Chapter 10

Glossary

Absorption — The dissipation of the energy of a radio wave as it travels through a medium such as the ionosphere.

Accredited — Formally recognized and qualified by a **VEC**.

Active — A device that amplifies, switches or changes the characteristics of a signal and which usually requires a source of power to operate.

Adapters — Special connectors that convert one style of connector to another.

AFSK (see **FSK**)

Air core — An inductor without any magnetic material in its core.

Air link — That part of a digital communications system implemented using radio transmission and reception.

Allocation — The assignment of frequencies or other privileges to a particular service.

Amateur Auxiliary — A formally-organized amateur group that supports the FCC with enforcement issues.

Amateur Radio Emergency Service (ARES) — Sponsored by the ARRL and provides emergency communications by working with groups such as the American Red Cross and local Emergency Operations Centers.

American Radio Relay League (ARRL) — The national association for Amateur Radio in the United States.

Ammeter — A test instrument that measures current.

Ampacity — A wire's current rating.

Amplifier — A device or piece of equipment used to increase the strength of a signal, called *amplification*.

Amplitude modulated (AM) phone — Radiotelephone (phone) transmission in which voice signals modulate the carrier. Most AM transmission is *double-sideband* (AM-DSB) in which the signal is composed of two sidebands and a carrier. Shortwave broadcast stations use this type of AM as do stations in the Standard Broadcast Band (535-1710 kHz). The most popular form of AM phone on the amateur bands is **single sideband (SSB)** although AM-DSB is used by amateurs who enjoy the mode's characteristics.

Amplitude modulation (AM) — The process of adding information to a signal or *carrier* by varying its amplitude characteristics.

Analog (linear) — Circuits or devices that operate over a continuous range of voltage and current.

Analog signals — A signal (usually electrical) that can have any amplitude (voltage or current) value and whose amplitude can vary smoothly over time. When referring to a communications **mode**, refers to **modulation** in which the modulating signal is an analog signal. Also see **digital signals** and **digital communications**.

Analog-to-digital converter (ADC) — A circuit that converts an analog signal to a digital value. (see also **Digital-to-analog converter**)

Angle modulation — Modulation by varying a signal's phase angle. (see also **Frequency modulation** and **Phase modulation**)

Anode — In semiconductor diodes and vacuum tubes (the **plate**) the electrode to which electrons flow during conduction.

Antenna analyzer — Test equipment that contains a low-power **signal generator**, **frequency counter**, and impedance measuring circuit; used for measuring the impedance characteristics of antennas and transmission lines.

Antenna switch — A switch used to connect one transmitter, receiver or transceiver to several different antennas.

Antenna tuner — A device that matches the antenna system input impedance to the transmitter, receiver or transceiver output impedance. Also called an *antenna coupler*, *antenna-matching network* or *unit (ATU)*, *impedance matcher* or *transmatch*.

Antipode — Location at the diametrically opposite point on the Earth's surface.

ARQ mode — Automatic Repeat reQuest; a digital mode that returns ACK (OK) or NAK (not OK) messages based on error checking so that corrupted data can be retransmitted.

Array — An antenna that uses more than one element to direct radiated energy in a specific direction. A *driven array* is one in which all elements receive power via a feed line from the transmitter. A *parasitic array* is one in which at least one element picks up and re-radiates power without a direct connection to the transmitter.

Attenuation — To reduce the strength of a signal.

Audio frequency shift keying (AFSK) — Frequency shift keying (FSK) performed by modulating the transmitter with audio tones.

Automatic gain control (AGC) — Receiver circuitry used to maintain a constant audio output level.

Automatic level control (ALC) — Transmitter circuitry that prevents excessive modulation of an AM or SSB signal.

Automatic operation — A station being operated under the control of a computer or other device, also known as **automatic control**.

Average forward current (I_F) — The maximum average current that a rectifier is rated to carry.

Back-feeding — Supplying electrical power to the utility grid through a home power distribution panel when using a generator.

Back light — Illuminating a display from behind.

Backscatter — (see **Scatter modes**)

Balanced (feed line) — See **parallel-conductor feed line**.

Balun — Contraction of "balanced to unbalanced." A device to couple a balanced load to an unbalanced feed line or device, or vice versa.

Band plan — Voluntary organization of communications activity on a frequency band.

Bandpass — Filter that rejects signals outside a certain frequency range (the *passband*).

Bandwidth — (1) Bandwidth describes a range of frequencies occupied by a signal. (2) FCC Part 97 defines bandwidth for regulatory purposes as "The width of a frequency band outside of which the mean power is attenuated at least 26 dB below the mean power of the transmitted signal within the band." [§97.3 (8)]

Battery — A device that converts chemical energy into electrical energy.

Battery chemistry — The type of chemicals used to store energy in a battery.

Battery pack — A package of several individual batteries connected together (usually in series to provide higher voltages) and treated as a single battery.

Baud (also **bauds**) — The rate at which individual data symbols are transmitted (see also **symbol rate**).

Beacon station — An amateur station transmitting communications for the purposes of observation of propagation and reception or other related experimental activities.

Beam antenna — A directional antenna. A beam antenna must be rotated to provide coverage in different directions.

Beamwidth — The angle between the points in the main lobe at which gain is 3 dB less than the maximum value.

Beta match — The technique of placing an inductor (also called a *hairpin*) across an antenna's feed point to achieve an impedance match.

Bias — An applied voltage to a circuit or component. *Forward bias* causes current to flow. *Reverse bias* prevents current from flowing.

Binary data (number) — Information represented by 1s and 0s. A binary number consists entirely of 1s and 0s representing powers of 2.

Bipolar transistor — (See **Transistor**).

Birdie — An unwanted receiver response to an internal signal.

Bit rate — The rate at which digital bits are carried by a transmitted signal.

Bleeder resistor — A high-value resistor that discharges a filter capacitor when power is removed.

BNC connector — A type of connector for RF signals.

Boom — The central support of an **array** antenna.

BPSK (see **Phase shift keying**)

Break-in — Switching rapidly between transmit and receive so that signals can be heard between keying elements (*full break-in* or *QSK*) or words (*semi-break-in*).

Breaking in — Interrupting an ongoing contact to join the conversation or contribute to the discussion.

Bridge — A circuit with two parallel current paths and a path between the midpoints of the two paths. In a *bridge rectifier*, ac voltage is applied to rectifier diodes that make up the parallel current paths and dc voltage is obtained across the midpoints of the parallel paths.

Buffer — An amplifier intended to isolate a circuit from loads connected to its output.

Calling frequency — A frequency on which amateurs establish contact before moving to a different frequency. Usually used by hams with a common interest or activity.

Capacitance (C) — The ability of a **capacitor** to store energy in an **electric field**.

Capacitor — An electrical component usually formed by separating two conductive plates with an insulating material. A capacitor stores energy in an **electric field**.

Carrier — A steady, single-frequency signal that is modulated to add an information signal to be transmitted. For example, a voice signal added to a carrier produces a **phone emission** signal.

Cathode — In semiconductor diodes and vacuum tubes, the electrode from which electrons flow during conduction.

Cathode-ray tube (CRT) — A vacuum tube with a flat, phosphor coated face used for visual displays. *Deflection plates* in the tube use varying voltage created by *channel amplifiers* to steer an electron beam across the tube's face, creating a visible *trace*, while a *time base* controls the timing of the beam.

Center tapped — A transformer winding that is split into two equal halves with a connection (tap) at the center point.

Changeover relay (see **Transmit-receive relay**)

Characteristic impedance — The ratio of RF voltage and current for power flowing in a feed line.

Chassis ground — The common connection for all parts of a circuit that connect to the metal enclosure of the circuit. Chassis ground is usually connected to the negative side of the power supply.

Checksum — A general term for an algorithm that allows the receiving system to detect errors in transmitted data. A *Cyclical Redundancy Check (CRC)* is a strong type of checksum.

Chip (see **Integrated circuit**)

Choke — An inductance used to resist or "choke off" ac current flow. An inductor used in a power supply to reduce **ripple** is called a *filter choke* and a power supply filter that uses inductors as the primary means of reducing **ripple** is a *choke filter.*

Circuit — Any path in which **current** can flow.

Class A — Amplifier operation in which the amplifying device is active during the entire cycle of the signal.

Class AB — Amplifier operation in which the amplifying device is active for between one-half of and the entire signal cycle.

Class B — Amplifier operation in which the amplifying device is active for one-half of the signal's cycle. Also known as *push-pull* if two amplifying devices operating in Class B are combined in a single circuit.

Class C — Amplifier operation in which the amplifying device is only active during a fraction of the cycle.

Clock — In a digital circuit, a signal that synchronizes circuit operation.

CMOS (complementary metal oxide semiconductor) — A popular type of low-power digital logic circuit.

Coaxial cable — Coax (pronounced kó-aks). A type of feed line with one conductor inside the other and both sharing a concentric central axis.

Combination logic — Digital circuits with an output determined solely by the current state of the input signals.

Common-mode — Currents that flow equally on all conductors of a multiconductor cable, such as speaker wires or telephone cables, or on the outside of shielded cables, such as coaxial or twisted-pair.

Composite signal — A signal composed of one or more *component* signals.

Conductor — A material whose electrons move freely in response to voltage, so an electrical current can pass through it.

Constant power — A signal whose power is constant, regardless of modulation, such as FM or PM.

Continuous wave (CW) — Radio communications transmitted by on/off keying of a continuous radio-frequency signal. Another name for international Morse code.

Controlled environment — Any area in which an RF signal may cause radiation exposure to people who are aware of the radiated electric and magnetic fields and who can exercise some control over their exposure to these fields. The FCC generally considers amateur operators and their families to be in a controlled RF exposure environment to determine the maximum permissible exposure levels.

Conventional current — Current in which the moving particles are assumed to be positively charged, the opposite of **electronic current**.

Conversion — The process of converting a signal from one frequency to another by a receiver. A *single-conversion* receiver has a single conversion step, a *double-conversion* two steps, and so forth.

Conversion efficiency — The percentage of solar energy that is converted to electricity by a solar cell.

Corona ball — A round ball placed at the tip of **whip** antennas to prevent high-voltage discharge.

Coronal hole (mass ejection) — Small or large-scale ejections of plasma through the Sun's corona

Coulomb (C) — The basic unit of charge. 1 coulomb is the quantity of 6.25×10^{18} electrons. 1 ampere equals the flow of 1 coulomb of electrons per second.

Counter — A circuit that accumulates a total number of events or a device that displays the frequency of an input signal.

Coupling — The sharing or transfer of energy between two components or circuits.

CRC (see **Checksum**)

Clipping — Overmodulating an AM signal so that the envelope reaches the maximum or minimum value for an extended period. Also known as *flat-topping*.

Critical angle — The largest angle at which a radio wave of a specified frequency can be returned to a specific point on Earth by the ionosphere.

Critical frequency — The highest frequency for which a signal transmitted straight up is returned to Earth.

Current gain (beta) — The control of a large collector-emitter current by a small base-emitter current, numerically equal to the ratio of collector-emitter current to base-emitter current. Beta (β) is the symbol for dc current gain. h_{fe} is the symbol for ac current gain.

Cutoff — The point at which current flow in a transistor or vacuum tube is reduced to zero.

Cutoff frequency — The frequency at which a filter's output is one-half the input power.

CW (Morse code) — Radio communications transmitted by on/off keying of a continuous radio-frequency signal. Another name for international Morse code.

D region — The lowest region of the ionosphere. The D region (or layer) contributes very little to short-wave radio propagation. It acts mainly to absorb energy from radio waves as they pass through it.

Data modes — see **digital communications**

Decibel (dB) — In electronics decibels are used to express ratios of power, voltage, or current. One dB = 10 log (power ratio) or 20 log (voltage or current ratio). The smallest change in sound level that can be detected by the human ear is approximately 1 dB.

Delta loop antenna — A variation of the **quad antenna** with triangular elements.

Demodulate or **demodulation** — Recovering information from a **modulated** signal.

Detector — The stage in a receiver in which the modulation (voice or other information) is recovered from the RF signal without reversing the process of modulation (*detection*). An *envelope detector* recovers information from an AM signal's **envelope**.

Deviation — The change in frequency of an FM carrier due to a modulating signal.

Dielectric — The insulating material that separates the two conducting surfaces of a capacitor and in which electrical energy is stored.

Diffract — To alter the direction of a radio wave as it passes by the edges of obstructions such as buildings or hills.

Digital (logic) — Circuits or devices that operate with discrete values of voltage and current. A *digital logic family* is a group of digital circuits with a common set of characteristics.

Digital communication (digital mode) — Computer-to-computer communication, such as by **packet radio** or **radioteletype (RTTY)**, which transmit and receive digital information.

Digital signal — (1) A signal (usually electrical) that can only have certain specific amplitude values, or steps — usually two; 0 and 1 or ON and OFF. (2) On the air, a digital signal is the same as a **digital mode** or **digital communication**.

Digital-to-analog converter (DAC) — A circuit that converts a digital value to an analog signal. (see also **Analog-to-digital converter**)

Digital signal processing (DSP) — The process of converting an **analog signal** to **digital** form and using a microprocessor to process the signal in some way such as filtering or reducing noise.

Diode — An electronic component that allows electric current to flow in only one direction.

Dipole — From "two electric polarities", an antenna consisting of a straight conductor approximately ½ wavelength long and fed in the middle. An *off-center fed dipole* (OCF) has a feed point away from the center. (see also **Doublet**)

Direct digital synthesis (DDS) — The technique of creating a signal with a rapid sequence of digital signal values.

Direct pickup — A type of **RF interference** caused by a device's internal wiring receiving the interfering signal directly.

Directional antenna — An antenna with **gain** in one or more preferred directions.

Directional wattmeter — An RF power meter that can measure both forward and reflected power in a transmission line (also see **wattmeter**).

Director — A parasitic element in front of the driven element in a directional antennas.

Discriminator — A type of **detector** used in some FM receivers. Also known as a *frequency discriminator*.

Display (visual) — A device that is capable of presenting text or graphics information in visual form.

Doping — Adding impurities (*dopants*) to semiconductor material in order to control its electrical properties.

Doublet — A general term for a center-fed antenna similar to a dipole but which is generally non-resonant.

Driven array (see **Array**)

Driven element — The part of an antenna that connects directly to the feed line.

Driver — An amplifier that brings low-power signals to a level suitable to drive a power amplifier to full power output.

Dummy antenna or **dummy load** — A station accessory that allows you to test or adjust transmitting equipment without sending a signal out over the air.

Duty cycle — A measure of the amount of time a transmitter is operating at full output power during a single transmission. A lower duty cycle reduces **RF radiation** exposure for the same PEP output. *Duty factor* is the same as duty cycle expressed as a fraction instead of in percent. *Emission duty cycle* includes the transmission characteristics associated with a particular mode. *Operating duty cycle* includes the transmit/receive behavior associated with a particular and style of communication.

DX — Distance, distant stations, foreign countries.

E region — The second lowest ionospheric region, the E region (or layer) exists only during the day. Under certain conditions, it may refract radio waves enough to return them to Earth.

Earth ground — A circuit connection to a ground rod driven into the Earth or to a metallic cold-water pipe that goes into the ground.

Effective radiated power (ERP) — The power level that would be required to be applied to a dipole to achieve the same signal strength in the direction of maximum radiation.

Electric field — An electric field exists in a region of space if an electrically charged object placed in the region is subjected to an electrical force.

Electromagnetic wave — A wave of energy composed of electric and magnetic fields.

Electron — A negatively charged subatomic particle.

Electronic current — The flow of electrons. (see also **Conventional current**)

Electronic keyer — A device that makes it easier to send well-timed Morse code. It sends a continuous string of either dots or dashes, depending on which lever of the *paddle* is pressed.

Element — (1) The conducting part or parts of an antenna designed to radiate or receive radio waves. (2) An electrode in a vacuum tube used to control the tube's operation.

Encapsulation — The process of packaging information from one protocol inside another.

Encoding — Changing the form of a signal into one suitable for storage or transmission. *Decoding* is the process of returning the signal to its original form.

End-fed half wave (EFHW) — A half-wave dipole fed at one end.

Envelope — The shape formed by the maximum values of the instantaneous amplitude of an **AM** signal.

Equalization (audio) — Adjusting the frequency response of a circuit or signal.

Equivalent — An electrically identical circuit or component.

Equivalent series resistance — A single **parasitic** resistance that accounts for all of a capacitor's losses.

Equivalent series inductance — A single **parasitic** inductance that accounts for all of the inductance exhibited by a capacitor.

Error correction (detection) — Techniques of detecting and correcting transmission errors in digital data.

F region — A combination of the two highest ionospheric regions (or layers), the F1 and F2 regions. The F region refracts radio waves and returns them to Earth. Its height varies greatly depending on the time of day, season of the year and amount of sunspot activity.

Farad (F) — The basic unit of capacitance.

FEC (Forward error correction) — A technique of sending redundant data so that common transmission errors can be corrected without retransmission.

Feedback — The technique of routing some fraction of an output signal back to the system's or circuit's input.

Feed line — The wires or cable used to connect a transmitter, receiver or transceiver to an antenna. The feed line connects to an antenna at its **feed point**. Also see **transmission line**.

Feed point — The point at which a feed line is electrically connected to an antenna.

Feed point impedance — The ratio of RF voltage to current at the feed point of an antenna.

FET (JFET) — See **Transistor**

Ferrite — A ceramic material that can store or dissipate magnetic energy. A ferrite core can be used to increase inductance and ferrite beads can be used to block RF current flow.

Field strength meter — A calibrated meter that measures the electric field strength of a transmitted signal.

Filter (network) — A circuit that acts on signals depending on their frequency.

Filter capacitor — A capacitor used to reduce **ripple** in a power supply.

Flat-topping (see **Clipping**)

Flip-flop — Digital circuit with two stable output states controlled by the sequence of input signals.

Forward power — The power traveling along a transmission line from the transmitter to the load or antenna.

Forward voltage — The voltage required to cause current to flow through a **PN junction**. The voltage at which current starts to flow is the *junction threshold*.

Frame — (1) A packet of data including a header, data payload, and trailer. (2) A single image in a video signal.

Free electron — An electron not bound to an atom.

Frequency — The number of complete cycles of an alternating current that occur per second.

Frequency band — A continuous range of frequencies. An **amateur band** is a frequency band in which amateur communications take place.

Frequency counter — Test equipment used to measure frequency. (see also **Counter**)

Frequency modulation (FM) — The process of adding information to an RF signal or *carrier* by varying its frequency.

Frequency shift keying (FSK) — Frequency shift keying in which different bit values are represented by different transmitted frequencies. *AFSK (audio FSK)* is created by inputting tones into the voice modulation circuitry of a voice-mode transmitter.

Front-to-back (front-to-side) ratio — The ratio in dB of an antenna's radiation in the main lobe to that in the directly opposite direction (at ±90° to the direction of maximum radiation).

FT8 — a digital mode, part of the ***WSJT-X*** software suite.

Full-wave rectifier — A rectifier circuit that converts every half-cycle (360 degrees) of the input waveform to dc.

Fundamental (see **Harmonic**)

Fundamental overload — Overload of a receiver by the fundamental of a transmitted signal. (see also **Receiver overload**)

Gain — (1) Focusing of an antenna's radiated energy in one direction. Gain in one direction requires that gain in other directions is diminished. (2) The amount of amplification of a signal in a circuit. (3) A control that determines the amount of amplification by a piece of equipment, such as AF Gain (volume) or RF Gain (sensitivity).

Gain compression (blocking) — A reduction in gain due to the presence of strong signals.

Gamma match — A type of **impedance matching** structure used to transform the low impedance of an antenna's driven element to a higher value closer to that of standard feed lines.

Gate (logic) — A circuit that performs a specific logic function such as inversion, NOR, NAND, XOR, and so on.

Gateway — A station that transfers communications between Amateur Radio and commercial networks such as the Internet. (see also **Mailbox**)

Geomagnetic field — The Earth's magnetic field. Disruption of the geomagnetic field can result in a *geomagnetic storm* that alters ionospheric propagation.

GFCI (or **GFI**) — Ground-fault interrupting circuit breaker that opens a circuit when an imbalance of current flow is detected between the hot and neutral wires of an ac power circuit.

Great circle — The direct path across the surface of the Earth between two points.

Grid-driven (cathode-driven) — Vacuum tube amplifier for which the input signal is applied to the control grid (cathode) of the amplifying tube.

Ground loop — A current path that connects two or more pieces of equipment in a loop in which voltage can be induced by RF or magnetic fields.

Ground rod — A copper or copper-clad steel rod that is driven into the earth. A heavy copper wire or strap connects all station equipment to the ground rod.

Ground plane — A conducting surface of continuous metal or discrete wires that acts to create an electrical image of an antenna. **Ground-plane antennas** require a ground-plane in order to operate properly.

Ground wave propagation — Propagation in which radio waves travel along the Earth's surface.

Hairpin — see **Beta match**.

Half-wave rectifier — A rectifier circuit that converts every other half-cycle (180 degrees) of the input waveform to dc.

Halo — a half-wave dipole antenna bent into a circle or square (a "squalo"), used at VHF and UHF.

Harmful interference — Interference that seriously degrades, obstructs or repeatedly interrupts a radio communication service operating in accordance with the Radio Regulations. [§97.3 (a) (22)] (see also **malicious interference**)

Harmonic — Signals from a transmitter or oscillator occurring at integer multiples (2×, 3×, 4×, etc) of the original or **fundamental** frequency. Frequencies of signals at harmonics of a fundamental are *harmonically related*, such as 3.5, 7, 14, 21 and 28 MHz.

Header — The portion of a data frame that contains information for routing or other control functions.

Henry (H) — The basic unit of inductance.

Heterodyne — Combining two signals in order to obtain signals at the sum and difference of the frequencies of the original signals.

High pass — A type of filter that rejects signals below the cutoff frequency.

Hop (see **Skip**)

Hot switching — Opening or closing relay or switch contacts while current is flowing through them, often a destructive practice.

Hum — Unwanted 60- or 120-Hz modulation of a RF signal due to inadequate filtering in a power supply. Also called *buzz*, particularly 120 Hz and higher frequency artifacts.

Image — An unwanted response by the receiver to signals that create **mixing products** at the same **IF** as desired signals.

Impedance (Z) — The opposition to electric current in a circuit. Impedance includes both reactance and resistance, and applies to both alternating and direct currents.

Impedance match — To adjust impedances to be equal or the case in which two impedances are equal. Usually refers to the point at which a feed line is connected to an antenna or to transmitting equipment. If the impedances are different, that is a *mismatch*.

Impedance matcher — (circuit) A circuit that transforms impedance from one value to another. Adjustable impedance matching circuits are used at the output of transmitters and amplifiers to allow maximum power output over a wide range of load impedances. (equipment) A device that matches one impedance level to another. For example, it may match the impedance of an antenna system to the impedance of a transmitter or receiver. (see also **Antenna tuner**)

Impedance transformer — A transformer designed specifically for transforming impedances in RF equipment.

Indicator — Characters added after a slash or other separating phrase at the end of a call sign to modify the license class or location implied by the call sign. For example, "portable AG" added after a call sign indicates that the operator has obtained General class privileges.

Indicator (visual) — A device that presents on/off information visually by the presence, absence, or color of light.

Inductance (L) — A measure of the ability of a coil to store energy in a *magnetic field*.

Inductor — An electrical component usually composed of a coil of wire wound on a central core. An inductor stores energy in a *magnetic field*.

Integrated circuit (IC) — Multiple semiconductor devices in a circuit created on a single substrate.

Inter-electrode capacitance — The capacitance between the elements of a vacuum tube.

Interference (constructive and destructive) — The reinforcement (constructive) or cancellation (destructive) of signals caused by their relative phase.

Intermediate frequency (IF) — The stages in a receiver that follow the input amplifier and mixer circuits. Most of the receiver's gain and selectivity are achieved at the IF stages.

Intermodulation — Two signals mixing together in a receiver circuit or non-linear contact in a strong RF field to produce mixing products that are received along with actual signals.

International Telecommunication Union (ITU) — The organization of the United Nations responsible for coordinating international telecommunications agreements.

Inversion — (digital) the function of changing 0 to 1 and vice-versa. An *inverter* is a circuit that performs inversion.

Inverted V — A dipole supported at the center with legs sloping toward the ground.

Ion (ionized) — An atom that is missing one or more electrons.

Ionizing radiation — Electromagnetic radiation that has sufficient energy to knock electrons free from their atoms, producing positive and negative ions. X-rays, gamma rays and ultraviolet radiation are examples of ionizing radiation. Radiation below this energy (such as RF waves) is called *non-ionizing radiation.*

Ionosphere — A region of electrically charged (ionized) gases high in the atmosphere. The ionosphere bends radio waves as they travel through it, returning them to Earth. Also see **sky-wave propagation**.

I/Q modulation — The technique of modulating two signals (I and Q) that are out of phase by 90° and combining them in a composite, modulated signal.

Isotropic antenna — An antenna that radiates and receives equally in all possible directions.

Jack — Connector mounted on equipment and into which a mating connector (the *plug*) is inserted. Also referred to as a *receptacle*.

JFET — Junction FET (see **Transistor**)

Junction (see **PN junction**)

Junction capacitance (C_J) — The capacitance created by a PN junction.

Junction threshold (see **Forward voltage**)

Key (see **Straight key**)

Keyed connector — Connectors with a contact arrangement or body shape that only allows mating in one orientation.

Keyer or **electronic keyer** — A piece of equipment that generates Morse code automatically.

Kilo (or lower case **k**) — The metric prefix for 10^3, or multiply by 1000.

Kirchoff's Laws — Electrical laws that describe the distribution of voltage (Kirchoff's Voltage Law, KVL) and current (Kirchoff's Current Law, KCL) in electrical circuits.

Ladder line (feed line) — See **Parallel-conductor feed line**.

Lamination — Strips of metal in an inductor or transformer core.

LCD — Liquid crystal display.

LC circuit — A circuit made entirely from inductors (L) and capacitors (C).

LED — Light-emitting diode.

Limiter — A type of high-gain **IF amplifier** that strips all AM information from the signal, leaving only frequency variations.

Linear amplifier — Also known as a *linear*, a piece of equipment that amplifies the output of a transmitter, often to the full legal amateur power limit of 1500 W PEP.

Linear supply — A power supply that uses capacitor- or inductor-filter output circuits and a passive rectifier circuit.

Loading — The technique of increasing an antenna's electrical size by adding inductive (coils) or capacitive (capacity hats) reactance to the antenna. *Linear loading* folds the antenna back on itself to reduce physical size.

Local oscillator (LO) — An oscillator used to generate one of the input signals to a **mixer**.

Log — A record of a station's operation. In cases of interference-related problems, it can be used as supporting evidence and for troubleshooting.

Log periodic antenna — A frequency-independent antenna whose element dimensions and placement are arranged in a logarithmic pattern.

Logic (see **Digital**)

Long path — The longest of the two great circle paths between two stations.

Loop antenna — An antenna with element(s) constructed as continuous lengths of wire or tubing. A symmetrical square loop is called a *quad loop* and a symmetrical triangular loop is a *delta loop*.

Loss — A reduction in power, voltage, or current due to dissipation of energy. (see also **attenuation**).

Lower sideband (LSB) — (1) In an AM signal, the sideband located below the carrier frequency. (2) The common single-sideband operating mode on the 40, 80 and 160-meter amateur bands.

Magnetosphere — The interface between charged particles from the Sun (the *solar wind*) and the Earth's **geomagnetic field**.

Mailbox (station) — An automatically controlled station that receives and transmits stored messages, usually email or data files. (see also **Gateway** and **Winlink**)

Malicious (willful) interference — Intentional, deliberate obstruction of radio transmissions. (see also **Harmful interference**)

Match (impedance) — Equal impedance values

Maximum Power Transfer Theorem — A proof showing that the maximum energy can be transferred between a source and a load when the source and load impedances are equal.

Maximum useable frequency (MUF) — The highest-frequency radio signal that will reach a particular destination using **sky-wave propagation**, or *skip*. The MUF may vary for radio signals sent to different destinations.

Maximum permissible exposure (MPE) — The maximum intensity of RF radiation to which a human being may be exposed. FCC rules establish maximum permissible exposure values for humans to RF radiation. [§1.1310 and §97.13 (c)]

Mean — The average value.

Memory bus — The interface between a microprocessor and memory devices that supports high-speed data transfer.

Micro (or **μ**) — The metric prefix for 10^{-6}, or divide by 1,000,000.

Microcontroller — A microprocessor combined with circuitry designed to interface with external signal and control circuits.

Microwave — Radio waves or signals with frequencies greater than 1000 MHz (1 GHz). This is not a strict definition, just a conventional way of referring to those frequencies.

Milli (or lower case **m**) — The metric prefix for 10^{-3}, or divide by 1000.

Mismatch — A difference between the impedance of a load from the equipment or feed line to which it is connected.

Mix — The combination of materials used to make a **ferrite** or **powdered iron** magnetic core for inductors.

Mixer — Circuitry that combines two signals and generates signals called *mixing products* at both their sum and difference frequencies.

Mode — The combination of a type of information and a method of transmission. For example, FM radiotelephony or *FM phone* consists of using FM modulation to carry voice information.

Modem — Short for *mo*dulator/*dem*odulator. A modem changes data into audio signals that can be transmitted by radio and demodulates a received signal to recover transmitted data.

Modulate or **modulation** — The process of adding information to an RF signal or *carrier* by varying its amplitude, frequency, or phase.

Modulation envelope — The waveform created by connecting the peak values of a modulated signal.

Monitor — Observe by listening or watching.

Morse code (see **CW**)

MOSFET — Metal-oxide semiconductor FET (see **Transistor**), also known as an insulated-gate FET (IGFET).

Multiband antenna — An antenna capable of operating on more than one amateur frequency band, usually using a single feed line.

Multihop propagation — Long-distance radio propagation using several skips or hops between the Earth and the ionosphere.

Multipath propagation — Propagation by multiple paths to a single receiver.

Multimeter — An electronic test instrument used to measure current, voltage and resistance in a circuit. Describes all meters capable of making these measurements, such as the *volt-ohm-milliammeter (VOM)* or *digital multimeter (DMM)*.

Multiplier — A circuit that creates a signal that is a **harmonic** of the input signal.

Mutual inductance — The ability of inductors to share or transfer energy through a common magnetic field

N or **Type N connector** — A type of RF connector.

National Electrical Code (NEC) — A set of guidelines governing electrical safety, including antennas.

Near vertical incidence sky-wave (NVIS) — The use of high-angle radiation for local and regional communication.

Network — (1) A term used to describe several digital stations linked together to relay data over long distances. (2) A general term for any circuit or set of electrical connections.

Neutralization — The technique of preventing self-oscillation in an amplifier.

Noise blanking — The technique of muting a receiver during a noise pulse.

Noise reduction — Removing random noise from a receiver's audio output.

Nominal value — The rated amount of ohms, farads, henrys, or other electrical characteristics that a component is supposed to present to a circuit.

Nonionizing radiation — Electromagnetic radiation that does not have sufficient energy to knock electrons free from their atoms. Radio frequency (RF) radiation is nonionizing.

Notch filter — A filter that removes a very narrow range of frequencies, usually from a receiver's audio output to remove interfering tones. An *automatic notch filter (ANF)* can detect the presence of one or more such tones and adapt to remove them.

OCF dipole (see **Dipole**) — Off-center fed dipole.

Ohm — The basic unit of electrical **resistance**.

Ohm's Law — A basic law of electronics. Ohm's Law states the relationship between voltage (E), current (I) and resistance (R). The voltage applied to a circuit is equal to the current through the circuit times the resistance of the circuit ($E = I \times R$).

Ohmmeter — A device used to measure resistance.

Omnidirectional — An antenna that radiates and receives equally in all horizontal directions.

Open circuit voltage — The voltage at the output of a circuit with no load connected.

Open-wire (feed line) — See **Parallel-conductor feed line.**

Optimization — Adjustment of design parameters for a circuit or antenna to improve performance.

Oscillate — To vibrate continuously at a single frequency. An **oscillator** is a device or circuit that generates a signal at a single frequency.

Oscillator — A circuit that produces a single frequency output signal. An *LC oscillator* uses inductors and capacitors to form a resonant circuit that determines the oscillator's frequency. A *crystal oscillator* replaces the LC circuit with a quartz crystal.

Oscilloscope — Test instrument that visually displays voltage versus time on a **cathode-ray tube**.

Overload (see **Receiver overload**)

Overdeviation (overmodulation) — Applying excessive modulation so that the recovered information is distorted or that distortion products create a modulated signal with an excessive bandwidth.

PACTOR — A digital ARQ mode that exchanges data as frames or packets.

Paddle — Instrument with one or two lever-operated contacts for controlling an electronic **keyer** that generates Morse code automatically.

Parallel circuit — An electrical **circuit** in which the electrons may follow more than one path in traveling between the negative supply terminal and positive terminal.

Parallel-conductor line — A type of transmission line that uses two parallel wires spaced apart from each other by insulating material. Also known as *balanced, open-wire, ladder, or window line*.

Parallel interface — A data interface through which multiple bits of data are transferred at one time. A byte-wide interface transfers eight data bits in each operation.

Parasitic (component) — An unwanted characteristic of an electrical component whose effects are represented by a component of a different type, such as parasitic inductance of a resistor lead or parasitic capacitance between turns of an inductor.

Parasitic element (see **Array**)

Parasitic (signal) — Unwanted signal generated by a circuit and not harmonically related to the circuit's input or output frequencies.

Parity bit — A bit that indicates whether there is an odd or even number of 1 bits in an encoded character.

Passive — A device that functions without requiring a source of power.

Peak envelope power (PEP) — The average power of an RF signal during one complete cycle at the peak of a signal's modulation envelope.

Peak envelope voltage (PEV) — The voltage at the peak of a modulated signal's **envelope**.

Peak inverse (reverse) voltage (PIV) — The maximum reverse bias that a rectifier is rated to withstand.

Permeability — The ability of a material to contain magnetic energy.

Phase — A measure of position in time within a repeating waveform, such as a sine wave. Phase is measured in degrees or radians. There are 360 degrees or 2ϖ radians in one complete cycle.

Phase angle — The phase angle of a signal is a measure of the relative difference in phase between the signal and a reference signal or some point in time.

Phase-locked loop (PLL) — A circuit that adjusts the frequency of an oscillator to have the same phase as that of a reference circuit.

Phase modulation (PM) — The process of adding information to a signal by varying its **phase angle**.

Phase shift keying (PSK) — Phase modulation that consists of shifting a signal between two different phases (*binary PSK* or *BPSK*) or two signals between four relative phases (*quadrature PSK* or *QPSK*). **PSK31** and **PSK63** are popular digital modes that use PSK.

Phone — Another name for voice communications. An abbreviation for *radiotelephone*.

Phone emission — The FCC name for voice or other sound transmissions.

Phone patch — Using radio to transmit and receive audio from the public telephone system.

Phonetics — Words substituted for letters in order to convey a message during voice communication.

Photovoltaic conversion — The direct conversion of sunlight to electricity.

Pi (π) — A mathematical constant approximately equal to 3.14159. The ratio of a circle's circumference to its diameter.

Pico (or lower case **p**) — The metric prefix for 10^{-12}, or divide by 1,000,000,000,000.

Plug (see **Jack**)

PN junction — The interface between two types of semiconductor material, forming a *junction diode*.

Polarity — The convention of assigning positive and negative directions or quantities. (see also **phase**)

Polarization — The orientation of the electrical-field of a radio wave with respect to the surface of the Earth. An antenna that is parallel to the surface of the Earth, such as a dipole, produces horizontally polarized waves. One that is perpendicular to the Earth's surface, such as a quarter-wave vertical, produces vertically polarized waves. An antenna that has both horizontal and vertical polarization is said to be *circularly polarized*.

Polarized capacitor — A capacitor to which dc voltage may only be applied with one polarity without damage (non-polarized capacitors are insensitive to the polarity of the applied voltage).

Powdered iron — Finely ground iron particles combined with an electrically inert material and used as a core for inductors at high frequencies.

Power — The rate of energy consumption or expenditure. Calculate power in an electrical circuit by multiplying the voltage applied to the circuit times the current through the circuit ($P = I \times E$).

Power amplifier (see **Linear amplifier**)

Power (or **voltage** or **current**) **rating** — The rated ability of the component to withstand electrical stress.

Power density — The concentration of RF energy in a certain area.

Power resistor — A resistor designed to dissipate several watts of power or more.

Power supply — A circuit that provides a direct-current output at some desired voltage from an ac input voltage.

PRB-1 — An FCC rule that requires zoning regulations to accommodate Amateur Radio.

Preamplifier — An amplifier placed ahead of a receiver's input circuitry to increase the strength of a received signal.

Preselector — A filter at the input to a receiver to reject strong out-of-band signals.

Primary battery — A battery that can only be charged once and is discarded after it is discharged.

Primary service — When a frequency band is shared among two or more different radio services, the primary service is preferred. Stations in the **secondary service** must not cause harmful interference to, and must accept interference from stations in the primary service. [§97.303]

Product detector — A type of mixer circuit that allows a receiver to demodulate CW and SSB signals.

Propagation — The process through which radio waves travel.

Prosign — A Morse code character used to control contact flow or indicate status

Protocol — A method of encoding, packaging, exchanging, and decoding digital data.

PSK31 or **PSK63** (see **Phase shift keying**)

Push to talk (PTT) — Turning a transmitter on and off manually with a switch, usually thumb- or foot-activated.

QPSK (see **Phase shift keying**)

QRL — A Q-signal used to inquire if a channel is occupied or if an operator is busy.

QRM — Interference from other signals.

QRN — Interference from natural or man-made static or noise.

QRS — A Q-signal used to ask a station sending CW to send slower. **QRQ** means to speed up.

QSK — A Q-signal indicating a station can receive between individual dots and dashes, called "full break-in".

QSL (card) — QSL is a Q-signal meaning "received and understood." QSL cards or QSLs are postcards which serve as a confirmation of communication between two hams. The exchange of QSLs is *QSLing.*

Quad antenna — An antenna built with its elements in the shape of four-sided loops.

Quadrature detector (see **Discriminator**)

Radial — Wires connected to the feed point of a **ground-plane** antenna that act as an electrical mirror for the physical portion of the antenna.

Radiation pattern — A graph showing how an antenna radiates and receives in different directions. An *azimuthal pattern* shows radiation in horizontal directions. An *elevation pattern* shows how an antenna radiates and receives at different vertical angles. *Lobes* are regions in which the antenna radiates and receives and *nulls* are the minima between lobes. The strongest lobe is the *major lobe.*

Radio frequency (RF) exposure — FCC Rules establish maximum permissible exposure (MPE) values for humans to RF radiation. [§1.1310 and §97.13 (c)]

Radio-frequency interference (RFI) — Disturbance to electronic equipment caused by radio-frequency signals.

Radioteletype (RTTY) — Radio signals sent from one teleprinter machine to another machine using the *Baudot code* encoded as *mark* and *space* tones using. Also known as narrow-band direct-printing telegraphy.

Random wire (antenna) — An antenna of any length and generally connected directly to the transmitter or impedance matching device.

Range — The longest distance over which radio signals can be exchanged.

Rating — A maximum value of electrical stress to which a component can be subjected and still perform properly.

Reactance (X) — The opposition to ac current flow by a capacitor or inductor.

Receiver incremental tuning (RIT) — Adjustment of the receive frequency without changing the main tuning control.

Receiver overload — Interference to a receiver caused by a RF signal too strong for the receiver input circuits. A signal that overloads the receiver RF amplifier (front end) causes *front-end overload.* Receiver overload is sometimes called *RF overload.*

Rectification — The process of changing ac current into pulses of dc current.

Rectifier — (Circuit) A circuit that performs **rectification**. (Component) A diode intended for high current or voltage **rectification**. A *rectifier string* is several rectifiers connected in series to withstand reverse voltages higher than a single diode's **PIV** rating.

Reflected (reverse) power — The power flowing in a transmission from the antenna or load back towards the transmitter.

Reflector — A parasitic element behind the driven element in a directional antennas.

Refract — Bending of an electromagnetic wave as it travels through materials with different properties.

Region — One of the three administrative areas defined by the **ITU**; 1 — Europe and Africa, 2 — North and South America, and 3 — Asia and the Pacific.

Regulation — The ability to maintain a voltage or current at a specified level.

Rejection (see **Attenuation**)

Reliable transport — A protocol capable of delivering only data in which no transmission errors have occurred within the limits of its error correction and detection mechanisms.

Re-radiation — Radiation from a parasitic antenna element resulting from energy received from a driven element.

Resistance (R) — Opposition to electric current in which some of the energy carried by the current is dissipated as heat.

Resistor — An electronic component specifically designed to oppose or control current through a circuit.

Resonance — (1) The frequency at which the maximum response of a circuit or antenna occurs. (2) The frequency at which a circuit's capacitive and inductive reactances are equal and cancel, leaving a purely resistive impedance.

Resonant frequency — The desired operating frequency of a tuned circuit. In an antenna, the resonant frequency is one at which the feed point impedance is composed only of resistance.

Reverse breakdown — Flow of current in the reverse direction across a **PN junction** due to excessive applied voltage.

RF burn — A burn produced by coming in contact with RF voltage.

RF feedback — Distortion caused by RF signals disturbing the function of an audio circuit.

RF safety — Preventing injury or illness to humans from the effects of radio-frequency energy.

Ring — The middle contact in a multiple-circuit phone-type connector between the *tip* contact at the end of the plug and the *sleeve* contact usually connected to circuit common or ground.

Ripple — Variations in power supply output voltage due to current pulses in a rectifier circuit.

Root mean square (RMS) — A measure of voltage of an ac signal that would deliver the same amount of power as a dc voltage of the same value. Root Mean Square refers to the method used to calculate the voltage.

Rotator — A device used to turn an antenna.

Rotor — A part of a device or motor that turns. (see **Rotator**)

S-meter — A meter that provides an indication of the relative strength of received signals. The meter's calibration is in *S-units* that are generally represent 5 to 6 dB changes in signal strength.

Safety interlock — A switch that automatically turns off power to a piece of equipment when the enclosure is opened.

Saturation — The point at which an increase in input signal results in no change in the output signal.

Scatter modes — HF propagation by means of multiple reflections in the layers of the atmosphere or from the ground (*backscatter*).

Secondary battery — A battery that can be recharged and reused (also known as a **storage battery**).

Secondary service or allocation — When a frequency band is shared among two or more different radio services, the **primary service** is preferred. Stations in the secondary service must not cause harmful interference to, and must accept interference from stations in the primary service. [§97.303]

Selectivity — The ability of a receiver to distinguish between signals. Selectivity is important when many signals are present and when it is desired to receive weak signals in the presence of strong signals.

Self policing — The practice of amateurs encouraging and assisting other amateurs to abide by FCC regulations.

Self-resonance — Resonance caused by the reactance from a component's parasitic reactance cancelling the component's intended reactance.

Self-discharge — The gradual loss of stored energy by a battery.

Sensitivity — The ability of a receiver to detect weak signals.

Sequential logic — Digital circuits with an output determined by the history of the input signal states.

Serial interface — A data interface through which data is transferred one bit at a time.

Series circuit — An electrical **circuit** in which all the electrons must flow through every part of the circuit because there is only one path for the electrons to follow.

Shack — Slang for a room or building containing an amateur's station.
Shared allocation — A frequency range used by two or more communication services.
Shielding — Surrounding an electronic circuit to block RF signals from being radiated or received.
Shift — In an AFSK or FSK signal, the difference between the tones that represent different bit values.
Shift register — Digital circuit that stores information as a sequence of internal states.
Short path — The shortest of the two great circle paths between two stations.
Sidebands — Signals adjacent to a **carrier** generated by the process of **modulation**.
Signal diode (switching diode) — A diode designed for use with low power signals that operate at high frequencies.
Signal generator — A device that produces low-level signals similar to those received over the air; used for testing receivers and other equipment.
Signal to noise ratio (SNR) — The ratio of a signal's amplitude to that of the noise in a specific bandwidth.
Single sideband (SSB) phone — SSB is a form of double-sideband **amplitude modulation** in which one sideband and the carrier are removed.
Skip — Propagation by means of ionospheric reflection. Traversing the distance to the ionosphere and back to the ground is called a *hop*. *Short skip* is propagation that covers distance much shorter than the maximum range for skip propagation.
Skip zone — A ring-shaped area of poor radio communication, too distant for ground wave and too close for sky wave propagation.
Sky-wave propagation — The method by which radio waves travel through the ionosphere and back to Earth. Sometimes called *skip*, sky-wave propagation has a far greater range than **line-of-sight** and **ground-wave propagation**.
Sleeve (see **Ring**)
SMA connector — A type of RF connector.
Software-defined radio (SDR) — A transceiver or receiver in which all major signal processing functions are performed by software.
Solar cycle — The 10.7 year period of variation in solar activity.
Solar flare — A sudden eruption of energy and material from the surface of the Sun.
Solar indices — Measurements of solar activity. *Solar-flux index (SFI)* is a measure of solar activity at 10.7 cm. The *A* and *K indices* are measures of long-term and short-term geomagnetic field stability, respectively.
Solenoid (solenoidal winding) — An inductor wound around a cylindrical core.
Specific absorption rate (SAR) — A term that describes the rate at which RF energy is absorbed into the human body. Maximum permissible exposure (MPE) limits are based on whole-body SAR values.
Speech compression or **processing** — Increasing the average power and intelligibility of a voice signal by amplifying low-level components of the signal more than high-level components.
Splatter — A type of interference to stations on nearby frequencies. Splatter occurs when a transmitter is **overmodulated**.
Splitter — A circuit or connector that divides a signal between two or more circuits.
Sporadic E — A form of enhanced radio-wave propagation that occurs when radio signals are reflected from small, dense ionization patches in the E region of the ionosphere. Sporadic E is observed on the 15, 10, 6 and 2-meter bands, and occasionally on the 1.25-meter band.
Spurious emissions — Signals from a transmitter on frequencies other than the operating frequency.
Spurs (see **Parasitic**).

SSB (see **Amplitude modulation**)

Stacking — The process of increasing forward gain and controlling the vertical angle of radiation by adding antennas vertically or horizontally.

Stage — One of a sequence of circuits that process signals.

Standing-wave ratio (SWR) — Sometimes called *voltage standing-wave ratio* (VSWR), the ratio feed line's characteristic impedance and the load (usually an antenna). VSWR is the ratio of maximum voltage to minimum voltage along the feed line which is the same the ratio of antenna impedance to feed-line impedance. SWR is always stated so as to be greater than 1:1.

Start bit — A bit preceding the data bits in a character in order to synchronize the receiving system.

Step rate (size) — The smallest increment by which frequency changes as a **VFO** control is operated.

Stop bit — A bit following the data bits in a character in order to synchronize the receiving system.

Storage battery (see **secondary battery**)

Straight key — manual instrument for sending Morse code

Stub (transmission line) — A section of transmission line that is used to modify the impedance of an antenna system.

Sudden ionospheric disturbance (SID) — Short-term disruption of ionospheric propagation called a *radio blackout* as a result of a sudden increase in solar radiation.

Sunspot cycle — The number of **sunspots** increases and decreases in a predictable cycle that lasts about 11 years.

Sunspots — Dark spots on the surface of the Sun. When there are few sunspots, long-distance radio propagation is poor on the higher-frequency bands. When there are many sunspots, long-distance HF propagation improves.

Surface-mount technology (SMT) — Printed-circuit board components that solder directly to connection pads without mounting holes.

Switch-mode supply (switching supply) — A power supply that uses active devices to create high-frequency current pulses in an inductor to regulate output voltage.

SWR bridge (meter) — A measuring instrument that senses forward and reflected power to display SWR.

Symbol rate (signaling rate) — The rate at which individual data *symbols* are transmitted (see also **baud**).

Tank circuit — A resonant circuit that stabilizes the frequency of an oscillator or amplifier.

Temperature coefficient — The variation of a component's actual value with temperature.

Thermistor — A resistor manufactured with a precisely controlled **temperature coefficient** so as to be used as a temperature sensor.

Third-party — An unlicensed person on whose behalf communications is passed by Amateur Radio.

Third-party communications — Messages passed from one amateur to another on behalf of a third person.

Third-party communications agreement — An official understanding between the United States and another country that allows amateurs in both countries to participate in third-party communications.

Third-party participation — An unlicensed person participating in amateur communications. A control operator must ensure compliance with FCC rules.

Through-hole — Printed-circuit board components that have wire leads that are inserted into holes through connection pads and then soldered to the pads.

Timeout — In digital communications, for a station to terminate a contact because of excessive errors or delays.

Tip (see **Ring**)

Tolerance — The amount the actual value is allowed to vary from the nominal value, usually expressed in percent.

Toroidal winding — An inductor wound around a circular core with a central hole (a toroid).

Trailer — Control or error correction/detection information added after the data in a digital data **frame**.

Transconductance (g_m) — The ratio of output current to input voltage.

Transfer switch — A switch that connects a home power distribution panel to either a generator or the utility lines.

Transform (impedance) — To alter the ratio of voltage and current (impedance) from an undesired value to a desired value.

Transceiver (XCVR) — A radio transmitter and receiver combined in one unit.

Transistor — A solid-state device made of semiconductor material and used as a switch or amplifier. A *bipolar junction transistor (BJT)* is made of three layers of doped material forming two **PN junctions** and is controlled by current. A *field-effect transistor (FET)* consists of a *channel* and a *gate* and is controlled by voltage.

Transformer — Two or more inductors wound on a common core for the purpose of transferring energy between them.

Transmission line — The wires or cable used to connect a transmitter or receiver to an antenna. Also called **feed line**.

Transmit-receive (TR) relay (switch) — A relay that switches an antenna or transceiver between transmit and receive functions. Also known as a *changeover relay*.

Transmitter incremental tuning (XIT) — Adjustment of the transmit frequency without changing the main frequency control.

Trap — A tuned circuit that acts as an electrical switch in a multiband antenna, such as a *trapped dipole* or *trapped Yagi*.

Traveling-wave antenna — An antenna whose characteristics are determined by radio waves moving along or across it.

Triband Yagi (tribander) — A common design that operates on each of the three main HF bands, 20, 15, and 10 meters, through the use of **traps** or other features.

Turns ratio — The ratio of the number of turns in a transformer's primary winding to the number of turns in the secondary winding.

Twin-lead (feed line) — See **Parallel-conductor feed line**.

Two-tone testing — Using a pair of non-harmonically related tones to evaluate the linearity of an AM transmitter.

UHF connector — A type of RF connector.

Unbalanced feed line — Feed line with one conductor at ground potential, such as coaxial cable.

Uncontrolled environment — Any area in which an RF signal may cause radiation exposure to people who may not be aware of the radiated electric and magnetic fields. The FCC generally considers members of the general public and an amateur's neighbors to be in an uncontrolled **RF radiation** exposure environment to determine the maximum permissible exposure levels.

Upper sideband (USB) — (1) In an AM signal, the sideband located above the carrier frequency. (2) The common single-sideband operating mode on the 60, 20, 17, 15, 12 and 10-meter HF amateur bands, and all the VHF and UHF bands.

Variable-frequency oscillator (VFO) — An oscillator used in receivers and transmitters. The frequency is set by a tuned circuit using capacitors and inductors and can be changed by adjusting the components of the tuned circuit.

Varicode — A digital code in which the codes for each value have a different number of bits.

Velocity Factor (VF) — velocity of electromagnetic waves in a specific medium relative to free space and expressed as a percentage or a value between 0 and 1.

Velocity of propagation — The speed at which electromagnetic waves propagate through a media or a transmission line. The constant *c* is often used to represent the speed of light.

Vertical antenna — A common amateur antenna whose radiating element is vertical. There are usually four or more radial elements parallel to or on the ground.

Virtual height — The height at which a reflecting surface would have to be to create **sky-wave propagation** between two points.

Voice-operated transmit (VOX) — Activating the transmitter under the control of the operator's voice.

Volatile (memory) — Memory that loses its stored data when power is removed (**nonvolatile** memory retains the data when power is removed).

Voltage drop — The difference in voltage caused by current flow through an **impedance**.

Voltmeter — A test instrument used to measure **voltage**.

Volt-ohm-meter (VOM) — See **Multimeter**

Volunteer Examiner (VE) — A licensed amateur who is accredited by a Volunteer Examiner Coordinator (VEC) to administer amateur license examinations.

Volunteer Examiner Coordinator (VEC) — An organization that has entered into an agreement with the FCC to coordinate amateur license examinations.

Waterfall display — A method of displaying signal strength and frequency on a sequence of lines with newer lines appearing at the top or left of the display, giving the appearance of flow.

Wattmeter — Also called a *power meter*, a test instrument used to measure the power output (in watts) of a transmitter in a feed line.

Wavelength (λ) — The distance a radio wave travels in one RF cycle. The wavelength relates to frequency. Higher frequencies have shorter wavelengths.

Whip antenna — An antenna with an element made of a single, flexible rod or tube.

Willful interference (see **Malicious interference**)

Windings — The inductors that share a common core in a **transformer.** Energy is supplied via the *primary windings* and extracted via the *secondary windings.*

Winlink — A system of **mailbox** and **gateway** stations for email transmission and distribution using Amateur Radio.

Window line (feed line) — See **Parallel-conductor feed line**.

WINMOR — A digital ARQ mode that exchanges data as frames or packets.

WSJT (also ***WSJT-X)* —** A software suite that implements several digital modes optimized for weak-signal operation, originally developed by Joe Taylor, K1JT.

XCVR — Transceiver.

XIT (see **Transmitter incremental tuning**)

XMTR — Transmitter.

Yagi antenna — The most popular type of directional (beam) antenna. It has one driven element and one or more additional parasitic elements.

Chapter 11

Question Pool

General Class (Element 3) Syllabus

Effective July 1, 2019 to June 30, 2023

SUBELEMENT G1 — COMMISSION'S RULES

[5 Exam Questions — 5 Groups] 64 Questions

G1A — General class control operator frequency privileges; primary and secondary allocations
G1B — Antenna structure limitations; good engineering and good amateur practice; beacon operation; prohibited transmissions; retransmitting radio signals
G1C — Transmitter power regulations; data emission standards; 60-meter operation requirements
G1D — Volunteer Examiners and Volunteer Examiner Coordinators; temporary identification; element credit
G1E — Control categories; repeater regulations; third-party rules; ITU regions; automatically controlled digital station

SUBELEMENT G2 — OPERATING PROCEDURES

[5 Exam Questions — 5 Groups] 60 Questions

G2A — Phone operating procedures; USB/LSB conventions; breaking into a contact; VOX operation
G2B — Operating courtesy; band plans; emergencies, including drills and emergency communications
G2C — CW operating procedures and procedural signals; Q signals and common abbreviations; full break-in
G2D — Volunteer Monitoring Program; HF operations
G2E — Digital operating procedures

SUBELEMENT G3 — RADIO WAVE PROPAGATION

[3 Exam Questions — 3 Groups] 36 Questions

G3A — Sunspots and solar radiation; ionospheric disturbances; propagation forecasting and indices
G3B — Maximum Usable Frequency; Lowest Usable Frequency; propagation
G3C — Ionospheric layers; critical angle and frequency; HF scatter; Near Vertical Incidence Skywave

SUBELEMENT G4 — AMATEUR RADIO PRACTICES

[5 Exam Questions — 5 groups] 67 Questions

G4A — Station operation and setup
G4B — Test and monitoring equipment; two-tone test
G4C — Interference to consumer electronics; grounding; DSP
G4D — Speech processors; S meters; sideband operation near band edges
G4E — HF mobile radio installations; alternative energy source operation

SUBELEMENT G5 — ELECTRICAL PRINCIPLES

[3 Exam Questions — 3 Groups] 43 Questions

G5A — Reactance; inductance; capacitance; impedance; impedance matching
G5B — The decibel; current and voltage dividers; electrical power calculations; sine wave root-mean-square (RMS) values; PEP calculations
G5C — Resistors, capacitors, and inductors in series and parallel; transformers

SUBELEMENT G6 — CIRCUIT COMPONENTS

[2 Exam Questions — 2 Groups] 27 Questions

G6A — Resistors; capacitors; inductors; rectifiers; solid-state diodes and transistors; vacuum tubes; batteries
G6B — Analog and digital integrated circuits (ICs); microprocessors; memory; I/O devices; microwave ICs (MMICs); display devices; connectors; ferrite cores

SUBELEMENT G7 — PRACTICAL CIRCUITS

[3 Exam Questions — 3 Groups] 40 Questions

G7A — Power supplies; schematic symbols
G7B — Digital circuits; amplifiers and oscillators
G7C — Receivers and transmitters; filters; oscillators

SUBELEMENT G8 — SIGNALS AND EMISSIONS

[3 Exam Questions — 3 Groups] 38 Questions

G8A — Carriers and modulation: AM; FM; single sideband; modulation envelope; digital modulation; overmodulation
G8B — Frequency mixing; multiplication; bandwidths of various modes; deviation; duty cycle; intermodulation
G8C — Digital emission modes

SUBELEMENT G9 — ANTENNAS AND FEED LINES

[4 Exam Questions — 4 Groups] 54 Questions

G9A — Antenna feed lines: characteristic impedance and attenuation; SWR calculation, measurement, and effects; matching networks
G9B — Basic antennas
G9C — Directional antennas
G9D — Specialized antennas

SUBELEMENT G0 — ELECTRICAL AND RF SAFETY

[2 Exam Questions — 2 Groups] 25 Questions

G0A — RF safety principles, rules and guidelines; routine station evaluation
G0B — Station safety: electrical shock, safety grounding, fusing, interlocks, wiring, antenna and tower safety

General Class (Element 3) Question Pool

Effective for VEC examinations on July 1, 2019 through June 30, 2023

SUBELEMENT G1 — COMMISSION'S RULES
[5 Exam Questions — 5 Groups]

G1A — General class control operator frequency privileges; primary and secondary allocations

G1A01
On which HF/MF bands is a General class license holder granted all amateur frequency privileges?
A. 60 meters, 20 meters, 17 meters, and 12 meters
B. 160 meters, 80 meters, 40 meters, and 10 meters
C. 160 meters, 60 meters, 30 meters, 17 meters, 12 meters, and 10 meters
D. 160 meters, 30 meters, 17 meters, 15 meters, 12 meters, and 10 meters

G1A01
(C)
[97.301(d)]
Page 3-8

G1A02
On which of the following bands is phone operation prohibited?
A. 160 meters
B. 30 meters
C. 17 meters
D. 12 meters

G1A02
(B)
[97.305]
Page 3-8

G1A03
On which of the following bands is image transmission prohibited?
A. 160 meters
B. 30 meters
C. 20 meters
D. 12 meters

G1A03
(B)
[97.305]
Page 3-8

G1A04
Which of the following amateur bands is restricted to communication only on specific channels, rather than frequency ranges?
A. 11 meters
B. 12 meters
C. 30 meters
D. 60 meters

G1A04
(D)
[97.303 (h)]
Page 3-8

G1A05
Which of the following frequencies is in the General class portion of the 40-meter band (in ITU Region 2)?
A. 7.250 MHz
B. 7.500 MHz
C. 40.200 MHz
D. 40.500 MHz

G1A05
(A)
[97.301(d)]
Page 3-8

G1A06
(C)
[97.301(d)]
Page 3-8

G1A06
Which of the following frequencies is within the General class portion of the 75-meter phone band?
A. 1875 kHz
B. 3750 kHz
C. 3900 kHz
D. 4005 kHz

G1A07
(C)
[97.301(d)]
Page 3-8

G1A07
Which of the following frequencies is within the General class portion of the 20-meter phone band?
A. 14005 kHz
B. 14105 kHz
C. 14305 kHz
D. 14405 kHz

G1A08
(C)
[97.301(d)]
Page 3-8

G1A08
Which of the following frequencies is within the General class portion of the 80-meter band?
A. 1855 kHz
B. 2560 kHz
C. 3560 kHz
D. 3650 kHz

G1A09
(C)
[97.301(d)]
Page 3-8

G1A09
Which of the following frequencies is within the General class portion of the 15-meter band?
A. 14250 kHz
B. 18155 kHz
C. 21300 kHz
D. 24900 kHz

G1A10
(D)
[97.301(d)]
Page 3-8

G1A10
Which of the following frequencies is available to a control operator holding a General class license?
A. 28.020 MHz
B. 28.350 MHz
C. 28.550 MHz
D. All these choices are correct

G1A11
(B)
[97.301]
Page 3-8

G1A11
When General class licensees are not permitted to use the entire voice portion of a band, which portion of the voice segment is generally available to them?
A. The lower frequency end
B. The upper frequency end
C. The lower frequency end on frequencies below 7.3 MHz, and the upper end on frequencies above 14.150 MHz
D. The upper frequency end on frequencies below 7.3 MHz, and the lower end on frequencies above 14.150 MHz

G1A12
(C)
[97.303]
Page 3-8

G1A12
Which of the following applies when the FCC rules designate the Amateur Service as a secondary user on a band?
A. Amateur stations must record the call sign of the primary service station before operating on a frequency assigned to that station
B. Amateur stations can use the band only during emergencies
C. Amateur stations can use the band only if they do not cause harmful interference to primary users
D. Amateur stations may only operate during specific hours of the day, while primary users are permitted 24- hour use of the band

G1A13
What is the appropriate action if, when operating on either the 30-meter or 60-meter bands, a station in the primary service interferes with your contact?
A. Notify the FCCs regional Engineer in Charge of the interference
B. Increase your transmitter's power to overcome the interference
C. Attempt to contact the station and request that it stop the interference
D. Move to a clear frequency or stop transmitting

G1A13
(D)
[97.303(5)(h)(2)(j)]
Page 3-8

G1A14
Which of the following may apply in areas under FCC jurisdiction outside of ITU Region 2?
A. Station identification may have to be in a language other than English
B. Morse code may not be permitted
C. Digital transmission may not be permitted
D. Frequency allocations may differ

G1A14
(D)
[97.301(d)]
Page 3-2

G1A15
What portion of the 10-meter band is available for repeater use?
A. The entire band
B. The portion between 28.1 MHz and 28.2 MHz
C. The portion between 28.3 MHz and 28.5 MHz
D. The portion above 29.5 MHz

G1A15
(D)
[97.205(b)]
Page 3-9

G1B — Antenna structure limitations; good engineering and good amateur practice; beacon operation; prohibited transmissions; retransmitting radio signals

G1B01
What is the maximum height above ground to which an antenna structure may be erected without requiring notification to the FAA and registration with the FCC, provided it is not at or near a public use airport?
A. 50 feet
B. 100 feet
C. 200 feet
D. 300 feet

G1B01
(C)
[97.15(a)]
Page 3-3

G1B02
With which of the following conditions must beacon stations comply?
A. A beacon station may not use automatic control
B. The frequency must be coordinated with the National Beacon Organization
C. The frequency must be posted on the internet or published in a national periodical
D. There must be no more than one beacon signal transmitting in the same band from the same station location

G1B02
(D)
[97.203(b)]
Page 3-10

G1B03
Which of the following is a purpose of a beacon station as identified in the FCC rules?
A. Observation of propagation and reception
B. Automatic identification of repeaters
C. Transmission of bulletins of general interest to Amateur Radio licensees
D. Identifying net frequencies

G1B03
(A)
[97.3(a)(9)]
Page 3-10

G1B04
(C)
[97.113(c)]
Page 3-13

G1B04
Which of the following transmissions is permitted?
A. Unidentified transmissions for test purposes only
B. Retransmission of other amateur station signals by any amateur station
C. Occasional retransmission of weather and propagation forecast information from U.S. government stations
D. Coded messages of any kind, if not intended to facilitate a criminal act

G1B05
(B)
[97.111((5)
(b)]
Page 3-13

G1B05
Which of the following one-way transmissions are permitted?
A. Unidentified test transmissions of less than one minute in duration
B. Transmissions necessary to assist learning the International Morse code
C. Regular transmissions offering equipment for sale, if intended for Amateur Radio use
D. All these choices are correct

G1B06
(D)
[97.15(b),
PRB-1, 101
FCC 2d 952
(1985)]
Page 3-3

G1B06
Under what conditions are state and local governments permitted to regulate Amateur Radio antenna structures?
A. Under no circumstances, FCC rules take priority
B. At any time and to any extent necessary to accomplish a legitimate purpose of the state or local entity, provided that proper filings are made with the FCC
C. Only when such structures exceed 50 feet in height and are clearly visible 1000 feet from the structure
D. Amateur Service communications must be reasonably accommodated, and regulations must constitute the minimum practical to accommodate a legitimate purpose of the state or local entity

G1B07
(B)
[97.113(a)
(4)]
Page 3-13

G1B07
What are the restrictions on the use of abbreviations or procedural signals in the Amateur Service?
A. Only "Q" signals are permitted
B. They may be used if they do not obscure the meaning of a message
C. They are not permitted
D. Only "10 codes" are permitted

G1B08
(D)
[97.101(a)]
Page 2-4

G1B08
When choosing a transmitting frequency, what should you do to comply with good amateur practice?
A. Ensure that the frequency and mode selected are within your license class privileges
B. Follow generally accepted band plans agreed to by the Amateur Radio community
C. Monitor the frequency before transmitting
D. All these choices are correct

G1B09
(D)
[97.203(d)]
Page 3-10

G1B09
On what HF frequencies are automatically controlled beacons permitted?
A. On any frequency if power is less than 1 watt
B. On any frequency if transmissions are in Morse code
C. 21.08 MHz to 21.09 MHz
D. 28.20 MHz to 28.30 MHz

G1B10
(C)
[97.203(c)]
Page 3-10

G1B10
What is the power limit for beacon stations?
A. 10 watts PEP output
B. 20 watts PEP output
C. 100 watts PEP output
D. 200 watts PEP output

G1B11
Who or what determines "good engineering and good amateur practice," as applied to the operation of an amateur station in all respects not covered by the Part 97 rules?
A. The FCC
B. The control operator
C. The IEEE
D. The ITU

G1B11
(A)
[97.101(a)]
Page 3-14

G1B12
When is it permissible to communicate with amateur stations in countries outside the areas administered by the Federal Communications Commission?
A. Only when the foreign country has a formal third-party agreement filed with the FCC
B. When the contact is with amateurs in any country except those whose administrations have notified the ITU that they object to such communications
C. When the contact is with amateurs in any country as long as the communication is conducted in English
D. Only when the foreign country is a member of the International Amateur Radio Union

G1B12
(B)
[97.111(a)(1)]
Page 3-13

G1C — Transmitter power regulations; data emission standards; 60-meter operation requirements

G1C01
What is the maximum transmitting power an amateur station may use on 10.140 MHz?
A. 200 watts PEP output
B. 1000 watts PEP output
C. 1500 watts PEP output
D. 2000 watts PEP output

G1C01
(A)
[97.313(c)(1)]
Page 3-15

G1C02
What is the maximum transmitting power an amateur station may use on the 12-meter band?
A. 50 watts PEP output
B. 200 watts PEP output
C. 1500 watts PEP output
D. An effective radiated power equivalent to 100 watts from a half-wave dipole

G1C02
(C)
[97.313]
Page 3-14

G1C03
What is the maximum bandwidth permitted by FCC rules for Amateur Radio stations transmitting on USB frequencies in the 60-meter band?
A. 2.8 kHz
B. 5.6 kHz
C. 1.8 kHz
D. 3 kHz

G1C03
(A)
[97.303(h)(1)]
Page 3-15

G1C04
Which of the following limitations apply to transmitter power on every amateur band?
A. Only the minimum power necessary to carry out the desired communications should be used
B. Power must be limited to 200 watts when using data transmissions
C. Power should be limited as necessary to avoid interference to another radio service on the frequency
D. Effective radiated power cannot exceed 1500 watts

G1C04
(A)
[97.313(a)]
Page 3-15

G1C05
(C)
[97.313]
Page 3-15

G1C05
What is the limit for transmitter power on the 28 MHz band for a General Class control operator?
A. 100 watts PEP output
B. 1000 watts PEP output
C. 1500 watts PEP output
D. 2000 watts PEP output

G1C06
(D)
[97.313]
Page 3-14

G1C06
What is the limit for transmitter power on the 1.8 MHz band?
A. 200 watts PEP output
B. 1000 watts PEP output
C. 1200 watts PEP output
D. 1500 watts PEP output

G1C07
(D)
[97.305(c), 97.307(f)(3)]
Page 3-16

G1C07
What is the maximum symbol rate permitted for RTTY or data emission transmission on the 20-meter band?
A. 56 kilobaud
B. 19.6 kilobaud
C. 1200 baud
D. 300 baud

G1C08
(D)
[97.307(f)(3)]
Page 3-16

G1C08
What is the maximum symbol rate permitted for RTTY or data emission transmitted at frequencies below 28 MHz?
A. 56 kilobaud
B. 19.6 kilobaud
C. 1200 baud
D. 300 baud

G1C09
(A)
[97.305(c) and 97.307(f)(5)]
Page 3-16

G1C09
What is the maximum symbol rate permitted for RTTY or data emission transmitted on the 1.25-meter and 70-centimeter bands?
A. 56 kilobaud
B. 19.6 kilobaud
C. 1200 baud
D. 300 baud

G1C10
(C)
[97.305(c) and 97.307(f)(4)]
Page 3-16

G1C10
What is the maximum symbol rate permitted for RTTY or data emission transmissions on the 10-meter band?
A. 56 kilobaud
B. 19.6 kilobaud
C. 1200 baud
D. 300 baud

G1C11
(B)
[97.305(c) and 97.307(f)(5)]
Page 3-16

G1C11
What is the maximum symbol rate permitted for RTTY or data emission transmissions on the 2-meter band?
A. 56 kilobaud
B. 19.6 kilobaud
C. 1200 baud
D. 300 baud

G1C12
Which of the following is required by the FCC rules when operating in the 60-meter band?
A. If you are using an antenna other than a dipole, you must keep a record of the gain of your antenna
B. You must keep a record of the date, time, frequency, power level, and stations worked
C. You must keep a record of all third-party traffic
D. You must keep a record of the manufacturer of your equipment and the antenna used

G1C12
(A)
[97.303(i)]
Page 2-6

G1C13
What must be done before using a new digital protocol on the air?
A. Type-certify equipment to FCC standards
B. Obtain an experimental license from the FCC
C. Publicly document the technical characteristics of the protocol
D. Submit a rule-making proposal to the FCC describing the codes and methods of the technique

G1C13
(C)
[97.309(a)(4)]
Page 3-16

G1C14
What is the maximum power limit on the 60-meter band?
A. 1500 watts PEP
B. 10 watts RMS
C. ERP of 100 watts PEP with respect to a dipole
D. ERP of 100 watts PEP with respect to an isotropic antenna

G1C14
(C)
[97.313(i)]
Page 3-15

G1C15
What measurement is specified by FCC rules that regulate maximum power output?
A. RMS
B. Average
C. Forward
D. PEP

G1C15
(D)
[97.313]
Page 3-14

G1D — Volunteer Examiners and Volunteer Examiner Coordinators; temporary identification; element credit

G1D01
Who may receive partial credit for the elements represented by an expired Amateur Radio license?
A. Any person who can demonstrate that they once held an FCC-issued General, Advanced, or Amateur Extra class license that was not revoked by the FCC
B. Anyone who held an FCC-issued Amateur Radio license that has been expired for not less than 5 years and not more than 15 years
C. Any person who previously held an amateur license issued by another country, but only if that country has a current reciprocal licensing agreement with the FCC
D. Only persons who once held an FCC issued Novice, Technician, or Technician Plus license

G1D01
(A)
[97.501, 97.505(a)]
Page 3-5

G1D02
What license examinations may you administer when you are an accredited VE holding a General class operator license?
A. General and Technician
B. General only
C. Technician only
D. Amateur Extra, General, and Technician

G1D02
(C)
[97.509(b)(3)(i)]
Page 3-4

G1D03
(C)
[97.9(b)]
Page 3-5

G1D03
On which of the following band segments may you operate if you are a Technician class operator and have a Certificate of Successful Completion of Examination (CSCE) for General class privileges?
A. Only the Technician band segments until your upgrade is posted in the FCC database
B. Only on the Technician band segments until your license arrives in the mail
C. On any General or Technician class band segment
D. On any General or Technician class band segment except 30 meters and 60 meters

G1D04
(A)
[97.509(3)(i)(c)]
Page 3-4

G1D04
Which of the following is a requirement for administering a Technician class license examination?
A. At least three General class or higher VEs must observe the examination
B. At least two General class or higher VEs must be present
C. At least two General class or higher VEs must be present, but only one need be Amateur Extra class
D. At least three VEs of Technician class or higher must observe the examination

G1D05
(D)
[97.509(b)(3)(i)]
Page 3-4

G1D05
Which of the following must a person have before they can be an administering VE for a Technician class license examination?
A. Notification to the FCC that you want to give an examination
B. Receipt of a Certificate of Successful Completion of Examination (CSCE) for General class
C. Possession of a properly obtained telegraphy license
D. An FCC General class or higher license and VEC accreditation

G1D06
(A)
[97.119(f)(2)]
Page 3-5

G1D06
When must you add the special identifier "AG" after your call sign if you are a Technician class licensee and have a Certificate of Successful Completion of Examination (CSCE) for General class operator privileges, but the FCC has not yet posted your upgrade on its website?
A. Whenever you operate using General class frequency privileges
B. Whenever you operate on any amateur frequency
C. Whenever you operate using Technician frequency privileges
D. A special identifier is not required if your General class license application has been filed with the FCC

G1D07
(C)
[97.509(b)(1)]
Page 3-4

G1D07
Volunteer Examiners are accredited by what organization?
A. The Federal Communications Commission
B. The Universal Licensing System
C. A Volunteer Examiner Coordinator
D. The Wireless Telecommunications Bureau

G1D08
(B)
[97.509(b)(3)]
Page 3-4

G1D08
Which of the following criteria must be met for a non-U.S. citizen to be an accredited Volunteer Examiner?
A. The person must be a resident of the U.S. for a minimum of 5 years
B. The person must hold an FCC granted Amateur Radio license of General class or above
C. The person's home citizenship must be in ITU region 2
D. None of these choices is correct; a non-U.S. citizen cannot be a Volunteer Examiner

G1D09
(C)
[97.9(b)]
Page 3-4

G1D09
How long is a Certificate of Successful Completion of Examination (CSCE) valid for exam element credit?
A. 30 days
B. 180 days
C. 365 days
D. For as long as your current license is valid

G1D10
What is the minimum age that one must be to qualify as an accredited Volunteer Examiner?
A. 12 years
B. 18 years
C. 21 years
D. There is no age limit

G1D10
(B)
[97.509(b)(2)]
Page 3-4

G1D11
What is required to obtain a new General Class license after a previously-held license has expired and the two-year grace period has passed?
A. They must have a letter from the FCC showing they once held an amateur or commercial license
B. There are no requirements other than being able to show a copy of the expired license
C. The applicant must be able to produce a copy of a page from a call book published in the U.S. showing his or her name and address
D. The applicant must pass the current Element 2 exam

G1D11
(D)
[97.505]
Page 3-5

G1E — Control categories; repeater regulations; third-party rules; ITU regions; automatically controlled digital station

G1E01
Which of the following would disqualify a third party from participating in stating a message over an amateur station?
A. The third party's amateur license has been revoked and not reinstated
B. The third party is not a U.S. citizen
C. The third party is a licensed amateur
D. The third party is speaking in a language other than English

G1E01
(A)
[97.115(b)(2)]
Page 3-11

G1E02
When may a 10-meter repeater retransmit the 2-meter signal from a station that has a Technician class control operator?
A. Under no circumstances
B. Only if the station on 10-meters is operating under a Special Temporary Authorization allowing such retransmission
C. Only during an FCC-declared general state of communications emergency
D. Only if the 10-meter repeater control operator holds at least a General class license

G1E02
(D)
[97.205(b)]
Page 3-13

G1E03
What is required to conduct communications with a digital station operating under automatic control outside the automatic control band segments?
A. The station initiating the contact must be under local or remote control
B. The interrogating transmission must be made by another automatically controlled station
C. No third-party traffic may be transmitted
D. The control operator of the interrogating station must hold an Amateur Extra Class license

G1E03
(A)
[97.221]
Page 6-13

G1E04
Which of the following conditions require a licensed Amateur Radio operator to take specific steps to avoid harmful interference to other users or facilities?
A. When operating within one mile of an FCC Monitoring Station
B. When using a band where the Amateur Service is secondary
C. When a station is transmitting spread spectrum emissions
D. All these choices are correct

G1E04
(D)
[97.13(b), 97.303, 97.311(b)]
Page 3-8

G1E05
(C)
[97.115(a)
(2),97.117]
Page 3-11

G1E05
What types of messages for a third party in another country may be transmitted by an amateur station?
A. Any message, as long as the amateur operator is not paid
B. Only messages for other licensed amateurs
C. Only messages relating to Amateur Radio or remarks of a personal character, or messages relating to emergencies or disaster relief
D. Any messages, as long as the text of the message is recorded in the station log

G1E06
(C)
[97.301,
ITU Radio
Regulations]
Page 3-2

G1E06
The frequency allocations of which ITU region apply to radio amateurs operating in North and South America?
A. Region 4
B. Region 3
C. Region 2
D. Region 1

G1E07
(D)
[97.111]
Page 3-8

G1E07
In what part of the 13-centimeter band may an amateur station communicate with non-licensed Wi-Fi stations?
A. Anywhere in the band
B. Channels 1 through 4
C. Channels 42 through 45
D. No part

G1E08
(B)
[97.313(j)]
Page 3-15

G1E08
What is the maximum PEP output allowed for spread spectrum transmissions?
A. 100 milliwatts
B. 10 watts
C. 100 watts
D. 1500 watts

G1E09
(A)
[97.115]
Page 6-14

G1E09
Under what circumstances are messages that are sent via digital modes exempt from Part 97 third-party rules that apply to other modes of communication?
A. Under no circumstances
B. When messages are encrypted
C. When messages are not encrypted
D. When under automatic control

G1E10
(A)
[97.101]
Page 3-10

G1E10
Why should an amateur operator normally avoid transmitting on 14.100, 18.110, 21.150, 24. 930 and 28.200 MHz?
A. A system of propagation beacon stations operates on those frequencies
B. A system of automatic digital stations operates on those frequencies
C. These frequencies are set aside for emergency operations
D. These frequencies are set aside for bulletins from the FCC

G1E11
(D)
[97.221,
97.305]
Page 6-13

G1E11
On what bands may automatically controlled stations transmitting RTTY or data emissions communicate with other automatically controlled digital stations?
A. On any band segment where digital operation is permitted
B. Anywhere in the non-phone segments of the 10-meter or shorter wavelength bands
C. Only in the non-phone Extra Class segments of the bands
D. Anywhere in the 6 meter or shorter wavelength bands, and in limited segments of some of the HF bands

SUBELEMENT G2 — OPERATING PROCEDURES
[5 Exam Questions — 5 Groups]

G2A — Phone operating procedures; USB/LSB conventions; breaking into a contact; VOX operation

G2A01
Which sideband is most commonly used for voice communications on frequencies of 14 MHz or higher?
A. Upper sideband
B. Lower sideband
C. Vestigial sideband
D. Double sideband

G2A01
(A)
Page 2-9

G2A02
Which of the following modes is most commonly used for voice communications on the 160-meter, 75-meter, and 40-meter bands?
A. Upper sideband
B. Lower sideband
C. Vestigial sideband
D. Double sideband

G2A02
(B)
Page 2-9

G2A03
Which of the following is most commonly used for SSB voice communications in the VHF and UHF bands?
A. Upper sideband
B. Lower sideband
C. Vestigial sideband
D. Double sideband

G2A03
(A)
Page 2-9

G2A04
Which mode is most commonly used for voice communications on the 17-meter and 12-meter bands?
A. Upper sideband
B. Lower sideband
C. Vestigial sideband
D. Double sideband

G2A04
(A)
Page 2-9

G2A05
Which mode of voice communication is most commonly used on the HF amateur bands?
A. Frequency modulation
B. Double sideband
C. Single sideband
D. Phase modulation

G2A05
(C)
Page 2-9

G2A06
Which of the following is an advantage when using single sideband, as compared to other analog voice modes on the HF amateur bands?
A. Very high fidelity voice modulation
B. Less subject to interference from atmospheric static crashes
C. Ease of tuning on receive and immunity to impulse noise
D. Less bandwidth used and greater power efficiency

G2A06
(D)
Page 2-9

G2A07
(B)
Page 2-9

G2A07
Which of the following statements is true of the single sideband voice mode?
A. Only one sideband and the carrier are transmitted; the other sideband is suppressed
B. Only one sideband is transmitted; the other sideband and carrier are suppressed
C. SSB is the only voice mode that is authorized on the 20-meter, 15-meter, and 10-meter amateur bands
D. SSB is the only voice mode that is authorized on the 160-meter, 75-meter, and 40-meter amateur bands

G2A08
(B)
Page 2-5

G2A08
What is the recommended way to break in to a phone contact?
A. Say "QRZ" several times, followed by your call sign
B. Say your call sign once
C. Say "Breaker Breaker"
D. Say "CQ" followed by the call sign of either station

G2A09
(D)
Page 2-9

G2A09
Why do most amateur stations use lower sideband on the 160-meter, 75-meter, and 40-meter bands?
A. Lower sideband is more efficient than upper sideband at these frequencies
B. Lower sideband is the only sideband legal on these frequency bands
C. Because it is fully compatible with an AM detector
D. It is good amateur practice

G2A10
(B)
Page 2-12

G2A10
Which of the following statements is true of voice VOX operation versus PTT operation?
A. The received signal is more natural sounding
B. It allows "hands free" operation
C. It occupies less bandwidth
D. It provides more power output

G2A11
(C)
Page 2-5

G2A11
Generally, who should respond to a station in the contiguous 48 states who calls "CQ DX"?
A. Any caller is welcome to respond
B. Only stations in Germany
C. Any stations outside the lower 48 states
D. Only contest stations

G2A12
(B)
Page 5-11

G2A12
What control is typically adjusted for proper ALC setting on an amateur single sideband transceiver?
A. The RF clipping level
B. Transmit audio or microphone gain
C. Antenna inductance or capacitance
D. Attenuator level

G2B — Operating courtesy; band plans; emergencies, including drills and emergency communications

G2B01
(C)
[97.101(b), (c)]
Page 2-2

G2B01
Which of the following is true concerning access to frequencies?
A. Nets always have priority
B. QSOs in progress always have priority
C. Except during emergencies, no amateur station has priority access to any frequency
D. Contest operations must always yield to non-contest use of frequencies

G2B02
What is the first thing you should do if you are communicating with another amateur station and hear a station in distress break in?
A. Continue your communication because you were on the frequency first
B. Acknowledge the station in distress and determine what assistance may be needed
C. Change to a different frequency
D. Immediately cease all transmissions

G2B02
(B)
Page 2-18

G2B03
What is good amateur practice if propagation changes during a contact and you notice interference from other stations on the frequency?
A. Tell the interfering stations to change frequency
B. Report the interference to your local Amateur Auxiliary Coordinator
C. Attempt to resolve the interference problem with the other stations in a mutually acceptable manner
D. Increase power to overcome interference

G2B03
(C)
Page 2-4

G2B04
When selecting a CW transmitting frequency, what minimum separation should be used to minimize interference to stations on adjacent frequencies?
A. 5 to 50 Hz
B. 150 to 500 Hz
C. 1 to 3 kHz
D. 3 to 6 kHz

G2B04
(B)
Page 2-2

G2B05
When selecting an SSB transmitting frequency, what minimum separation should be used to minimize interference to stations on adjacent frequencies?
A. 5 to 50 Hz
B. 150 to 500 Hz
C. Approximately 3 kHz
D. Approximately 6 kHz

G2B05
(C)
Page 2-2

G2B06
What is a practical way to avoid harmful interference on an apparently clear frequency before calling CQ on CW or phone?
A. Send "QRL?" on CW, followed by your call sign; or, if using phone, ask if the frequency is in use, followed by your call sign
B. Listen for 2 minutes before calling CQ
C. Send the letter "V" in Morse code several times and listen for a response, or say "test" several times and listen for a response
D. Send "QSY" on CW or if using phone, announce "the frequency is in use," then give your call sign and listen for a response

G2B06
(A)
Page 2-2

G2B07
Which of the following complies with good amateur practice when choosing a frequency on which to initiate a call?
A. Check to see if the channel is assigned to another station
B. Identify your station by transmitting your call sign at least 3 times
C. Follow the voluntary band plan for the operating mode you intend to use
D. All these choices are correct

G2B07
(C)
Page 2-2

G2B08
(A)
Page 2-5

G2B08
What is the voluntary band plan restriction for U.S. stations transmitting within the 48 contiguous states in the 50.1 to 50.125 MHz band segment?
A. Only contacts with stations not within the 48 contiguous states
B. Only contacts with other stations within the 48 contiguous states
C. Only digital contacts
D. Only SSTV contacts

G2B09
(A)
[97.407(a)]
Page 2-17

G2B09
Who may be the control operator of an amateur station transmitting in RACES to assist relief operations during a disaster?
A. Only a person holding an FCC-issued amateur operator license
B. Only a RACES net control operator
C. A person holding an FCC-issued amateur operator license or an appropriate government official
D. Any control operator when normal communication systems are operational

G2B10
(C)
[97.405(b)]
Page 2-18

G2B10
When is an amateur station allowed to use any means at its disposal to assist another station in distress?
A. Only when transmitting in RACES
B. At any time when transmitting in an organized net
C. At any time during an actual emergency
D. Only on authorized HF frequencies

G2B11
(A)
[97.405]
Page 2-18

G2B11
What frequency should be used to send a distress call?
A. Whichever frequency has the best chance of communicating the distress message
B. Only frequencies authorized for RACES or ARES stations
C. Only frequencies that are within your operating privileges
D. Only frequencies used by police, fire, or emergency medical services

G2C — CW operating procedures and procedural signals; Q signals and common abbreviations: full break-in

G2C01
(D)
Page 2-13

G2C01
Which of the following describes full break-in telegraphy (QSK)?
A. Breaking stations send the Morse code prosign "BK"
B. Automatic keyers, instead of hand keys, are used to send Morse code
C. An operator must activate a manual send/receive switch before and after every transmission
D. Transmitting stations can receive between code characters and elements

G2C02
(A)
Page 2-13

G2C02
What should you do if a CW station sends "QRS?"
A. Send slower
B. Change frequency
C. Increase your power
D. Repeat everything twice

G2C03
(C)
Page 2-13

G2C03
What does it mean when a CW operator sends "KN" at the end of a transmission?
A. Listening for novice stations
B. Operating full break-in
C. Listening only for a specific station or stations
D. Closing station now

G2C04
What does the Q signal "QRL?" mean?
A. "Will you keep the frequency clear?"
B. "Are you operating full break-in?" or "Can you operate full break-in?"
C. "Are you listening only for a specific station?"
D. "Are you busy?" or "Is this frequency in use?"

G2C04
(D)
Page 2-2

G2C05
What is the best speed to use when answering a CQ in Morse code?
A. The fastest speed at which you are comfortable copying, but no slower than the CQ
B. The fastest speed at which you are comfortable copying, but no faster than the CQ
C. At the standard calling speed of 10 wpm
D. At the standard calling speed of 5 wpm

G2C05
(B)
Page 2-13

G2C06
What does the term "zero beat" mean in CW operation?
A. Matching the speed of the transmitting station
B. Operating split to avoid interference on frequency
C. Sending without error
D. Matching the transmit frequency to the frequency of a received signal

G2C06
(D)
Page 2-13

G2C07
When sending CW, what does a "C" mean when added to the RST report?
A. Chirpy or unstable signal
B. Report was read from an S meter rather than estimated
C. 100 percent copy
D. Key clicks

G2C07
(A)
Page 2-11

G2C08
What prosign is sent to indicate the end of a formal message when using CW?
A. SK
B. BK
C. AR
D. KN

G2C08
(C)
Page 2-13

G2C09
What does the Q signal "QSL" mean?
A. Send slower
B. We have already confirmed by card
C. I acknowledge receipt
D. We have worked before

G2C09
(C)
Page 2-13

G2C10
What does the Q signal "QRN" mean?
A. Send more slowly
B. Stop sending
C. Zero beat my signal
D. I am troubled by static

G2C10
(D)
Page 2-11

G2C11
What does the Q signal "QRV" mean?
A. You are sending too fast
B. There is interference on the frequency
C. I am quitting for the day
D. I am ready to receive messages

G2C11
(D)
Page 2-13

G2D — Volunteer Monitoring Program; HF operations

G2D01
(A)
Page 3-3

G2D01
What is the Volunteer Monitoring Program?
A. Amateur volunteers who are formally enlisted to monitor the airwaves for rules violations
B. Amateur volunteers who conduct amateur licensing examinations
C. Amateur volunteers who conduct frequency coordination for amateur VHF repeaters
D. Amateur volunteers who use their station equipment to help civil defense organizations in times of emergency

G2D02
(B)
Page 3-2

G2D02
Which of the following are objectives of the Volunteer Monitoring Program?
A. To conduct efficient and orderly amateur licensing examinations
B. To encourage amateur radio operators to self-regulate and comply with the rules
C. To coordinate repeaters for efficient and orderly spectrum usage
D. To provide emergency and public safety communications

G2D03
(B)
Page 3-3

G2D03
What skills learned during hidden transmitter hunts are of help to the Volunteer Monitoring Program?
A. Identification of out-of-band operation
B. Direction finding used to locate stations violating FCC rules
C. Identification of different call signs
D. Hunters have an opportunity to transmit on non-amateur frequencies

G2D04
(B)
Page 7-9

G2D04
Which of the following describes an azimuthal projection map?
A. A map that shows accurate land masses
B. A map that shows true bearings and distances from a particular location
C. A map that shows the angle at which an amateur satellite crosses the equator
D. A map that shows the number of degrees longitude that an amateur satellite appears to move westward at the equator with each orbit

G2D05
(C)
Page 2-5

G2D05
Which of the following is a good way to indicate on a clear frequency in the HF phone bands that you are looking for a contact with any station?
A. Sign your call sign once, followed by the words "listening for a call" -- if no answer, change frequency and repeat
B. Say "QTC" followed by "this is" and your call sign -- if no answer, change frequency and repeat
C. Repeat "CQ" a few times, followed by "this is," then your call sign a few times, then pause to listen, repeat as necessary
D. Transmit an unmodulated carried for approximately 10 seconds, followed by "this is" and your call sign, and pause to listen -- repeat as necessary

G2D06
(C)
Page 8-5

G2D06
How is a directional antenna pointed when making a "long-path" contact with another station?
A. Toward the rising sun
B. Along the grayline
C. 180 degrees from the station's short-path heading
D. Toward the north

G2D07
Which of the following are examples of the NATO Phonetic Alphabet?
A. Able, Baker, Charlie, Dog
B. Adam, Boy, Charles, David
C. America, Boston, Canada, Denmark
D. Alpha, Bravo, Charlie, Delta

G2D07
(D)
Page 2-2

G2D08
What is a reason why many amateurs keep a station log?
A. The ITU requires a log of all international contacts
B. The ITU requires a log of all international third-party traffic
C. The log provides evidence of operation needed to renew a license without retest
D. To help with a reply if the FCC requests information

G2D08
(D)
Page 2-6

G2D09
Which of the following is required when participating in a contest on HF frequencies?
A. Submit a log to the contest sponsor
B. Send a QSL card to the stations worked, or QSL via Logbook of The World
C. Identify your station per normal FCC regulations
D. All these choices are correct

G2D09
(C)
Page 2-5

G2D10
What is QRP operation?
A. Remote piloted model control
B. Low-power transmit operation
C. Transmission using Quick Response Protocol
D. Traffic relay procedure net operation

G2D10
(B)
Page 3-14

G2D11
Which of the following is typical of the lower HF frequencies during the summer?
A. Poor propagation at any time of day
B. World-wide propagation during the daylight hours
C. Heavy distortion on signals due to photon absorption
D. High levels of atmospheric noise or "static"

G2D11
(D)
Page 8-5

G2E — Digital operating procedures

G2E01
Which mode is normally used when sending RTTY signals via AFSK with an SSB transmitter?
A. USB
B. DSB
C. CW
D. LSB

G2E01
(D)
Page 6-9

G2E02
How can a PACTOR modem or controller be used to determine if the channel is in use by other PACTOR stations?
A. Unplug the data connector temporarily and see if the channel-busy indication is turned off
B. Put the modem or controller in a mode which allows monitoring communications without a connection
C. Transmit UI packets several times and wait to see if there is a response from another PACTOR station
D. Send the message, "Is this frequency in use?"

G2E02
(B)
Page 6-7

G2E03
(D)
Page 6-14

G2E03
What symptoms may result from other signals interfering with a PACTOR or WINMOR transmission?
A. Frequent retries or timeouts
B. Long pauses in message transmission
C. Failure to establish a connection between stations
D. All these choices are correct

G2E04
(B)
Page 6-2

G2E04
What segment of the 20-meter band is most often used for digital transmissions (avoiding the DX propagation beacons)?
A. 14.000 - 14.050 MHz
B. 14.070 - 14.112 MHz
C. 14.150 - 14.225 MHz
D. 14.275 - 14.350 MHz

G2E05
(B)
Page 6-9

G2E05
What is the standard sideband used to generate a JT65, JT9, or FT8 digital signal when using AFSK in any amateur band?
A. LSB
B. USB
C. DSB
D. SSB

G2E06
(B)
Page 6-5

G2E06
What is the most common frequency shift for RTTY emissions in the amateur HF bands?
A. 85 Hz
B. 170 Hz
C. 425 Hz
D. 850 Hz

G2E07
(A)
Page 6-2

G2E07
What segment of the 80-meter band is most commonly used for digital transmissions?
A. 3570 — 3600 kHz
B. 3500 — 3525 kHz
C. 3700 — 3750 kHz
D. 3775 — 3825 kHz

G2E08
(D)
Page 6-2

G2E08
In what segment of the 20-meter band are most PSK31 operations commonly found?
A. At the bottom of the slow-scan TV segment, near 14.230 MHz
B. At the top of the SSB phone segment, near 14.325 MHz
C. In the middle of the CW segment, near 14.100 MHz
D. Below the RTTY segment, near 14.070 MHz

G2E09
(C)
Page 6-7

G2E09
How do you join a contact between two stations using the PACTOR protocol?
A. Send broadcast packets containing your call sign while in MONITOR mode
B. Transmit a steady carrier until the PACTOR protocol times out and disconnects
C. Joining an existing contact is not possible, PACTOR connections are limited to two stations
D. Send a NAK response continuously so that the sending station must stand by

G2E10
Which of the following is a way to establish contact with a digital messaging system gateway station?
A. Send an email to the system control operator
B. Send QRL in Morse code
C. Respond when the station broadcasts its SSID
D. Transmit a connect message on the station's published frequency

G2E10
(D)
Page 6-12

G2E11
Which of the following is characteristic of the FT8 mode of the WSJT-X family?
A. It is a keyboard-to-keyboard chat mode
B. Each transmission takes exactly 60 seconds
C. It is limited to use on VHF
D. Typical exchanges are limited to call signs, grid locators, and signal reports

G2E11
(D)
Page 6-9

G2E12
Which of the following connectors would be a good choice for a serial data port?
A. PL-259
B. Type N
C. Type SMA
D. DE-9

G2E12
(D)
Page 4-40

G2E13
Which communication system sometimes uses the internet to transfer messages?
A. Winlink
B. RTTY
C. ARES
D. SKYWARN

G2E13
(A)
Page 6-8

G2E14
What could be wrong if you cannot decode an RTTY or other FSK signal even though it is apparently tuned in properly?
A. The mark and space frequencies may be reversed
B. You may have selected the wrong baud rate
C. You may be listening on the wrong sideband
D. All these choices are correct

G2E14
(D)
Page 6-9

G2E15
Which of the following is a requirement when using the FT8 digital mode?
A. A special hardware modem
B. Computer time accurate within approximately 1 second
C. Receiver attenuator set to -12 dB
D. A vertically polarized antenna

G2E15
(B)
Page 6-6

SUBELEMENT G3 — RADIO WAVE PROPAGATION
[3 Exam Questions — 3 Groups]

G3A — Sunspots and solar radiation; ionospheric disturbances; propagation forecasting and indices

G3A01
(A)
Page 8-7

G3A01
What is the significance of the sunspot number with regard to HF propagation?
A. Higher sunspot numbers generally indicate a greater probability of good propagation at higher frequencies
B. Lower sunspot numbers generally indicate greater probability of sporadic E propagation
C. A zero sunspot number indicates that radio propagation is not possible on any band
D. A zero sunspot number indicates undisturbed conditions

G3A02
(B)
Page 8-11

G3A02
What effect does a Sudden Ionospheric Disturbance have on the daytime ionospheric propagation of HF radio waves?
A. It enhances propagation on all HF frequencies
B. It disrupts signals on lower frequencies more than those on higher frequencies
C. It disrupts communications via satellite more than direct communications
D. None, because only areas on the night side of the Earth are affected

G3A03
(C)
Page 8-10

G3A03
Approximately how long does it take the increased ultraviolet and X-ray radiation from solar flares to affect radio propagation on Earth?
A. 28 days
B. 1 to 2 hours
C. 8 minutes
D. 20 to 40 hours

G3A04
(D)
Page 8-7

G3A04
Which of the following are least reliable for long-distance communications during periods of low solar activity?
A. 80 meters and 160 meters
B. 60 meters and 40 meters
C. 30 meters and 20 meters
D. 15 meters, 12 meters, and 10 meters

G3A05
(D)
Page 8-9

G3A05
What is the solar flux index?
A. A measure of the highest frequency that is useful for ionospheric propagation between two points on Earth
B. A count of sunspots that is adjusted for solar emissions
C. Another name for the American sunspot number
D. A measure of solar radiation at 10.7 centimeters wavelength

G3A06
(D)
Page 8-11

G3A06
What is a geomagnetic storm?
A. A sudden drop in the solar flux index
B. A thunderstorm that affects radio propagation
C. Ripples in the ionosphere
D. A temporary disturbance in Earth's magnetosphere

G3A07
At what point in the solar cycle does the 20-meter band usually support worldwide propagation during daylight hours?
A. At the summer solstice
B. Only at the maximum point of the solar cycle
C. Only at the minimum point of the solar cycle
D. At any point in the solar cycle

G3A07
(D)
Page 8-8

G3A08
Which of the following effects can a geomagnetic storm have on radio propagation?
A. Improved high-latitude HF propagation
B. Degraded high-latitude HF propagation
C. Improved ground wave propagation
D. Degraded ground wave propagation

G3A08
(B)
Page 8-12

G3A09
What benefit can high geomagnetic activity have on radio communications?
A. Auroras that can reflect VHF signals
B. Higher signal strength for HF signals passing through the polar regions
C. Improved HF long path propagation
D. Reduced long delayed echoes

G3A09
(A)
Page 8-12

G3A10
What causes HF propagation conditions to vary periodically in a roughly 28-day cycle?
A. Long term oscillations in the upper atmosphere
B. Cyclic variation in Earth's radiation belts
C. The sun's rotation on its axis
D. The position of the moon in its orbit

G3A10
(C)
Page 8-8

G3A11
How long does it take charged particles from coronal mass ejections to affect radio propagation on Earth?
A. 28 days
B. 14 days
C. 4 to 8 minutes
D. 20 to 40 hours

G3A11
(D)
Page 8-11

G3A12
What does the K-index indicate?
A. The relative position of sunspots on the surface of the sun
B. The short-term stability of Earth's magnetic field
C. The stability of the sun's magnetic field
D. The solar radio flux at Boulder, Colorado

G3A12
(B)
Page 8-9

G3A13
What does the A-index indicate?
A. The relative position of sunspots on the surface of the sun
B. The amount of polarization of the sun's electric field
C. The long-term stability of Earth's geomagnetic field
D. The solar radio flux at Boulder, Colorado

G3A13
(C)
Page 8-9

G3A14
(B)
Page 8-12

G3A14
How are radio communications usually affected by the charged particles that reach Earth from solar coronal holes?
A. HF communications are improved
B. HF communications are disturbed
C. VHF/UHF ducting is improved
D. VHF/UHF ducting is disturbed

G3B — Maximum Usable Frequency; Lowest Usable Frequency; propagation

G3B01
(D)
Page 8-6

G3B01
What is a characteristic of skywave signals arriving at your location by both short-path and long-path propagation?
A. Periodic fading approximately every 10 seconds
B. Signal strength increased by 3 dB
C. The signal might be cancelled causing severe attenuation
D. A slightly delayed echo might be heard

G3B02
(D)
Page 8-9

G3B02
What factors affect the MUF?
A. Path distance and location
B. Time of day and season
C. Solar radiation and ionospheric disturbances
D. All these choices are correct

G3B03
(A)
Page 8-10

G3B03
Which of the following applies when selecting a frequency for lowest attenuation when transmitting on HF?
A. Select a frequency just below the MUF
B. Select a frequency just above the LUF
C. Select a frequency just below the critical frequency
D. Select a frequency just above the critical frequency

G3B04
(A)
Page 8-10

G3B04
What is a reliable way to determine if the MUF is high enough to support skip propagation between your station and a distant location on frequencies between 14 and 30 MHz?
A. Listen for signals from an international beacon in the frequency range you plan to use
B. Send a series of dots on the band and listen for echoes from your signal
C. Check the strength of TV signals from western Europe
D. Check the strength of signals in the MF AM broadcast band

G3B05
(A)
Page 8-10

G3B05
What usually happens to radio waves with frequencies below the MUF and above the LUF when they are sent into the ionosphere?
A. They are bent back to Earth
B. They pass through the ionosphere
C. They are amplified by interaction with the ionosphere
D. They are bent and trapped in the ionosphere to circle Earth

G3B06
What usually happens to radio waves with frequencies below the LUF?
A. They are bent back to Earth
B. They pass through the ionosphere
C. They are completely absorbed by the ionosphere
D. They are bent and trapped in the ionosphere to circle Earth

G3B06
(C)
Page 8-10

G3B07
What does LUF stand for?
A. The Lowest Usable Frequency for communications between two points
B. The Longest Universal Function for communications between two points
C. The Lowest Usable Frequency during a 24-hour period
D. The Longest Universal Function during a 24-hour period

G3B07
(A)
Page 8-9

G3B08
What does MUF stand for?
A. The Minimum Usable Frequency for communications between two points
B. The Maximum Usable Frequency for communications between two points
C. The Minimum Usable Frequency during a 24-hour period
D. The Maximum Usable Frequency during a 24-hour period

G3B08
(B)
Page 8-9

G3B09
What is the approximate maximum distance along the Earth's surface that is normally covered in one hop using the F2 region?
A. 180 miles
B. 1,200 miles
C. 2,500 miles
D. 12,000 miles

G3B09
(C)
Page 8-2

G3B10
What is the approximate maximum distance along the Earth's surface that is normally covered in one hop using the E region?
A. 180 miles
B. 1,200 miles
C. 2,500 miles
D. 12,000 miles

G3B10
(B)
Page 8-2

G3B11
What happens to HF propagation when the LUF exceeds the MUF?
A. No HF radio frequency will support ordinary skywave communications over the path
B. HF communications over the path are enhanced
C. Double hop propagation along the path is more common
D. Propagation over the path on all HF frequencies is enhanced

G3B11
(A)
Page 8-10

G3C — Ionospheric layers; critical angle and frequency; HF scatter; Near Vertical Incidence Skywave

G3C01
Which ionospheric layer is closest to the surface of Earth?
A. The D layer
B. The E layer
C. The F1 layer
D. The F2 layer

G3C01
(A)
Page 8-2

G3C02
(A)
Page 8-2

G3C02
Where on Earth do ionospheric layers reach their maximum height?
A. Where the sun is overhead
B. Where the sun is on the opposite side of Earth
C. Where the sun is rising
D. Where the sun has just set

G3C03
(C)
Page 8-2

G3C03
Why is the F2 region mainly responsible for the longest distance radio wave propagation?
A. Because it is the densest ionospheric layer
B. Because of the Doppler effect
C. Because it is the highest ionospheric region
D. Because of meteor trails at that level

G3C04
(D)
Page 8-2

G3C04
What does the term "critical angle" mean, as used in radio wave propagation?
A. The long path azimuth of a distant station
B. The short path azimuth of a distant station
C. The lowest takeoff angle that will return a radio wave to Earth under specific ionospheric conditions
D. The highest takeoff angle that will return a radio wave to Earth under specific ionospheric conditions

G3C05
(C)
Page 8-5

G3C05
Why is long-distance communication on the 40-meter, 60-meter, 80-meter, and 160-meter bands more difficult during the day?
A. The F layer absorbs signals at these frequencies during daylight hours
B. The F layer is unstable during daylight hours
C. The D layer absorbs signals at these frequencies during daylight hours
D. The E layer is unstable during daylight hours

G3C06
(B)
Page 8-12

G3C06
What is a characteristic of HF scatter?
A. Phone signals have high intelligibility
B. Signals have a fluttering sound
C. There are very large, sudden swings in signal strength
D. Scatter propagation occurs only at night

G3C07
(D)
Page 8-12

G3C07
What makes HF scatter signals often sound distorted?
A. The ionospheric layer involved is unstable
B. Ground waves are absorbing much of the signal
C. The E-region is not present
D. Energy is scattered into the skip zone through several different radio wave paths

G3C08
(A)
Page 8-12

G3C08
Why are HF scatter signals in the skip zone usually weak?
A. Only a small part of the signal energy is scattered into the skip zone
B. Signals are scattered from the magnetosphere, which is not a good reflector
C. Propagation is through ground waves, which absorb most of the signal energy
D. Propagation is through ducts in the F region, which absorb most of the energy

G3C09
What type of propagation allows signals to be heard in the transmitting station's skip zone?
A. Faraday rotation
B. Scatter
C. Chordal hop
D. Short-path

G3C09
(B)
Page 8-12

G3C10
What is Near Vertical Incidence Skywave (NVIS) propagation?
A. Propagation near the MUF
B. Short distance MF or HF propagation using high elevation angles
C. Long path HF propagation at sunrise and sunset
D. Double hop propagation near the LUF

G3C10
(B)
Page 8-12

G3C11
Which ionospheric layer is the most absorbent of long skip signals during daylight hours on frequencies below 10 MHz?
A. The F2 layer
B. The F1 layer
C. The E layer
D. The D layer

G3C11
(D)
Page 8-5

SUBELEMENT G4 — AMATEUR RADIO PRACTICES
[5 Exam Questions — 5 groups]

G4A — Station operation and setup

G4A01
(B)
Page 5-20

G4A01
What is the purpose of the "notch filter" found on many HF transceivers?
A. To restrict the transmitter voice bandwidth
B. To reduce interference from carriers in the receiver passband
C. To eliminate receiver interference from impulse noise sources
D. To enhance the reception of a specific frequency on a crowded band

G4A02
(C)
Page 5-20

G4A02
What is one advantage of selecting the opposite, or "reverse," sideband when receiving CW signals on a typical HF transceiver?
A. Interference from impulse noise will be eliminated
B. More stations can be accommodated within a given signal passband
C. It may be possible to reduce or eliminate interference from other signals
D. Accidental out-of-band operation can be prevented

G4A03
(C)
Page 2-4

G4A03
What is normally meant by operating a transceiver in "split" mode?
A. The radio is operating at half power
B. The transceiver is operating from an external power source
C. The transceiver is set to different transmit and receive frequencies
D. The transmitter is emitting an SSB signal, as opposed to DSB operation

G4A04
(B)
Page 5-15

G4A04
What reading on the plate current meter of a vacuum tube RF power amplifier indicates correct adjustment of the plate tuning control?
A. A pronounced peak
B. A pronounced dip
C. No change will be observed
D. A slow, rhythmic oscillation

G4A05
(C)
Page 5-15

G4A05
What is a reason to use Automatic Level Control (ALC) with an RF power amplifier?
A. To balance the transmitter audio frequency response
B. To reduce harmonic radiation
C. To reduce distortion due to excessive drive
D. To increase overall efficiency

G4A06
(C)
Page 7-22

G4A06
What type of device is often used to match transmitter output impedance to an impedance not equal to 50 ohms?
A. Balanced modulator
B. SWR bridge
C. Antenna coupler or antenna tuner
D. Q multiplier

G4A07
What condition can lead to permanent damage to a solid-state RF power amplifier?
A. Insufficient drive power
B. Low input SWR
C. Shorting the input signal to ground
D. Excessive drive power

G4A07
(D)
Page 5-15

G4A08
What is the correct adjustment for the load or coupling control of a vacuum tube RF power amplifier?
A. Minimum SWR on the antenna
B. Minimum plate current without exceeding maximum allowable grid current
C. Highest plate voltage while minimizing grid current
D. Maximum power output without exceeding maximum allowable plate current

G4A08
(D)
Page 5-15

G4A09
Why is a time delay sometimes included in a transmitter keying circuit?
A. To prevent stations from interfering with one another
B. To allow the transmitter power regulators to charge properly
C. To allow time for transmit-receive changeover operations to complete properly before RF output is allowed
D. To allow time for a warning signal to be sent to other stations

G4A09
(C)
Page 5-14

G4A10
What is the purpose of an electronic keyer?
A. Automatic transmit/receive switching
B. Automatic generation of strings of dots and dashes for CW operation
C. VOX operation
D. Computer interface for PSK and RTTY operation

G4A10
(B)
Page 2-13

G4A11
Which of the following is a use for the IF shift control on a receiver?
A. To avoid interference from stations very close to the receive frequency
B. To change frequency rapidly
C. To permit listening on a different frequency from that on which you are transmitting
D. To tune in stations that are slightly off frequency without changing your transmit frequency

G4A11
(A)
Page 5-20

G4A12
Which of the following is a common use for the dual-VFO feature on a transceiver?
A. To allow transmitting on two frequencies at once
B. To permit full duplex operation — that is, transmitting and receiving at the same time
C. To permit monitoring of two different frequencies
D. To facilitate computer interface

G4A12
(C)
Page 2-4

G4A13
What is one reason to use the attenuator function that is present on many HF transceivers?
A. To reduce signal overload due to strong incoming signals
B. To reduce the transmitter power when driving a linear amplifier
C. To reduce power consumption when operating from batteries
D. To slow down received CW signals for better copy

G4A13
(A)
Page 5-19

G4A14
(B)
Page 6-11

G4A14
What is likely to happen if a transceiver's ALC system is not set properly when transmitting AFSK signals with the radio using single sideband mode?
A. ALC will invert the modulation of the AFSK mode
B. Improper action of ALC distorts the signal and can cause spurious emissions
C. When using digital modes, too much ALC activity can cause the transmitter to overheat
D. All these choices are correct

G4A15
(D)
Page 5-22

G4A15
Which of the following can be a symptom of transmitted RF being picked up by an audio cable carrying AFSK data signals between a computer and a transceiver?
A. The VOX circuit does not un-key the transmitter
B. The transmitter signal is distorted
C. Frequent connection timeouts
D. All these choices are correct

G4A16
(C)
Page 5-20

G4A16
How does a noise blanker work?
A. By temporarily increasing received bandwidth
B. By redirecting noise pulses into a filter capacitor
C. By reducing receiver gain during a noise pulse
D. By clipping noise peaks

G4A17
(A)
Page 5-20

G4A17
What happens as the noise reduction control level in a receiver is increased?
A. Received signals may become distorted
B. Received frequency may become unstable
C. CW signals may become severely attenuated
D. Received frequency may shift several kHz

G4B — Test and monitoring equipment; two-tone test

G4B01
(D)
Page 4-42

G4B01
What item of test equipment contains horizontal and vertical channel amplifiers?
A. An ohmmeter
B. A signal generator
C. An ammeter
D. An oscilloscope

G4B02
(D)
Page 4-42

G4B02
Which of the following is an advantage of an oscilloscope versus a digital voltmeter?
A. An oscilloscope uses less power
B. Complex impedances can be easily measured
C. Input impedance is much lower
D. Complex waveforms can be measured

G4B03
(A)
Page 4-42

G4B03
Which of the following is the best instrument to use when checking the keying waveform of a CW transmitter?
A. An oscilloscope
B. A field strength meter
C. A sidetone monitor
D. A wavemeter

G4B04
What signal source is connected to the vertical input of an oscilloscope when checking the RF envelope pattern of a transmitted signal?
A. The local oscillator of the transmitter
B. An external RF oscillator
C. The transmitter balanced mixer output
D. The attenuated RF output of the transmitter

G4B04
(D)
Page 4-42

G4B05
Why is high input impedance desirable for a voltmeter?
A. It improves the frequency response
B. It decreases battery consumption in the meter
C. It improves the resolution of the readings
D. It decreases the loading on circuits being measured

G4B05
(D)
Page 4-41

G4B06
What is an advantage of a digital voltmeter as compared to an analog voltmeter?
A. Better for measuring computer circuits
B. Better for RF measurements
C. Better precision for most uses
D. Faster response

G4B06
(C)
Page 4-41

G4B07
What signals are used to conduct a two-tone test?
A. Two audio signals of the same frequency shifted 90 degrees
B. Two non-harmonically related audio signals
C. Two swept frequency tones
D. Two audio frequency range square wave signals of equal amplitude

G4B07
(B)
Page 5-11

G4B08
Which of the following instruments may be used to monitor relative RF output when making antenna and transmitter adjustments?
A. A field strength meter
B. An antenna noise bridge
C. A multimeter
D. A Q meter

G4B08
(A)
Page 4-43

G4B09
Which of the following can be determined with a field strength meter?
A. The radiation resistance of an antenna
B. The radiation pattern of an antenna
C. The presence and amount of phase distortion of a transmitter
D. The presence and amount of amplitude distortion of a transmitter

G4B09
(B)
Page 4-43

G4B10
Which of the following can be determined with a directional wattmeter?
A. Standing wave ratio
B. Antenna front-to-back ratio
C. RF interference
D. Radio wave propagation

G4B10
(A)
Page 4-43

G4B11
(C)
Page 4-42

G4B11
Which of the following must be connected to an antenna analyzer when it is being used for SWR measurements?
A. Receiver
B. Transmitter
C. Antenna and feed line
D. All these choices are correct

G4B12
(B)
Page 4-43

G4B12
What problem can occur when making measurements on an antenna system with an antenna analyzer?
A. Permanent damage to the analyzer may occur if it is operated into a high SWR
B. Strong signals from nearby transmitters can affect the accuracy of measurements
C. The analyzer can be damaged if measurements outside the ham bands are attempted
D. Connecting the analyzer to an antenna can cause it to absorb harmonics

G4B13
(C)
Page 4-43

G4B13
What is a use for an antenna analyzer other than measuring the SWR of an antenna system?
A. Measuring the front-to-back ratio of an antenna
B. Measuring the turns ratio of a power transformer
C. Determining the impedance of coaxial cable
D. Determining the gain of a directional antenna

G4B14
(D)
Page 4-41

G4B14
What is an instance in which the use of an instrument with analog readout may be preferred over an instrument with digital readout?
A. When testing logic circuits
B. When high precision is desired
C. When measuring the frequency of an oscillator
D. When adjusting tuned circuits

G4B15
(A)
Page 5-11

G4B15
What type of transmitter performance does a two-tone test analyze?
A. Linearity
B. Percentage of suppression of carrier and undesired sideband for SSB
C. Percentage of frequency modulation
D. Percentage of carrier phase shift

G4C — Interference to consumer electronics; grounding; DSP

G4C01
(B)
Page 5-24

G4C01
Which of the following might be useful in reducing RF interference to audio frequency devices?
A. Bypass inductor
B. Bypass capacitor
C. Forward-biased diode
D. Reverse-biased diode

G4C02
(C)
Page 5-24

G4C02
Which of the following could be a cause of interference covering a wide range of frequencies?
A. Not using a balun or line isolator to feed balanced antennas
B. Lack of rectification of the transmitter's signal in power conductors
C. Arcing at a poor electrical connection
D. Using a balun to feed an unbalanced antenna

G4C03
What sound is heard from an audio device or telephone if there is interference from a nearby single sideband phone transmitter?
A. A steady hum whenever the transmitter is on the air
B. On-and-off humming or clicking
C. Distorted speech
D. Clearly audible speech

G4C03
(C)
Page 5-24

G4C04
What is the effect on an audio device when there is interference from a nearby CW transmitter?
A. On-and-off humming or clicking
B. A CW signal at a nearly pure audio frequency
C. A chirpy CW signal
D. Severely distorted audio

G4C04
(A)
Page 5-24

G4C05
What might be the problem if you receive an RF burn when touching your equipment while transmitting on an HF band, assuming the equipment is connected to a ground rod?
A. Flat braid rather than round wire has been used for the ground wire
B. Insulated wire has been used for the ground wire
C. The ground rod is resonant
D. The ground wire has high impedance on that frequency

G4C05
(D)
Page 5-23

G4C06
What effect can be caused by a resonant ground connection?
A. Overheating of ground straps
B. Corrosion of the ground rod
C. High RF voltages on the enclosures of station equipment
D. A ground loop

G4C06
(C)
Page 5-23

G4C07
Why should soldered joints not be used with the wires that connect the base of a tower to a system of ground rods?
A. The resistance of solder is too high
B. Solder flux will prevent a low conductivity connection
C. Solder has too high a dielectric constant to provide adequate lightning protection
D. A soldered joint will likely be destroyed by the heat of a lightning strike

G4C07
(D)
Page 9-8

G4C08
Which of the following would reduce RF interference caused by common-mode current on an audio cable?
A. Placing a ferrite choke around the cable
B. Adding series capacitors to the conductors
C. Adding shunt inductors to the conductors
D. Adding an additional insulating jacket to the cable

G4C08
(A)
Page 5-24

G4C09
How can a ground loop be avoided?
A. Connect all ground conductors in series
B. Connect the AC neutral conductor to the ground wire
C. Avoid using lock washers and star washers when making ground connections
D. Connect all ground conductors to a single point

G4C09
(D)
Page 5-23

G4C10
(A)
Page 5-23

G4C10
What could be a symptom of a ground loop somewhere in your station?
A. You receive reports of "hum" on your station's transmitted signal
B. The SWR reading for one or more antennas is suddenly very high
C. An item of station equipment starts to draw excessive amounts of current
D. You receive reports of harmonic interference from your station

G4C11
(C)
Page 5-22

G4C11
What technique helps to minimize RF "hot spots" in an amateur station?
A. Building all equipment in a metal enclosure
B. Using surge suppressor power outlets
C. Bonding all equipment enclosures together
D. Low-pass filters on all feed lines

G4C12
(A)
Page 5-18

G4C12
Which of the following is an advantage of a receiver DSP IF filter as compared to an analog filter?
A. A wide range of filter bandwidths and shapes can be created
B. Fewer digital components are required
C. Mixing products are greatly reduced
D. The DSP filter is much more effective at VHF frequencies

G4C13
(D)
Page 5-22

G4C13
Why must the metal enclosure of every item of station equipment be grounded?
A. It prevents a blown fuse in the event of an internal short circuit
B. It prevents signal overload
C. It ensures that the neutral wire is grounded
D. It ensures that hazardous voltages cannot appear on the chassis

G4D — Speech processors; S meters; sideband operation near band edges

G4D01
(A)
Page 5-12

G4D01
What is the purpose of a speech processor as used in a modern transceiver?
A. Increase the intelligibility of transmitted phone signals during poor conditions
B. Increase transmitter bass response for more natural-sounding SSB signals
C. Prevent distortion of voice signals
D. Decrease high-frequency voice output to prevent out-of-band operation

G4D02
(B)
Page 5-12

G4D02
Which of the following describes how a speech processor affects a transmitted single sideband phone signal?
A. It increases peak power
B. It increases average power
C. It reduces harmonic distortion
D. It reduces intermodulation distortion

G4D03
(D)
Page 5-12

G4D03
Which of the following can be the result of an incorrectly adjusted speech processor?
A. Distorted speech
B. Splatter
C. Excessive background pickup
D. All these choices are correct

G4D04
What does an S meter measure?
A. Conductance
B. Impedance
C. Received signal strength
D. Transmitter power output

G4D04
(C)
Page 5-19

G4D05
How does a signal that reads 20 dB over S9 compare to one that reads S9 on a receiver, assuming a properly calibrated S meter?
A. It is 10 times less powerful
B. It is 20 times less powerful
C. It is 20 times more powerful
D. It is 100 times more powerful

G4D05
(D)
Page 5-19

G4D06
Where is an S meter found?
A. In a receiver
B. In an SWR bridge
C. In a transmitter
D. In a conductance bridge

G4D06
(A)
Page 5-19

G4D07
How much must the power output of a transmitter be raised to change the S meter reading on a distant receiver from S8 to S9?
A. Approximately 1.5 times
B. Approximately 2 times
C. Approximately 4 times
D. Approximately 8 times

G4D07
(C)
Page 5-19

G4D08
What frequency range is occupied by a 3 kHz LSB signal when the displayed carrier frequency is set to 7.178 MHz?
A. 7.178 to 7.181 MHz
B. 7.178 to 7.184 MHz
C. 7.175 to 7.178 MHz
D. 7.1765 to 7.1795 MHz

G4D08
(C)
Page 5-12

G4D09
What frequency range is occupied by a 3 kHz USB signal with the displayed carrier frequency set to 14.347 MHz?
A. 14.347 to 14.647 MHz
B. 14.347 to 14.350 MHz
C. 14.344 to 14.347 MHz
D. 14.3455 to 14.3485 MHz

G4D09
(B)
Page 5-12

G4D10
How close to the lower edge of the phone segment should your displayed carrier frequency be when using 3 kHz wide LSB?
A. At least 3 kHz above the edge of the segment
B. At least 3 kHz below the edge of the segment
C. At least 1 kHz below the edge of the segment
D. At least 1 kHz above the edge of the segment

G4D10
(A)
Page 5-12

G4D11
(B)
Page 5-12

G4D11
How close to the upper edge of the phone segment should your displayed carrier frequency be when using 3 kHz wide USB?
A. At least 3 kHz above the edge of the band
B. At least 3 kHz below the edge of the band
C. At least 1 kHz above the edge of the segment
D. At least 1 kHz below the edge of the segment

G4E — HF mobile radio installations; alternative energy source operation

G4E01
(C)
Page 7-6

G4E01
What is the purpose of a capacitance hat on a mobile antenna?
A. To increase the power handling capacity of a whip antenna
B. To allow automatic band changing
C. To electrically lengthen a physically short antenna
D. To allow remote tuning

G4E02
(D)
Page 7-6

G4E02
What is the purpose of a corona ball on an HF mobile antenna?
A. To narrow the operating bandwidth of the antenna
B. To increase the "Q" of the antenna
C. To reduce the chance of damage if the antenna should strike an object
D. To reduce RF voltage discharge from the tip of the antenna while transmitting

G4E03
(A)
Page 5-21

G4E03
Which of the following direct, fused power connections would be the best for a 100 watt HF mobile installation?
A. To the battery using heavy-gauge wire
B. To the alternator or generator using heavy-gauge wire
C. To the battery using resistor wire
D. To the alternator or generator using resistor wire

G4E04
(B)
Page 5-21

G4E04
Why is it best NOT to draw the DC power for a 100 watt HF transceiver from a vehicle's auxiliary power socket?
A. The socket is not wired with an RF-shielded power cable
B. The socket's wiring may be inadequate for the current drawn by the transceiver
C. The DC polarity of the socket is reversed from the polarity of modern HF transceivers
D. Drawing more than 50 watts from this socket could cause the engine to overheat

G4E05
(C)
Page 5-21

G4E05
Which of the following most limits an HF mobile installation?
A. "Picket fencing"
B. The wire gauge of the DC power line to the transceiver
C. Efficiency of the electrically short antenna
D. FCC rules limiting mobile output power on the 75-meter band

G4E06
(C)
Page 7-6

G4E06
What is one disadvantage of using a shortened mobile antenna as opposed to a full-size antenna?
A. Short antennas are more likely to cause distortion of transmitted signals
B. Short antennas can only receive circularly polarized signals
C. Operating bandwidth may be very limited
D. Harmonic radiation may increase

G4E07
Which of the following may cause receive interference in a radio installed in a vehicle?
A. The battery charging system
B. The fuel delivery system
C. The vehicle control computer
D. All these choices are correct

G4E07
(D)
Page 5-22

G4E08
What is the name of the process by which sunlight is changed directly into electricity?
A. Photovoltaic conversion
B. Photon emission
C. Photosynthesis
D. Photon decomposition

G4E08
(A)
Page 4-36

G4E09
What is the approximate open-circuit voltage from a fully illuminated silicon photovoltaic cell?
A. 0.02 VDC
B. 0.5 VDC
C. 0.2 VDC
D. 1.38 VDC

G4E09
(B)
Page 4-36

G4E10
What is the reason that a series diode is connected between a solar panel and a storage battery that is being charged by the panel?
A. The diode serves to regulate the charging voltage to prevent overcharge
B. The diode prevents self-discharge of the battery through the panel during times of low or no illumination
C. The diode limits the current flowing from the panel to a safe value
D. The diode greatly increases the efficiency during times of high illumination

G4E10
(B)
Page 4-37

G4E11
Which of the following is a disadvantage of using wind as the primary source of power for an emergency station?
A. The conversion efficiency from mechanical energy to electrical energy is less than 2 percent
B. The voltage and current ratings of such systems are not compatible with amateur equipment
C. A large energy storage system is needed to supply power when the wind is not blowing
D. All these choices are correct

G4E11
(C)
Page 4-37

SUBELEMENT G5 — ELECTRICAL PRINCIPLES
[3 Exam Questions — 3 Groups]

G5A — Reactance; inductance; capacitance; impedance; impedance matching

G5A01
(C)
Page 4-21

G5A01
What is impedance?
A. The electric charge stored by a capacitor
B. The inverse of resistance
C. The opposition to the flow of current in an AC circuit
D. The force of repulsion between two similar electric fields

G5A02
(B)
Page 4-19

G5A02
What is reactance?
A. Opposition to the flow of direct current caused by resistance
B. Opposition to the flow of alternating current caused by capacitance or inductance
C. A property of ideal resistors in AC circuits
D. A large spark produced at switch contacts when an inductor is de-energized

G5A03
(D)
Page 4-19

G5A03
Which of the following causes opposition to the flow of alternating current in an inductor?
A. Conductance
B. Reluctance
C. Admittance
D. Reactance

G5A04
(C)
Page 4-19

G5A04
Which of the following causes opposition to the flow of alternating current in a capacitor?
A. Conductance
B. Reluctance
C. Reactance
D. Admittance

G5A05
(D)
Page 4-20

G5A05
How does an inductor react to AC?
A. As the frequency of the applied AC increases, the reactance decreases
B. As the amplitude of the applied AC increases, the reactance increases
C. As the amplitude of the applied AC increases, the reactance decreases
D. As the frequency of the applied AC increases, the reactance increases

G5A06
(A)
Page 4-19

G5A06
How does a capacitor react to AC?
A. As the frequency of the applied AC increases, the reactance decreases
B. As the frequency of the applied AC increases, the reactance increases
C. As the amplitude of the applied AC increases, the reactance increases
D. As the amplitude of the applied AC increases, the reactance decreases

G5A07
What happens when the impedance of an electrical load is equal to the output impedance of a power source, assuming both impedances are resistive?
A. The source delivers minimum power to the load
B. The electrical load is shorted
C. No current can flow through the circuit
D. The source can deliver maximum power to the load

G5A07
(D)
Page 4-22

G5A08
What is one reason to use an impedance matching transformer?
A. To minimize transmitter power output
B. To maximize the transfer of power
C. To reduce power supply ripple
D. To minimize radiation resistance

G5A08
(B)
Page 4-23

G5A09
What unit is used to measure reactance?
A. Farad
B. Ohm
C. Ampere
D. Siemens

G5A09
(B)
Page 4-19

G5A10
Which of the following devices can be used for impedance matching at radio frequencies?
A. A transformer
B. A Pi-network
C. A length of transmission line
D. All these choices are correct

G5A10
(D)
Page 4-23

G5A11
Which of the following describes one method of impedance matching between two AC circuits?
A. Insert an LC network between the two circuits
B. Reduce the power output of the first circuit
C. Increase the power output of the first circuit
D. Insert a circulator between the two circuits

G5A11
(A)
Page 4-23

G5B — The decibel; current and voltage dividers; electrical power calculations; sine wave root-mean-square (RMS) values; PEP calculations

G5B01
What dB change represents a factor of two increase or decrease in power?
A. Approximately 2 dB
B. Approximately 3 dB
C. Approximately 6 dB
D. Approximately 12 dB

G5B01
(B)
Page 4-2

G5B02
How does the total current relate to the individual currents in each branch of a purely resistive parallel circuit?
A. It equals the average of each branch current
B. It decreases as more parallel branches are added to the circuit
C. It equals the sum of the currents through each branch
D. It is the sum of the reciprocal of each individual voltage drop

G5B02
(C)
Page 4-15

G5B03
(B)
Page 4-1

G5B03
How many watts of electrical power are used if 400 VDC is supplied to an 800 ohm load?
A. 0.5 watts
B. 200 watts
C. 400 watts
D. 3200 watts

G5B04
(A)
Page 4-2

G5B04
How many watts of electrical power are used by a 12 VDC light bulb that draws 0.2 amperes?
A. 2.4 watts
B. 24 watts
C. 6 watts
D. 60 watts

G5B05
(A)
Page 4-2

G5B05
How many watts are dissipated when a current of 7.0 milliamperes flows through a 1250 ohm resistance?
A. Approximately 61 milliwatts
B. Approximately 61 watts
C. Approximately 11 milliwatts
D. Approximately 11 watts

G5B06
(B)
Page 4-7

G5B06
What is the output PEP from a transmitter if an oscilloscope measures 200 volts peak-to-peak across a 50 ohm dummy load connected to the transmitter output?
A. 1.4 watts
B. 100 watts
C. 353.5 watts
D. 400 watts

G5B07
(C)
Page 4-5

G5B07
What value of an AC signal produces the same power dissipation in a resistor as a DC voltage of the same value?
A. The peak-to-peak value
B. The peak value
C. The RMS value
D. The reciprocal of the RMS value

G5B08
(D)
Page 4-6

G5B08
What is the peak-to-peak voltage of a sine wave with an RMS voltage of 120.0 volts?
A. 84.8 volts
B. 169.7 volts
C. 240.0 volts
D. 339.4 volts

G5B09
(B)
Page 4-6

G5B09
What is the RMS voltage of a sine wave with a value of 17 volts peak?
A. 8.5 volts
B. 12 volts
C. 24 volts
D. 34 volts

G5B10
What percentage of power loss would result from a transmission line loss of 1 dB?
A. 10.9 percent
B. 12.2 percent
C. 20.6 percent
D. 25.9 percent

G5B10
(C)
Page 4-3

G5B11
What is the ratio of peak envelope power to average power for an unmodulated carrier?
A. 0.707
B. 1.00
C. 1.414
D. 2.00

G5B11
(B)
Page 4-7

G5B12
What would be the RMS voltage across a 50 ohm dummy load dissipating 1200 watts?
A. 173 volts
B. 245 volts
C. 346 volts
D. 692 volts

G5B12
(B)
Page 4-7

G5B13
What is the output PEP of an unmodulated carrier if an average reading wattmeter connected to the transmitter output indicates 1060 watts?
A. 530 watts
B. 1060 watts
C. 1500 watts
D. 2120 watts

G5B13
(B)
Page 4-7

G5B14
What is the output PEP from a transmitter if an oscilloscope measures 500 volts peak-to-peak across a 50 ohm resistive load connected to the transmitter output?
A. 8.75 watts
B. 625 watts
C. 2500 watts
D. 5000 watts

G5B14
(B)
Page 4-7

G5C — Resistors, capacitors, and inductors in series and parallel; transformers

G5C01
What causes a voltage to appear across the secondary winding of a transformer when an AC voltage source is connected across its primary winding?
A. Capacitive coupling
B. Displacement current coupling
C. Mutual inductance
D. Mutual capacitance

G5C01
(C)
Page 4-13

G5C02
What happens if a signal is applied to the secondary winding of a 4:1 voltage step-down transformer instead of the primary winding?
A. The output voltage is multiplied by 4
B. The output voltage is divided by 4
C. Additional resistance must be added in series with the primary to prevent overload
D. Additional resistance must be added in parallel with the secondary to prevent overload

G5C02
(A)
Page 4-14

G5C03
(B)
Page 4-15

G5C03
Which of the following components increases the total resistance of a resistor?
A. A parallel resistor
B. A series resistor
C. A series capacitor
D. A parallel capacitor

G5C04
(C)
Page 4-17

G5C04
What is the total resistance of three 100 ohm resistors in parallel?
A. 0.30 ohms
B. 0.33 ohms
C. 33.3 ohms
D. 300 ohms

G5C05
(C)
Page 4-18

G5C05
If three equal value resistors in series produce 450 ohms, what is the value of each resistor?
A. 1500 ohms
B. 90 ohms
C. 150 ohms
D. 175 ohms

G5C06
(C)
Page 4-14

G5C06
What is the RMS voltage across a 500-turn secondary winding in a transformer if the 2250-turn primary is connected to 120 VAC?
A. 2370 volts
B. 540 volts
C. 26.7 volts
D. 5.9 volts

G5C07
(A)
Page 4-22

G5C07
What is the turns ratio of a transformer used to match an audio amplifier having 600 ohm output impedance to a speaker having 4 ohm impedance?
A. 12.2 to 1
B. 24.4 to 1
C. 150 to 1
D. 300 to 1

G5C08
(D)
Page 4-18

G5C08
What is the equivalent capacitance of two 5.0 nanofarad capacitors and one 750 picofarad capacitor connected in parallel?
A. 576.9 nanofarads
B. 1733 picofarads
C. 3583 picofarads
D. 10.750 nanofarads

G5C09
(C)
Page 4-17

G5C09
What is the capacitance of three 100 microfarad capacitors connected in series?
A. 0.30 microfarads
B. 0.33 microfarads
C. 33.3 microfarads
D. 300 microfarads

G5C10
What is the inductance of three 10 millihenry inductors connected in parallel?
A. 0.30 henries
B. 3.3 henries
C. 3.3 millihenries
D. 30 millihenries

G5C10
(C)
Page 4-17

G5C11
What is the inductance of a 20 millihenry inductor connected in series with a 50 millihenry inductor?
A. 0.07 millihenries
B. 14.3 millihenries
C. 70 millihenries
D. 1000 millihenries

G5C11
(C)
Page 4-17

G5C12
What is the capacitance of a 20 microfarad capacitor connected in series with a 50 microfarad capacitor?
A. 0.07 microfarads
B. 14.3 microfarads
C. 70 microfarads
D. 1000 microfarads

G5C12
(B)
Page 4-17

G5C13
Which of the following components should be added to a capacitor to increase the capacitance?
A. An inductor in series
B. A resistor in series
C. A capacitor in parallel
D. A capacitor in series

G5C13
(C)
Page 4-15

G5C14
Which of the following components should be added to an inductor to increase the inductance?
A. A capacitor in series
B. A resistor in parallel
C. An inductor in parallel
D. An inductor in series

G5C14
(D)
Page 4-15

G5C15
What is the total resistance of a 10 ohm, a 20 ohm, and a 50 ohm resistor connected in parallel?
A. 5.9 ohms
B. 0.17 ohms
C. 10000 ohms
D. 80 ohms

G5C15
(A)
Page 4-18

G5C16
Why is the conductor of the primary winding of many voltage step-up transformers larger in diameter than the conductor of the secondary winding?
A. To improve the coupling between the primary and secondary
B. To accommodate the higher current of the primary
C. To prevent parasitic oscillations due to resistive losses in the primary
D. To ensure that the volume of the primary winding is equal to the volume of the secondary winding

G5C16
(B)
Page 4-14

G5C17
(C)
Page 4-13

G5C17
What is the value in nanofarads (nF) of a 22,000 picofarad (pF) capacitor?
A. 0.22
B. 2.2
C. 22
D. 220

G5C18
(D)
Page 4-13

G5C18
What is the value in microfarads of a 4700 nanofarad (nF) capacitor?
A. 47
B. 0.47
C. 47,000
D. 4.7

SUBELEMENT G6 — CIRCUIT COMPONENTS
[2 Exam Questions — 2 Groups]

G6A — Resistors; capacitors; inductors; rectifiers; solid-state diodes and transistors; vacuum tubes; batteries

G6A01
What is the minimum allowable discharge voltage for maximum life of a standard 12 volt lead-acid battery?
A. 6 volts
B. 8.5 volts
C. 10.5 volts
D. 12 volts

G6A01
(C)
Page 4-36

G6A02
What is an advantage of the low internal resistance of nickel-cadmium batteries?
A. Long life
B. High discharge current
C. High voltage
D. Rapid recharge

G6A02
(B)
Page 4-36

G6A03
What is the approximate junction threshold voltage of a germanium diode?
A. 0.1 volt
B. 0.3 volts
C. 0.7 volts
D. 1.0 volts

G6A03
(B)
Page 4-24

G6A04
Which of the following is an advantage of an electrolytic capacitor?
A. Tight tolerance
B. Much less leakage than any other type
C. High capacitance for a given volume
D. Inexpensive RF capacitor

G6A04
(C)
Page 4-12

G6A05
What is the approximate junction threshold voltage of a conventional silicon diode?
A. 0.1 volt
B. 0.3 volts
C. 0.7 volts
D. 1.0 volts

G6A05
(C)
Page 4-24

G6A06
Which of the following is a reason not to use wire-wound resistors in an RF circuit?
A. The resistor's tolerance value would not be adequate for such a circuit
B. The resistor's inductance could make circuit performance unpredictable
C. The resistor could overheat
D. The resistor's internal capacitance would detune the circuit

G6A06
(B)
Page 4-21

G6A07
What are the stable operating points for a bipolar transistor used as a switch in a logic circuit?
A. Its saturation and cutoff regions
B. Its active region (between the cutoff and saturation regions)
C. Its peak and valley current points
D. Its enhancement and depletion modes

G6A07
(A)
Page 4-25

G6A08
(D)
Page 4-12

G6A08
What is an advantage of using a ferrite core toroidal inductor?
A. Large values of inductance may be obtained
B. The magnetic properties of the core may be optimized for a specific range of frequencies
C. Most of the magnetic field is contained in the core
D. All these choices are correct

G6A09
(B)
Page 4-25

G6A09
Which of the following describes the construction of a MOSFET?
A. The gate is formed by a back-biased junction
B. The gate is separated from the channel with a thin insulating layer
C. The source is separated from the drain by a thin insulating layer
D. The source is formed by depositing metal on silicon

G6A10
(A)
Page 4-26

G6A10
Which element of a triode vacuum tube is used to regulate the flow of electrons between cathode and plate?
A. Control grid
B. Heater
C. Screen grid
D. Trigger electrode

G6A11
(C)
Page 4-22

G6A11
What happens when an inductor is operated above its self-resonant frequency?
A. Its reactance increases
B. Harmonics are generated
C. It becomes capacitive
D. Catastrophic failure is likely

G6A12
(A)
Page 4-26

G6A12
What is the primary purpose of a screen grid in a vacuum tube?
A. To reduce grid-to-plate capacitance
B. To increase efficiency
C. To increase the control grid resistance
D. To decrease plate resistance

G6A13
(D)
Page 4-12

G6A13
Why is the polarity of applied voltages important for polarized capacitors?
A. Incorrect polarity can cause the capacitor to short-circuit
B. Reverse voltages can destroy the dielectric layer of an electrolytic capacitor
C. The capacitor could overheat and explode
D. All these choices are correct

G6A14
(D)
Page 4-13

G6A14
Which of the following is an advantage of ceramic capacitors as compared to other types of capacitors?
A. Tight tolerance
B. High stability
C. High capacitance for given volume
D. Comparatively low cost

G6B — Analog and digital integrated circuits (ICs); microprocessors; memory; I/O devices; microwave ICs (MMICs); display devices; connectors; ferrite cores

G6B01
What determines the performance of a ferrite core at different frequencies?
A. Its conductivity
B. Its thickness
C. The composition, or "mix," of materials used
D. The ratio of outer diameter to inner diameter

G6B01
(C)
Page 4-12

G6B02
What is meant by the term MMIC?
A. Multi-Megabyte Integrated Circuit
B. Monolithic Microwave Integrated Circuit
C. Military Manufactured Integrated Circuit
D. Mode Modulated Integrated Circuit

G6B02
(B)
Page 4-30

G6B03
Which of the following is an advantage of CMOS integrated circuits compared to TTL integrated circuits?
A. Low power consumption
B. High power handling capability
C. Better suited for RF amplification
D. Better suited for power supply regulation

G6B03
(A)
Page 4-28

G6B04
What is meant by the term ROM?
A. Resistor Operated Memory
B. Read Only Memory
C. Random Operational Memory
D. Resistant to Overload Memory

G6B04
(B)
Page 4-30

G6B05
What is meant when memory is characterized as non-volatile?
A. It is resistant to radiation damage
B. It is resistant to high temperatures
C. The stored information is maintained even if power is removed
D. The stored information cannot be changed once written

G6B05
(C)
Page 4-30

G6B06
What kind of device is an integrated circuit operational amplifier?
A. Digital
B. MMIC
C. Programmable Logic
D. Analog

G6B06
(D)
Page 4-27

G6B07
Which of the following describes a type N connector?
A. A moisture-resistant RF connector useful to 10 GHz
B. A small bayonet connector used for data circuits
C. A threaded connector used for hydraulic systems
D. An audio connector used in surround-sound installations

G6B07
(A)
Page 4-40

G6B08
(D)
Page 4-31

G6B08
How is an LED biased when emitting light?
A. Beyond cutoff
B. At the Zener voltage
C. Reverse biased
D. Forward biased

G6B09
(A)
Page 4-31

G6B09
Which of the following is a characteristic of a liquid crystal display?
A. It utilizes ambient or back lighting
B. It offers a wide dynamic range
C. It consumes relatively high power
D. It has relatively short lifetime

G6B10
(A)
Page 5-24

G6B10
How does a ferrite bead or core reduce common-mode RF current on the shield of a coaxial cable?
A. By creating an impedance in the current's path
B. It converts common-mode current to differential mode
C. By creating an out-of-phase current to cancel the common-mode current
D. Ferrites expel magnetic fields

G6B11
(B)
Page 4-40

G6B11
What is a type SMA connector?
A. A large bayonet connector usable at power levels more than 1 KW
B. A small threaded connector suitable for signals up to several GHz
C. A connector designed for serial multiple access signals
D. A type of push-on connector intended for high-voltage applications

G6B12
(C)
Page 4-38

G6B12
Which of these connector types is commonly used for audio signals in Amateur Radio stations?
A. PL-259
B. BNC
C. RCA Phono
D. Type N

G6B13
(C)
Page 4-39

G6B13
Which of these connector types is commonly used for RF connections at frequencies up to 150 MHz?
A. Octal
B. RJ-11
C. PL-259
D. DB-25

SUBELEMENT G7 — PRACTICAL CIRCUITS
[3 Exam Questions — 3 Groups]

G7A — Power supplies; schematic symbols

G7A01
What useful feature does a power supply bleeder resistor provide?
A. It acts as a fuse for excess voltage
B. It ensures that the filter capacitors are discharged when power is removed
C. It removes shock hazards from the induction coils
D. It eliminates ground loop current

G7A01
(B)
Page 4-33

G7A02
Which of the following components are used in a power supply filter network?
A. Diodes
B. Transformers and transducers
C. Quartz crystals
D. Capacitors and inductors

G7A02
(D)
Page 4-33

G7A03
Which type of rectifier circuit uses two diodes and a center-tapped transformer?
A. Full-wave
B. Full-wave bridge
C. Half-wave
D. Synchronous

G7A03
(A)
Page 4-32

G7A04
What is an advantage of a half-wave rectifier in a power supply?
A. Only one diode is required
B. The ripple frequency is twice that of a full-wave rectifier
C. More current can be drawn from the half-wave rectifier
D. The output voltage is two times the peak output voltage of the transformer

G7A04
(A)
Page 4-32

G7A05
What portion of the AC cycle is converted to DC by a half-wave rectifier?
A. 90 degrees
B. 180 degrees
C. 270 degrees
D. 360 degrees

G7A05
(B)
Page 4-32

G7A06
What portion of the AC cycle is converted to DC by a full-wave rectifier?
A. 90 degrees
B. 180 degrees
C. 270 degrees
D. 360 degrees

G7A06
(D)
Page 4-32

G7A07
What is the output waveform of an unfiltered full-wave rectifier connected to a resistive load?
A. A series of DC pulses at twice the frequency of the AC input
B. A series of DC pulses at the same frequency as the AC input
C. A sine wave at half the frequency of the AC input
D. A steady DC voltage

G7A07
(A)
Page 4-32

G7A08
(C)
Page 4-33

G7A08
Which of the following is an advantage of a switchmode power supply as compared to a linear power supply?
A. Faster switching time makes higher output voltage possible
B. Fewer circuit components are required
C. High-frequency operation allows the use of smaller components
D. All these choices are correct

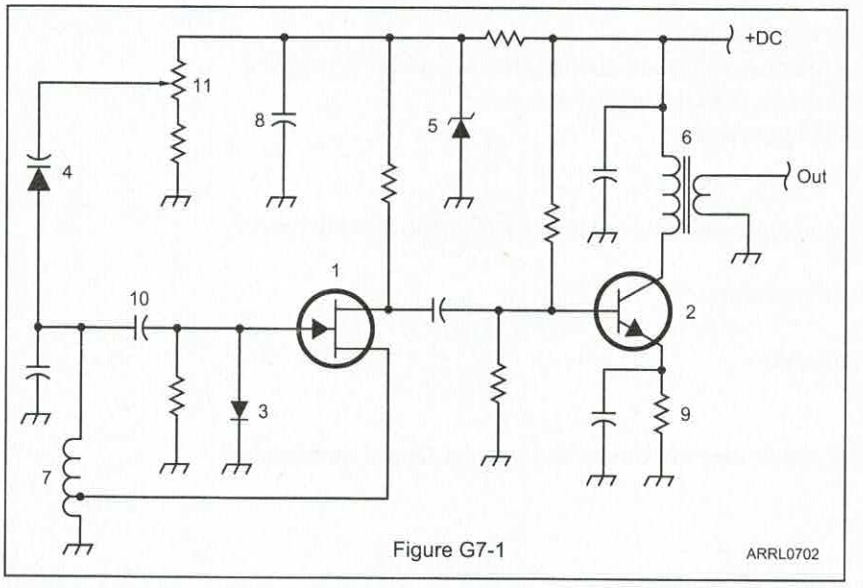

Figure G7-1 — This figure is used for questions G7A09 through G7A13.

G7A09
(C)
Page 4-7

G7A09
Which symbol in figure G7-1 represents a field effect transistor?
A. Symbol 2
B. Symbol 5
C. Symbol 1
D. Symbol 4

G7A10
(D)
Page 4-7

G7A10
Which symbol in figure G7-1 represents a Zener diode?
A. Symbol 4
B. Symbol 1
C. Symbol 11
D. Symbol 5

G7A11
(B)
Page 4-7

G7A11
Which symbol in figure G7-1 represents an NPN junction transistor?
A. Symbol 1
B. Symbol 2
C. Symbol 7
D. Symbol 11

G7A12
(C)
Page 4-7

G7A12
Which symbol in Figure G7-1 represents a solid core transformer?
A. Symbol 4
B. Symbol 7
C. Symbol 6
D. Symbol 1

G7A13
Which symbol in Figure G7-1 represents a tapped inductor?
A. Symbol 7
B. Symbol 11
C. Symbol 6
D. Symbol 1

G7A13
(A)
Page 4-7

G7B — Digital circuits; amplifiers and oscillators

G7B01
What is the reason for neutralizing the final amplifier stage of a transmitter?
A. To limit the modulation index
B. To eliminate self-oscillations
C. To cut off the final amplifier during standby periods
D. To keep the carrier on frequency

G7B01
(B)
Page 5-15

G7B02
Which of these classes of amplifiers has the highest efficiency?
A. Class A
B. Class B
C. Class AB
D. Class C

G7B02
(D)
Page 5-14

G7B03
Which of the following describes the function of a two-input AND gate?
A. Output is high when either or both inputs are low
B. Output is high only when both inputs are high
C. Output is low when either or both inputs are high
D. Output is low only when both inputs are high

G7B03
(B)
Page 4-28

G7B04
Which of the following describes the function of a two input NOR gate?
A. Output is high when either or both inputs are low
B. Output is high only when both inputs are high
C. Output is low when either or both inputs are high
D. Output is low only when both inputs are high

G7B04
(C)
Page 4-28

G7B05
How many states does a 3-bit binary counter have?
A. 3
B. 6
C. 8
D. 16

G7B05
(C)
Page 4-28

G7B06
What is a shift register?
A. A clocked array of circuits that passes data in steps along the array
B. An array of operational amplifiers used for tri-state arithmetic operations
C. A digital mixer
D. An analog mixer

G7B06
(A)
Page 4-28

G7B07
(D)
Page 5-4

G7B07
Which of the following are basic components of a sine wave oscillator?
A. An amplifier and a divider
B. A frequency multiplier and a mixer
C. A circulator and a filter operating in a feed-forward loop
D. A filter and an amplifier operating in a feedback loop

G7B08
(B)
Page 5-14

G7B08
How is the efficiency of an RF power amplifier determined?
A. Divide the DC input power by the DC output power
B. Divide the RF output power by the DC input power
C. Multiply the RF input power by the reciprocal of the RF output power
D. Add the RF input power to the DC output power

G7B09
(C)
Page 5-4

G7B09
What determines the frequency of an LC oscillator?
A. The number of stages in the counter
B. The number of stages in the divider
C. The inductance and capacitance in the tank circuit
D. The time delay of the lag circuit

G7B10
(B)
Page 5-9

G7B10
Which of the following describes a linear amplifier?
A. Any RF power amplifier used in conjunction with an amateur transceiver
B. An amplifier in which the output preserves the input waveform
C. A Class C high efficiency amplifier
D. An amplifier used as a frequency multiplier

G7B11
(B)
Page 5-14

G7B11
For which of the following modes is a Class C power stage appropriate for amplifying a modulated signal?
A. SSB
B. FM
C. AM
D. All these choices are correct

G7C — Receivers and transmitters; filters; oscillators

G7C01
(B)
Page 5-9

G7C01
Which of the following is used to process signals from the balanced modulator then send them to the mixer in some single sideband phone transmitters?
A. Carrier oscillator
B. Filter
C. IF amplifier
D. RF amplifier

G7C02
(D)
Page 5-9

G7C02
Which circuit is used to combine signals from the carrier oscillator and speech amplifier then send the result to the filter in some single sideband phone transmitters?
A. Discriminator
B. Detector
C. IF amplifier
D. Balanced modulator

G7C03
What circuit is used to process signals from the RF amplifier and local oscillator then send the result to the IF filter in a superheterodyne receiver?
A. Balanced modulator
B. IF amplifier
C. Mixer
D. Detector

G7C03
(C)
Page 5-16

G7C04
What circuit is used to combine signals from the IF amplifier and BFO and send the result to the AF amplifier in some single sideband receivers?
A. RF oscillator
B. IF filter
C. Balanced modulator
D. Product detector

G7C04
(D)
Page 5-17

G7C05
Which of the following is an advantage of a direct digital synthesizer (DDS)?
A. Wide tuning range and no need for band switching
B. Relatively high-power output
C. Relatively low power consumption
D. Variable frequency with the stability of a crystal oscillator

G7C05
(D)
Page 5-5

G7C06
What should be the impedance of a low-pass filter as compared to the impedance of the transmission line into which it is inserted?
A. Substantially higher
B. About the same
C. Substantially lower
D. Twice the transmission line impedance

G7C06
(B)
Page 5-23

G7C07
What is the simplest combination of stages that implement a superheterodyne receiver?
A. RF amplifier, detector, audio amplifier
B. RF amplifier, mixer, IF discriminator
C. HF oscillator, mixer, detector
D. HF oscillator, prescaler, audio amplifier

G7C07
(C)
Page 5-16

G7C08
What circuit is used in analog FM receivers to convert IF output signals to audio?
A. Product detector
B. Phase inverter
C. Mixer
D. Discriminator

G7C08
(D)
Page 5-18

G7C09
What is the phase difference between the I and Q signals that software-defined radio (SDR) equipment uses for modulation and demodulation?
A. Zero
B. 90 degrees
C. 180 degrees
D. 45 degrees

G7C09
(B)
Page 5-7

G7C10
(B)
Page 5-7

G7C10
What is an advantage of using I and Q signals in software-defined radios (SDRs)?
A. The need for high resolution analog-to-digital converters is eliminated
B. All types of modulation can be created with appropriate processing.
C. Minimum detectible signal level is reduced
D. Converting the signal from digital to analog creates mixing products

G7C11
(A)
Page 5-3

G7C11
What is meant by the term "software-defined radio" (SDR)?
A. A radio in which most major signal processing functions are performed by software
B. A radio that provides computer interface for automatic logging of band and frequency
C. A radio that uses crystal filters designed using software
D. A computer model that can simulate performance of a radio to aid in the design process

G7C12
(C)
Page 5-4

G7C12
What is the frequency above which a low-pass filter's output power is less than half the input power?
A. Notch frequency
B. Neper frequency
C. Cutoff frequency
D. Rolloff frequency

G7C13
(D)
Page 5-4

G7C13
What term specifies a filter's maximum ability to reject signals outside its passband?
A. Notch depth
B. Rolloff
C. Insertion loss
D. Ultimate rejection

G7C14
(A)
Page 5-4

G7C14
The bandwidth of a band-pass filter is measured between what two frequencies?
A. Upper and lower half-power
B. Cutoff and rolloff
C. Pole and zero
D. Image and harmonic

G7C15
(A)
Page 5-4

G7C15
What term specifies a filter's attenuation inside its passband?
A. Insertion loss
B. Return loss
C. Q
D. Ultimate rejection

G7C16
(A)
Page 5-5

G7C16
Which of the following is a typical application for a Direct Digital Synthesizer?
A. A high-stability variable frequency oscillator in a transceiver
B. A digital voltmeter
C. A digital mode interface between a computer and a transceiver
D. A high-sensitivity radio direction finder

SUBELEMENT G8 — SIGNALS AND EMISSIONS
[3 Exam Questions — 3 Groups]

G8A — Carriers and modulation: AM; FM; single sideband; modulation envelope; digital modulation; overmodulation

G8A01
How is an FSK signal generated?
A. By keying an FM transmitter with a sub-audible tone
B. By changing an oscillator's frequency directly with a digital control signal
C. By using a transceiver's computer data interface protocol to change frequencies
D. By reconfiguring the CW keying input to act as a tone generator

G8A01
(B)
Page 6-4

G8A02
What is the name of the process that changes the phase angle of an RF signal to convey information?
A. Phase convolution
B. Phase modulation
C. Phase transformation
D. Phase inversion

G8A02
(B)
Page 5-2

G8A03
What is the name of the process that changes the instantaneous frequency of an RF wave to convey information?
A. Frequency convolution
B. Frequency transformation
C. Frequency conversion
D. Frequency modulation

G8A03
(D)
Page 5-2

G8A04
What emission is produced by a reactance modulator connected to a transmitter RF amplifier stage?
A. Multiplex modulation
B. Phase modulation
C. Amplitude modulation
D. Pulse modulation

G8A04
(B)
Page 5-7

G8A05
What type of modulation varies the instantaneous power level of the RF signal?
A. Frequency shift keying
B. Phase modulation
C. Frequency modulation
D. Amplitude modulation

G8A05
(D)
Page 5-1

G8A06
Which of the following is characteristic of QPSK31?
A. It is sideband sensitive
B. Its encoding provides error correction
C. Its bandwidth is approximately the same as BPSK31
D. All these choices are correct

G8A06
(D)
Page 6-5

G8A07
(A)
Page 5-2

G8A07
Which of the following phone emissions uses the narrowest bandwidth?
A. Single sideband
B. Double sideband
C. Phase modulation
D. Frequency modulation

G8A08
(D)
Page 5-11

G8A08
Which of the following is an effect of overmodulation?
A. Insufficient audio
B. Insufficient bandwidth
C. Frequency drift
D. Excessive bandwidth

G8A09
(A)
Page 6-9

G8A09
What type of modulation is used by the FT8 digital mode?
A. 8-tone frequency shift keying
B. Vestigial sideband
C. Amplitude compressed AM
D. Direct sequence spread spectrum

G8A10
(C)
Page 5-10

G8A10
What is meant by the term "flat-topping," when referring to a single sideband phone transmission?
A. Signal distortion caused by insufficient collector current
B. The transmitter's automatic level control (ALC) is properly adjusted
C. Signal distortion caused by excessive drive
D. The transmitter's carrier is properly suppressed

G8A11
(A)
Page 5-10

G8A11
What is the modulation envelope of an AM signal?
A. The waveform created by connecting the peak values of the modulated signal
B. The carrier frequency that contains the signal
C. Spurious signals that envelop nearby frequencies
D. The bandwidth of the modulated signal

G8A12
(B)
Page 6-9

G8A12
Which of the following narrow-band digital modes can receive signals with very low signal-to-noise ratios?
A. MSK144
B. FT8
C. AMTOR
D. MFSK32

G8B — Frequency mixing; multiplication; bandwidths of various modes; deviation; duty cycle; intermodulation

G8B01
Which mixer input is varied or tuned to convert signals of different frequencies to an intermediate frequency (IF)?
A. Image frequency
B. Local oscillator
C. RF input
D. Beat frequency oscillator

G8B01
(B)
Page 5-16

G8B02
If a receiver mixes a 13.800 MHz VFO with a 14.255 MHz received signal to produce a 455 kHz intermediate frequency (IF) signal, what type of interference will a 13.345 MHz signal produce in the receiver?
A. Quadrature noise
B. Image response
C. Mixer interference
D. Intermediate interference

G8B02
(B)
Page 5-18

G8B03
What is another term for the mixing of two RF signals?
A. Heterodyning
B. Synthesizing
C. Cancellation
D. Phase inverting

G8B03
(A)
Page 5-5

G8B04
What is the stage in a VHF FM transmitter that generates a harmonic of a lower frequency signal to reach the desired operating frequency?
A. Mixer
B. Reactance modulator
C. Pre-emphasis network
D. Multiplier

G8B04
(D)
Page 5-4

G8B05
What is the approximate bandwidth of a PACTOR-III signal at maximum data rate?
A. 31.5 Hz
B. 500 Hz
C. 1800 Hz
D. 2300 Hz

G8B05
(D)
Page 6-10

G8B06
What is the total bandwidth of an FM phone transmission having 5 kHz deviation and 3 kHz modulating frequency?
A. 3 kHz
B. 5 kHz
C. 8 kHz
D. 16 kHz

G8B06
(D)
Page 5-10

G8B07
(B)
Page 5-10

G8B07
What is the frequency deviation for a 12.21 MHz reactance modulated oscillator in a 5 kHz deviation, 146.52 MHz FM phone transmitter?
A. 101.75 Hz
B. 416.7 Hz
C. 5 kHz
D. 60 kHz

G8B08
(B)
Page 6-10

G8B08
Why is it important to know the duty cycle of the mode you are using when transmitting?
A. To aid in tuning your transmitter
B. Some modes have high duty cycles that could exceed the transmitter's average power rating
C. To allow time for the other station to break in during a transmission
D. The attenuator will have to be adjusted accordingly

G8B09
(D)
Page 5-18

G8B09
Why is it good to match receiver bandwidth to the bandwidth of the operating mode?
A. It is required by FCC rules
B. It minimizes power consumption in the receiver
C. It improves impedance matching of the antenna
D. It results in the best signal-to-noise ratio

G8B10
(B)
Page 6-10

G8B10
What is the relationship between transmitted symbol rate and bandwidth?
A. Symbol rate and bandwidth are not related
B. Higher symbol rates require wider bandwidth
C. Lower symbol rates require wider bandwidth
D. Bandwidth is always half the symbol rate

G8B11
(C)
Page 5-5

G8B11
What combination of a mixer's Local Oscillator (LO) and RF input frequencies is found in the output?
A. The ratio
B. The average
C. The sum and difference
D. The arithmetic product

G8B12
(A)
Page 5-24

G8B12
What process combines two signals in a non-linear circuit or connection to produce unwanted spurious outputs?
A. Intermodulation
B. Heterodyning
C. Detection
D. Rolloff

G8C — Digital emission modes

G8C01
(C)
Page 3-9

G8C01
On what band do amateurs share channels with the unlicensed Wi-Fi service?
A. 432 MHz
B. 902 MHz
C. 2.4 GHz
D. 10.7 GHz

G8C02
Which digital mode is used as a low-power beacon for assessing HF propagation?
A. WSPR
B. Olivia
C. PSK31
D. SSB-SC

G8C02
(A)
Page 6-9

G8C03
What part of a packet radio frame contains the routing and handling information?
A. Directory
B. Preamble
C. Header
D. Footer

G8C03
(C)
Page 6-7

G8C04
Which of the following describes Baudot code?
A. A 7-bit code with start, stop, and parity bits
B. A code using error detection and correction
C. A 5-bit code with additional start and stop bits
D. A code using SELCAL and LISTEN

G8C04
(C)
Page 6-5

G8C05
In the PACTOR protocol, what is meant by a NAK response to a transmitted packet?
A. The receiver is requesting the packet be retransmitted
B. The receiver is reporting the packet was received without error
C. The receiver is busy decoding the packet
D. The entire file has been received correctly

G8C05
(A)
Page 6-7

G8C06
What action results from a failure to exchange information due to excessive transmission attempts when using PACTOR or WINMOR?
A. The checksum overflows
B. The connection is dropped
C. Packets will be routed incorrectly
D. Encoding reverts to the default character set

G8C06
(B)
Page 6-14

G8C07
How does the receiving station respond to an ARQ data mode packet containing errors?
A. It terminates the contact
B. It requests the packet be retransmitted
C. It sends the packet back to the transmitting station
D. It requests a change in transmitting protocol

G8C07
(B)
Page 6-7

G8C08
Which of the following statements is true about PSK31?
A. Upper case letters are sent with more power
B. Upper case letters use longer Varicode bit sequences and thus slow down transmission
C. Error correction is used to ensure accurate message reception
D. Higher power is needed as compared to RTTY for similar error rates

G8C08
(B)
Page 6-6

G8C09
What does the number 31 represent in "PSK31"?
A. The approximate transmitted symbol rate
B. The version of the PSK protocol
C. The year in which PSK31 was invented
D. The number of characters that can be represented by PSK31

G8C09
(A)
Page 6-5

G8C10
(C)
Page 6-7

G8C10
How does forward error correction (FEC) allow the receiver to correct errors in received data packets?
A. By controlling transmitter output power for optimum signal strength
B. By using the Varicode character set
C. By transmitting redundant information with the data
D. By using a parity bit with each character

G8C11
(D)
Page 6-4

G8C11
How are the two separate frequencies of a Frequency Shift Keyed (FSK) signal identified?
A. Dot and dash
B. On and off
C. High and low
D. Mark and space

G8C12
(A)
Page 6-5

G8C12
Which type of code is used for sending characters in a PSK31 signal?
A. Varicode
B. Viterbi
C. Volumetric
D. Binary

G8C13
(D)
Page 6-11

G8C13
What is indicated on a waterfall display by one or more vertical lines on either side of a digital signal?
A. Long path propagation
B. Backscatter propagation
C. Insufficient modulation
D. Overmodulation

G8C14
(C)
Page 6-13

G8C14
Which of the following describes a waterfall display?
A. Frequency is horizontal, signal strength is vertical, time is intensity
B. Frequency is vertical, signal strength is intensity, time is horizontal
C. Frequency is horizontal, signal strength is intensity, time is vertical
D. Frequency is vertical, signal strength is horizontal, time is intensity

SUBELEMENT G9 — ANTENNAS AND FEED LINES
[4 Exam Questions — 4 Groups]

G9A — Antenna feed lines: characteristic impedance and attenuation; SWR calculation, measurement, and effects; matching networks

G9A01
Which of the following factors determine the characteristic impedance of a parallel conductor antenna feed line?
A. The distance between the centers of the conductors and the radius of the conductors
B. The distance between the centers of the conductors and the length of the line
C. The radius of the conductors and the frequency of the signal
D. The frequency of the signal and the length of the line

G9A01
(A)
Page 7-21

G9A02
What are the typical characteristic impedances of coaxial cables used for antenna feed lines at amateur stations?
A. 25 and 30 ohms
B. 50 and 75 ohms
C. 80 and 100 ohms
D. 500 and 750 ohms

G9A02
(B)
Page 7-21

G9A03
What is the typical characteristic impedance of "window line" parallel transmission line?
A. 50 ohms
B. 75 ohms
C. 100 ohms
D. 450 ohms

G9A03
(D)
Page 7-21

G9A04
What might cause reflected power at the point where a feed line connects to an antenna?
A. Operating an antenna at its resonant frequency
B. Using more transmitter power than the antenna can handle
C. A difference between feed-line impedance and antenna feed-point impedance
D. Feeding the antenna with unbalanced feed line

G9A04
(C)
Page 7-21

G9A05
How does the attenuation of coaxial cable change as the frequency of the signal it is carrying increases?
A. Attenuation is independent of frequency
B. Attenuation increases
C. Attenuation decreases
D. Attenuation reaches a maximum at approximately 18 MHz

G9A05
(B)
Page 7-23

G9A06
In what units is RF feed line loss usually expressed?
A. Ohms per 1000 feet
B. Decibels per 1000 feet
C. Ohms per 100 feet
D. Decibels per 100 feet

G9A06
(D)
Page 7-23

G9A07
(D)
Page 7-22

G9A07
What must be done to prevent standing waves on an antenna feed line?
A. The antenna feed point must be at DC ground potential
B. The feed line must be cut to a length equal to an odd number of electrical quarter wavelengths
C. The feed line must be cut to a length equal to an even number of physical half wavelengths
D. The antenna feed point impedance must be matched to the characteristic impedance of the feed line

G9A08
(B)
Page 7-22

G9A08
If the SWR on an antenna feed line is 5 to 1, and a matching network at the transmitter end of the feed line is adjusted to 1 to 1 SWR, what is the resulting SWR on the feed line?
A. 1 to 1
B. 5 to 1
C. Between 1 to 1 and 5 to 1 depending on the characteristic impedance of the line
D. Between 1 to 1 and 5 to 1 depending on the reflected power at the transmitter

G9A09
(A)
Page 7-21

G9A09
What standing wave ratio will result when connecting a 50 ohm feed line to a non-reactive load having 200 ohm impedance?
A. 4:1
B. 1:4
C. 2:1
D. 1:2

G9A10
(D)
Page 7-21

G9A10
What standing wave ratio will result when connecting a 50 ohm feed line to a non-reactive load having 10 ohm impedance?
A. 2:1
B. 50:1
C. 1:5
D. 5:1

G9A11
(B)
Page 7-21

G9A11
What standing wave ratio will result when connecting a 50 ohm feed line to a non-reactive load having 50 ohm impedance?
A. 2:1
B. 1:1
C. 50:50
D. 0:0

G9A12
(B)
Page 7-23

G9A12
What is the interaction between high standing wave ratio (SWR) and transmission line loss?
A. There is no interaction between transmission line loss and SWR
B. If a transmission line is lossy, high SWR will increase the loss
C. High SWR makes it difficult to measure transmission line loss
D. High SWR reduces the relative effect of transmission line loss

G9A13
(A)
Page 7-23

G9A13
What is the effect of transmission line loss on SWR measured at the input to the line?
A. The higher the transmission line loss, the more the SWR will read artificially low
B. The higher the transmission line loss, the more the SWR will read artificially high
C. The higher the transmission line loss, the more accurate the SWR measurement will be
D. Transmission line loss does not affect the SWR measurement

G9B — Basic antennas

G9B01
What is one disadvantage of a directly fed random-wire HF antenna?
A. It must be longer than 1 wavelength
B. You may experience RF burns when touching metal objects in your station
C. It produces only vertically polarized radiation
D. It is more effective on the lower HF bands than on the higher bands

G9B01
(B)
Page 7-16

G9B02
Which of the following is a common way to adjust the feed-point impedance of a quarter wave ground-plane vertical antenna to be approximately 50 ohms?
A. Slope the radials upward
B. Slope the radials downward
C. Lengthen the radials
D. Shorten the radials

G9B02
(B)
Page 7-5

G9B03
Which of the following best describes the radiation pattern of a quarter-wave, ground-plane vertical antenna?
A. Bi-directional in azimuth
B. Isotropic
C. Hemispherical
D. Omnidirectional in azimuth

G9B03
(D)
Page 7-4

G9B04
What is the radiation pattern of a dipole antenna in free space in a plane containing the conductor?
A. It is a figure-eight at right angles to the antenna
B. It is a figure-eight off both ends of the antenna
C. It is a circle (equal radiation in all directions)
D. It has a pair of lobes on one side of the antenna and a single lobe on the other side

G9B04
(A)
Page 7-2

G9B05
How does antenna height affect the horizontal (azimuthal) radiation pattern of a horizontal dipole HF antenna?
A. If the antenna is too high, the pattern becomes unpredictable
B. Antenna height has no effect on the pattern
C. If the antenna is less than 1/2 wavelength high, the azimuthal pattern is almost omnidirectional
D. If the antenna is less than 1/2 wavelength high, radiation off the ends of the wire is eliminated

G9B05
(C)
Page 7-6

G9B06
Where should the radial wires of a ground-mounted vertical antenna system be placed?
A. As high as possible above the ground
B. Parallel to the antenna element
C. On the surface of the Earth or buried a few inches below the ground
D. At the center of the antenna

G9B06
(C)
Page 7-4

G9B07
How does the feed-point impedance of a 1/2 wave dipole antenna change as the antenna is lowered below 1/4 wave above ground?
A. It steadily increases
B. It steadily decreases
C. It peaks at about 1/8 wavelength above ground
D. It is unaffected by the height above ground

G9B07
(B)
Page 7-6

G9B08
(A)
Page 7-3

G9B08
How does the feed point impedance of a 1/2 wave dipole change as the feed point is moved from the center toward the ends?
A. It steadily increases
B. It steadily decreases
C. It peaks at about 1/8 wavelength from the end
D. It is unaffected by the location of the feed point

G9B09
(A)
Page 7-7

G9B09
Which of the following is an advantage of a horizontally polarized as compared to a vertically polarized HF antenna?
A. Lower ground reflection losses
B. Lower feed-point impedance
C. Shorter radials
D. Lower radiation resistance

G9B10
(D)
Page 7-4

G9B10
What is the approximate length for a 1/2 wave dipole antenna cut for 14.250 MHz?
A. 8 feet
B. 16 feet
C. 24 feet
D. 33 feet

G9B11
(C)
Page 7-3

G9B11
What is the approximate length for a 1/2 wave dipole antenna cut for 3.550 MHz?
A. 42 feet
B. 84 feet
C. 132 feet
D. 263 feet

G9B12
(A)
Page 7-5

G9B12
What is the approximate length for a 1/4 wave vertical antenna cut for 28.5 MHz?
A. 8 feet
B. 11 feet
C. 16 feet
D. 21 feet

G9C — Directional antennas

G9C01
(A)
Page 7-10

G9C01
Which of the following would increase the bandwidth of a Yagi antenna?
A. Larger-diameter elements
B. Closer element spacing
C. Loading coils in series with the element
D. Tapered-diameter elements

G9C02
(B)
Page 7-10

G9C02
What is the approximate length of the driven element of a Yagi antenna?
A. 1/4 wavelength
B. 1/2 wavelength
C. 3/4 wavelength
D. 1 wavelength

G9C03
How do the lengths of a three-element Yagi reflector and director compare to that of the driven element?
A. The reflector is longer, and the director is shorter
B. The reflector is shorter, and the director is longer
C. They are all the same length
D. Relative length depends on the frequency of operation

G9C03
(A)
Page 7-3

G9C04
How does antenna gain stated in dBi compare to gain stated in dBd for the same antenna?
A. dBi gain figures are 2.15 dB lower than dBd gain figures
B. dBi gain figures are 2.15 dB higher than dBd gain figures
C. dBi gain figures are the same as the square root of dBd gain figures multiplied by 2.15
D. dBi gain figures are the reciprocal of dBd gain figures + 2.15 dB

G9C04
(B)
Page 7-3

G9C05
How does increasing boom length and adding directors affect a Yagi antenna?
A. Gain increases
B. Beamwidth increases
C. Front-to-back ratio decreases
D. Front-to-side ratio decreases

G9C05
(A)
Page 7-10

G9C06
What configuration of the loops of a two-element quad antenna must be used for the antenna to operate as a beam antenna, assuming one of the elements is used as a reflector?
A. The driven element must be fed with a balun transformer
B. There must be an open circuit in the driven element at the point opposite the feed point
C. The reflector element must be approximately 5 percent shorter than the driven element
D. The reflector element must be approximately 5 percent longer than the driven element

G9C06
(D)
Page 7-13

G9C07
What does "front-to-back ratio" mean in reference to a Yagi antenna?
A. The number of directors versus the number of reflectors
B. The relative position of the driven element with respect to the reflectors and directors
C. The power radiated in the major radiation lobe compared to that in the opposite direction
D. The ratio of forward gain to dipole gain

G9C07
(C)
Page 7-10

G9C08
What is meant by the "main lobe" of a directive antenna?
A. The magnitude of the maximum vertical angle of radiation
B. The point of maximum current in a radiating antenna element
C. The maximum voltage standing wave point on a radiating element
D. The direction of maximum radiated field strength from the antenna

G9C08
(D)
Page 7-9

G9C09
How does the gain of two three-element, horizontally polarized Yagi antennas spaced vertically 1/2 wavelength apart typically compare to the gain of a single three-element Yagi?
A. Approximately 1.5 dB higher
B. Approximately 3 dB higher
C. Approximately 6 dB higher
D. Approximately 9 dB higher

G9C09
(B)
Page 7-17

G9C10
(D)
Page 7-11

G9C10
Which of the following can be adjusted to optimize forward gain, front-to-back ratio, or SWR bandwidth of a Yagi antenna?
A. The physical length of the boom
B. The number of elements on the boom
C. The spacing of each element along the boom
D. All these choices are correct

G9C11
(C)
Page 7-8

G9C11
Which HF antenna would be the best to use for minimizing interference?
A. A quarter-wave vertical antenna
B. An isotropic antenna
C. A directional antenna
D. An omnidirectional antenna

G9C12
(A)
Page 7-12

G9C12
Which of the following is an advantage of using a gamma match with a Yagi antenna?
A. It does not require that the driven element be insulated from the boom
B. It does not require any inductors or capacitors
C. It is useful for matching multiband antennas
D. All these choices are correct

G9C13
(A)
Page 7-13

G9C13
Approximately how long is each side of the driven element of a quad antenna?
A. 1/4 wavelength
B. 1/2 wavelength
C. 3/4 wavelength
D. 1 wavelength

G9C14
(A)
Page 7-15

G9C14
How does the forward gain of a two-element quad antenna compare to the forward gain of a three-element Yagi antenna?
A. About the same
B. About 2/3 as much
C. About 1.5 times as much
D. About twice as much

G9C15
(A)
Page 7-3

G9C15
What is meant by the terms dBi and dBd when referring to antenna gain?
A. dBi refers to an isotropic antenna, dBd refers to a dipole antenna
B. dBi refers to an ionospheric reflecting antenna, dBd refers to a dissipative antenna
C. dBi refers to an inverted-vee antenna, dBd refers to a downward reflecting antenna
D. dBi refers to an isometric antenna, dBd refers to a discone antenna

G9C16
(A)
Page 7-12

G9C16
What is a beta or hairpin match?
A. It is a shorted transmission line stub placed at the feed point of a Yagi antenna to provide impedance matching
B. It is a ¼ wavelength section of 75 ohm coax in series with the feed point of a Yagi to provide impedance matching
C. It is a series capacitor selected to cancel the inductive reactance of a folded dipole antenna
D. It is a section of 300 ohm twinlead used to match a folded dipole antenna

G9D — Specialized antennas

G9D01
Which of the following antenna types will be most effective as a Near Vertical Incidence Skywave (NVIS) antenna for short-skip communications on 40 meters during the day?
A. A horizontal dipole placed between 1/10 and 1/4 wavelength above the ground
B. A vertical antenna placed between 1/4 and 1/2 wavelength above the ground
C. A left-hand circularly polarized antenna
D. A right-hand circularly polarized antenna

G9D01
(A)
Page 7-7

G9D02
What is the feed-point impedance of an end-fed half-wave antenna?
A. Very low
B. Approximately 50 ohms
C. Approximately 300 ohms
D. Very high

G9D02
(D)
Page 7-3

G9D03
In which direction is the maximum radiation from a portable VHF/UHF "halo" antenna?
A. Broadside to the plane of the halo
B. Opposite the feed point
C. Omnidirectional in the plane of the halo
D. Toward the halo's supporting mast

G9D03
(C)
Page 7-15

G9D04
What is the primary purpose of antenna traps?
A. To permit multiband operation
B. To notch spurious frequencies
C. To provide balanced feed-point impedance
D. To prevent out-of-band operation

G9D04
(A)
Page 7-19

G9D05
What is an advantage of vertical stacking of horizontally polarized Yagi antennas?
A. It allows quick selection of vertical or horizontal polarization
B. It allows simultaneous vertical and horizontal polarization
C. It narrows the main lobe in azimuth
D. It narrows the main lobe in elevation

G9D05
(D)
Page 7-17

G9D06
Which of the following is an advantage of a log periodic antenna?
A. Wide bandwidth
B. Higher gain per element than a Yagi antenna
C. Harmonic suppression
D. Polarization diversity

G9D06
(A)
Page 7-17

G9D07
Which of the following describes a log periodic antenna?
A. Element length and spacing vary logarithmically along the boom
B. Impedance varies periodically as a function of frequency
C. Gain varies logarithmically as a function of frequency
D. SWR varies periodically as a function of boom length

G9D07
(A)
Page 7-17

G9D08
(B)
Page 7-6

G9D08
How does a "screwdriver" mobile antenna adjust its feed-point impedance?
A. By varying its body capacitance
B. By varying the base loading inductance
C. By extending and retracting the whip
D. By deploying a capacitance hat

G9D09
(A)
Page 7-17

G9D09
What is the primary use of a Beverage antenna?
A. Directional receiving for low HF bands
B. Directional transmitting for low HF bands
C. Portable direction finding at higher HF frequencies
D. Portable direction finding at lower HF frequencies

G9D10
(B)
Page 7-15

G9D10
In which direction or directions does an electrically small loop (less than 1/3 wavelength in circumference) have nulls in its radiation pattern?
A. In the plane of the loop
B. Broadside to the loop
C. Broadside and in the plane of the loop
D. Electrically small loops are omnidirectional

G9D11
(D)
Page 7-19

G9D11
Which of the following is a disadvantage of multiband antennas?
A. They present low impedance on all design frequencies
B. They must be used with an antenna tuner
C. They must be fed with open wire line
D. They have poor harmonic rejection

G9D12
(A)
Page 7-4

G9D12
What is the common name of a dipole with a single central support?
A. Inverted V
B. Inverted L
C. Sloper
D. Lazy H

G9D13
(C)
Page 7-13

G9D13
What is the combined vertical and horizontal polarization pattern of a multi-wavelength, horizontal loop antenna?
A. A figure-eight, similar to a dipole
B. Four major loops with deep nulls
C. Virtually omnidirectional with a lower peak vertical radiation angle than a dipole
D. Radiation maximum is straight up

SUBELEMENT G0 — ELECTRICAL AND RF SAFETY
[2 Exam Questions — 2 Groups]

G0A — RF safety principles, rules and guidelines; routine station evaluation

G0A01
What is one way that RF energy can affect human body tissue?
A. It heats body tissue
B. It causes radiation poisoning
C. It causes the blood count to reach a dangerously low level
D. It cools body tissue

G0A01
(A)
Page 9-9

G0A02
Which of the following properties is important in estimating whether an RF signal exceeds the maximum permissible exposure (MPE)?
A. Its duty cycle
B. Its frequency
C. Its power density
D. All these choices are correct

G0A02
(D)
Page 9-9

G0A03
How can you determine that your station complies with FCC RF exposure regulations?
A. By calculation based on FCC OET Bulletin 65
B. By calculation based on computer modeling
C. By measurement of field strength using calibrated equipment
D. All these choices are correct

G0A03
(D)
[97.13(c)(1)]
Page 9-12

G0A04
What does "time averaging" mean in reference to RF radiation exposure?
A. The average amount of power developed by the transmitter over a specific 24-hour period
B. The average time it takes RF radiation to have any long-term effect on the body
C. The total time of the exposure
D. The total RF exposure averaged over a certain time

G0A04
(D)
Page 9-10

G0A05
What must you do if an evaluation of your station shows RF energy radiated from your station exceeds permissible limits?
A. Take action to prevent human exposure to the excessive RF fields
B. File an Environmental Impact Statement (EIS-97) with the FCC
C. Secure written permission from your neighbors to operate above the controlled MPE limits
D. All these choices are correct

G0A05
(A)
Page 9-13

G0A06
What precaution should be taken when installing a ground-mounted antenna?
A. It should not be installed higher than you can reach
B. It should not be installed in a wet area
C. It should be limited to 10 feet in height
D. It should be installed such that it is protected against unauthorized access

G0A06
(D)
Page 9-13

G0A07
(A)
Page 9-11

G0A07
What effect does transmitter duty cycle have when evaluating RF exposure?
A. A lower transmitter duty cycle permits greater short-term exposure levels
B. A higher transmitter duty cycle permits greater short-term exposure levels
C. Low duty cycle transmitters are exempt from RF exposure evaluation requirements
D. High duty cycle transmitters are exempt from RF exposure requirements

G0A08
(C)
Page 9-12

G0A08
Which of the following steps must an amateur operator take to ensure compliance with RF safety regulations when transmitter power exceeds levels specified in FCC Part 97.13?
A. Post a copy of FCC Part 97.13 in the station
B. Post a copy of OET Bulletin 65 in the station
C. Perform a routine RF exposure evaluation
D. Contact the FCC for a visit to conduct a station evaluation

G0A09
(B)
Page 9-12

G0A09
What type of instrument can be used to accurately measure an RF field?
A. A receiver with an S meter
B. A calibrated field strength meter with a calibrated antenna
C. An SWR meter with a peak-reading function
D. An oscilloscope with a high-stability crystal marker generator

G0A10
(D)
Page 9-13

G0A10
What is one thing that can be done if evaluation shows that a neighbor might receive more than the allowable limit of RF exposure from the main lobe of a directional antenna?
A. Change to a non-polarized antenna with higher gain
B. Post a warning sign that is clearly visible to the neighbor
C. Use an antenna with a higher front-to-back ratio
D. Take precautions to ensure that the antenna cannot be pointed in their direction

G0A11
(C)
Page 9-14

G0A11
What precaution should you take if you install an indoor transmitting antenna?
A. Locate the antenna close to your operating position to minimize feed-line radiation
B. Position the antenna along the edge of a wall to reduce parasitic radiation
C. Make sure that MPE limits are not exceeded in occupied areas
D. Make sure the antenna is properly shielded

G0B — Station safety: electrical shock, safety grounding, fusing, interlocks, wiring, antenna and tower safety

G0B01
(A)
Page 9-5

G0B01
Which wire or wires in a four-conductor connection should be attached to fuses or circuit breakers in a device operated from a 240 VAC single phase source?
A. Only the two wires carrying voltage
B. Only the neutral wire
C. Only the ground wire
D. All wires

G0B02
(C)
Page 9-5

G0B02
According the National Electrical Code, what is the minimum wire size that may be used safely for wiring with a 20 ampere circuit breaker?
A. AWG number 20
B. AWG number 16
C. AWG number 12
D. AWG number 8

G0B03
Which size of fuse or circuit breaker would be appropriate to use with a circuit that uses AWG number 14 wiring?
A. 100 amperes
B. 60 amperes
C. 30 amperes
D. 15 amperes

G0B03
(D)
Page 9-5

G0B04
Which of the following is a primary reason for not placing a gasoline-fueled generator inside an occupied area?
A. Danger of carbon monoxide poisoning
B. Danger of engine over torque
C. Lack of oxygen for adequate combustion
D. Lack of nitrogen for adequate combustion

G0B04
(A)
Page 9-7

G0B05
Which of the following conditions will cause a Ground Fault Circuit Interrupter (GFCI) to disconnect the 120 or 240 Volt AC line power to a device?
A. Current flowing from one or more of the voltage-carrying wires to the neutral wire
B. Current flowing from one or more of the voltage-carrying wires directly to ground
C. Overvoltage on the voltage-carrying wires
D. All these choices are correct

G0B05
(B)
Page 9-6

G0B06
Which of the following is covered by the National Electrical Code?
A. Acceptable bandwidth limits
B. Acceptable modulation limits
C. Electrical safety inside the ham shack
D. RF exposure limits of the human body

G0B06
(C)
Page 9-4

G0B07
Which of these choices should be observed when climbing a tower using a safety belt or harness?
A. Never lean back and rely on the belt alone to support your weight
B. Confirm that the belt is rated for the weight of the climber and that it is within its allowable service life
C. Ensure that all heavy tools are securely fastened to the belt D-ring
D. All these choices are correct

G0B07
(B)
Page 9-15

G0B08
What should be done by any person preparing to climb a tower that supports electrically powered devices?
A. Notify the electric company that a person will be working on the tower
B. Make sure all circuits that supply power to the tower are locked out and tagged
C. Unground the base of the tower
D. All these choices are correct

G0B08
(B)
Page 9-15

G0B09
Which of the following is true of an emergency generator installation?
A. The generator should be located in a well-ventilated area
B. The generator must be insulated from ground
C. Fuel should be stored near the generator for rapid refueling in case of an emergency
D. All these choices are correct

G0B09
(A)
Page 9-7

G0B10
(A)
Page 9-3

G0B10
Which of the following is a danger from lead-tin solder?
A. Lead can contaminate food if hands are not washed carefully after handling the solder
B. High voltages can cause lead-tin solder to disintegrate suddenly
C. Tin in the solder can "cold flow," causing shorts in the circuit
D. RF energy can convert the lead into a poisonous gas

G0B11
(D)
Page 9-8

G0B11
Which of the following is good practice for lightning protection grounds?
A. They must be bonded to all buried water and gas lines
B. Bends in ground wires must be made as close as possible to a right angle
C. Lightning grounds must be connected to all ungrounded wiring
D. They must be bonded together with all other grounds

G0B12
(C)
Page 9-6

G0B12
What is the purpose of a power supply interlock?
A. To prevent unauthorized changes to the circuit that would void the manufacturer's warranty
B. To shut down the unit if it becomes too hot
C. To ensure that dangerous voltages are removed if the cabinet is opened
D. To shut off the power supply if too much voltage is produced

G0B13
(A)
Page 9-7

G0B13
What must you do when powering your house from an emergency generator?
A. Disconnect the incoming utility power feed
B. Insure that the generator is not grounded
C. Insure that all lightning grounds are disconnected
D. All these choices are correct

G0B14
(B)
Page 9-15

G0B14
What precaution should you take whenever you adjust or repair an antenna?
A. Ensure that you and the antenna structure are grounded
B. Turn off the transmitter and disconnect the feed line
C. Wear a radiation badge
D. All these choices are correct

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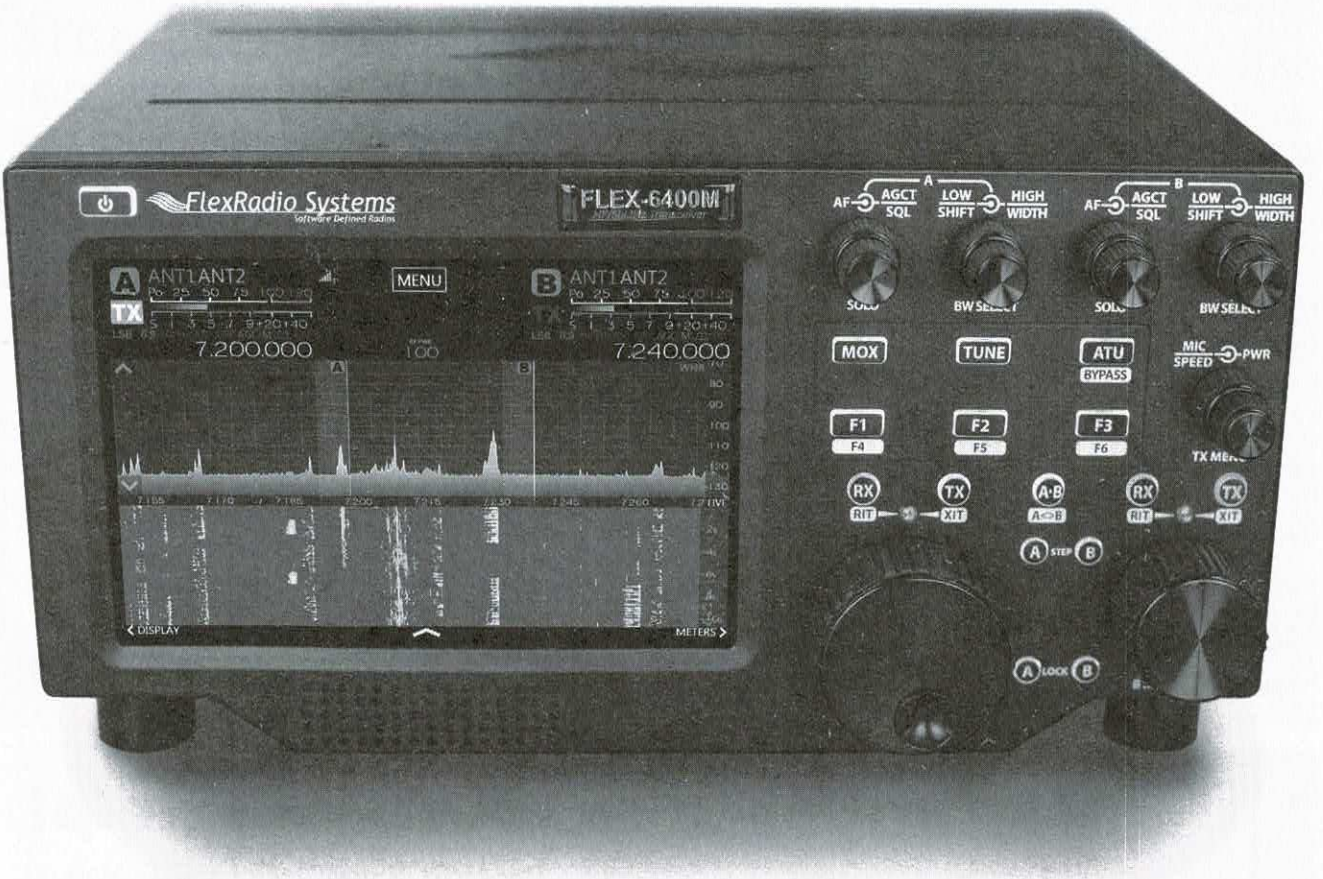

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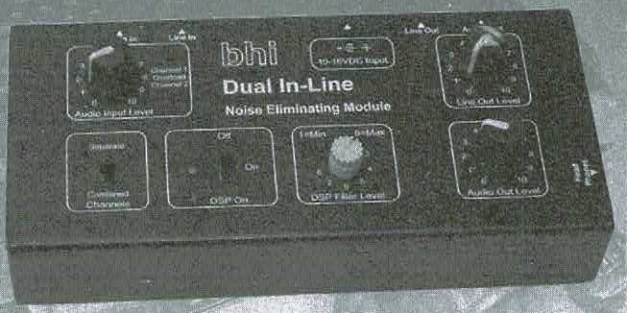

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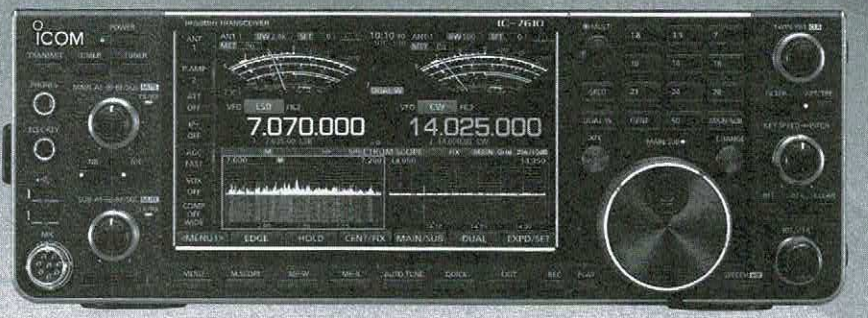

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