to open the squelch of a receiver?
D. CTCSS
- ☐ T2B03 Which of the following describes the muting of receiver audio controlled solely by the presence or absence of an RF signal?
B. Carrier squelch

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B. The repeater receiver requires a CTCSS tone for access
C. The repeater receiver may require a DCS tone sequence for access
D. All of these choices are correct

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A. Its signal occupies more bandwidth

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- **T2B08 What is the proper course of action if your station's transmission unintentionally interferes with another station?**
B. Properly identify your transmission and move to a different frequency

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A. Use of a phonetic alphabet

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 - A. QRM

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A. QRM
- **T2B11 What is the "Q" signal used to indicate that you are changing frequency?**
B. QSY

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- **T2C01 What set of rules applies to proper operation of your station when using amateur radio at the request of public service officials?**
C. FCC Rules

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D. Both organizations may provide communications during emergencies

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C. Do not transmit on the net frequency until asked to do so by the net control station

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A. Passing messages exactly as written, spoken or as received

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

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D. The information needed to track the message as it passes through the amateur radio traffic handling system
- **T2C11 What is meant by the term "check" in reference to a formal traffic message?**
A. The check is a count of the number of words or word equivalents in the text portion of the message

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Electromagnetic Waves

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Electromagnetic waves are energy waves that move through space, similar to the way waves move in water or sound through air. In a vacuum these waves move at the speed of light $299,792,458m/s$ or $186,282.397miles/second$. This is good as these waves are light.

Speed of light

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We can round up to $300,000,000m/s$. Some distance measured in terms of light-time

Average distance between the Sun and Earth - 8 minutes

GEO Satellite to Earth's Surface - about a half second

Nearest other star to our Sun 4.25 Years

Voyager Space probe to the Sun at 18,884,401,200 Km from the sun?

Speed of light

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$$\text{sun? } \frac{18884401200Km}{300000Km/s} = \text{Hours}$$

Speed of light

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Frequency - not just an ok movie

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We often refer to a wave by it's frequency. Frequency is the number of times a wave cycles in a given time. We use Hertz (Hz) which has the unites of $\frac{1}{\text{Seconds}}$.

Middle C is 440Hz, or 440 cycles per second.

KLOO-AM is 1.340MHz, or 1,340,000 cycles per second.

SI Prefixs

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Sometimes it is a lot easier to shorten things up a bit.

Tera T 10^{12} 1,000,000,000,000

Giga G 10^9 1,000,000,000

Mega M 10^6 1,000,000

Kilo K 10^3 1,000

Deci d 10^{-1} 0.1

Ceni c 10^{-2} 0.01

Milli m 10^{-3} 0.001

Micro μ 10^{-6} 0.000001

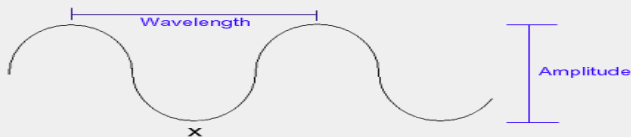
Nano n 10^{-9} 0.000000001

Pico p 10^{-12} 0.000000000001

Wavelength

We also use wavelength to describe waves. The wavelength is the distance between two like points on the wave exactly one cycle apart, e.g. the distance between peaks.

Low frequency (longer wavelength) radio wave:



Higher frequency (shorter wavelength) radio wave:



Direction of travel
at 300,000,000 metres per second

ElectoMagnetic

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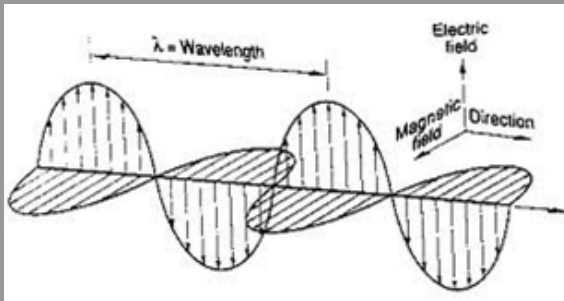
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Electromagnetic waves have two parts, one electric part, and one magnetic part. The magnetic part is rotated and phase shifted by 90deg

Wavelength to frequency and back

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It is easy to convert between wavelength and frequency just use the equation below.

Wavelength to frequency and back

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It is easy to convert between wavelength and frequency just use the equation below.

$$Wavelength(meters) = \frac{300}{Freq.(MHz)}$$

Wavelength to frequency and back

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$$Wavelength(meters) = \frac{300}{Freq.(MHz)}$$

We'll practice on the next slide

MATH!!!

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- Lets try to convert 7.025MHz into a wavelength to figure out which band it belongs to.

MATH!!!

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- Lets try to convert 7.025MHz into a wavelength to figure out which band it belongs to.

$$Wavelength(\lambda) = \frac{300}{7.025}$$

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- Lets try to convert 7.025MHz into a wavelength to figure out which band it belongs to.

$Wavelength(\lambda) = \frac{300}{7.025}$ that comes out to 42.7meters

MATH!!!

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- Lets try to convert 7.025MHz into a wavelength to figure out which band it belongs to.

$$\text{Wavelength}(\lambda) = \frac{300}{7.025} \text{ that comes out to } 42.7\text{meters}$$

That fits nicely in the 40meter band

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- Lets try to convert 7.025MHz into a wavelength to figure out which band it belongs to.

$$\text{Wavelength}(\lambda) = \frac{300}{7.025} \text{ that comes out to 42.7meters}$$

That fits nicely in the 40meter band

- Now lets try 223.50MHz
 $\frac{300}{223.50} = ?$

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- Lets try to convert 7.025MHz into a wavelength to figure out which band it belongs to.

$$\text{Wavelength}(\lambda) = \frac{300}{7.025} \text{ that comes out to 42.7meters}$$

That fits nicely in the 40meter band

- Now lets try 223.50MHz
 $\frac{300}{223.50} = ? 1.35$, for the 1.25meter band.

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Just like light radio waves travel in a straight line.

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Just like light radio waves travel in a straight line.
They also reflect off some things like light.

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Just like light radio waves travel in a straight line.

They also reflect off some things like light.

If there are multiple ways for radio waves to get between two points we call this Multipath, and it creates interference.

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Reflections can be really useful when you don't have a direct line of sight.

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They also reflect off some things like light.

If there are multiple ways for radio waves to get between two points we call this Multipath, and it creates interference.

Reflections can be really useful when you don't have a direct line of sight.

Radio waves will also refract.

Solar Wind

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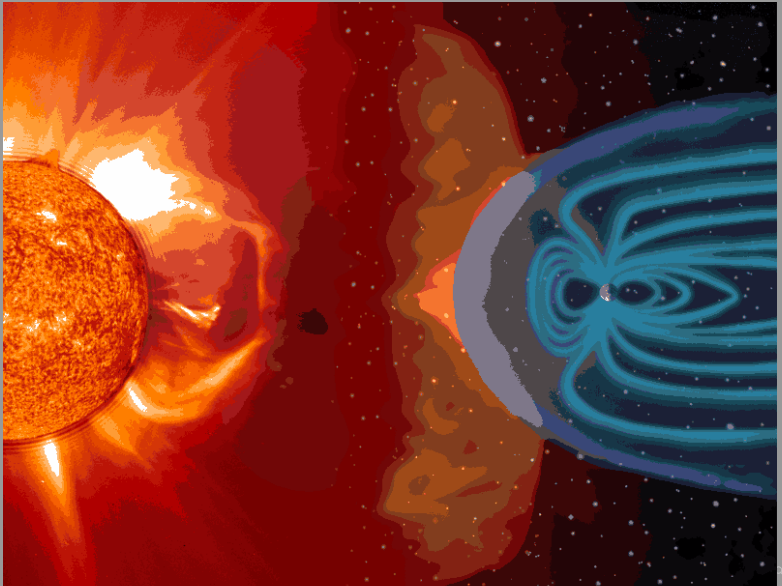
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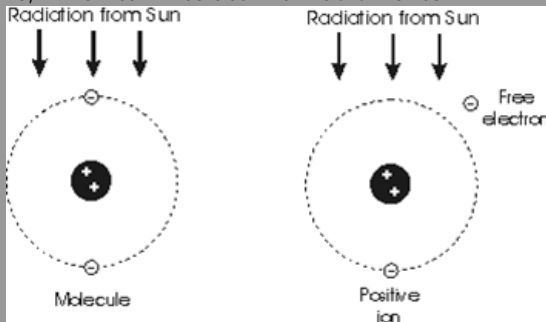
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Solar radiation charges atoms in the atmosphere, breaking loose electrons, to create ions, which can interact with radio waves.

At night the electrons recombine with their atoms. This means things change from day to night.



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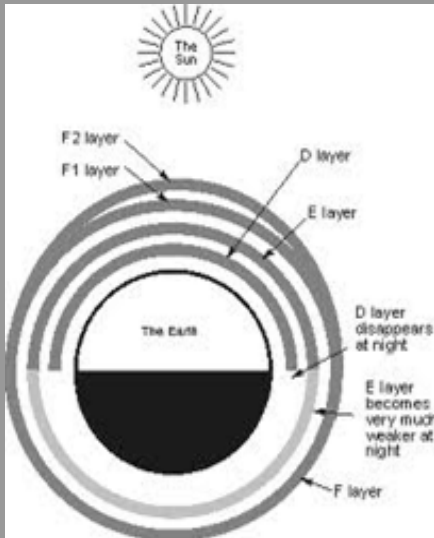
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The parts of the atmosphere most affected by ionization are collectively called the ionosphere! It has multiple layers, each interact differently with radio waves. The D layers mostly absorbs RF, while the E and F layers reflect. HF is ruled by the ionosphere VHF and up ... not so much.

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During the day the D layers absorbs a large chunk of HF, at night it goes away and signals bounce (refract) off the E and F layers. VHF and above mostly just goes through the ionosphere. . . But sometimes at night there is just enough E layer to refract VHF signals. We call this "Sporadic E"

Auroras and Meteor Showers

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The auroras are a visible sign of ionization, as they move they can cause received signals to sound fluttery.

Meteor showers leave short lived trails of ionized gases, that can refract signals, these effects are impossible to predict and last seconds.

You can even bounce radio signals off the moon!

Tropospheric Ducting

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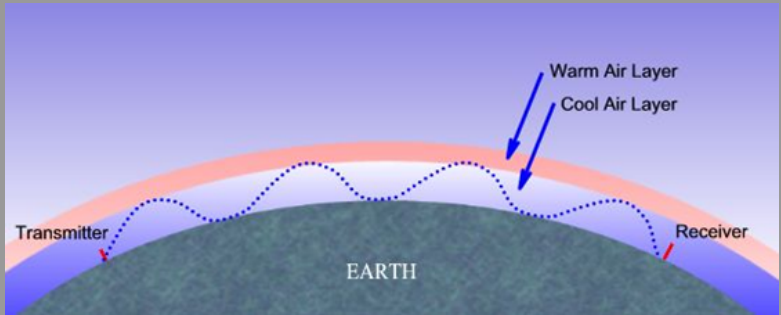
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Air can refract electromagnetic radiation. A temperature inversion (warm air above cold) can cause VHF signals to refract and travel long distances.

This is called "Tropospheric Ducting" and often happens between here and Hawaii, it mostly affects VHF.

Knife Edge

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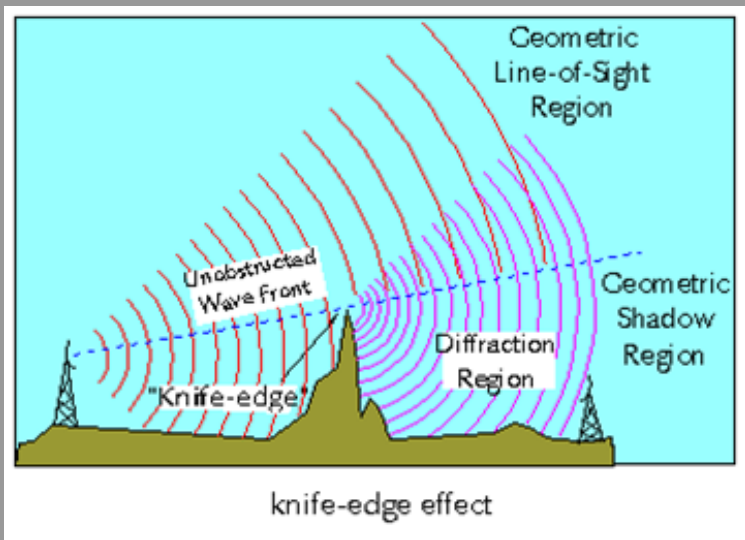
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- **T3A01** What should you do if another operator reports that your station's 2 meter signals were strong just a moment ago, but now they are weak or distorted?
D. Try moving a few feet, as random reflections may be causing multi-path distortion

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B. Signals could be significantly weaker

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B. Picket fencing

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- **T3A07 What type of wave carries radio signals between transmitting and receiving stations?**
A. Electromagnetic

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- **T3A07 What type of wave carries radio signals between transmitting and receiving stations?**
A. Electromagnetic
- **T3A08 What is the cause of irregular fading of signals from distant stations during times of generally good reception?**
C. Random combining of signals arriving via different path lengths

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A. Electromagnetic
- **T3A08 What is the cause of irregular fading of signals from distant stations during times of generally good reception?**
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- **T3A09 Which of the following is a common effect of "skip" reflections between the Earth and the ionosphere?**
B. The polarization of the original signal is randomized

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- **T3A09 Which of the following is a common effect of "skip" reflections between the Earth and the ionosphere?**
B. The polarization of the original signal is randomized
- **T3A10 What may occur if VHF or UHF data signals propagate over multiple paths?**
D. Error rates are likely to increase

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- **T3A10 What may occur if VHF or UHF data signals propagate over multiple paths?**
D. Error rates are likely to increase
- **T3A11 Which part of the atmosphere enables the propagation of radio signals around the world?**
C. The ionosphere

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- ☐ **T3B01 What is the name for the distance a radio wave travels during one complete cycle?**
C. Wavelength

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C. Wavelength
- **T3B02 What term describes the number of times per second that an alternating current reverses direction?**
D. Frequency

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- ☐ **T3B02** What term describes the number of times per second that an alternating current reverses direction?
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- ☐ **T3B03** What are the two components of a radio wave?
C. Electric and magnetic fields

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A. At the speed of light

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C. Electric and magnetic fields
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A. At the speed of light
- **T3B05** How does the wavelength of a radio wave relate to its frequency?
B. The wavelength gets shorter as the frequency increases

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A. At the speed of light
- **T3B05 How does the wavelength of a radio wave relate to its frequency?**
B. The wavelength gets shorter as the frequency increases
- **T3B06 What is the formula for converting frequency to wavelength in meters?**
D. Wavelength in meters equals 300 divided by frequency in megahertz

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- **T3B05 How does the wavelength of a radio wave relate to its frequency?**
B. The wavelength gets shorter as the frequency increases
- **T3B06 What is the formula for converting frequency to wavelength in meters?**
D. Wavelength in meters equals 300 divided by frequency in megahertz
- **T3B07 What property of radio waves is often used to identify the different frequency bands?**
A. The approximate wavelength

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- **T3B01 What is the name for the distance a radio wave travels during one complete cycle?**
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- **T3B02 What term describes the number of times per second that an alternating current reverses direction?**
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- **T3B03 What are the two components of a radio wave?**
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C. 3 to 30 MHz

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C. 3 to 30 MHz
- **T3B11 What is the approximate velocity of a radio wave as it travels through free space?**
B. 300,000,000 meters per second

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C. Signals are partially refracted around solid objects exhibiting sharp edges

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A. During daylight hours

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A. The distance at which radio signals between two points are effectively blocked by the curvature of the Earth

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A. The distance at which radio signals between two points are effectively blocked by the curvature of the Earth
- **T3C11 Why do VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations?**
C. The Earth seems less curved to radio waves than to light

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