NOVICE

FCC License Preparation
Element 2

To go to an explanation press the Search button and select the required question designator

N1A01
You should obtain a copy of Part 97 of Title 47 of the Code of Federal Regulations.   The PART97.HLP file in the NuTest package contains the entire text of this document.   [97]

N1A02
The FCC makes and enforces amateur radio rules in the United States and certain other territories. [97]

N1A03
The FCC rules determine operation standards, technical standards of equipment and emergency communications.

The rules do not cover operating procedures or repeater locations. Station construction standards may be covered by other regulations but are not part of the FCC rules. The only exception to this is a general requirement for safe practices. Although knowledge of Ohms law is required to answer some Novice Class Theory questions it is not part of the FCC rules. [97]

N1A04
Specific station construction standards are not part of the FCC rules and regulations. Your station is, however, required to be constructed so that it is safe for you and other people. [97]

N1A05
Section 97.1 of the FCC rules explains the official reasons for the existence of this hobby. [97.1]

N1A06
The Federal Communications Commission rules, Part 97.1 lists the fundamental purposes of the amateur radio service.

To increase the number of trained operators and electronics experts. is specifically mentioned in paragraph d).

To improve international goodwill, is mentioned in paragraph e).

[97.1]

N1A07
When you have passed:

a) The Novice written theory exam
b) The 5 words-per-minute Morse code test

You will be eligible to apply to the FCC for a ten-year license to operate an amateur radio station. If you do not already have it the Windows Morse code trainer NuMorse is highly recommended for studying the Morse code. 97.3]

N1A08

Paragraph 4), section 97.3 of the FCC rules defines the amateur service. This paragraph specifies that we pursue our hobby out of interest, for fun, and not for commercial gain. [97.3]

N1A09
In the FCC rules an amateur station is defined as A station in an amateur radio service consisting of the apparatus necessary for carrying on radio communications.. The apparatus means the radio equipment you need to carry out amateur communications.[97.3]

N1A10
If you are the licensee then this is you, or another licensed radio amateur designated by you. The control operator is responsible for ensuring that station operation is within the FCC rules. [97.3]

N1A11
Volunteer examiners (VEs) administer all amateur radio written examinations.   [97.509]

N1B01
An amateur license permits you to transmit on amateur service frequencies only. [97.5]

N1B02

Once licensed you may operate an amateur radio station in any region that is administered by the FCC without any special permissions. Section 97.11
of the FCC document lists some extra rules for operation aboard aircraft and ships. [97.5]

N1B03

The FCC Form 610 plus license fee are sent to the FCC. Some portions of the form are to be filled in by you, other portions by the VE who administers your examination. If you have a severe disability that makes it impossible for you to take a Morse code test then a section of the Form 610 is to be completed by a physician. On receipt of the Form 610 and fee the FCC will issue your unique call sign. [97.5]

N1B04
You may operate wherever the FCC has jurisdiction; these places are listed in the appendix to the FCC rules. Special rules apply for amateur radio stations aboard ships or aircraft. [97.5]

N1B05
There is no limit to the number of radios at your station. [97.5]

N1B06
Keep the original of your license safe at your primary station. Make copies for other sites that you operate from. [97.9]

N1B07
European amateur radio operators are not allowed to control a US amateur station without an FCC-issued reciprocal permit. [97.7]

N1B08
The types of license classes are listed in section [97.5] of the FCC rules.

N1B09
The Novice and Technician licenses are the entry level licenses. The progression is then General, Advanced and Amateur Extra. [97.3]

N1B10
The Novice and Technician licenses are the entry level licenses. The progression is then General, Advanced and Amateur Extra. [97.9]

N1B11
The Novice and Technician licenses are the entry level licenses. The progression is then General, Advanced and Amateur Extra. [97.9]

N1B12
All stations may, subject to FCC rules, transmit third party messages. [97.115]

N1B13
Element 1 (code) is not required for the Technician license. [97.501]

N1C01
The 80-meter wavelength band is good at night for long range CW contacts.   Be sure to note that Novice and Technician class Hams have access to only part of the 80 meter band.   [97.301]

N1C02
The 40-meter band is good at night for long range CW contacts. During the day CW contacts may be made up to 400 miles away. Note Novice and Technician class Hams have access to only part of the 40 meter band. [97.301]

N1C03
Contacts can easily exceed 3,000 miles on CW using the 15 meter amateur band during periods of high solar activity. Note that Novice and Technician class Hams have access to only part of the 15 meter band. [97.301]

N1C04
This band is good during the daytime. Notice that the Novice and Technician class have access to only part of the 10 wavelength amateur band. This band is divided into sections. CW is used between 28.1 and 28.3 MHz while telephony is used between 28.3 and 28.5 MHz. [97.301]

N1C05
The 1.25-meter Novice band is a VHF band. Novices have access to all of this band but are restricted to 25 watts PEP output. [97.301]

N1C06
At these frequencies propagation is normally line of sight. Repeaters are used to extend the range of amateur transmissions. [97.301]

N1C07
Amateur bands are often referred to in meters of wavelength, even though each band covers a range of wavelengths.   This is done for convenience.

If you are given a frequency then the wavelength is found by the equation:
(Wavelength in meters) = 300 / f (MHz).
Where f (MHz) is the frequency in MHz.

If you are given a frequency in kHz then you must first convert it to MHz by dividing by 1000.

To convert a frequency to a wavelength we use the equation:
f (frequency in MHz) = 300 /   (Wavelength in meters).

In the question, the frequency is given as 3710 kHz.   This converts to 3.71 MHz.
So the wavelength is found by 300 / 3.71 = 80.8 meters and this is part of the 80 meter band.

[97.301]

N1C08
The frequency 7135 kHz is the same as 7.135 MHz. Amateur bands are often referred to in meters of wavelength. So, we need to convert 7.135 MHz to wavelength using the equation:
(Wavelength in meters) = 300/f(MHz)
Where f (MHz) is the frequency in MHz.

In this question we have (Wavelength in meters) =300 / 7.135 = 42.04 meters. This is part of the 40 meter amateur band.

[97.301]

N1C09
Amateur bands are often referred to in meters of wavelength. So, we need to convert 21.150 MHz to wavelength using the equation:

(Wavelength in meters) = 300/f(MHz)
Where f (MHz) is the frequency in MHz.

This gives (Wavelength in meters) = 300 / 21.165 = 14.17 meters. This is part of the 15 meter amateur band.

[97.301]

N1C10

Amateur bands are often referred to in meters of wavelength.   So, we need to convert 28.400 MHz to wavelength using the equation:
(Wavelength in meters) = 300/f(MHz)
Where f (MHz) is the frequency in MHz.

This gives   (Wavelength in meters) = 300 / 28.400   = 10.56 meters.   This is part of the 10 meter amateur band. [97.301]

N1C11
Amateur bands are often referred to in meters of wavelength.   So, we need to convert 223.5 MHz to wavelength using the equation:
(Wavelength in meters) = 300/f(MHz)
Where f (MHz) is the frequency in MHz.

This gives   (Wavelength in meters) = 300 / 223.5 = 1.34 meters.   This is part of the 1.25 meter amateur band.

[97.301]

N1D01
The FCC rules state that anyone who qualifies by examination is eligible to apply for a station license, except for representatives of foreign governments. [97.5]

N1D02
No age limits are specified in the FCC rules. Even young children can become operators if they can qualify. [97.51]

N1D03
Element 1(A) is the name of the 5 wpm Morse code test. Element 2 is name for the Novice written examination. [97.501]

N1D04

When you fill out the FCC Form 610 to apply for your amateur operator primary station license, you will have to provide a mailing address. The FCC cannot send your license to you if it does not have it. It is difficult to change your mailing address later so use a permanent one. [97.23]

N1D05
If you lose your license, write to the FCC for a replacement. The address is: Federal Communications Commission, 1270 Fairfield Road, Gettysburg, Pennsylvania 17325. [97.29]

N1D06
You will need to fill out an FCC Form 610 if you change your mailing address. Send a COPY of your license to the FCC. [97.23]

N1D07
US call signs have one or two letters, then a number, then up to three letters. The VE prefix is allocated to stations licensed in Canada.

N1D08
The first characters of an amateur radio station call sign indicate the country where the station is licensed to operate.   The prefixes to US amateur stations are AA-AL, KA-KZ, NA-NZ, WA-WZ.

N1D09
The number in the call sign indicates the geographic area of the license. Maps are available showing what numbers are allocated to geographic areas.

N1D10

Radio amateur licenses last for ten years before they will need to be renewed. There is a two year grace period after license expiration where you can apply for a new one. However, you are not allowed to operate if your license has expired. If you go beyond the grace period, you have to start over and pass all of your examination elements again. [97.25]

N1D11

You should fill out a form 610 or 610-R up to 90 days in advance for a license renewal. The FCC does not send you a renewal reminder. [97.21]

N1D12
It can take just a few days for the FCC to grant a license. [97.5]

N1E01
CW means Morse code. Other names for this type of emission are telegraphy and A1a. On the 80 meter band you may operate telegraphy on 3675-3725 kHz when you gain your Novice class license. [97.305]

N1E02
As a Novice you may use only Morse code on the 40 meter band (7100-7150 kHz). [97.305]

N1E03
As a Novice you may only use Morse code on the 15 meter bend from 21, 100-21,200 kHz. [97.305]

N1E04
Novices may only use Morse code on the 80 meter band. [97.305]

N1E05
Novices may only use Morse code (CW) on the 40 meter amateur band. [97.305]

N1E06
Novices are allowed to use Morse code (CW) only on the 15 meter Amateur band. [97.305]

N1E07
Novices may transmit data from computers or RTTY (teleprinter messages) between 28.1 and 28.3 MHz. This is in the 10 meter Amateur band. [97.305]

N1E08
Novices are allowed to send and receive Morse code on the voice portion of 10 meters. They are also allowed to use single sideband telephony on this band. [97.305]

N1E09
Between 222.1 and 223.91 MHz you may use any permitted emission type. [97.305]

N1E10
Between 1270 and 1295 MHz you may use any permitted emission type. [97.305]

N1E11
The 10 meter band is from 28.3 to 28.5 MHz. This band can offer long distance voice communications to Novices when propagation conditions are good. [97.305]

N1E12
Novices may use any permitted emission type on the 1.25 meter band but are limited to 25 watts PEP output. [97.305]

N1E13
Novices may transmit and receive radio teletype messages (RTTY) as well as Morse code between 28.1 and 28.3 MHz in the 10 meter amateur band. [97.301]

N1E14
The frequencies from 28.1 to 28.3 MHz in the 10 meter Amateur band are used for data, packet radio and teleprinter (RTTY) transmissions. [97.301]

N1F01
Always use the minimum of power needed to contact another station. [97.313]

N1F02
All amateur radio operators must stay below 200 Watts PEP output on this band. [97.313]

N1F03
All amateur radio operators must stay below 200 Watts PEP output on this sub-band. [97.313]

N1F04
All amateur radio operators must stay below 200 Watts PEP output on this sub-band. [97.313]

N1F05
Novice class Hams must stay below 200 Watts PEP output on the 10 meter amateur band. [97.313]

N1F06
Novice class Hams must stay below 200 Watts PEP output on the 10 meter amateur band. [97.313]

N1F07
On the 1.25 meter amateur band your power output is limited to 25 Watts PEP. [97.313]

N1F08
On the 1270 MHz microwave band your power output is limited to 5 Watts.   Be aware that high microwave power levels can cause heating and severe damage to human tissue.   [97.313]

N1F09
The Novice sub-bands on 80, 40, 15 and 10 meters are restricted to output power levels of 200 Watts PEP. Part of the reason for this is safety. As a Novice you dont want to be handling higher power levels. [97.313]

N1F10
Novice stations may transmit up to 25 Watts of output power on the 222-225 MHz band. [97.313]

N1F11
Radio waves with a wavelength of only 23 cm are in the microwave range. Radiation in the microwave range is similar to that used in microwave ovens. The power limit is for the personal safety of Novice operators who may be relatively inexperienced. [97.313]

N1F12
You must always use the minimum power for reliable communications. [97.313]

N1F13
Data transmission techniques such as CLOVER, G-TOR, or PacTOR, as well as the various RTTY formats are regarded as data by the FCC. [97.309]

N1F14
All of the common 5 unit and 7 unit RTTY codes are permitted. [97.309]

N1G01
The control operator is whoever is designated by the licensee (including the licensee herself) to be responsible for station transmissions. [97.105]

N1G02
The FCC rules state that when the control operator is a different person from the station licensee then both persons are equally responsible for proper station operation. [97.103]

N1G03
The FCC rules state that when the control operator is a different person from the station licensee then both persons are equally responsible for proper station operation. [97.103]

N1G04
Both you and anyone else who operates your station are responsible for compliance with FCC rules.
[97.103]

N1G05
The FCC normally assumes that the station licensee is also the control operator unless another operator is shown in your station records. [97.103]

N1G06
The designated control operator you may only operate within the privileges authorized for their license class. This is regardless of the license class held by the station licensee. [97.103]

N1G07
As a designated control operator you may operate within the privileges authorized for your own license class. This is regardless of the license class held by the station licensee. [97.105]

N1G08
As a designated control operator you may operate within the privileges authorized for your own license class.   This is regardless of the license class held by the station licensee.   [97.105]

N1G09

Every amateur station must have a properly licensed control operator while transmitting [97.7]. Special rules apply to beacon [97.203], repeater [97.205] and space [97.207] station operation.

N1G10

In the case of locally controlled operation (by the other operator) you must be at the control point [97.109]. Usually this means being in the same room. Special rules apply to beacon [97.203], repeater [97.205] and space [97.207] station operation.

N1G11
Any control operator for an amateur radio station, including family members, must be licensed. [97.109]

N1H01

No station may transmit unidentified communications or signals. Notice that the rules do not say that you must identify at the start of a contact although it obviously makes sense to do so. [97.119]

N1H02
You must always send your own call sign when operating from your   station.   [97.119]

N1H03
The rules do not say that you must identify at the start of a contact although it obviously makes sense to do so. [97.119]

N1H04
You must always send your own call sign when operating from your station. [97.119]

N1H05
Your own callsign and the foreign station callsign must be transmitted. [97.115]

N1H06
State your call sign regularly. [97.119]

N1H07
For example, certain military stations during RACES exercises. [97.111]

N1H08
During RACES exercises participating amateur stations are allowed to communicate with none amateur stations.

The FCC rules list the types of amateur stations with which amateur stations may communicate. Briefly, these are:

Other amateur stations.
Emergency communications with other FCC regulated stations.
Transmissions with US government stations for RACES communications.
Communications with non-FCC regulated stations that are authorized to communicate with amateur stations.
Communications with US military stations during communications exercises.
Brief test transmissions.
Brief transmissions to establish communications.
Command transmissions to automatic devices.
Emergency communications.
Transmissions for the purpose of teaching the Morse code.
Information bulletins.
Telemetry.
[97.113]

N1H09
No special permission is required to operate from an alternative location. [97.5]

N1H10
Communications for the purpose of material gain are specifically prohibited. [97.113]

N1H11
Occasional communications for the purchase and sale of amateur radio equipment is permitted. [97.113]

N1H12
Your station must not constitute a hazard to the safety of life or property. [97.11]

N1I01
A great thing about this hobby is the freedom to speak to radio amateurs anywhere in the world. [97.111]

N1I02
Special rules apply to space station operation. [97.3]

N1I03
Any amateur station may be a space station. [97.207]

N1I04
If you are employed by an organization that transmits ham radio news bulletins and CW practice transmissions, you may accept compensation or wages. [97.113]

N1I05
Public broadcasting is not permitted. Dissemination of telegraphy practice sessions and information bulletins of specific interest to radio amateurs is permitted. [97.113]

N1I06
No music is permitted on ham radio, not even background music. No exceptions! [97.113]

N1I07
Codes designed to obscure an amateur radio message are not permitted. [97.113] Data transmission using specified publicly available codes are allowed and certain secure telemetry links to amateur satellites are permitted to use secret codes.

N1I08
When a third party is stating a message the control operator must always supervise them to make sure that they comply with the FCC rules. Be aware that some countries do not permit third party amateur radio communications. [97.3]

N1I09
It is the control operator's responsibility to make sure that there is a third part agreement in force at both stations. [97.3]

N1I10
Lists of countries permitting third party traffic are available. [97.115]

N1I11
Lists of countries permitting third party traffic are available. [97.115]

N1I12
In a genuine emergency it is permitted to transmit on any frequency.   In fact, all the FCC rules can be waived if the emergency is severe enough.   [97.405]

N1I13
The word MAYDAY is used to indicate an immediate and severe risk to life and if used indiscriminately could cause much waste of time by other amateurs and emergency services. [97.403]

N1I14
The word MAYDAY is used to indicate an immediate and severe risk to life and if used indiscriminately could cause much waste of time by other amateurs and emergency services. [97.405]

N1J01
False and deceptive transmissions are specifically prohibited.   There should never be any reason to do this!   [97.113]

N1J02
False and deceptive transmissions are specifically prohibited. There should never be any reason to do this! [97.113]

N1J03
Deliberate interference is illegal and could result in penalties such as permanent revocation of your amateur radio license. [97.3]

N1J04
The 23cm band is allocated to radio amateurs on a secondary basis. You must not cause harmful interference to other services but are not protected from interference by those services. [97.303]

N1J05
Deliberate interference is illegal and could result in penalties such as permanent revocation of your amateur radio license. [97.3]

N1J06
Deliberate interference is illegal and could result in penalties such as permanent revocation of your amateur radio license. [97.101]

N1J07
If you do not identify your station by transmitting your call sign every ten minutes and at end of transmission then you are transmitting unidentified signals. These are prohibited. [97.119]

N1J08
If you do not identify your station by transmitting your call sign every ten minutes and at end of transmission then you are transmitting unidentified signals. These are prohibited. [97.119]

N1J09
If you do not identify your station by transmitting your call sign every ten minutes and at end of transmission then you are transmitting unidentified signals.   These are prohibited.   [97.119]

N1J10
If you do not identify your station by transmitting your call sign every ten minutes and at end of transmission then you are transmitting unidentified signals.   These are prohibited.   [97.119]

N1J11
Deliberate interference is illegal and could result in penalties such as permanent revocation of your amateur radio license. [97.322]

N2A01
This is polite and avoids possible infringement of FCC rules that call for cooperation in making use of available bandwidth. [97.101]

N2A02

A dummy load is a resistive device designed to convert most of the RF power from your transmitter into heat. It can be as simple as an electric light bulb, or it may be a sophisticated non-inductive oil cooled affair depending on transmitter frequency and power.

A dummy load temporarily replaces your antenna and allows you to carry out tests without radiating signals. There is usually enough RF leakage from a dummy load and the connecting cables for you to clearly hear the output of your transmitter on a nearby receiver.

N2A03

Emergency calls have highest priority. Take whatever steps are necessary to provide assistance and alert the emergency services. Remember that the normal FCC rules can be waived in the case of a life threatening emergency. [97.405]

N2A04

Be sure to send at a speed at which you can comfortably receive because any stations that respond will do so at the same speed.

N2A05

Always respond at the rate that the sending station is using. You can agree to speed up when initial contact is established.

N2A06

Do not transmit Morse code faster than you can receive it else the responding station may reply at a rate you cannot copy.

N2A07

This is an exciting method to establish contact since you never know what station or stations will respond.

N2A08

Knowledge of the abbreviations (procedural signals) is important, especially when sending and receiving CW.

N2A09
K is an abbreviation for over or go ahead.'

N2A10

Sometimes you may hear a station calling CQ DX.'   This means calling any long distance station.'

N2A11

You may hear a phrase such as 73 es gd dx de KI5YT when listening to a CW transmission.   This is a series of abbreviations that expands to Best regards and hope you work many long distance stations, from station KI5YT.

N2A12

The RST system is in use by radio amateurs worldwide.
The first digit R indicates readability on a subjective scale of 0 to 5.
The second digit S indicates received signal strength on a scale of 0 to 9.
The third digit T represents CW tone quality and is often omitted with telephony signals.

A phrase such as you are RST 599 here old man means I can read you perfectly, your signal is very strong and your tone quality is perfect.

N2A13

The RST system is in use by radio amateurs worldwide.
The first digit R indicates readability on a subjective scale of 0 to 5.
The second digit S indicates received signal strength on a scale of 0 to 9.
The third digit T represents CW tone quality and is often omitted with telephony signals.

A phrase such as you are RST 599 here old man means I can read you perfectly, your signal is very strong and your tone quality is perfect.

N2A14
This is likely to be used by you when starting out on CW!

N2A15
The phrase QTH here is England simply means I live in England.'

N2A16

The exchanging of QSL cards with people from other countries is a fascinating branch of the hobby.   They come in many colorful designs.

N2A17

Sometimes you may hear a station calling CQ DX.' This means calling any long distance station.'

N2A18

Many amateur radio contacts start off with a CQ call. You may either go on air and call CQ or if you wish you can tune around the bands listening for other stations calling CQ.' It is up to you.

N2A19
QRL strictly means "Are you busy?". It is one of a set of Q-codes (abbreviations) that are used by radio amateurs worldwide.

N2A20
This is one of a set of Q-codes (abbreviations) that are used by radio amateurs worldwide.

N2A21
QSO is also used to describe an amateur radio two way exchange of messages. It is one of a set of Q-codes (abbreviations) that are used by radio amateurs worldwide.

N2A22
It is often used to invite the calling station to try again under difficult reception conditions.

N2A23

Radio reception may not always be perfect. If someone uses the letter F in a call sign it may sound like a letter S.' There are several other letter pairs that can be confused under less than perfect reception conditions. The Standard International Phonetics alphabet is designed to solve this problem by providing a standard clearly recognized word for each letter of the alphabet. Here is the alphabet:

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

You do not need to learn these for the examination!

N2B01
Remember, CQ is a general call inviting anyone to respond.

N2B02

When making a CQ call be sure to send at a speed at which you can comfortably receive because any stations that respond will do so at the same speed.

N2B03
Typewriter-like machines used to be used for RTTY but nowadays computers are usually used by radio amateurs to receive and send RTTY signals.

N2B04
Your computer screen will indicate your station's connection status amongst other things.

N2B05

Listening to other people's traffic is a perfectly acceptable and legitimate practice on all amateur bands.

N2B06
A combination of the terms "Digital" and "repeater".

N2B07

Network nodes or digipeaters allow packet radio stations to form networks that extend right across the world. Packet radio is a communications medium that can rival telephone network based systems for some purposes. Also, use of packet radio does not incur connection charges.

N2B08
Repeater operating protocol is different from other modes.

N2B09

A repeater receives signals on its input frequency and re-transmits them on its output frequency. The difference between input and output frequencies is known as the offset.' For your signals to appear on the repeater output frequency you need to transmit on its input frequency.

N2B10

The difference between repeater input and output is called an offset.' Many amateur radio sets allow for this by automatically offsetting the receive and transmit frequencies. You may have to select the correct offset and frequencies for the individual repeater you are trying to use. Lists of repeater frequencies are published by organizations such as the ARRL.

N2B11

The calls are subject to all the usual FCC rules regarding content and procedures.

N2B12

Many amateurs like to rag chew and this is fine. Unfortunately rag chewing over a repeater can block access for other users. Time-out timers prevent occupation for long periods by individual stations.

N2B13

CTCSS stands for Continuous Tone Coded Squelch System that is used on the VHF bands. This is a sub-audible tone that is mixed in with your transmission. It switches on the audio output of receivers that may be monitoring. It is useful to mute or squelch the audio output of receivers that are used for monitoring purposes to avoid the continuous hiss that would otherwise be heard.

N2B14

In simplex operation both stations use the same frequency and take turns to transmit and receive. Duplex operation involves two frequencies and both stations simultaneously transmit and receive. Simplex operation is the more common method used in amateur radio.

N2B15

If you do not need the repeater, then changing to simplex mode and speaking directly to the other station allows others to use the repeater.

N3A01

Signals on the VHF and UHF bands travel in straight lines, just like light. Occasionally atmospheric conditions may extend the limit to somewhat beyond the horizon.

N3A02
Although the signals travel in straight lines, like light, they also reflect off buildings and tall objects. Communication can occur even though the two stations cannot actually see each other.

N3A03

Ground waves have a much shorter range than sky waves reflected off the ionosphere. Ground waves travel for a few hundred miles at most while sky waves can bounce between ground and ionosphere and travel many thousands of miles. All stations on all frequencies emit ground waves that can travel up to about 100 miles.

N3A04

Ground waves have a much shorter range than sky waves reflected off the ionosphere. Ground waves travel for a few hundred miles at most while sky waves can bounce between ground and ionosphere and travel many thousands of miles. All stations on all frequencies emit ground waves that can travel up to about 100 miles.

N3A05

This sky-wave propagation can allow communication right round the planet on some amateur bands.

N3A06

The ionosphere acts as a mirror to HF radio signals and reflects them back to the ground where they may bounce upward again.   This process can continue for thousands of miles.

N3A07

The ground wave will fade away after 100 miles or so.   However, sky wave signals may reach the ground some thousands of miles from the sending station.

N3A08

The layers of ionized gases high above the earth are called the ionosphere. The ions, or charged particles, are generated by radiation from the sun.

N3A09

The layers of ionized gases high above the earth are called the ionosphere. The ions, or charged particles, are generated by radiation from the sun.

N3A10

The layers of ionized gases high above the earth are called the ionosphere. The ions, or charged particles, are generated by radiation from the sun.

N3A11

The ionosphere is made up of charged particles caused by ultraviolet solar radiation. When solar activity increases, the ionization is greater.

N3A12
The D-region is the lowest and causes extreme absorption on the 160 and 80 m bands during daytime. At night this layer disappears and long distance propagation is easier on these bands.

N3A13
Most long distance contacts are due to the F2 layer on bands between 7.0 and 28.0 MHz.

N3A14
In daytime the F region splits into the F1 and F2 regions.

N3A15
In daytime the F region splits into the F1 and F2 regions.

N3A16

Sunspots correspond to periods of greater solar activity which results in a greater amount of radiation. Hence the ionization levels of the upper atmosphere will increase.

N3A17

The sun goes through its cycle of activity about once every 11 years. At the solar peak reflections from the ionosphere will allow reliable communications around the entire world. At a solar minimum worldwide communications may be more sporadic.

N3A18

Although the signals travel in straight lines, like light, they also reflect off buildings and tall objects. Communication can occur even though the two stations cannot actually see each other.

N4A01
You are responsible for any unauthorized use of your station and must take reasonable steps to avoid this. A key operated switch is one method.

N4A02

The microphone is a visible temptation to anyone looking in your car.   Put it out of sight.

N4A03

You are responsible for any unauthorized use of your station and must take reasonable steps to avoid this. A key operated switch is one method.

N4A04

Your amateur radio antenna may well be the highest point in your locality. A likely target for lightning strikes. Grounding of the antenna cable will not prevent lightning strikes, but will minimize the damage that such strikes cause.

N4A05

Make sure that your set is disconnected from the antenna and unplugged from the power line.

N4A06

The grounding should be done with thick braid. Good grounding will provide other beneficial effects along with protection from shock. Grounding will give better immunity from interference and reduce spurious transmitted signals.

N4A07

Connect a common bus bar to a good earth ground such as a water pipe. Then, run copper braid from the chassis of each piece of equipment to the common bar. Make sure that the pipe provides a metallic path all way into the ground and that there are no plastic sections. An alternative to a water pipe is a copper coated grounding rod. If you choose this grounding method, make sure there is sufficient soil moisture in the area of the rod.

N4A08
The National Electrical Code (NEC) is published by the National Fire Protection Association. Most local electrical wiring regulations are based on the NEC.

N4A09

Connecting the chassis of each item of equipment to a good ground connection will reduce the chance of electric shock.

N4A10

The steel provides physical strength while driving the rod into the ground. The copper cladding provides the required high electrical conductivity.

N4A11
Eight feet is a minimum for the rod.

N4B01

All high voltage equipment must be treated with respect. The interlock switch is often placed in the supply circuit to the power supply.

N4B02

All high voltage equipment must be treated with respect. The interlock switch is often placed in the supply circuit to the power supply.

N4B03

Make sure that the safety equipment is properly tested. Especially the safety belt. Make sure that the belt is fit for the purpose and carefully examined. Utility companies using safety equipment such as safety belts have procedures to make sure that all equipment is examined regularly.

N4B04

Just think what a fall from 20 feet would be like, even if you didnt get hit by something on the way down. Did that thought make you shudder? Good, you will remember the advice to wear a properly checked safety belt. In organizations where people regularly climb structures there is always a safety belt testing schedule. Make sure that your safety belt is regularly tested.

N4B05

It is quite common for spanners, nuts and bolts to fall from towers during construction and maintenance. This is one reason that construction workers and anyone else on construction sites wear hard hats.

N4B06
The steel provides the high tensile strength while the copper provides the required electrical conductivity.

N4B07
There will also be appreciable electrical resistance.

N4B08
Make sure that no one (and no breakable property) is in the potential landing area of the weight.

N4B09
A good rule of thumb is to allow a minimum of twice the height of the antenna away from any power lines.

N4B10
A safety interlock automatically disconnects the power when the door or lid of the power supply is opened.

N4B11
The interlock needs to be able to carry the full power supply current during operation and be able to safely disconnect if the lid or door is opened while the power is still applied.

N4B12
All of these devices contain potentially lethal voltages.

N4B13
The better grades of rope contain ultraviolet inhibitors which prevent chemical breakdown of the material when exposed to sunlight.

N4C01

Standing wave ratio is a measure of power going away from the transmitter compared with power going back to the transmitter. A ratio of 1:1 shows that no power is being reflected back to the transmitter by the antenna. SWR meters have an upper frequency limit. Those that work at 30 MHz and below are fairly inexpensive. As the maximum working frequency of the meter increases, so does the cost. A standing ratio of more than about 1:1.5 suggests that you have a problem with your antenna or antenna feed. A value less than this suggests that most of the transmitter power is being transferred to the antenna. Of course, there are several other factors that will also determine the effectiveness of your antenna.

N4C02
The relative impedance match is a measure of how effectively power is transferred. We speak of a good impedance match when most power is transferred.

N4C03
A 4:1 reading is a sure sign that something is wrong.   Either the feeder, antenna or SWR meter is faulty.

N4C04

Once a transmission starts the SWR reading should be constant. Erratic readings show that a bad connection exists somewhere in your antenna system. You may notice that the changes occur more in windy weather or when you rotate your antenna. This could indicate that nearby objects such as trees are affecting the performance of your antenna. The remedy is to either remove the objects or relocate your antenna.

N4C05

Or the antenna is too close to other objects such as trees, buildings or power lines. You should never contemplate erecting an antenna tower anywhere near power lines for safety reasons.

N4C06

Ideally the SWR should rise very slightly as each band edge is approached. If the SWR rise is greater at the higher frequency end then it is too long. Shorten it.

N4C07

Ideally the SWR should rise very slightly as each band edge is approached. If the SWR rise is greater at the lower frequency end then it is too short.   Lengthen it.

N4C08

For UHF measurements you must use a specially designed SWR meter.

N4C09

SWR meters have an upper frequency limit. Those that work at 30 MHz and below are fairly inexpensive. As the maximum working frequency of the meter increases, so does the cost.

N4C10
SWR meters measure standing wave ratio and the relative impedance mismatch can be calculated from this.

N4C11

This is the best place to measure standing wave ratio of your antenna since the effect of the antenna feeder is eliminated. In practice, many amateurs take this measurement at the input to the feedline. This is because the antenna may not be easily accessible.

N4D01

Television sets can easily suffer from receiver overload. It is caused by the strong signal from a transmitter swamping the sensitive aerial input circuitry of the television. Televisions are generally not designed to work in near powerful transmitters. One way to reduce front end overload in nearby televisions is to site your antenna as far away from them as possible. One way to reduce the problem when transmitting on HF is for the owner of the television to connect a high pass filter to the antenna input of his television set.

N4D02

If the interference is frequency sensitive then is probably harmonic interference. Harmonics are low level spurious emissions from your transmitter at multiples of your intended transmit frequency. It is your responsibility to ensure that radiation of harmonics is kept to a minimum. If you are transmitting on HF then you could try adding a low pass filter to the antenna feed of your transmitter. Older style tube type transmitters can emit high levels of harmonics if they are not tuned properly.

N4D03

Harmonics will always be produced in the circuitry of your transmitter. They are reduced to low levels before they appear at the antenna output, but can still affect users of other services. An amateur transmission on 28 MHz will have low level harmonics at:

56 MHz, the second harmonic. This is can be a problem because television sets receive at around this frequency.

84 MHz, the third harmonic can affect services using this band.

Further harmonics occur at 112 MHz, 140 MHz and so on.

N4D04

Modern transceivers do not require power amplifier tuning. Older tube type transmitters require careful tuning to minimize harmonic radiation. The problem is worse if you have a multiband antenna that is efficient at both its intended frequency and at a harmonic of this frequency.

N4D05

If you operate a transmitter with the metal cover removed there will spurious RF radiation from the exposed components.   There may also be a safety hazard due to high RF field strength and high voltages.

N4D06

Modern transmitters will contain harmonic suppression. You may further reduce the level of harmonic radiation by adding a low pass filter to your transmitter antenna feed.

N4D07

It is always a good idea to check out interference problems on your own television set first. This is likely to be the closest one to your transmitter. Some amateurs have a television set in the shack that is dedicated to monitoring for interference problems.

N4D08

Television Receiver overload may be reduced by keeping your transmitting antenna as far away from your neighbors television antennas as possible. Another way to reduce the problem when transmitting on HF is for the owner of the television to connect a high pass filter to the antenna input of his television set. You might offer to fit the filters for your neighbors. Remember though, reduction of front-end overload is the responsibility of the television set owner. Dont overlook the possibility of reducing your transmitter power. This can sometimes drastically reduce the problem and the loss of transmitter range may be quite small.

N4D09

If the interference is frequency sensitive then is probably harmonic interference. Harmonics are low level spurious emissions from your transmitter at multiples of your intended transmit frequency. It is your responsibility to ensure that radiation of harmonics is kept to a minimum. If you are transmitting on HF then you could try adding a low pass filter to the antenna feed of your transmitter. Older style tube type transmitters can emit high levels of harmonics if they are not tuned properly.

N4D10
A high pass filter will allow the VHF television signals to pass through, but will stop the lower frequency HF signals from your transmitter.

N4D11
Loose or corroded connectors in the cable system or receiver input can generate spurious interfering signals in the presence of strong signals from your transmitter.

N4D12
The break in the cable causes a line unbalance which can allow the cable transmission system to radiate TV interference. It will also cause the cable to act as an antenna and pick up signals from your transmitter.

N4D13

It is always a good idea to check out interference problems on your own television set first. This is likely to be the closest one to your transmitter. Some amateurs have a television set in the shack that is dedicated to monitoring for interference problems.

N4D14

Modern transmitters will contain harmonic suppression. You may further reduce the level of harmonic radiation by adding a low pass filter to your transmitter antenna feed. Harmonic radiation cannot be cured by modifications to the television receiver or adding filters to the receiving television antenna line.

N4D15

Front-end overload is cause by the strong signal from a transmitter swamping the sensitive aerial input circuitry of the television.   Televisions are generally not designed to work in near powerful transmitters.   One way to reduce front end overload in nearby televisions is to site your antenna as far away from them as possible.   One way to reduce the problem when transmitting on HF is for the owner of the television to connect a high pass filter to the antenna input of his television set.   Even though the owner is responsible for taking care of the problem you might consider assisting and advising out of goodwill.

N5A01
Divide by 1000 to convert kHz to MHz.   This is the same as moving the decimal point three places to the left.

N5A02

Multiply by 1000 to convert MHz to kHz. This is the same as moving the decimal point three places to the right.

N5A03

Multiply by 1,000,000 to convert MHz to Hz. This is the same as moving the decimal point six places to the right.

N5A04

One hundred centimeters is 1 meter. Divide a distance in centimeters by 100 to get the distance in meters. A meter is just over 3 feet.

N5A05

Milli means a thousandth. One milli-Ampere is one thousandth of an Ampere so you divide milliAmperes by 1000 to get Amperes. (Amperes are usually called Amps.)

N5A06

Milli means a thousandth.   One milli-Volt is one thousandth of a Volt.   You divide millivolts by 1000 to get Volts.

N5A07

Micro means one millionth. To get microfarads to farads you divide by 1,000,000. An easy way to do this is to move the decimal point six places to the left.

N5A08
Micro means one millionth.
Pico means a millionth of a millionth.
To get from pico to micro we divide by 1,000,000.

N5A09

Kilo means one thousand.   1 kilo Hertz is 1000 Hertz.

N5A10

Kilo means one thousand.   1 kilo Hertz is 1000 Hertz.
Mega means one million.   1 mega Hertz is 1,000,000 Hertz.
So there are 1000 kilo Hertz in 1 mega Hertz.

N5A11

Milli means one thousandth.
There are 1000 milli Watts in 1 Watt.
To get from milli watts to Watts we divide by 1000.
So 500 Milliwatts is 500/1000 = 0.5 Watts.

N5A12

Milli means one thousandth.
There are 1000 milli Watts in 1 Watt.
To get from milli watts to Watts we divide by 1000.
So 250 Milliwatts is 500/1000 = 0.25 Watts.

N5A13
MHz is short for Mega Hertz.
Mega means millions.
GHz is short for Giga Hertz.
Giga means thousand millions.

So to get from Giga Hertz to Mega Hertz we multiply by a thousand.
1.265 GHz means 1,265 MHz

N5B01
Think of the flow of electrons as the flow of water in a pipe.

N5B02

The flow of electrons in a conductor is called the current and it is measured in Amperes.   Amperes are often called Amps.

N5B03
An Ammeter measures Amps which is electrical current.
A Voltmeter measures Volts which is electrical pressure.

N5B04

Think of water flowing through a pipe. There must be a pressure causing the flow. The electrical pressure that causes electrical current to flow is called voltage or electromotive force.

N5B05

The electrical pressure (voltage) that pushes the current round an electrical circuit is measured in Volts.

N5B06
Automobile batteries have 12 Volts between the terminals.

N5B07

The voltage coming from a wall outlet in the United States is 120 Volts. Be careful when taking amateur equipment abroad. As well as having different outlet fittings the outlet's voltage can be different. For example in Britain a wall outlet will supply 240 Volts! Your Ham radio equipment would be damaged unless it could be adjusted to accept this voltage.

N5B08
An Ammeter measures Amps which is electrical current.
A Voltmeter measures Volts which is electrical pressure.

N5B09

Imagine a thin pipe with water flowing through it. The flow of the water will be hindered by friction with the walls. A similar thing happens with the flow of electric current; all normal materials offer some resistance to flow. Certain materials that offer high resistance are incorporated into electronic components called resistors.

N5B10

All normal materials offer resistance to the flow of electrical current. The basic unit of electrical resistance is called the Ohm.

If one Volt of electrical pressure is applied to a circuit and one Ampere of current flows then the circuit has one Ohm of resistance. This statement is the basis of Ohms law.

N5B11
Resistance is measured in Ohms, so a meter that measures resistance is called an Ohmmeter.

N5B12
A good conductor is one that easily allows an electrical current to flow through it. We use good conductors for wire. A good insulator will not easily allow an electrical current to flow though it. We often surround wire with insulation to make sure the current stays in the wire and doesnt leak into surrounding objects.

Copper is a good electrical conductor, which is why most wire is made from copper. Silver is even better and silver wire is occasionally used where very good conduction is required, for example in some UHF radio equipment.

Some relays use gold or silver contacts.

Aluminum is a good conductor, but it is difficult to make good connections to it because of a thin surface insulating layer that quickly forms when exposed to air.

Mica is a very good insulator.

Wood and paper are good insulators if they can be kept dry.

N5B13

An insulator has a very high resistance and so electricity cannot flow easily through it.

N5B14

An insulator has a very high resistance and so electricity cannot flow easily through it. Plastic, glass, air and rubber are all insulators.

N5C01

The relationship between voltage current and resistance is called Ohms law.   You need to be familiar with this simple law:

E = I x R.

Where:
E is voltage measured in Volts.
I is current measured in Amperes.
R is resistance measured in Ohms.

N5C02

The relationship between voltage current and resistance is called Ohms law.   You need to be familiar with this simple law:

E = I x R.

Where:
E is voltage measured in Volts.
I is current measured in Amperes.
R is resistance measured in Ohms.

N5C03

According to Ohms law:

E = I x R.

Where:
E is voltage measured in Volts.
I is current measured in Amperes.
R is resistance measured in Ohms.

In the question we have:

E = 2 Amperes x 50   Ohms = 100 Volts.

N5C04

The Ohms law equation relating voltage current and resistance is:
E = I x R.

Where:
E is voltage measured in Volts.
I is current measured in Amperes.
R is resistance measured in Ohms.

And so we have:
200 Volts = I Amperes x 100 Ohms.

To balance both sides of the equation I must be 2 Amperes.

N5C05

The Ohms law equation relating voltage current and resistance is:
E = I x R.

Where:
E is voltage measured in Volts.
I is current measured in Amperes.
R is resistance measured in Ohms.

And so we have:
90 Volts = 3 Amperes x R Ohms.

To balance both sides of the equation R must be 30 Ohms.

N5C06

Power is the rate at which energy is being transferred.   A high power transmitter is transferring a lot of energy to the antenna.

N5C07

A high power light bulb is transferring more electrical energy into heat and light than a low powered bulb. Electrical power is measured in Watts.

N5C08

Power is the rate at which energy is being transferred. It is measured in Watts. If 1 Ampere of current is flowing and the electrical force is 1 Volt then the power is 1 Watt. Here is how to calculate power:

P = V x I.

Where P is power in Watts.
V is voltage in Volts.
I is current in Amps.

N5C09

Imagine an open circuit as a gap that has opened up in the circuit and so no current can flow around it. The circuit will not function.

N5C10

Imagine an open circuit as a gap that has opened up in the circuit and so no current can flow around it. The circuit will not function. When a fuse blows due to too much current it acts as a break or gap that prevents any further current from flowing.

N5C11

Imagine an electrical circuit that performs some function. Now an extra piece of wire is added so that the current can take the easy or short path instead of performing its function.

N5D01

Batteries always generate direct current. There will be a positive terminal and a negative terminal.

N5D02

Alternating current changes direction a specified number of times every second. The power supply to homes in the US is alternating current that changes direction 60 times every second.

N5D03

An alternating current supply changes direction many times per second. The frequency of an ac (alternating current) supply is the number of times per second that the direction changes.

N5D04

Batteries always generate direct current. There will be a positive terminal and a negative terminal.

N5D05

Frequency is measured in Hertz. The frequency of an ac (alternating current) supply is the number of times per second that the direction changes.

N5D06

Frequency is measured in Hertz. The frequency of an ac (alternating current) supply is the number of times per second that the direction changes. A 60 Hertz supply changes direction 60 times each second.

N5D07

This figure is for young people. As we get older the upper limit reduces. Exposure to loud machinery or heavy-metal rock music is believed to accelerate high frequency hearing loss. Black Sabbath fans beware!

N5D08

Audio frequencies are those that people can hear; they are audible!

N5D09
A way to remember this is that radio frequencies start where audio frequencies end, at 20 kHz.

N5D10

This is way above the 20 kHz point and so it is in the radio frequency range.

N5D11

The phrase 'Cycles per second' means the same as frequency in Hertz, or Hz.   The question also tests that you understand that kilo means thousands.

N5D12

The phrase 'Cycles per second' means the same as frequency in Hertz, or Hz.

N5D13

Imagine a wave traveling in water. Count how many peaks pass you every second. This is the frequency. Now measure the distance between the peaks. This is the wavelength.

N5D14

Imagine a wave traveling in water. Count how many peaks pass you every second. This is the frequency. Now measure the distance between the peaks. This is the wavelength.

If a lot of peaks go past every second then they are close together and the wavelength is small.

N5D15

Imagine a wave traveling in water. Count how many peaks pass you every second. This is the frequency. Now measure the distance between the peaks. This is the wavelength.

If only a few peaks go past every second then they are far apart; the wavelength is large.

N6A01

With switches the throw is the number of outputs, while the pole is the number of individual switching elements.

A single pole double throw switch switches one input (via the pole) to one of two outputs (the throws).

N6A02

With switches the throw is the number of outputs, while the pole is the number of individual switching elements.

It is double pole and so can handle two inputs. It is single throw, so each input has a single output to which it is either connected or not.

N6A03

A fuse is a component that is designed to open the circuit if too much current flows. Fuses are safety devices that prevent damage or fire elsewhere in an item of equipment. Fuses are rated to blow at various currents. Make sure that replacement fuses have the correct rating. Many fuses are small tubular glass or ceramic devices with a metal cap at each end.

N6A04
A battery has a positive and a negative terminal.

N6A05

A potentiometer (pot) is a type of variable resistance often used in electronic equipment. An example is the volume control found in radio and audio equipment.

N6A06

In schematic diagrams an arrow often indicates a component with a variable value.

N6A07

The jagged bends might remind you of a road that is difficult to negotiate. The cars must travel more slowly. A resistor presents electrical resistance and slows down the current.

N6A08

A fuse is a component that is designed to open the circuit if too much current flows. Fuses are safety devices that prevent damage or fire elsewhere in an item of equipment. Fuses are rated to blow at various currents. Make sure that replacement fuses have the correct rating. Many fuses are small tubular glass or ceramic devices with a metal cap at each end. They look like the diagram.

N6A09

The dissimilar parallel lines represent the plates in a lead-acid cell that are dissimilar when charged. You have to imagine the electrolyte that is between them!

N6A10
A single-pole, single-throw switch is a simple on/off switch.

N6A11

This switch is useful for routing an input to either of two outputs. You may wish to route the RF from your transmitter to two different antenna systems depending on the band you are using.

N6A12

This sort of switch is often used to switch power to a shack. It disconnects both conductors of the power feed when in the off position.

N6A13

This switch could be used to route a single power feed to two pieces of equipment at different times.

N6B01
A transistor can amplify small signals using a low voltage power supply.

N6B02

A transistor has an emitter, collector and base. An NPN transistor has to have the emitter negative and the collector positive. A PNP transistor has a positive emitter and negative collector.

N6B03
The same antenna can radiate energy from a transmitter and collect energy for a receiver.

N6B04

This symbol looks a bit like a plant pot containing earth. The symbol represents a connection to the Earth. One way to obtain this is by connection to a grounding rod hammered into the soil.

N6B05

A chassis ground is indicated by this symbol. A chassis ground is a connection to the metal chassis of an item of electronic equipment. (Which may, or may not, be connected to an earth ground.)

N6B06

Imagine three conductors pointing upwards, like an antenna.

N6B07

In symbols 2 and 3 the internal parts are not touching.   They have a vacuum between them and must be vacuum tubes.   The transistors are symbols 1 and 4.   Look at the arrows in the transistor symbols.   A pointing in arrow is a PNP transistor, so the correct answer for this question is symbol 4.

N6B08

In symbols 2 and 3 the internal parts are not touching. They have a vacuum between them and must be vacuum tubes. The transistors are symbols 1 and 4. Look at the arrows in the transistor symbols. A pointing in arrow is a PNP transistor, so the correct answer is symbol 1.

N6B09

In symbols 2 and 3 the internal parts are not touching. They have a vacuum between them and must be vacuum tubes. The triode has three elements on the inside (tri- meaning three of).

N6B10

In symbols 2 and 3 the internal parts are not touching. They have a vacuum between them and must be vacuum tubes. The pentode has three elements on the inside (pent- meaning five of).

N6B11

The good old vacuum tube is still needed for high power RF amplifier circuits. However, solid state RF amplifiers are gaining ground.

N6B12

Tubes require relatively high voltages for their operation. Where a transistor will typically require a power supply of 9 Volts an equivalent vacuum tube might require 200 Volts. High power tubes can require 2000 Volts or more!

N6B13

They combine the functions by having many internal components that function as transistors resistors and so on.

N7A01

We use an antenna switch. This could well be a single pole double throw switch incorporated into an electrically operated relay. Antenna switches designed for HF use may give high losses at VHF and UHF. Make sure your antenna switch is designed for the power and frequencies you will be using.

N7A02
An antenna tuner can be used as a matching device to maximize the amount of RF power transferred to the antenna. You determine best match condition using a SWR meter.

N7A03

Coaxial cable carrying RF from your transmitter to your antenna is often referred to as feedline.

N7A04

An SWR meter can show if a fault is developing in your antenna systems by monitoring the SWR. An unexplained increase would alert you to a bad connection developing in the system.

N7A05

The SWR meter can go between your transceiver and an antenna tuner or an antenna switch to monitor for faults developing in the antenna system. It will also provide a check that the antenna tuner is doing a proper job of matching your transmitter and antenna system.

N7A06

A receiver will have sensitive components connected to the antenna input. Any transmitter will be capable of delivering signals millions of times more powerful than the receiver is designed to handle. Permanent damage will be the most likely result, even if the power is not switched on to the receiver.

N7A07

Your car will provide a 12 Volt DC supply.   Your home will have a 120 Volt ac supply. A unit is sometimes used to produce a 12 Volt DC supply from your homes ac supply.

N7A08
An antenna tuner is designed to allow a transmitter to transfer maximum power into an antenna that may not otherwise be a good match.

N7A09

This diagram shows a typical setup that allows the transmitter output to be temporarily diverted into a dummy load for test purposes.   Tests can then be carried out without the possibility of spurious signals being radiated.

N7A10

Block one is the transceiver connected to block two, which is an SWR meter. Then, block three is the antenna switch. The antenna switch is used to select the correct antenna or dummy load.

N7A11

Block three is an antenna tuner, used to match the transmitter to the antenna. Of course, an SWR meter could be placed in this position, but this option was not presented.

N7A12

A SWR meter is often connected between the transceiver and the antenna switch. It can monitor for faults developing in the antenna system. It will also provide a check that the antenna tuner is doing a proper job of matching your transmitter and antenna system.

N7A13

An SWR meter can show if a fault is developing in your antenna systems by monitoring the SWR.   An unexplained increase would alert you to a bad connection developing in the system.

N7A14

This could well be a single pole double throw switch incorporated into an electrically operated relay. Antenna switches designed for HF use may give high losses at VHF and UHF. Make sure your antenna switch is designed for the power and frequencies you will be using.

N7A15
An antenna tuner is designed to allow a transmitter to transfer maximum power into an antenna that may not otherwise be a good match.

N7A16
A SWR meter is often connected between the transceiver and the antenna switch. It can monitor for faults developing in the antenna system. It will also provide a check that the antenna tuner is doing a proper job of matching your transmitter and antenna system.

N7A17

Block one is the transceiver connected to block two, which is an SWR meter. Then, block three is the antenna tuner. An antenna tuner is designed to allow a transmitter to transfer maximum power into an antenna that may not otherwise be a good match.

N7A18

Your car will provide a 12 Volt DC supply. Your home will have a 120 Volt ac supply. A unit is sometimes used to produce a 12 Volt DC supply from your homes ac supply so that you can use a mobile transceiver in your home as well as in your car.

N7A19

A transceiver designed to output several hundred Watts of power must get this power from the power supply.

N7B01
To send Morse code a telegraph key is required which plugs in to special socket on your transceiver.

N7B02

To send Morse code a telegraph key is required which plugs in to special socket on your transceiver.

N7B03

An electronic keyer gives perfect dits and dahs in the Morse code.

N7B04
The microphone plugs in a special socket on your transceiver.

N7B05

To transmit telephony (speech) you need a microphone.

N7B06

Teleprinters are like automatic mechanical typewriters and can used to send and receive text messages via radio. Computer systems are now more common than mechanical teleprinters.   Kits and suitable software are readily obtainable to allow easy connection of a computer to your transceiver.

N7B07

Your transceiver is designed to receive and transmit audible signals. The purpose of the modem is to convert the signals from the format used by a computer into audio signals that can be accepted by your transceiver. Kits and suitable software are readily obtainable to allow easy connection of a computer to your transceiver.

N7B08

In packet radio operation, messages are assembled into packets. Each one has address information added. The terminal node controller (TNC) is used to assemble and disassemble these packets of information.

N7B09

The terminal node controller functions as an interface between your computer and your transceiver. If you have a PC there are plug-in TNCs available.

N7B10

To operate RTTY you need a transceiver and a teleprinter or computer. Teleprinters are like automatic mechanical typewriters and can used to send and receive text messages via radio. Computer systems are now more common than mechanical teleprinters.   Kits and suitable software are readily obtainable to allow easy connection of a computer to your transceiver.

N7B11

The terminal node controller functions as an interface between your computer and your transceiver. If you have a PC there are plug-in TNCs available.

N7B12
During digital operation there tends to be rapid switching from transmit to receive and back again as data flows in each direction.

N7B13
A digital signal processor can function as a very good audio filter to select out the desired signal from the interference.

N8A01

The RF signal is switched on and off by operating the telegraph key. When the signal is on, it produces a plain continuous signal or continuous wave. Hence, the alternative term for Morse code transmission is 'CW'.

N8A02

CW stands for Continuous Wave. In Morse code, each DIT and DAH consists of a plain continuous signal. The signals are sent for a short period of time.

N8A03

The RF signal is switched on and off by operating the telegraph key.   When the signal is on, it produces a plain continuous signal or continuous wave.   Hence, the alternative term for Morse code transmission is 'CW'.

N8A04

Phone, or telephony, is another name for voice communications.

N8A05

By convention upper side band (USB) is used on 10 meters, 12 meters, 15 meters and 20 meters. Lower sideband (LSB) is used on 40 meters, 80 meters and 160 meters.

N8A06

Phone, or telephony, is another name for voice communications.

N8A07
The frequency of the signal is shifted slightly as the letter codes are sent.

N8A08

RTTY stands for radioteletype. Narrow band means that the frequency of the signal shifts only slightly as the codes are sent, the signal stays within a narrow bans. Direct printing means that the messages are typed as they are received.

N8A09

The digital data from a computer is packaged up into packets before being transmitted.

N8A10
Data is a rapid stream of on/off signals which can represent speech, text or images. A computer is needed to convert the original signals into the on/off signals.

N8A11
The data can be sent rapidly and it is possible to introduce error checking signals to make data transmission very reliable and immune to interference and noise.

N8B01

Harmonic frequencies are always multiples of the desired fundamental frequency. They are spurious emissions and need to be kept at low levels in the output of a transmitter.

N8B02

Harmonic frequencies are always multiples of the desired transmitted signal frequency. In this case 7160 kHz x 4 = 28,640 kHz.

N8B03

Since 7,125 kHz x 3 = 21,375 the two frequencies are harmonically related.   One is a multiple of the other.

N8B04
Your hand held may be faulty if it is radiating signals other than the intended one.

N8B05
If it is radiating signals other than the intended one they are spurious emissions.

N8B06

The cover and shielding are intended to prevent internal transmitter components from radiating spurious emissions. They are also there to prevent exposure to hazardous voltages and high levels of RF radiation.

N8B07

Splatter has a characteristic sound. A signal with splatter is taking up more band space than necessary as well as advertising the fact the station is being operated incorrectly. Read your transceiver operating instructions to learn how to adjust your microphone gain setting so as not to cause splatter.

N8B08

A speech processor can be useful to enhance your speech signals. If too much speech processing is used the result will be a broadening of your signal called splatter. Splatter has a characteristic sound. A signal with splatter is taking up more band space than necessary as well as advertising the fact the station is being operated incorrectly. Read your transceiver operating instructions to learn how to adjust your speech processor so as not to cause splatter.

N8B09
On commercial FM equipment there is usually no microphone gain control.

N8B10
Always speak in a normal voice with the microphone held about an inch away from the mouth.

N8B11

Deviation is the amount that your speech is affecting the RF signal of an FM transmission. Talk farther from the microphone to reduce deviation.

N8B12

Chirp is a characteristic sound made by transmitters with poor power supplies. It is heard as a change or wobble in frequency at the start of each dit or dah.

To correct the power supply problem you:

a) Cure the fault if the power supply is of the correct rating for your transceiver.
b) Get a power supply that is capable of providing sufficient power for your transceiver
c) In the case of battery powered equipment, make sure that the batteries are charged.

N8B13

Chirp is a characteristic sound made by transmitters with poor power supplies. It is heard as a change or wobble in frequency at the start of each dit or dah.

To correct the power supply problem you:
a) Cure the fault if the power supply is of the correct rating for your transceiver.
b) Get a power supply that is capable of providing sufficient power for your transceiver
c) In the case of battery powered equipment, make sure that the batteries are charged.

N8B14

Old style power supplies used filter capacitors to clean up the DC power supply to a transmitter. These capacitors contained a liquid that could gradually dry out over the years and they would lose their function. The result was a harsh 60 hertz buzz superimposed on the transmitter signal. Modern power supply circuits do not use these 60 hertz filter capacitors.

N8B15
Put out a call and ask anyone who returns what your signal sounds like.   Any fellow radio amateur will be pleased to give you a report on signal quality.

N8B16

The grounding should be done with thick braid.   Good grounding will provide other beneficial effects along with protection from shock. Grounding will give better immunity from interference and reduce spurious transmitted signals.

N9A01

The thing to watch for here is that the length is required in feet, not meters.

Half wave dipole length (feet) = 468 / Frequency (MHz)

Half wave dipole length (meters) = 150 / Frequency (MHz)

N9A02

A quarter wave antenna is half as long as a half wave dipole.

Quarter wave antenna length (feet) = 234/frequency (MHz).

Quarter wave antenna length (meters) = 75/frequency (MHz).

N9A03

The formula for calculating the length of a half wave dipole is:

Half wave dipole length (feet) = 468 / Frequency (MHz).

The frequency given in the question is in kHz, so the first thing to do is to convert this to MHz as required by the formula. We do this by dividing by 1000:

3725 kHz = 3.725 MHz.

We can now plug this value into the formula:

Half wave dipole length (feet) = 468 / 3.725 = 126 Feet (approximately).

A half wave dipole is easy to make. Just suspend the required horizontal length of ordinary wire as high as you can get it with the ends insulated. Connect your antenna feedline to the center of this antenna.

N9A04

The required length is in feet so we use the formula:

Half wave dipole length (feet) = 468 / Frequency (MHz).

Plug the frequency into the formula to give:

Half wave dipole length (feet) = 468 / 28.150 MHz = 17 Feet (approximately).

N9A05

A quarter wave antenna is half as long as a half wave dipole.

Quarter wave antenna length (feet) = 234/frequency (MHz).

The frequency given in the question is in kHz, so the first thing to do is to convert this to MHz as required by the formula. We do this by dividing by 1000:

7125 kHz / 1000 = 7.125 MHz.

Plug the frequency into the formula to give:

Quarter wave antenna length (feet) = 234/ 7.125MHz = 33 feet (approximately).

N9A06

A quarter wave antenna is half as long as a half wave dipole.

Quarter wave antenna length (feet) = 234/frequency (MHz).

Plug the given frequency into the formula to give:

Quarter wave antenna length (feet) = 234/ 21.125 MHz = 11 feet (approximately).

N9A07

We use the formula:

Half wave dipole length (feet) = 468 / Frequency (MHz).

Plug the frequency into the formula to give:

Half wave dipole length (feet) = 468 / 223 MHz = 2.1 feet (approximately).

However, the question asks for the length in inches.   So we need to multiply the feet by 12:

2.1 x 12 = 25 approximately.

N9A08
Use the formula for a half wave dipole:

Half wave dipole length (feet) = 468 / Frequency (MHz)

Try putting in some different frequencies. You will see that the bigger the frequency the smaller the length and vice versa. The same thing happens with all the other antenna length equations. Try it!

N9A09

Use the formula for a half wave dipole:

Half wave dipole length (feet) = 468 / Frequency (MHz).

Try putting in some different frequencies. You will see that the bigger the frequency the smaller the length and vice versa. The same thing happens with all the other antenna length equations. Try it. So if you remove the tip of an antenna to make it shorter its resonant frequency will increase.

N9A10

Use the formula for a half wave dipole:

Half wave dipole length (feet) = 468 / Frequency (MHz).

Lets try putting in some frequencies:

At 28.150 MHz the length is 468/28.150 MHz = 16.6 feet.

At 28.000 MHz the length is 468/28.000 MHz = 16.7 feet.

The longer antenna corresponds to the lower frequency.   To lower the resonant frequency of an antenna you have to add to its length.   This is the reason why VHF antennas are small compared to HF antennas, they work at much higher frequencies.

N9A11
Use the formula for a half wave dipole:

Half wave dipole length (feet) = 468 / Frequency (MHz).

Lets try putting in some frequencies:

At 28.150 MHz the length is 468/28.150 MHz = 16.6 feet.

At 28.300 MHz the length is 468/28.300 MHz = 16.5 feet.

The shorter antenna corresponds to the higher frequency.   To raise the resonant frequency of an antenna you have to shorten it.

N9A12
A multiband antenna is an efficient radiator on several amateur bands. A disadvantage is that if you use one of the lower frequency bands then the antenna will efficiently radiate certain harmonics if they are present in the transmitter output. You need to be sure that your transmitter output is free of harmonics.

N9A13
With a single band antenna any harmonics in your transmitter output will be suppressed. In a multiband antenna they will be efficiently radiated. You need to be sure that your transmitter output contains no appreciable harmonics.

N9B01

Most of the radio energy goes in a direction from the reflector toward the director. The reflector is the longest element, the director(s) the shortest.

N9B02

The driven element is fed with RF energy from the transmitter.

N9B03
The driven element is fed with RF energy from the transmitter.

N9B04

The director is shorter than the driven element and is placed in front of it.   Most of the transmitted signal goes in the direction of the director.

N9B05

A reflector is longer than the driven element, most of the transmitted signal goes in a direction away from the reflector.

N9B06

If the dipole is erected with the elements aligned in an East to West direction, the RF radiation goes mainly North and South. Many radio amateurs have some means of rotating their antennas to make use of the directional effects.

N9B07

The design and theory of the Yagi antenna are complex. However, these antennas can be bought ready made or built using readily available instructions.

N9B08

An antenna does not have to be a half or quarter wavelength long to be effective. In this question the advantage of a 5/8 wavelength antenna is highlighted.

N9B09

With a vertical antenna most of the radiation is horizontal. Very little radiation goes straight up. The omnidirectional property of a vertical antenna is useful for mobile installations.

N9B10

If the dipole is erected with the elements aligned in an East to West direction, the RF radiation goes mainly North and South.   Many radio amateurs have some means of rotating their antennas to make use of the directional effects.

N9B11
A short "rubber duck" antenna is very much a compromise between efficiency and convenience.

N9C01

Coaxial cable comes in many different grades. Make sure that you use the correct grade. For example VHF antenna cable for television use will not be adequate for UHF work. The use of inadequate coaxial cable will result in loss of RF power before it can reach your antenna. There will also be some loss of received signals.

N9C02

There is no RF radiation present on the outside of good quality coaxial cable.   You can run it close to building structures without affecting the performance.

N9C03

Make sure that the cable is sufficiently moisture proof and make sure that it cannot be cut or dug up!

N9C04

Coaxial cable comes in many different grades. Make sure that you use the correct grade. For example VHF antenna cable for television use will not be adequate for UHF work. The use of inadequate coaxial cable will result in loss of RF power before it can reach your antenna. There will also be some loss of received signals.

N9C05

The outer shield of coaxial is at ground potential and so it is OK to run it close to metal or other objects.

N9C06

Parallel conductor line has very low loss because the medium separating the two conductors is mostly air that does not absorb RF energy.

Operating at a high SWR can heat up and damage coaxial cable; this is less likely with parallel conductor feed-line.

N9C07

Parallel conductor line has very low loss because the medium separating the two conductors is mostly air that does not absorb RF energy.

Operating at a high SWR can heat up and damage coaxial cable; this is less likely with parallel conductor feed-line.

N9C08

Parallel conductor feedline cannot be used close to metal objects. You will often see it strung on plastic rods held well away from roofs and guttering.

You will need an antenna tuner to match the impedance of 300 Ohm parallel conductor feedline to the 52 Ohm impedance output of your transmitter.

N9C09

It is not very popular nowadays, even though it has very low loss. Coaxial cable is preferred because it can be run close to other objects and it is weatherproof.

N9C10

Many radio amateurs use an impedance matching device to match the antenna to the transceiver.

N9C11

Coaxial cable is unbalanced. The two conductors (inner and shield) are not identical. A dipole antenna is a balanced device, the two halves are identical. A balun is often used to efficiently transfer RF energy from an unbalanced coaxial feedline to a balanced dipole.

N9C12

Coaxial cable is unbalanced; the two conductors (inner and shield) are not identical. A dipole antenna is a balanced device, the two halves are identical. A balun is often used to efficiently transfer RF energy from an unbalanced coaxial feedline to a balanced dipole.

N0A01
Frequency can have an effect on how much RF power is absorbed by a person. For example, the body and limbs are resonant at certain frequencies. The power level of the source is an obvious factor, a high power source will result in higher RF fields. An antenna at the top of a tall tower is safer than one at ground level because of its distance.

The radiation pattern of an antenna can result in much of the RF power being concentrated in certain directions. For example, a Yagi antenna will radiate most strongly in a direction from the reflector toward the director.

N0A02
Microwave cookers use the heating effect of high levels of RF energy. The heating effect can occur deep inside body tissues and little or no pain may be experienced even while considerable damage is occurring.

N0A03
If you touch the antenna you will not get an electric shock. However there will be considerable local heating and possibly cooking of your body tissues. There may also be some electrical arcing and charring of your skin.

N0A04
Pain nerves tend to be under the skin surface, RF heating occurs deep within body tissues. Considerable heat damage can be inflicted before much pain is felt.

N0A05
Ionization of atoms disrupts chemical bonds within biological molecules such as DNA. This damage can give rise to genetic damage or cause cells to become cancerous. In extreme cases high levels of ionizing radiation give rise to "radiation sickness". RF radiation is non ionizing. It is not capable of ionizing atoms and its harmful effects are due to heating.

N0A06

Most of the potentially harmful exposure levels will occur in the near field area surrounding an antenna or feedline. The near field boundary is a few wavelengths away from the radiating object. A short wavelength will give a small near field boundary. A small antenna will have a small near field.

N0A07
If you touch the antenna you will not get an electric shock. However there will be considerable local heating and possibly cooking of your body tissues. There may also be some electrical arcing and charring of your skin. Depending on the radiation pattern it might be possible to be injured by standing close to a transmitting antenna if the RF field is high enough. A high gain Yagi will concentrate the RF energy in the forward direction, so do not stand near it when it is being fed with RF energy.

N0A08
If you touch the antenna you will not get an electric shock. However there will be considerable local heating and possibly cooking of your body tissues. There may also be some electrical arcing and charring of your skin.   Depending on the radiation pattern it might be possible to be injured through RF heating effects by standing close to a transmitting antenna if the RF field is high enough.

N0A09
If you touch the antenna you will not get an electric shock. However there will be considerable local heating and possibly cooking of your body tissues. There may also be some electrical arcing and charring of your skin. Be aware that a dish antenna will direct most of the RF power in the forward direction so do not stand in front of it when it is being fed with RF power.

N0A10
If you touch the antenna you will not get an electric shock. However there will be considerable local heating and possibly cooking of your body tissues. There may also be some electrical arcing and charring of your skin. Be aware that a Yagi antenna will direct and concentrate most of the RF power in the forward direction, so do not stand in front of it when it is being fed with energy.

N0A11
There will be considerable local heating and possibly cooking of your body tissues. There may also be some electrical arcing and charring of your skin. Be aware that a high gain antenna will direct and concentrate most of the RF power in the forward direction, so do not stand in front of it when it is being fed with energy. High gain arrays such as those used for EME (moonbounce) work may give an effective radiated power of 250,000 W or more.

N0B01
A controlled environment is one in which EM field strength can be determined and where all persons on the premises have been made aware of the existence of EM fields.

N0B02
A public place would normally be regarded as an uncontrolled environment because the EM field strength is not known or the people in it are not aware of the presence of EM fields.

N0B03
A ham radio shack is an example of a controlled environment because persons in it will be aware of the potential for RF radiation exposure.

N0B04

Field strength measurements require special equipment not normally available to radio amateurs. The FCC do not require field-strength measurements. It is possible to consult various charts and tables to get an idea of field strengths in and around a specific amateur radio station and this is acceptable by the FCC. An RF field contains both magnetic and electric fields, V/m is a unit of electric field strength.

N0B05
Field strength measurements require special equipment not normally available to radio amateurs. The FCC do not require field-strength measurements. It is possible to consult various charts and tables to get an idea of field strengths in and around a specific amateur radio station and this is acceptable by the FCC. An RF field contains both magnetic and electric fields, A/m is a unit of magnetic field strength.

N0B06
High energy radiation such as x-rays, gamma radiation and ultraviolet radiation can dislodge electrons from atoms. This process is called ionization and is very harmful to living tissues. RF energy cannot do this but, nevertheless, can inflict considerable damage due to heating.

N0B07
A controlled environment is one in which EM field strength can be determined and where all persons on the premises have been made aware of the existence of EM fields.

N0B08
Below 3kHz the radiation is regarded as low frequency EM fields. Such fields are radiated by power lines. Above 300GHz the radiation is bordering on infra-red EM radiation.

N0B09
They may not be aware of the significance of your hobby and will certainly have no control over RF levels caused by amateur radio activities.

N0B10
Power density is Milliwatts per square centimeter.
Electric field strength is Volts per meter.
Magnetic field strength is Amperes per meter.
Figure NT0-1 gives limits of both magnetic and electric field strengths at various frequencies.

N0B11

All of the options refer to power density and so the required equation is in the fourth column. Figure NT0-1 Section A) refers to controlled limits. The Novice HF bands lie within 3.0-30 MHz so the second row is used and on this row the power density exposure limit is given by ($900/f^2$) where f is frequency in MHz.

N0B12
All of the options refer to electric field strength and so the required equation is in the second column. Figure NT0-1 Section A) refers to controlled limits. The Novice HF bands lie within 3.0-30 MHz so the second row is used and on this row the electric field strength exposure limit is given by 1842/f where f is frequency in MHz.

N0B13

All of the options refer to power density and so the required equation is in the fourth column. Figure NT0-1 Section B) refers to uncontrolled limits. The Novice HF bands lie within 1.34-30 MHz so the second row is used and on this row the power density exposure limit is given by $(180/f^2)$ where f is frequency in MHz.

N0B14
All of the options refer to magnetic field strength and so the required equation is in the third column. Figure NT0-1 Section B) refers to uncontrolled limits. The Novice HF bands lie within 1.34-30 MHz so the second row is used and on this row the magnetic field strength exposure limit is given by 2.19/f where f is frequency in MHz.

N0C01
All amateur stations must comply with MPE limits but only stations using a transmitter power of more than 50W PEP are required to be evaluated.   At less than 50W a station is presumed to comply with the MPE limits. [97.13]

N0C02
You will be required to certify on your licence application Form 610 that you have carried out an evaluation of the RF exposure levels for both controlled and uncontrolled exposure areas.
[97.13]

N0C03
This is the range of frequencies in the first column of Figure NT0-1.

N0C04
All amateur stations must comply with MPE limits but only stations using a transmitter power of more than 50W PEP are required to be evaluated.   At less than 50W a station is presumed to comply with the MPE limits. [97.13]

N0C05
This time period is shown in column 5 of Figure NT0-1 section B).

N0C06
This time period is shown in column 5 of Figure NT0-1 section A).

N0C07
It is important to realize that the limits are exposure limits and not emission limits. These limits are given in Figure NT0-1.

N0C08

It is important to realize that the limits are exposure limits and not emission limits. These limits are given in Figure NT0-1.

N0C09
This time period is shown in column 5 of Figure NT0-1 section A).

N0C10
This time period is shown in column 5 of Figure NT0-1 section B).

N0C11
The question is referring to a controlled environment and so section A) of Figure NT0-1 should be used. The frequency is 3.7 MHz and so the correct row is row 2 which covers 3.0-30 MHz. Look in the power density column of this row and the formula ($900/f^2$) is shown.
Plugging our value of f=3.7MHz into this formula gives $900 / 3.7^2$ which is equal to 65.7 mW/cm^2

Remember to use the frequency in MHz and that the answer is in mW/cm^2

N0C12
The question is referring to an uncontrolled environment and so section B) of Figure NT0-1 should be used. The frequency is 28.4 MHz and so the correct row is row 2 which covers 3.0-30 MHz. Look in the power density column of this row and the formula ($180/f^2$) is shown.
Plugging our value of f=28.4MHz into this formula gives $180 / 28.4^2$ which is equal to 0.22 mW/cm^2

Remember to use the frequency in MHz and that the answer is in mW/cm^2

N0C13
The question is referring to an uncontrolled environment and so section B) of Figure NT0-1 should be used. The frequency is 222 MHz and so the correct row is row 3 which covers 30-300 MHz. Look in the power density column of this row and the value 0.2 mW/cm² is shown.
No calculations are needed in this case.

Remember to use the frequency in MHz and that the answer is in mW/cm²

N0C14
The question is referring to an controlled environment and so section A) of Figure NT0-1 should be used. The frequency is 1270 MHz and so the correct row is row 4 which covers 300-1500 MHz. Look in the power density column of this row and the formula f/300 is shown.
Plugging our value of f=1270MHz into this formula gives 1270/300 which is equal to 4.2 mW/cm²

Remember to use the frequency in MHz and that the answer is in mW/cm²

N0C15
You will be required to certify understanding of the FCC exposure limits on Form 610 station applications. You are not required to file proof of exposure evaluation of your station with the FCC. The Commission recommends, however, that radio amateurs keep a record of the routine station evaluation procedure and its results.

N0C16

Section C of Table NT0-1 refers to half-wavelength dipole antenna estimated distances. The first table in this section covers 3.5MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 3 under the heading "Distance to uncontrolled limit" and the required distance of 1.5' will be found.

N0C17

Section B of Table NT0-1 refers to quarter-wavelength vertical antenna estimated distances. The fifth table in this section covers 28MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 2 under the heading "Distance to controlled limit" and the required distance of 4.9' will be found.

N0C18

Section C of Table NT0-1 refers to half-wavelength dipole antenna estimated distances. The second table in this section covers 7MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 2 under the heading "Distance to controlled limit" and the required distance of 1.4' will be found.

N0C19
Section C of Table NT0-1 refers to half-wavelength dipole antenna estimated distances. The fourth table in this section covers 21MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 2 under the heading "Distance to controlled limit" and the required distance of 4.1' will be found.

N0C20
Section C of Table NT0-1 refers to half-wavelength dipole antenna estimated distances. The fourth table in this section covers 21MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 3 under the heading "Distance to uncontrolled limit" and the required distance of 9.2' will be found.

N0C21
Section C of Table NT0-1 refers to half-wavelength dipole antenna estimated distances. The first table in this section covers 3.5MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 2 under the heading "Distance to controlled limit" and the required distance of 0.7' will be found.

N0C22
Section B of Table NT0-1 refers to quarter-wavelength vertical antenna estimated distances. The second table in this section covers 7MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 3 under the heading "Distance to uncontrolled limit" and the required distance of 2.7' will be found.

N0C23
Section C of Table NT0-1 refers to half-wavelength dipole antenna estimated distances. The second table in this section covers 7.0MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 2 under the heading "Distance to controlled limit" and the required distance of 1.4' will be found.

N0C24
Section B of Table NT0-1 refers to quarter-wavelength vertical antenna estimated distances. The fourth table in this section covers 21MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 2 under the heading "Distance to controlled limit" and the required distance of 3.7' will be found.

N0C25

Section B of Table NT0-1 refers to quarter-wavelength vertical antenna estimated distances. The fourth table in this section covers 21MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 3 under the heading "Distance to uncontrolled limit" and the required distance of 8.2' will be found.

N0C26
Section C of Table NT0-1 refers to half-wavelength dipole antenna estimated distances. The fourth table in this section covers 21MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 3 under the heading "Distance to uncontrolled limit" and the required distance of 9.2' will be found.

N0C27
Section C of Table NT0-1 refers to half-wavelength dipole antenna estimated distances. The fifth table in this section covers 28MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 3 under the heading "Distance to uncontrolled limit" and the required distance of 12.3' will be found.

N0D01
Assuming similar RF power there are two factors to consider.

Radiation pattern. All of the antennas except for the dipole tend to have horizontal main lobes. That is, most of the RF power is radiated horizontally rather than toward the ground. In the case of a half wave dipole considerable energy is directed toward the ground.

Distance from source. The RF field increases rapidly as the antenna is approached. The proximity of the half wave dipole antenna to the ground would produce a much stronger RF field.

N0D02
The FCC regulations do not require field-strength measurements although you can elect to measure the field strength if you have the required expertise and equipment. It is possible to consult various charts and tables to get an idea of field strengths in and around a specific amateur radio station and this is acceptable by the FCC.

N0D03
The FCC regulations do not require field-strength measurements although you can elect to measure the field strength if you have the required expertise and equipment. An alternative is to use computer modeling to evaluate the likely RF exposure levels in and around your station.

The FCC document: 'Evaluating Compliance With FCC-Specified Guidelines for Human Exposure to Radio Frequency Radiation' (also known as "OET Bulletin 65.") will have a set of guidelines for calculating field strengths in and around amateur radio stations. Contact the FCC at 1270 Fairfield Rd, Gettysburg, PA 17325; tel. 717-337-1433 for copies or visit their web pages on http:www.fcc.gov.

It is possible to consult various charts and tables to get an idea of field strengths in and around a specific amateur radio station. This is acceptable by the FCC and is expected to be the method used by the majority of radio amateurs.

N0D04
All amateur stations must comply with MPE limits but only stations using a transmitter power of more than 50W PEP are required to be evaluated. At less than 50W a station is presumed to comply with the MPE limits. [97.13]

N0D05
All amateur stations must comply with MPE limits but only stations using a transmitter power of more than 50W PEP are required to be evaluated.   At less than 50W a station is presumed to comply with the MPE limits. [97.13]

N0D06
You will be required to certify on your licence application Form 610 that you have carried out an evaluation of the RF exposure levels for both controlled and uncontrolled exposure areas. You are advised, but not required, to keep a record of this evaluation.
[97.13]

N0D07
A radio amateur who elects to make measurements will need calibrated equipment (including probes) and knowledge of its use. Some expertise in near-field measurement techniques is also desirable.

N0D08
The field will be affected by reflections from nearby people and the measuring instruments themselves.

The frequency response of the test equipment will effect the accuracy.

The near field polarity will not necessarily be the same as the antenna polarity.

N0D09
A high gain directional antenna will give rise to much higher field strengths in certain directions. Options B and C are incorrect MPE limits do not bear a simple relationship to antenna gain or directivity; they depend on frequency and other factors..

N0D10
The field strength around an antenna will have local hot spots as well as nulls.

N0D11
Field strength tends to drop off rapidly with increasing distance.

N0E01
Power and distance from source are major factors that determine field strength.

A low duty cycle will give a lower field strength when averaged over a time period. Time periods of 6 and 30 minutes are used for controlled and uncontrolled exposure evaluations.

A low pass filter will have little or no effect on the total RF radiation.

N0E02
If the antenna is radiating ("key down" radiation) for a total of 15 minutes in every 30 minute period then the average field strength is regarded as being reduced by 50% for uncontrolled exposure evaluations.

N0E03
If the antenna is radiating ("key down" radiation) for a total of 3 minutes in every 6 minute period then the average field strength is regarded as being reduced by 50% for controlled exposure evaluations.

N0E04
Even though there may be just a few watts of RF power available from a hand-held the distance from your brain to the antenna is very small!

N0E05
RF field strength tends to drop off rapidly with increasing distance and so an antenna high up a tower will produce smaller fields at ground level. There will also be less likelihood of anyone touching it and getting burns.

N0E06
Even though there may be just a few watts of RF power available from a hand-held the distance from your brain to the antenna is very small!

N0E07
RF field strength tends to drop off rapidly with increasing distance and so an antenna high up a tower will produce smaller fields at ground level. There will also be less likelihood of anyone touching it and getting burns. RF burns can be very painful and difficult to heal since they tend to tunnel into living tissue.

N0E08
Unlike coaxial feedlines open wire feedlines can have high field strengths in their vicinity.

N0E09

RF field strength tends to drop off rapidly with increasing distance and so an antenna high up a tower will produce smaller fields at ground level. Mounting the antenna up a tower will also give best communications performance.

N0E10
RF field strength tends to drop off rapidly with increasing distance and so an antenna high up a tower will produce smaller fields at ground level. Mounting the antenna up a tower will also give best communications performance.

N0E11
RF field strength tends to drop off rapidly with increasing distance and so a wire antenna high up will produce smaller fields at ground level. There will also be less likelihood of anyone touching it and getting burns. RF burns can be very painful and difficult to heal since they tend to tunnel into living tissue.

N0E12
Most RF radiation is in the direction of the antenna main lobe so altering the direction and size of the lobe could reduce field strength in certain directions.
The figures and tables used for obtaining exposure limits include frequency and power as parameters.
The duty cycle, averaged over 6/30 minutes for controlled/uncontrolled exposure limits will be effected by the emission type. For example an FM telephony emission will have a duty cycle of 100% while the station is transmitting while the duty cycle of an SSB emission will be much less.
Relocating the antenna could increase the distance from people, thus reducing their exposure.

N0E13
Two-way exchanges reduce the duty cycle of the station transmitter since it will be radiating no RF during the receive part of the exchange. Since all of the options are two-way exchanges we need to examine the duty cycle of each emission type:
PM and FM telephony emissions have a duty cycle of 100% since the carrier is at a maximum for the entire transmit period.
Morse code has an intermediate duty cycle, the carrier being at maximum during dits and dahs with rest periods of no carrier in between.
SSB has the lowest duty cycle of all. Little or no carrier is present during speech pauses and during speech the average RF level is much lower than the peak level even with considerable speech processing.

N0E14

Section A of Table NT0-1 refers to "triband" Yagi antenna estimated distances. The second table in this section covers 21MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 3 under the heading "Distance to uncontrolled limit" and the required distance of 16.4' will be found.

N0E15
Section A of Table NT0-1 refers to "triband" Yagi antenna estimated distances. The second table in this section covers 21MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 2 under the heading "Distance to controlled limit" and the required distance of 7.3' will be found.

N0E16
Section A of Table NT0-1 refers to "triband" Yagi antenna estimated distances. The third table in this section covers 28MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 2 under the heading "Distance to controlled limit" and the required distance of 11' will be found.

N0E17
Section A of Table NT0-1 refers to "triband" Yagi antenna estimated distances. The third table in this section covers 28MHz. Row 1 is used for 100 watts transmitter power. Look on row 1 column 3 under the heading "Distance to uncontrolled limit" and the required distance of 24.5' will be found.