

Technician Licensing Class

About Ham Radio

Section One

Valid July 1, 2018

Through

June 30, 2022



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About Ham Radio

T1A01 One **Purpose** of the Amateur Radio Service is **advancing skills** in the **technical** and **communication** phases of the radio art.



There is no age requirement for holding an FCC Amateur Radio License.

About Ham Radio

T1A02 The agency that regulates and enforces the rules for the Amateur Radio Service in the United States is the **FCC**.

T1C10 You may operate a transmitter on an amateur service frequency after you pass the examination required for your first amateur radio license and **as soon as your name and call sign appear in the FCC's Universal Licensing System (ULS) database.** [97.5a]



About Ham Radio

T1C08 The normal term for an FCC-issued primary station/operator license grant is **ten years**.

T1C09 The **grace period** following the expiration of an amateur license within which the license may be renewed is **two years**.



About Ham Radio

T1C01 The **license classes** currently available from the **FCC** are **Technician, General, and Amateur Extra**.

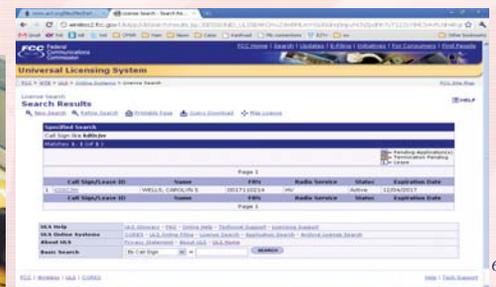
T1A04 Any **one person** may only hold **ONE** operator/primary station license.

T1A05 Proof of possession of an FCC-issued operator/primary license grant is shown by the control operator's operator/primary station license appearing in the **FCC ULS consolidated licensee database**

About Ham Radio

T1C11 If your license has expired and is still within the allowable grace period, you may **not** continue to operate to transmit until the ULS database shows that the license has been renewed.

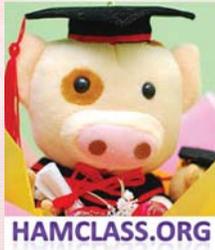
Make sure the FCC has issued your call sign before you go on the air for the first time.



Take Aways

Section One Take Aways

Words that are **bold** and **red** appear in the correct answer.



7

Take Aways

- One purpose of the Amateur Radio Service is **advancing skills in the technical and communication phases of the radio art.**
- The license classes currently available from the FCC are **Technician, General, and Amateur Extra.**
- You may operate a transmitter after you pass the examination elements required for your first amateur radio license as soon as your name and call sign appear in the **FCC's license database**

8

Take Aways

- One Person may only have **ONE** Operator/Primary Station license grant.
- Proof of possession of the control operator's operator/primary station license is the appearance of the **license assignment in the FCC ULS consolidated licensee database**

9

Take Aways

- The normal term for an FCC-issued primary station/operator license grant is **Ten Years.** [97.25]
- There is a **grace period of two years** following the expiration of an amateur license within which the license may be renewed. [97.21(a)(b)]
- If your license has expired and is still within the allowable grace period, you may **NOT continue to operate a transmitter** on amateur service frequencies until the ULS database shows that the license has been renewed. [97.21(b)]

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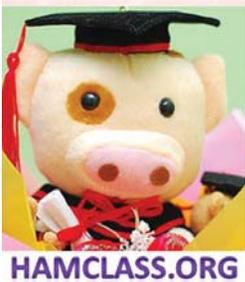
Element 2 Technician Class Question Pool

About Ham Radio

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

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

T1A02

12

Which of the following is a purpose of the Amateur Radio Service as stated in the FCC rules and regulations?

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

T1A01

13

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

- A. Novice, Technician, General, Advanced
- B. Technician, Technician Plus, General, Advanced
- C. Novice, Technician Plus, General, Advanced
- D. Technician, General, Amateur Extra

T1C01 n

14

How soon after passing the examination for your first amateur radio license may you operate a transmitter on an Amateur Radio Service frequency?

- A. Immediately
- B. 30 days after the test date
- C. As soon as your operator/station license grant appears in the FCC's ULS database
- D. You must wait until you receive your license in the mail from the FCC

T1C10

15

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

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

T1A04

What is proof of possession of an FCC-issued operator/primary license grant?

- A. A printed operator/primary station license issued by the FCC must be displayed at the transmitter site
- B. The control operator must have an operator/primary station license in his or her possession when in control of a transmitter
- C. The control operator's operator/primary station license must appear in the FCC ULS consolidated licensee database
- D. All of these choices are correct

T1A05

What is the normal term for an FCC-issued primary station/operator license grant?

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

T1C08

18

What is the grace period following the expiration of an amateur license within which the license may be renewed?

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

T1C09

19

If your license has expired and is still within the allowable grace period, may you continue to operate a transmitter on Amateur Radio Service frequencies?

- A. No, transmitting is not allowed until the ULS database shows that the license has been renewed
- B. Yes, but only if you identify using the suffix GP
- C. Yes, but only during authorized nets
- D. Yes, for up to two years

T1C11

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Technician Licensing Class

Call Signs

Section Two

Valid July 1, 2018
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1

Call Signs

T1F03 An amateur station is required to transmit its assigned call sign at least **every 10 minutes during** and **at the end** of a contact.

Callsigns issued by the FCC **start with an A, K, N, or W** and all include a single numeric digit, 0 to 9.

How Often Do We Use Our Call Signs?????
Every 10 and at the End
Say it with me: **“Every 10 and at the end”**

2

Call Signs

T1D11 An amateur station may transmit **without** on-the air identification when transmitting **signals to control model craft**



3

Call Signs

The number in your new call sign is determined by your permanent mailing address when you are assigned your call.

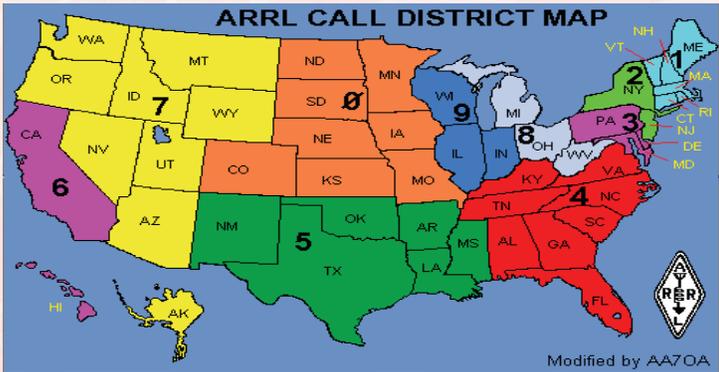


Most states offer Amateur Radio call signs on license plates. Matt's call has a "4" in it because he was first licensed in FL

4

Call Signs

The number in your new call sign is determined by your permanent mailing address when you are assigned your call.



5

Call Signs

T1C02 **Any** licensed amateur may select a **desired call sign** under the **vanity call sign rules** (if it is available)

KC0BS NOCJ WOJMD are all vanity call signs

T1C05 A vanity call sign available to a Technician Class amateur operation is **K1XXX**.

T1F11 At **least 4 persons** are required to be members of a club for a club station license to be issued by the FCC. [97.5(b)(2)]

6

Call Signs

T1A03 Use of a **phonetic alphabet** is the method **encouraged** by the FCC when identifying your station when using phone (voice).

A Alpha	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	

7

Call Signs



T2C02 The term "**NCS**" refers to the **Net Control Station** in an amateur radio net operation. This is an example of a **tactical call sign**.

T1F02 When using **tactical** identifiers you must transmit your station's FCC-assigned call sign at the **end of every communication** and **every ten minutes** during the communication.



Call Signs

T1F04 **Phone** (voice) emission in the English language is an acceptable method of station identification when operating in the phone sub-band.

Testing your radio?
Give your call sign
(in English).



9

Call Signs

T1F06 **KL7CC stroke W3**, **KL7CC slant W3** and **KL7CC slash W3** are acceptable formats of **self-assigned indicators** when identifying using a phone transmission.

- KL7CC/W3 ... Stroke
- KL7CC/W3 ... Slant
- KL7CC/W3 ... Slash

10

Call Signs

T1B01 The ITU (International Telecommunications Union) is a **United Nations** agency for information and communication technology issues.



North American amateur stations are located in ITU Region 2 11

Call Signs

T1D01 FCC-licensed amateur are prohibited from exchanging communications with **any country whose administration has notified the ITU** (Not the UN!) that it objects to communications with FCC-licensed amateur stations. (Check the ITU webpage {ITU.INT} for current list)

T1C03 Communications incidental to the purposes of the amateur service and remarks of a **personal character** are types of international communications permitted by an FCC-licensed amateur station.

(No business communications allowed)

12

Call Signs

T1F07 A **restriction** that applies when a non-licensed person is allowed to speak to a foreign station using a station under the control of a Technician Class control operator is that the **foreign station** must be one with which the U.S. has a **third party agreement**.

T1F08 Any time the conversation between two amateur radio stations includes traffic on behalf of someone else it is considered **third party traffic**.

13

Call Signs

T1C04 You are allowed to operate your amateur station **in** a foreign country when the **foreign country authorizes it**.

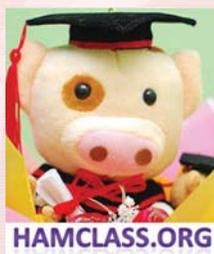
T1C06 In addition to places where the FCC regulates communications, an FCC-licensed amateur station can transmit from **any vessel or craft** that is documented or registered in the **United States**

14

Take Aways

Section Two Take Aways

Words that are **bold** and **red** appear in the correct answer.



- An amateur station is required to transmit its assigned call sign **at least every 10 minutes during and at the end of a communication**.
- An amateur station may transmit without identifying **when transmitting signals to control a model craft**
- NCS refers to the **Net Control Station** in net operations.
- When using tactical identifiers, your station must transmit the station's FCC-assigned call sign **at the end of each communication and every ten minutes during a communication**.

16

Take Aways

- **Any licensed amateur** may select a desired call sign, if it is available, under the vanity call sign rules.
- A vanity call sign available to a Technician Class amateur operation is **K1XXX**.
- **It is encouraged** by the FCC to use the phonetic alphabet when identifying your station in the Amateur Radio Service.
- **A club** station license grant requires **at least 4 members** to be issued by the FCC.

17

Take Aways

- **The English language** is an acceptable language for use for station identification when operating in a phone sub-band.
- **ALL** of the following formats of a self-assigned indicators are acceptable when identifying using a phone transmission
 - KL7CC **stroke** W3
 - KL7CC **slant** W3
 - KL7CC **slash** W3

18

Take Aways

- The International Telecommunication Union (**ITU**) is a **United Nations agency for information and communication technology issues**.
- FCC-licensed amateur stations are prohibited from exchanging communications with **any country whose administration has notified the ITU that it objects to such communications**.

19

Take Aways

- International communications permitted by an FCC-licensed amateur station are **communications incidental to the purposes of the amateur service and remarks of a personal character**.
- A restriction that applies when a non-licensed person is allowed to speak to a foreign station using a station under the control of a Technician Class control operator **is that the foreign station must be one with which the U.S. has a third party agreement**.
- Third Party Communications is **a message from a control operator to another amateur station control operator on behalf of another person**.

20

Take Aways

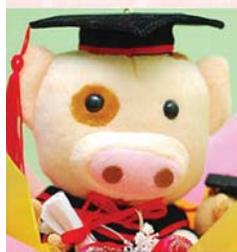
- You are allowed to operate your amateur station in a foreign country **when the foreign country authorizes it**.
- An FCC-licensed amateur station may transmit **from any vessel or craft located in international waters and documented or registered in the United States**, in addition to places where the FCC regulates communications.

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Element 2 Technician Class Question Pool

Call Signs

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When is an amateur station required to transmit its assigned call sign?

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

T1F03

23

When may an amateur station transmit without on-the-air identification?

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

T1D11

24

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

- A. Only a licensed amateur with a General or Amateur Extra class license
- B. Only a licensed amateur with an Amateur Extra class license
- C. Only a licensed amateur who has been licensed continuously for more than 10 years
- D. Any licensed amateur

T1C02

25

Which of the following is a valid call sign for a Technician class amateur radio station?

- A. K1XXX
- B. KA1X
- C. W1XX
- D. All of the choices are correct

T1C05

26

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

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

T1F11

27

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

- A. It is required when transmitting emergency messages
- B. It is prohibited
- C. It is required when in contact with foreign stations
- D. It is encouraged

T1A03

28

What is meant by the term "NCS" used in net operation?

- A. Nominal Control System
- B. Net Control Station
- C. National Communications Standard
- D. Normal Communications Syntax

T2C02

29

When using tactical identifiers such as "Race Headquarters" during a community service net operations, how often must your station transmit the station's FCC-assigned call sign?

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

T1F02

30

Which of the following is an acceptable language to use for station identification when operating in the phone sub-band?

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

T1F04

31

Which of the following formats of a self-assigned indicator is acceptable when identifying using a phone transmission?

- A. KL7CC stroke W3
- B. KL7CC slant W3
- C. KL7CC slash W3
- D. All of these choices are correct

T1F06

32

What is the International Telecommunications Union (ITU) ?

- A. An agency of the United States Department of Telecommunications Management
- B. A United Nations agency for information and communication technology issues
- C. An independent frequency coordination agency
- D. A department of the FCC

T1B01

33

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

- A. Any country whose administration has notified the International Telecommunication Union (ITU) that it objects to such communications
- B. Any country whose administration has notified the American Radio Relay League (ARRL) that it objects to such communications
- C. Any country engaged in hostilities with another country
- D. Any country in violation of the War Powers Act of 1934

T1D01

34

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

- A. Communications incidental to the purposes of the Amateur Radio Service and remarks of a personal character
- B. Communications incidental to conducting business or remarks of a personal nature
- C. Only communications incidental to contest exchanges, all other communications are prohibited
- D. Any communications that would be permitted on an international broadcast station

T1C03

35

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

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

T1F07

36

What is meant by the term "Third Party Communications"?

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

T1F08

37

When are you allowed to operate your amateur station in a foreign country?

- A. When the foreign country authorizes it
- B. When there is a mutual agreement allowing third party communications
- C. When authorization permits amateur communications in a foreign language
- D. When you are communicating with non-licensed individuals in another country

T1C04

38

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

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

T1C06

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Technician Licensing Class

Control

Section Three

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Control

T1E01 An amateur station must always have a control operator when the station is **transmitting**. Thus, a station should **never** be operated without a control operator [97.7(a)]



When you operate your station you're the **"control operator,"** and you are at the station's **"control point."**

2

Control

T1E02 Any amateur whose license privileges allow them to transmit on the satellite **uplink** frequency may be the control operator of a station communicating through an amateur satellite or space station.

T1E03 The **station licensee** must designate the station control operator. (If two separate people).

T1E07 The control operator and the station licensee **are equally responsible** for the proper operation of the station when the control operator is not the station licensee.

When the operator license class held by the **control operator** exceeds that of the **station licensee**, an indicator consisting of the call sign assigned to the control operator's station must be included after the call sign.

3

Control

T1E04 The class of operator license **held by the control operator determines** the transmitting privileges of an amateur station.



When you operate from another ham's station, using **YOUR** callsign, **YOUR** license class privileges apply.

4

Control

T1E06 Under normal circumstances, a Technician Class licensee may **at no time** be the control operator of a station operating in an exclusive Extra Class operator segment of the amateur bands.

You must stay within your Technician Class privileges.

T1E05 The location at which the **control operator function is performed** is considered the amateur station **control point**.



The **control point** is the spot where you can make **ADJUSTMENTS** to your equipment. This is the spot where you have complete capabilities to turn on the equipment.

5

Control

Local Control



6

Control

Remote Control

T1E10 **Remote control** is the type of control used when the control operator is not at the station location but can manipulate the operating adjustments of a station **over the Internet**.



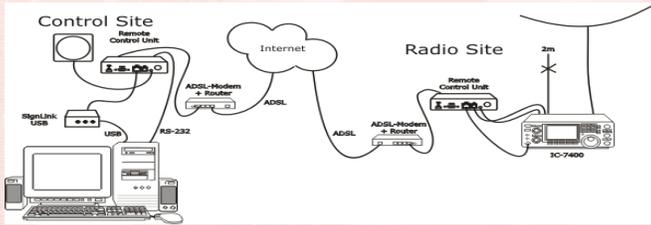
Adjusting settings from a **location OTHER** than where the transmitter is located

7

Control

Remote Control Operations

- T1E09 Remote control operations include:
- Control operator at the control point,
 - Control operator is required at all times,
 - Control operator can indirectly manipulate the controls. Often this is done via the internet.



8

Control

T1E08 **Automatic control** is the type of control being used for a **repeater** when the control operator is not present at a control point.

T1E11 The **FCC** presumes the **station licensee** to be the **control operator** of an amateur station unless documentation to the contrary is in the station records.

When another licensee uses your callsign, log who it was.

When deemed necessary by an FCC District Director, to assure compliance with the FCC Rules, the station licensee must maintain a record of station operations

9

Control

T1D08 The control operator of an amateur station may receive compensation for operating a station when the communication is **incidental to classroom instruction** at an educational institution.



T1F10 The **control operator of the originating station** is accountable should a repeater inadvertently retransmit communications that violate the FCC rules.

School teachers can receive their regular pay when teaching about ham radio

10

Take Aways

Section Three Take Aways

Words that are **bold** and **red** appear in the correct answer.



Take Aways

- An amateur station is **never** permitted to transmit without a control operator.
- **Any amateur whose license privileges allow them to transmit on the satellite uplink frequency** may be the control operator of a station communicating through an amateur satellite or space station.
- The control operator of an amateur station may receive compensation for operating the station **when the communication is incidental to classroom instruction at an educational institution.**

12

Take Aways

- The **station licensee** must designate the station control operator.
- When the control operator is not the station licensee, the **control operator and the station licensee are equally responsible** for the proper operation of the station.

13

Take Aways

- **The class of operator license held by the control operator** determines the transmitting privileges of an amateur station.
- A Technician Class licensee may **at no time** be the control operator of a station operating in an exclusive Extra Class operator segment of the amateur bands.
- The amateur station control point is **the location at which the control operator function is performed.**

14

Take Aways

- **Repeater operation** is an example of Automatic Control.
- **Operating the station over the Internet** is an example of Remote Control.
- Remote control operations include **all of these:**
 - Control operator at the **control point**
 - Required at **all times**
 - Can **indirectly manipulate** the controls

15

Take Aways

- The FCC presumes **the station licensee** to be the control operator of an amateur station, unless documentation to the contrary is in the station records.
- **The control operator of the originating station** is accountable should a repeater inadvertently retransmit communications that violate the FCC rules.

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Element 2 Technician Class Question Pool

Control

Section Three

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When is an amateur station permitted to transmit without control operator?

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

T1E01

18

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

- A. Only an Amateur Extra class operator
- B. A General class or higher licensee who has a satellite operator certification
- C. Only an Amateur Extra class operator who is also an AMSAT member
- D. Any amateur whose license privileges allow them to transmit on the satellite uplink frequency

T1E02

19

Who must designate the station control operator?

- A. The station licensee
- B. The FCC
- C. The frequency coordinator
- D. The ITU

T1E03

20

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

- A. All licensed amateurs who are present at the operation
- B. Only the station licensee
- C. Only the control operator
- D. The control operator and the station licensee are equally responsible

T1E07

21

What determines the transmitting privileges of an amateur station?

- A. The frequency authorized by the frequency coordinator
- B. The frequencies printed on the license grant
- C. The highest class of operator license held by anyone on the premises
- D. The class of operator license held by the control operator

T1E04

22

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

- A. At no time
- B. When operating a special event station.
- C. As part of a multi-operator contest team
- D. When using a club station whose trustee is an Amateur Extra class operator licensee

T1E06

23

Which of the following is an example of automatic control?

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

T1E08

24

What is an amateur station control point?

- A. The location of the station's transmitting antenna
- B. The location of the station transmitting apparatus.
- C. The location at which the control operator function is performed
- D. The mailing address of the station licensee

T1E05

25

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

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

T1E10

26

Which of the following is true of remote control operation?

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

T1E09

27

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

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

T1E11

28

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

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

T1D08

29

Who is accountable should a repeater inadvertently retransmit communications that violate the FCC rules?

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

T1F10

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Technician Licensing Class

Mind The Rules

Section Four

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Mind the Rules

Amateur radio rules are found in **Part 97** of the **FCC regulations**.

T1D06 **Indecent and obscene language transmission** is prohibited on any amateur radio frequency, including repeaters. And there is NO list.

T1A11 Radio Amateurs share radio spectrum with countless other radio amateurs and other duly licensed radio services. **No willful interference** with other amateur radio communications **at any time is permissible**.

2

Mind the Rules

T1D10 Transmissions intended for reception by the general public is called **broadcasting**. You may not operate your station like an AM, FM or shortwave broadcast station. **You cannot transmit directly to the public**.

T1D02 Broadcasting to a general audience is explicitly forbidden by amateur radio rules. However, **one-way transmissions intended for reception only by radio amateurs are permitted**. These include Morse code practice, amateur radio bulletins, or in an emergency. For example, W1AW, the ARRL's station, has provided CW practice transmissions for many decades.

3

Mind the Rules

T1D03 The transmission of codes or ciphers is allowed to hide the meaning of a message transmitted by an amateur station only when transmitting control commands **to space stations or radio control craft**.



Space station



Radio control craft

4

Mind the Rules

T1D04 The only time an amateur station is authorized to transmit music using **phone emission** is when it is incidental to an authorized retransmission of manned spacecraft communications. **(Phone = Voice)**

T1D05 Amateur radio operators may use their stations to notify other amateurs of the availability of equipment for sale or trade **when the equipment is normally used in an amateur station and such activity is not conducted on a regular basis**.

T1D09 Amateur stations are authorized to transmit signals related to broadcasting, program production, or news gathering, **assuming no other means is available only where such communications directly relate to the immediate safety of human life or protection of property**.

5

Mind the Rules

T1F01 Any time upon request by an **FCC representative** is when the station licensee must make the station and its **records available for FCC inspection**.

T1C07 Revocation of the station license or suspension of the operator license may result when **correspondence from the FCC** is returned as **undeliverable** because the grantee failed to provide the correct mailing address.

6

Take Aways

Section Four Take Aways

Words that are **bold** and **red** appear in the correct answer.



Take Aways

- In the FCC rules for the amateur services, the term broadcasting means **transmissions intended for reception by the general public.**
- Specific one-way transmissions are permitted. **These include code practice, information bulletins, or transmissions necessary to provide emergency communications.**
- Assuming no other means is available, amateur stations are authorized to transmit signals related to broadcasting, program production, or news gathering, **only where such communications directly relate to the immediate safety of human life or protection of property.**

8

Take Aways

- The transmission of codes or ciphers are allowed to hide the meaning of a message transmitted by an amateur station **only when transmitting control commands to space stations or radio control craft.**
- **At no time** is willful interference allowed.
- Restrictions concerning transmissions that contain obscene or indecent words: **Any such language is prohibited.**

9

Take Aways

- The only time an amateur station is authorized to **transmit music** using phone emission is **when incidental to an authorized retransmission of manned spacecraft communications.**
- Amateur radio operators may use their stations to notify other amateurs of the availability of equipment for sale or trade **when the equipment is normally used in an amateur station and such activity is not conducted on a regular basis.**

10

Take Aways

- The station licensee must make the station and its records available for FCC inspection **at any time upon request by an FCC representative.**
- When correspondence from the FCC is returned as undeliverable because the grantee failed to provide the correct mailing address **revocation of the station license or suspension of the operator license** may be the result.

11

Element 2 Technician Class Question Pool

Mind The Rules

Section Four

Valid July 1, 2018

Through

June 30, 2022



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

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

T1D06

13

When is willful interference to other amateur radio stations permitted?

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

T1A11

14

What is the meaning of the term “broadcasting” in the FCC rules for the Amateur Radio Service?

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

T1D10

15

Under which of the following circumstances may an amateur radio station make one-way transmissions?

- A. Under no circumstances
- B. When transmitting code practice, information bulletins, or transmissions necessary to provide emergency communications
- C. At any time, as long as no music is transmitted
- D. At any time, as long as the material being transmitted did not originate from a commercial broadcast station

T1D02 n

16

Under which of the following circumstances are amateur stations authorized to transmit signals related to broadcasting, program production, or news gathering, assuming no other means is available?

- A. Only where such communications directly relate to the immediate safety of human life or protection of property
- B. Only when broadcasting communications to or from the space shuttle.
- C. Only where noncommercial programming is gathered and supplied exclusively to the National Public Radio network
- D. Only when using amateur repeaters linked to the internet

T1D09

17

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

- A. Only during contests
- B. Only when operating mobile
- C. Only when transmitting control commands to space stations or radio control craft
- D. Only when frequencies above 1280 MHz are used

T1D03

18

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

- A. When incidental to an authorized retransmission of manned spacecraft communications
- B. When the music produces no spurious emissions
- C. When the purpose is to interfere with an illegal transmission
- D. When the music is transmitted above 1280 MHz

T1D04

19

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

- A. When the equipment is normally used in an amateur station and such activity is not conducted on a regular basis
- B. When the asking price is \$100.00 or less
- C. When the asking price is less than its appraised value
- D. When the equipment is not the personal property of either the station licensee or the control operator or their close relatives

T1D05

20

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

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

T1F01

21

What may result when correspondence from the FCC is returned as undeliverable because the grantee failed to provide and maintain a correct mailing address with the FCC?

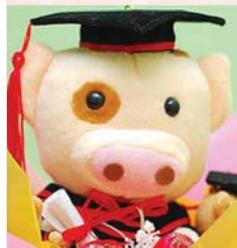
- A. Fine or imprisonment
- B. Revocation of the station license or suspension of the operator license
- C. Require the licensee to be re-examined
- D. A reduction of one rank in operator class

T1C07

22

Technician Licensing Class

Tech Frequencies



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Section Five

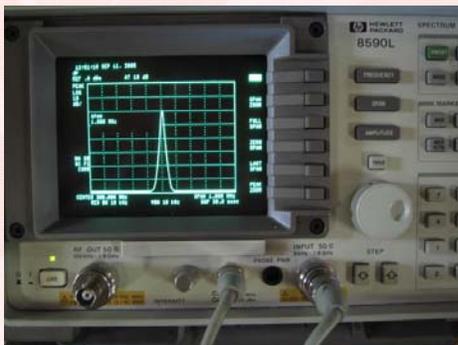
Valid July 1, 2018

Through

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Tech Frequencies

T8C06 **RF** is the abbreviation that refers to **R**adio **F**requency signals of all types.



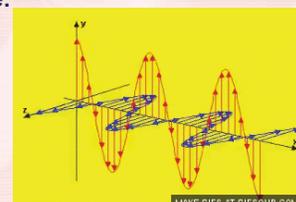
2

Tech Frequencies

T8C07 Radio waves are made of electromagnetic energy that travel through space.

T3A07 **E**lectromagnetic waves carry radio signals between transmitting and receiving stations.

T3B03 **E**lectric and **m**agnetic fields are the two components of a radio wave.



3

Tech Frequencies

T3B04 Radio waves travel through free space at the **speed of light**.

T3B11 The approximate **velocity** of a radio wave as it travels through free space is **300,000,000 meters** per second.

300 MILLION! MPS

4

Tech Frequencies

T5C05 **Hertz** is the unit of frequency.

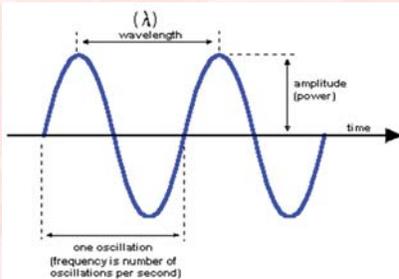
T5C14 **MHz** is the proper abbreviation for **megahertz**
kHz is the proper abbreviation for kilohertz

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

5

Tech Frequencies

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

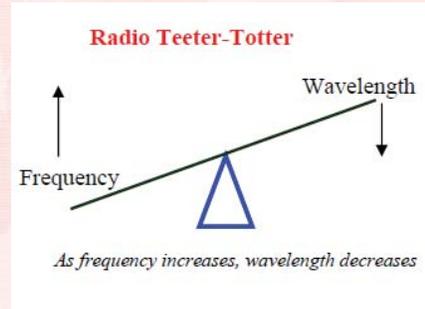


Wavelength of the band: 2 meters (146.520 MHz); 40 meters (7.625MHz); etc

6

Tech Frequencies

T3B05 The wavelength of a radio wave relates to its frequency **inversely**, as the wavelength gets shorter the frequency increases.



7

Tech Frequencies

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

Conversions Between Wavelength and Frequency



Elmer Tip

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

$$\frac{300}{\text{Freq (MHz)}}$$

$$\frac{300}{\text{Wavelength (meters)}}$$

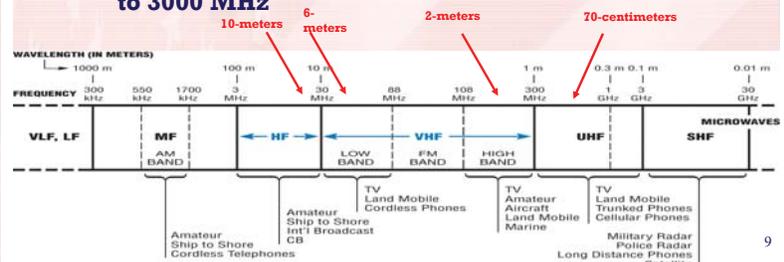
8

Tech Frequencies

T3B10 The frequency range referred to as **HF** is **3 MHz to 30 MHz**.

T3B08 The frequency limits of the **VHF** spectrum are **30 MHz to 300 MHz**.

T3B09 The frequency limits of the **UHF** spectrum are **300 MHz to 3000 MHz**



9

Tech Frequencies

T1B03 52.525 MHz is a frequency is within the 6 meter band .



T1B04 146.520 MHz is a frequency is within the 2 meter band.



T1B07 Some portions of the 6 Meter and 2 Meter band are set aside as sub bands for **CW operation only**. 50.0 to 50.1 and 144.0 to 144.1 respectively

Tech Frequencies

1.25-Meter Band



T1B13 Only fixed digital message forwarding systems may be used by a Technician Class operator between 219 and 220 MHz.

Tech Frequencies

T1B10 The **only HF band** that has voice, RTTY, and data transmission frequencies available to the Technician class operator is **10 meters**. (Reference the ARRL Frequency Chart).

T1B06 Technician Class license holders have **HF phone privileges** only in the **10 Meter** band

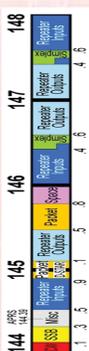
Tech Frequencies

T1B11 The **maximum** peak envelope **power (PEP)** output for Technician class operators using their assigned portions of the **HF bands** is **200 watts**.

T1B12 Except for some specific restrictions, the **maximum** peak envelope power output for Technician class operators using frequencies above 30 MHz (**VHF and UHF**) is **1500 watts**

Tech Frequencies

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

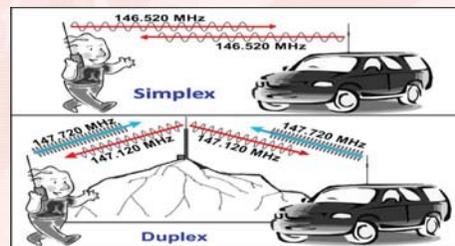


144.000 - 144.050	EME (CW)
144.050 - 144.100	CW and Weak Signals
144.100 -	CW National Calling Frequency
144.100 - 144.200	EME and Weak Signal SSB
144.200 -	SSB National Calling Frequency
144.200 - 144.275	General SSB Operation
144.275 - 144.300	Propagation beacons
144.300 - 144.500	OSCAR Sub-band (Satellite)
144.390 -	APRS Nationwide
144.510 - 144.890	FM and Digital Repeater Inputs
144.900 - 145.100	FM Digital/Packet
145.110 - 145.490	FM and Digital Repeater Outputs
145.500 - 145.790	FM Digital/Packet
145.800 - 146.000	OSCAR Sub band (Satellite)
146.010 - 146.385	FM Repeater Inputs
146.400 - 146.595	FM Simplex and Digital Repeater Inputs
146.520 -	FM National Calling Frequency
146.610 - 147.390	FM and Digital Repeater Outputs
147.405 - 147.585	FM Simplex and Digital Repeater Outputs
147.600 - 147.990	FM and Digital Repeater Inputs

Tech Frequencies

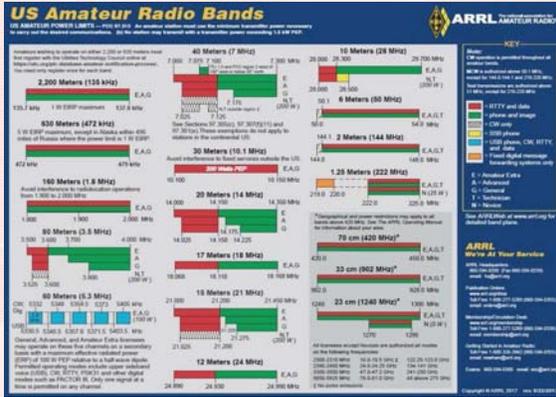
T2B12 In VHF/UHF band plans, **simplex** channels are designated so that stations within mutual communications range can communicate without tying up a repeater.

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



Tech Frequencies

Valid Amateur Radio bands are different from 'Band Plans' which are a voluntary guidance over and above the bands authorized by the FCC.



Tech Frequencies

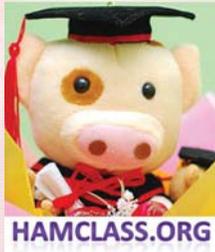
T1B08 When an amateur frequency band is said to be available on a **secondary basis** in some portions of the 70 cm band, U.S. amateurs may find non-amateur stations in the bands and **must avoid interfering** with them

- T1B09 You should **not set** your transmit frequency to be **exactly at the edge** of an amateur band or sub-band:
- so that modulation sidebands do not extend beyond the band edge;
 - to allow for calibration error in the transmitter frequency display;
 - to allow for transmitter frequency drift.

Take Aways

Section Five Take Aways

Words that are **bold** and **red** appear in the correct answer.



Take Aways

- The abbreviation, RF, refers to **radio frequency signals of all types**.
- Radio waves are made of **electromagnetic** energy.
- An **Electromagnetic** wave carries radio signals between transmitting and receiving stations.
- The two components of a radio wave are **electric** and **magnetic fields**.
- A radio wave travels through free space **at the speed of light**.

Take Aways

- The approximate velocity of a radio wave as it travels through free space is **300,000,000 meters per second**.
- The unit of frequency is **Hertz**.
- **MHz** is the proper abbreviation for megahertz

Take Aways

- **Wavelength** is the name for the distance a radio wave travels during one complete cycle.
- **The approximate wavelength** property of radio waves is often used to identify the different frequency bands, e.g., 2 meters for 144 to 148 MHz band.
- There is an inverse relationship between wavelength of a radio wave and its frequency. **The wavelength gets shorter as the frequency increases**.



Take Aways

- The formula for converting frequency to wavelength in meters is **wavelength in meters equals 300 divided by frequency in megahertz.**
- Frequency range of the **HF** spectrum is **3 to 30 MHz.**
- Frequency limits of the **VHF** spectrum are **30 to 300 MHz.**
- Frequency limits of the **UHF** spectrum are **300 to 3000 MHz.**

22

Take Aways

- The frequency, **52.525 MHz**, is within the 6 meter band.
- You are using the **2 meter band** when your station is transmitting on **146.52 MHz.**
- Portions of both 6 meter (**50.0 to 50.1 MHz**) and (**144.0 to 144.1 MHz**) 2 meter bands are restricted to CW only
- **Fixed digital message forwarding systems only** may be used by a Technician Class operator between 219 and 220 MHz.

23

Take Aways

- **Ten meters** is the only HF band that has frequencies available to the technician class operator for RRTY and data transmission.
- Technician Class license holders have HF phone privileges only in the **10 Meter band**

24

Take Aways

- The maximum peak envelope power output for Technician class operators using their assigned portions of the **HF bands** is **200 watts.**
- Except for some specific restrictions, the maximum peak envelope power output for Technician class operators using frequencies **above 30 MHz** (VHF and UHF) is **1500 watts**

25

Take Aways

- In VHF/UHF band plans, **simplex channels** are designated so that **stations within mutual communications range** can communicate without **tying up a repeater.**
- The **national calling frequency** is **146.520 MHz** for FM simplex operation on the 2 meter band

26

Take Aways

- A band plan is **a voluntary guideline for using different modes or activities within an amateur band** supplementing, but not replacing, those established by the FCC.
- According to the FCC rules, when an amateur frequency band is said to be available on a secondary basis, **U.S. amateurs may find non-amateur stations in the bands and must avoid interfering with them.**

27

Take Aways

- For **ALL of the following reasons**: You should not set your transmit frequency to be exactly at the edge of an amateur band or sub-band
 - To allow for calibration error in the transmitter frequency display
 - So that modulation sidebands do not extend beyond the band edge
 - To allow for transmitter frequency drift

28

Element 2 Technician Class Question Pool

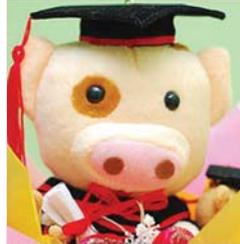
Tech Frequencies

Section Five

Valid July 1, 2014

Through

June 30, 2018



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What does the abbreviation “RF” refer to?

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

T5C06

30

What type of wave carries radio signals between transmitting and receiving stations?

- A. Electromagnetic
- B. Electrostatic
- C. Surface acoustic
- D. Ferromagnetic

T3A07

31

What are the two components of a radio wave?

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

T3B03

32

A radio wave is made up of what type of energy?

- A. Pressure
- B. Electromagnetic
- C. Gravity
- D. Thermal

T5C07

33

How fast does a radio wave travel through free space?

- A. At the speed of light
- B. At the speed of sound
- C. Its speed is inversely proportional to its wavelength
- D. Its speed increases as the frequency increases

T3B04

34

What is the approximate velocity of a radio wave as it travels through free space?

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

T3B11

35

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

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

T5A12

36

What is the unit of frequency?

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

T5C05

37

What is the proper abbreviation for megahertz?

- A. mHz
- B. mhZ
- C. Mhz
- D. MHz

T5C14

38

What is the name for the distance a radio wave travels during one complete cycle?

- A. Wave speed
- B. Waveform
- C. Wavelength
- D. Wave spread

T3B01

39

What property of radio waves is often used to identify the different frequency bands?

- A. The approximate wavelength
- B. The magnetic intensity of waves
- C. The time it takes for waves to travel one mile
- D. The voltage standing wave ratio of waves

T3B07

40

How does the wavelength of a radio wave relate to its frequency?

- A. The wavelength gets longer as the frequency increases
- B. The wavelength gets shorter as the frequency increases
- C. There is no relationship between wavelength and frequency
- D. The wavelength depends on the bandwidth of the signal

T3B05

41

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

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

T3B06

42

What frequency range is referred to as HF?

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

T3B10

43

What are the frequency limits of the VHF spectrum?

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

T3B08

44

What are the frequency limits of the UHF spectrum?

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

T3B09

45

Which frequency is within the 6 meter amateur band?

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

T1B03

46

Which amateur band are you using when your station is transmitting on 146.52 MHz?

- A. 2 meter band
- B. 20 meter band
- C. 14 meter band
- D. 6 meter band

T1B04

47

Which of the following VHF/UHF frequencies ranges are limited to CW only?

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

T1B07

48

What is the limitation for emissions on the frequencies between 219 and 220 MHz?

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

T1B05

49

Which of the following HF bands have frequencies available to the Technician class operator for RTTY and data transmissions?

- A. 10 meters, 12 meters, 17 meters, and 40 meters
- B. 10 meters, 15 meters, 40 meters, 80 meters
- C. 30 meters only
- D. 10 meters only

T1B10

50

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

- A. None
- B. 10 meters only
- C. 80 meters, 40 meters, 15 meters and 10 meters
- D. 30 meters only

T1B06

51

What is the maximum peak envelope power output for Technician class operators using their assigned portions of the HF bands?

- A. 200 watts
- B. 100 watts
- C. 50 watts
- D. 10 watts

T1B11

52

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

- A. 50 watts
- B. 100 watts
- C. 500 watt
- D. 1500 watts

T1B12

53

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

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

T2A10

54

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

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

T2B12

55

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

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

T2A02

56

Which of the following is a result of the fact that the Amateur Radio Service is secondary in all or portions of some amateur bands (such as portions of the 70 cm band)?

- A. U.S. amateurs may find non-amateur stations in those portions and must avoid interfering with them
- B. U.S. amateurs must give foreign amateur stations priority in those portions
- C. International communications is not permitted on 70 cm
- D. Digital transmission are not permitted on 70 cm

T1B08

57

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

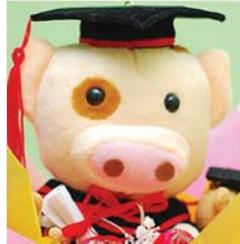
- A. To allow for calibration error in the transmitter frequency display
- B. So that modulation sidebands do not extend beyond the band edge
- C. To allow for transmitter frequency drift
- D. All of these choices are correct

T1B09

58

Technician Licensing Class

Multi-Mode Radio Excitement



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Section Six

Valid July 1, 2018

Through

June 30, 2022

Multi-Mode Radio Excitement

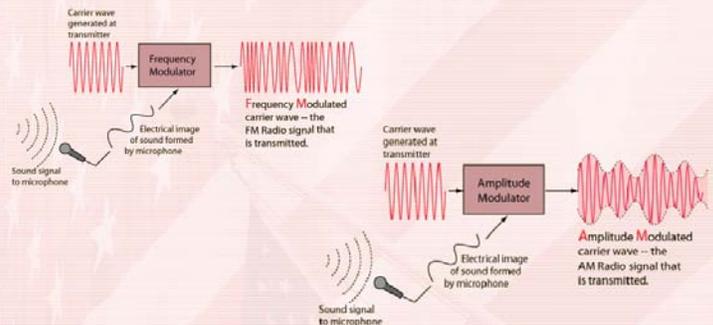
T7A02 A **“transceiver”** combines both **transmitting and receiving** functions in one package



2

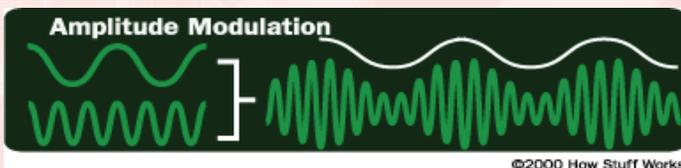
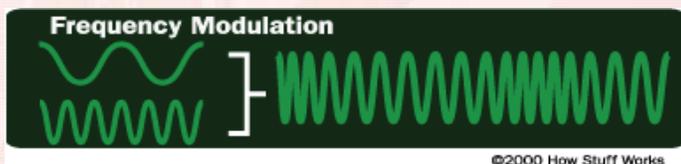
Multi-Mode Radio Excitement

T7A08 Modulation is the process of applying information (voice, video, or digital) onto a radio signal.



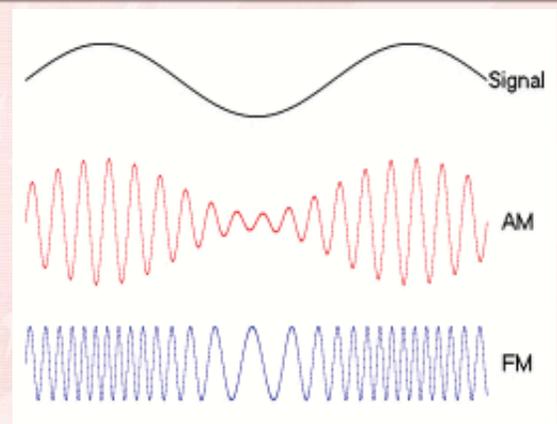
3

Multi-Mode Radio Excitement



4

Multi-Mode Radio Excitement



5

Multi-Mode Radio Excitement

T8A01 Single sideband is a form of **amplitude modulation**.



Carrier only CW

Tones produce both side bands or AM

Remove one sideband and suppress carrier becomes SSB

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

6

Multi-Mode Radio Excitement

T8A07 The primary **advantage of single sideband** over FM for voice transmissions is that SSB signals have **narrower bandwidth**

T8A08 **3 kHz** is the approximate bandwidth of a single sideband voice signal.

T4B09 For **single sideband** -- **2400 Hz** would be the appropriate receive filter to minimize noise and interference (2400Hz equals 2.4 MHz)

T8A06 **The upper sideband** is normally used for 10 meter HF, VHF and UHF single-sideband communications

7

Multi-Mode Radio Excitement

T2B13 The use of **SSB phone** is permitted in at least some portion of **all** the amateur bands above **50 MHz**

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

T4B7 The term "RIT" means **Receiver Incremental Tuning**.



Set knob to neutral, press RIT button to turn on function, and then adjust slightly for proper SSB voice reception

RIT adjusts voice pitch, not the frequency of received station.

8

Multi-Mode Radio Excitement

T7A05 An **oscillator** is a **circuit** that generates a signal of a **desired frequency**.

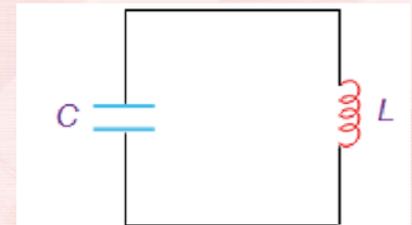


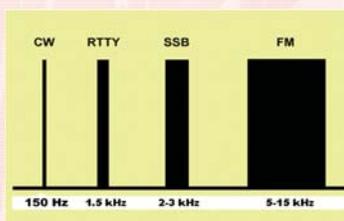
Figure 1 LC Tank Circuit

9

Multi-Mode Radio Excitement

T8A05 **CW** (Continuous Wave or Morse Code) is the type of emission that has the narrowest bandwidth.

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



CW Signal 150 Hz wide
SSB Signal 2 - 3 kHz wide
FM Signal 5 - 15 kHz wide
UHF Fast-Scan TV ~ 6 MHz

10

Multi-Mode Radio Excitement

T4B10 **500 Hz** is an appropriate receive filter to select in order to minimize noise and interference for **CW reception**.

Bandwidth filters vary for the mode being received.

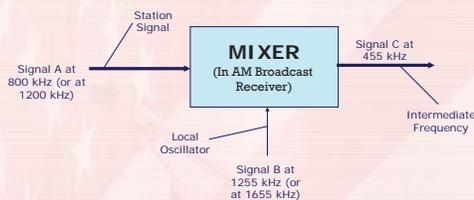
T4B08 The **advantage** of having multiple receive bandwidth choices on a multimode transceiver will **permit noise or interference reduction** by selecting a bandwidth matching the mode.



11

Multi-Mode Radio Excitement

T7A03 The function of a **mixer** is to **convert** a radio signal from one **frequency** to another.



Block Diagram of an AM Broadcast Receiver Mixer

12

Multi-Mode Radio Excitement

T7A04 **Selectivity** is the term that describes the ability of a receiver to **discriminate** between multiple signals.

T7A01 **Sensitivity** is the ability of a receiver to **detect** the presence of a signal.

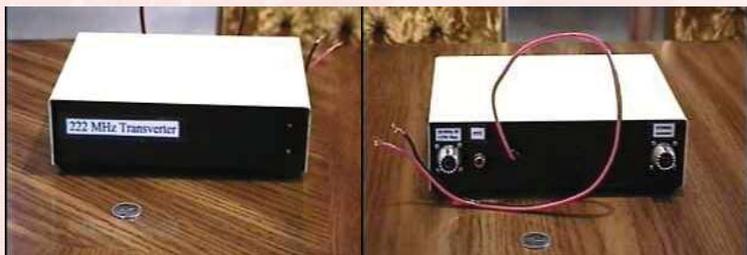
T4B11 **AGC** or **automatic gain control** is used to keep received audio relatively constant.

T7A11 An **RF pre-amp** is installed between the antenna input and the receiver.

13

Multi-Mode Radio Excitement

T7A06 A **transverter** is a device that converts RF input and output of a transceiver in one band into another band.



For example this transverter takes a 10meter signal and converts it to a 222 MHz (1.25 meter)

14

Multi-Mode Radio Excitement

T4A01 To determine the minimum current capacity needed for a transceiver's power supply, you must consider all of the following:

- **Efficiency** of the transmitter at **full power** output
- **Receiver and control circuit** power
- **Power supply regulation** and **heat dissipation**



MFJ-4125
13.8VDC@22Amp

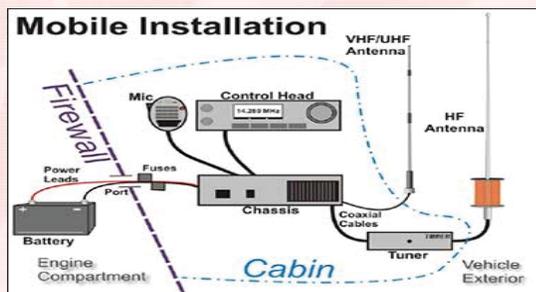


Jetstream JTPS30M
Regulated Power Supply

15

Multi-Mode Radio Excitement

T4A03 **Wiring** between the power source and radio needs to be **heavy-gauge wire** and **short as possible** to avoid voltage falling below what is needed for proper operation.

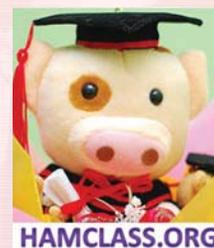


16

Take Aways

Section Six Take Aways

Words that are **bold** and **red** appear in the correct answer.



Take Aways

- A transceiver is a **unit combining the functions of a transmitter and receiver**
- Modulation is the term used to **describe combining speech with an RF carrier**
- **Single sideband** is a form of amplitude modulation
- Single Sideband **SSB** is the type of voice mode is most often used for long-distance (weak signal) contacts on the VHF and UHF bands.

18

Take Aways

- The **primary advantage** of single sideband over FM for voice transmissions is that **SSB signals have narrower bandwidth**
- **3 kHz** is the approximate **bandwidth** of a single sideband voice signal. (3 kHz equals 3000 Hz)
- For single sideband **2400 Hz** would be the appropriate receive filter to minimize noise and interference (2400 Hz equals 2.4 kHz)
- The **upper sideband** is normally used for 10 meter HF, all VHF and all UHF single-sideband communications

19

Take Aways

- The use of **SSB phone** is permitted in at least some portion of **all** the amateur bands **above 50 MHz**.
- The **receiver RIT or clarifier** controls could be used if the **voice pitch** of a single-sideband signal seems too high or low.
- The term "RIT" means **Receiver Incremental Tuning**.
- An **oscillator** is a circuit that generates a signal of a desired frequency.

20

Take Aways

- In comparison to SSB and FM, **CW** emission has the narrowest bandwidth.
- The approximate maximum bandwidth to transmit a **CW** signal is **150 Hz**.
- An appropriate receive filter bandwidth used in order to minimize noise and interference for CW reception is **500 Hz**.
- The advantage of having multiple receive bandwidth choices on a multimode transceiver **permits noise or interference reduction by selecting a bandwidth matching the mode**.

21

Take Aways

- The function of a **mixer** is to convert a radio signal from one frequency to another
- **Selectivity** is the term that describes the ability of a receiver to **discriminate** between multiple signals.
- **Sensitivity** is the ability of a receiver to **detect** the presence of a signal.
- The function of **AGC** or automatic gain control is to **keep received audio relatively constant**.
- An **RF pre-amp** is installed **between the antenna and the receiver**.

22

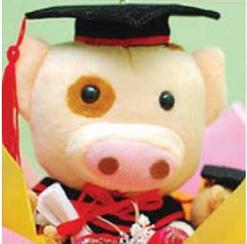
Take Aways

- A **transverter** is a device that converts the RF input and output of a transceiver to another band.
- Wiring between the power source and radio needs to be heavy-gauge wire and short as possible to **avoid voltage falling below what is needed for proper operation**.
- **All of these** are considered to determine the **minimum current capacity** needed for a transceiver's power supply is
 - > **Efficiency** of the transmitter **at full power** output
 - > **Receiver and control circuit** power
 - > Power supply **regulation and heat dissipation**

23

Element 2 Technician Class Question Pool

Multi-Mode Radio Excitement



Section Six

Valid July 1, 2018

Through

June 30, 2022

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What is a transceiver?

- A. A type of antenna switch
- B. A unit combining the functions of a transmitter and receiver
- C. A component in a repeater that filters out unwanted interference
- D. A type of antenna matching network

T7A02

25

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

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

T8A03

26

What is an advantage of single sideband (SSB) over FM for voice transmissions?

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

T8A07

27

Which of the following is a form of amplitude modulation?

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

T8A01

28

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

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

T8A06

29

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

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

T7A08

30

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

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

T8A08

31

Which of the following is an appropriate receive filter bandwidth for minimizing noise and interference for SSB reception?

- A. 500 Hz
- B. 1000 Hz
- C. 2400 Hz
- D. 5000 Hz

T4B09

32

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

- A. Only in sub-bands allocated to General class or higher licensees
- B. Only on repeaters
- C. In at least some portion of all these bands
- D. On any band as long as power is limited to 25 watts

T2B13

33

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

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

T4B06

34

What does the term "RIT" mean?

- A. Receiver Input Tone
- B. Receiver Incremental Tuning
- C. Rectifier Inverter Test
- D. Remote Input Transmitter

T4B07

35

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

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

T7A05

36

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

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

T8A05

37

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

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

T8A11

38

Which of the following is an appropriate receive filter bandwidth for minimizing noise and interference for CW reception?

- A. 500 Hz
- B. 1000 Hz
- C. 2400 Hz
- D. 5000 Hz

T4B10

39

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

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

T4B08

40

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

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

T7A01

41

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

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

T7A03

42

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

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

T7A04

43

What is the function of automatic gain control, or AGC?

- A. To keep received audio relatively constant
- B. To protect an antenna from lightning
- C. To eliminate RF on the station cabling
- D. asymmetric goniometer control used for antenna matching

T4B11

44

Where is an RF preamplifier installed?

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

T7A11

45

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

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

T7A06

46

What must be considered to determine the minimum current capacity needed for a transceiver's power supply?

- A. Efficiency of the transmitter at full power output
- B. Receiver and control circuit power
- C. Power supply regulation and heat dissipation
- D. All of these are correct

T4A01

47

Why should wiring between the power source and radio be heavy-gauge wire and kept as short as possible?

- A. To avoid voltage falling below that needed for proper operation
- B. To provide a good counterpoise for the antenna
- C. To avoid RF interference
- D. All of these choices are correct

T4A03

48

Technician Licensing Class

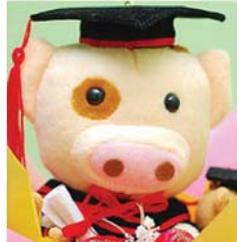
Run Some Interference Protection

Section Seven

Valid July 1, 2018

Through

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Run Some Interference Protection

T7B10 If you receive a report that your **audio signal** through the repeater is **distorted or unintelligible**:

- Your transmitter may be slightly off frequency,
- Your batteries may be running low,
- You could be in a bad location.

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

2

Run Some Interference Protection

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

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

3

Run Some Interference Protection

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

- Not on common FM handheld or mobile FM radios
- On bigger high-frequency, multi-mode transceiver



NB – Noise Blanker

PreAmp built in

Even this older Icom 730 has the NB function

T4B12 A **noise blanker** could be used to **remove power line noise** or ignition noise at your transceiver.

4

Run Some Interference Protection

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

T4A09 You would use a ferrite choke to reduce **RF current flowing on the shield** of an audio cable.

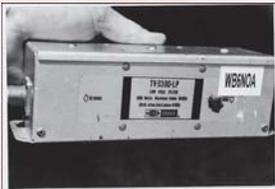


Clam shell iron devices just snap on over wiring

5

Run Some Interference Protection

T7B12 The first step to resolve **cable TV** interference from your ham radio transmission is to be sure all TV **coaxial connections** are installed properly.



There are **low-pass filters like this one**, band-pass filters, and high-pass filters that can be used to solve interference problems

6

Run Some Interference Protection

T6D12 A common reason to **use shielded wire** is to prevent coupling of unwanted signals to or from the wire

T7B02 A broadcast AM or FM radio will receive an amateur radio transmission unintentionally when the receiver is unable to **reject strong signals** from outside the AM or FM band.

7

Run Some Interference Protection

T7B03 **Causes of radio frequency interference:**

- Fundamental overload;
- Harmonics;
- Spurious emissions.

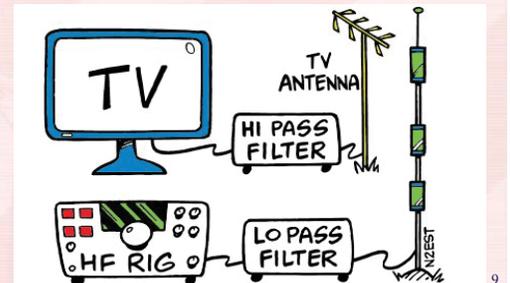
T7B11 Reports of garbled, distorted, or unintelligible transmissions can be caused by **RF feedback** in a transmitter or transceiver.

T7B06 If someone tells you that your station's transmissions are interfering with their radio or TV reception make sure that your station is operating properly and that it **does not cause interference to your own radio or television** when it is tuned to the same channel.

8

Run Some Interference Protection

T7B05 To **reduce or eliminate overload** by an amateur signal to a non-amateur radio or TV receiver, **block** the amateur signal with a **filter at the antenna input** of the non-amateur radio or TV receiver.



9

Run Some Interference Protection

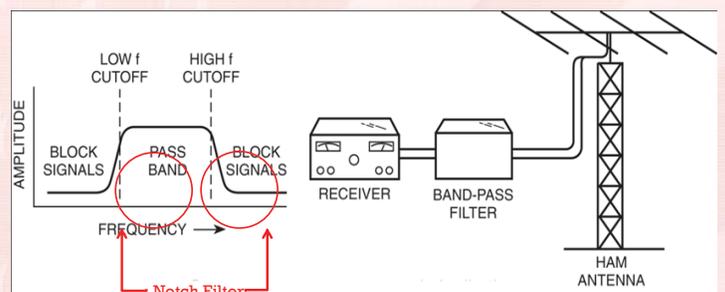
T7B07 A **Band-reject filter** can reduce overload to a VHF transceiver from a nearby **FM broadcast station**



10

Run Some Interference Protection

A **Notch Filter** is a filter on a radio receiver that is designed to eliminate a narrow, sharply-defined band, or "notch", of frequencies



11

Run Some Interference Protection

T7B04 Install an **RF filter** at the telephone as a logical first step when attempting to cure a radio frequency interference problem in a nearby telephone.

- Snap filters over telephone power cord
- Snap filters over curly cord
- Snap filters on the actual incoming telephone line cord
- The more you add, the less likely you'll have interference



12

Run Some Interference Protection

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

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including that which may cause undesired operation. Patent pending in USA and other countries.

This Class B digital apparatus complies with Canadian ICES-003. Cet appareil numérique de la classe B est conforme à la norme NWN-003 du Canada.

T7B08 If a "Part 15" device in your neighbor's home is causing harmful interference to your amateur station:

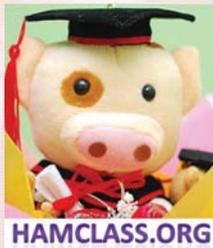
- Work with your neighbor to identify the offending device;
- Politely inform your neighbor about the rules that require him to stop using the device if it causes interference;
- Check your station and make sure it meets the standards of good amateur practice.

13

Take Aways

Section Seven Take Aways

Words that are **bold** and **red** appear in the correct answer.



Take Aways

- **ALL of these** might be the problem if you receive a report that your audio signal through the repeater is distorted or unintelligible:
 - Your transmitter may be slightly **off frequency**
 - Your **batteries** may be running low
 - You could be in a bad **location**
- If you are told your FM handheld or mobile transceiver is over deviating **talk farther away from the microphone.**
- If a repeater user says your transmissions are breaking up on voice peaks, the problem might be **you are talking too loudly.**

15

Take Aways

- If a transmitter is operated with the microphone gain set too high **the output signal might become distorted.**
- **Turn on the noise blanker** to reduce ignition interference to a receiver.
- A **noise blanker** could be used to remove power line noise or ignition noise at your transceiver.
- **The alternator** is the source of a high-pitched whine that varies with engine speed in a mobile transceiver's receive audio.

16

Take Aways

- A **Ferrite choke** could be used to cure distorted audio caused by RF current flowing on the shield of an microphone cable.
- The first step to resolve cable TV interference from your ham radio transmission is to **be sure the all TV coaxial connections are installed properly.**
- **ALL of the following** may be a cause of radio frequency interference:
 - Fundamental overload
 - Harmonics
 - Spurious emissions

17

Take Aways

- A Part 15 device is an **unlicensed device that may emit low-powered radio signals on frequencies used by a licensed service**
- You should do **all of the following** if something in your neighbor's home is causing harmful interference to your amateur station:
 - **Work** with your neighbor to identify the offending device
 - Politely **inform** your neighbor about the rules that prohibit the use of devices that causes interference
 - **Check** your station and make sure it meets the standards of good amateur practice

18

Take Aways

- A common reason to use shielded wire is to prevent **coupling of unwanted signals to or from the wire.**
- A broadcast AM or FM radio will receive an amateur radio transmission unintentionally when **the receiver is unable to reject strong signals from outside the AM or FM band.**
- A **Band-reject filter** can reduce overload to a VHF transceiver from a nearby **FM broadcast station**

19

Take Aways

- A symptom of RF feedback in a transmitter or transceiver is **reports of garbled, distorted, or unintelligible voice transmissions.**
- If a neighbor tells you that your station's transmissions are interfering with their radio or TV reception, you should **make sure that your station is functioning properly and that it does not cause interference to your own radio or television tuned to the same channel.**

20

Take Aways

- **Block the amateur signal with a filter at the antenna input of the affected receiver** to reduce or eliminate overload by the amateur signal.
- A way to reduce or eliminate interference from an amateur transmitter to a nearby telephone is to **put an RF filter at the telephone.**

21

Element 2 Technician Class Question Pool

Run Some Interference Protection

Section Seven

Valid July 1, 2018

Through

June 30, 2022



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

- A. Your transmitter is slightly off frequency
- B. Your batteries are running low
- C. You are in a bad location
- D. All of these choices are correct

T7B10

23

What may happen if a transmitter is operated with the microphone gain set too high?

- A. The output power might be too high
- B. The output signal might become distorted
- C. The frequency might vary
- D. The SWR might increase

T4B01

24

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

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

T7B01

25

What might be the problem if a repeater user says your transmissions are breaking up on voice peaks?

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

T2B05

26

Which of the following would reduce ignition interference to a receiver?

- A. Change frequency slightly
- B. Decrease the squelch setting
- C. Turn on the noise blanker
- D. Use the RIT control

T4B05

27

Which of the following could be used to remove power line noise or ignition noise?

- A. Squelch
- B. Noise blanker
- C. Notch filter
- D. All of these choices are correct

T4B12

28

Which of the following can reduce overload to a VHF transceiver from a nearby FM broadcast station?

- A. RF preamplifier
- B. Double-shielded coaxial cable
- C. Using headphones instead of the speaker
- D. Band-reject filter

T7B07

29

What is the source of a high-pitched whine that varies with engine speed in a mobile transceiver's receive audio?

- A. The ignition system
- B. The alternator
- C. The electric fuel pump
- D. Anti-lock braking system controllers

T4A10

30

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

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

T4A09

31

What should be the first step to resolve cable TV interference from your ham radio transmission?

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

T7B12

32

Which of the following can cause radio frequency interference?

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

T7B03

33

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

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

T7B11

34

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

- A. To decrease the resistance of DC power connections
- B. To increase the current carrying capability of the wire
- C. To prevent coupling of unwanted signals to or from the wire
- D. To couple the wire to other signals

T6D12

35

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

- A. Make sure that your station is functioning properly and that it does not cause interference to your own radio or television when it is tuned to the same channel
- B. Immediately turn off your transmitter and contact the nearest FCC office for assistance
- C. Tell them that your license gives you the right to transmit and nothing can be done to reduce the interference
- D. Install a harmonic doubler on the output of your transmitter and tune it until the interference is eliminated

T7B06

36

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

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

T7B02

37

Which of the following is a way to reduce or eliminate interference from an amateur transmitter to a nearby telephone?

- A. Put a filter on the amateur transmitter
- B. Reduce the microphone gain
- C. Reduce the SWR on the transmitter transmission line
- D. Put an RF filter on the telephone

T7B04

38

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

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

T7B05

39

What is a Part 15 device?

- A. An unlicensed device that may emit low-powered radio signals on frequencies used by a licensed service
- B. An amplifier that has been type-certified for amateur radio
- C. A device for long-distance communications using special codes sanctioned by the International Amateur Radio Union
- D. A type of test set used to determine whether a transmitter complies with FCC regulation 91.15

T7B09

40

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

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

T7B08

41

Technician Licensing Class

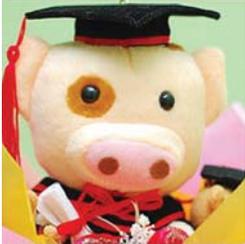
Electrons Go With the Flow!

Section Eight

Valid July 1, 2018

Through

June 30, 2022



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Electrons – Go With the Flow!

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

- Think of voltage as water pressure in the pipes (not the flow)

T5A11 The **volt** is the basic unit of electromotive force.

T7D01 A **voltmeter** is an instrument you would use to measure electric potential or electromotive force.

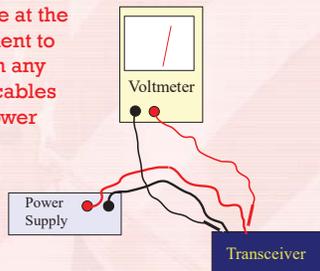
T7D02 The correct way to connect a voltmeter to a circuit is **in parallel** with the circuit.

- Car battery is measured in parallel
- House wall sockets are measured in parallel

2

Electrons – Go With the Flow!

Measure at the equipment to factor in any loss in cables from power source.



3

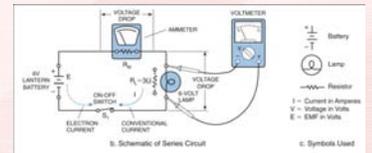
Electrons – Go With the Flow!

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

- Think of the flow of water in a pipe (not the force)

T7D04 An **ammeter** is an instrument used to measure electric current.

Ammeter in series to measure current.



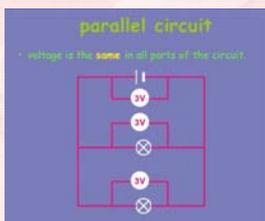
T7D03 An ammeter is connected to a circuit **in series** with the circuit.

T5A01 Electrical current is measured in **amperes**.

4

Electrons – Go With the Flow!

T5A14 **Voltage** the **same** across all components in a **parallel** circuit

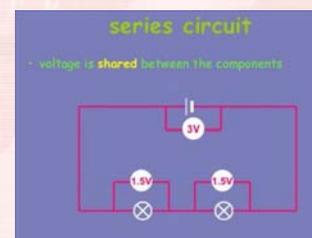


T5D16 **Voltage** across each of two components in **parallel** with a **voltage source** is the **same** as the source

5

Electrons – Go With the Flow!

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



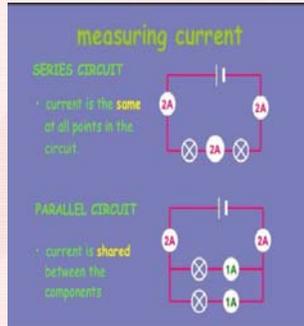
6

Electrons – Go With the Flow!

T5A13 **Current** is the **same** across all components in a **series** circuit

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

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



7

Electrons – Go With the Flow!

T6A10 These battery types are **rechargeable**.

- Nickel-metal hydride
- Lithium-ion
- Lead-acid gel-cell.

T6A11 A carbon-zinc battery type is **not** rechargeable

Ni-Cad rechargeable 1.25 volt batteries in a marine hand held.



Small and compact just like Ham Radio handhelds.

9

Electrons – Go With the Flow!

T5A06 A **mobile transceiver** usually requires about 12 volts.

T4A11 A mobile transceiver's power **negative connection** should be made at the battery or engine block ground strap.

- Power leads need to be connected directly at the battery source.

T5A07 Copper is a good **electrical conductor**.



T5A08 **Glass** is a good electrical insulator.

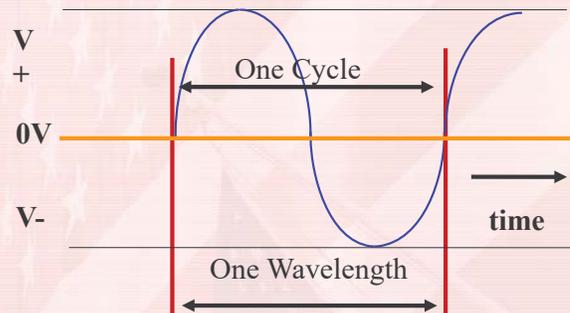


10

Electrons – Go With the Flow!

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

T5A12 The term that describes the **number of times** per second that an alternating current reverses direction is **frequency**.



11

Electrons – Go With the Flow!

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



9 Volt battery
 AA cell
 Power Pack battery
 Hand held battery

12

Electrons – Go With the Flow!

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

- Rectification is process of changing AC to pulsating DC
- Diode stops current flow when it tries to go in the reverse direction

T6B09 **Anode and cathode** are the names of the two electrodes of a diode.

Semiconductor Diode



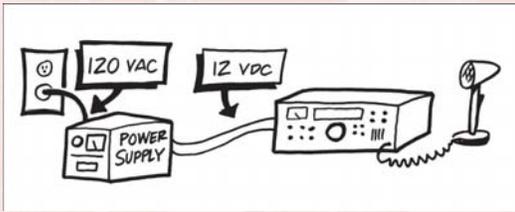
Here is the schematic symbol of a diode. Current will only flow **ONE WAY** in a diode. You can remember this diode diagram as a one-way arrow (key words).

T6B06 A semiconductor diode's **cathode lead** usually identified with a **stripe** often marked on the package.

13

Electrons – Go With the Flow!

T6D01 **Rectifier devices** or circuits change an alternating current into a varying direct current signal.



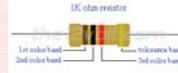
A Power supply contains: Transformer, rectifier (diodes), filter choke, capacitors, and regulators.

This circuitry converts the house 120 VAC to varying DC and that is filtered and smoothed out to produce DC current that we need for our ham radio equipment.

14

Electrons – Go With the Flow!

T6A01 A **resistor** is the electrical component used to **oppose** the flow of current in a DC circuit.



Schematic Symbol

T7D05 An **ohmmeter** is an instrument used to measure resistance.



A D'Arsonval-type meter uses a mechanical needle to indicate the test results.



Digital meter

Both use internal batteries.

Caution: NEVER measure voltage or current in the Ohm position

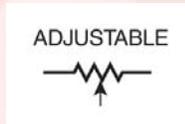
15

Electrons – Go With the Flow!

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



Schematic Symbol



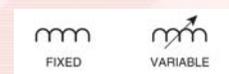
T6A03 **Resistance** is the electrical parameter controlled by a potentiometer.

16

Electrons – Go With the Flow!

T6A06 An **inductor** is the type of electrical component that stores energy in a **magnetic field**.

T6A07 The **inductor** is an electrical component usually composed of a **coil of wire**.



Schematic Symbol

T8C03 The ability to store energy in a magnetic field is called **inductance**.

T8C04 The basic unit of inductance is the **henry**. (Joseph Henry)

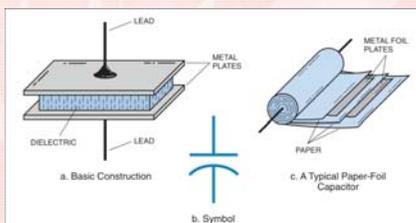
17

Electrons – Go With the Flow!

T8C01 The ability to store energy in an **electric field** is called **capacitance**.

T8C02 The basic unit of capacitance is the **farad**. (Michael Faraday)

T6A04 A **capacitor** is the electrical component that stores energy in an electric field.



Various types of capacitors

Typical construction and schematic symbol for capacitors.

18

Electrons – Go With the Flow!

T6A05 The capacitor is the type of electrical component consisting of two or more conductive surfaces **separated by an insulator**. Paper, glass, air, etc...

T6A08 A **switch** is an electrical component that is used to connect or disconnect electrical circuits.



Toggle Switch



Slide Switch



Rocker Switch



Schematic Symbol

T6A09 A **fuse** is an electrical component used to protect other circuit components from current overloads.



Slow Blow Fuse



Automobile Blade Fuse



Schematic Symbol

19

Electrons – Go With the Flow!

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

T5C13 The units of Impedance is the **Ohm**.

- **Resistance** for **DC** current flow
- **Impedance** for **AC** current flow

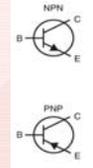
20

Electrons – Go With the Flow!

T6B03 A **transistor** is a component that can be used as an electronic switch or amplifier.

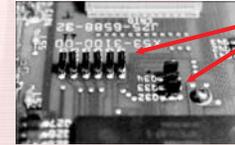


Small Signal Transistors



Schematic Symbol

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



Rows of Transistors

21

Electrons – Go With the Flow!

T6B05 The **transistor** is an electronic components that can **amplify** signals.

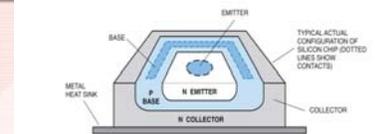
T6B11 **Gain** is the term that describes a **device's** ability to amplify a signal.

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

22

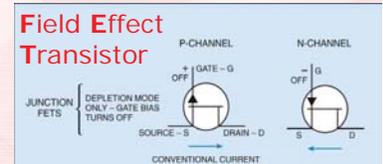
Electrons – Go With the Flow!

T6B04 The **transistor** is a component that is made of **three** layers of semiconductor material.



Layers of a Transistor

T6B08 The abbreviation "FET" stands for **Field Effect Transistor**.

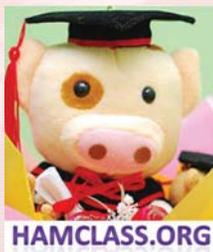


23

Take Aways

Section Eight Take Aways

Words that are **bold** and **red** appear in the correct answer.

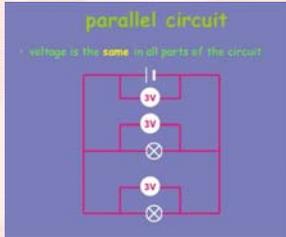


- **Voltage** is the electrical term for the electromotive force (EMF) that causes electron flow.
- The **volt** is the basic unit of electromotive force.
- The instrument you would use to measure electric potential or electromotive force is a **voltmeter**.
- The correct way to connect a voltmeter to a circuit is **in parallel with the circuit**.

25

Take Aways

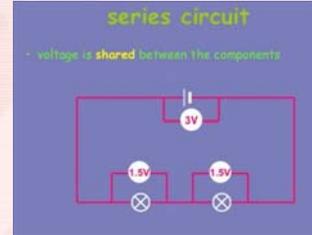
- Voltage the same across all components in a **parallel** circuit
- Voltage across each of two components in parallel with a voltage source is **the same voltage as the source**



26

Take Aways

- Voltage across each of two components in series with a voltage source **is determined by the type and value of the components**



27

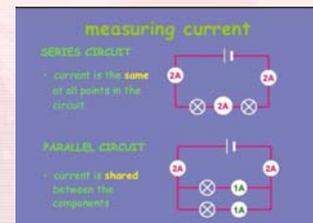
Take Aways

- **Current** is the name for the flow of electrons in an electric circuit
- Electrical current is measured in units of **Amperes**.
- **An ammeter** is used to measure electric current.
- A simple ammeter is usually connected **in series with the circuit**.

28

Take Aways

- Current the same across all components in a **series** circuit
- Current at the junction of two components in series **is unchanged**
- Current at the junction of two components in parallel **divides between them dependent on the value of the components**



29

Take Aways

- **All of these** battery types are rechargeable.
 - Nickel-metal hydride
 - Lithium-ion
 - Lead-acid gel-cell
- A battery type that is not rechargeable is **Carbon-zinc**.
- A mobile transceiver usually requires **about 12 volts (DC)**.
- A mobile transceiver's power negative return connection should be made **at the battery or engine block ground strap**.



30

Take Aways

- **Glass** is a good electrical insulator.
- **Copper** is a good electrical conductor.
- **Alternating current** is the name for a current that reverses direction on a regular basis.
- **Frequency** is the term describing the number of times per second that an alternating current reverses direction.
- **Rectifier** devices or circuits change an alternating current into a varying direct current signal.

31

Take Aways

- **Direct current** is the name for a current that flows only in one direction.
- A **Diode** allows current to flow in only one direction. 
- The names of the two electrodes of a diode are **anode and cathode**.
- A semiconductor diode's cathode lead is usually identified **with a stripe** often marked on the package.

32

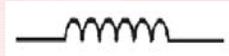
Take Aways

- The **Resistor** is the electrical component used to oppose the flow of current in a DC circuit.
- **An ohmmeter** is used to measure resistance. Resistance is measured in OHMS.
- A **Potentiometer** is a component often used as an adjustable volume control.
- **Resistance** is the electrical parameter is controlled by a potentiometer.

33

Take Aways

- **Inductance** is the ability to store energy in a magnetic field.
- An **Inductor** is usually composed of a coil of wire.
- An **Inductor** is a type of electrical component that stores energy in a magnetic field
- **The Henry** is the basic unit of inductance



34

Take Aways

- **Capacitance** is the ability to store energy in an electric field.
- **The Farad** is the basic unit of capacitance. 
- A **Capacitor** is an electrical component that stores energy in an electric field.
- A **Capacitor** consists of two or more conductive surfaces separated by an insulator.

35

Take Aways

- Impedance is **the measure of the opposition AC current flow in a circuit**
- The unit of Impedance is **Ohms**.
- A **Switch** is an electrical component used to connect or disconnect electrical circuits 
- A **fuse** is an electrical component used to protect other circuit components from current overloads.



36

Take Aways

- A **Transistor** can be used as an electronic switch or amplifier.
- **Transistors** are a class of electronic components capable of using a voltage or current signal to control current flow.
- **Transistors** can amplify signals. 
- **Gain** is the term that describes a device's ability to amplify a signal.
- A **Transistor** could be the primary gain-producing component in an RF power amplifier

37

Take Aways

- A **transistor** is made of three layers of semiconductor material.
- The abbreviation "FET" stands for **Field Effect Transistor**.

38

Element 2 Technician Class Question Pool

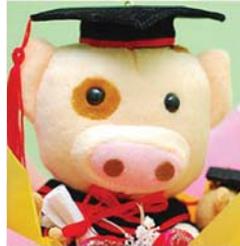
Electrons Go With the Flow!

Section Eight

Valid July 1, 2018

Through

June 30, 2022



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What is the electrical term for the electromotive force (EMF) that causes electron flow?

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

T5A05

40

What is the unit of electromotive force?

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

T5A11

41

Which instrument would you use to measure electric potential or electromotive force?

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

T7D01

42

What is the correct way to connect a voltmeter to a circuit?

- A. In series with the circuit
- B. In parallel with the circuit
- C. In quadrature with the circuit
- D. In phase with the circuit

T7D02

43

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

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

T5A03

44

Which instrument is used to measure electric current?

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

T7D04

45

How is a simple ammeter connected to a circuit?

- A. In series with the circuit
- B. In parallel with the circuit
- C. In quadrature with the circuit
- D. In phase with the circuit

T7D03

46

Electrical current is measured in which of the following units?

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

T5A01

47

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

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

T5A13

48

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

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

T5A14

49

What happens to current at the junction of two components in series?

- A. It divides equally between them
- B. It is unchanged
- C. It divides based on the on the value of the components
- D. The current in the second component is zero

T5D13

50

What happens to current at the junction of two components in parallel?

- A. It divides between them dependent on the value of the components
- B. It is the same in both components
- C. Its value doubles
- D. Its value is halved

T5D14

51

What is the voltage across each of two components in series with a voltage source?

- A. The same voltage as the source
- B. Half the source voltage
- C. It is determined by the type and value of the components
- D. Twice the source voltage

T5D15

52

What is the voltage across each of two components in parallel with a voltage source?

- A. It is determined by the type and value of the components
- B. Half the source voltage
- C. Twice the source voltage
- D. The same voltage as the source

T5D16

53

Which of the following battery types is rechargeable?

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

T6A10

54

Which of the following battery types is not rechargeable?

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

T6A11

55

How much voltage does a mobile transceiver typically require?

- A. About 12 volts
- B. About 30 volts
- C. About 120 volts
- D. About 240 volts

T5A06

56

Where should the negative return connection of a mobile transceiver's power cable be connected?

- A. At the battery or engine block ground strap
- B. At the antenna mount
- C. To any metal part of the vehicle
- D. Through the transceiver's mounting bracket

T4A11

57

What is the name for a current that reverses direction on a regular basis?

- A. Alternating current
- B. Direct current
- C. Circular current
- D. Vertical current

T5A09

58

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

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

T6D01

59

What is the name for a current that flows only in one direction?

- A. Alternating current
- B. Direct current
- C. Normal current
- D. Smooth current

T5A04

60

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

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

T6B02

61

What are the names of the two electrodes of a diode?

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

T6B09

62

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

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

T6B06

63

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

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

T6A01

64

What instrument is used to measure resistance?

- A. An oscilloscope
- B. A spectrum analyzer
- C. A noise bridge
- D. An ohmmeter

T7D05

65

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

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

T6A02

66

What electrical parameter is controlled by a potentiometer?

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

T6A03

67

Which of the following is a good electrical conductor?

- A. Glass
- B. Wood
- C. Copper
- D. Rubber

T5A07

68

Which of the following is a good electrical insulator?

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

T5A08

69

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

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

T6A06

70

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

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

T6A07

71

What is the ability to store energy in a magnetic field called?

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

T5C03

72

What is the basic unit of inductance?

- A. The Coulomb
- B. The Farad
- C. The Henry
- D. The Ohm

T5C04

73

What is the ability to store energy in an electric field called?

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

T5C01

74

What is the basic unit of capacitance?

- A. The Farad
- B. The Ohm
- C. The Volt
- D. The Henry

T5C02

75

What electrical component stores energy in an electric field?

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

T6A04

76

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

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

T6A05

77

What is impedance?

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

T5C12

78

What is a unit of impedance?

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

T5C13

79

What electrical component is used to connect or disconnect electrical circuits?

- A. Magnetron
- B. Switch
- C. Thermistor
- D. All of these choices are correct

T6A08

80

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

- A. Fuse
- B. Capacitor
- C. Inductor
- D. All of these choices are correct

T6A09

81

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

- A. Oscillator
- B. Potentiometer
- C. Transistor
- D. Voltmeter

T6B03

82

What class of electronic components is capable of using a voltage or current signal to control current flow?

- A. Capacitors
- B. Inductors
- C. Resistors
- D. Transistors

T6B01

83

Which of the following electronic components can amplify signals?

- A. Transistor
- B. Variable resistor
- C. Electrolytic capacitor
- D. Multi-cell battery

T6B05

84

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

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

T6B11

85

Which of the following could be the primary gain-producing component in an RF power amplifier?

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

T6B10

86

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

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

T6B04

87

What does the abbreviation FET stand for?

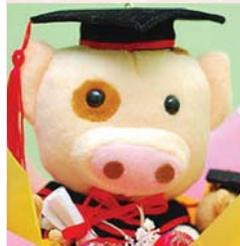
- A. Field Effect Transistor
- B. Fast Electron Transistor
- C. Free Electron Transmitter
- D. Frequency Emission Transmitter

T6B08

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Technician Licensing Class

It's the Law, per Mr. Ohm!



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Section Nine

Valid July 1, 2018

Through

June 30, 2022

It's the Law, per Mr. Ohm!

The PIE and EIR Wagon



Power Law Wheel Ohms Law Wheel

2

It's the Law, per Mr. Ohm!

T6A10 **Power** is the term that describes the rate at which electrical energy is used.

T6A02 Electrical power is measured in **watts**.

- The power meter outside is called 'watt meter'

T6C08 Power (P) equals voltage (E) multiplied by current (I) is the formula used to calculate electrical power in a DC circuit.

P is for power, **E** is for Voltage, and **I** is for current

The math is easy
Two known numbers are
given, solve for the
unknown



Cover up the unknown
and plug the numbers
in the other two

$$P = I \times E$$

Finding Power

$$I = P / E$$

Finding Amperes

$$E = P / I$$

Finding Voltage

3

It's the Law, per Mr. Ohm!

T8C09 How much **power** is being used in a circuit when the applied voltage is 13.8 volts DC and the current is 10 amperes.

- Solving for "P" so cover up the P and plug in the other two numbers
- E is given as 13.8 volts and I is given as 10 amperes



$$P = I \times E$$

$$P = 10 \times 13.8$$

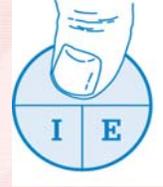
$$P = 138 \text{ watts}$$

4

It's the Law, per Mr. Ohm!

T8C10 How much **power** is being used in a circuit when the applied voltage is 12 volts DC and the current is 2.5 amperes.

- Solving for "P" so cover up the "P" and plug in the other two numbers
- E is given as 12 volts and I is given as 2.5 amperes



$$P = I \times E$$

$$P = 2.5 \times 12$$

$$P = 30 \text{ watts}$$

5

It's the Law, per Mr. Ohm!

T8C11 How many **amperes** are flowing in a circuit when the applied voltage is 12 volts DC and the load is 120 watts.

- Solving for "I" so cover up the "I" and plug in the other two numbers
- P is given as 120 watts and E is given as 12 volts



$$I = P / E$$

$$I = 120 / 12$$

$$I = 10 \text{ Amperes}$$

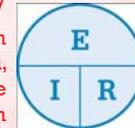
6

It's the Law, per Mr. Ohm!

T8D02 The formula Voltage (E) equals current (I) multiplied by resistance (R) is used to calculate voltage in a circuit.

- E is for Voltage, I is for current, and R is for resistance

The math is easy
Two known numbers are given, solve for the unknown



Cover up the unknown and plug the numbers in the other two

$E = I \times R$	$I = E / R$	$R = E / I$
Finding Voltage	Finding Amperes	Finding Resistance

7

It's the Law, per Mr. Ohm!

T8D10 What is the **voltage** across a 2-ohm resistor if a current of 0.5 amperes flows through it?

- Solving for "E" so cover up the "E" and plug in the other two numbers
- I is given as 0.5 amperes and R is given as 2 ohms



$$E = I \times R$$

$$E = 0.5 \times 2$$

$$E = 1 \text{ volt}$$

8

It's the Law, per Mr. Ohm!

T8D11 What is the **voltage** across a 10-ohm resistor if a current of 1 amperes flows through it?

- Solving for "E" so cover up the "E" and plug in the other two numbers
- I is given as 1 ampere and R is given as 10 ohms



$$E = I \times R$$

$$E = 1 \times 10$$

$$E = 10 \text{ volts}$$

9

It's the Law, per Mr. Ohm!

TSD12 What is the **voltage** across a 10-ohm resistor if a current of 2 amperes flows through it?

- Solving for "E" so cover up the "E" and plug in the other two numbers
- I is given as 2 amperes and R is given as 10 ohms



$$E = I \times R$$

$$E = 2 \times 10$$

$$E = 20 \text{ volts}$$

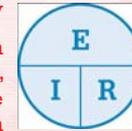
10

It's the Law, per Mr. Ohm!

TSD01 The formula Current (I) equals voltage (E) divided by resistance (R) is used to calculate current in a circuit.

- E is for Voltage, I is for current, and R is for resistance

The math is easy
Two known numbers are given, solve for the unknown



Cover up the unknown and plug the numbers in the other two

$$E = I \times R \quad I = E / R \quad R = E / I$$

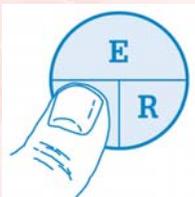
Finding Voltage Finding Amperes Finding Resistance

11

It's the Law, per Mr. Ohm!

TSD09 What is the **current** through a 24-ohm resistor connected across 240 volts?

- Solving for "I" so cover up the "I" and plug in the other two numbers
- E is given as 240 volts and R is given as 24 ohms



$$I = E / R$$

$$I = 240 / 24$$

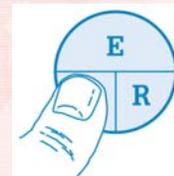
$$I = 10 \text{ amperes}$$

12

It's the Law, per Mr. Ohm!

TSD08 What is the **current** through a 100-ohm resistor connected across 200 volts?

- Solving for "I" so cover up the "I" and plug in the other two numbers
- E is given as 200 volts and R is given as 100 ohms



$$I = E / R$$

$$I = 200 / 100$$

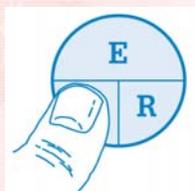
$$I = 2 \text{ amperes}$$

13

It's the Law, per Mr. Ohm!

TSD07 What is the **current** in a circuit with an applied voltage of 120 volts and a resistance of 80 ohms?

- Solving for "I" so cover up the "I" and plug in the other two numbers
- E is given as 120 volts and R is given as 80 ohms



$$I = E / R$$

$$I = 120 / 80$$

$$I = 1.5 \text{ amperes}$$

14

It's the Law, per Mr. Ohm!

TSD03 The formula Resistance (R) equals voltage (E) divided by current (I) is used to calculate resistance in a circuit.

- E is for Voltage, I is for current, and R is for resistance

The math is easy
Two known numbers are given, solve for the unknown



Cover up the unknown and plug the numbers in the other two

$$E = I \times R \quad I = E / R \quad R = E / I$$

Finding Voltage Finding Amperes Finding Resistance

15

It's the Law, per Mr. Ohm!

TSD04 What is the **resistance** of a circuit in which a current of **3 amperes** flows through a resistor connected to **90 volts**?

- Solving for "R" so cover up the "R" and plug in the other two numbers
- **E** is given as 90 volts and **I** is given as 3 amperes



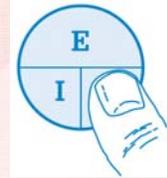
$$R = E / I$$
$$R = 90 / 3$$
$$R = 30 \text{ ohms}$$

16

It's the Law, per Mr. Ohm!

TSD05 What is the **resistance** in a circuit for which the applied voltage is 12 volts and the current flow is 1.5 amperes?

- Solving for "R" so cover up the "R" and plug in the other two numbers
- **E** is given as 12 volts and **I** is given as 1.5 amperes



$$R = E / I$$
$$R = 12 / 1.5$$
$$R = 8 \text{ ohms}$$

17

It's the Law, per Mr. Ohm!

TSD06 What is the **resistance** of a circuit that draws 4 amperes from a 12-volt source?

- Solving for "R" so cover up the "R" and plug in the other two numbers
- **E** is given as 12 volts and **I** is given as 4 amperes



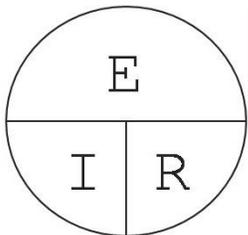
$$R = E / I$$
$$R = 12 / 4$$
$$R = 3 \text{ ohms}$$

18

Take Aways

Section Nine Take Aways

Words that are **bold** and **red** appear in the correct answer.



Take Aways

Resistance (R) equals **voltage (E)** divided by **current (I)** or $R=E/I$

Voltage (E) equals **current (I)** multiplied by **resistance (R)** or $E=I \cdot R$

Current (I) equals **voltage (E)** divided by **resistance (R)** or $I=E/R$

20



Take Aways

The formula used to calculate electrical **power** in a DC circuit is:

Power (P) equals **voltage (E)** multiplied by **current (I)**

Voltage (E) equals **power (P)** divided by **current (I)** or $E=P/I$

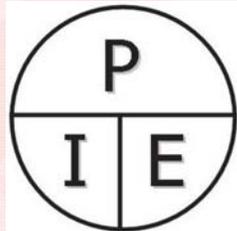
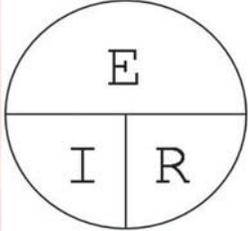
Power (P) equals **current (I)** multiplied by **voltage (E)** or $P=I \cdot E$

Current (I) equals **Power (P)** divided by **voltage (E)** or $I=P/E$

21

Take Aways

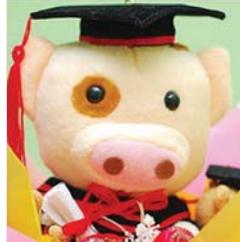
- The term, **Power**, describes the **rate at which electrical energy** is used.
- **Electrical power** is measured in units of **Watts**.



22

Element 2 Technician Class Question Pool

It's the Law, per Mr. Ohm!



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Section Nine

Valid July 1, 2018

Through

June 30, 2022

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

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

T5A10

24

Electrical power is measured in which of the following units?

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

T5A02

25

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

- A. Power (P) equals voltage (E) multiplied by current (I)
- B. Power (P) equals voltage (E) divided by current (I)
- C. Power (P) equals voltage (E) minus current (I)
- D. Power (P) equals voltage (E) plus current (I)

T5C08

26

How much power is being used in a circuit when the applied voltage is 13.8 volts DC and the current is 10 amperes?

- A. 138 watts
- B. 0.7 watts
- C. 23.8 watts
- D. 3.8 watts

T5C09

27

How much power is being used in a circuit when the applied voltage is 12 volts DC and the current is 2.5 amperes?

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

T5C10

28

How many amperes are flowing in a circuit when the applied voltage is 12 volts DC and the load is 120 watts?

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

T5C11

29

What formula is used to calculate voltage in a circuit?

- A. Voltage (E) equals current (I) multiplied by resistance (R)
- B. Voltage (E) equals current (I) divided by resistance (R)
- C. Voltage (E) equals current (I) added to resistance (R)
- D. Voltage (E) equals current (I) minus resistance (R)

T5D02

30

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

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

T5D10

31

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

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

T5D11

32

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

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

T5D12

33

What formula is used to calculate current in a circuit?

- A. Current (I) equals voltage (E) multiplied by resistance (R)
- B. Current (I) equals voltage (E) divided by resistance (R)
- C. Current (I) equals voltage (E) added to resistance (R)
- D. Current (I) equals voltage (E) minus resistance (R)

T5D01

34

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

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

T5D09

35

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

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

T5D08

36

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

- A. 9600 amperes
- B. 200 amperes
- C. 0.667 amperes
- D. 1.5 amperes

T5D07

37

What formula is used to calculate resistance in a circuit?

- A. Resistance (R) equals voltage (E) multiplied by current (I)
- B. Resistance (R) equals voltage (E) divided by current (I)
- C. Resistance (R) equals voltage (E) added to current (I)
- D. Resistance (R) equals voltage (E) minus current (I)

T5D03

38

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

- A. 3 ohms
- B. 30 ohms
- C. 93 ohms
- D. 270 ohms

T5D04

39

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

- A. 18 ohms
- B. 0.125 ohms
- C. 8 ohms
- D. 13.5 ohms

T5D05

40

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

- A. 3 ohms
- B. 16 ohms
- C. 48 ohms
- D. 8 ohms

T5D06

41

Technician Licensing Class

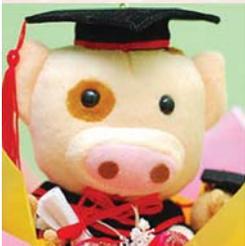
Picture This!

Section Ten

Valid July 1, 2018

Through

June 30, 2022

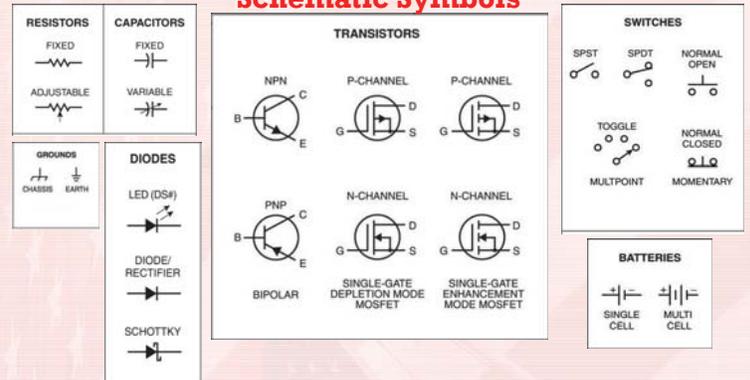


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1

Picture This!

Schematic Symbols



2

Picture This!

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

T6C12 The **symbols** on an electrical schematic represent **electrical components**.

T6C13 The way electrical components are **interconnected** is accurately represented in electrical schematics.

3

Picture This!

T6D08 We use series and parallel **inductors** and **capacitors** to develop a **tuned circuit** inside your radio..

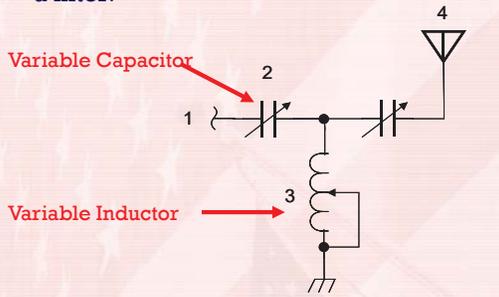


Tank Circuit or Tuned Circuit

4

Picture This!

T6D11 A resonant circuit must contain at least **one inductor** and **one capacitor** connected **in series or parallel** to form a filter.



Tank or Tuned Circuit Schematic

5

Picture This!

T6C02 Component 1 in figure T1 is a resistor.

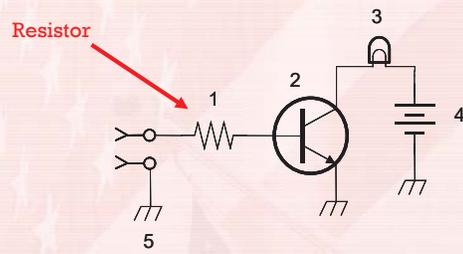
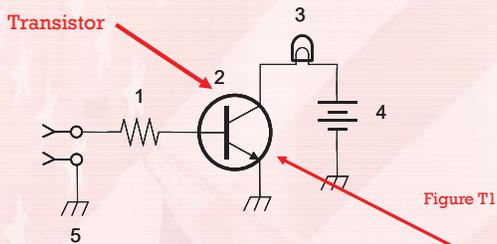


Figure T1

6

Picture This!

T6C03 Component 2 in figure T1 is a transistor.

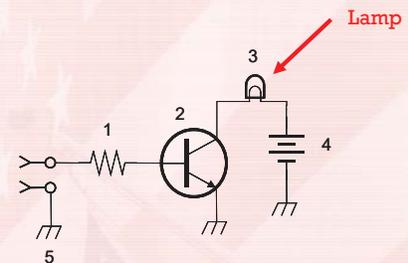


T6D10 To control the flow of current is the function of component 2 in Figure T1.

7

Picture This!

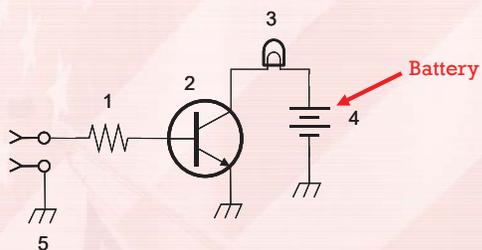
T6C04 Component 3 in figure T1 is a lamp.



8

Picture This!

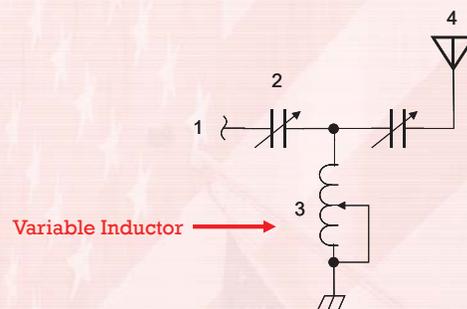
T6C02 Component 4 in figure T1 is a battery.



9

Picture This!

T6C10 Component 3 in figure T3 is an Variable Inductor



10

Picture This!

T6C11 Component 4 in figure T3 is an antenna.

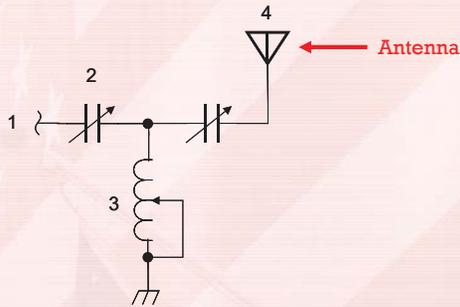


Figure T3

11

Picture This!

T6D03 A single-pole single-throw switch is represented by item 3 in figure T2.

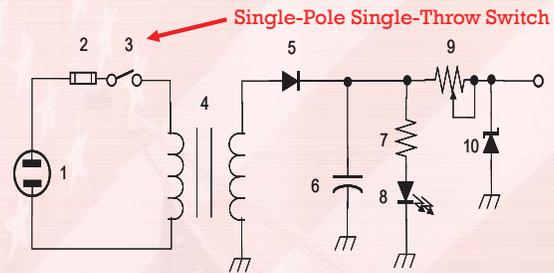


Figure T2

12

Picture This!

T6C09 Component 4 takes in everything around it, and is a **transformer**. Voltage is passed from the windings on the left, to the windings on the right, with the two vertical lines representing an iron core.

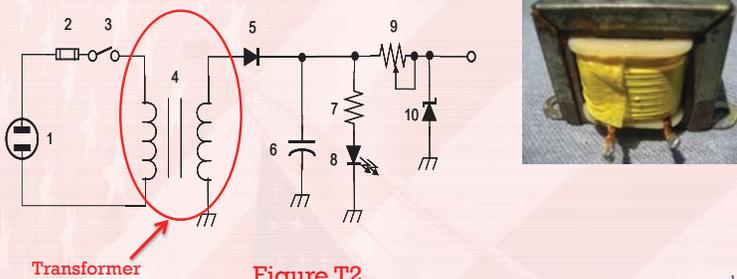


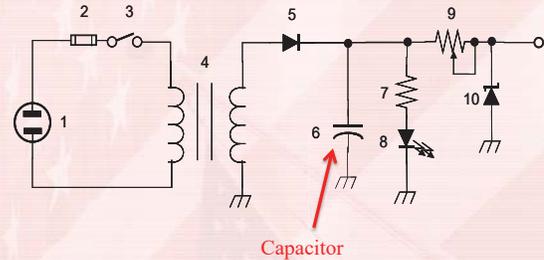
Figure T2

13

Picture This!

T6C06 Component 6 has 2 parallel (sort of) plates, separated by an insulation, so it must be a **capacitor**.

Figure T2



Capacitor

14

Picture This!

T6C07 Component 8 is a **Light Emitting Diode (LED)**.

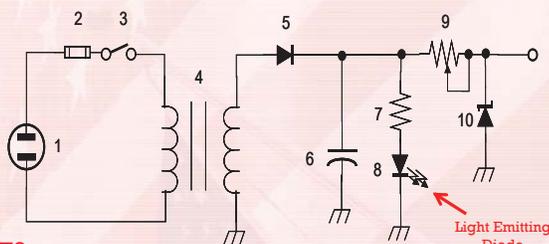


Figure T2

15

Picture This!

T6C08 Component 9 is a resistor, but it has a variable tap point on it, so it is a **variable resistor**. It is called a **potentiometer**, and this could be the volume control on your handheld.

Variable Resistor

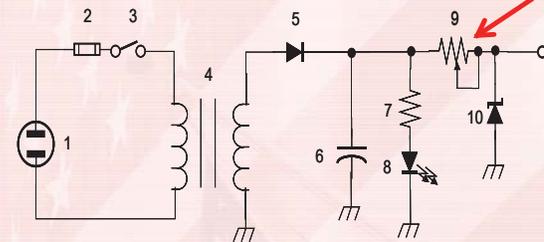
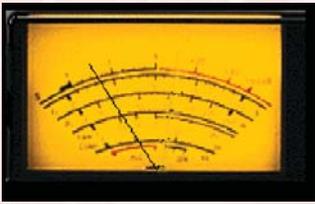


Figure T2

16

Picture This!

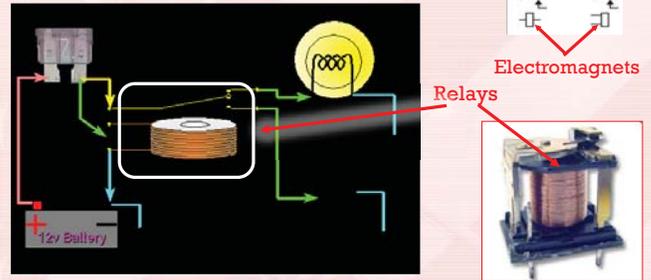
T6D04 Your larger, high-frequency transceivers may have a mechanical meter movement to illustrate incoming signal strength. Even if it is an LED or LCD readout, we still call it a **signal strength meter**.



17

Picture This!

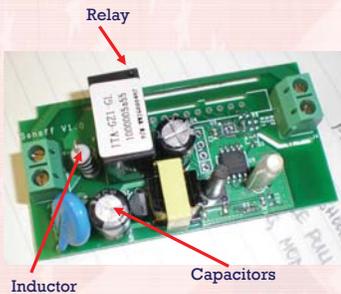
T6D02 A mobile radio that puts out 50 watts will likely contain a relay. The relay is a **mechanical switch**, opened and closed by **current** passing through a coil, creating an **electromagnet**. As soon as the coil is energized, the switch goes from one state to another.



18

Picture This!

A relay is used in “smart home” device to turn light on/off using WiFi (radio frequency 2.4 GHz) to initiate action



19

Picture This!

T6D05 A **regulator** is a type of circuit that **controls** the amount of **voltage** from a power supply.



Voltage Regulators

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



Voltage Transformer

T6D09 **Integrated circuit** is the name of a device that combines several semiconductors and other components into one package.



Large-scale integrated circuit chips

20

Picture This!

dB	Power Change
3 dB	2x Power change
6 dB	4x Power change
9 dB	8x Power change
10 dB	10x Power change
20 dB	100x Power change
30 dB	1000x Power change

T5B09 The approximate amount of change, measured in **decibels (dB)**, of a power increase from 5 watts to 10 watts is 3dB. (2X)

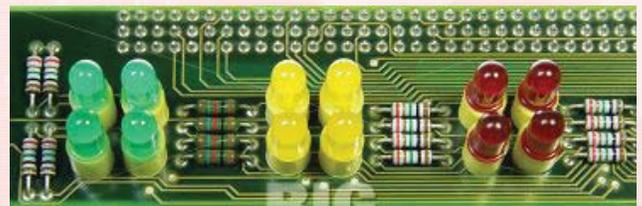
T5B10 The approximate amount of change, measured in **decibels (dB)**, of a power decrease from 12 watts to 3 watts is -6dB. (4X)

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

21

Picture This!

T6B07 LED stands for Light Emitting Diode, The LED draws almost no amount of current and will last for hundreds of thousands of hours without burnout. **LED = Light Emitting Diode.**



T6D07 A good **visual indicator** on a handheld radio is the **LED** – the light emitting diode that is often used as a transmit indicator.

22

Picture This!

T5B02 Another way to specify a radio signal frequency of **1,500,000 Hz** as **1,500 kHz**, or 1.5 MHz.

T5B13 If a frequency readout shows a reading of **2425 MHz**, what frequency is that in **GHz**? There are 1,000 MHz in one GHz, so we can simply divide by 1000 to get the final answer, **2.425 GHz**.

T5B07 If a frequency readout shows a reading of **3.525 MHz**, what frequency is that in kHz? There are 1,000 kHz in one MHz, so we can simply multiply by 1000 to get the final answer, **3525 kHz**.

23

Picture This!

T5B03 Kilo means **one thousand**. 1000 volts equals 1 kilovolt.

T5B06 One **ampere** equal 1000 **milliamperes**. If an ammeter calibrated in amperes is used to measure a 3000-milliampere of current, the reading would it to be 3 amperes.

T5B12 There are a thousand **Kilohertz** in one **Megahertz**, so 28,400 kHz is equal to 28.400 MHz

24

Picture This!

Metric Prefixes

1,000,000,000,000

M e g a k i l o m i l l i m i c r o
M e g a k i l o m i l l i m i c r o

25

Picture This!

Metric	Exponent	English
Tera	10^{12}	Trillion
Giga	10^9	Billion
Mega	10^6	Million
Kilo	10^3	Thousand
Centi	10^{-2}	Hundredth
Milli	10^{-3}	Thousandth
Micro	10^{-6}	Millionth
Nano	10^{-9}	Billionth
Pico	10^{-12}	Trillionth

T5B05 0.5 watts is equivalent to 500 milliwatts.

T5B01 1,500 milliamperes is 1.5 amperes.

T5B08 One microfarads is equal to 1,000,000 picofarads.

T5B04 One one-millionth of a volts is equal to one microvolt

26

Picture This!

T7D08 **Rosin-core** is best for radio and electronic use.

Always use **rosin-core solder**.

Always wear protective glasses



27

Picture This!

T7D09 It's easy to tell if you've made a good solder connection – the solder looks shiny. However, a “cold,” poorly-soldered joint looks **grainy and dull**.



28

Picture This!

T7D07 Voltage and resistance measurements are commonly made using a **multimeter**. A multimeter is a **multiple function meter** which may include capability to measure voltage, current and resistance.

T7D11 Any time you are checking a circuit with an ohmmeter, **make sure the circuit is not powered!**

T7D06 You're likely to **damage** your multimeter by **measuring voltage** if you accidentally leave it in the **resistance setting**.



29

Picture This!

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

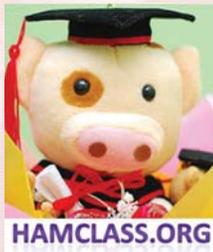


30

Take Aways

Section Ten Take Aways

Words that are **bold** and **red** appear in the correct answer.



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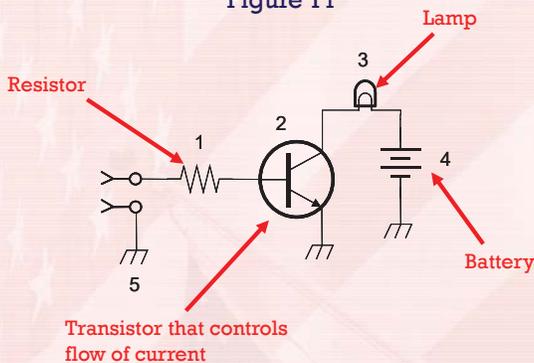
Take Aways

- The electrical wiring diagram that uses standard component symbols is named a **schematic**.
- The symbols on an electrical schematic **represent electrical components**.
- **The way components are interconnected** is accurately represented in electrical schematic.
- A **meter** can be used to display an electrical quantity as a numeric value.

32

Take Aways

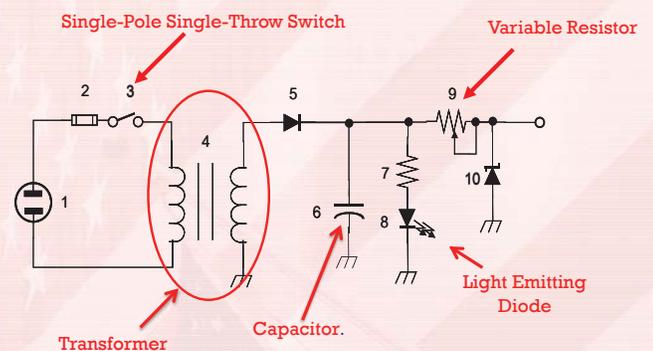
Figure T1



33

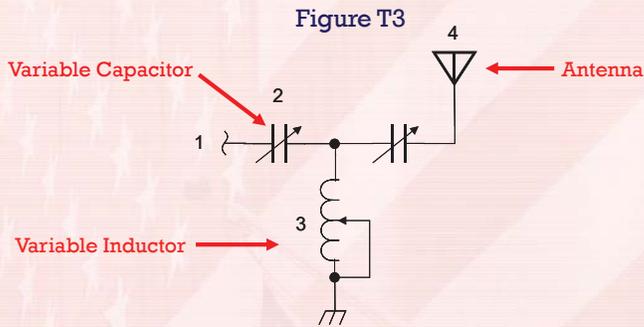
Take Aways

Figure T2



34

Take Aways



35

Take Aways

- A **capacitor** is combined with an inductor to make a tuned circuit
- A **Tuned Circuit** is an inductor and a capacitor connected in series or parallel to form a filter
- A relay is a **electrically controlled switch**.
- A **regulator** circuit controls the amount of voltage from a power supply.
- A **transformer** is commonly used to change 120V AC house current to a **lower AC** voltage for other uses.
- An **Integrated circuit** is a device that combines several semiconductors and other components into **one package**.

36

Take Aways

- The abbreviation "**LED**" stands for **Light Emitting Diode**.
- A **LED** is commonly used as a **visual indicator**.
- An approximate amount of change, measured in decibels (dB), of a power increase from **5 watts to 10 watts** (change factor of 2) is **3dB**.
- An approximate amount of change, measured in decibels (dB), of a power decrease from **12 watts to 3 watts** (change factor of 4) is **-6dB**.
- The amount of change, measured in decibels (dB), of a power increase from **20 watts to 200 watts** (change factor of 10) is **10 dB**.

37

Take Aways

- Another way to specify a radio signal frequency of 1,500,000 hertz is **1500 kHz**.
- A frequency of 2425 **MHz** is equal to **2.425 GHz**.
- A frequency readout of 3.525 MHz would show as **3525 kHz**.
- One one-millionth of a volt is equal to **one microvolt**.
- 1,000,000 **picofarads** is equal to **1 microfarad**.

38

Take Aways

- **One thousand volts** are equal to one kilovolt.
- If an ammeter calibrated in **amperes** is used to measure a 3000-**milliampere** current, the reading shown is **3 amperes**.
- **0.5 watts** is equivalent to 500 **milliwatts**.
- **1,500 milliamperes** equals 1.5 amperes.
- **28.400 MHz** is equal to 28,400 kHz?

39

Take Aways

- **Rosin-core solder** is best for radio and electronic use.
- A **grainy or dull surface** is the characteristic appearance of a "cold" solder joint.
- Measurements commonly made using a **multimeter** are **voltage and resistance**.

40

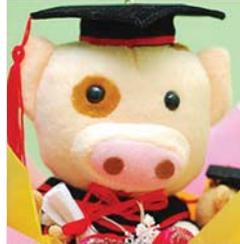
Take Aways

- A **precaution** that should be taken when measuring circuit resistance with an **ohmmeter** is to **ensure that the circuit is not powered**.
- **Attempting to measure voltage when using the resistance setting** might damage a **multimeter**.
- When an **ohmmeter**, connected across a circuit, initially indicates a low resistance and then **shows increasing resistance** with time the **circuit contains a large capacitor**.

41

Element 2 Technician Class Question Pool

Picture This!



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Section Ten

Valid July 1, 2018

Through

June 30, 2022

42

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

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

T6C01

43

What do the symbols on an electrical schematic represent?

- A. Electrical components
- B. Logic states
- C. Digital codes
- D. Traffic nodes

T6C12

44

Which of the following is accurately represented in electrical schematics?

- A. Wire lengths
- B. Physical appearance of components
- C. The way components are interconnected
- D. All of these choices

T6C13

45

What is component 3 in figure T3?

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

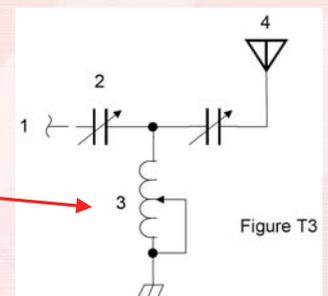


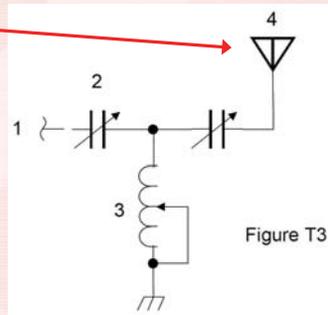
Figure T3

T6C10

46

What is component 4 in figure T3?

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



T6C11

47

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

- A. Resistor
- B. Zener diode
- C. Potentiometer
- D. Capacitor

T6D08

48

Which of the following is a resonant or tuned circuit?

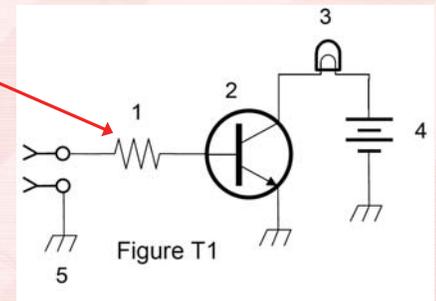
- A. An inductor and a capacitor connected in series or parallel to form a filter
- B. A type of voltage regulator
- C. A resistor circuit used for reducing standing wave ratio
- D. A circuit designed to provide high-fidelity audio

T6D11

49

What is component 1 in figure T1?

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

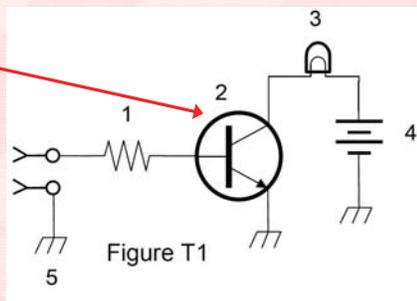


T6C02

50

What is component 2 in figure T1?

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

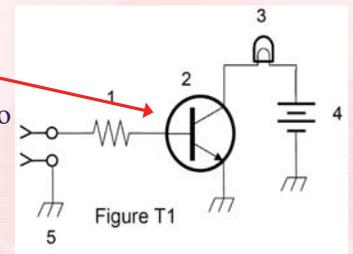


T6C03

51

What is the function of component 2 in Figure T1?

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

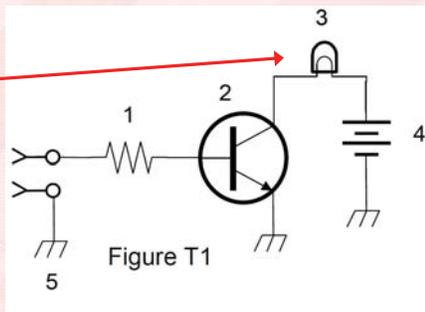


T6D10

52

What is component 3 in figure T1?

- A. Resistor
- B. Transistor
- C. Lamp
- D. Ground symbol

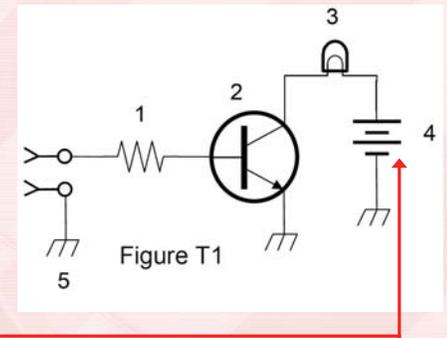


T6C04

53

What is component 4 in figure T1?

- A. Resistor
- B. Transistor
- C. Battery
- D. Ground symbol

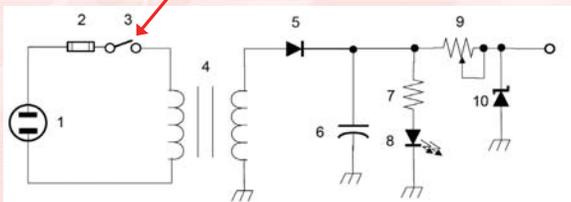


T6C05

54

What type of switch is represented by item 3 in figure T2?

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



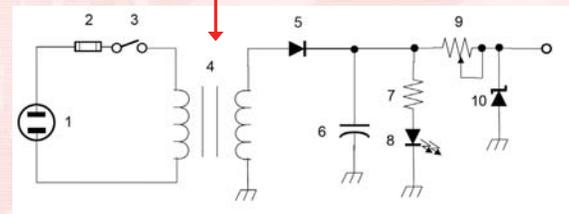
T6D03

Figure T2

55

What is component 4 in figure T2?

- A. Variable inductor
- B. Double-pole switch
- C. Potentiometer
- D. Transformer



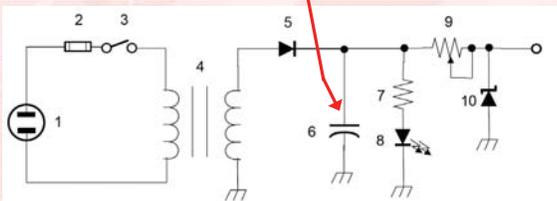
T6C09

Figure T2

56

What is component 6 in figure T2?

- A. Resistor
- B. Capacitor
- C. Regulator IC
- D. Transistor



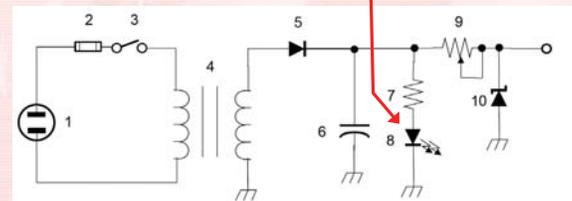
T6C06

Figure T2

57

What is component 8 in figure T2?

- A. Resistor
- B. Inductor
- C. Regulator IC
- D. Light emitting diode



T6C07

Figure T2

58

What is component 9 in figure T2?

- A. Variable capacitor
- B. Variable inductor
- C. Variable resistor
- D. Variable transformer

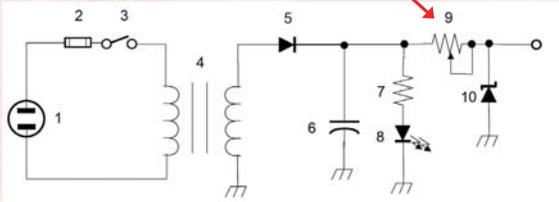


Figure T2

T6C08

59

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

- A. Potentiometer
- B. Transistor
- C. Meter
- D. Relay

T6D04

60

What is a relay?

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

T6D02

61

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

- A. Regulator
- B. Oscillator
- C. Filter
- D. Phase inverter

T6D05

62

What component is commonly used to change 120V AC house current to a lower AC voltage for other uses?

- A. Variable capacitor
- B. Transformer
- C. Transistor
- D. Diode

T6D06

63

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

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

T6D09

64

What is the approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts?

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

T5B09

65

What is the approximate amount of change, measured in decibels (dB), of a power decrease from 12 watts to 3 watts?

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

T5B10

66

What is the amount of change, measured in decibels (dB), of a power increase from 20 watts to 200 watts?

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

T5B11

67

What does the abbreviation "LED" stand for?

- A. Low Emission Diode
- B. Light Emitting Diode
- C. Liquid Emission Detector
- D. Long Echo Delay

T6B07

68

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

- A. LED
- B. FET
- C. Zener diode
- D. Bipolar transistor

T6D07

69

What is another way to specify a radio signal frequency of 1,500,000 hertz?

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

T5B02

70

If a frequency display shows a reading of 2425 MHz, what frequency is that in GHz?

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

T5B13

71

If a frequency display calibrated in megahertz shows a reading of 3.525 MHz, what would it show if it were calibrated in kilohertz?

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

T5B07

72

How many volts are equal to one kilovolt?

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

T5B03

73

If an ammeter calibrated in amperes is used to measure a 3000-milliampere current, what reading would it show?

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

T5B06

74

Which of the following frequencies is equal to 28,400 kHz?

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

T5B12

75

Which of the following is equal to 500 milliwatts?

- A. 0.02 watts
- B. 0.5 watts
- C. 5 watts
- D. 50 watts

T5B05

76

How many milliamperes is 1.5 amperes?

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

T5B01

77

How many microfarads are 1,000,000 picofarads?

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

T5B08

78

How many volts are equal to one microvolt?

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

T5B04

79

Which of the following types of solder is best for radio and electronic use?

- A. Acid-core solder
- B. Silver solder
- C. Rosin-core solder
- D. Aluminum solder

T7D08

80

What is the characteristic appearance of a "cold" solder joint?

- A. Dark black spots
- B. A bright or shiny surface
- C. A grainy or dull surface
- D. A greenish tint

T7D09

81

Which of the following measurements are commonly made using a multimeter?

- A. SWR and RF power
- B. Signal strength and noise
- C. Impedance and reactance
- D. Voltage and resistance

T7D07

82

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

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

T7D11

83

Which of the following might damage a multimeter?

- A. Measuring a voltage too small for the chosen scale
- B. Leaving the meter in the milliamps position overnight
- C. Attempting to measure voltage when using the resistance setting
- D. Not allowing it to warm up properly

T7D06

84

What is probably happening when an ohmmeter, connected across an unpowered circuit, initially indicates a low resistance and then shows increasing resistance with time?

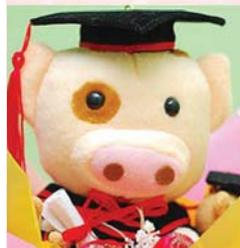
- A. The ohmmeter is defective
- B. The circuit contains a large capacitor
- C. The circuit contains a large inductor
- D. The circuit is a relaxation oscillator

T7D10

85

Technician Licensing Class

Your First Radio



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Section Eleven

Valid July 1, 2018

Through

June 30, 2022

Your First Radio

T4B04 **Quick access** to a favorite frequency on your transceiver can be done by **storing the frequency** in a memory channel.



T4B13 To **scan through a range** of frequencies to check for activity, use the **scanning function** of the FM transceiver. This scans the channels in the transceiver's memory for activity.

2

Your First Radio

T9A04 A disadvantage of the "**rubber duck**" antenna supplied with most handheld radio transceivers is that it **does not transmit or receive as effectively** as a full-sized antenna.



3

Your First Radio

T9A07 A good reason **not** to use a "rubber duck" antenna inside your car is that **signals might not propagate** well due to the shielding effect of the vehicle



VHF/UHF Power Amplifier



T7A10 An RF **power amplifier** increases the low-power output from a handheld transceiver.

4

Your First Radio

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



5

Your First Radio

T7A07 **PTT** is the term used for the push to talk function which switches between receive and transmit.

T8A04 **FM** (frequency modulation) is the type of **modulation** most commonly used for VHF and UHF **voice** repeaters.

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

T8A02 **FM** is the type of modulation most commonly used for VHF **packet** radio transmissions. (Packet is wireless data transmission)

6

Your First Radio

T4A02 A **computer** can be used as part of an amateur radio station for:

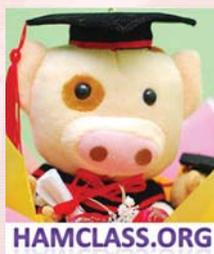
- Logging contacts and contact information
- Sending and/or receiving CW
- Generating and decoding digital signals.

7

Take Aways

Section Eleven Take Aways

Words that are **bold** and **red** appear in the correct answer.



Take Aways

- **PTT** is the term used for the **push to talk function that switches between receive and transmit**.
- A way to enable **quick access** to a favorite frequency on your transceiver is to **store the frequency in a memory channel**.
- The **scanning function** of a FM transceiver can be used to **scan through a range of frequencies to check for activity**.

9

Take Aways

- A disadvantage of the "**rubber duck**" antenna supplied with most handheld radio transceivers is it **does not transmit or receive as effectively** as a full-sized antenna.
- A good reason **NOT** to use a "rubber duck" antenna inside your car is that **signals might not propagate well due to the shielding effect of the vehicle**

10

Take Aways

- An **RF power amplifier** increases the low-power output from a handheld transceiver.
- The **SSB/CW-FM** switch on a VHF power amplifier **sets the amplifier for proper operation in the selected mode**
- **FM** is most commonly used for VHF and UHF **voice repeaters**.
- The approximate bandwidth of a **VHF repeater FM** phone signal is **between 10 and 15 kHz**.
- **Frequency modulation (FM)** is most commonly used for VHF **packet radio** transmissions.

11

Take Aways

- A **computer** can be used as part of an amateur radio station for **all of these tasks**:
 - Logging contacts and contact information
 - Sending and/or receiving CW
 - Generating and decoding digital signals.

12

Element 2 Technician Class Question Pool

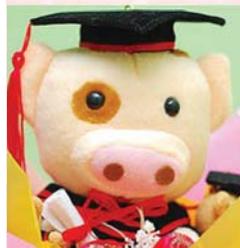
Your First Radio

Section Eleven

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13

What is meant by "PTT"?

- A. Pre-transmission tuning to reduce transmitter harmonic emission
- B. Precise tone transmissions used to limit repeater access to only certain signals
- C. A primary transformer tuner use to match antennas
- D. The push-to-talk function that switches between receive and transmit

T7A07

14

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

- A. Enable the CTCSS tones
- B. Store the frequency in a memory channel
- C. Disable the CTCSS tones
- D. Use the scan mode to select the desired frequency

T4B04

15

Which of the following is a use for the scanning function of an FM transceiver?

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

T4B13

16

What is a disadvantage of the "rubber duck" antenna supplied with most handheld radio transceivers when compared to a full-sized quarter-wave antenna?

- A. It does not transmit or receive as effectively
- B. It transmits only circularly polarized signals
- C. If the rubber end cap is lost, it will unravel very easily
- D. All of these choices are correct

T9A04

17

What is a disadvantage of using a handheld VHF transceiver, with its integral antenna, inside a vehicle?

- A. Signals might not propagate well due to the shielding effect of the vehicle
- B. It might cause the transceiver to overheat
- C. The SWR might decrease, decreasing the signal strength
- D. All of these choices are correct

T9A07

18

What device increases the low-power output from a handheld transceiver?

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

T7A10

19

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

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

T7A09

20

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

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

T8A04

21

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

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

T8A09

22

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

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

T8A02

23

How might a computer be used as part of an amateur radio station?

- A. For logging contacts and contact information
- B. For sending and/or receiving CW
- C. For generating and decoding digital signals
- D. All of these choices are correct

T4A02

24

Technician Licensing Class

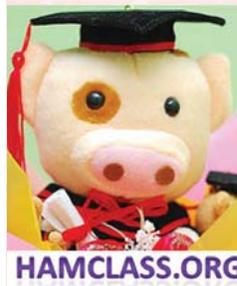
Going On The Air!

Section Twelve

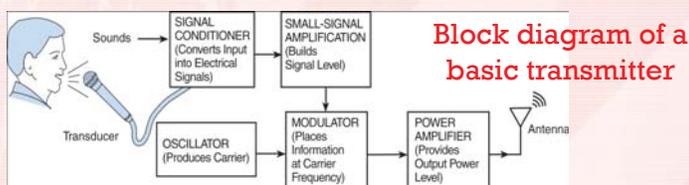
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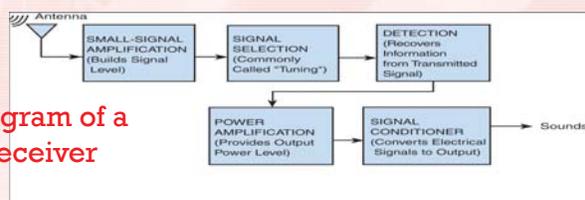
June 30, 2022



Going On The Air!



Block diagram of a basic receiver



2

Going On The Air!

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



Mic Keypad
VFO knob



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

squelch control

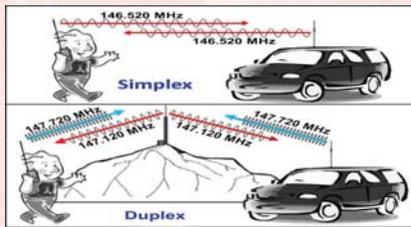


squelch control

3

Going On The Air!

T2A11 **Simplex communication** is the term used to describe communication taking place when amateur station that is transmitting and receiving on the **same frequency**.



T2A06 When making on-air transmissions to **test** equipment or antennas an amateur operator must properly **identify** the transmitting station.

4

Going On The Air!

T2A08 The procedural signal "**CQ**" means calling any station.

T2A05 When **responding** to a call of CQ you should transmit the **other station's** call sign followed by **your** call sign

W5YI this is K3DIO

T2A12 A guideline to use when **choosing** an operating **frequency** for calling **CQ** is:

- Listen first to be sure that no one else is using the frequency
- Ask if the frequency is in use
- Make sure you are in your assigned band



5

Going On The Air!

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

W2HLD this is K3DIO

T3A01 Should another operator reports that your stations 2 meter signals were **strong** just a moment ago, but now they are **weak** or **distorted**, try **moving a few feet**, as random reflections may be causing multi-path distortion.

T3A06 **Picket fencing** is the term commonly used to describe the **rapid fluttering sound** sometimes heard from mobile stations that are moving while transmitting.

6

Going On The Air!

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

T2B10 **QRM** is the "Q" signal used to indicate that you are receiving **interference** from other stations.

T2B11 **QSY** is the "Q" signal used to indicate that you are **changing frequency**.

7

Going On The Air!

QRM **Something is causing interference**

QRN I am troubled by static/noise.

QRP I am running low power.

QRT I am going off the air.

QRZ Who is calling me?

QSB Your signal is fading.

QSL I received the message.

QSO I will communicate with _____ directly.

QSY **I am changing frequency to _____.**

QTH My location is _____.

8

Going On The Air!

T8C03 **Contesting** is a popular operating activity that involves contacting as many stations as possible during a specified period of time.



Field Day Every June Enjoyed By Hams the World Over

9

Going On The Air!

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

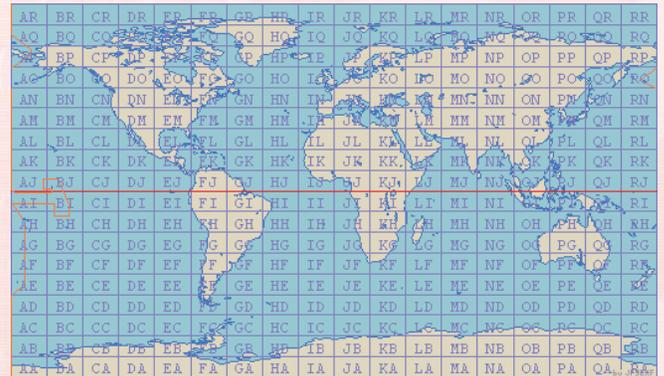
Chit chat is fine for normal QSO's, but not for contests.



10

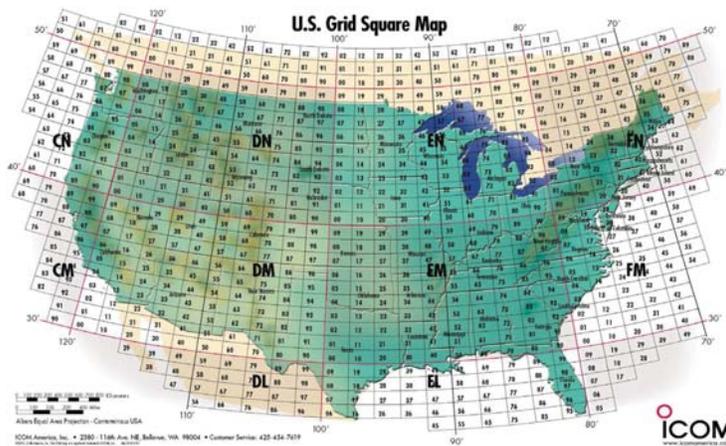
Going On The Air!

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



11

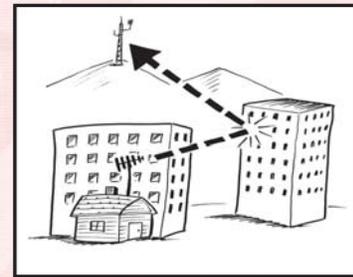
Going On The Air!



2

Going On The Air!

T3A05 When using a **directional antenna** you might be able to reach a distant repeater whose direct path is blocked by buildings or obstructions by finding a path that **reflects signals to the repeater**.

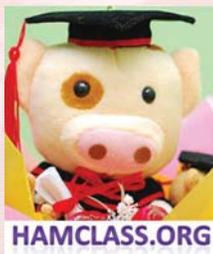


13

Take Aways

Section Twelve Take Aways

Words that are **bold** and **red** appear in the correct answer.



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14

Take Aways

- The **keypad or VFO** knob can be used to **enter the operating frequency** on a modern transceiver.
- The purpose of the **squelch control** on a transceiver is to **mute receiver output noise when no signal is being received**.
- **Simplex communication** is the term used to describe communication taking place when an amateur station is transmitting and receiving **on the same frequency**.

15

Take Aways

- An amateur operator must properly **identify the transmitting station** when making on-air transmissions to test equipment or antennas.
- The meaning of the procedural signal "CQ" is **calling any station**.
- When responding to a call of CQ, you should **transmit the other station's call sign followed by your call sign**.

16

Take Aways

- **All of the following are guidelines** to use when **choosing an operating frequency** for calling CQ:
 - Listen first to be sure that no one else is using the frequency
 - Ask if the frequency is in use
 - Make sure you are in your assigned band
- When two stations transmitting on the same frequency interfere with each other, **common courtesy should prevail, but no one has absolute right to an amateur frequency**.

17

Take Aways

- An appropriate way to call another station on a repeater, if you know the other station's call sign, is to **say the station's call sign then identify with your call sign**.
- Another operator reports that your station's 2 meter signals were strong just a moment ago, but now they are weak or distorted **try moving a few feet or changing the direction of your antenna if possible, as reflections may be causing multi-path distortion**.
- **Picket fencing** is commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting.

18

Take Aways

- The "Q" signal, **QRM**, is used to indicate that you are **receiving interference** from other stations.
- The "Q" signal, **QSY**, is used to indicate that you are **changing frequency**.
- **Contesting** is a popular operating activity involving contacting as many stations as possible during a specified period of time.

19

Take Aways

- A good procedure when contacting another station in a radio contest is to **send only the minimum information needed for proper identification and the contest exchange**.
- A grid locator is **a letter-number designator assigned to a geographic location**.
- When using a directional antenna to reach a distant repeater with the direct line of sight blocked by buildings or obstructions, **try to find a path that reflects signals to the repeater**.

20

Element 2 Technician Class Question Pool

Going On The Air!



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Section Twelve

Valid July 1, 2018

Through

June 30, 2022

21

Which of the following can be used to enter the operating frequency on a modern transceiver?

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

T4B02

22

What is the purpose of the squelch control on a transceiver?

- A. To set the highest level of volume desired
- B. To set the transmitter power level
- C. To adjust the automatic gain control
- D. To mute receiver output noise when no signal is being received

T4B03

23

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

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

T2A11

24

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

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

T2A06

25

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

- A. Call on the quarter hour
- B. A new antenna is being tested (no station should answer)
- C. Only the called station should transmit
- D. Calling any station

T2A08

26

Which of the following is a guideline when choosing an operating frequency for calling CQ?

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

T2A12

27

How should you respond to a station calling CQ?

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

T2A05

28

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

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

T2A04

29

What should you do if another operator reports that your station's 2 meter signals were strong just a moment ago, but now they are weak or distorted?

- A. Change the batteries in your radio to a different type
- B. Turn on the CTCSS tone
- C. Ask the other operator to adjust his squelch control
- D. Try moving a few feet or changing the direction of your antenna if possible, as reflections may be causing multi-path distortion

T3A01

30

What term is commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting?

- A. Flip-flopping
- B. Picket fencing
- C. Frequency shifting
- D. Pulsing

T3A06

31

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

- A. Common courtesy should prevail, but no one has absolute right to an amateur frequency
- B. Whoever has the strongest signal has priority on the frequency
- C. Whoever has been on the frequency the longest has priority on the frequency
- D. The station which has the weakest signal has priority on the frequency

T2B08

32

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

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

T2B10

33

Which Q signal indicates that you are changing frequency?

- A. QRU
- B. QSY
- C. QSL
- D. QRZ

T2B11

34

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

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

T8C03

35

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

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

T8C04

36

What is a grid locator?

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

T8C05

37

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

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

T3A05

38

Technician Licensing Class

Repeaters

Section Thirteen

Valid July 1, 2018

Through

June 30, 2022

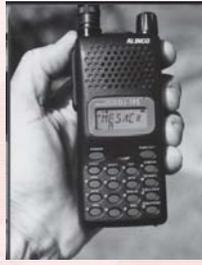


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1

Repeaters

Before you press the PTT switch, **LISTEN** to make sure the frequency is clear for use.



Once you're licensed, listen for a week on a repeater to get the feel for how to communicate.

2

Repeaters

T1F09 A **Repeater** station is the type of amateur station that **simultaneously retransmits** the signal of another amateur station on a different channel or channels.

T1D07 Amateur stations are authorized to automatically retransmit the radio signals of other amateur stations when the signals are from an **repeater, auxiliary, or space station**.

3

Repeaters

T1A06 A **beacon** is defined as an amateur station transmitting communications for the purposes of **observing propagation** or related experimental activities

T2A07 The **difference** between the repeater's transmit and receive frequencies describes the common meaning of the term "**repeater offset**".

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

T2A03 Plus or minus **5 MHz** is a common repeater frequency **offset in the 70 cm band**.

4

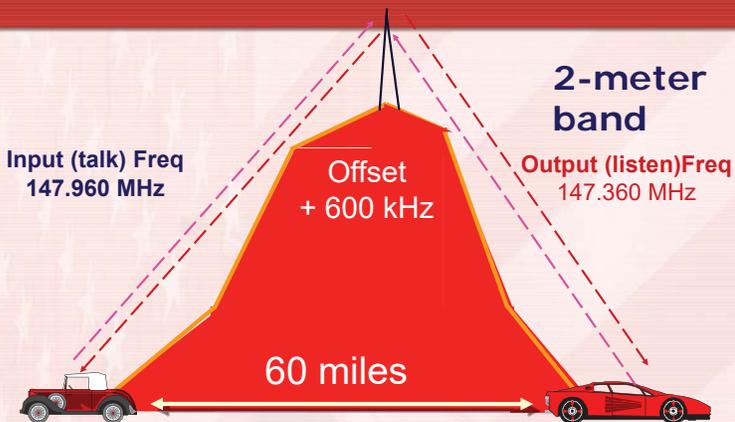
Repeaters

T2B04 **Common problems** that cause you to be able to hear but not access a repeater even when transmitting with the proper offset:

- The repeater receiver requires **audio burst** for access
- The repeater receiver requires a **CTCSS** tone for access
 - **CTCSS** – **C**ontinuous **T**one **C**ontrol **S**quelch **S**ystem
- The repeater receiver may require a **DCS** tone sequence for access
 - **DCS** – **D**igital **C**ode **S**quelch

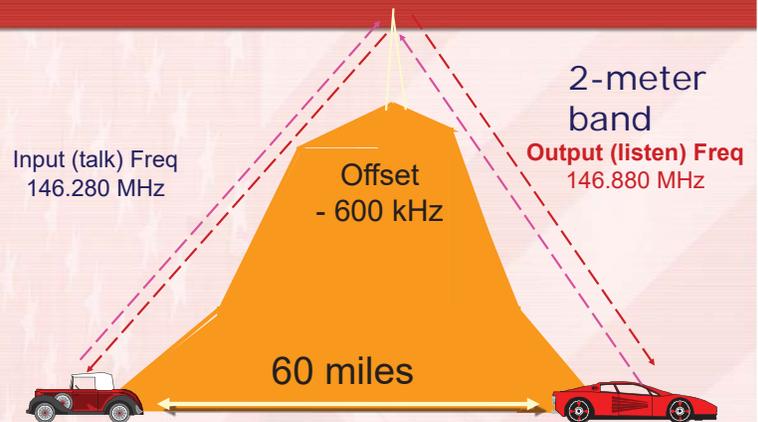
5

Repeaters



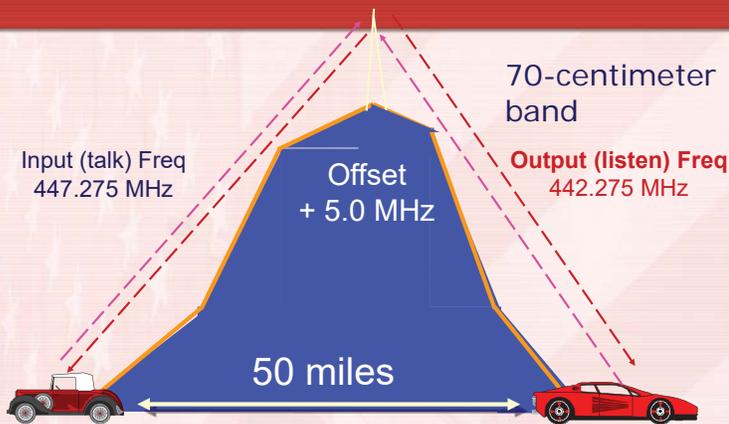
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Repeaters



7

Repeaters

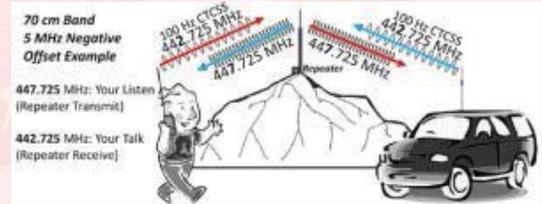


8

Repeaters

T2B01 The most common use of the "reverse split" function of a VHF/UHF transceiver is so you can listen on the repeater's **INPUT** frequency.

T2B03 If a station is not strong enough to keep a repeater's receiver squelch open, listening on the repeater **INPUT** frequency might allow you to receive the station's signal.



9

Repeaters

T2B02 **CTCSS** is the term used to describe the use of a **sub-audible** tone transmitted with normal voice audio to open the squelch of a receiver.

CTCSS -
Continuous
Tone-
Coded
Squelch
System
(also called a PL tone)

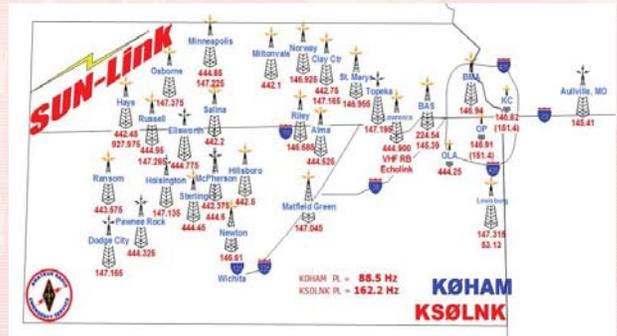


T2A09 A brief statement of **saying your call sign** is often used to indicate that you are listening on a repeater.

10

Repeaters

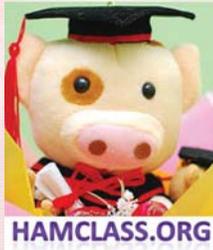
T2B14 A **linked repeater** network is a network of repeaters where **signals** received by one repeater **are repeated by all the repeaters** in that network..



Take Aways

Section Thirteen Take Aways

Words that are **bold** and **red** appear in the correct answer.



14

Take Aways

- A **Repeater station** simultaneously retransmits the signal of another amateur station on a different channel or channels.
- An amateur station is authorized to automatically retransmit the radio signals of other amateur stations when the signals are from an **repeater, auxiliary, or space station**.

15

Take Aways

- A beacon is defined as **an amateur station transmitting communications for the purposes of observing propagation or related experimental activities**
- The common meaning of the term "repeater offset" is **the difference between the repeater's transmit and receive frequencies**.

16

Take Aways

- The most common repeater frequency offset in the 2 meter band is **plus or minus 600 kHz**.
- A common repeater frequency offset in the 70 cm band is **plus or minus 5 MHz**.
- **ALL of the following common problems** might cause you to be able to hear but not access a repeater even when transmitting with the proper offset:
 - The repeater receiver requires **audio tone** burst for access
 - The repeater receiver requires a **CTCSS tone** for access
 - The repeater receiver may require a **DCS tone** sequence for access

17

Take Aways

- **Listening on the repeater's INPUT frequency** is the most common use of the "reverse split" function of a VHF/UHF transceiver.
- **Listening on the repeater's INPUT frequency** might allow you to receive the station's signal if it is not strong enough to keep the repeater's receiver squelch open.
- A linked repeater network is **a network of repeaters where signals received by one repeater are repeated by all the repeaters**.

18

Take Aways

- **CTCSS** (Continuous Tone Coded Squelch System) is the term used to describe the use of a sub-audible tone transmitted with normal voice audio to open the squelch of a receiver.
- A **Volunteer Frequency Coordinator, recognized by local amateurs**, recommends transmit/receive channels and other parameters for auxiliary and repeater stations.
- **Amateur operators in a local or regional area whose stations are eligible to be auxiliary or repeater stations** select a Frequency Coordinator.

19

Take Aways

- The method of call sign identification required for a station transmitting phone signals is **sending the call sign using CW or phone emission.**
- A brief statement often used to indicate that you are listening on a repeater is to **say your call sign.**

20

Element 2 Technician Class Question Pool

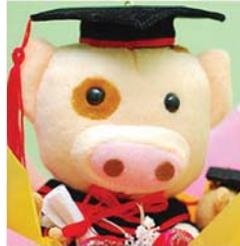
Repeaters

Section Thirteen

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21

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

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

T1F09

22

What is the FCC Part 97 definition of a "beacon"?

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

T1A06

23

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

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

T1D07

24

What is meant by "repeater offset"?

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

T2A07

25

Which of the following is a common repeater frequency offset in the 2 meter band?

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

T2A01

26

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

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

T2A03

27

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

- A. The improper transceiver offset
- B. The repeater may require a proper CTCSS tone from your transceiver
- C. The repeater may require a proper DCS tone from your transceiver
- D. All of these choices are correct

T2B04

28

What is the most common use of the “reverse split” function of a VHF/UHF transceiver?

- A. Reduce power output
- B. Increase power output
- C. Listen on a repeater’s input frequency
- D. Listen on a repeater’s output frequency

T2B01

29

If a station is not strong enough to keep a repeater’s receiver squelch open, which of the following might allow you to receive the station’s signal?

- A. Open the squelch on your radio
- B. Listen on the repeater input frequency
- C. Listen on the repeater output frequency
- D. Increase your transmit power

T2B03

30

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

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

T2B02

31

Which of the following describes a linked repeater network?

- A. A network of repeaters where signals received by one repeater are repeated by all the repeaters
- B. A repeater with more than one receiver
- C. Multiple repeaters with the same owner
- D. A system of repeaters linked by APRS

T2B14

32

What brief statement indicates that you are listening on a repeater and looking for a contact?

- A. The words "Hello test" followed by your call sign
- B. Your call sign
- C. The repeater call sign followed by your call sign
- D. The letters "QSY" followed by your call sign

T2A09

33

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

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

T1A08

34

Who selects a frequency coordinator?

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

T1A09

35

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

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

T1F05

36

Technician Licensing Class

Emergency

Section Fourteen

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Emergency!

T2C06 Common practice during net operations to get the immediate attention of the net control station when reporting an emergency is to begin your transmission with “**Priority**” or “**Emergency**” followed by your call sign.



Another way to interrupt a conversation to signal a distress call is to say the word “BREAK” several times to indicate a priority or emergency distress call.

2

Emergency!

T2C09 When normal communications systems are not available, an amateur station may use **any means of radio communications** at its disposal for essential communications in connection with **immediate safety of human life and protection of property**. This may mean operating outside of the frequency privileges of their license class.

Amateur radio operators are well known for their volunteer assistance in emergencies—from local problems to national disasters like 9/11 and Hurricanes Katrina and Rita and the Joplin tornado.



In an Emergency use any means necessary to convey the message

3

Emergency!

T2C07 In order to minimize disruptions to an emergency traffic net once you have checked in, do **not** transmit on the net frequency **until asked to do so by the net control station**.

T2C01 **FCC rules always apply** to proper operation of your station when using amateur radio at the request of public service officials.

T2C12 The Amateur Radio Emergency Services (**ARES**) are licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the **public service**



4

Emergency!

T1A10 Radio Amateur Civil Emergency Service (**RACES**) is a radio service using amateur stations for **emergency management** or **civil defense** communications.

- A radio service using amateur **frequencies** for emergency management or civil defense communications
- A radio service using amateur **stations** for emergency management or civil defense communications
- An emergency service using amateur **operators** certified by a civil defense organization as being enrolled in that organization



5

Emergency!

T2C04 Both RACES (Radio Amateur Civil Emergency Service) and ARES (Amateur Radio Emergency Service) have a common goal to provide communications during emergencies.



RACES



ARES



6

Emergency!

T2C08 Passing messages exactly as received is usually considered to be a **characteristic of good emergency traffic handling**

T2C03 To insure that voice message traffic containing proper names and unusual words **are copied correctly** by the receiving station, such words and terms should be spelled out using a **standard phonetic alphabet**.

7

Emergency!

T2C05 During net operations, the term "**traffic**" refers to **formal messages** exchanged by the net stations.

T2C10 In a formal traffic message the information needed to track the message as it passes through the amateur radio traffic handling system is called the **preamble**. The preamble is the top most portion of the Radiogram form.

8

Emergency!

T2C11 The term "**check**" in reference to a formal traffic message is a **count of the number of words** or word equivalents in the text portion of the message. **Check**

Preamble

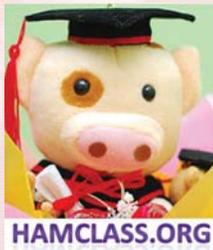
When you're working emergency traffic, it's important to make sure every word and number is passed along just as you received it. A "check" helps assure accuracy.

9

Take Aways

Section Fourteen Take Aways

Words that are **bold** and **red** appear in the correct answer.



- A common practice during net operations to get the immediate attention of the net control station when reporting an emergency is to **begin your transmission with "Priority" or "Emergency" followed by your call sign.**
- To minimize disruptions to an emergency traffic net, once you have checked in, **remain on frequency without transmitting until asked to do so by the net control station.**

11

Take Aways

- When normal communications systems are not available, an amateur station may use any means of radio communications at its disposal for essential communications, **but only if necessary in situations involving the immediate safety of human life or protection of property**
- **FCC rules always apply** to proper operation of your station when using amateur radio at the request of public service officials

12

Take Aways

- The Amateur Radio Emergency Service (ARES) are **licensed amateurs who have voluntarily registered their qualifications and equipment for communications duty in the public service.**
- **RACES and ARES** have in common; that **both organizations may provide communications during emergencies.**

13

Take Aways

- **All of the following** describe the Radio Amateur Civil Emergency Service (RACES) :
 - A radio service using amateur **frequencies** for emergency management or civil defense communications
 - A radio service using amateur **stations** for emergency management or civil defense communications
 - An emergency service using amateur **operators** certified by a civil defense organization as being enrolled in that organization

14

Take Aways

- The term “traffic” refers to the **formal messages exchanged by net stations** in net operation.
- The preamble in a formal traffic message is the **information needed to track the message as it passes through the amateur radio traffic handling system.**
- The term, “check” is a count of the **number of words or word equivalents in the text portion** of the formal traffic message.

15

Take Aways

- To insure that voice message traffic containing proper names and unusual words **are copied correctly** by the receiving station, such words and terms should be spelled out using a **standard phonetic alphabet**
- Passing messages exactly as received is usually considered to be a **characteristic of good emergency traffic handling.**

16

Element 2 Technician Class Question Pool

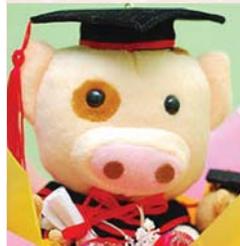
Emergency

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Which of the following is an accepted practice to get the immediate attention of the net control station when reporting an emergency?

- A. Repeat the SOS three times followed by the call sign of the reporting station
- B. Press the push-to-talk button three times
- C. Begin your transmission with “Priority” or “Emergency” followed by your call sign
- D. Play a pre-recorded emergency alert tone followed by your call sign

T2C06

18

Which of the following is an accepted practice for an amateur operator who has checked into a net?

- A. Provided that the frequency is quiet, announce the station call sign and location every 5 minutes
- B. Move 5 kHz away from the net's frequency and use high power to ask other hams to keep clear of the net frequency
- C. Remain on frequency without transmitting until asked to do so by the net control station
- D. All of the choices are correct

T2C07

19

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

- A. When operating a RACES station
- B. When operating under special FEMA rules
- C. When operating under special ARES rules
- D. Never, FCC rules always apply

T2C01

20

Which of the following describes the Radio Amateur Civil Emergency Service (RACES)?

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

T1A10

21

What is the Amateur Radio Emergency Service (ARES)?

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

T2C12

22

What do RACES and ARES have in common?

- A. They represent the two largest ham clubs in the United States
- B. Both organizations broadcast road and weather information
- C. Neither may handle emergency traffic supporting public service agencies
- D. Both organizations may provide communications during emergencies

T2C04

23

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

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

T2C09

24

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

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

T2C10

25

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

- A. Passing messages exactly as received
- B. Making decisions as whether or not messages should be relayed or delivered
- C. Communicating messages to the news media for broadcast outside the disaster area
- D. All of these choices are correct

T2C08

26

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

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

T2C05

27

What should be done when using voice modes to ensure that voice messages containing unusual words are received correctly?

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

T2C03

28

What is meant by the term "check" in reference to a formal traffic message?

- A. The number of words or word equivalents in the text portion of the message
- B. The value of a money order attached to the message
- C. A list of stations that have relayed the message
- D. A box on the message form that indicates the message was received and/or relayed

T2C11

29

Technician Licensing Class

Weak Signal Propagation

Section Fifteen

Valid July 1, 2018

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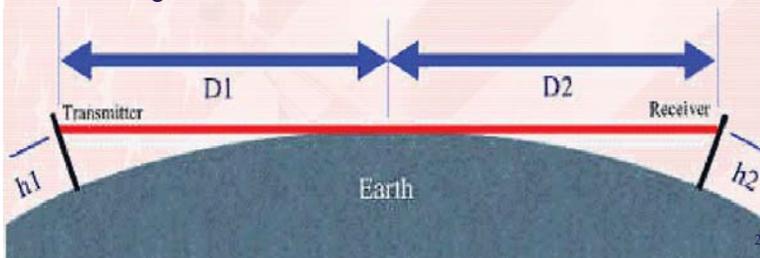


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Weak Signal Propagation

Line-of-sight propagation is defined as electro-magnetic (RF) waves travelling in a straight line.

T3C11 Signals travel **somewhat farther** than the visual line of sight because the **Earth seems less curved** to radio waves than to light

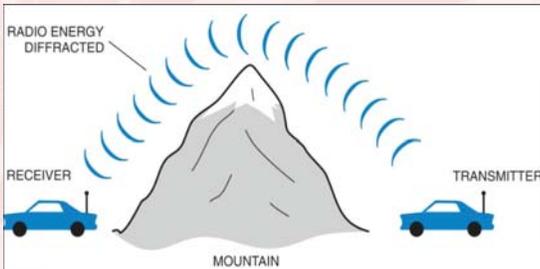


2

Weak Signal Propagation

T3C05 The effects of **knife-edge diffraction** causes radio signals to be heard **despite obstructions** between the transmitting and receiving stations.

Knife-Edge Diffraction

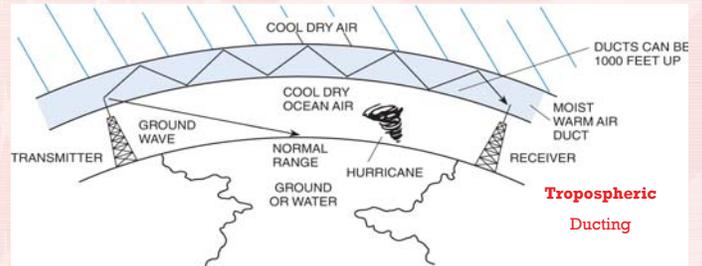


3

Weak Signal Propagation

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

T3C08 **Temperature inversions** in the atmosphere causes "tropospheric ducting".



4

Weak Signal Propagation

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



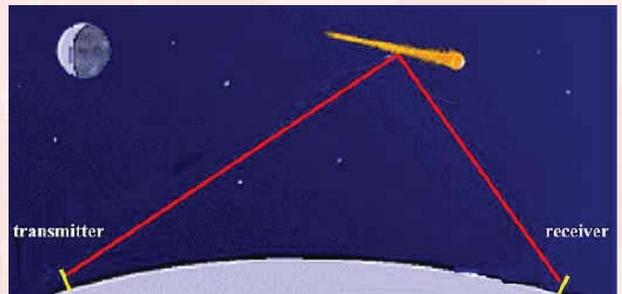
Incoming signals from a distant station heard hundreds of miles away will sound fluttery and distorted by auroral bounce

5

Weak Signal Propagation

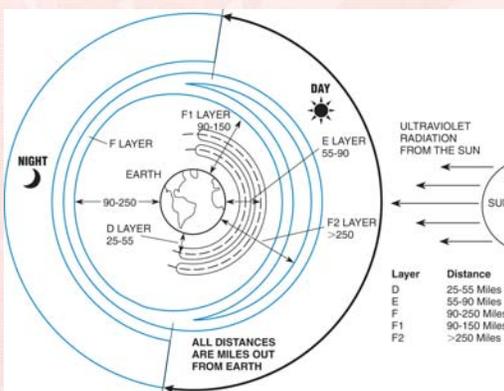
T3C07 The **6 meter band** is best suited to communicating via meteor scatter.

- Leonids and Geminids meteor showers provide these conditions
- Bounce signals off meteor trail



6

Weak Signal Propagation



Ionosphere Layers

Basically five layers:
D, E, F, F1, and F2.

Differences in Day-time and Night-time:

D and E disappear at night.

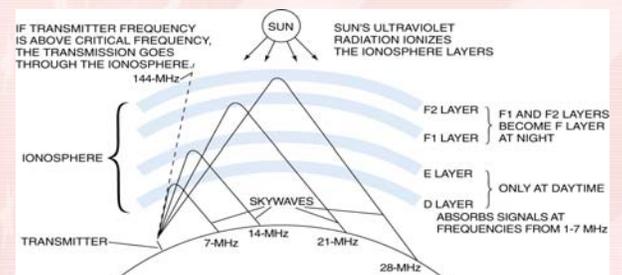
F1 and F2 combine at night to become just F.

7

Weak Signal Propagation

T3A11 The **ionosphere** is the part of the atmosphere that enables the propagation of radio signals around the world.

T3C09 During **daylight hours** (dawn to shortly after sunset) is generally the best time for long-distance 10 meter band **F-layer** propagation.



8

Weak Signal Propagation

T3C01 UHF signals "direct" (not via a repeater) are rarely heard from stations outside your local coverage area because **UHF signals** are usually **not reflected** by the ionosphere.

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

T3A08 The cause of irregular fading of signals from distant stations during times of generally good reception is due to random combining of signals arriving via **different path lengths**.

9

Weak Signal Propagation

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

T3A09 A common effect of "**skip**" reflections between the Earth and the ionosphere is the original signal becomes randomized or **elliptically polarized**. Either vertically or horizontally polarized antennas may be used for transmission or reception.

- Skip happens when signals refract and reflect off the ionosphere.
- DX stations 1000 miles away come booming in.
- Every 30 seconds signal goes from strong to weak and back.
- Caused by random, ever changing polarization of the original signal.

10

Weak Signal Propagation

T3C10 The **Six or Ten** meter bands may provide long distance communications during the peak of the **sunspot cycle**.

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

11

Weak Signal Propagation

T3A02 **Vegetation** (trees and leaves) have an **impact** on **UHF/VHF** signal range due to signal absorption and reflection. In the **winter**, this absorption is reduced which **increase the range** of those signals.

T3A12 Unlike VHF and UHF, **HF bands** (10 and 6 meters) are **rarely impacted by local weather** conditions such as fog and light rain.

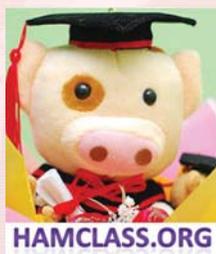
T3A13 **Microwave** frequencies are **impacted by precipitation** which decreases the signal range.

12

Take Aways

Section Fifteen Take Aways

Words that are **bold** and **red** appear in the correct answer.



Take Aways

- VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations because **the Earth seems less curved to radio waves than to light**.
- The term "**knife-edge diffraction**" refers to signals that are partially refracted around solid objects exhibiting sharp edges. This allows radio signals to be heard **despite obstructions** between the transmitting and receiving stations,

14

Take Aways

- **Tropospheric scatter mode** is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately **300 miles** on a regular basis.
- Tropospheric ducting is caused by **temperature inversions in the atmosphere**.

15

Take Aways

- The **6 meter** band is best suited to communicating via **meteor scatter**.
- The part of the atmosphere called the **ionosphere** enables the propagation of radio signals around the world.
- An advantage of **HF** vs VHF and higher frequencies is that **long distance ionospheric propagation is far more common on HF**.
- Generally, the best time for long-distance 10 meter band propagation is **from dawn to shortly after sunset during periods of high sunspot activity**.

16

Take Aways

- A common effect of "skip" reflections between the Earth and the ionosphere is the original signal is elliptically polarized and **either vertically or horizontally polarized antennas may be used for transmission or reception**.
- The **Sporadic E propagation** type is most commonly associated with occasional strong over-the-horizon signals on the **10, 6, and 2 meter** bands.
- Direct UHF signals (not via a repeater) are rarely heard from stations outside your local coverage area because **UHF signals are usually not reflected by the ionosphere**.

17

Take Aways

- **Random combining of signals arriving via different path lengths** is the cause of **irregular fading** of signals from distant stations during times of generally good reception.
- The **Six or Ten meter bands** may provide long distance communications during the peak of the **sunspot cycle**.
- The **orientation** of the **electric field** is the property of a radio wave is used to describe its polarization.
- **Signals exhibiting rapid fluctuations of strength and often sounding distorted** is a characteristic of VHF signals received via auroral reflection.

18

Take Aways

- The range of VHF and UHF signals is greater in the **winter** because of **less absorption by vegetation**.
- Unlike VHF and UHF, **HF bands** (10 and 6 meters) are **rarely impacted by local weather conditions such as fog and light rain**.
- **Precipitation** decreases the signal range of **microwave** frequencies.

19

Element 2 Technician Class Question Pool

Weak Signal Propagation



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Section Fifteen

Valid July 1, 2018

Through

June 30, 2022

Why do VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations?

- A. Radio signals move somewhat faster than the speed of light
- B. Radio waves are not blocked by dust particles
- C. The Earth seems less curved to radio waves than to light
- D. Radio waves are blocked by dust particles

T3C11

21

Which of the following might cause radio signals to be heard despite obstructions between the transmitting and receiving stations?

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

T3C05

22

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

- A. Tropospheric scatter
- B. D-layer refraction
- C. F2-layer refraction
- D. Faraday rotation

T3C06

23

What causes tropospheric ducting?

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

T3C08

24

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

- A. Signals from distances of 10,000 or more miles are common
- B. The signals exhibit rapid fluctuations of strength and often sound distorted
- C. These types of signals occur only during winter nighttime hours
- D. These types of signals are generally strongest when your antenna is aimed west

T3C03

25

What band is best suited to communicating via meteor scatter?

- A. 10 meters
- B. 6 meters
- C. 2 meters
- D. 70 centimeters

T3C07

26

Which part of the atmosphere enables the propagation of radio signals around the world?

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

T3A11

27

Which of the following is an advantage of HF vs VHF and higher frequencies?

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

T3C02

28

Why are direct (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?

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

T3C01

29

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

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

T3C09

30

Which of the following results from the fact that skip signals refracted from the ionosphere are elliptically polarized?

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

T3A09

31

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

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

T3C04

32

Which of the following bands may provide long distance communications during the peak of the sunspot cycle ?

- A. 6 or 10 meter bands
- B. 23 centimeters band
- C. 70 centimeters or 1.25 meter bands
- D. All of these choices are correct

T3C10

33

What property of a radio wave is used to describe its polarization?

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

T3B02

34

Which of the following is a likely cause of irregular fading of signals received by ionospheric reflection?

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

T3A08

35

Why might the range of VHF and UHF signals be greater in the winter?

- A. Less ionospheric absorption
- B. Less absorption by vegetation
- C. Less solar activity
- D. Less tropospheric absorption

T3A02

36

How might fog and light rain affect radio range on 10 meters and 6 meters?

- A. Fog and rain absorb these wavelength bands
- B. Fog and light rain will have little effect on these bands
- C. Fog and rain will deflect these signals
- D. Fog and rain will increase radio range

T3A12

37

What weather condition would decrease range at microwave frequencies?

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

T3A13

38

Talk to Outer Space

T8B11 **Anyone** who can receive a telemetry signal **MAY** receive telemetry from a space station. There are no rules about what you can receive, only rules about who can transmit a signal.

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

Frequency Bands	Frequency Range	Modes
High Frequency	21 - 30 MHz	Mode H
VHF	144 - 146 MHz	Mode V
UHF	435 - 438 MHz	Mode U

7

Talk to Outer Space

T8B12 A good way to judge whether your **uplink power is correct** (neither too low or too high) is **your signal strength** on the downlink should be **about the same** as the **beacon**.

T8B02 If you use too much **effective radiated power** on a satellite uplink, the **impact** would be **blocking access by other users** because a signal that is unnecessarily strong could overwhelm a weaker signal.

8

Talk to Outer Space

T8B09 **Rotation** of the satellite and its antennas causes "**spin fading**" when referring to satellite signals.

- Rotation in space makes the signals fade in and out.
- This rotation keeps solar panels from overheating.

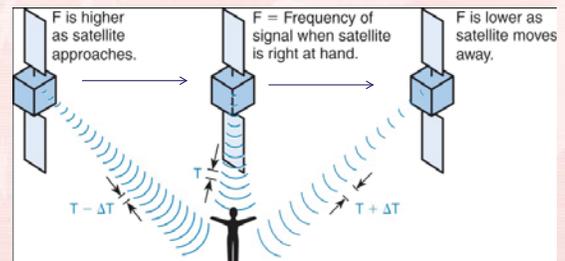
Tracking and communicating through amateur satellites can be done with a cross-polarized satellite antenna



9

Talk to Outer Space

T8B07 With regards to satellite communications **Doppler shift** is a **change in signal frequency** caused by relative motion between the satellite and the earth station.



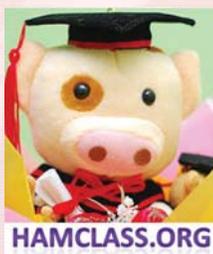
Doppler Effect

10

Take Aways

Section Sixteen Take Aways

Words that are **bold** and **red** appear in the correct answer.



Take Aways

- The FCC Part 97 definition of a Space Station is **an amateur station located more than 50 km above the Earth's surface**.
- **Any amateur holding a Technician or higher class license** may make contact with an amateur station on the International Space Station using 2 meter and 70 cm band amateur radio frequencies.
- **Anyone who can receive a telemetry signal may receive** telemetry from a space station. (no license needed to listen).

12

Take Aways

- The **Keplerian elements** are inputs to a satellite tracking program to help determine the orbits of satellites.
- A satellite tracking program provides **all of the following**:
 - **Maps** showing the real-time position of the satellite track over the earth
 - The **time, azimuth, and elevation** of the start, maximum altitude, and end of a pass
 - The **apparent frequency** of the satellite transmission, including effects of Doppler shift

13

Take Aways

- The initials **LEO** tell you an **amateur satellite is in a Low Earth Orbit**
- A satellite beacon is **a transmission from a space station that contains information about a satellite**.
- The type of telemetry information typically transmitted by satellite beacons is the **"health and status"** of the satellite. This can include data about the voltage of the batteries, interior temperature, current mode configuration
- **All of these** are modes of transmission used for amateur radio satellites: **SSB, FM** and **CW/data**.

14

Take Aways

- When referring to satellite signals, **rotation of the satellite and its antennas causes "spin fading"**.
- With regard to satellite communications, **Doppler shift is an observed change in signal frequency caused by relative motion between the satellite and the earth station**.

15

Take Aways

- The statement that a satellite is operating in "**mode U/V**" means the **satellite uplink is in the 70 cm band and the downlink is in the 2 meter band**.
- A good way to judge whether your **uplink power** is correct (neither too low or too high) is **your signal strength on the downlink should be about the same as the beacon**.
- If you use too much effective radiated power on a satellite uplink, the **impact** would be **blocking access by other users** because a signal that is unnecessarily strong could overwhelm a weaker signal.

16

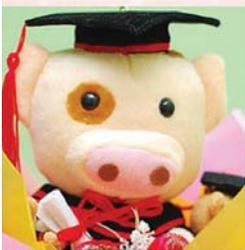
Element 2 Technician Class Question Pool

Talk to Outer Space

Section Sixteen

Valid July 1, 2018

Through
June 30, 2022



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17

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

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

T1A07

18

Which amateur radio stations may make contact with an amateur station on the International Space Station (ISS) using 2 meter and 70 cm band frequencies?

- A. Only members of amateur radio clubs at NASA facilities
- B. Any amateur holding a Technician or higher-class license
- C. Only the astronaut's family members who are hams
- D. Contacts with the ISS are not permitted on amateur radio frequencies

T1B02

19

What do the initials LEO tell you about an amateur satellite?

- A. The satellite battery is in Low Energy Operation mode
- B. The satellite is performing a Lunar Ejection Orbit maneuver
- C. The satellite is in a Low Earth Orbit
- D. The satellite uses Light Emitting Optics

T8B10

20

Which of the following are provided by satellite tracking programs?

- A. Maps showing the real-time position of the satellite track over the earth
- B. The time, azimuth, and elevation of the start, maximum altitude, and end of a pass
- C. The apparent frequency of the satellite transmission, including effects of Doppler shift
- D. All of these choices are correct

T8B03

21

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

- A. The weight of the satellite
- B. The Keplerian elements
- C. The last observed time of zero Doppler Shift
- D. All of these choices are correct

T8B06

22

What is a satellite beacon?

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

T8B05

23

What telemetry information is typically transmitted by satellite beacons?

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

T8B01

24

What mode of transmission is used for satellite beacons?

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

T8B04

25

Who may receive telemetry from a space station?

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

T8B11

26

What causes spin fading of satellite signals?

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

T8B09

27

With regard to satellite communications, what is Doppler shift?

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

T8B07

28

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

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

T8B08

29

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

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

T8B02

30

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

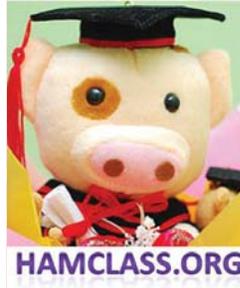
- A. Check your signal strength report in the telemetry data
- B. Listen for distortion on your downlink signal
- C. Your signal strength on the downlink should be about the same as the beacon
- D. All of these choices are correct

T8B12

31

Technician Licensing Class

Your Computer Goes Ham Digital



Section Seventeen

Valid July 1, 2018

Through

June 30, 2022

Your Computer Goes Ham Digital!

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

T8D14 An electronic keyer is a device that assists in manual sending of Morse code. These keyers can help send signals that are easier to read due to consistent dots and dash tone and length



2

Your Computer Goes Ham Digital!

T8D01 The following are examples of digital communications methods:

- Packet radio
- IEEE 802.11 (you use this for WIFI)
- JT65

T8D06 The abbreviation PSK mean **Phase Shift Keying** (This is a digital modulation process)

3

Your Computer Goes Ham Digital!

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

T4A07 The **sound card** provides **audio** to the microphone input and converts received audio to digital form when conducting digital communications using a computer.

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

Laptop, TNC, and handheld comprise a packet station.



4

Your Computer Goes Ham Digital!

T8D08 **Packet transmissions** may include:

- A check sum which permits error detection;
- A header which contains the call sign of the station to which the information is being sent;
- Automatic repeat request in case of error.

T8D11 The **ARQ (Automatic Repeat ReQuest) Transmission System** is a digital scheme whereby the receiving station detects errors and sends a request to the sending station to retransmit the information.

T3A10 **Error** rates are likely to increase if data signals are propagated **over multiple paths**.

5

Your Computer Goes Ham Digital!

T8D02 **APRS** means **A**utomatic **P**acket **R**eporting **S**ystem.



Kenwood dual bander plugged into the Avmap G5 GPS position display.

6

Your Computer Goes Ham Digital!

T8D05 **APRS** (Automatic Packet Reporting System) provides real time tactical **digital communications** in conjunction with a **map** showing the location of systems.



T8D03 A **Global Positioning System** receiver is normally used when sending automatic location reports via amateur radio.

7

Your Computer Goes Ham Digital!

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

T8C08 **IRLP – Internet Radio Linking Project** – is a technique to connect amateur radio system, such as repeaters, via the internet using **Voice Over Internet Protocol (VOIP)**.

T8C06 **IRLP nodes** are basically “phone numbers” which access the node in question. **DTMF** (dual tone multi frequency) **signals** sent from the keypad of your handheld or mobile microphone are the most practical way of **accessing these nodes**.

8

Your Computer Goes Ham Digital!

T2B06 **DTMF** tones are used to **control repeaters** linked by the Internet Relay Linking Project (IRLP) protocol

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

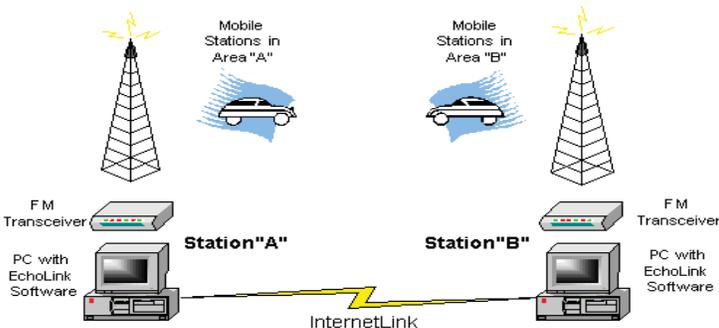
T8C09 You might **obtain a list** of active nodes that use **VoIP**

- By subscribing to an on line service
- From on line repeater lists maintained by the local repeater frequency coordinator
- From a repeater directory

9

Your Computer Goes Ham Digital!

EchoLink Linking Example

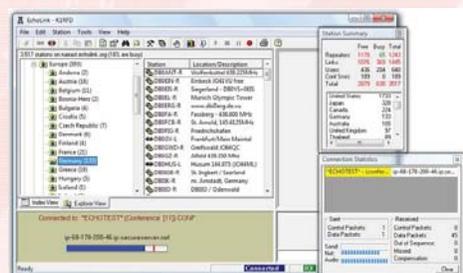


10

Your Computer Goes Ham Digital!

T8C10 Before you may use the **Echolink** system to communicate using a repeater, you **must register** your call sign and provide proof of license.

You register and validate at <http://www.echolink.org/>
You can use EchoLink on your computer without a radio



11

Your Computer Goes Ham Digital!

Three Current Digital Modes

DMR Digital Mobile Radio - Handheld-Repeater-Internet

FT8 15 seconds transmit / 15 seconds receive

Broadband-Hamnet Mesh Wi-Fi on modified routers

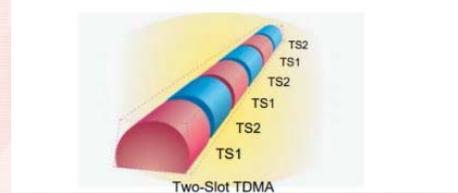
WSJT-X Software that supports multiple digital protocols

12

Your Computer Goes Ham Digital!

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

DMR uses time slots to share bandwidth



13

Your Computer Goes Ham Digital!

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

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



Check with your local repeater operator to find out what Talk Groups/Time Slots are available on a repeater.

14

Your Computer Goes Ham Digital!

T8D10 The **WSJT** suite is software supporting **digital modes** including these operating activities:

- **Moonbounce** or Earth-Moon-Earth
- **Weak-signal** propagation beacons
- **Meteor scatter**

WSJT is software for **Weak Signals** developed by **K1JT**.

Other modes are **FT8**, **JT4**, **JT9**, **JT65**, **QRA64**, **ISCAT**, **MSK144**, and **WSPR**



15

Your Computer Goes Ham Digital!

T8D13 **FT-8** is a digital mode capable of operating in low signal-to-noise conditions that transmits on 15 second intervals. (15 sec transmit / 15 sec receive)



FT-8 is **popular in contests** where the minimum information is exchanged
FT-8 lets you use your computer and radio to text other hams.

16

Your Computer Goes Ham Digital!

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

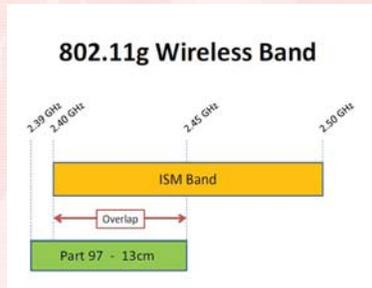


18

Your Computer Goes Ham Digital!

Broadband Hamnet works because of the **overlap** between the **802.11g** Wi-Fi frequencies and the **13 cm** ham radio band (2.40 GHz)

The Mesh Network consists of **Linksys WRT-54G** routers with modified software connected together using amateur radio antennas and bands.



19

Your Computer Goes Ham Digital!

T8D04 The type of transmission indicated by the term **NTSC** is an **analog fast scan color TV** signal.



NTSC stands for **National Television System Committee**.

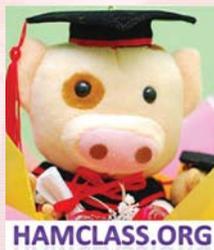
T8A10 Analog fast-scan television (ATV) has a very wide bandwidth – **about 6 MHz** – and can be found on 70-centimeter frequencies

20

Take Aways

Section Seventeen Take Aways

Words that are **bold** and **red** appear in the correct answer.



Take Aways

- **International Morse** code is used when sending CW (continuous wave) in the amateur bands.
- **A device that assists in the manual sending of Morse code** is an electronic keyer.
- The abbreviation PSK mean **Phase Shift Keying**
- **ALL of the following** are examples of digital communication methods:
 - Packet radio
 - IEEE 802.11
 - JT65

22

Take Aways

- **Receive audio, transmit audio, and push-to-talk (PTT)** connections might be used between a **voice transceiver** and a **computer** for digital operation.
- When conducting digital communications, **the computer's sound card provides audio to the microphone input and converts received audio to digital form.**
- The **microphone or line input** computer sound card port is connected to a transceiver's headphone or speaker output for operating digital modes

23

Take Aways

- **ALL of the following** may be included in packet transmissions:
 - A **check sum** which permits error detection
 - A **header** which contains the call sign of the station to which the information is being sent
 - **Automatic repeat** request in case of error
- An ARQ transmission system is a **digital scheme that allows the receiving station to automatically detect errors and send a request for retransmission of the information.** (Automatic Repeat ReQuest)
- **Error rates are likely to increase** if data signals are propagated over multiple paths.

24

Take Aways

- The term APRS means **Automatic Packet Reporting System**.
- APRS application include **providing real time tactical digital communications in conjunction with a map showing locations of stations**.
- A **Global Positioning System receiver** is normally used when sending automatic location reports via amateur radio.

25

Take Aways

- A **gateway** is an amateur radio station that is used to connect other amateur stations to the Internet.
- **Internet Radio Linking Project (IRLP)** a technique to connect amateur radio systems, such as repeaters, via the internet using **Voice Over Internet Protocol (VOIP)**.
- Access to some IRLP nodes is accomplished **by using DTMF signals**.
- **DTMF** tones are used to control repeaters linked by the **Internet Relay Linking Project (IRLP)** protocol

26

Take Aways

- Voice Over Internet Protocol (VOIP) is **a method of delivering voice communications over the internet using digital techniques**.
- **All of these** are ways to obtain a list of active nodes that use VoIP
 - By subscribing to an **on line service**
 - From **on line repeater lists** maintained by the local repeater frequency coordinator
 - From a **repeater directory**
- **You must register your call sign and provide proof of license** before you may use the Echolink system to communicate using a repeater.

27

Take Aways

- DMR (**Digital Mobile Radio or Digital Migration Radio**) can be described as **a technique for time-multiplexing two digital voice signals on a single 12.5 kHz repeater channel**.
- A “talk group” on a DMR digital repeater is **a way for groups of users to share a channel at different times without being heard by other users on the channel**.
- You can join a digital repeater’s “**talk group**” by **programming your radio with the group’s ID or code**

28

Take Aways

All of these are operating activities supported by WSJT digital mode software (Weak Signal Communication Software)

- **Moonbounce** or Earth-Moon-Earth
- **Weak-signal** propagation beacons
- **Meteor scatter**
- FT-8 is **a digital mode capable of operating in low signal-to-noise conditions that transmits on 15 second intervals**.
- Broadband Hamnet™ (also referred to as a high-speed multi-media network) is an **amateur-radio-based data network using commercial Wi-Fi gear with modified firmware**

29

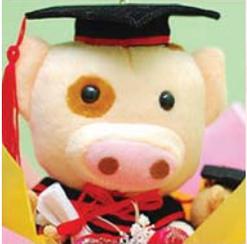
Take Aways

- The type of transmission indicated by the term NTSC is an **analog fast scan color TV signal**
- Analog fast-scan television (ATV) has a very wide bandwidth – **about 6 MHz** – and can be found on 70-centimeter frequencies

30

Element 2 Technician Class Question Pool

Your Computer Goes Ham Digital



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Section Seventeen

Valid July 1, 2018

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31

What code is used when sending CW in the amateur bands?

- A. Baudot
- B. Hamming
- C. International Morse
- D. All of these choices are correct

T8D09

32

What is an electronic keyer?

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

T8D14

33

Which of the following is a digital communications mode?

- A. Packet radio
- B. IEEE 802.11
- C. JT65
- D. All of these choices are correct

T8D01

34

How is the computer's sound card used when conducting digital communications?

- A. The sound card communicates between the computer CPU and the video display
- B. The sound card records the audio frequency for video display
- C. The sound card provides audio to the radio's microphone input and converts received audio to digital form
- D. All of these choices are correct

T4A07

35

Which computer sound card port is connected to a transceiver's headphone or speaker output for operating digital modes?

- A. Headphone output
- B. Mute
- C. Microphone or line input
- D. PCI or SDI

T4A04

36

Which of the following connections might be used between a voice transceiver and a computer for digital operation?

- A. Receive and transmit mode, status, and location
- B. Antenna and RF power
- C. Receive audio, transmit audio, and push-to-talk (PTT)
- D. NMEA GPS location and DC power

T4A06

37

Which of the following may be included in packet transmissions?

- A. A check sum that permits error detection
- B. A header that contains the call sign of the station to which the information is being sent
- C. Automatic repeat request in case of error
- D. All of these choices are correct

T8D08

38

What is an ARQ transmission system?

- A. A special transmission format limited to video signals
- B. A system used to encrypt command signals to an amateur radio satellite
- C. A digital scheme whereby the receiving station detects errors and sends a request to the sending station to retransmit the information
- D. A method of compressing the data in a message so more information can be sent in a shorter time

T8D11

39

What may occur if data signals arrive via multiple paths?

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

T3A10

40

Which of the following is an application of APRS (Automatic Packet Reporting System)?

- A. Providing real-time tactical digital communications in conjunction with a map showing the locations of stations
- B. Showing automatically the number of packets transmitted via PACTOR during a specific time interval
- C. Providing voice over internet connection between repeaters
- D. Providing information on the number of stations signed into a repeater

T8D05

41

What does the term "APRS" mean?

- A. Automatic Packet Reporting System
- B. Associated Public Radio Station
- C. Auto Planning Radio Set-up
- D. Advanced Polar Radio System

T8D02

42

Which of the following is used to provide data to the transmitter when sending automatic position reports from a mobile amateur radio station?

- A. The vehicle speedometer
- B. A WWV receiver
- C. A connection to a broadcast FM sub-carrier receiver
- D. A Global Positioning System receiver

T8D03

43

What does the abbreviation PSK mean?

- A. Pulse Shift Keying
- B. Phase Shift Keying
- C. Packet Short Keying
- D. Phased Slide Keying

T8D06

44

What name is given to an amateur radio station that is used to connect other amateur stations to the Internet?

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

T8C11

45

What is the Internet Radio Linking Project (IRLP)?

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

T8C08

46

How is access to some IRLP nodes accomplished?

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

T8C06

47

What type of tones are used to control repeaters linked by the Internet Relay Linking Project (IRLP) protocol?

- A. DTMF
- B. CTCSS
- C. Echolink
- D. Sub-audible

T2B06

48

What must be done before you may use the Echolink system to communicate using a repeater?

- A. You must complete the required Echolink training
- B. You must have purchased a license to use the Echolink software
- C. You must be sponsored by a current Echolink user
- D. You must register your call sign and provide proof of license

T8C10

49

What is meant by Voice Over Internet Protocol (VoIP) as used in amateur radio?

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

T8C07

50

How might you obtain a list of active nodes that use VoIP?

- A. By subscribing to an on line service
- B. From on line repeater lists maintained by the local repeater frequency coordinator
- C. From a repeater directory
- D. All of these choices are correct

T8C09

51

Which of the following best describes DMR (Digital Mobile Radio or Digital Migration Radio)?

- A. A technique for time-multiplexing two digital voice signals on a single 12.5 kHz repeater channel
- B. An automatic position tracking mode for FM mobiles communicating through repeaters
- C. An automatic computer logging technique for hands-off logging when communicating while operating a vehicle
- D. A digital technique for transmitting on two repeater inputs simultaneously for automatic error correction

T8D07

52

How can you join a digital repeater's "talk group"?

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

T2B07

53

What is a "talk group" on a DMR digital repeater?

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

T2B09

54

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

- A. Moonbounce or Earth-Moon-Earth
- B. Weak-signal propagation beacons
- C. Meteor scatter
- D. All of these choices are correct

T8D10

55

Which of the following best describes Broadband-Hamnet(TM), also referred to as a high-speed multi-media network?

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

T8D12

56

What is FT8?

- A. A wideband FM voice mode
- B. A digital mode capable of operating in low signal-to-noise conditions that transmits on 15-second intervals
- C. An eight channel multiplex mode for FM repeaters
- D. A digital slow scan TV mode with forward error correction and automatic color compensation

T8D13

57

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

- A. A Normal Transmission mode in Static Circuit
- B. A special mode for earth satellite uplink
- C. An analog fast scan color TV signal
- D. A frame compression scheme for TV signals

T8D04

58

What is the typical bandwidth of analog fast-scan TV transmissions on the 70 centimeter band ?

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

T8A10

59

Technician Licensing Class

Antennas

Section Eighteen

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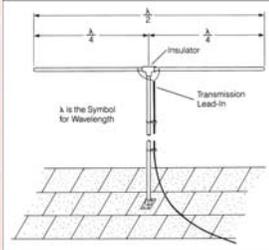


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Antennas

T9A03 A simple dipole mounted so the conductor is **parallel** to the Earth's surface is a **horizontally** polarized antenna.

- Polarization is relative to the Earth's surface
- Horizontal or Vertical



Simple Dipole



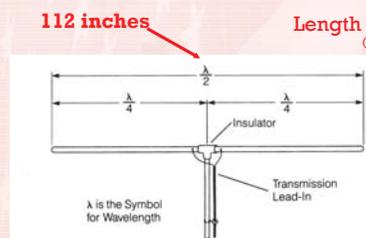
Three element beam

2

Antennas

T9A10 The **strongest radiation** from a half-wave dipole antenna in free space is **broadside** to the antenna.

T9A09 The approximate length of a **6 meter 1/2-wavelength** wire dipole antenna is **112 inches**.



Six Meter 1/2 Wavelength Dipole

$$\text{Length of vertical in feet} = \frac{468}{f \text{ (MHz)}}$$

(for half-wave dipole)

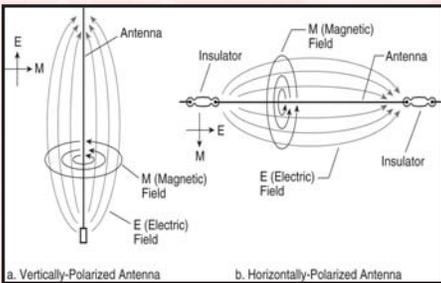
$$\text{Feet} = 468/50 = 9.36$$

$$9.36 \times 12 = 112.3 \text{ inches}$$

3

Antennas

T9A05 You would change a dipole antenna to make it resonant on a **higher** frequency by making it **shorter**.



Vertical and Horizontal Polarization

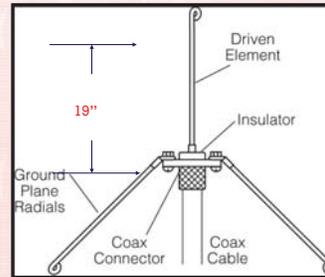


H & V Polarized Antennas

4

Antennas

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



Radiation Pattern of an Antenna Changes as Height Above Ground is Varied

$$\text{Length of vertical in feet} = \frac{234}{f \text{ (MHz)}}$$

(for quarter-wave dipole)
(2-meters is 144-148 MHz)

$$\text{Feet} = 234/146 = 1.6$$

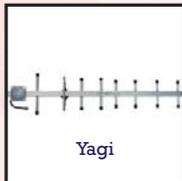
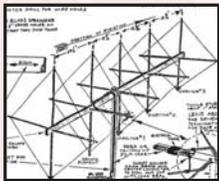
$$1.6 \times 12 = 19 \text{ inches}$$

5

Antennas

T9A06 Directional antennas are the **quad, Yagi, and dish**.

quad

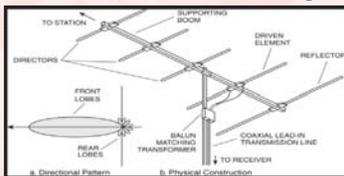


Yagi



dish

T9A01 A **beam** antenna **concentrates** signals in **one direction**



A Beam Antenna - The Yagi Antenna

6

Antennas

T8C01 **Radio direction finding** methods are used to locate sources of noise interference or jamming.



7

Antennas

T8C02 A **directional antenna** would be useful for a **hidden transmitter hunt**.



Hidden Transmitter Hunts are called Fox Hunting

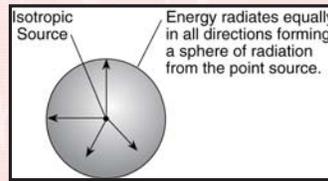


All ages participate in a Fox Hunt

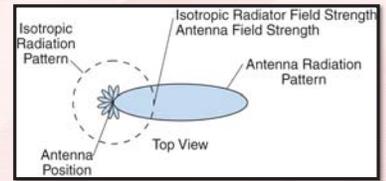
8

Antennas

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



Isotropic Radiator Pattern



"Gain" of an antenna

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

9

Antennas

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

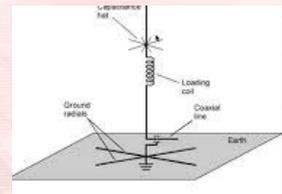


10

Antennas

T9A12 A properly mounted **5/8 wavelength antenna** offers a lower angle of radiation and more gain than a $\frac{1}{4}$ wavelength antenna and **usually provides improved coverage** for VHF and UHF mobile service.

T9A02 A type of **loading** to make an antenna **electrically longer** is done by inserting an **inductor** in the radiating portion of the antenna.

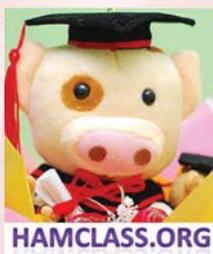


11

Take Aways

Section Eighteen Take Aways

Words that are **bold** and **red** appear in the correct answer.



12

Take Aways

- A simple dipole mounted so the conductor is **parallel** to the Earth's surface is a **horizontally polarized antenna**.
- The radiation is **strongest** from a half-wave dipole antenna, in free space, **broadside to the antenna**.
- The approximate **length** of a 6 meter **1/2-wavelength** wire dipole antenna is **112 inches**.
- The approximate length of a **quarter-wavelength** vertical antenna for 146 MHz is **19 inches**.
- A **directional antenna** would be useful for a hidden transmitter hunt.

13

Take Aways

- You would **shorten** a dipole antenna to make it resonant on a **higher frequency**.
- The quad, Yagi, and dish are all types of **directional antennas**.
- A beam antenna is **an antenna that concentrates signals in one direction**.
- **Radio direction finding** is a method used to locate sources of noise interference or jamming.

14

Take Aways

- The **gain** of an antenna is the **increase in signal strength in a specified direction when compared to a reference antenna**.
- **Horizontal** antenna polarization is normally used for **long-distance** weak-signal CW and SSB contacts using the VHF and UHF bands.
- **Signals could be significantly weaker** if the antennas at opposite ends of a VHF or UHF line of sight radio link are **not using the same polarization**.

15

Take Aways

- A properly mounted **5/8 wavelength antenna has a lower radiation angle and more gain than a 1/4 wavelength antenna and usually provides improved coverage** for VHF and UHF mobile service.
- A type of antenna loading is done by **inserting an inductor in the radiating portion of the antenna to make it electrically longer**.

16

Element 2 Technician Class Question Pool

Antennas

Section Eighteen

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

- A. A ground wave antenna
- B. A horizontally polarized antenna
- C. A rhombic antenna
- D. A vertically polarized antenna

T9A03

18

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

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

T9A10

19

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

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

T9A09

20

How would you change a dipole antenna to make it resonant on a higher frequency?

- A. Lengthen it
- B. Insert coils in series with radiating wires
- C. Shorten it
- D. Add capacity hats to the ends of the radiating wires

T9A05

21

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

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

T9A08

22

What type of antennas are the quad, Yagi, and dish?

- A. Non-resonant antennas
- B. Log periodic antennas
- C. Directional antennas
- D. Isotropic antennas

T9A06

23

What is a beam antenna?

- A. An antenna built from aluminum I-beams
- B. An omnidirectional antenna invented by Clarence Beam
- C. An antenna that concentrates signals in one direction
- D. An antenna that reverses the phase of received signals

T9A01

24

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

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

T8C01

25

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

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

T8C02

26

What is the gain of an antenna?

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

T9A11

27

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

- A. Right-hand circular
- B. Left-hand circular
- C. Horizontal
- D. Vertical

T3A03

28

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

- A. The modulation sidebands might become inverted
- B. Signals could be significantly weaker
- C. Signals have an echo effect on voices
- D. Nothing significant will happen

T3A04

29

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

- A. It has a lower radiation angle and more gain than a 1/4 wavelength antenna and usually provides improved coverage
- B. It has very high angle radiation for better communicating through a repeater
- C. It eliminates distortion caused by reflected signals
- D. It has 10 times the power gain of a 1/4 wavelength design

T9A12

30

Which of the following describes a type of antenna loading?

- A. Inserting an inductor in the radiating portion of the antenna to make it electrically longer
- B. Inserting a resistor in the radiating portion of the antenna to make it resonant
- C. Installing a spring in the base of a mobile vertical antenna to make it more flexible
- D. Strengthening the radiating elements of a beam antenna to better resist wind damage

T9A02

31

Technician Licensing Class

Feed Me with Some Good Coax!



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Section Nineteen

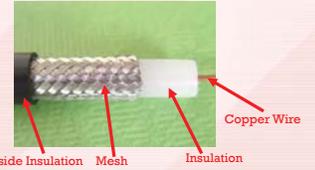
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Feed Me with Some Good Coax!

T9B03 **Coaxial cable** is used more often than any other feedline for amateur radio antenna systems because it is easy to use and requires few special installation considerations.



T9B02 **50 ohms** is the impedance of the most commonly used coaxial cable in typical amateur radio installations.

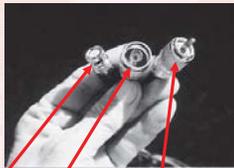
2

Feed Me with Some Good Coax!

T9B05 As the frequency of a signal passing through coaxial cable is increased the loss increases.

The Higher the frequency the more the loss

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

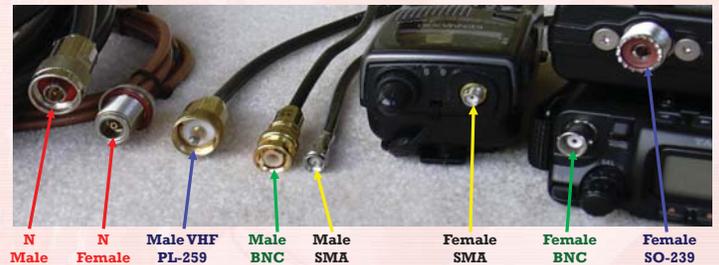


BNC, Type N, and PL 259 Connectors

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

3

Feed Me with Some Good Coax!



Understand the type of connector on your radio

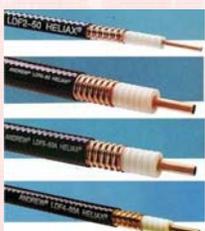
You may need an adapter from your coax connector to your radio

Never buy cheap coax, connectors, or adapters

4

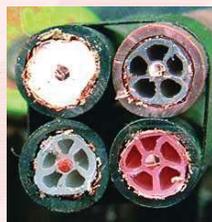
Feed Me with Some Good Coax!

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



Smaller Heliax
solid core

Foam core



Air core

T9B11 Large coax, with hollow center - a low loss conductor. **Air-insulated hard line** types of feedline have the **lowest loss** at VHF and UHF frequencies

5

Feed Me with Some Good Coax!

T7C09 The most common cause for failure of coaxial cables is **moisture contamination**.

- Regular BNC, Type N, and PL259 connectors are not water-tight.

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

T7C10 The **outer jacket** of coaxial cable should be **resistant** to ultraviolet light because **UV** light can damage the jacket and allow water to enter the cable.

T9B10 **Electrical differences** exists between the smaller RG-58 and larger RG-8 coaxial cables in that **RG-8** cable has **less loss** at a given frequency.

6

Feed Me with Some Good Coax!

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

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

T9B01 It is important to have a **low SWR** in an antenna system that uses coaxial cable feedline to provide **efficient transfer of power and reduce losses**.



Impedance Mismatch Causes Reflected Wave

MFJ-269
SWR
Analyzer



7

Feed Me with Some Good Coax!

T7C04 A "1 to 1" reading on an SWR meter indicates a **perfect impedance match** between the antenna and the feedline.

SWR Reading	Antenna Condition
1:1	Perfectly Matched
1.5:1	Good Match
2:1	Fair Match
3:1	Poor Match
4:1	Something Definitely Wrong

Coax Cable Type, Size, and Loss per 100 feet

Coax Type	Size	Loss @ 100 MHz	Loss @ 400 MHz
RG-58	Small	4.3 dB	9.4 dB
RG-8X	Medium	3.7 dB	8.0 dB
RG-8U	Large	1.9 dB	4.1 dB
RG-213	Large	1.9 dB	4.5 dB
Hardline	Large, Rigid	0.5 dB	1.5 dB



A battery operated SWR analyzer for tower antenna work

8

Feed Me with Some Good Coax!

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

T7C06 An SWR reading of **4:1** means there is an impedance **mismatch**.

T4A05 An in-line **SWR meter** is connected in series with the feed line, **between the transmitter and antenna**, to monitor the standing wave ratio of the station antenna system.

10

Feed Me with Some Good Coax!

T9B09 A **loose connection** in an antenna or a feedline might cause **erratic changes** in SWR readings.

Make sure all coax connections are tight to help minimize interference



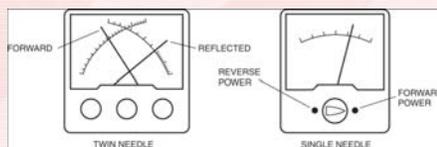
11

Feed Me with Some Good Coax!

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



Dual/Twin Needle



Single Needle

12

Feed Me with Some Good Coax!

T7C07 **Power lost** in a feedline is converted into **heat**.

T9B04 An **antenna tuner** matches the antenna system impedance to the transceiver's output impedance.



Palstar 1500 Watt Auto-Tuner



Icom 7000 with LDG 7000 Auto-Tuner



Miracle QPak 50 Watt Manual Tuner



13

Feed Me with Some Good Coax!

T7C01 The primary purpose of a **dummy load** is to prevent the radiation of signals when making tests.

- Prevents signals from being sent out over the air

T7C12 A **dummy load** consists of a non-inductive resistor and a **heat sink**.



300 Watt Dry Dummy Load



Dummy Load-Can
1kw with oil



Dry Dummy Load

14

Take Aways

Section Nineteen Take Aways

Words that are **bold** and **red** appear in the correct answer.



15

Take Aways

- The **impedance** of the most commonly used coaxial cable in typical amateur radio installations is **50 ohms**.
- Coaxial cable is used more often than any other feedline for amateur radio antenna systems because **it is easy to use and requires few special installation considerations**.
- Generally, the **loss increases** as the **frequency** of a signal passing through coaxial cable is **increased**.

16

Take Aways

- The **PL-259** type coax connectors are **commonly used at HF frequencies**.
- A **Type N connector** is most suitable for frequencies **above 400 MHz**.
- A **disadvantage** of "air core" coaxial cable when compared to foam or solid dielectric types is that **it requires special techniques to prevent water absorption**.
- The most common cause for failure of coaxial cables is **moisture contamination**.

17

Take Aways

- Coax connectors exposed to the weather should be **sealed** against water intrusion **to prevent an increase in feedline loss**.
- The outer jacket of coaxial cable should be **resistant** to ultraviolet light because **ultraviolet light can damage the jacket and allow water to enter the cable**.
- The primary electrical difference between the smaller RG-58 and larger RG-8 coaxial cables is that **RG-8 cable has less loss at a given frequency**.
- **Air-insulated hard line** types of feedline have the lowest loss at VHF and UHF.

18

Take Aways

- An **antenna analyzer** can be used to determine if an antenna is resonant at the desired operating frequency.
- In general terms, **standing wave ratio (SWR)** is **a measure of how well a load is matched to a transmission line**.
- It is important to have a **low SWR** in an antenna system that uses coaxial cable feedline to **reduce signal losses**.
- A reading of **1 to 1** on an SWR meter indicates a perfect **impedance match** between the antenna and the feedline.

19

Take Aways

- **Most solid-state** amateur radio transmitters **reduce** output power as SWR increases to **protect the output amplifier transistors**
- An SWR reading of **4:1** means there is **an impedance mismatch**.
- **A loose connection in an antenna or a feedline** might cause erratic changes in SWR readings.
- An instrument, other than an SWR meter, that you could use to determine if a feedline and antenna are properly matched is a **directional wattmeter**.

20

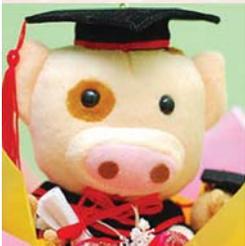
Take Aways

- An in-line SWR meter is connected **in series with the feed line, between the transmitter and antenna**, to monitor the standing wave ratio of the station antenna system
- Power lost in a feedline **is converted into heat**.
- An antenna tuner **matches the antenna system impedance to the transceiver's output impedance**.
- The primary purpose of a dummy load is **to prevent transmitting of signals over the air when making tests**.
- A dummy load consists of a **non-inductive resistor and a heat sink**.

21

Element 2 Technician Class Question Pool

Feed Me with Some Good Coax!



Section Nineteen

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22

Why is coaxial cable the most common feedline selected for amateur radio antenna systems?

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

T9B03

23

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

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

T9B02

24

In general, what happens as the frequency of a signal passing through coaxial cable is increased?

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

T9B05

25

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

- A. They are preferred for microwave operation
- B. They are watertight
- C. They are commonly used at HF frequencies
- D. They are a bayonet type connector

T9B07

26

Which of the following connectors is most suitable for frequencies above 400 MHz?

- A. A UHF (PL-259/SO-239) connector
- B. A Type N connector
- C. An RS-213 connector
- D. A DB-25 connector

T9B06

27

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

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

T7C11

28

Which of the following is the most common cause for failure of coaxial cables?

- A. Moisture contamination
- B. Gamma rays
- C. The velocity factor exceeds 1.0
- D. Overloading

T7C09

29

Why should coax connectors exposed to the weather be sealed against water intrusion?

- A. To prevent an increase in feedline loss
- B. To prevent interference to telephones
- C. To keep the jacket from becoming loose
- D. All of these choices are correct

T9B08

30

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

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

T7C10

31

What is the electrical difference between RG-58 and larger RG-8 coaxial cable?

- A. There is no significant difference between the two types
- B. RG-58 cable has two shields
- C. RG-8 cable has less loss at a given frequency
- D. RG-58 cable can handle higher power levels

T9B10

32

Which of the following types of feedline has the lowest loss at VHF and UHF?

- A. 50-ohm flexible coax
- B. Multi-conductor unbalanced cable
- C. Air-insulated hard line
- D. 75-ohm flexible coax

T9B11

33

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

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

T7C02

34

What, in general terms, is standing wave ratio (SWR)?

- A. A measure of how well a load is matched to a transmission line
- B. The ratio of high to low impedance in a feedline
- C. The transmitter efficiency ratio
- D. An indication of the quality of your station’s ground connection

T7C03

35

What is the proper location for an external SWR meter?

- A. In series with the feed line, between the transmitter and antenna
- B. In series with the station’s ground
- C. In parallel with the push-to-talk line and the antenna
- D. In series with the power supply cable, as close as possible to the radio

T4A05

36

Why is it important to have low SWR when using coaxial cable feed line?

- A. To reduce television interference
- B. To reduce signal loss
- C. To prolong antenna life
- D. All of these choices are correct

T9B01

37

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

- A. 2 to 1
- B. 1 to 3
- C. 1 to 1
- D. 10 to 1

T7C04

38

Why do most solid-state amateur radio transmitters reduce output power as SWR increases?

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

T7C05

39

What does an SWR reading of 4:1 mean?

- A. An loss of 4 dB
- B. A good impedance match
- C. Gain of 4 dB
- D. Impedance mismatch

T7C06

40

What can cause erratic changes in SWR readings?

- A. The transmitter is being modulated
- B. A loose connection in an antenna or a feedline
- C. The transmitter is being over-modulated
- D. Interference from other stations is distorting your signal

T9B09

41

What instrument other than an SWR meter could you use to determine if a feedline and antenna are properly matched?

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

T7C08

42

What happens to power lost in a feedline?

- A. It increases the SWR
- B. It comes back into your transmitter and could cause damage
- C. It is converted into heat
- D. It can cause distortion of your signal

T7C07

43

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

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

T9B04

44

What is the primary purpose of a dummy load?

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

T7C01

45

What does a dummy load consist of ?

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

T7C12

46

Technician Licensing Class

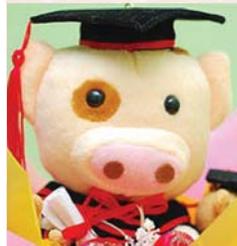
Safety First!

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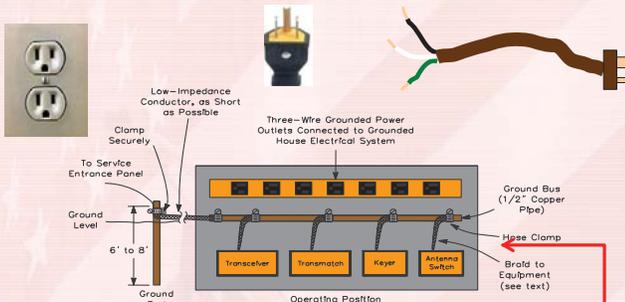


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Safety First!

Electrical shock can be a problem at your station.

1. Use **three-wire cords** and plugs for all AC powered equipment.

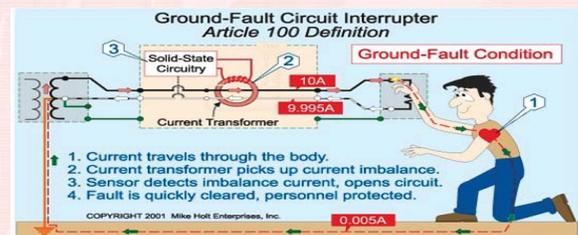


2. Connect all AC powered station equipment to a **common safety ground**.

2

Safety First!

3. Use a circuit protected by a **ground-fault interrupter**.



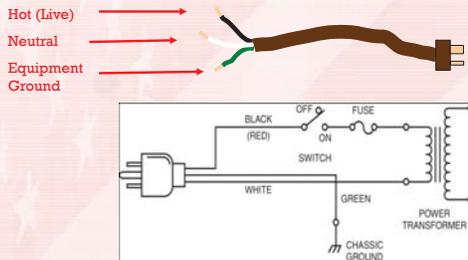
TOA06 All three are good ways to guard against electrical shock at your station:

- Use three-wire cords and plugs for all AC powered equipment
- Connect all AC powered station equipment to a common safety ground
- Use a circuit protected by a ground-fault interrupter

3

Safety First!

TOA03 The green wire in a three-wire electrical AC plug is **equipment ground** in the United States.



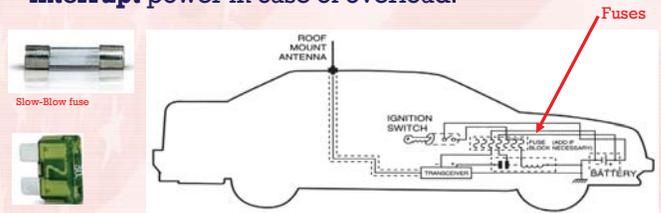
AC Line Connections

4

Safety First!

TOA08 A **fuse or circuit breaker** in series with the AC "hot" conductor is safety equipment that should always be included in home-built equipment that is powered from 120V AC power circuits.

TOA04 The **purpose** of a fuse in an electrical circuit is to **interrupt** power in case of overload.



Automobile fuse

Place the fuses as close to the battery as possible

5

Safety First!

TOA05 It is unwise to install a 20-ampere fuse in the place of a 5-ampere fuse because excessive current could **cause a fire**.

TOA11 The kind of hazard that might exist in a power supply when it is turned off and disconnected is that you might receive an **electric shock** from **stored charge in large capacitors**.



Filter Capacitors



Charges stored from capacitors can **HURT!**

6

Safety First!

T7D12 When measuring **high voltages** with a voltmeter ensure that the voltmeter and leads are rated for use at the voltages to be measured.

TOA02 Current flowing through the body cause a **health hazard**:

- By heating tissue;
- It disrupts the electrical functions of cells;
- It causes involuntary muscle contractions.

7

Safety First!

TOA10 If a lead-acid storage battery is charged or discharged **too quickly** it could overheat and give off flammable gas or explode

TOA01 **Shorting** the terminals of a 12-volt storage battery can cause burns, fire, or an explosion.

TOB09 You should **avoid attaching** an antenna to a utility pole as the antenna could contact **high-voltage power wires**.

And it may be illegal to do

8

Safety First!

TOB04 **Looking for and staying clear of any overhead electrical wires** is an important safety precaution to observe when putting up an antenna tower.

- Overhead electrical wires carry more than 120 VAC
- Use common sense and think safety first
- Have help, don't work alone
- Always **LOOK UP** first

TOB06 The **minimum safe distance** to allow from a power line when installing an antenna is to ensure that no part of the antenna can come closer than **10 feet** to the power wires if antenna falls unexpectedly.

- This is a '**minimum**' distance
- Keep away from all wires

9

Safety First!

TOB02 Putting on a carefully inspected **climbing harness** (fall arrester) and **safety glasses** is a good precaution to observe before climbing an antenna tower.



Climbing
Harness

Safety
Glasses

And
Hard
Hat



TOB01 Members of a tower work team should wear a hard hat and safety glasses **at all times** when any work is being done on the tower.

10

Safety First!

TOB03 It is **never** safe to climb a tower without a helper or observer.

Never work on a tower without a helper

TOB07 An important safety rule to remember when using a **crank-up tower** is that this type of tower must **never** be climbed unless it is in the fully retracted position or mechanical safety locking devices have been installed.

Think about
weight overload
and **never** climb a
cranked up
tower.



11

Safety First!

TOB13 The purpose of a **safety wire** through a **turnbuckle** used to tension guy lines is to prevent loosening of the guy line from vibration.



12

Safety First!

TOB11 Grounding requirements for an amateur radio tower or antenna are established by **local electrical codes**

Check local codes before putting up an antenna

TOB08 **Proper grounding method** for a tower is to have separate eight-foot long ground rods for each tower leg, bonded to the tower and each other.

TOA09 All external ground rods or earth connections should be **bonded** together with **heavy wire or conductive straps**.

13

Safety First!

T4A08 A **Flat strap** conductor is best to use for **RF** grounding.

- Offers best surface area
- Bleed off static and minimize ground currents
- Straps usually are 3 inches wide
- Folding okay to snake down to a healthy ground rod



Copper Ground
Strap provides
good surface area
ground

14

Safety First!

TOB12 A good practice when installing ground wires on a tower for **lightning protection** is to ensure that connections are **short and direct**.

TOB10 **Sharp bends** must be avoided in grounding conductors used for lightning protection.

TOA07 Precautions should be taken when installing devices for lightning protection in a **coaxial cable feedline** by grounding all of the protectors to a common plate which is in turn connected to an external ground.

*Good for nearby lightning strikes
Direct hits, forget it, kiss everything goodbye for good*

15

Safety First!

TOB05 The purpose of a **gin pole** is to lift tower sections or antennas.



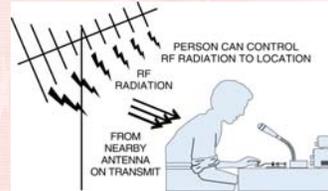
Gin Pole

16

Safety First!

TOC04 Factors affecting the **RF exposure of people** near an amateur station antenna:

- Frequency and power level of the RF field
- Distance from the antenna to a person
- Radiation pattern of the antenna



Controlled



Uncontrolled

17

Safety First!

TOC05 Exposure limits **vary with frequency** because the **human body absorbs more** RF energy at some frequencies than at others.

TOC02 Of the following frequencies - 3.5 MHz, 50 MHz, 440 MHz, and 1296 MHz - a **50 MHz frequency has the lowest** Maximum Permissible Exposure limit.

TOC03 The maximum power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required is **50 watts PEP** at the antenna.



Never stand in front of a microwave feedhorn antenna. On transmit, it radiates a concentrated beam of RF energy.

18

Safety First!

TOC01 VHF and UHF radio signals are **non-ionizing** radiation. Quite different from X-ray, gamma ray, and ultra violet radiation

TOC06 **Acceptable methods** to determine that your station complies with FCC RF exposure regulations:

- By calculation based on FCC OET Bulletin 65
- By calculation based on computer modeling
- By measurement of field strength using calibrated equipment

TOC08 An action amateur operators might take to prevent exposure to RF radiation in excess of FCC-supplied limits is to **relocate antennas**.

The safest place to mount the mobile antenna for minimum RF exposure is on the metal roof as shown.



19

Safety First!

TOC09 To make sure your station stays in compliance with RF safety regulations, re-evaluate the station whenever an item of **equipment is changed**.

TOC11 When referring to RF exposure, "**duty cycle**" is the percentage of time the transceiver is **transmitting**.

TOC10 Duty cycle is one of the factors used to determine safe RF radiation exposure levels because it affects the **average exposure** of people to radiation.

20

Safety First!

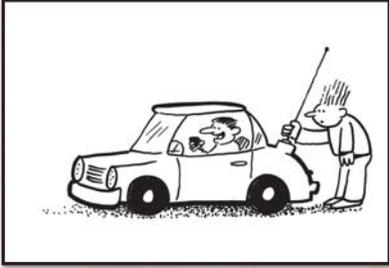
TOC12 **RF radiation** differs from ionizing radiation (radioactivity) because RF radiation does not have sufficient energy to cause **genetic damage**.

TOC13 If the averaging time for exposure is 6 minutes, **2 times** the **power density** is permitted if the signal is present for 3 minutes and absent for 3 minutes rather than being present for the entire 6 minutes. This is based on **exposure limits** for a given frequency from the FCC OET Bulletin 65 or computer modeling tools. **Duty cycle** is used as the time the signal is present.

21

Safety First!

TOC07 If a person accidentally touched your antenna while you were transmitting they might receive a painful **RF burn**.



Be sure to place your antennas where no one can touch them. All antennas, not just the mobile ones.

22

Take Aways

Section Twenty Take Aways

Words that are **bold** and **red** appear in the correct answer.



23

Take Aways

- **All of these choices** are good ways to **guard against electrical shock** at your station
 - Use three-wire cords and plugs for all AC powered equipment
 - Connect all AC powered station equipment to a common safety ground
 - Use a circuit protected by a ground-fault interrupter
- Current flowing through the body can cause a health hazard **all of the following:**
 - By heating tissue
 - It disrupts the electrical functions of cells
 - It causes involuntary muscle contractions
- **Equipment ground** is connected to the **green wire** in a three-wire electrical AC plug in the United States.

24

Take Aways

- It is unwise to install a 20-ampere fuse in the place of a 5-ampere fuse because **excessive current could cause a fire**.
- Precautions that should be taken when installing devices for lightning protection in a coaxial cable feedline include **grounding all of the protectors to a common plate which is in turn connected to an external ground**.
- If a lead-acid storage battery is charged or discharged too quickly, the **battery could overheat and give off flammable gas or explode**.
- Shorting the terminals of a 12-volt storage battery **can cause burns, fire, or an explosion**.

25

Take Aways

- A good practice when installing ground wires on a tower for lightning protection is to ensure that **connections are short and direct**.
- An important safety rule to remember when using a crank-up tower is that this **type of tower must not be climbed unless retracted or mechanical safety locking devices have been installed**.
- The purpose of a safety wire through a turnbuckle used to tension guy lines is to **prevent loosening of the guy line from vibration**.
- The purpose of a fuse in an electrical circuit is to **interrupt power in case of overload**.

26

Take Aways

- **A fuse or circuit breaker in series with the AC "hot" conductor** should always be included in home-built equipment that is powered from 120V AC power circuits.
- The kind of **hazard** that might exist in a power supply when it is turned off and disconnected is that **you might receive an electric shock from stored charge in large capacitors**.
- Members of a tower work team should wear a hard hat and safety glasses **at all times when any work is being done on the tower**.
- A good precaution to observe before climbing an antenna tower is to **put on a carefully inspected climbing harness (fall arrester) and safety glasses**.

27

Take Aways

- It is **never** safe to climb a tower without a helper or observer.
- An important safety precaution to observe when putting up an antenna tower is **look for and stay clear of any overhead electrical wires**.
- The purpose of a gin pole is to **lift tower sections or antennas**.
- The minimum safe distance from a power line to allow when installing an antenna is that **if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires**. (Look Up)
- When measuring high voltages with a voltmeter **ensure that the voltmeter and leads are rated for use at the voltages to be measured**.

28

Take Aways

- A **Flat strap type** of conductor is best to use for RF grounding.
- **Separate eight-foot long ground rods for each tower leg, bonded to the tower and each other**, is considered to be a proper grounding method for a tower.
- All external ground rods or earth connections should be **bonded together with heavy wire or conductive straps**.
- You should avoid attaching an antenna to a utility pole **because the antenna could contact high-voltage power wires**.
- **Avoid sharp bends** when routing ground conductors used for lightning protection.

29

Take Aways

- **Local electrical codes** establish grounding requirements for an amateur radio tower or antenna
- VHF and UHF radio signals are **non-ionizing radiation**.
- **50 MHz** has the lowest Maximum Permissible Exposure limit.
- **ALL of these factors** affect the RF exposure of people near an amateur station antenna:
 - Frequency and power level of the RF field
 - Distance from the antenna to a person
 - Radiation pattern of the antenna

30

Take Aways

- The **maximum** power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required is **50 watts PEP at the antenna**.
- Exposure limits **vary with frequency** because the **human body absorbs more RF energy at some frequencies than at others**.
- **ALL of these** are acceptable methods to determine that your station complies with **FCC RF exposure regulations**:
 - By calculation based on FCC OET Bulletin 65
 - By calculation based on computer modeling
 - By measurement of field strength using calibrated equipment

31

Take Aways

- If a person accidentally touched your antenna while you were transmitting **they might receive a painful RF burn**.
- An action amateur operators might take to prevent exposure to RF radiation in excess of FCC-supplied limits includes **relocating the antenna**.
- You can make sure your station stays in compliance with RF safety regulations by **re-evaluating the station whenever an item of equipment is changed**.
- Duty cycle is one of the factors used to determine safe RF radiation exposure levels because **it affects the average exposure of people to radiation**.

32

Take Aways

- When referring to RF exposure, duty cycle is the **percentage of time that a transmitter transmits**.
- RF radiation differs from ionizing radiation (radioactivity) because **RF radiation does not have sufficient energy to cause genetic damage**.
- If the averaging time for exposure is 6 minutes, **2 times** the power density is permitted if the signal is present for 3 minutes and absent for 3 minutes rather than being present for the entire 6 minutes. This is based on **exposure limits** for a given frequency. **Duty cycle** is used as the time the signal is present.

33

Element 2 Technician Class Question Pool

Safety First!

Section Twenty

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34

What is a good way to guard against electrical shock at your station?

- A. Use three-wire cords and plugs for all AC powered equipment
- B. Connect all AC powered station equipment to a common safety ground
- C. Use a circuit protected by a ground-fault interrupter
- D. All of these choices are correct

TOA06

35

In the United States, what is connected to the green wire in a three-wire electrical AC plug?

- A. Neutral
- B. Hot
- C. Equipment ground
- D. The white wire

TOA03

36

What safety equipment should always be included in home-built equipment that is powered from 120V AC power circuits?

- A. A fuse or circuit breaker in series with the AC hot conductor
- B. An AC voltmeter across the incoming power source
- C. An inductor in parallel with the AC power source
- D. A capacitor in series with the AC power source

TOA08

37

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

- A. To prevent power supply ripple from damaging a circuit
- B. To interrupt power in case of overload
- C. To limit current to prevent shocks
- D. All of these choices are correct

TOA04

38

Why is it unwise to install a 20-ampere fuse in the place of a 5-ampere fuse?

- A. The larger fuse would be likely to blow because it is rated for higher current
- B. The power supply ripple would greatly increase
- C. Excessive current could cause a fire
- D. All of these choices are correct

TOA05

39

What kind of hazard might exist in a power supply when it is turned off and disconnected?

- A. Static electricity could damage the grounding system
- B. Circulating currents inside the transformer might cause damage
- C. The fuse might blow if you remove the cover
- D. You might receive an electric shock from the charge stored in large capacitors

TOA11

40

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

- A. Ensure that the voltmeter has very low impedance
- B. Ensure that the voltmeter and leads are rated for use at the voltage to be measured
- C. Ensure that the circuit is grounded through the voltmeter
- D. Ensure that the voltmeter is set to the correct frequency

T7D12

41

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

- A. It may cause injury by heating tissue
- B. It may disrupt the electrical functions of cells
- C. It may cause involuntary muscle contractions
- D. All of these choices are correct

TOA02

42

What can happen if a lead-acid storage battery is charged or discharged too quickly?

- A. The battery could overheat, give off flammable gas, or explode
- B. The voltage can become reversed
- C. The memory effect will reduce the capacity of the battery
- D. All of these choices are correct

TOA10

43

Which of the following is a safety hazard of a 12 voltage storage battery?

- A. Touching both terminals with the hands can cause electrical shock
- B. Shorting the terminals can cause burns, fire, or an explosion
- C. RF emissions from the battery
- D. All of these choices are correct

TOA01

44

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

- A. Wear a ground strap connected to your wrist at all times
- B. Insulate the base of the tower to avoid lightning strikes
- C. Look for and stay clear of any overhead electrical wires
- D. All of these choices are correct

TOB04

45

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

- A. Half the width of your property
- B. The height of the power line above ground
- C. 1/2 wavelength at the operating frequency
- D. Enough so that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power wires

TOB06

46

Why should you avoid attaching an antenna to a utility pole?

- A. The antenna will not work properly because of induced voltages
- B. The utility company will charge you an extra monthly fee
- C. The antenna could contact high-voltage power lines
- D. All of these choices are correct

TOB09

47

What is a good precaution to observe before climbing an antenna tower?

- A. Make sure that you wear a grounded wrist strap
- B. Remove all tower grounding connections
- C. Put on a carefully inspected climbing harness (fall arrester) and safety glasses
- D. All of these choices are correct

TOB02

48

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

- A. When no electrical work is being performed
- B. When no mechanical work is being performed
- C. When the work being done is not more than 20 feet above the ground
- D. Never

TOB03

49

When should members of a tower work team wear a hard hat and safety glasses?

- A. At all times except when climbing the tower
- B. At all times except when belted firmly to the tower
- C. At all times when any work is being done on the tower
- D. Only when the tower exceeds 30 feet in height

TOB01

50

What is the purpose of a gin pole?

- A. To temporarily replace guy wires
- B. To be used in place of a safety harness
- C. To lift tower sections or antennas
- D. To provide a temporary ground

TOB05

51

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

- A. This type of tower must never be painted
- B. This type of tower must never be grounded
- C. This type of tower must not be climbed unless retracted or mechanical safety locking devices have been installed
- D. All of these choices are correct

TOB07

52

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

- A. Secure the guy if the turnbuckle breaks
- B. Prevent loosening of the guy line from vibration
- C. Prevent theft or vandalism
- D. Deter unauthorized climbing of the tower

TOB13

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

- A. FCC Part 97 Rules
- B. Local electrical codes
- C. FAA tower lighting regulations
- D. UL recommended practices

TOB11

54

What is considered to be a proper grounding method for a tower?

- A. A single four-foot ground rod, driven into the ground no more than 12 inches from the base
- B. A ferrite-core RF choke connected between the tower and ground
- C. Separate eight-foot long ground rods for each tower leg, bonded to the tower and each other
- D. A connection between the tower base and a cold water pipe

TOB08

55

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

- A. Waterproof them with silicone caulk or electrical tape
- B. Keep them as far apart as possible
- C. Bond them together with heavy wire or conductive strap
- D. Tune them for resonance on the lowest frequency of operation

TOA09

56

Which of the following conductors provides the lowest impedance to RF signals?

- A. Round stranded wire
- B. Round copper-clad steel wire
- C. Twisted-pair cable
- D. Flat strap

T4A08

57

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

- A. Put a loop in the ground connection to prevent water damage to the ground system
- B. Make sure that all bends in the ground wires are clean, right angle bends
- C. Ensure that connections are short and direct
- D. All of these choices are correct

TOB12

58

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

- A. Only non-insulated wire must be used
- B. Wires must be carefully routed with precise right-angle bends
- C. Sharp bends must be avoided
- D. Common grounds must be avoided

TOB10

59

Which of these precautions should be taken when installing devices for lightning protection in a coaxial cable feedline?

- A. Include a parallel bypass switch for each protector so that it can be switched out of the circuit when running high power
- B. Include a series switch in the ground line of each protector to prevent RF overload from inadvertently damaging the protector
- C. Keep the ground wires from each protector separate and connected to station ground
- D. Mount all of the protectors on a metal plate that is in turn connected to an external ground rod

TOA07

60

What factors affect the RF exposure of people near an amateur station antenna?

- A. Frequency and power level of the RF field
- B. Distance from the antenna to a person
- C. Radiation pattern of the antenna
- D. All of these choices are correct

TOC04

61

Why do exposure limits vary with frequency?

- A. Lower frequency RF fields have more energy than higher frequency fields
- B. Lower frequency RF fields do not penetrate the human body
- C. Higher frequency RF fields are transient in nature
- D. The human body absorbs more RF energy at some frequencies than at others

TOC05

62

Which of the following frequencies has the lowest Maximum Permissible Exposure limit?

- A. 3.5 MHz
- B. 50 MHz
- C. 440 MHz
- D. 1296 MHz

TOC02

63

What is the maximum power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required?

- A. 1500 watts PEP transmitter output
- B. 1 watt forward power
- C. 50 watts PEP at the antenna
- D. 50 watts PEP reflected power

TOC03

64

What type of radiation are VHF and UHF radio signals?

- A. Gamma radiation
- B. Ionizing radiation
- C. Alpha radiation
- D. Non-ionizing radiation

TOC01

65

Which of the following is an acceptable method to determine that your station complies with FCC RF exposure regulations?

- A. By calculations based FCC OET Bulletin 65
- B. By calculation based on computer modeling
- C. By measurement of field strength using calibrated equipment
- D. All of these choices are correct

TOC06

66

Which of the following actions might amateur operators take to prevent exposure to RF radiation in excess of FCC-supplied limits?

- A. Relocate antennas
- B. Relocate the transmitter
- C. Increase the duty cycle
- D. All of these choices are correct

TOC08

67

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

- A. By informing the FCC of any changes made in your station
- B. By re-evaluating the station whenever an item of equipment is changed
- C. By making sure your antennas have low SWR
- D. All of these choices are correct

TOC09

68

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

- A. The difference between lowest power output and highest output power of a transmitter
- B. The difference between the PEP and average power output power of a transmitter
- C. The percentage of time that a transmitter transmits
- D. The percentage of time that a transmitter is not transmitting

TOC11

69

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

- A. RF radiation does not have sufficient energy to cause genetic damage
- B. RF radiation can only be detected with an RF dosimeter
- C. RF radiation is limited in range to a few feet
- D. RF radiation is perfectly safe

TOC12

70

If the averaging time for exposure is 6 minutes, how much power density is permitted if the signal is present for 3 minutes and absent for 3 minutes rather than being present for the entire 6 minutes?

- A. 3 times as much
- B. 1/2 as much
- C. 2 times as much
- D. There is no adjustment allowed for shorter exposure times

TOC13

71

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

- A. It affects the average exposure of people to radiation
- B. It affects the peak exposure of people to radiation
- C. It takes into account the antenna feedline loss
- D. It takes into account the thermal effects of the final amplifier

TOC10

72

What could happen if a person accidentally touched your antenna while you were transmitting?

- A. Touching the antenna could cause television interference
- B. They might receive a painful RF burn
- C. They might develop radiation poisoning
- D. All of these choices are correct

TOC07

73

Yippee!

That was the last question!

74

We've covered the content ...

- Are there any questions?
- Any special areas to go back over quickly?

75

Now What Do I Do?

- Support Amateur Radio locally. Be involved in local clubs and associations.
- Get involved in community service & fun activities through your local group.
 - Public Service Events= Larry's List
 - Skywarn (Weather Spotting)
 - RACES, ARES (Disaster Comms)
 - KCHEART (Hospital Comms)

◆ **Get on the air and say something!**

76

This Completes the Course...

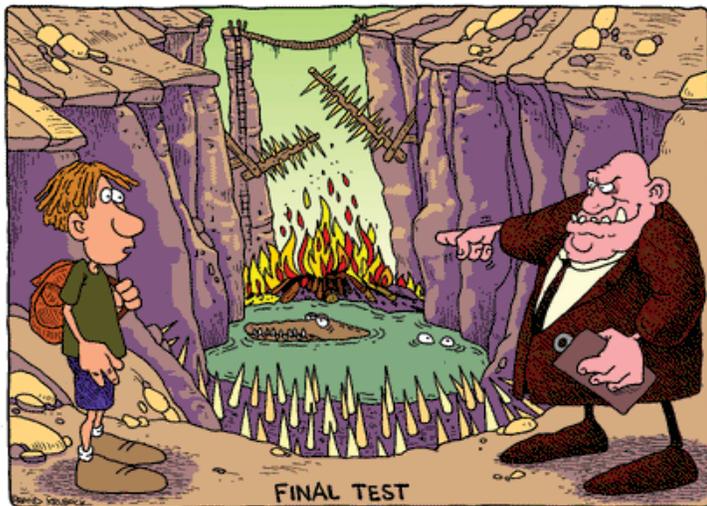


...and begins a worldwide journey that will last you a lifetime.



Enjoy your new hobby!

77



78