

Below are 7 Amateur Extra quizzes good until June 30, 2024.

Take a quiz. Grade a quiz. For those questions you got wrong, look up the question's E code in one of the below books, refer to that section in the book and understand what is the correct answer. Once you have completed one quiz, take the next quiz.

Study books, for use until June 2024, may be available at your local library and at:

<http://www.arrl.org/extra-class-license-manual>

https://www.gordonwestradioschool.com/main/page_w5yi_training_resources.html

If you do not write or take notes in your book, please consider donating your study book to your local library to help others study for their Amateur Extra license test.

Please visit <http://www.arrl.org/what-to-bring-to-an-exam-session> and read "What to Bring to an ARRL Exam Session". Please note Social Security Numbers will no longer be used on the NCVEC Form 605 and you must get a Federal Registration Number (FRN) see #4 and also #9.

Once you have the FRN, please visit <http://www.arrl.org/605-instructions> and complete the NCVEC Form 605 and print and bring to the exam along with a copy of your Amateur license (if applicable) for submittal to ARRL.

Find an exam session:

<http://www.arrl.org/find-an-amateur-radio-license-exam-session>

The exam fee (<http://www.arrl.org/arrl-vec-exam-fees>) allows student to take one version of exam. Exam retakes will cost an additional fee.

Frequency Chart: <http://www.arrl.org/graphical-frequency-allocations>

Questions about quizzes, exams, ARES or RACES? Please contact me at kb9ezz@arrl.net

73 and many thanks,

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Amateur Extra Quiz 1

1 E1A01 Which of the following carrier frequencies is illegal for LSB AFSK emissions on the 17 meter band RTTY and data segment of 18.068 to 18.110 MHz?

- A. 18.068 MHz
- B. 18.100 MHz
- C. 18.107 MHz
- D. 18.110 MHz

2 E1B03 Within what distance must an amateur station protect an FCC monitoring facility from harmful interference?

- A. 1 mile
- B. 3 miles
- C. 10 miles
- D. 30 miles

3 E1C03 How do the control operator responsibilities of a station under automatic control differ from one under local control?

- A. Under local control there is no control operator
- B. Under automatic control the control operator is not required to be present at the control point
- C. Under automatic control there is no control operator
- D. Under local control a control operator is not required to be present at a control point

4 E1D01 What is the definition of telemetry?

- A. One-way transmission of measurements at a distance from the measuring instrument
- B. Two-way transmissions in excess of 1000 feet
- C. Two-way transmissions of data
- D. One-way transmission that initiates, modifies, or terminates the functions of a device at a distance

5 E1E03 What is a Volunteer Examiner Coordinator?

- A. A person who has volunteered to administer amateur operator license examinations
- B. A person who has volunteered to prepare amateur operator license examinations
- C. An organization that has entered into an agreement with the FCC to coordinate, prepare, and administer amateur operator license examinations
- D. The person who has entered into an agreement with the FCC to be the VE session manager

6 E1F01 On what frequencies are spread spectrum transmissions permitted?

- A. Only on amateur frequencies above 50 MHz
- B. Only on amateur frequencies above 222 MHz
- C. Only on amateur frequencies above 420 MHz
- D. Only on amateur frequencies above 144 MHz

14 E3C01 What does the radio communication term "ray tracing" describe?

- A. The process in which an electronic display presents a pattern
- B. Modeling a radio wave's path through the ionosphere
- C. Determining the radiation pattern from an array of antennas
- D. Evaluating high voltage sources for x-rays

15 E4A02 Which of the following parameters does a spectrum analyzer display on the vertical and horizontal axes?

- A. RF amplitude and time
- B. RF amplitude and frequency
- C. SWR and frequency
- D. SWR and time

16 E4B01 Which of the following factors most affects the accuracy of a frequency counter?

- A. Input attenuator accuracy
- B. Time base accuracy
- C. Decade divider accuracy
- D. Temperature coefficient of the logic

17 E4C02 Which of the following receiver circuits can be effective in eliminating interference from strong out-of-band signals?

- A. A front-end filter or pre-selector
- B. A narrow IF filter
- C. A notch filter
- D. A properly adjusted product detector

18 E4D02 Which of the following describes problems caused by poor dynamic range in a receiver?

- A. Spurious signals caused by cross-modulation and desensitization from strong adjacent signals
- B. Oscillator instability requiring frequent retuning and loss of ability to recover the opposite sideband
- C. Cross-modulation of the desired signal and insufficient audio power to operate the speaker
- D. Oscillator instability and severe audio distortion of all but the strongest received signals

19 E4E01 What problem can occur when using an automatic notch filter (ANF) to remove interfering carriers while receiving CW signals?

- A. Removal of the CW signal as well as the interfering carrier
- B. Any nearby signal passing through the DSP system will overwhelm the desired signal
- C. Received CW signals will appear to be modulated at the DSP clock frequency
- D. Ringing in the DSP filter will completely remove the spaces between the CW characters

- 20 E5A02 What is resonance in an LC or RLC circuit?
A. The highest frequency that will pass current
B. The lowest frequency that will pass current
C. The frequency at which the capacitive reactance equals the inductive reactance
D. The frequency at which the reactive impedance equals the resistive impedance
- 21 E5B02 What letter is commonly used to represent susceptance?
A. G B. X C. Y D. B
- 22 E5C03 Which of the following represents an inductive reactance in polar coordinates?
A. A positive magnitude B. A negative magnitude
C. A positive phase angle D. A negative phase angle
- 23 E5D02 Why is it important to keep lead lengths short for components used in circuits for VHF and above?
A. To increase the thermal time constant
B. To avoid unwanted inductive reactance
C. To maintain component lifetime
D. All these choices are correct
- 24 E6A01 In what application is gallium arsenide used as a semiconductor material?
A. In high-current rectifier circuits
B. In high-power audio circuits
C. In microwave circuits
D. In very low-frequency RF circuits
- 25 E6B03 What type of bias is required for an LED to emit light?
A. Reverse bias B. Forward bias C. Zero bias D. Inductive bias
- 26 E6C02 What happens when the level of a comparator's input signal crosses the threshold?
A. The IC input can be damaged
B. The comparator changes its output state
C. The comparator enters latch-up
D. The feedback loop becomes unstable
- 27 E6D03 Which of the following is an aspect of the piezoelectric effect?
A. Mechanical deformation of material by the application of a voltage
B. Mechanical deformation of material by the application of a magnetic field
C. Generation of electrical energy in the presence of light
D. Increased conductivity in the presence of light

28 E6E03 Which of the following materials is likely to provide the highest frequency of operation when used in MMICs?

- A. Silicon B. Silicon nitride C. Silicon dioxide D. Gallium nitride

29 E6F02 What happens to the conductivity of a photoconductive material when light shines on it?

- A. It increases B. It decreases C. It stays the same D. It becomes unstable

30 E7A02 What is the function of a decade counter?

- A. It produces one output pulse for every 10 input pulses
B. It decodes a decimal number for display on a seven-segment LED display
C. It produces 10 output pulses for every input pulse
D. It decodes a binary number for display on a seven-segment LED display

31 E7B01 For what portion of the signal cycle does each active element in a push-pull Class AB amplifier conduct?

- A. More than 180 degrees but less than 360 degrees B. Exactly 180 degrees
C. The entire cycle D. Less than 180 degrees

32 E7C02 Which of the following is a property of a T-network with series capacitors and a parallel shunt inductor?

- A. It is a low-pass filter B. It is a band-pass filter
C. It is a high-pass filter D. It is a notch filter

33 E7D03 What device is typically used as a stable voltage reference in a linear voltage regulator?

- A. A Zener diode B. A tunnel diode C. An SCR D. A varactor diode

34 E7E02 What is the function of a reactance modulator?

- A. To produce PM signals by using an electrically variable resistance
B. To produce AM signals by using an electrically variable inductance or capacitance
C. To produce AM signals by using an electrically variable resistance
D. To produce PM or FM signals by using an electrically variable inductance or capacitance

35 E7F01 What is meant by direct digital conversion as applied to software defined radios?

- A. Software is converted from source code to object code during operation of the receiver
B. Incoming RF is converted to a control voltage for a voltage controlled oscillator
C. Incoming RF is digitized by an analog-to-digital converter without being mixed with a local oscillator signal
D. A switching mixer is used to generate I and Q signals directly from the RF input

- 36 E7G02 What is ringing in a filter?
A. An echo caused by a long time delay
B. A reduction in high frequency response
C. Partial cancellation of the signal over a range of frequencies
D. Undesired oscillations added to the desired signal
- 37 E7H01 What are three oscillator circuits used in amateur radio equipment?
A. Taft, Pierce and negative feedback B. Pierce, Fenner and Beane
C. Taft, Hartley and Pierce D. Colpitts, Hartley and Pierce
- 38 E8A02 Which of the following is a type of analog-to-digital conversion?
A. Successive approximation B. Harmonic regeneration
C. Level shifting D. Phase reversal
- 39 E8B02 How does the modulation index of a phase-modulated emission vary with RF carrier frequency?
A. It increases as the RF carrier frequency increases
B. It decreases as the RF carrier frequency increases
C. It varies with the square root of the RF carrier frequency
D. It does not depend on the RF carrier frequency
- 40 E8C02 What is the definition of symbol rate in a digital transmission?
A. The number of control characters in a message packet
B. The duration of each bit in a message sent over the air
C. The rate at which the waveform changes to convey information
D. The number of characters carried per second by the station-to-station link
- 41 E8D02 What spread spectrum communications technique uses a high-speed binary bit stream to shift the phase of an RF carrier?
A. Frequency hopping B. Direct sequence
C. Binary phase-shift keying D. Phase compandored spread spectrum
- 42 E9A02 What is the effective radiated power relative to a dipole of a repeater station with 150 watts transmitter power output, 2 dB feed line loss, 2.2 dB duplexer loss, and 7 dBd antenna gain?
A. 1977 watts B. 78.7 watts C. 420 watts D. 286 watts
- 43 E9B04 What is the front-to-back ratio of the radiation pattern shown in Figure E9-2?
A. 15 dB B. 28 dB C. 3 dB D. 38 dB

- 44 E9C02 What is the radiation pattern of two 1/4 wavelength vertical antennas spaced 1/4 wavelength apart and fed 90 degrees out of phase?
- A. Cardioid
 - B. A figure-8 end-fire along the axis of the array
 - C. A figure-8 broadside to the axis of the array
 - D. Omni-directional
- 45 E9D01 How much does the gain of an ideal parabolic dish antenna change when the operating frequency is doubled?
- A. 2 dB
 - B. 3 dB
 - C. 4 dB
 - D. 6 dB
- 46 E9E03 What is the name of the matching system that uses a section of transmission line connected in parallel with the feed line at or near the feedpoint?
- A. The gamma match
 - B. The delta match
 - C. The omega match
 - D. The stub match
- 47 E9F02 Which of the following has the biggest effect on the velocity factor of a transmission line?
- A. The termination impedance
 - B. The line length
 - C. Dielectric materials used in the line
 - D. The center conductor resistivity
- 48 E9G02 What type of coordinate system is used in a Smith chart?
- A. Voltage circles and current arcs
 - B. Resistance circles and reactance arcs
 - C. Voltage lines and current chords
 - D. Resistance lines and reactance chords
- 49 E9H03 What is Receiving Directivity Factor (RDF)?
- A. Forward gain compared to the gain in the reverse direction
 - B. Relative directivity compared to isotropic
 - C. Relative directivity compared to a dipole
 - D. Forward gain compared to average gain over the entire hemisphere
- 50 E0A02 When evaluating RF exposure levels from your station at a neighbor's home, what must you do?
- A. Ensure signals from your station are less than the controlled Maximum Permitted Exposure (MPE) limits
 - B. Ensure signals from your station are less than the uncontrolled Maximum Permitted Exposure (MPE) limits
 - C. Ensure signals from your station are less than the controlled Maximum Permitted Emission (MPE) limits
 - D. Ensure signals from your station are less than the uncontrolled Maximum Permitted Emission (MPE) limits

Extra Quiz 1

- | | | | |
|----|-----------|----|-----------|
| 1 | E1A01 (A) | 26 | E6C02 (B) |
| 2 | E1B03 (A) | 27 | E6D03 (A) |
| 3 | E1C03 (B) | 28 | E6E03 (D) |
| 4 | E1D01 (A) | 29 | E6F02 (A) |
| 5 | E1E03 (C) | 30 | E7A02 (A) |
| 6 | E1F01 (B) | 31 | E7B01 (A) |
| 7 | E2A03 (D) | 32 | E7C02 (C) |
| 8 | E2B02 (C) | 33 | E7D03 (A) |
| 9 | E2C01 (D) | 34 | E7E02 (D) |
| 10 | E2D01 (B) | 35 | E7F01 (C) |
| 11 | E2E04 (A) | 36 | E7G02 (D) |
| 12 | E3A02 (B) | 37 | E7H01 (D) |
| 13 | E3B03 (C) | 38 | E8A02 (A) |
| 14 | E3C01 (B) | 39 | E8B02 (D) |
| 15 | E4A02 (B) | 40 | E8C02 (C) |
| 16 | E4B01 (B) | 41 | E8D02 (B) |
| 17 | E4C02 (A) | 42 | E9A02 (D) |
| 18 | E4D02 (A) | 43 | E9B04 (B) |
| 19 | E4E01 (A) | 44 | E9C02 (A) |
| 20 | E5A02 (C) | 45 | E9D01 (D) |
| 21 | E5B02 (D) | 46 | E9E03 (D) |
| 22 | E5C03 (C) | 47 | E9F02 (C) |
| 23 | E5D02 (B) | 48 | E9G02 (B) |
| 24 | E6A01 (C) | 49 | E9H03 (D) |
| 25 | E6B03 (B) | 50 | E0A02 (B) |

Amateur Extra Quiz 2

1 E1A03 What is the maximum legal carrier frequency on the 20 meter band for transmitting USB AFSK digital signals having a 1 kHz bandwidth?

- A. 14.070 MHz
- B. 14.100 MHz
- C. 14.149 MHz
- D. 14.349 MHz

2 E1B04 What must be done before placing an amateur station within an officially designated wilderness area or wildlife preserve, or an area listed in the National Register of Historic Places?

- A. A proposal must be submitted to the National Park Service
- B. A letter of intent must be filed with the Environmental Protection Agency
- C. An Environmental Assessment must be submitted to the FCC
- D. A form FSD-15 must be submitted to the Department of the Interior

3 E1C04 What is meant by IARP?

- A. An international amateur radio permit that allows U.S. amateurs to operate in certain countries of the Americas
- B. The internal amateur radio practices policy of the FCC
- C. An indication of increased antenna reflected power
- D. A forecast of intermittent aurora radio propagation

4 E1D03 What is a space telecommand station?

- A. An amateur station located on the surface of the Earth for communication with other Earth stations by means of Earth satellites
- B. An amateur station that transmits communications to initiate, modify or terminate functions of a space station
- C. An amateur station located in a satellite or a balloon more than 50 kilometers above the surface of the earth
- D. An amateur station that receives telemetry from a satellite or balloon more than 50 kilometers above the surface of the earth

5 E1E04 Which of the following best describes the Volunteer Examiner accreditation process?

- A. Each General, Advanced and Amateur Extra Class operator is automatically accredited as a VE when the license is granted
- B. The amateur operator applying must pass a VE examination administered by the FCC Enforcement Bureau
- C. The prospective VE obtains accreditation from the FCC
- D. The procedure by which a VEC confirms that the VE applicant meets FCC requirements to serve as an examiner

6 E1F05 Amateur stations may not transmit in which of the following frequency segments if they are located in the contiguous 48 states and north of Line A?

- A. 440 MHz - 450 MHz
- B. 53 MHz - 54 MHz
- C. 222 MHz - 223 MHz
- D. 420 MHz - 430 MHz

7 E2A04 What is meant by the term "mode" as applied to an amateur radio satellite?

- A. Whether the satellite is in a low earth or geostationary orbit
- B. The satellite's uplink and downlink frequency bands
- C. The satellite's orientation with respect to the Earth
- D. Whether the satellite is in a polar or equatorial orbit

8 E2B05 Which of the following describes the use of vestigial sideband in analog fast-scan TV transmissions?

- A. The vestigial sideband carries the audio information
- B. The vestigial sideband contains chroma information
- C. Vestigial sideband reduces bandwidth while allowing for simple video detector circuitry
- D. Vestigial sideband provides high frequency emphasis to sharpen the picture

9 E2C03 From which of the following bands is amateur radio contesting generally excluded?

- A. 30 meters
- B. 6 meters
- C. 2 meters
- D. 33 centimeters

10 E2D02 Which of the following is a good technique for making meteor scatter contacts?

- A. 15-second timed transmission sequences with stations alternating based on location
- B. Use of special digital modes
- C. Short transmissions with rapidly repeated call signs and signal reports
- D. All these choices are correct

11 E2E05 Which of these digital modes does not support keyboard-to-keyboard operation?

- A. PACTOR
- B. RTTY
- C. PSK31
- D. MFSK

12 E3A03 When scheduling EME contacts, which of these conditions will generally result in the least path loss?

- A. When the moon is at perigee
- B. When the moon is full
- C. When the moon is at apogee
- D. When the MUF is above 30 MHz

- 13 E3B04 What is meant by the terms "extraordinary" and "ordinary" waves?
- A. Extraordinary waves describe rare long-skip propagation compared to ordinary waves, which travel shorter distances
 - B. Independent waves created in the ionosphere that are elliptically polarized
 - C. Long-path and short-path waves
 - D. Refracted rays and reflected waves
- 14 E3C04 What does the value of B_z (B sub Z) represent?
- A. Geomagnetic field stability
 - B. Critical frequency for vertical transmissions
 - C. Direction and strength of the interplanetary magnetic field
 - D. Duration of long-delayed echoes
- 15 E4A03 Which of the following test instruments is used to display spurious signals and/or intermodulation distortion products generated by an SSB transmitter?
- A. A wattmeter
 - B. A spectrum analyzer
 - C. A logic analyzer
 - D. A time-domain reflectometer
- 16 E4B03 Which S parameter is equivalent to forward gain?
- A. S_{11}
 - B. S_{12}
 - C. S_{21}
 - D. S_{22}
- 17 E4C03 What is the term for the suppression in an FM receiver of one signal by another stronger signal on the same frequency?
- A. Desensitization
 - B. Cross-modulation interference
 - C. Capture effect
 - D. Frequency discrimination
- 18 E4D03 How can intermodulation interference between two repeaters occur?
- A. When the repeaters are in close proximity and the signals cause feedback in the final amplifier of one or both transmitters
 - B. When the repeaters are in close proximity and the signals mix in the final amplifier of one or both transmitters
 - C. When the signals from the transmitters are reflected out of phase from airplanes passing overhead
 - D. When the signals from the transmitters are reflected in phase from airplanes passing overhead
- 19 E4E02 Which of the following types of noise can often be reduced with a digital signal processing noise filter?
- A. Broadband white noise
 - B. Ignition noise
 - C. Power line noise
 - D. All these choices are correct

20 E5A06 What is the magnitude of the circulating current within the components of a parallel LC circuit at resonance?

- A. It is at a minimum
- B. It is at a maximum
- C. It equals 1 divided by the quantity 2 times pi, multiplied by the square root of inductance L multiplied by capacitance C
- D. It equals 2 multiplied by pi, multiplied by frequency, multiplied by inductance

21 E5B03 How is impedance in polar form converted to an equivalent admittance?

- A. Take the reciprocal of the angle and change the sign of the magnitude
- B. Take the reciprocal of the magnitude and change the sign of the angle
- C. Take the square root of the magnitude and add 180 degrees to the angle
- D. Square the magnitude and subtract 90 degrees from the angle

22 E5C04 What coordinate system is often used to display the resistive, inductive, and/or capacitive reactance components of impedance?

- A. Maidenhead grid
- B. Faraday grid
- C. Elliptical coordinates
- D. Rectangular coordinates

23 E5D04 Why are short connections used at microwave frequencies?

- A. To increase neutralizing resistance
- B. To reduce phase shift along the connection
- C. To increase compensating capacitance
- D. To reduce noise figure

24 E6A04 What is the name given to an impurity atom that adds holes to a semiconductor crystal structure?

- A. Insulator impurity
- B. N-type impurity
- C. Acceptor impurity
- D. Donor impurity

25 E6B04 What type of semiconductor device is designed for use as a voltage-controlled capacitor?

- A. Varactor diode
- B. Tunnel diode
- C. Silicon-controlled rectifier
- D. Zener diode

26 E6C03 What is tri-state logic?

- A. Logic devices with 0, 1, and high-impedance output states
- B. Logic devices that utilize ternary math
- C. Low-power logic devices designed to operate at 3 volts
- D. Proprietary logic devices manufactured by Tri-State Devices

27 E6D05 What is one reason for using ferrite cores rather than powdered iron in an inductor?

- A. Ferrite toroids generally have lower initial permeability
- B. Ferrite toroids generally have better temperature stability
- C. Ferrite toroids generally require fewer turns to produce a given inductance value
- D. Ferrite toroids are easier to use with surface mount technology

28 E6E04 Which is the most common input and output impedance of circuits that use MMICs?

- A. 50 ohms
- B. 300 ohms
- C. 450 ohms
- D. 10 ohms

29 E6F03 What is the most common configuration of an optoisolator or optocoupler?

- A. A lens and a photomultiplier
- B. A frequency modulated helium-neon laser
- C. An amplitude modulated helium-neon laser
- D. An LED and a phototransistor

30 E7A03 Which of the following can divide the frequency of a pulse train by 2?

- A. An XOR gate
- B. A flip-flop
- C. An OR gate
- D. A multiplexer

31 E7B02 What is a Class D amplifier?

- A. A type of amplifier that uses switching technology to achieve high efficiency
- B. A low power amplifier that uses a differential amplifier for improved linearity
- C. An amplifier that uses drift-mode FETs for high efficiency
- D. A frequency doubling amplifier

32 E7C03 What advantage does a series-L Pi-L-network have over a series-L Pi-network for impedance matching between the final amplifier of a vacuum-tube transmitter and an antenna?

- A. Greater harmonic suppression
- B. Higher efficiency
- C. Does not require a capacitor
- D. Greater transformation range

33 E7D04 Which of the following types of linear voltage regulator usually make the most efficient use of the primary power source?

- A. A series current source
- B. A series regulator
- C. A shunt regulator
- D. A shunt current source

34 E7E05 What circuit is added to an FM transmitter to boost the higher audio frequencies?

- A. A de-emphasis network
- B. A heterodyne suppressor
- C. A heterodyne enhancer
- D. A pre-emphasis network

- 35 E7F02 What kind of digital signal processing audio filter is used to remove unwanted noise from a received SSB signal?
- A. An adaptive filter B. A crystal-lattice filter
 C. A Hilbert-transform filter D. A phase-inverting filter
- 36 E7G03 What is the typical input impedance of an op-amp?
- A. 100 ohms B. 1000 ohms C. Very low D. Very high
- 37 E7H06 Which of the following oscillator circuits are commonly used in VFOs?
- A. Pierce and Zener B. Colpitts and Hartley
 C. Armstrong and deForest D. Negative feedback and balanced feedback
- 38 E8A03 What type of wave does a Fourier analysis show to be made up of sine waves of a given fundamental frequency plus all its harmonics?
- A. A sawtooth wave B. A square wave C. A sine wave D. A cosine wave
- 39 E8B03 What is the modulation index of an FM-phone signal having a maximum frequency deviation of 3000 Hz either side of the carrier frequency when the modulating frequency is 1000 Hz?
- A. 3 B. 0.3 C. 3000 D. 1000
- 40 E8C03 Why should phase-shifting of a PSK signal be done at the zero crossing of the RF signal?
- A. To minimize bandwidth B. To simplify modulation
 C. To improve carrier suppression D. All these choices are correct
- 41 E8D03 How does the spread spectrum technique of frequency hopping work?
- A. If interference is detected by the receiver it will signal the transmitter to change frequencies
 B. If interference is detected by the receiver it will signal the transmitter to wait until the frequency is clear
 C. A binary bit stream is used to shift the phase of an RF carrier very rapidly in a pseudorandom sequence
 D. The frequency of the transmitted signal is changed very rapidly according to a pseudorandom sequence also used by the receiving station
- 42 E9A03 What is the radiation resistance of an antenna?
- A. The combined losses of the antenna elements and feed line
 B. The specific impedance of the antenna
 C. The value of a resistance that would dissipate the same amount of power as that radiated from an antenna
 D. The resistance in the atmosphere that an antenna must overcome to be able to radiate a signal

43 E9B06 What is the elevation angle of peak response in the antenna radiation pattern shown in Figure E9-2?

- A. 45 degrees
- B. 75 degrees
- C. 7.5 degrees
- D. 25 degrees

44 E9C03 What is the radiation pattern of two 1/4-wavelength vertical antennas spaced 1/2 wavelength apart and fed in phase?

- A. Omni-directional
- B. Cardioid
- C. A Figure-8 broadside to the axis of the array
- D. A Figure-8 end-fire along the axis of the array

45 E9D03 Where should a high Q loading coil be placed to minimize losses in a shortened vertical antenna?

- A. Near the center of the vertical radiator
- B. As low as possible on the vertical radiator
- C. As close to the transmitter as possible
- D. At a voltage node

46 E9E04 What is the purpose of the series capacitor in a gamma-type antenna matching network?

- A. To provide DC isolation between the feed line and the antenna
- B. To cancel the inductive reactance of the matching network
- C. To provide a rejection notch that prevents the radiation of harmonics
- D. To transform the antenna impedance to a higher value

47 E9F03 Why is the physical length of a coaxial cable transmission line shorter than its electrical length?

- A. Skin effect is less pronounced in the coaxial cable
- B. The characteristic impedance is higher in a parallel feed line
- C. The surge impedance is higher in a parallel feed line
- D. Electrical signals move more slowly in a coaxial cable than in air

48 E9G03 Which of the following is often determined using a Smith chart?

- A. Beam headings and radiation patterns
- B. Satellite azimuth and elevation bearings
- C. Impedance and SWR values in transmission lines
- D. Trigonometric functions

49 E9H04 What is an advantage of placing a grounded electrostatic shield around a small loop direction-finding antenna?

- A. It adds capacitive loading, increasing the bandwidth of the antenna
- B. It eliminates unbalanced capacitive coupling to the surroundings, improving the nulls
- C. It eliminates tracking errors caused by strong out-of-band signals
- D. It increases signal strength by providing a better match to the feed line

50 E0A03 Over what range of frequencies are the FCC human body RF exposure limits most restrictive?

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

Amateur Extra Quiz 2

- | | | | |
|----|-----------|----|-----------|
| 1 | E1A03 (C) | 26 | E6C03 (A) |
| 2 | E1B04 (C) | 27 | E6D05 (C) |
| 3 | E1C04 (A) | 28 | E6E04 (A) |
| 4 | E1D03 (B) | 29 | E6F03 (D) |
| 5 | E1E04 (D) | 30 | E7A03 (B) |
| 6 | E1F05 (D) | 31 | E7B02 (A) |
| 7 | E2A04 (B) | 32 | E7C03 (A) |
| 8 | E2B05 (C) | 33 | E7D04 (B) |
| 9 | E2C03 (A) | 34 | E7E05 (D) |
| 10 | E2D02 (D) | 35 | E7F02 (A) |
| 11 | E2E05 (A) | 36 | E7G03 (D) |
| 12 | E3A03 (A) | 37 | E7H06 (B) |
| 13 | E3B04 (B) | 38 | E8A03 (A) |
| 14 | E3C04 (C) | 39 | E8B03 (A) |
| 15 | E4A03 (B) | 40 | E8C03 (A) |
| 16 | E4B03 (C) | 41 | E8D03 (D) |
| 17 | E4C03 (C) | 42 | E9A03 (C) |
| 18 | E4D03 (B) | 43 | E9B06 (C) |
| 19 | E4E02 (D) | 44 | E9C03 (C) |
| 20 | E5A06 (B) | 45 | E9D03 (A) |
| 21 | E5B03 (B) | 46 | E9E04 (B) |
| 22 | E5C04 (D) | 47 | E9F03 (D) |
| 23 | E5D04 (B) | 48 | E9G03 (C) |
| 24 | E6A04 (C) | 49 | E9H04 (B) |
| 25 | E6B04 (A) | 50 | E0A03 (C) |

Amateur Extra Quiz 3

1 E1A08 If a station in a message forwarding system inadvertently forwards a message that is in violation of FCC rules, who is primarily accountable for the rules violation?

- A. The control operator of the packet bulletin board station
- B. The control operator of the originating station
- C. The control operators of all the stations in the system
- D. The control operators of all the stations in the system not authenticating the source from which they accept communications

2 E1B05 What is the National Radio Quiet Zone?

- A. An area in Puerto Rico surrounding the Arecibo Radio Telescope
- B. An area in New Mexico surrounding the White Sands Test Area
- C. An area surrounding the National Radio Astronomy Observatory
- D. An area in Florida surrounding Cape Canaveral

3 E1C05 When may an automatically controlled station originate third party communications?

- A. Never
- B. Only when transmitting RTTY or data emissions
- C. When agreed upon by the sending or receiving station
- D. When approved by the National Telecommunication and Information Administration

4 E1D04 Which of the following is required in the identification transmissions from a balloon-borne telemetry station?

- A. Call sign
- B. The output power of the balloon transmitter
- C. The station's six-character Maidenhead grid locator
- D. All these choices are correct

5 E1E05 What is the minimum passing score on all amateur operator license examinations?

- A. Minimum passing score of 70%
- B. Minimum passing score of 74%
- C. Minimum passing score of 80%
- D. Minimum passing score of 77%

6 E1F06 Under what circumstances might the FCC issue a Special Temporary Authority (STA) to an amateur station?

- A. To provide for experimental amateur communications
- B. To allow regular operation on Land Mobile channels
- C. To provide additional spectrum for personal use
- D. To provide temporary operation while awaiting normal licensing

7 E2A05 What do the letters in a satellite's mode designator specify?

- A. Power limits for uplink and downlink transmissions
- B. The location of the ground control station
- C. The polarization of uplink and downlink signals
- D. The uplink and downlink frequency ranges

8 E2B06 What is vestigial sideband modulation?

- A. Amplitude modulation in which one complete sideband and a portion of the other are transmitted
- B. A type of modulation in which one sideband is inverted
- C. Narrow-band FM modulation achieved by filtering one sideband from the audio before frequency modulating the carrier
- D. Spread spectrum modulation achieved by applying FM modulation following single sideband amplitude modulation

9 E2C04 Which of the following frequencies are sometimes used for amateur radio mesh networks?

- A. HF frequencies where digital communications are permitted
- B. Frequencies shared with various unlicensed wireless data services
- C. Cable TV channels 41 through 43
- D. The 60 meter band channel centered on 5373 kHz

10 E2D03 Which of the following digital modes is especially useful for EME communications?

- A. MSK144
- B. PACTOR III
- C. Olivia
- D. JT65

11 E2E08 Which of the following HF digital modes can be used to transfer binary files?

- A. Hellschreiber
- B. PACTOR
- C. RTTY
- D. AMTOR

12 E3A04 What do Hepburn maps predict?

- A. Sporadic E propagation
- B. Locations of auroral reflecting zones
- C. Likelihood of rain scatter along cold or warm fronts
- D. Probability of tropospheric propagation

13 E3B05 Which amateur bands typically support long-path propagation?

- A. Only 160 meters to 40 meters
- B. Only 30 meters to 10 meters
- C. 160 meters to 10 meters
- D. 6 meters to 2 meters

14 E3C06 By how much does the VHF/UHF radio horizon distance exceed the geometric horizon?

- A. By approximately 15 percent of the distance
- B. By approximately twice the distance
- C. By approximately 50 percent of the distance
- D. By approximately four times the distance

15 E4A04 How is the compensation of an oscilloscope probe typically adjusted?

- A. A square wave is displayed and the probe is adjusted until the horizontal portions of the displayed wave are as nearly flat as possible
- B. A high frequency sine wave is displayed and the probe is adjusted for maximum amplitude
- C. A frequency standard is displayed and the probe is adjusted until the deflection time is accurate
- D. A DC voltage standard is displayed and the probe is adjusted until the displayed voltage is accurate

16 E4B05 What three test loads are used to calibrate an RF vector network analyzer?

- A. 50 ohms, 75 ohms, and 90 ohms
- B. Short circuit, open circuit, and 50 ohms
- C. Short circuit, open circuit, and resonant circuit
- D. 50 ohms through $1/8$ wavelength, $1/4$ wavelength, and $1/2$ wavelength of coaxial cable

17 E4C04 What is the noise figure of a receiver?

- A. The ratio of atmospheric noise to phase noise
- B. The ratio of the noise bandwidth in hertz to the theoretical bandwidth of a resistive network
- C. The ratio of thermal noise to atmospheric noise
- D. The ratio in dB of the noise generated by the receiver to the theoretical minimum noise

18 E4D04 Which of the following may reduce or eliminate intermodulation interference in a repeater caused by another transmitter operating in close proximity?

- A. A band-pass filter in the feed line between the transmitter and receiver
- B. A properly terminated circulator at the output of the repeater's transmitter
- C. Utilizing a Class C final amplifier
- D. Utilizing a Class D final amplifier

19 E4E03 Which of the following signals might a receiver noise blanker be able to remove from desired signals?

- A. Signals that are constant at all IF levels
- B. Signals that appear across a wide bandwidth
- C. Signals that appear at one IF but not another
- D. Signals that have a sharply peaked frequency distribution

20 E5A08 What is the phase relationship between the current through and the voltage across a series resonant circuit at resonance?

- A. The voltage leads the current by 90 degrees
- B. The current leads the voltage by 90 degrees
- C. The voltage and current are in phase
- D. The voltage and current are 180 degrees out of phase

21 E5B04 What is the time constant of a circuit having two 220 microfarad capacitors and two 1 megohm resistors, all in parallel?

- A. 55 seconds
- B. 110 seconds
- C. 440 seconds
- D. 220 seconds

22 E5C05 What is the name of the diagram used to show the phase relationship between impedances at a given frequency?

- A. Venn diagram
- B. Near field diagram
- C. Phasor diagram
- D. Far field diagram

23 E5D05 What is the power factor of an RL circuit having a 30-degree phase angle between the voltage and the current?

- A. 1.73
- B. 0.5
- C. 0.866
- D. 0.577

24 E6A05 How does DC input impedance at the gate of a field-effect transistor compare with the DC input impedance of a bipolar transistor?

- A. They are both low impedance
- B. An FET has lower input impedance
- C. An FET has higher input impedance
- D. They are both high impedance

25 E6B05 What characteristic of a PIN diode makes it useful as an RF switch?

- A. Extremely high reverse breakdown voltage
- B. Ability to dissipate large amounts of power
- C. Reverse bias controls its forward voltage drop
- D. Low junction capacitance

- 26 E6C04 Which of the following is an advantage of BiCMOS logic?
- A. Its simplicity results in much less expensive devices than standard CMOS
 - B. It is immune to electrostatic damage
 - C. It has the high input impedance of CMOS and the low output impedance of bipolar transistors
 - D. All these choices are correct
- 27 E6D06 What core material property determines the inductance of an inductor?
- A. Thermal impedance
 - B. Resistance
 - C. Reactivity
 - D. Permeability
- 28 E6E06 What characteristics of the MMIC make it a popular choice for VHF through microwave circuits?
- A. The ability to retrieve information from a single signal even in the presence of other strong signals
 - B. Plate current that is controlled by a control grid
 - C. Nearly infinite gain, very high input impedance, and very low output impedance
 - D. Controlled gain, low noise figure, and constant input and output impedance over the specified frequency range
- 29 E6F04 What is the photovoltaic effect?
- A. The conversion of voltage to current when exposed to light
 - B. The conversion of light to electrical energy
 - C. The conversion of electrical energy to mechanical energy
 - D. The tendency of a battery to discharge when exposed to light
- 30 E7A05 Which of the following is a circuit that continuously alternates between two states without an external clock?
- A. Monostable multivibrator
 - B. J-K flip-flop
 - C. T flip-flop
 - D. Astable multivibrator
- 31 E7B03 Which of the following components form the output of a class D amplifier circuit?
- A. A low-pass filter to remove switching signal components
 - B. A high-pass filter to compensate for low gain at low frequencies
 - C. A matched load resistor to prevent damage by switching transients
 - D. A temperature compensating load resistor to improve linearity
- 32 E7C05 Which filter type is described as having ripple in the passband and a sharp cutoff?
- A. A Butterworth filter
 - B. An active LC filter
 - C. A passive op-amp filter
 - D. A Chebyshev filter

- 33 E7D06 What is the purpose of Q1 in the circuit shown in Figure E7-2?
- A. It provides negative feedback to improve regulation
 - B. It provides a constant load for the voltage source
 - C. It controls the current supplied to the load
 - D. It provides D1 with current
- 34 E7E06 Why is de-emphasis commonly used in FM communications receivers?
- A. For compatibility with transmitters using phase modulation
 - B. To reduce impulse noise reception
 - C. For higher efficiency
 - D. To remove third-order distortion products
- 35 E7F04 What is a common method of generating an SSB signal using digital signal processing?
- A. Mixing products are converted to voltages and subtracted by adder circuits
 - B. A frequency synthesizer removes the unwanted sidebands
 - C. Varying quartz crystal characteristics emulated in digital form
 - D. Signals are combined in quadrature phase relationship
- 36 E7G04 What is meant by the "op-amp input offset voltage"?
- A. The output voltage of the op-amp minus its input voltage
 - B. The difference between the output voltage of the op-amp and the input voltage required in the immediately following stage
 - C. The differential input voltage needed to bring the open loop output voltage to zero
 - D. The potential between the amplifier input terminals of the op-amp in an open loop condition
- 37 E7H07 How can an oscillator's microphonic responses be reduced?
- A. Use NP0 capacitors
 - B. Reduce noise on the oscillator's power supply
 - C. Increase the bias voltage
 - D. Mechanically isolate the oscillator circuitry from its enclosure
- 38 E8A04 What is "dither" with respect to analog-to-digital converters?
- A. An abnormal condition where the converter cannot settle on a value to represent the signal
 - B. A small amount of noise added to the input signal to allow more precise representation of a signal over time
 - C. An error caused by irregular quantization step size
 - D. A method of decimation by randomly skipping samples

39 E8B05 What is the deviation ratio of an FM-phone signal having a maximum frequency swing of plus-or-minus 5 kHz when the maximum modulation frequency is 3 kHz?

- A. 60
- B. 0.167
- C. 0.6
- D. 1.67

40 E8C04 What technique minimizes the bandwidth of a PSK31 signal?

- A. Zero-sum character encoding
- B. Reed-Solomon character encoding
- C. Use of sinusoidal data pulses
- D. Use of trapezoidal data pulses

41 E8D05 What is the most common method of reducing key clicks?

- A. Increase keying waveform rise and fall times
- B. Low-pass filters at the transmitter output
- C. Reduce keying waveform rise and fall times
- D. High-pass filters at the transmitter output

42 E9A05 What is included in the total resistance of an antenna system?

- A. Radiation resistance plus space impedance
- B. Radiation resistance plus transmission resistance
- C. Transmission-line resistance plus radiation resistance
- D. Radiation resistance plus loss resistance

43 E9B07 How does the total amount of radiation emitted by a directional gain antenna compare with the total amount of radiation emitted from a theoretical isotropic antenna, assuming each is driven by the same amount of power?

- A. The total amount of radiation from the directional antenna is increased by the gain of the antenna
- B. The total amount of radiation from the directional antenna is stronger by its front-to-back ratio
- C. They are the same
- D. The radiation from the isotropic antenna is 2.15 dB stronger than that from the directional antenna

44 E9C04 What happens to the radiation pattern of an unterminated long wire antenna as the wire length is increased?

- A. The lobes become more perpendicular to the wire
- B. The lobes align more in the direction of the wire
- C. The vertical angle increases
- D. The front-to-back ratio decreases

- 45 E9D05 What usually occurs if a Yagi antenna is designed solely for maximum forward gain?
- A. The front-to-back ratio increases
 - B. The front-to-back ratio decreases
 - C. The frequency response is widened over the whole frequency band
 - D. The SWR is reduced
- 46 E9E05 How must an antenna's driven element be tuned to use a hairpin matching system?
- A. The driven element reactance must be capacitive
 - B. The driven element reactance must be inductive
 - C. The driven element resonance must be lower than the operating frequency
 - D. The driven element radiation resistance must be higher than the characteristic impedance of the transmission line
- 47 E9F05 What is the approximate physical length of a solid polyethylene dielectric coaxial transmission line that is electrically 1/4 wavelength long at 14.1 MHz?
- A. 10.6 meters
 - B. 5.3 meters
 - C. 4.3 meters
 - D. 3.5 meters
- 48 E9G04 What are the two families of circles and arcs that make up a Smith chart?
- A. Resistance and voltage
 - B. Reactance and voltage
 - C. Resistance and reactance
 - D. Voltage and impedance
- 49 E9H05 What is the main drawback of a small wire-loop antenna for direction finding?
- A. It has a bidirectional pattern
 - B. It has no clearly defined null
 - C. It is practical for use only on VHF and higher bands
 - D. All these choices are correct
- 50 E0A04 When evaluating a site with multiple transmitters operating at the same time, the operators and licensees of which transmitters are responsible for mitigating over-exposure situations?
- A. Only the most powerful transmitter
 - B. Only commercial transmitters
 - C. Each transmitter that produces 5 percent or more of its MPE limit in areas where the total MPE limit is exceeded.
 - D. Each transmitter operating with a duty cycle greater than 50 percent

Amateur Extra Quiz 3

- | | | | |
|----|-----------|----|-----------|
| 1 | E1A08 (B) | 26 | E6C04 (C) |
| 2 | E1B05 (C) | 27 | E6D06 (D) |
| 3 | E1C05 (A) | 28 | E6E06 (D) |
| 4 | E1D04 (A) | 29 | E6F04 (B) |
| 5 | E1E05 (B) | 30 | E7A05 (D) |
| 6 | E1F06 (A) | 31 | E7B03 (A) |
| 7 | E2A05 (D) | 32 | E7C05 (D) |
| 8 | E2B06 (A) | 33 | E7D06 (C) |
| 9 | E2C04 (B) | 34 | E7E06 (A) |
| 10 | E2D03 (D) | 35 | E7F04 (D) |
| 11 | E2E08 (B) | 36 | E7G04 (C) |
| 12 | E3A04 (D) | 37 | E7H07 (D) |
| 13 | E3B05 (C) | 38 | E8A04 (B) |
| 14 | E3C06 (A) | 39 | E8B05 (D) |
| 15 | E4A04 (A) | 40 | E8C04 (C) |
| 16 | E4B05 (B) | 41 | E8D05 (A) |
| 17 | E4C04 (D) | 42 | E9A05 (D) |
| 18 | E4D04 (B) | 43 | E9B07 (C) |
| 19 | E4E03 (B) | 44 | E9C04 (B) |
| 20 | E5A08 (C) | 45 | E9D05 (B) |
| 21 | E5B04 (D) | 46 | E9E05 (A) |
| 22 | E5C05 (C) | 47 | E9F05 (D) |
| 23 | E5D05 (C) | 48 | E9G04 (C) |
| 24 | E6A05 (C) | 49 | E9H05 (A) |
| 25 | E6B05 (D) | 50 | E0A04 (C) |

Amateur Extra Quiz 4

1 E1A09 What action or actions should you take if your digital message forwarding station inadvertently forwards a communication that violates FCC rules?

- A. Discontinue forwarding the communication as soon as you become aware of it
- B. Notify the originating station that the communication does not comply with FCC rules
- C. Notify the nearest FCC Field Engineers office
- D. All these choices are correct

2 E1B06 Which of the following additional rules apply if you are installing an amateur station antenna at a site at or near a public use airport?

- A. You may have to notify the Federal Aviation Administration and register it with the FCC as required by Part 17 of the FCC rules
- B. You must submit engineering drawings to the FAA
- C. You must file an Environmental Impact Statement with the EPA before construction begins
- D. You must obtain a construction permit from the airport zoning authority

3 E1C06 Which of the following is required in order to operate in accordance with CEPT rules in foreign countries where permitted?

- A. You must identify in the official language of the country in which you are operating
- B. The U.S. embassy must approve of your operation
- C. You must bring a copy of FCC Public Notice DA 16-1048
- D. You must append "/CEPT" to your call sign

4 E1D06 What is the maximum permitted transmitter output power when operating a model craft by telecommand?

- A. 1 watt
- B. 2 watts
- C. 5 watts
- D. 100 watts

5 E1E06 Who is responsible for the proper conduct and necessary supervision during an amateur operator license examination session?

- A. The VEC coordinating the session
- B. The FCC
- C. Each administering VE
- D. The VE session manager

6 E1F08 Which of the following types of amateur station communications are prohibited?

- A. Communications transmitted for hire or material compensation, except as otherwise provided in the rules
- B. Communications that have political content, except as allowed by the Fairness Doctrine
- C. Communications that have religious content
- D. Communications in a language other than English

7 E2A06 What are Keplerian elements?

- A. Parameters that define the orbit of a satellite
- B. Phase reversing elements in a Yagi antenna
- C. High-emission heater filaments used in magnetron tubes
- D. Encrypting codes used for spread spectrum modulation

8 E2B07 What is the name of the signal component that carries color information in NTSC video?

- A. Luminance
- B. Chroma
- C. Hue
- D. Spectral intensity

9 E2C05 What is the function of a DX QSL Manager?

- A. To allocate frequencies for DXpeditions
- B. To handle the receiving and sending of confirmation cards for a DX station
- C. To run a net to allow many stations to contact a rare DX station
- D. To relay calls to and from a DX station

10 E2D04 What technology is used to track, in real time, balloons carrying amateur radio transmitters?

- A. Ultrasonics
- B. Bandwidth compressed LORAN
- C. APRS
- D. Doppler shift of beacon signals

11 E2E09 Which of the following HF digital modes uses variable-length coding for bandwidth efficiency?

- A. RTTY
- B. PACTOR
- C. MT63
- D. PSK31

12 E3A05 Tropospheric propagation of microwave signals often occurs in association with what phenomenon?

- A. Grayline
- B. Lightning discharges
- C. Warm and cold fronts
- D. Sprites and jets

13 E3B06 Which of the following amateur bands most frequently provides long-path propagation?

- A. 80 meters
- B. 20 meters
- C. 10 meters
- D. 6 meters

14 E3C10 What does the 304A solar parameter measure?

- A. The ratio of x-ray flux to radio flux, correlated to sunspot number
- B. UV emissions at 304 angstroms, correlated to the solar flux index
- C. The solar wind velocity at 304 degrees from the solar equator, correlated to solar activity
- D. The solar emission at 304 GHz, correlated to x-ray flare levels

15 E4A05 What is the purpose of the prescaler function on a frequency counter?
A. It amplifies low-level signals for more accurate counting
B. It multiplies a higher frequency signal so a low-frequency counter can display the operating frequency
C. It prevents oscillation in a low-frequency counter circuit
D. It divides a higher frequency signal so a low-frequency counter can display the input frequency

16 E4B06 How much power is being absorbed by the load when a directional power meter connected between a transmitter and a terminating load reads 100 watts forward power and 25 watts reflected power?
A. 100 watts B. 125 watts C. 25 watts D. 75 watts

17 E4C05 What does a receiver noise floor of -174 dBm represent?
A. The minimum detectable signal as a function of receive frequency
B. The theoretical noise in a 1 Hz bandwidth at the input of a perfect receiver at room temperature
C. The noise figure of a 1 Hz bandwidth receiver
D. The galactic noise contribution to minimum detectable signal

18 E4D06 What is the term for spurious signals generated by the combination of two or more signals in a non-linear device or circuit?
A. Amplifier desensitization B. Neutralization
C. Adjacent channel interference D. Intermodulation

19 E4E04 How can conducted and radiated noise caused by an automobile alternator be suppressed?
A. By installing filter capacitors in series with the DC power lead and a blocking capacitor in the field lead
B. By installing a noise suppression resistor and a blocking capacitor in both leads
C. By installing a high-pass filter in series with the radio's power lead and a low-pass filter in parallel with the field lead
D. By connecting the radio's power leads directly to the battery and by installing coaxial capacitors in line with the alternator leads

20 E5A09 How is the Q of an RLC parallel resonant circuit calculated?
A. Reactance of either the inductance or capacitance divided by the resistance
B. Reactance of either the inductance or capacitance multiplied by the resistance
C. Resistance divided by the reactance of either the inductance or capacitance
D. Reactance of the inductance multiplied by the reactance of the capacitance

21 E5B05 What happens to the magnitude of a pure reactance when it is converted to a susceptance?

- A. It is unchanged
- B. The sign is reversed
- C. It is shifted by 90 degrees
- D. It becomes the reciprocal

22 E5C06 What does the impedance $50-j25$ represent?

- A. 50 ohms resistance in series with 25 ohms inductive reactance
- B. 50 ohms resistance in series with 25 ohms capacitive reactance
- C. 25 ohms resistance in series with 50 ohms inductive reactance
- D. 25 ohms resistance in series with 50 ohms capacitive reactance

23 E5D06 In what direction is the magnetic field oriented about a conductor in relation to the direction of electron flow?

- A. In the same direction as the current
- B. In a direction opposite to the current
- C. In all directions; omni-directional
- D. In a circle around the conductor

24 E6A06 What is the beta of a bipolar junction transistor?

- A. The frequency at which the current gain is reduced to 0.707
- B. The change in collector current with respect to base current
- C. The breakdown voltage of the base to collector junction
- D. The switching speed

25 E6B06 Which of the following is a common use of a Schottky diode?

- A. As a rectifier in high current power supplies
- B. As a variable capacitance in an automatic frequency control circuit
- C. As a constant voltage reference in a power supply
- D. As a VHF/UHF mixer or detector

26 E6C05 What is an advantage of CMOS logic devices over TTL devices?

- A. Differential output capability
- B. Lower distortion
- C. Immune to damage from static discharge
- D. Lower power consumption

27 E6D07 What is current in the primary winding of a transformer called if no load is attached to the secondary?

- A. Magnetizing current
- B. Direct current
- C. Excitation current
- D. Stabilizing current

28 E6E07 What type of transmission line is used for connections to MMICs?

- A. Miniature coax
- B. Circular waveguide
- C. Parallel wire
- D. Microstrip

29 E6F05 Which describes an optical shaft encoder?

- A. A device that detects rotation of a control by interrupting a light source with a patterned wheel
- B. A device that measures the strength of a beam of light using analog to digital conversion
- C. A digital encryption device often used to encrypt spacecraft control signals
- D. A device for generating RTTY signals by means of a rotating light source

30 E7A06 What is a characteristic of a monostable multivibrator?

- A. It switches momentarily to the opposite binary state and then returns to its original state after a set time
- B. It produces a continuous square wave oscillating between 1 and 0
- C. It stores one bit of data in either a 0 or 1 state
- D. It maintains a constant output voltage, regardless of variations in the input voltage

31 E7B05 What can be done to prevent unwanted oscillations in an RF power amplifier?

- A. Tune the stage for maximum SWR
- B. Tune both the input and output for maximum power
- C. Install parasitic suppressors and/or neutralize the stage
- D. Use a phase inverter in the output filter

32 E7C06 What are the distinguishing features of an elliptical filter?

- A. Gradual passband rolloff with minimal stop band ripple
- B. Extremely flat response over its pass band with gradually rounded stop band corners
- C. Extremely sharp cutoff with one or more notches in the stop band
- D. Gradual passband rolloff with extreme stop band ripple

33 E7D07 What is the purpose of C2 in the circuit shown in Figure E7-2?

- A. It bypasses rectifier output ripple around D1
- B. It is a brute force filter for the output
- C. To self-resonate at the hum frequency
- D. To provide fixed DC bias for Q1

34 E7E07 What is meant by the term "baseband" in radio communications?

- A. The lowest frequency band that the transmitter or receiver covers
- B. The frequency range occupied by a message signal prior to modulation
- C. The unmodulated bandwidth of the transmitted signal
- D. The basic oscillator frequency in an FM transmitter that is multiplied to increase the deviation and carrier frequency

- 35 E7F07 What function is performed by a Fast Fourier Transform?
- A. Converting analog signals to digital form
 - B. Converting digital signals to analog form
 - C. Converting digital signals from the time domain to the frequency domain
 - D. Converting 8-bit data to 16-bit data
- 36 E7G05 How can unwanted ringing and audio instability be prevented in an op-amp RC audio filter circuit?
- A. Restrict both gain and Q
 - B. Restrict gain but increase Q
 - C. Restrict Q but increase gain
 - D. Increase both gain and Q
- 37 E7H12 Which of the following must be done to ensure that a crystal oscillator provides the frequency specified by the crystal manufacturer?
- A. Provide the crystal with a specified parallel inductance
 - B. Provide the crystal with a specified parallel capacitance
 - C. Bias the crystal at a specified voltage
 - D. Bias the crystal at a specified current
- 38 E8A05 What of the following instruments would be the most accurate for measuring the RMS voltage of a complex waveform?
- A. A grid dip meter
 - B. A D'Arsonval meter
 - C. An absorption wave meter
 - D. A true-RMS calculating meter
- 39 E8B07 Orthogonal Frequency Division Multiplexing is a technique used for which type of amateur communication?
- A. High-speed digital modes
 - B. Extremely low-power contacts
 - C. EME
 - D. OFDM signals are not allowed on amateur bands
- 40 E8C05 What is the approximate bandwidth of a 13-WPM International Morse Code transmission?
- A. 13 Hz
 - B. 26 Hz
 - C. 52 Hz
 - D. 104 Hz
- 41 E8D06 What is the advantage of including parity bits in ASCII characters?
- A. Faster transmission rate
 - B. The signal can overpower interfering signals
 - C. Foreign language characters can be sent
 - D. Some types of errors can be detected
- 42 E9A07 What is the effective isotropic radiated power of a repeater station with 200 watts transmitter power output, 2 dB feed line loss, 2.8 dB duplexer loss, 1.2 dB circulator loss, and 7 dBi antenna gain?
- A. 159 watts
 - B. 252 watts
 - C. 632 watts
 - D. 63.2 watts

43 E9B08 What is the far field of an antenna?

- A. The region of the ionosphere where radiated power is not refracted
- B. The region where radiated power dissipates over a specified time period
- C. The region where radiated field strengths are constant
- D. The region where the shape of the antenna pattern is independent of distance

44 E9C05 Which of the following is a type of OCFD antenna?

- A. A dipole fed approximately 1/3 the way from one end with a 4:1 balun to provide multiband operation
- B. A remotely tunable dipole antenna using orthogonally controlled frequency diversity
- C. A folded dipole center-fed with 300-ohm transmission line
- D. A multiband dipole antenna using one-way circular polarization for frequency diversity

45 E9D06 What happens to the SWR bandwidth when one or more loading coils are used to resonate an electrically short antenna?

- A. It is increased
- B. It is decreased
- C. It is unchanged if the loading coil is located at the feed point
- D. It is unchanged if the loading coil is located at a voltage maximum point

46 E9E07 What parameter describes the interactions at the load end of a mismatched transmission line?

- A. Characteristic impedance
- B. Reflection coefficient
- C. Velocity factor
- D. Dielectric constant

47 E9F07 How does ladder line compare to small-diameter coaxial cable such as RG-58 at 50 MHz?

- A. Lower loss
- B. Higher SWR
- C. Smaller reflection coefficient
- D. Lower velocity factor

48 E9G05 Which of the following is a common use for a Smith chart?

- A. Determine the length and position of an impedance matching stub
- B. Determine the impedance of a transmission line, given the physical dimensions
- C. Determine the gain of an antenna given the physical and electrical parameters
- D. Determine the loss/100 feet of a transmission line, given the velocity factor and conductor materials

49 E9H06 What is the triangulation method of direction finding?

- A. The geometric angles of sky waves from the source are used to determine its position
- B. A fixed receiving station plots three headings to the signal source
- C. Antenna headings from several different receiving locations are used to locate the signal source
- D. A fixed receiving station uses three different antennas to plot the location of the signal source

50 E0A06 Why are there separate electric (E) and magnetic (H) field MPE limits?

- A. The body reacts to electromagnetic radiation from both the E and H fields
- B. Ground reflections and scattering make the field strength vary with location
- C. E field and H field radiation intensity peaks can occur at different locations
- D. All these choices are correct

Amateur Extra Quiz 4

1	E1A09 (A)	26	E6C05 (D)
2	E1B06 (A)	27	E6D07 (A)
3	E1C06 (C)	28	E6E07 (D)
4	E1D06 (A)	29	E6F05 (A)
5	E1E06 (C)	30	E7A06 (A)
6	E1F08 (A)	31	E7B05 (C)
7	E2A06 (A)	32	E7C06 (C)
8	E2B07 (B)	33	E7D07 (A)
9	E2C05 (B)	34	E7E07 (B)
10	E2D04 (C)	35	E7F07 (C)
11	E2E09 (D)	36	E7G05 (A)
12	E3A05 (C)	37	E7H12 (B)
13	E3B06 (B)	38	E8A05 (D)
14	E3C10 (B)	39	E8B07 (A)
15	E4A05 (D)	40	E8C05 (C)
16	E4B06 (D)	41	E8D06 (D)
17	E4C05 (B)	42	E9A07 (B)
18	E4D06 (D)	43	E9B08 (D)
19	E4E04 (D)	44	E9C05 (A)
20	E5A09 (C)	45	E9D06 (B)
21	E5B05 (D)	46	E9E07 (B)
22	E5C06 (B)	47	E9F07 (A)
23	E5D06 (D)	48	E9G05 (A)
24	E6A06 (B)	49	E9H06 (C)
25	E6B06 (D)	50	E0A06 (D)

Amateur Extra Quiz 5

- 1 E1A10 If an amateur station is installed aboard a ship or aircraft, what condition must be met before the station is operated?
- A. Its operation must be approved by the master of the ship or the pilot in command of the aircraft
 - B. The amateur station operator must agree not to transmit when the main radio of the ship or aircraft is in use
 - C. The amateur station must have a power supply that is completely independent of the main ship or aircraft power supply
 - D. The amateur operator must have an FCC Marine or Aircraft endorsement on his or her amateur license
- 2 E1B07 To what type of regulations does PRB-1 apply?
- A. Homeowners associations
 - B. FAA tower height limits
 - C. State and local zoning
 - D. Use of wireless devices in vehicles
- 3 E1C07 At what level below a signal's mean power level is its bandwidth determined according to FCC rules?
- A. 3 dB
 - B. 6 dB
 - C. 23 dB
 - D. 26 dB
- 4 E1D07 Which HF amateur bands have frequencies authorized for space stations?
- A. Only the 40, 20, 17, 15, 12, and 10 meter bands
 - B. Only the 40, 20, 17, 15, and 10 meter bands
 - C. Only the 40, 30, 20, 15, 12, and 10 meter bands
 - D. All HF bands
- 5 E1E08 To which of the following examinees may a VE not administer an examination?
- A. Employees of the VE
 - B. Friends of the VE
 - C. Relatives of the VE as listed in the FCC rules
 - D. All these choices are correct
- 6 E1F09 Which of the following conditions apply when transmitting spread spectrum emissions?
- A. A station transmitting SS emission must not cause harmful interference to other stations employing other authorized emissions
 - B. The transmitting station must be in an area regulated by the FCC or in a country that permits SS emissions
 - C. The transmission must not be used to obscure the meaning of any communication
 - D. All these choices are correct

7 E2A10 What type of satellite appears to stay in one position in the sky?

- A. HEO
- B. Geostationary
- C. Geomagnetic
- D. LEO

8 E2B08 What technique allows commercial analog TV receivers to be used for fast-scan TV operations on the 70 cm band?

- A. Transmitting on channels shared with cable TV
- B. Using converted satellite TV dishes
- C. Transmitting on the abandoned TV channel 2
- D. Using USB and demodulating the signal with a computer sound card

9 E2C06 During a VHF/UHF contest, in which band segment would you expect to find the highest level of SSB or CW activity?

- A. At the top of each band, usually in a segment reserved for contests
- B. In the middle of each band, usually on the national calling frequency
- C. In the weak signal segment of the band, with most of the activity near the calling frequency
- D. In the middle of the band, usually 25 kHz above the national calling frequency

10 E2D07 What digital protocol is used by APRS?

- A. PACTOR
- B. 802.11
- C. AX.25
- D. AMTOR

11 E2E10 Which of these digital modes has the narrowest bandwidth?

- A. MFSK16
- B. 170 Hz shift, 45-baud RTTY
- C. PSK31
- D. 300-baud packet

12 E3A07 Atmospheric ducts capable of propagating microwave signals often form over what geographic feature?

- A. Mountain ranges
- B. Forests
- C. Bodies of water
- D. Urban areas

13 E3B10 Why is chordal hop propagation desirable?

- A. The signal experiences less loss compared to multi-hop using Earth as a reflector.
- B. The MUF for chordal hop propagation is much lower than for normal skip propagation.
- C. Atmospheric noise is lower in the direction of chordal hop propagation.
- D. Signals travel faster along ionospheric chords.

14 E3C13 What type of polarization is best for ground-wave propagation?

- A. Vertical
- B. Horizontal
- C. Circular
- D. Elliptical

15 E4A06 What is the effect of aliasing on a digital oscilloscope caused by setting the time base too slow?

- A. A false, jittery low-frequency version of the signal is displayed.
- B. All signals will have a DC offset.
- C. Calibration of the vertical scale is no longer valid.
- D. Excessive blanking occurs, which prevents display of the signal.

16 E4B08 Which of the following can be used to measure the Q of a series-tuned circuit?

- A. The inductance to capacitance ratio
- B. The frequency shift
- C. The bandwidth of the circuit's frequency response
- D. The resonant frequency of the circuit

17 E4C06 A CW receiver with the AGC off has an equivalent input noise power density of -174 dBm/Hz. What would be the level of an unmodulated carrier input to this receiver that would yield an audio output SNR of 0 dB in a 400 Hz noise bandwidth?

- A. -174 dBm
- B. -164 dBm
- C. -155 dBm
- D. -148 dBm

18 E4D09 What is the purpose of the preselector in a communications receiver?

- A. To store often-used frequencies
- B. To provide a range of AGC time constants
- C. To increase rejection of signals outside the desired band
- D. To allow selection of the optimum RF amplifier device

19 E4E05 How can radio frequency interference from an AC motor be suppressed?

- A. By installing a high-pass filter in series with the motor's power leads
- B. By installing a brute-force AC-line filter in series with the motor leads
- C. By installing a bypass capacitor in series with the motor leads
- D. By using a ground-fault current interrupter in the circuit used to power the motor

20 E5A10 How is the Q of an RLC series resonant circuit calculated?

- A. Reactance of either the inductance or capacitance divided by the resistance
- B. Reactance of either the inductance or capacitance multiplied by the resistance
- C. Resistance divided by the reactance of either the inductance or capacitance
- D. Reactance of the inductance multiplied by the reactance of the capacitance

21 E5B07 What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 500 ohms, R is 1 kilohm, and XL is 250 ohms?

- A. 68.2 degrees with the voltage leading the current
- B. 14.0 degrees with the voltage leading the current
- C. 14.0 degrees with the voltage lagging the current
- D. 68.2 degrees with the voltage lagging the current

22 E5C07 Where is the impedance of a pure resistance plotted on rectangular coordinates?

- A. On the vertical axis
- B. On a line through the origin, slanted at 45 degrees
- C. On a horizontal line, offset vertically above the horizontal axis
- D. On the horizontal axis

23 E5D07 How many watts are consumed in a circuit having a power factor of 0.71 if the apparent power is 500VA?

- A. 704 W B. 355 W C. 252 W D. 1.42 mW

24 E6A08 What term indicates the frequency at which the grounded-base current gain of a transistor has decreased to 0.7 of the gain obtainable at 1 kHz?

- A. Corner frequency B. Alpha rejection frequency
C. Beta cutoff frequency D. Alpha cutoff frequency

25 E6B07 What is the failure mechanism when a junction diode fails due to excessive current?

- A. Excessive inverse voltage B. Excessive junction temperature
C. Insufficient forward voltage D. Charge carrier depletion

26 E6C06 Why do CMOS digital integrated circuits have high immunity to noise on the input signal or power supply?

- A. Large bypass capacitance is inherent
B. The input switching threshold is about two times the power supply voltage
C. The input switching threshold is about one-half the power supply voltage
D. Bandwidth is very limited

27 E6D08 What is one reason for using powdered-iron cores rather than ferrite cores in an inductor?

- A. Powdered-iron cores generally have greater initial permeability
B. Powdered-iron cores generally maintain their characteristics at higher currents
C. Powdered-iron cores generally require fewer turns to produce a given inductance
D. Powdered-iron cores use smaller diameter wire for the same inductance

28 E6E08 How is power supplied to the most common type of MMIC?

- A. Through a resistor and/or RF choke connected to the amplifier output lead
B. MMICs require no operating bias
C. Through a capacitor and RF choke connected to the amplifier input lead
D. Directly to the bias voltage (VCC IN) lead

29 E6F09 What is the efficiency of a photovoltaic cell?

- A. The output RF power divided by the input DC power
B. Cost per kilowatt-hour generated
C. The open-circuit voltage divided by the short-circuit current under full illumination
D. The relative fraction of light that is converted to current

- 30 E7A08 What logical operation does an OR gate perform?
- A. It produces logic 1 at its output if any or all inputs are logic 1
 - B. It produces logic 0 at its output if all inputs are logic 1
 - C. It only produces logic 0 at its output when all inputs are logic 1
 - D. It produces logic 1 at its output if all inputs are logic 0
- 31 E7B08 How can an RF power amplifier be neutralized?
- A. By increasing the driving power
 - B. By reducing the driving power
 - C. By feeding a 180-degree out-of-phase portion of the output back to the input
 - D. By feeding an in-phase component of the output back to the input
- 32 E7C07 Which describes a Pi-L-network used for matching a vacuum tube final amplifier to a 50-ohm unbalanced output?
- A. A Phase Inverter Load network
 - B. A Pi-network with an additional series inductor on the output
 - C. A network with only three discrete parts
 - D. A matching network in which all components are isolated from ground
- 33 E7D08 What type of circuit is shown in Figure E7-2?
- A. Switching voltage regulator
 - B. Grounded emitter amplifier
 - C. Linear voltage regulator
 - D. Monostable multivibrator
- 34 E7E08 What are the principal frequencies that appear at the output of a mixer circuit?
- A. Two and four times the original frequency
 - B. The square root of the product of input frequencies
 - C. The two input frequencies along with their sum and difference frequencies
 - D. 1.414 and 0.707 times the input frequency
- 35 E7F08 What is the function of decimation?
- A. Converting data to binary code decimal form
 - B. Reducing the effective sample rate by removing samples
 - C. Attenuating the signal
 - D. Removing unnecessary significant digits
- 36 E7G06 What is the gain-bandwidth of an operational amplifier?
- A. The maximum frequency for a filter circuit using that type of amplifier
 - B. The frequency at which the open-loop gain of the amplifier equals one
 - C. The gain of the amplifier at a filter's cutoff frequency
 - D. The frequency at which the amplifier's offset voltage is zero

37 E7H13 Which of the following is a technique for providing highly accurate and stable oscillators needed for microwave transmission and reception?

- A. Use a GPS signal reference
- B. Use a rubidium stabilized reference oscillator
- C. Use a temperature-controlled high Q dielectric resonator
- D. All these choices are correct

38 E8A06 What is the approximate ratio of PEP-to-average power in a typical single-sideband phone signal?

- A. 2.5 to 1
- B. 25 to 1
- C. 1 to 1
- D. 100 to 1

39 E8B08 What describes Orthogonal Frequency Division Multiplexing?

- A. A frequency modulation technique that uses non-harmonically related frequencies
- B. A bandwidth compression technique using Fourier transforms
- C. A digital mode for narrow-band, slow-speed transmissions
- D. A digital modulation technique using subcarriers at frequencies chosen to avoid intersymbol interference

40 E8C09 Which digital code allows only one bit to change between sequential code values?

- A. Binary Coded Decimal Code
- B. Extended Binary Coded Decimal Interchange Code
- C. Excess 3 code
- D. Gray code

41 E8D07 What is a common cause of overmodulation of AFSK signals?

- A. Excessive numbers of retries
- B. Ground loops
- C. Bit errors in the modem
- D. Excessive transmit audio levels

42 E9A09 What is antenna efficiency?

- A. Radiation resistance divided by transmission resistance
- B. Radiation resistance divided by total resistance
- C. Total resistance divided by radiation resistance
- D. Effective radiated power divided by transmitter output

43 E9B09 What type of computer program technique is commonly used for modeling antennas?

- A. Graphical analysis
- B. Method of Moments
- C. Mutual impedance analysis
- D. Calculus differentiation with respect to physical properties

44 E9C07 What is the approximate feed point impedance at the center of a two-wire folded dipole antenna?

- A. 300 ohms
- B. 72 ohms
- C. 50 ohms
- D. 450 ohms

45 E9D07 What is an advantage of using top loading in a shortened HF vertical antenna?

- A. Lower Q
- B. Greater structural strength
- C. Higher losses
- D. Improved radiation efficiency

46 E9E09 Which of the following is used to shunt-feed a grounded tower at its base?

- A. Double-bazooka match
- B. Hairpin match
- C. Gamma match
- D. All these choices are correct

47 E9F08 Which of the following is a significant difference between foam dielectric coaxial cable and solid dielectric cable, assuming all other parameters are the same?

- A. Foam dielectric has lower safe operating voltage limits
- B. Foam dielectric has lower loss per unit of length
- C. Foam dielectric has higher velocity factor
- D. All these choices are correct

48 E9G08 What is the process of normalization with regard to a Smith chart?

- A. Reassigning resistance values with regard to the reactance axis
- B. Reassigning reactance values with regard to the resistance axis
- C. Reassigning impedance values with regard to the prime center
- D. Reassigning prime center with regard to the reactance axis

49 E9H08 What is the function of a sense antenna?

- A. It modifies the pattern of a DF antenna array to provide a null in one direction
- B. It increases the sensitivity of a DF antenna array
- C. It allows DF antennas to receive signals at different vertical angles
- D. It provides diversity reception that cancels multipath signals

50 E0A07 How may dangerous levels of carbon monoxide from an emergency generator be detected?

- A. By the odor
- B. Only with a carbon monoxide detector
- C. Any ordinary smoke detector can be used
- D. By the yellowish appearance of the gas

Amateur Extra Quiz 5

1	E1A10 (A)	26	E6C06 (C)
2	E1B07 (C)	27	E6D08 (B)
3	E1C07 (D)	28	E6E08 (A)
4	E1D07 (A)	29	E6F09 (D)
5	E1E08 (C)	30	E7A08 (A)
6	E1F09 (D)	31	E7B08 (C)
7	E2A10 (B)	32	E7C07 (B)
8	E2B08 (A)	33	E7D08 (C)
9	E2C06 (C)	34	E7E08 (C)
10	E2D07 (C)	35	E7F08 (B)
11	E2E10 (C)	36	E7G06 (B)
12	E3A07 (C)	37	E7H13 (D)
13	E3B10 (A)	38	E8A06 (A)
14	E3C13 (A)	39	E8B08 (D)
15	E4A06 (A)	40	E8C09 (D)
16	E4B08 (C)	41	E8D07 (D)
17	E4C06 (D)	42	E9A09 (B)
18	E4D09 (C)	43	E9B09 (B)
19	E4E05 (B)	44	E9C07 (A)
20	E5A10 (A)	45	E9D07 (D)
21	E5B07 (C)	46	E9E09 (C)
22	E5C07 (D)	47	E9F08 (D)
23	E5D07 (B)	48	E9G08 (C)
24	E6A08 (D)	49	E9H08 (A)
25	E6B07 (B)	50	E0A07 (B)

Amateur Extra Quiz 6

1 E1A11 Which of the following describes authorization or licensing required when operating an amateur station aboard a U.S.-registered vessel in international waters?

- A. Any amateur license with an FCC Marine or Aircraft endorsement
- B. Any FCC-issued amateur license
- C. Only General Class or higher amateur licenses
- D. An unrestricted Radiotelephone Operator Permit

2 E1B08 What limitations may the FCC place on an amateur station if its signal causes interference to domestic broadcast reception, assuming that the receivers involved are of good engineering design?

- A. The amateur station must cease operation
- B. The amateur station must cease operation on all frequencies below 30 MHz
- C. The amateur station must cease operation on all frequencies above 30 MHz
- D. The amateur station must avoid transmitting during certain hours on frequencies that cause the interference

3 E1C08 What is the maximum permissible duration of a remotely controlled station's transmissions if its control link malfunctions?

- A. 30 seconds
- B. 3 minutes
- C. 5 minutes
- D. 10 minutes

4 E1D08 Which VHF amateur bands have frequencies authorized for space stations?

- A. 6 meters and 2 meters
- B. 6 meters, 2 meters, and 1.25 meters
- C. 2 meters and 1.25 meters
- D. 2 meters

5 E1E11 What must the VE team do if an examinee scores a passing grade on all examination elements needed for an upgrade or new license?

- A. Photocopy all examination documents and forward them to the FCC for processing
- B. Three VEs must certify that the examinee is qualified for the license grant and that they have complied with the administering VE requirements
- C. Issue the examinee the new or upgrade license
- D. All these choices are correct

6 E1F10 Who may be the control operator of an auxiliary station?

- A. Any licensed amateur operator
- B. Only Technician, General, Advanced or Amateur Extra Class operators
- C. Only General, Advanced or Amateur Extra Class operators
- D. Only Amateur Extra Class operators

7 E2A11 What type of antenna can be used to minimize the effects of spin modulation and Faraday rotation?

- A. A linearly polarized antenna
- B. A circularly polarized antenna
- C. An isotropic antenna
- D. A log-periodic dipole array

8 E2B10 What aspect of an analog slow-scan television signal encodes the brightness of the picture?

- A. Tone frequency
- B. Tone amplitude
- C. Sync amplitude
- D. Sync frequency

9 E2C07 What is the Cabrillo format?

- A. A standard for submission of electronic contest logs
- B. A method of exchanging information during a contest QSO
- C. The most common set of contest rules
- D. The rules of order for meetings between contest sponsors

10 E2D08 What type of packet frame is used to transmit APRS beacon data?

- A. Unnumbered Information
- B. Disconnect
- C. Acknowledgement
- D. Connect

11 E2E11 What is the difference between direct FSK and audio FSK?

- A. Direct FSK applies the data signal to the transmitter VFO, while AFSK transmits tones via phone
- B. Direct FSK occupies less bandwidth
- C. Direct FSK can transmit faster baud rates
- D. Only direct FSK can be decoded by computer

12 E3A08 When a meteor strikes the Earth's atmosphere, a cylindrical region of free electrons is formed at what layer of the ionosphere?

- A. The E layer
- B. The F1 layer
- C. The F2 layer
- D. The D layer

13 E3B11 At what time of day can sporadic E propagation occur?

- A. Only around sunset
- B. Only around sunset and sunrise
- C. Only in hours of darkness
- D. Any time

14 E3C14 Why does the radio-path horizon distance exceed the geometric horizon?

- A. E-region skip
- B. D-region skip
- C. Due to the Doppler effect
- D. Downward bending due to density variations in the atmosphere

15 E4A08 Which of the following measures SWR?

- A. A spectrum analyzer
- B. A Q meter
- C. An ohmmeter
- D. An antenna analyzer

16 E4B09 What is indicated if the current reading on an RF ammeter placed in series with the antenna feed line of a transmitter increases as the transmitter is tuned to resonance?

- A. There is possibly a short to ground in the feed line
- B. The transmitter is not properly neutralized
- C. There is an impedance mismatch between the antenna and feed line
- D. There is more power going into the antenna

17 E4C07 What does the MDS of a receiver represent?

- A. The meter display sensitivity
- B. The minimum discernible signal
- C. The multiplex distortion stability
- D. The maximum detectable spectrum

18 E4D10 What does a third-order intercept level of 40 dBm mean with respect to receiver performance?

- A. Signals less than 40 dBm will not generate audible third-order intermodulation products
- B. The receiver can tolerate signals up to 40 dB above the noise floor without producing third-order intermodulation products
- C. A pair of 40 dBm input signals will theoretically generate a third-order intermodulation product that has the same output amplitude as either of the input signals
- D. A pair of 1 mW input signals will produce a third-order intermodulation product that is 40 dB stronger than the input signal

19 E4E09 What undesirable effect can occur when using an IF noise blanker?

- A. Received audio in the speech range might have an echo effect
- B. The audio frequency bandwidth of the received signal might be compressed
- C. Nearby signals may appear to be excessively wide even if they meet emission standards
- D. FM signals can no longer be demodulated

20 E5A11 What is the half-power bandwidth of a resonant circuit that has a resonant frequency of 7.1 MHz and a Q of 150?

- A. 157.8 Hz
- B. 315.6 Hz
- C. 47.3 kHz
- D. 23.67 kHz

21 E5B11 What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 25 ohms, R is 100 ohms, and XL is 50 ohms?

- A. 14 degrees with the voltage lagging the current
- B. 14 degrees with the voltage leading the current
- C. 76 degrees with the voltage lagging the current
- D. 76 degrees with the voltage leading the current

22 E5C08 What coordinate system is often used to display the phase angle of a circuit containing resistance, inductive and/or capacitive reactance?

- A. Maidenhead grid
- B. Faraday grid
- C. Elliptical coordinates
- D. Polar coordinates

23 E5D10 How can the true power be determined in an AC circuit where the voltage and current are out of phase?

- A. By multiplying the apparent power by the power factor
- B. By dividing the reactive power by the power factor
- C. By dividing the apparent power by the power factor
- D. By multiplying the reactive power by the power factor

24 E6A10 In Figure E6-1, what is the schematic symbol for an N-channel dual-gate MOSFET?

- A. 2
- B. 4
- C. 5
- D. 6

25 E6B09 What is a common use for point-contact diodes?

- A. As a constant current source
- B. As a constant voltage source
- C. As an RF detector
- D. As a high-voltage rectifier

26 E6C08 In Figure E6-3, what is the schematic symbol for a NAND gate?

- A. 1
- B. 2
- C. 3
- D. 4

27 E6D09 What devices are commonly used as VHF and UHF parasitic suppressors at the input and output terminals of a transistor HF amplifier?

- A. Electrolytic capacitors
- B. Butterworth filters
- C. Ferrite beads
- D. Steel-core toroids

28 E6E09 Which of the following component package types would be most suitable for use at frequencies above the HF range?

- A. TO-220
- B. Axial lead
- C. Radial lead
- D. Surface mount

29 E6F10 What is the most common type of photovoltaic cell used for electrical power generation?

- A. Selenium
- B. Silicon
- C. Cadmium Sulfide
- D. Copper oxide

30 E7A10 What is a truth table?

- A. A table of logic symbols that indicate the high logic states of an op-amp
- B. A diagram showing logic states when the digital device output is true
- C. A list of inputs and corresponding outputs for a digital device
- D. A table of logic symbols that indicate the logic states of an op-amp

31 E7B11 In Figure E7-1, what is the purpose of R3?

- A. Fixed bias
- B. Emitter bypass
- C. Output load resistor
- D. Self bias

32 E7C08 Which of the following factors has the greatest effect on the bandwidth and response shape of a crystal ladder filter?

- A. The relative frequencies of the individual crystals
- B. The DC voltage applied to the quartz crystal
- C. The gain of the RF stage preceding the filter
- D. The amplitude of the signals passing through the filter

33 E7D09 What is the main reason to use a charge controller with a solar power system?

- A. Prevention of battery undercharge
- B. Control of electrolyte levels during battery discharge
- C. Prevention of battery damage due to overcharge
- D. Matching of day and night charge rates

34 E7E09 What occurs when an excessive amount of signal energy reaches a mixer circuit?

- A. Spurious mixer products are generated
- B. Mixer blanking occurs
- C. Automatic limiting occurs
- D. A beat frequency is generated

35 E7F09 Why is an anti-aliasing digital filter required in a digital decimator?

- A. It removes high-frequency signal components that would otherwise be reproduced as lower frequency components
- B. It peaks the response of the decimator, improving bandwidth
- C. It removes low-frequency signal components to eliminate the need for DC restoration
- D. It notches out the sampling frequency to avoid sampling errors

36 E7G08 How does the gain of an ideal operational amplifier vary with frequency?

- A. It increases linearly with increasing frequency
- B. It decreases linearly with increasing frequency
- C. It decreases logarithmically with increasing frequency
- D. It does not vary with frequency

37 E7H14 What is a phase-locked loop circuit?

- A. An electronic servo loop consisting of a ratio detector, reactance modulator, and voltage-controlled oscillator
- B. An electronic circuit also known as a monostable multivibrator
- C. An electronic servo loop consisting of a phase detector, a low-pass filter, a voltage-controlled oscillator, and a stable reference oscillator
- D. An electronic circuit consisting of a precision push-pull amplifier with a differential input

38 E8A07 What determines the PEP-to-average power ratio of a single-sideband phone signal?

- A. The frequency of the modulating signal
- B. Speech characteristics
- C. The degree of carrier suppression
- D. Amplifier gain

39 E8B09 What is deviation ratio?

- A. The ratio of the audio modulating frequency to the center carrier frequency
- B. The ratio of the maximum carrier frequency deviation to the highest audio modulating frequency
- C. The ratio of the carrier center frequency to the audio modulating frequency
- D. The ratio of the highest audio modulating frequency to the average audio modulating frequency

40 E8C10 How may symbol rate be increased without increasing bandwidth?

- A. It is impossible
- B. Increasing analog-to-digital conversion resolution
- C. Using a more efficient digital code
- D. Using forward error correction

41 E8D09 What is considered an acceptable maximum IMD level for an idling PSK signal?

- A. +10 dB
- B. +15 dB
- C. -20 dB
- D. -30 dB

42 E9A12 How much gain does an antenna have compared to a 1/2-wavelength dipole when it has 6 dB gain over an isotropic antenna?

- A. 3.85 dB
- B. 6.0 dB
- C. 8.15 dB
- D. 2.79 dB

43 E9B10 What is the principle of a Method of Moments analysis?

- A. A wire is modeled as a series of segments, each having a uniform value of current
- B. A wire is modeled as a single sine-wave current generator
- C. A wire is modeled as a single sine-wave voltage source
- D. A wire is modeled as a series of segments, each having a distinct value of voltage across it

44 E9C08 What is a folded dipole antenna?

- A. A dipole one-quarter wavelength long
- B. A type of ground-plane antenna
- C. A half-wave dipole with an additional parallel wire connecting its two ends
- D. A dipole configured to provide forward gain

45 E9D10 What happens to feed-point impedance at the base of a fixed length HF mobile antenna when operated below its resonant frequency?

- A. The radiation resistance decreases and the capacitive reactance decreases
- B. The radiation resistance decreases and the capacitive reactance increases
- C. The radiation resistance increases and the capacitive reactance decreases
- D. The radiation resistance increases and the capacitive reactance increases

46 E9E10 Which of these choices is an effective way to match an antenna with a 100-ohm feed point impedance to a 50-ohm coaxial cable feed line?

- A. Connect a 1/4-wavelength open stub of 300-ohm twinlead in parallel with the coaxial feed line where it connects to the antenna
- B. Insert a 1/2 wavelength piece of 300-ohm twinlead in series between the antenna terminals and the 50-ohm feed cable
- C. Insert a 1/4-wavelength piece of 75-ohm coaxial cable transmission line in series between the antenna terminals and the 50-ohm feed cable
- D. Connect a 1/2 wavelength shorted stub of 75-ohm cable in parallel with the 50-ohm cable where it attaches to the antenna

47 E9F09 What is the approximate physical length of a foam polyethylene dielectric coaxial transmission line that is electrically 1/4 wavelength long at 7.2 MHz?

- A. 10.4 meters
- B. 8.3 meters
- C. 6.9 meters
- D. 5.2 meters

48 E9G10 What do the arcs on a Smith chart represent?

- A. Frequency
- B. SWR
- C. Points with constant resistance
- D. Points with constant reactance

49 E9H09 What is a Pennant antenna?

- A. A four-element, high-gain vertical array invented by George Pennant
- B. A small, vertically oriented receiving antenna consisting of a triangular loop terminated in approximately 900 ohms
- C. A form of rhombic antenna terminated in a variable capacitor to provide frequency diversity
- D. A stealth antenna built to look like a flagpole

50 E0A09 Which insulating material commonly used as a thermal conductor for some types of electronic devices is extremely toxic if broken or crushed and the particles are accidentally inhaled?

A. Mica B. Zinc oxide C. Beryllium Oxide D. Uranium Hexafluoride

Amateur Extra Quiz 6

- | | | | |
|----|-----------|----|-----------|
| 1 | E1A11 (B) | 26 | E6C08 (B) |
| 2 | E1B08 (D) | 27 | E6D09 (C) |
| 3 | E1C08 (B) | 28 | E6E09 (D) |
| 4 | E1D08 (D) | 29 | E6F10 (B) |
| 5 | E1E11 (B) | 30 | E7A10 (C) |
| 6 | E1F10 (B) | 31 | E7B11 (D) |
| 7 | E2A11 (B) | 32 | E7C08 (A) |
| 8 | E2B10 (A) | 33 | E7D09 (C) |
| 9 | E2C07 (A) | 34 | E7E09 (A) |
| 10 | E2D08 (A) | 35 | E7F09 (A) |
| 11 | E2E11 (A) | 36 | E7G08 (D) |
| 12 | E3A08 (A) | 37 | E7H14 (C) |
| 13 | E3B11 (D) | 38 | E8A07 (B) |
| 14 | E3C14 (D) | 39 | E8B09 (B) |
| 15 | E4A08 (D) | 40 | E8C10 (C) |
| 16 | E4B09 (D) | 41 | E8D09 (D) |
| 17 | E4C07 (B) | 42 | E9A12 (A) |
| 18 | E4D10 (C) | 43 | E9B10 (A) |
| 19 | E4E09 (C) | 44 | E9C08 (C) |
| 20 | E5A11 (C) | 45 | E9D10 (B) |
| 21 | E5B11 (B) | 46 | E9E10 (C) |
| 22 | E5C08 (D) | 47 | E9F09 (B) |
| 23 | E5D10 (A) | 48 | E9G10 (D) |
| 24 | E6A10 (B) | 49 | E9H09 (B) |
| 25 | E6B09 (C) | 50 | E0A09 (C) |

Extra Quiz 7

1 E1A13 Who must be in physical control of the station apparatus of an amateur station aboard any vessel or craft that is documented or registered in the United States?

- A. Only a person with an FCC Marine Radio license grant
- B. Any person holding an FCC issued amateur license or who is authorized for alien reciprocal operation
- C. Only a person named in an amateur station license grant
- D. Any person named in an amateur station license grant or a person holding an unrestricted Radiotelephone Operator Permit

2 E1B10 What frequencies are authorized to an amateur station operating under RACES rules?

- A. All amateur service frequencies authorized to the control operator
- B. Specific segments in the amateur service MF, HF, VHF and UHF bands
- C. Specific local government channels
- D. Military Auxiliary Radio System (MARS) channels

3 E1C10 What is the permitted mean power of any spurious emission relative to the mean power of the fundamental emission from a station transmitter or external RF amplifier installed after January 1, 2003 and transmitting on a frequency below 30 MHz?

- A. At least 43 dB below
- B. At least 53 dB below
- C. At least 63 dB below
- D. At least 73 dB below

4 E1D09 Which UHF amateur bands have frequencies authorized for space stations?

- A. 70 cm only
- B. 70 cm and 13 cm
- C. 70 cm and 33 cm
- D. 33 cm and 13 cm

5 E1E12 What must the VE team do with the application form if the examinee does not pass the exam?

- A. Return the application document to the examinee
- B. Maintain the application form with the VEC's records
- C. Send the application form to the FCC and inform the FCC of the grade
- D. Destroy the application form

6 E1F11 Which of the following best describes one of the standards that must be met by an external RF power amplifier if it is to qualify for a grant of FCC certification?

- A. It must produce full legal output when driven by not more than 5 watts of mean RF input power
- B. It must be capable of external RF switching between its input and output networks
- C. It must exhibit a gain of 0 dB or less over its full output range
- D. It must satisfy the FCC's spurious emission standards when operated at the lesser of 1500 watts or its full output power

7 E2A12 What is the purpose of digital store-and-forward functions on an amateur radio satellite?

- A. To upload operational software for the transponder
- B. To delay download of telemetry between satellites
- C. To store digital messages in the satellite for later download by other stations
- D. To relay messages between satellites

8 E2B12 What signals SSTV receiving software to begin a new picture line?

- A. Specific tone frequencies
- B. Elapsed time
- C. Specific tone amplitudes
- D. A two-tone signal

9 E2C12 What technique do individual nodes use to form a mesh network?

- A. Forward error correction and Viterbi codes
- B. Acting as store-and-forward digipeaters
- C. Discovery and link establishment protocols
- D. Custom code plugs for the local trunking systems

10 E2D10 How can an APRS station be used to help support a public service communications activity?

- A. An APRS station with an emergency medical technician can automatically transmit medical data to the nearest hospital
- B. APRS stations with General Personnel Scanners can automatically relay the participant numbers and time as they pass the check points
- C. An APRS station with a Global Positioning System unit can automatically transmit information to show a mobile station's position during the event
- D. All these choices are correct

11 E2E13 Which of these digital modes has the fastest data throughput under clear communication conditions?

- A. AMTOR
- B. 170 Hz shift, 45 baud RTTY
- C. PSK31
- D. 300 baud packet

12 E3A09 Which of the following frequency ranges is most suited for meteor scatter communications?

- A. 1.8 MHz - 1.9 MHz
- B. 10 MHz - 14 MHz
- C. 28 MHz - 148 MHz
- D. 220 MHz - 450 MHz

- 13 E3B12 What is the primary characteristic of chordal hop propagation?
- A. Propagation away from the great circle bearing between stations
 - B. Successive ionospheric refractions without an intermediate reflection from the ground
 - C. Propagation across the geomagnetic equator
 - D. Signals reflected back toward the transmitting station
- 14 E3C15 What might be indicated by a sudden rise in radio background noise across a large portion of the HF spectrum?
- A. A temperature inversion has occurred
 - B. A solar flare has occurred
 - C. Increased transequatorial propagation is likely
 - D. Long-path propagation is likely
- 15 E4A10 Which of the following displays multiple digital signal states simultaneously?
- A. Network analyzer
 - B. Bit error rate tester
 - C. Modulation monitor
 - D. Logic analyzer
- 16 E4B10 Which of the following methods measures intermodulation distortion in an SSB transmitter?
- A. Modulate the transmitter using two RF signals having non-harmonically related frequencies and observe the RF output with a spectrum analyzer
 - B. Modulate the transmitter using two AF signals having non-harmonically related frequencies and observe the RF output with a spectrum analyzer
 - C. Modulate the transmitter using two AF signals having harmonically related frequencies and observe the RF output with a peak reading wattmeter
 - D. Modulate the transmitter using two RF signals having harmonically related frequencies and observe the RF output with a logic analyzer
- 17 E4C08 An SDR receiver is overloaded when input signals exceed what level?
- A. One-half the maximum sample rate
 - B. One-half the maximum sampling buffer size
 - C. The maximum count value of the analog-to-digital converter
 - D. The reference voltage of the analog-to-digital converter
- 18 E4D11 Why are odd-order intermodulation products, created within a receiver, of particular interest compared to other products?
- A. Odd-order products of two signals in the band of interest are also likely to be within the band
 - B. Odd-order products overload the IF filters
 - C. Odd-order products are an indication of poor image rejection
 - D. Odd-order intermodulation produces three products for every input signal within the band of interest

19 E4E10 What might be the cause of a loud roaring or buzzing AC line interference that comes and goes at intervals?

- A. Arcing contacts in a thermostatically controlled device
- B. A defective doorbell or doorbell transformer inside a nearby residence
- C. A malfunctioning illuminated advertising display
- D. All these choices are correct

20 E5A12 What is the half-power bandwidth of a resonant circuit that has a resonant frequency of 3.7 MHz and a Q of 118?

- A. 436.6 kHz
- B. 218.3 kHz
- C. 31.4 kHz
- D. 15.7 kHz

21 E5B12 What is admittance?

- A. The inverse of impedance
- B. The term for the gain of a field effect transistor
- C. The turns ratio of a transformer
- D. The inverse of Q factor

22 E5C09 When using rectangular coordinates to graph the impedance of a circuit, what do the axes represent?

- A. The X axis represents the resistive component and the Y axis represents the reactive component
- B. The X axis represents the reactive component and the Y axis represents the resistive component
- C. The X axis represents the phase angle and the Y axis represents the magnitude
- D. The X axis represents the magnitude and the Y axis represents the phase angle

23 E5D15 What is the power factor of an RL circuit having a 45-degree phase angle between the voltage and the current?

- A. 0.866
- B. 1.0
- C. 0.5
- D. 0.707

24 E6A11 In Figure E6-1, what is the schematic symbol for a P-channel junction FET?

- A. 1
- B. 2
- C. 3
- D. 6

25 E6B10 In Figure E6-2, what is the schematic symbol for a light-emitting diode?

- A. 1
- B. 5
- C. 6
- D. 7

26 E6C10 In Figure E6-3, what is the schematic symbol for a NOR gate?

- A. 1
- B. 2
- C. 3
- D. 4

27 E6D10 What is a primary advantage of using a toroidal core instead of a solenoidal core in an inductor?

- A. Toroidal cores confine most of the magnetic field within the core material
- B. Toroidal cores make it easier to couple the magnetic energy into other components
- C. Toroidal cores exhibit greater hysteresis
- D. Toroidal cores have lower Q characteristics

28 E6E11 What is a characteristic of DIP packaging used for integrated circuits?

- A. Package mounts in a direct inverted position
- B. Low leakage doubly insulated package
- C. Two chips in each package (Dual In Package)
- D. A total of two rows of connecting pins placed on opposite sides of the package (Dual In-line Package)

29 E6F11 What is the approximate open-circuit voltage produced by a fully illuminated silicon photovoltaic cell?

- A. 0.1 V
- B. 0.5 V
- C. 1.5 V
- D. 12 V

30 E7A11 What type of logic defines "1" as a high voltage?

- A. Reverse Logic
- B. Assertive Logic
- C. Negative logic
- D. Positive Logic

31 E7B14 Why are switching amplifiers more efficient than linear amplifiers?

- A. Switching amplifiers operate at higher voltages
- B. The power transistor is at saturation or cutoff most of the time
- C. Linear amplifiers have high gain resulting in higher harmonic content
- D. Switching amplifiers use push-pull circuits

32 E7C09 What is a crystal lattice filter?

- A. A power supply filter made with interlaced quartz crystals
- B. An audio filter made with four quartz crystals that resonate at 1kHz intervals
- C. A filter using lattice-shaped quartz crystals for high-Q performance
- D. A filter with narrow bandwidth and steep skirts made using quartz crystals

33 E7D15 What is the purpose of a step-start circuit in a high-voltage power supply?

- A. To provide a dual-voltage output for reduced power applications
- B. To compensate for variations of the incoming line voltage
- C. To allow for remote control of the power supply
- D. To allow the filter capacitors to charge gradually

34 E7E11 Which type of detector circuit is used for demodulating SSB signals?

- A. Discriminator
- B. Phase detector
- C. Product detector
- D. Phase comparator

- 35 E7F13 What is the function of taps in a digital signal processing filter?
- A. To reduce excess signal pressure levels
 - B. Provide access for debugging software
 - C. Select the point at which baseband signals are generated
 - D. Provide incremental signal delays for filter algorithms
- 36 E7G11 What absolute voltage gain can be expected from the circuit in Figure E7-3 when R1 is 3300 ohms and RF is 47 kilohms?
- A. 28 B. 14 C. 7 D. 0.07
- 37 E7H15 Which of these functions can be performed by a phase-locked loop?
- A. Wide-band AF and RF power amplification
 - B. Comparison of two digital input signals, digital pulse counter
 - C. Photovoltaic conversion, optical coupling
 - D. Frequency synthesis, FM demodulation
- 38 E8A08 Why would a direct or flash conversion analog-to-digital converter be useful for a software defined radio?
- A. Very low power consumption decreases frequency drift
 - B. Immunity to out-of-sequence coding reduces spurious responses
 - C. Very high speed allows digitizing high frequencies
 - D. All these choices are correct
- 39 E8B10 What is frequency division multiplexing?
- A. The transmitted signal jumps from band to band at a predetermined rate
 - B. Two or more information streams are merged into a baseband, which then modulates the transmitter
 - C. The transmitted signal is divided into packets of information
 - D. Two or more information streams are merged into a digital combiner, which then pulse position modulates the transmitter
- 40 E8C11 What is the relationship between symbol rate and baud?
- A. They are the same
 - B. Baud is twice the symbol rate
 - C. Symbol rate is only used for packet-based modes
 - D. Baud is only used for RTTY
- 41 E8D11 What is one advantage of using ASCII code for data communications?
- A. It includes built-in error correction features
 - B. It contains fewer information bits per character than any other code
 - C. It is possible to transmit both upper and lower case text
 - D. It uses one character as a shift code to send numeric and special characters

48 E9G11 How are the wavelength scales on a Smith chart calibrated?

- A. In fractions of transmission line electrical frequency
- B. In fractions of transmission line electrical wavelength
- C. In fractions of antenna electrical wavelength
- D. In fractions of antenna electrical frequency

49 E9H10 How can the output voltage of a multiple-turn receiving loop antenna be increased?

- A. By reducing the permeability of the loop shield
- B. By utilizing high impedance wire for the coupling loop
- C. By winding adjacent turns in opposing directions
- D. By increasing the number of turns and/or the area

50 E0A10

What toxic material may be present in some electronic components such as high voltage capacitors and transformers?

- A. Polychlorinated biphenyls
- B. Polyethylene
- C. Polytetrafluoroethylene
- D. Polymorphic silicon

Amateur Extra Quiz 7

1	E1A13 (B)	26	E6C10 (D)
2	E1B10 (A)	27	E6D10 (A)
3	E1C10 (A)	28	E6E11 (D)
4	E1D09 (B)	29	E6F11 (B)
5	E1E12 (A)	30	E7A11 (D)
6	E1F11 (D)	31	E7B14 (B)
7	E2A12 (C)	32	E7C09 (D)
8	E2B12 (A)	33	E7D15 (D)
9	E2C12 (C)	34	E7E11 (C)
10	E2D10 (C)	35	E7F13 (D)
11	E2E13 (D)	36	E7G11 (B)
12	E3A09 (C)	37	E7H15 (D)
13	E3B12 (B)	38	E8A08 (C)
14	E3C15 (B)	39	E8B10 (B)
15	E4A10 (D)	40	E8C11 (A)
16	E4B10 (B)	41	E8D11 (C)
17	E4C08 (D)	42	E9A13 (C)
18	E4D11 (A)	43	E9B11 (C)
19	E4E10 (D)	44	E9C13 (B)
20	E5A12 (C)	45	E9D12 (C)
21	E5B12 (A)	46	E9E11 (A)
22	E5C09 (A)	47	E9F12 (D)
23	E5D15 (D)	48	E9G11 (B)
24	E6A11 (A)	49	E9H10 (D)
25	E6B10 (B)	50	E0A10 (A)

NOTE: The graphics are required for certain questions in sections E5, E6, E7, and E9 are included on the following pages.

Figure E5-1

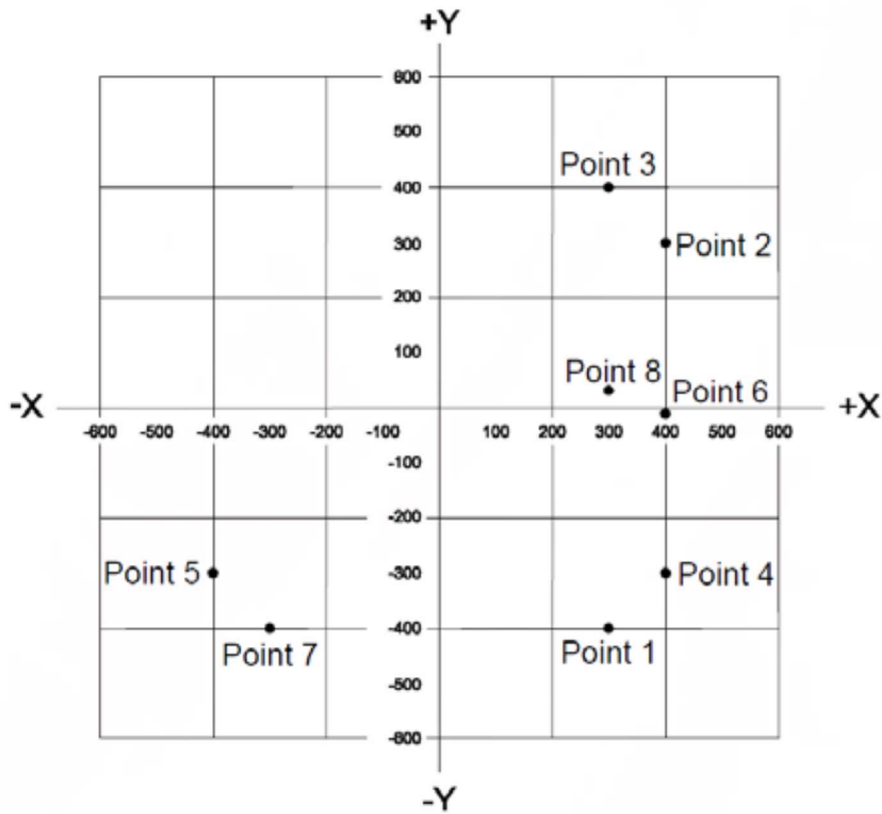


Figure E6-1

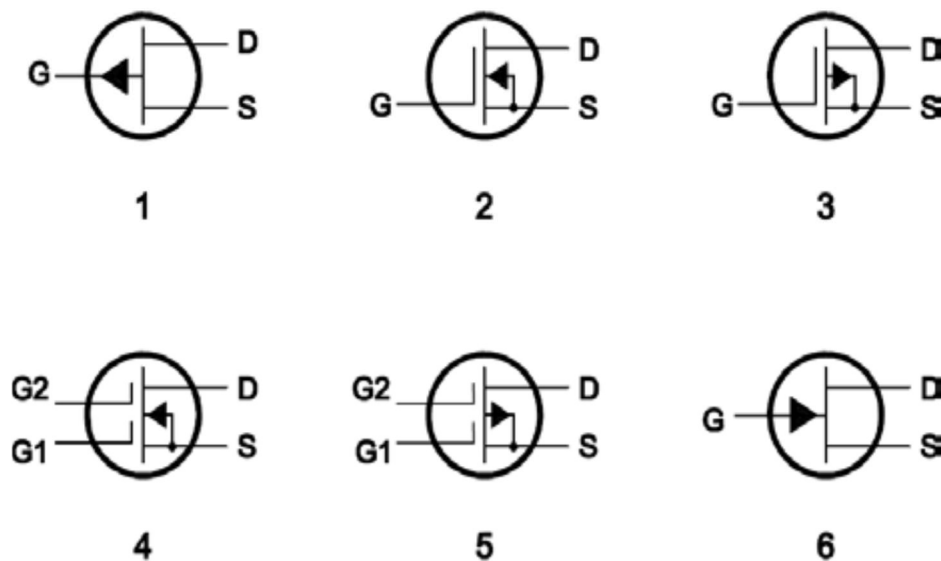


Figure E6-2

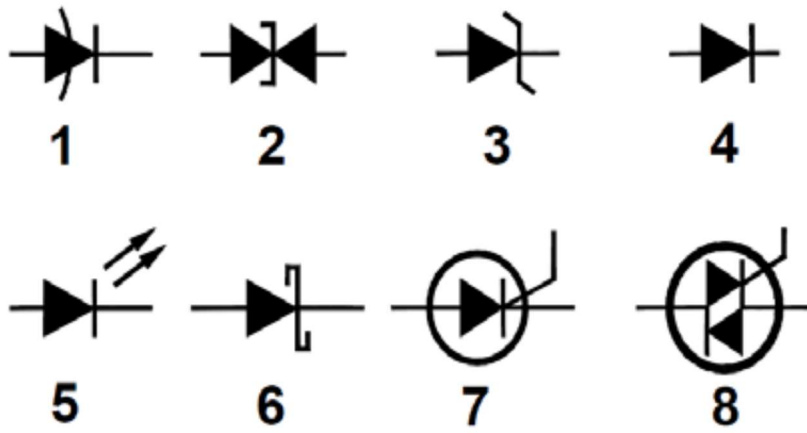


Figure E6-3

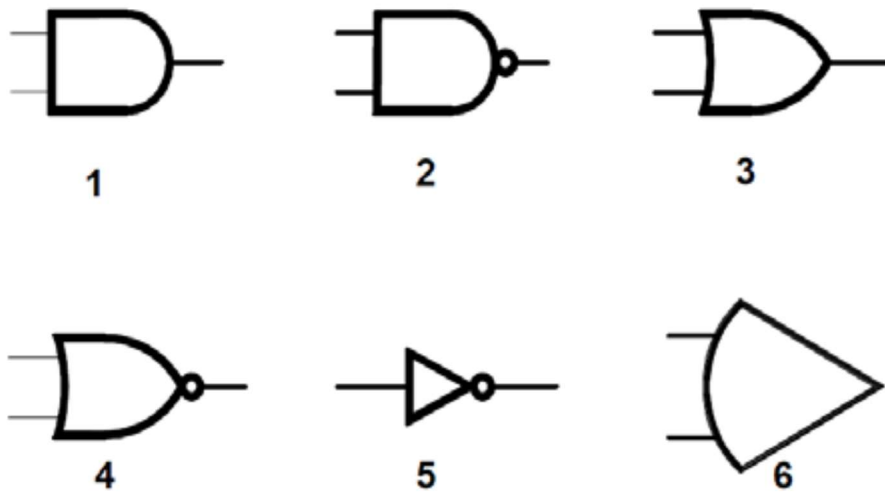


Figure E7-1

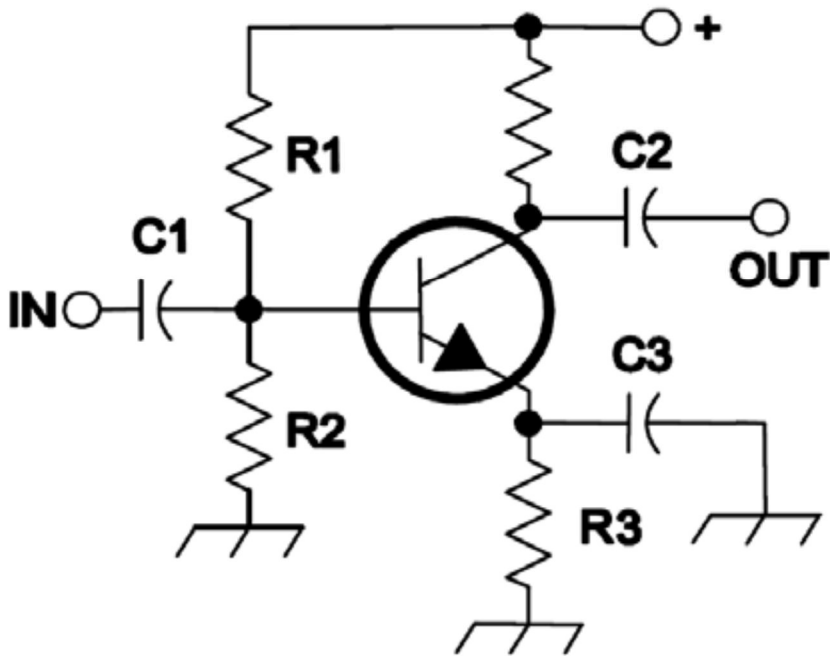


Figure E7-2

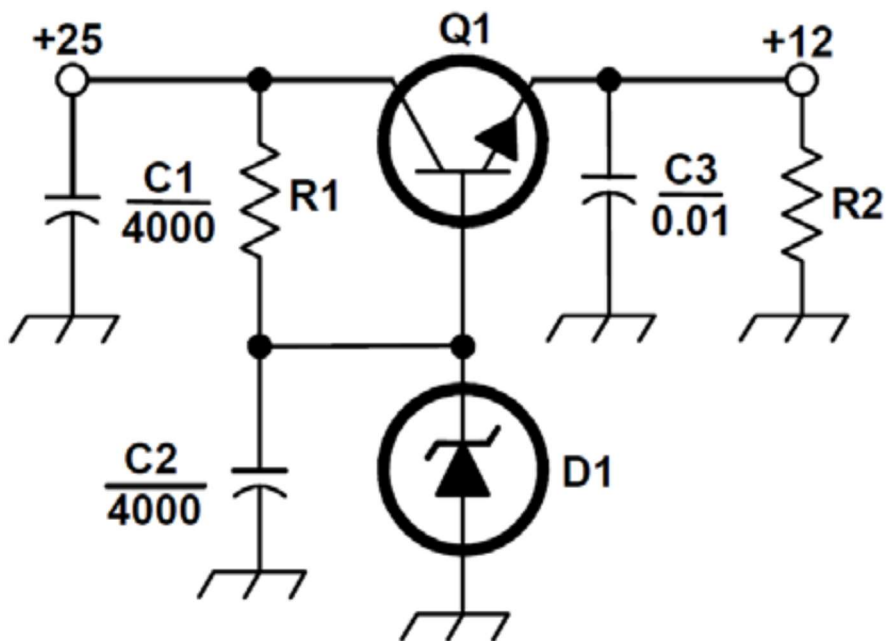


Figure E7-3

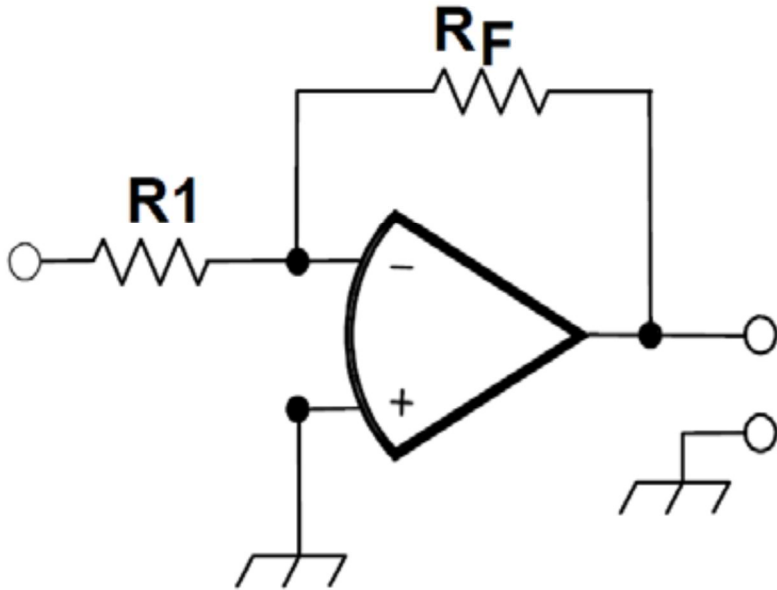


Figure E9-1

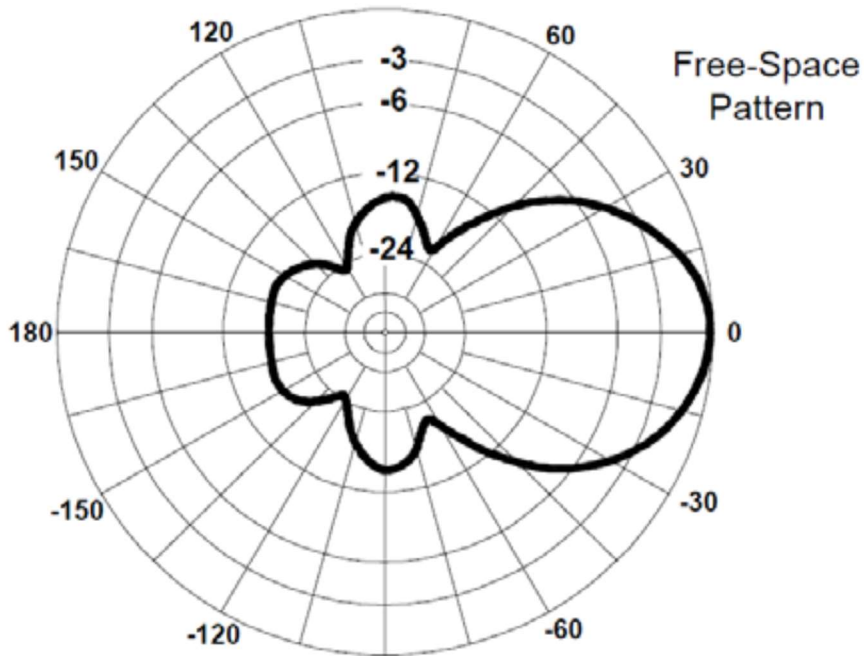


Figure E9-2

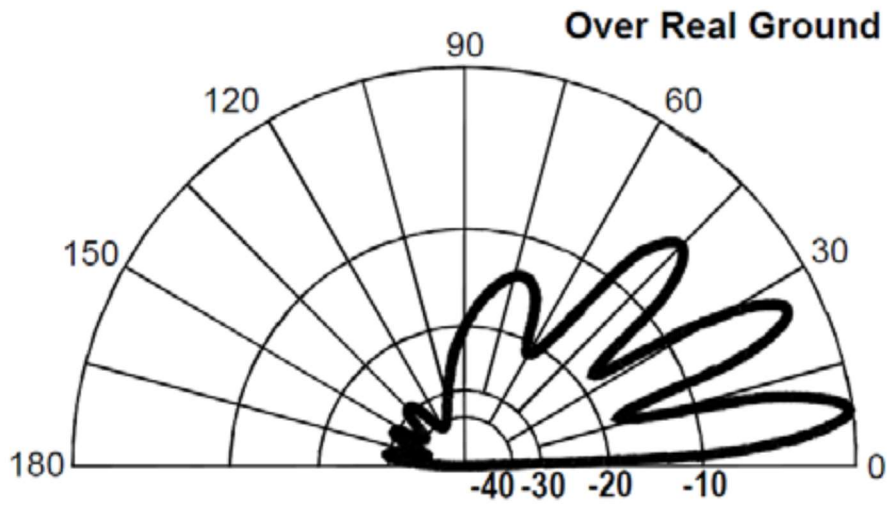


Figure E9-3

