2024-2028 Extra Class Pool Errata
Issued January 31, 2024

The following changes have been made to the posted
2024-2028 Extra Class Question Pool
Released December 7, 2023

In the diagrams, one diagram modified:

Diagram **E9-3** – the Smith Chart has been rotated 90 degrees to the conventional horizontal orientation with infinity on the right. All pool documents (PDF, JPG, and Word) have been updated.

In the pool itself, 1 question deleted and 5 questions modified:

E1D07 – in the question change "group of" to "of the following" to read:
Which of the following HF amateur bands include allocations for space stations?

E1F03 – replace answer D to read:
D. The amplifier is constructed or modified by an amateur radio operator for use at an amateur station

E4D12 – in the question change "100 W" to "**10 W**" to read:
What is the link margin in a system with a transmit power level of 10 W (+40 dBm), a system antenna gain of 10 dBi, a cable loss of 3 dB, a path loss of 136 dB, a receiver minimum discernable signal of -103 dBm, and a required signal-to-noise ratio of 6 dB?

E4D13 – in the question change "100 W" to "**10 W**" to read:
What is the received signal level with a transmit power of 10 W (+40 dBm), a transmit antenna gain of 6 dBi, a receive antenna gain of 3 dBi, and a path loss of 100 dB?

E6A06 – in answer B add "the change in" before base current to read:
B. The change in collector current with respect to the change in base current

E9E10– removed from use
Question E9E10 is withdrawn from the pool and marked as deleted; the remaining questions in E9E were not renumbered, leaving 10 questions.

In the pool itself, 2 questions FCC rule citation updated:
The citations do not affect the questions and are only included for reference.

E1E10 – update the rule citation's letter from "h" to "m" to read:
E1E10 (C) [97.509(m)]

E1E11 – update the rule citation's letter from "m" to "i" to read:
E1E11 (B) [97.509(i)]

E7D06 (C)
What is the purpose of Q1 in the circuit shown in Figure E7-2?
A. It provides negative feedback to improve regulation
B. It provides a constant load for the voltage source
C. It controls the current to keep the output voltage constant
D. It provides regulation by switching or “chopping” the input DC voltage
~~

E7D07 (A)
What is the purpose of C2 in the circuit shown in Figure E7-2?
A. It bypasses rectifier output ripple around D1
B. It is a brute force filter for the output
C. To prevent self-oscillation
D. To provide fixed DC bias for Q1
~~

E7D08 (C)
What type of circuit is shown in Figure E7-2?
A. Switching voltage regulator
B. Common emitter amplifier
C. Linear voltage regulator
D. Common base amplifier
~~

E7D09 (C)
How is battery operating time calculated?
A. Average current divided by capacity in amp-hours
B. Average current divided by internal resistance
C. Capacity in amp-hours divided by average current
D. Internal resistance divided by average current
~~

E7D10 (C)
Why is a switching type power supply less expensive and lighter than an equivalent linear power supply?
A. The inverter design does not require an output filter circuit
B. The control circuitry uses less current, therefore smaller heat sinks are required
C. The high frequency inverter design uses much smaller transformers and filter components for an equivalent power output
D. It recovers power from the unused portion of the AC cycle, thus using fewer components
~~

E7D11 (D)
What is the purpose of an inverter connected to a solar panel output?
A. Reduce AC ripple on the output
B. Maintain voltage with varying illumination levels
C. Prevent discharge when panel is not illuminated
D. Convert the panel’s output from DC to AC
~~

E7D12 (C)
What is the dropout voltage of a linear voltage regulator?
A. Minimum input voltage for rated power dissipation
B. Maximum output voltage drop when the input voltage is varied over its specified range
C. Minimum input-to-output voltage required to maintain regulation
D. Maximum that the output voltage may decrease at rated load
~~

E7D13 (C)
Which of the following calculates power dissipated by a series linear voltage regulator?
A. Input voltage multiplied by input current
B. Input voltage divided by output current
C. Voltage difference from input to output multiplied by output current
D. Output voltage multiplied by output current
~~

E7D14 (D)
What is the purpose of connecting equal-value resistors across power supply filter capacitors connected in series?
A. Equalize the voltage across each capacitor
B. Discharge the capacitors when voltage is removed
C. Provide a minimum load on the supply
D. All these choices are correct
~~

E7D15 (D)
What is the purpose of a step-start circuit in a high-voltage power supply?
A. To provide a dual-voltage output for reduced power applications
B. To compensate for variations of the incoming line voltage
C. To prevent arcing across the input power switch or relay contacts
D. To allow the filter capacitors to charge gradually
~~

E7E Modulation and demodulation: reactance, phase, and balanced modulators; detectors; mixers

E7E01 (B)
Which of the following can be used to generate FM phone signals?
A. Balanced modulation of the audio amplifier
B. Reactance modulation of a local oscillator
C. Reactance modulation of the final amplifier
D. Balanced modulation of a local oscillator
~~

E7E02 (D)
What is the function of a reactance modulator?
A. Produce PM or FM signals by varying a resistance

B. Produce AM signals by varying an inductance
C. Produce AM signals by varying a resistance
D. Produce PM or FM signals by varying a capacitance
~~

E7E03 (D)
What is a frequency discriminator?
A. An FM generator circuit
B. A circuit for filtering closely adjacent signals
C. An automatic band-switching circuit
D. A circuit for detecting FM signals
~~

E7E04 (A)
What is one way to produce a single-sideband phone signal?
A. Use a balanced modulator followed by a filter
B. Use a reactance modulator followed by a mixer
C. Use a loop modulator followed by a mixer
D. Use a product detector with a DSB signal
~~

E7E05 (D)
What is added to an FM speech channel to boost the higher audio frequencies?
A. A de-emphasis network
B. A harmonic enhancer
C. A heterodyne enhancer
D. A pre-emphasis network
~~

E7E06 (A)
Why is de-emphasis used in FM communications receivers?
A. For compatibility with transmitters using phase modulation
B. To reduce impulse noise reception
C. For higher efficiency
D. To remove third-order distortion products
~~

E7E07 (B)
What is meant by the term “baseband” in radio communications?
A. The lowest frequency band that the transmitter or receiver covers
B. The frequency range occupied by a message signal prior to modulation
C. The unmodulated bandwidth of the transmitted signal
D. The basic oscillator frequency in an FM transmitter that is multiplied to increase the deviation and carrier frequency
~~

E7E08 (C)
What are the principal frequencies that appear at the output of a mixer?

A. Two and four times the input frequency
B. The square root of the product of input frequencies
C. The two input frequencies along with their sum and difference frequencies
D. 1.414 and 0.707 times the input frequency
~~

E7E09 (A)
What occurs when the input signal levels to a mixer are too high?
A. Spurious mixer products are generated
B. Mixer blanking occurs
C. Automatic limiting occurs
D. Excessive AGC voltage levels are generated
~~

E7E10 (A)
How does a diode envelope detector function?
A. By rectification and filtering of RF signals
B. By breakdown of the Zener voltage
C. By mixing signals with noise in the transition region of the diode
D. By sensing the change of reactance in the diode with respect to frequency
~~

E7E11 (C)
Which type of detector is used for demodulating SSB signals?
A. Discriminator
B. Phase detector
C. Product detector
D. Phase comparator
~~

E7F Software defined radio fundamentals: digital signal processing (DSP) filtering, modulation, and demodulation; analog-digital conversion; digital filters

E7F01 (C)
What is meant by “direct sampling” in software defined radios?
A. Software is converted from source code to object code during operation of the receiver
B. I and Q signals are generated by digital processing without the use of RF amplification
C. Incoming RF is digitized by an analog-to-digital converter without being mixed with a local oscillator signal
D. A switching mixer is used to generate I and Q signals directly from the RF input
~~

E7F02 (A)
What kind of digital signal processing audio filter is used to remove unwanted noise from a received SSB signal?
A. An adaptive filter
B. A crystal-lattice filter

C. A Hilbert-transform filter
D. A phase-inverting filter
~~

E7F03 (C)
What type of digital signal processing filter is used to generate an SSB signal?
A. An adaptive filter
B. A notch filter
C. A Hilbert-transform filter
D. An elliptical filter
~~

E7F04 (D)
Which method generates an SSB signal using digital signal processing?
A. Mixing products are converted to voltages and subtracted by adder circuits
B. A frequency synthesizer removes unwanted sidebands
C. Varying quartz crystal characteristics are emulated in digital form
D. Signals are combined in quadrature phase relationship
~~

E7F05 (B)
How frequently must an analog signal be sampled to be accurately reproduced?
A. At least half the rate of the highest frequency component of the signal
B. At least twice the rate of the highest frequency component of the signal
C. At the same rate as the highest frequency component of the signal
D. At four times the rate of the highest frequency component of the signal
~~

E7F06 (D)
What is the minimum number of bits required to sample a signal with a range of 1 volt at a resolution of 1 millivolt?
A. 4 bits
B. 6 bits
C. 8 bits
D. 10 bits
~~

E7F07 (C)
What function is performed by a Fast Fourier Transform?
A. Converting analog signals to digital form
B. Converting digital signals to analog form
C. Converting signals from the time domain to the frequency domain
D. Converting signals from the frequency domain to the time domain
~~

E7F08 (B)
What is the function of decimation?
A. Converting data to binary-coded decimal form

B. Reducing the effective sample rate by removing samples
C. Attenuating the signal
D. Removing unnecessary significant digits
~~

E7F09 (A)
Why is an anti-aliasing filter required in a decimator?
A. It removes high-frequency signal components that would otherwise be reproduced as lower frequency components
B. It peaks the response of the decimator, improving bandwidth
C. It removes low-frequency signal components to eliminate the need for DC restoration
D. It notches out the sampling frequency to avoid sampling errors
~~

E7F10 (A)
What aspect of receiver analog-to-digital conversion determines the maximum receive bandwidth of a direct-sampling software defined radio (SDR)?
A. Sample rate
B. Sample width in bits
C. Integral non-linearity
D. Differential non-linearity
~~

E7F11 (B)
What sets the minimum detectable signal level for a direct-sampling software defined receiver in the absence of atmospheric or thermal noise?
A. Sample clock phase noise
B. Reference voltage level and sample width in bits
C. Data storage transfer rate
D. Missing codes and jitter
~~

E7F12 (A)
Which of the following is generally true of Finite Impulse Response (FIR) filters?
A. FIR filters can delay all frequency components of the signal by the same amount
B. FIR filters are easier to implement for a given set of passband rolloff requirements
C. FIR filters can respond faster to impulses
D. All these choices are correct
~~

E7F13 (D)
What is the function of taps in a digital signal processing filter?
A. To reduce excess signal pressure levels
B. Provide access for debugging software
C. Select the point at which baseband signals are generated
D. Provide incremental signal delays for filter algorithms
~~

E7F14 (B)
Which of the following would allow a digital signal processing filter to create a sharper filter response?
A. Higher data rate
B. More taps
C. Lower Q
D. Double-precision math routines
~~

E7G Operational amplifiers: characteristics and applications

E7G01 (A)
What is the typical output impedance of an op-amp?
A. Very low
B. Very high
C. 100 ohms
D. 10,000 ohms
~~

E7G02 (B)
What is the frequency response of the circuit in E7-3 if a capacitor is added across the feedback resistor?
A. High-pass filter
B. Low-pass filter
C. Band-pass filter
D. Notch filter
~~

E7G03 (D)
What is the typical input impedance of an op-amp?
A. 100 ohms
B. 10,000 ohms
C. Very low
D. Very high
~~

E7G04 (C)
What is meant by the term “op-amp input offset voltage”?
A. The output voltage of the op-amp minus its input voltage
B. The difference between the output voltage of the op-amp and the input voltage required in the immediately following stage
C. The differential input voltage needed to bring the open loop output voltage to zero
D. The potential between the amplifier input terminals of the op-amp in an open loop condition
~~

E7G05 (A)
How can unwanted ringing and audio instability be prevented in an op-amp audio filter?
A. Restrict both gain and Q
B. Restrict gain but increase Q

C. Restrict Q but increase gain
D. Increase both gain and Q
~~

E7G06 (B)
What is the gain-bandwidth of an operational amplifier?
A. The maximum frequency for a filter circuit using that type of amplifier
B. The frequency at which the open-loop gain of the amplifier equals one
C. The gain of the amplifier at a filter's cutoff frequency
D. The frequency at which the amplifier's offset voltage is zero
~~

E7G07 (C)
What voltage gain can be expected from the circuit in Figure E7-3 when R1 is 10 ohms and RF is 470 ohms?
A. 0.21
B. 4700
C. 47
D. 24
~~

E7G08 (D)
How does the gain of an ideal operational amplifier vary with frequency?
A. It increases linearly with increasing frequency
B. It decreases linearly with increasing frequency
C. It decreases logarithmically with increasing frequency
D. It does not vary with frequency
~~

E7G09 (D)
What will be the output voltage of the circuit shown in Figure E7-3 if R1 is 1,000 ohms, RF is 10,000 ohms, and 0.23 volts DC is applied to the input?
A. 0.23 volts
B. 2.3 volts
C. -0.23 volts
D. -2.3 volts
~~

E7G10 (C)
What absolute voltage gain can be expected from the circuit in Figure E7-3 when R1 is 1,800 ohms and RF is 68 kilohms?
A. 1
B. 0.03
C. 38
D. 76
~~

E7G11 (B)

What absolute voltage gain can be expected from the circuit in Figure E7-3 when R1 is 3,300 ohms and RF is 47 kilohms?
A. 28
B. 14
C. 7
D. 0.07
~~

E7G12 (A)
What is an operational amplifier?
A. A high-gain, direct-coupled differential amplifier with very high input impedance and very low output impedance
B. A digital audio amplifier whose characteristics are determined by components external to the amplifier
C. An amplifier used to increase the average output of frequency modulated amateur signals to the legal limit
D. A RF amplifier used in the UHF and microwave regions
~~

E7H Oscillators and signal sources: types of oscillators; synthesizers and phase-locked loops; direct digital synthesizers; stabilizing thermal drift; microphonics; high-accuracy oscillators

E7H01 (D)
What are three common oscillator circuits?
A. Taft, Pierce, and negative feedback
B. Pierce, Fenner, and Beane
C. Taft, Hartley, and Pierce
D. Colpitts, Hartley, and Pierce
~~

E7H02 (C)
What is a microphonic?
A. An IC used for amplifying microphone signals
B. Distortion caused by RF pickup on the microphone cable
C. Changes in oscillator frequency caused by mechanical vibration
D. Excess loading of the microphone by an oscillator
~~

E7H03 (C)
What is a phase-locked loop?
A. An electronic servo loop consisting of a ratio detector, reactance modulator, and voltage-controlled oscillator
B. An electronic circuit also known as a monostable multivibrator
C. An electronic servo loop consisting of a phase detector, a low-pass filter, a voltage-controlled oscillator, and a stable reference oscillator
D. An electronic circuit consisting of a precision push-pull amplifier with a differential phase input
~~

E7H04 (C)
How is positive feedback supplied in a Colpitts oscillator?
A. Through a tapped coil
B. Through link coupling
C. Through a capacitive divider
D. Through a neutralizing capacitor
~~

E7H05 (D)
How is positive feedback supplied in a Pierce oscillator?
A. Through a tapped coil
B. Through link coupling
C. Through a neutralizing capacitor
D. Through a quartz crystal
~~

E7H06 (B)
Which of these functions can be performed by a phase-locked loop?
A. Wide-band AF and RF power amplification
B. Frequency synthesis and FM demodulation
C. Photovoltaic conversion and optical coupling
D. Comparison of two digital input signals and digital pulse counting
~~

E7H07 (D)
How can an oscillator's microphonic responses be reduced?
A. Use NP0 capacitors
B. Reduce noise on the oscillator's power supply
C. Increase the gain
D. Mechanically isolate the oscillator circuitry from its enclosure
~~

E7H08 (A)
Which of the following components can be used to reduce thermal drift in crystal oscillators?
A. NP0 capacitors
B. Toroidal inductors
C. Wirewound resistors
D. Non-inductive resistors
~~

E7H09 (A)
What type of frequency synthesizer circuit uses a phase accumulator, lookup table, digital-to-analog converter, and a low-pass anti-alias filter?
A. A direct digital synthesizer
B. A hybrid synthesizer
C. A phase-locked loop synthesizer
D. A direct conversion synthesizer

~~

E7H10 (B)
What information is contained in the lookup table of a direct digital synthesizer (DDS)?
A. The phase relationship between a reference oscillator and the output waveform
B. Amplitude values that represent the desired waveform
C. The phase relationship between a voltage-controlled oscillator and the output waveform
D. Frequently used receiver and transmitter frequencies
~~

E7H11 (C)
What are the major spectral impurity components of direct digital synthesizers?
A. Broadband noise
B. Digital conversion noise
C. Spurious signals at discrete frequencies
D. Harmonics of the local oscillator
~~

E7H12 (B)
Which of the following ensures that a crystal oscillator operates on the frequency specified by the crystal manufacturer?
A. Provide the crystal with a specified parallel inductance
B. Provide the crystal with a specified parallel capacitance
C. Bias the crystal at a specified voltage
D. Bias the crystal at a specified current
~~

E7H13 (D)
Which of the following is a technique for providing highly accurate and stable oscillators needed for microwave transmission and reception?
A. Use a GPS signal reference
B. Use a rubidium stabilized reference oscillator
C. Use a temperature-controlled high Q dielectric resonator
D. All these choices are correct
~~

SUBELEMENT E8 - SIGNALS AND EMISSIONS [4 Exam Questions - 4 Groups]

E8A Fourier analysis; RMS measurements; average RF power and peak envelope power (PEP); analog/digital conversion

E8A01 (A)
What technique shows that a square wave is made up of a sine wave and its odd harmonics?
A. Fourier analysis
B. Vector analysis
C. Numerical analysis

D. Differential analysis
~~

E8A02 (A)
Which of the following is a type of analog-to-digital conversion?
A. Successive approximation
B. Harmonic regeneration
C. Level shifting
D. Phase reversal
~~

E8A03(B)
Which of the following describes a signal in the time domain?
A. Power at intervals of phase
B. Amplitude at different times
C. Frequency at different times
D. Discrete impulses in time order
~~

E8A04 (B)
What is “dither” with respect to analog-to-digital converters?
A. An abnormal condition where the converter cannot settle on a value to represent the signal
B. A small amount of noise added to the input signal to reduce quantization noise
C. An error caused by irregular quantization step size
D. A method of decimation by randomly skipping samples
~~

E8A05 (D)
What is the benefit of making voltage measurements with a true-RMS calculating meter?
A. An inverse Fourier transform can be used
B. The signal’s RMS noise factor is also calculated
C. The calculated RMS value can be converted directly into phasor form
D. RMS is measured for both sinusoidal and non-sinusoidal signals
~~

E8A06 (A)
What is the approximate ratio of PEP-to-average power in an unprocessed single-sideband phone signal?
A. 2.5 to 1
B. 25 to 1
C. 1 to 1
D. 13 to 1
~~

E8A07 (B)
What determines the PEP-to-average power ratio of an unprocessed single-sideband phone signal?
A. The frequency of the modulating signal
B. Speech characteristics

C. The degree of carrier suppression
D. Amplifier gain
~~

E8A08 (C)
Why are direct or flash conversion analog-to-digital converters used for a software defined radio?
A. Very low power consumption decreases frequency drift
B. Immunity to out-of-sequence coding reduces spurious responses
C. Very high speed allows digitizing high frequencies
D. All these choices are correct
~~

E8A09 (D)
How many different input levels can be encoded by an analog-to-digital converter with 8-bit resolution?
A. 8
B. 8 multiplied by the gain of the input amplifier
C. 256 divided by the gain of the input amplifier
D. 256
~~

E8A10 (C)
What is the purpose of a low-pass filter used at the output of a digital-to-analog converter?
A. Lower the input bandwidth to increase the effective resolution
B. Improve accuracy by removing out-of-sequence codes from the input
C. Remove spurious sampling artifacts from the output signal
D. All these choices are correct
~~

E8A11 (A)
Which of the following is a measure of the quality of an analog-to-digital converter?
A. Total harmonic distortion
B. Peak envelope power
C. Reciprocal mixing
D. Power factor
~~

E8B Modulation and demodulation: modulation methods; modulation index and deviation ratio; frequency- and time-division multiplexing; orthogonal frequency-division multiplexing (OFDM)

E8B01 (A)
What is the modulation index of an FM signal?
A. The ratio of frequency deviation to modulating signal frequency
B. The ratio of modulating signal amplitude to frequency deviation
C. The modulating signal frequency divided by the bandwidth of the transmitted signal
D. The bandwidth of the transmitted signal divided by the modulating signal frequency
~~

E8B02 (D)
How does the modulation index of a phase-modulated emission vary with RF carrier frequency?
A. It increases as the RF carrier frequency increases
B. It decreases as the RF carrier frequency increases
C. It varies with the square root of the RF carrier frequency
D. It does not depend on the RF carrier frequency
~~

E8B03 (A)
What is the modulation index of an FM phone signal having a maximum frequency deviation of 3000 Hz either side of the carrier frequency if the highest modulating frequency is 1000 Hz?
A. 3
B. 0.3
C. 6
D. 0.6
~~

E8B04 (B)
What is the modulation index of an FM phone signal having a maximum carrier deviation of plus or minus 6 kHz if the highest modulating frequency is 2 kHz?
A. 0.3
B. 3
C. 0.6
D. 6
~~

E8B05 (D)
What is the deviation ratio of an FM phone signal having a maximum frequency swing of plus or minus 5 kHz if the highest modulation frequency is 3 kHz?
A. 6
B. 0.167
C. 0.6
D. 1.67
~~

E8B06 (A)
What is the deviation ratio of an FM phone signal having a maximum frequency swing of plus or minus 7.5 kHz if the highest modulation frequency is 3.5 kHz?
A. 2.14
B. 0.214
C. 0.47
D. 47
~~

E8B07 (A)
Orthogonal frequency-division multiplexing (OFDM) is a technique used for which types of amateur communication?
A. Digital modes

B. Extremely low-power contacts
C. EME
D. OFDM signals are not allowed on amateur bands
~~

E8B08 (D)
What describes orthogonal frequency-division multiplexing (OFDM)?
A. A frequency modulation technique that uses non-harmonically related frequencies
B. A bandwidth compression technique using Fourier transforms
C. A digital mode for narrow-band, slow-speed transmissions
D. A digital modulation technique using subcarriers at frequencies chosen to avoid intersymbol interference
~~

E8B09 (B)
What is deviation ratio?
A. The ratio of the audio modulating frequency to the center carrier frequency
B. The ratio of the maximum carrier frequency deviation to the highest audio modulating frequency
C. The ratio of the carrier center frequency to the audio modulating frequency
D. The ratio of the highest audio modulating frequency to the average audio modulating frequency
~~

E8B10 (B)
What is frequency division multiplexing (FDM)?
A. The transmitted signal jumps from band to band at a predetermined rate
B. Dividing the transmitted signal into separate frequency bands that each carry a different data stream
C. The transmitted signal is divided into packets of information
D. Two or more information streams are merged into a digital combiner, which then pulse position modulates the transmitter
~~

E8B11 (B)
What is digital time division multiplexing?
A. Two or more data streams are assigned to discrete sub-carriers on an FM transmitter
B. Two or more signals are arranged to share discrete time slots of a data transmission
C. Two or more data streams share the same channel by transmitting time of transmission as the sub-carrier
D. Two or more signals are quadrature modulated to increase bandwidth efficiency
~~

E8C Digital signals: digital communication modes; information rate vs. bandwidth; error correction; constellation diagrams

E8C01 (B)
What is Quadrature Amplitude Modulation or QAM?
A. A technique for digital data compression used in digital television which removes redundancy in the data by comparing bit amplitudes

B. Transmission of data by modulating the amplitude of two carriers of the same frequency but 90 degrees out of phase
C. A method of performing single sideband modulation by shifting the phase of the carrier and modulation components of the signal
D. A technique for analog modulation of television video signals using phase modulation and compression
~~

E8C02 (C)
What is the definition of symbol rate in a digital transmission?
A. The number of control characters in a message packet
B. The maximum rate at which the forward error correction code can make corrections
C. The rate at which the waveform changes to convey information
D. The number of characters carried per second by the station-to-station link
~~

E8C03 (A)
Why should the phase of a PSK signal be changed at the zero crossing of the RF signal?
A. To minimize bandwidth
B. To simplify modulation
C. To improve carrier suppression
D. All these choices are correct
~~

E8C04 (C)
What technique minimizes the bandwidth of a PSK31 signal?
A. Zero-sum character encoding
B. Reed-Solomon character encoding
C. Use of sinusoidal data pulses
D. Use of linear data pulses
~~

E8C05 (C)
What is the approximate bandwidth of a 13-WPM International Morse Code transmission?
A. 13 Hz
B. 26 Hz
C. 52 Hz
D. 104 Hz
~~

E8C06 (B)
What is the bandwidth of an FT8 signal?
A. 10 Hz
B. 50 Hz
C. 600 Hz
D. 2.4 kHz
~~

E8C07 (A)
What is the bandwidth of a 4,800-Hz frequency shift, 9,600-baud ASCII FM transmission?
A. 15.36 kHz
B. 9.6 kHz
C. 4.8 kHz
D. 5.76 kHz
~~

E8C08 (D)
How does ARQ accomplish error correction?
A. Special binary codes provide automatic correction
B. Special polynomial codes provide automatic correction
C. If errors are detected, redundant data is substituted
D. If errors are detected, a retransmission is requested
~~

E8C09 (D)
Which digital code allows only one bit to change between sequential code values?
A. Binary Coded Decimal Code
B. Extended Binary Coded Decimal Interchange Code
C. Extended ASCII
D. Gray code
~~

E8C10 (C)
How can data rate be increased without increasing bandwidth?
A. It is impossible
B. Increasing analog-to-digital conversion resolution
C. Using a more efficient digital code
D. Using forward error correction
~~

E8C11 (A)
What is the relationship between symbol rate and baud?
A. They are the same
B. Baud is twice the symbol rate
C. Baud rate is half the symbol rate
D. The relationship depends on the specific code used
~~

E8C12 (C)
What factors affect the bandwidth of a transmitted CW signal?
A. IF bandwidth and Q
B. Modulation index and output power
C. Keying speed and shape factor (rise and fall time)
D. All these choices are correct
~~

E8C13 (B)
What is described by the constellation diagram of a QAM or QPSK signal?
A. How many carriers may be present at the same time
B. The possible phase and amplitude states for each symbol
C. Frequency response of the signal stream
D. The number of bits used for error correction in the protocol
~~

E8C14 (C)
What type of addresses do nodes have in a mesh network?
A. Email
B. Trust server
C. Internet Protocol (IP)
D. Talk group
~~

E8C15 (C)
What technique do individual nodes use to form a mesh network?
A. Forward error correction and Viterbi codes
B. Acting as store-and-forward digipeaters
C. Discovery and link establishment protocols
D. Custom code plugs for the local trunking systems
~~

E8D Keying defects and overmodulation of digital signals; digital codes; spread spectrum

E8D01 (A)
Why are received spread spectrum signals resistant to interference?
A. Signals not using the spread spectrum algorithm are suppressed in the receiver
B. The high power used by a spread spectrum transmitter keeps its signal from being easily overpowered
C. Built-in error correction codes minimize interference
D. If the receiver detects interference, it will signal the transmitter to change frequencies
~~

E8D02 (B)
What spread spectrum communications technique uses a high-speed binary bit stream to shift the phase of an RF carrier?
A. Frequency hopping
B. Direct sequence
C. Binary phase-shift keying
D. Phase compandored spread spectrum
~~

E8D03 (D)
Which describes spread spectrum frequency hopping?
A. If interference is detected by the receiver, it will signal the transmitter to change frequencies

B. RF signals are clipped to generate a wide band of harmonics which provides redundancy to correct errors
C. A binary bit stream is used to shift the phase of an RF carrier very rapidly in a pseudorandom sequence
D. Rapidly varying the frequency of a transmitted signal according to a pseudorandom sequence
~~

E8D04 (C)
What is the primary effect of extremely short rise or fall time on a CW signal?
A. More difficult to copy
B. The generation of RF harmonics
C. The generation of key clicks
D. More difficult to tune
~~

E8D05 (A)
What is the most common method of reducing key clicks?
A. Increase keying waveform rise and fall times
B. Insert low-pass filters at the transmitter output
C. Reduce keying waveform rise and fall times
D. Insert high-pass filters at the transmitter output
~~

E8D06 (D)
What is the advantage of including parity bits in ASCII characters?
A. Faster transmission rate
B. Signal-to-noise ratio is improved
C. A larger character set is available
D. Some types of errors can be detected
~~

E8D07 (D)
What is a common cause of overmodulation of AFSK signals?
A. Excessive numbers of retries
B. Excessive frequency deviation
C. Bit errors in the modem
D. Excessive transmit audio levels
~~

E8D08 (D)
What parameter evaluates distortion of an AFSK signal caused by excessive input audio levels?
A. Signal-to-noise ratio
B. Baud error rate
C. Repeat Request Rate (RRR)
D. Intermodulation Distortion (IMD)
~~

E8D09 (D)

What is considered an acceptable maximum IMD level for an idling PSK signal?
A. +5 dB
B. +10 dB
C. +15 dB
D. -30 dB
~~

E8D10 (B)
What are some of the differences between the Baudot digital code and ASCII?
A. Baudot uses 4 data bits per character, ASCII uses 7 or 8; Baudot uses 1 character as a letters/figures shift code, ASCII has no letters/figures code
B. Baudot uses 5 data bits per character, ASCII uses 7 or 8; Baudot uses 2 characters as letters/figures shift codes, ASCII has no letters/figures shift code
C. Baudot uses 6 data bits per character, ASCII uses 7 or 8; Baudot has no letters/figures shift code, ASCII uses 2 letters/figures shift codes
D. Baudot uses 7 data bits per character, ASCII uses 8; Baudot has no letters/figures shift code, ASCII uses 2 letters/figures shift codes
~~

E8D11 (C)
What is one advantage of using ASCII code for data communications?
A. It includes built-in error correction features
B. It contains fewer information bits per character than any other code
C. It is possible to transmit both uppercase and lowercase text
D. It uses one character as a shift code to send numeric and special characters
~~

SUBELEMENT E9 - ANTENNAS AND TRANSMISSION LINES [8 Exam Questions - 8 Groups]

E9A Basic antenna parameters: radiation resistance, gain, beamwidth, efficiency; effective radiated power (ERP) and effective isotropic radiated power (EIRP)

E9A01 (C)
What is an isotropic radiator?
A. A calibrated, unidirectional antenna used to make precise antenna gain measurements
B. An omnidirectional, horizontally polarized, precisely calibrated antenna used to make field measurements of antenna gain
C. A hypothetical, lossless antenna having equal radiation intensity in all directions used as a reference for antenna gain
D. A spacecraft antenna used to direct signals toward Earth
~~

E9A02 (D)
What is the effective radiated power (ERP) of a repeater station with 150 watts transmitter power output, 2 dB feed line loss, 2.2 dB duplexer loss, and 7 dBd antenna gain?
A. 469 watts

B. 78.7 watts
C. 420 watts
D. 286 watts
~~

E9A03 (C)
What term describing total radiated power takes into account all gains and losses?
A. Power factor
B. Half-power bandwidth
C. Effective radiated power
D. Apparent power
~~

E9A04 (B)
Which of the following factors affect the feed point impedance of an antenna?
A. Transmission line length
B. Antenna height
C. The settings of an antenna tuner at the transmitter
D. The input power level
~~

E9A05 (D)
What does the term “ground gain” mean?
A. The change in signal strength caused by grounding the antenna
B. The gain of the antenna with respect to a dipole at ground level
C. To force net gain to 0 dB by grounding part of the antenna
D. An increase in signal strength from ground reflections in the environment of the antenna
~~

E9A06 (A)
What is the effective radiated power (ERP) of a repeater station with 200 watts transmitter power output, 4 dB feed line loss, 3.2 dB duplexer loss, 0.8 dB circulator loss, and 10 dBd antenna gain?
A. 317 watts
B. 2,000 watts
C. 126 watts
D. 300 watts
~~

E9A07 (B)
What is the effective isotropic radiated power (EIRP) of a repeater station with 200 watts transmitter power output, 2 dB feed line loss, 2.8 dB duplexer loss, 1.2 dB circulator loss, and 7 dBi antenna gain?
A. 159 watts
B. 252 watts
C. 632 watts
D. 63.2 watts
~~

E9A08 (A)

Which frequency band has the smallest first Fresnel zone?
A. 5.8 GHz
B. 3.4 GHz
C. 2.4 GHz
D. 900 MHz
~~

E9A09 (B)
What is antenna efficiency?
A. Radiation resistance divided by transmission resistance
B. Radiation resistance divided by total resistance
C. Total resistance divided by radiation resistance
D. Effective radiated power divided by transmitter output
~~

E9A10 (A)
Which of the following improves the efficiency of a ground-mounted quarter-wave vertical antenna?
A. Installing a ground radial system
B. Isolating the coax shield from ground
C. Shortening the radiating element
D. All these choices are correct
~~

E9A11 (C)
Which of the following determines ground losses for a ground-mounted vertical antenna operating on HF?
A. The standing wave ratio
B. Distance from the transmitter
C. Soil conductivity
D. Take-off angle
~~

E9A12 (A)
How much gain does an antenna have compared to a half-wavelength dipole if it has 6 dB gain over an isotropic radiator?
A. 3.85 dB
B. 6.0 dB
C. 8.15 dB
D. 2.79 dB
~~

E9B Antenna patterns and designs: azimuth and elevation patterns; gain as a function of pattern; antenna modeling

E9B01 (B)
What is the 3 dB beamwidth of the antenna radiation pattern shown in Figure E9-1?
A. 75 degrees

B. 50 degrees
C. 25 degrees
D. 30 degrees
~~

E9B02 (D)
What is the front-to-back ratio of the antenna radiation pattern shown in Figure E9-1?
A. 36 dB
B. 14 dB
C. 24 dB
D. 18 dB
~~

E9B03 (D)
What is the front-to-side ratio of the antenna radiation pattern shown in Figure E9-1?
A. 12 dB
B. 24 dB
C. 18 dB
D. 14 dB
~~

E9B04 (B)
What is the front-to-back ratio of the radiation pattern shown in Figure E9-2?
A. 15 dB
B. 28 dB
C. 3 dB
D. 38 dB
~~

E9B05 (A)
What type of antenna pattern is shown in Figure E9-2?
A. Elevation
B. Azimuth
C. Near field
D. Polarization
~~

E9B06 (C)
What is the elevation angle of peak response in the antenna radiation pattern shown in Figure E9-2?
A. 45 degrees
B. 75 degrees
C. 7.5 degrees
D. 25 degrees
~~

E9B07 (C)
What is the difference in radiated power between a lossless antenna with gain and an isotropic radiator driven by the same power?

A. The power radiated from the directional antenna is increased by the gain of the antenna
B. The power radiated from the directional antenna is stronger by its front-to-back ratio
C. They are the same
D. The power radiated from the isotropic radiator is 2.15 dB greater than that from the directional antenna
~~

E9B08 (D)
What is the far field of an antenna?
A. The region of the ionosphere where radiated power is not refracted
B. The region where radiated power dissipates over a specified time period
C. The region where radiated field strengths are constant
D. The region where the shape of the radiation pattern no longer varies with distance
~~

E9B09 (B)
What type of analysis is commonly used for modeling antennas?
A. Graphical analysis
B. Method of Moments
C. Mutual impedance analysis
D. Calculus differentiation with respect to physical properties
~~

E9B10 (A)
What is the principle of a Method of Moments analysis?
A. A wire is modeled as a series of segments, each having a uniform value of current
B. A wire is modeled as a single sine-wave current generator
C. A wire is modeled as a single sine-wave voltage source
D. A wire is modeled as a series of segments, each having a distinct value of voltage across it
~~

E9B11 (C)
What is a disadvantage of decreasing the number of wire segments in an antenna model below 10 segments per half-wavelength?
A. Ground conductivity will not be accurately modeled
B. The resulting design will favor radiation of harmonic energy
C. The computed feed point impedance may be incorrect
D. The antenna will become mechanically unstable
~~

E9C Practical wire antennas; folded dipoles; phased arrays; effects of ground near antennas

E9C01 (D)
What type of radiation pattern is created by two 1/4-wavelength vertical antennas spaced 1/2-wavelength apart and fed 180 degrees out of phase?
A. Cardioid
B. Omni-directional

C. A figure-eight broadside to the axis of the array
D. A figure-eight oriented along the axis of the array
~~

E9C02 (A)
What type of radiation pattern is created by two 1/4-wavelength vertical antennas spaced 1/4-wavelength apart and fed 90 degrees out of phase?
A. Cardioid
B. A figure-eight end-fire along the axis of the array
C. A figure-eight broadside to the axis of the array
D. Omni-directional
~~

E9C03 (C)
What type of radiation pattern is created by two 1/4-wavelength vertical antennas spaced 1/2-wavelength apart and fed in phase?
A. Omni-directional
B. Cardioid
C. A figure-eight broadside to the axis of the array
D. A figure-eight end-fire along the axis of the array
~~

E9C04 (B)
What happens to the radiation pattern of an unterminated long wire antenna as the wire length is increased?
A. Fewer lobes form with the major lobes increasing closer to broadside to the wire
B. Additional lobes form with major lobes increasingly aligned with the axis of the antenna
C. The elevation angle increases, and the front-to-rear ratio decreases
D. The elevation angle increases, while the front-to-rear ratio is unaffected
~~

E9C05 (A)
What is the purpose of feeding an off-center-fed dipole (OCFD) between the center and one end instead of at the midpoint?
A. To create a similar feed point impedance on multiple bands
B. To suppress off-center lobes at higher frequencies
C. To resonate the antenna across a wider range of frequencies
D. To reduce common-mode current coupling on the feed line shield
~~

E9C06 (B)
What is the effect of adding a terminating resistor to a rhombic or long-wire antenna?
A. It reflects the standing waves on the antenna elements back to the transmitter
B. It changes the radiation pattern from bidirectional to unidirectional
C. It changes the radiation pattern from horizontal to vertical polarization
D. It decreases the ground loss
~~

E9C07 (A)
What is the approximate feed point impedance at the center of a two-wire half-wave folded dipole antenna?
A. 300 ohms
B. 72 ohms
C. 50 ohms
D. 450 ohms
~~

E9C08 (C)
What is a folded dipole antenna?
A. A dipole one-quarter wavelength long
B. A center-fed dipole with the ends folded down 90 degrees at the midpoint of each side
C. A half-wave dipole with an additional parallel wire connecting its two ends
D. A dipole configured to provide forward gain
~~

E9C09 (A)
Which of the following describes a G5RV antenna?
A. A wire antenna center-fed through a specific length of open-wire line connected to a balun and coaxial feed line
B. A multi-band trap antenna
C. A phased array antenna consisting of multiple loops
D. A wide band dipole using shorted coaxial cable for the radiating elements and fed with a 4:1 balun
~~

E9C10 (B)
Which of the following describes a Zepp antenna?
A. A horizontal array capable of quickly changing the direction of maximum radiation by changing phasing lines
B. An end-fed half-wavelength dipole
C. An omni-directional antenna commonly used for satellite communications
D. A vertical array capable of quickly changing the direction of maximum radiation by changing phasing lines
~~

E9C11 (D)
How is the far-field elevation pattern of a vertically polarized antenna affected by being mounted over seawater versus soil?
A. Radiation at low angles decreases
B. Additional lobes appear at higher elevation angles
C. Separate elevation lobes will combine into a single lobe
D. Radiation at low angles increases
~~

E9C12 (C)
Which of the following describes an extended double Zepp antenna?
A. An end-fed full-wave dipole antenna

B. A center-fed 1.5-wavelength dipole antenna
C. A center-fed 1.25-wavelength dipole antenna
D. An end-fed 2-wavelength dipole antenna
~~

E9C13 (B)
How does the radiation pattern of a horizontally polarized antenna vary with increasing height above ground?
A. The takeoff angle of the lowest elevation lobe increases
B. The takeoff angle of the lowest elevation lobe decreases
C. The horizontal beamwidth increases
D. The horizontal beamwidth decreases
~~

E9C14 (B)
How does the radiation pattern of a horizontally-polarized antenna mounted above a long slope compare with the same antenna mounted above flat ground?
A. The main lobe takeoff angle increases in the downhill direction
B. The main lobe takeoff angle decreases in the downhill direction
C. The horizontal beamwidth decreases in the downhill direction
D. The horizontal beamwidth increases in the uphill direction
~~

E9D Yagi antennas; parabolic reflectors; feed point impedance and loading of electrically short antennas; antenna Q; RF grounding

E9D01 (D)
How much does the gain of an ideal parabolic reflector antenna increase when the operating frequency is doubled?
A. 2 dB
B. 3 dB
C. 4 dB
D. 6 dB
~~

E9D02 (C)
How can two linearly polarized Yagi antennas be used to produce circular polarization?
A. Stack two Yagis to form an array with the respective elements in parallel planes fed 90 degrees out of phase
B. Stack two Yagis to form an array with the respective elements in parallel planes fed in phase
C. Arrange two Yagis on the same axis and perpendicular to each other with the driven elements at the same point on the boom and fed 90 degrees out of phase
D. Arrange two Yagis collinear to each other with the driven elements fed 180 degrees out of phase
~~

E9D03 (A)
What is the most efficient location for a loading coil on an electrically short whip?

A. Near the center of the vertical radiator
B. As low as possible on the vertical radiator
C. At a voltage maximum
D. At a voltage null
~~

E9D04 (C)
Why should antenna loading coils have a high ratio of reactance to resistance?
A. To swamp out harmonics
B. To lower the radiation angle
C. To maximize efficiency
D. To minimize the Q
~~

E9D05 (D)
Approximately how long is a Yagi's driven element?
A. 234 divided by frequency in MHz
B. 1005 divided by frequency in MHz
C. 1/4 wavelength
D. 1/2 wavelength
~~

E9D06 (B)
What happens to SWR bandwidth when one or more loading coils are used to resonate an electrically short antenna?
A. It is increased
B. It is decreased
C. It is unchanged if the loading coil is located at the feed point
D. It is unchanged if the loading coil is located at a voltage maximum point
~~

E9D07 (D)
What is an advantage of top loading an electrically short HF vertical antenna?
A. Lower Q
B. Greater structural strength
C. Higher losses
D. Improved radiation efficiency
~~

E9D08 (B)
What happens as the Q of an antenna increases?
A. SWR bandwidth increases
B. SWR bandwidth decreases
C. Gain is reduced
D. More common-mode current is present on the feed line
~~

E9D09 (D)

What is the function of a loading coil in an electrically short antenna?
A. To increase the SWR bandwidth by increasing net reactance
B. To lower the losses
C. To lower the Q
D. To resonate the antenna by cancelling the capacitive reactance
~~

E9D10 (B)
How does radiation resistance of a base-fed whip antenna change below its resonant frequency?
A. Radiation resistance increases
B. Radiation resistance decreases
C. Radiation resistance becomes imaginary
D. Radiation resistance does not depend on frequency
~~

E9D11 (D)
Why do most two-element Yagis with normal spacing have a reflector instead of a director?
A. Lower SWR
B. Higher receiving directivity factor
C. Greater front-to-side
D. Higher gain
~~

E9D12 (C)
What is the purpose of making a Yagi's parasitic elements either longer or shorter than resonance?
A. Wind torque cancellation
B. Mechanical balance
C. Control of phase shift
D. Minimize losses
~~

E9E Impedance matching: matching antennas to feed lines; phasing lines; power dividers

E9E01 (B)
Which matching system for Yagi antennas requires the driven element to be insulated from the boom?
A. Gamma
B. Beta or hairpin
C. Shunt-fed
D. T-match
~~

E9E02 (A)
What antenna matching system matches coaxial cable to an antenna by connecting the shield to the center of the antenna and the conductor a fraction of a wavelength to one side?
A. Gamma match
B. Delta match
C. T-match

D. Stub match
~~

E9E03 (D)
What matching system uses a short length of transmission line connected in parallel with the feed line at or near the feed point?
A. Gamma match
B. Delta match
C. T-match
D. Stub match
~~

E9E04 (B)
What is the purpose of the series capacitor in a gamma match?
A. To provide DC isolation between the feed line and the antenna
B. To cancel unwanted inductive reactance
C. To provide a rejection notch that prevents the radiation of harmonics
D. To transform the antenna impedance to a higher value
~~

E9E05 (A)
What Yagi driven element feed point impedance is required to use a beta or hairpin matching system?
A. Capacitive (driven element electrically shorter than 1/2 wavelength)
B. Inductive (driven element electrically longer than 1/2 wavelength)
C. Purely resistive
D. Purely reactive
~~

E9E06 (C)
Which of these transmission line impedances would be suitable for constructing a quarter-wave Q-section for matching a 100-ohm feed point impedance to a 50-ohm transmission line?
A. 50 ohms
B. 62 ohms
C. 75 ohms
D. 90 ohms
~~

E9E07 (B)
What parameter describes the interaction of a load and transmission line?
A. Characteristic impedance
B. Reflection coefficient
C. Velocity factor
D. Dielectric constant
~~

E9E08 (C)
What is a use for a Wilkinson divider?
A. To divide the operating frequency of a transmitter signal so it can be used on a lower frequency band

B. To feed high-impedance antennas from a low-impedance source
C. To divide power equally between two 50-ohm loads while maintaining 50-ohm input impedance
D. To divide the frequency of the input to a counter to increase its frequency range
~~

E9E09 (C)
Which of the following is used to shunt feed a grounded tower at its base?
A. Double-bazooka match
B. Beta or hairpin match
C. Gamma match
D. All these choices are correct
~~

E9E10 Question Deleted (section not renumbered)
~~

E9E11 (A)
What is the purpose of using multiple driven elements connected through phasing lines?
A. To control the antenna's radiation pattern
B. To prevent harmonic radiation from the transmitter
C. To allow single-band antennas to operate on other bands
D. To create a low-angle radiation pattern
~~

E9F Transmission lines: characteristics of open and shorted feed lines; coax versus open wire; velocity factor; electrical length; coaxial cable dielectrics; microstrip

E9F01 (D)
What is the velocity factor of a transmission line?
A. The ratio of its characteristic impedance to its termination impedance
B. The ratio of its termination impedance to its characteristic impedance
C. The velocity of a wave in the transmission line multiplied by the velocity of light in a vacuum
D. The velocity of a wave in the transmission line divided by the velocity of light in a vacuum
~~

E9F02 (C)
Which of the following has the biggest effect on the velocity factor of a transmission line?
A. The characteristic impedance
B. The transmission line length
C. The insulating dielectric material
D. The center conductor resistivity
~~

E9F03 (D)
Why is the electrical length of a coaxial cable longer than its physical length?
A. Skin effect is less pronounced in the coaxial cable
B. Skin effect is more pronounced in the coaxial cable

C. Electromagnetic waves move faster in coaxial cable than in air
D. Electromagnetic waves move more slowly in a coaxial cable than in air
~~

E9F04 (B)
What impedance does a 1/2-wavelength transmission line present to an RF generator when the line is shorted at the far end?
A. Very high impedance
B. Very low impedance
C. The same as the characteristic impedance of the line
D. The same as the output impedance of the RF generator
~~

E9F05 (D)
What is microstrip?
A. Special shielding material designed for microwave frequencies
B. Miniature coax used for low power applications
C. Short lengths of coax mounted on printed circuit boards to minimize time delay between microwave circuits
D. Precision printed circuit conductors above a ground plane that provide constant impedance interconnects at microwave frequencies
~~

E9F06 (C)
What is the approximate physical length of an air-insulated, parallel conductor transmission line that is electrically 1/2 wavelength long at 14.10 MHz?
A. 7.0 meters
B. 8.5 meters
C. 10.6 meters
D. 13.3 meters
~~

E9F07 (A)
How does parallel conductor transmission line compare to coaxial cable with a plastic dielectric?
A. Lower loss
B. Higher SWR
C. Smaller reflection coefficient
D. Lower velocity factor
~~

E9F08 (D)
Which of the following is a significant difference between foam dielectric coaxial cable and solid dielectric coaxial cable, assuming all other parameters are the same?
A. Foam dielectric coaxial cable has lower safe maximum operating voltage
B. Foam dielectric coaxial cable has lower loss per unit of length
C. Foam dielectric coaxial cable has higher velocity factor
D. All these choices are correct
~~

E9F09 (A)
What impedance does a 1/4-wavelength transmission line present to an RF generator when the line is shorted at the far end?
A. Very high impedance
B. Very low impedance
C. The same as the characteristic impedance of the transmission line
D. The same as the generator output impedance
~~

E9F10 (C)
What impedance does a 1/8-wavelength transmission line present to an RF generator when the line is shorted at the far end?
A. A capacitive reactance
B. The same as the characteristic impedance of the line
C. An inductive reactance
D. Zero
~~

E9F11 (C)
What impedance does a 1/8-wavelength transmission line present to an RF generator when the line is open at the far end?
A. The same as the characteristic impedance of the line
B. An inductive reactance
C. A capacitive reactance
D. Infinite
~~

E9F12 (D)
What impedance does a 1/4-wavelength transmission line present to an RF generator when the line is open at the far end?
A. The same as the characteristic impedance of the line
B. The same as the input impedance to the generator
C. Very high impedance
D. Very low impedance
~~

E9G The Smith chart

E9G01 (A)
Which of the following can be calculated using a Smith chart?
A. Impedance along transmission lines
B. Radiation resistance
C. Antenna radiation pattern
D. Radio propagation
~~

E9G02 (B)
What type of coordinate system is used in a Smith chart?
A. Voltage circles and current arcs
B. Resistance circles and reactance arcs
C. Voltage chords and current chords
D. Resistance lines and reactance chords
~~

E9G03 (C)
Which of the following is often determined using a Smith chart?
A. Beam headings and radiation patterns
B. Satellite azimuth and elevation bearings
C. Impedance and SWR values in transmission lines
D. Point-to-point propagation reliability as a function of frequency
~~

E9G04 (C)
What are the two families of circles and arcs that make up a Smith chart?
A. Inductance and capacitance
B. Reactance and voltage
C. Resistance and reactance
D. Voltage and impedance
~~

E9G05 (A)
Which of the following is a common use for a Smith chart?
A. Determine the length and position of an impedance matching stub
B. Determine the impedance of a transmission line, given the physical dimensions
C. Determine the gain of an antenna given the physical and electrical parameters
D. Determine the loss/100 feet of a transmission line, given the velocity factor and conductor materials
~~

E9G06 (B)
On the Smith chart shown in Figure E9-3, what is the name for the large outer circle on which the reactance arcs terminate?
A. Prime axis
B. Reactance axis
C. Impedance axis
D. Polar axis
~~

E9G07 (D)
On the Smith chart shown in Figure E9-3, what is the only straight line shown?
A. The reactance axis
B. The current axis
C. The voltage axis
D. The resistance axis
~~

E9G08 (C)
How is a Smith chart normalized?
A. Reassign the reactance axis with resistance values
B. Reassign the resistance axis with reactance values
C. Reassign the prime center's impedance value
D. Reassign the prime center to the reactance axis
~~

E9G09 (A)
What third family of circles is often added to a Smith chart during the process of designing impedance matching networks?
A. Constant-SWR circles
B. Transmission line length circles
C. Coaxial-length circles
D. Radiation-pattern circles
~~

E9G10 (D)
What do the arcs on a Smith chart represent?
A. Frequency
B. SWR
C. Points with constant resistance
D. Points with constant reactance
~~

E9G11 (B)
In what units are the wavelength scales on a Smith chart calibrated?
A. In fractions of transmission line electrical frequency
B. In fractions of transmission line electrical wavelength
C. In fractions of antenna electrical wavelength
D. In fractions of antenna electrical frequency
~~

E9H Receiving antennas: radio direction finding (RDF) techniques; Beverage antennas; single- and multiple-turn loops

E9H01 (D)
When constructing a Beverage antenna, which of the following factors should be included in the design to achieve good performance at the desired frequency?
A. Its overall length must not exceed 1/4 wavelength
B. It must be mounted more than 1 wavelength above ground
C. It should be configured as a four-sided loop
D. It should be at least one wavelength long
~~

E9H02 (A)

Which is generally true for 160- and 80-meter receiving antennas?
A. Atmospheric noise is so high that directivity is much more important than losses
B. They must be erected at least 1/2 wavelength above the ground to attain good directivity
C. Low loss coax transmission line is essential for good performance
D. All these choices are correct
~~

E9H03 (D)
What is receiving directivity factor (RDF)?
A. Forward gain compared to the gain in the reverse direction
B. Relative directivity compared to isotropic
C. Relative directivity compared to a dipole
D. Peak antenna gain compared to average gain over the hemisphere around and above the antenna
~~

E9H04 (B)
What is the purpose of placing an electrostatic shield around a small-loop direction-finding antenna?
A. It adds capacitive loading, increasing the bandwidth of the antenna
B. It eliminates unbalanced capacitive coupling to the antenna's surroundings, improving the depth of its nulls
C. It eliminates tracking errors caused by strong out-of-band signals
D. It increases signal strength by providing a better match to the feed line
~~

E9H05 (A)
What challenge is presented by a small wire-loop antenna for direction finding?
A. It has a bidirectional null pattern
B. It does not have a clearly defined null
C. It is practical for use only on VHF and higher bands
D. All these choices are correct
~~

E9H06 (D)
What indicates the correct value of terminating resistance for a Beverage antenna?
A. Maximum feed point DC resistance at the center of the desired frequency range
B. Minimum low-angle front-to-back ratio at the design frequency
C. Maximum DC current in the terminating resistor
D. Minimum variation in SWR over the desired frequency range
~~

E9H07 (B)
What is the function of a Beverage antenna's termination resistor?
A. Increase the front-to-side ratio
B. Absorb signals from the reverse direction
C. Decrease SWR bandwidth
D. Eliminate harmonic reception
~~

E9H08 (A)
What is the function of a sense antenna?
A. It modifies the pattern of a DF antenna to provide a null in only one direction
B. It increases the sensitivity of a DF antenna array
C. It allows DF antennas to receive signals at different vertical angles
D. It provides diversity reception that cancels multipath signals
~~

E9H09 (A)
What type of radiation pattern is created by a single-turn, terminated loop such as a pennant antenna?
A. Cardioid
B. Bidirectional
C. Omnidirectional
D. Hyperbolic
~~

E9H10 (C)
How can the output voltage of a multiple-turn receiving loop antenna be increased?
A. By reducing the permeability of the loop shield
B. By utilizing high impedance wire for the coupling loop
C. By increasing the number of turns and/or the area enclosed by the loop
D. All these choices are correct
~~

E9H11 (B)
What feature of a cardioid pattern antenna makes it useful for direction-finding antennas?
A. A very sharp peak
B. A single null
C. Broadband response
D. High radiation angle
~~

SUBELEMENT E0 - SAFETY - [1 exam question - 1 group]

E0A Safety: RF radiation hazards; hazardous materials; grounding

E0A01 (B)
What is the primary function of an external earth connection or ground rod?
A. Prevent static build up on power lines
B. Lightning charge dissipation
C. Reduce RF current flow between pieces of equipment
D. Protect breaker panel from power surges
~~

E0A02 (B)
When evaluating RF exposure levels from your station at a neighbor’s home, what must you do?

A. Ensure signals from your station are less than the controlled maximum permissible exposure (MPE) limits
B. Ensure signals from your station are less than the uncontrolled maximum permissible exposure (MPE) limits
C. Ensure signals from your station are less than the controlled maximum permissible emission (MPE) limits
D. Ensure signals from your station are less than the uncontrolled maximum permissible emission (MPE) limits
~~

E0A03 (C)
Over what range of frequencies are the FCC human body RF exposure limits most restrictive?
A. 300 kHz - 3 MHz
B. 3 - 30 MHz
C. 30 - 300 MHz
D. 300 - 3000 MHz
~~

E0A04 (C)
When evaluating a site with multiple transmitters operating at the same time, the operators and licensees of which transmitters are responsible for mitigating over-exposure situations?
A. Each transmitter that produces 20 percent or more of its MPE limit in areas where the total MPE limit is exceeded
B. Each transmitter operating with a duty cycle greater than 25 percent
C. Each transmitter that produces 5 percent or more of its MPE limit in areas where the total MPE limit is exceeded
D. Each transmitter operating with a duty cycle greater than 50 percent
~~

E0A05 (B)
What hazard is created by operating at microwave frequencies?
A. Microwaves are ionizing radiation
B. The high gain antennas commonly used can result in high exposure levels
C. Microwaves are in the frequency range where wave velocity is higher
D. The extremely high frequency energy can damage the joints of antenna structures
~~

E0A06 (D)
Why are there separate electric (E) and magnetic (H) MPE limits at frequencies below 300 MHz?
A. The body reacts to electromagnetic radiation from both the E and H fields
B. Ground reflections and scattering cause the field strength to vary with location
C. E field and H field radiation intensity peaks can occur at different locations
D. All these choices are correct
~~

E0A07 (B)
What is meant by “100% tie-off” regarding tower safety?
A. All loose ropes and guys secured to a fixed structure

B. At least one lanyard attached to the tower at all times
C. All tools secured to the climber's harness
D. All circuit breakers feeding power to the tower must be tied closed with tape, cable, or ties
~~

E0A08 (C)
What does SAR measure?
A. Signal attenuation ratio
B. Signal amplification rating
C. The rate at which RF energy is absorbed by the body
D. The rate of RF energy reflected from stationary terrain
~~

E0A09 (C)
Which of the following types of equipment are exempt from RF exposure evaluations?
A. Transceivers with less than 7 watts of RF output
B. Antennas that radiate only in the near field
C. Hand-held transceivers sold before May 3, 2021
D. Dish antennas less than one meter in diameter
~~

E0A10 (A)
When must an RF exposure evaluation be performed on an amateur station operating on 80 meters?
A. An evaluation must always be performed
B. When the ERP of the station is less than 10 watts
C. When the station's operating mode is CW
D. When the output power from the transmitter is less than 100 watts
~~

E0A11 (D)
To what should lanyards be attached while climbing?
A. Antenna mast
B. Guy brackets
C. Tower rungs
D. Tower legs
~~

E0A12 (A)
Where should a shock-absorbing lanyard be attached to a tower when working above ground?
A. Above the climber's head level
B. To the belt of the fall-arrest harness
C. Even with the climber's waist
D. To the next lowest set of guys
~~

~~~end of question pool text~~~
~~~

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

Figure E5-1

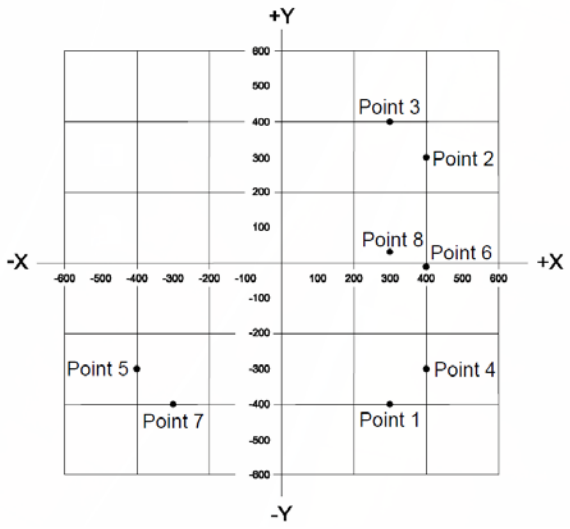


Figure E6-1

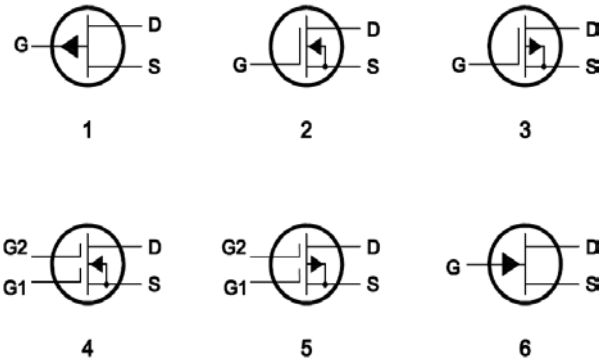


Figure E6-2

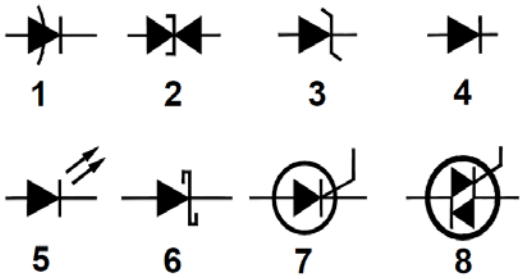


Figure E6-3

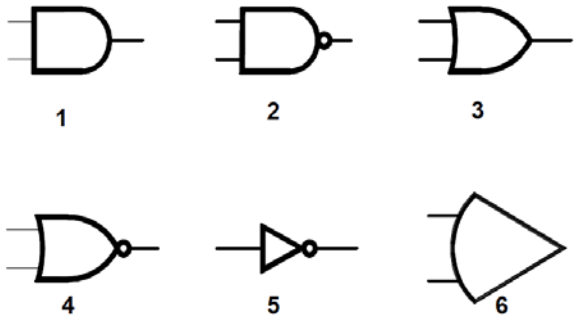
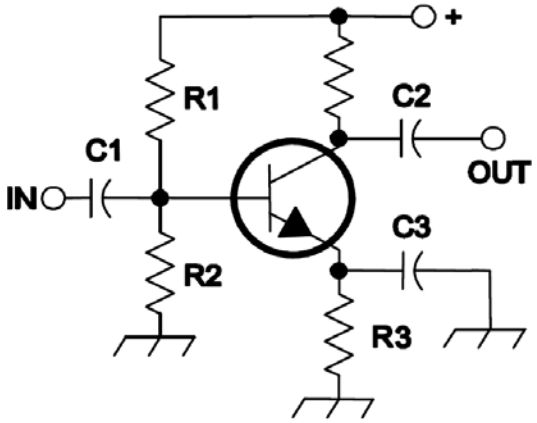


Figure E7-1



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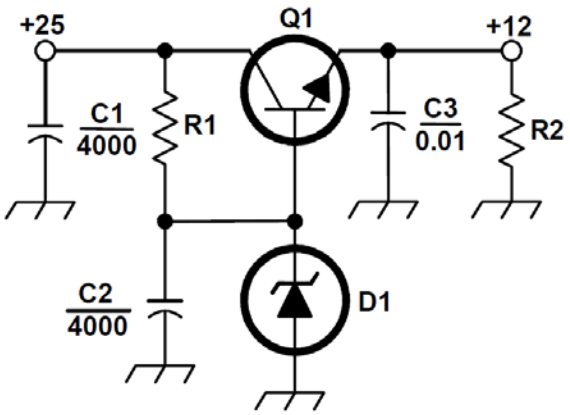


Figure E7-3

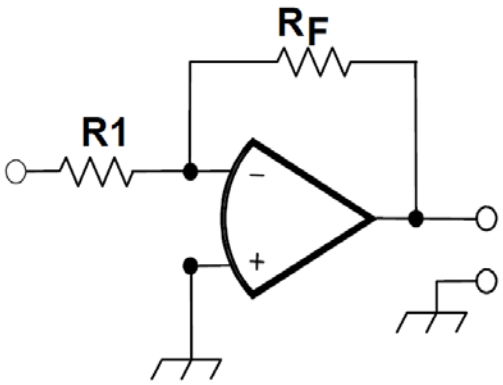
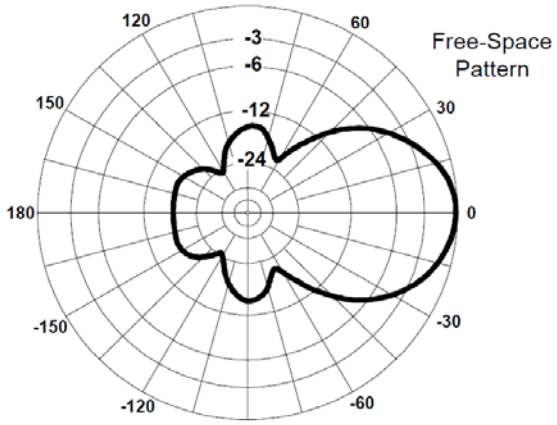


Figure E9-1



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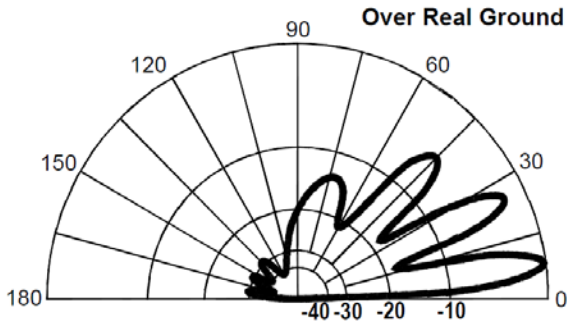
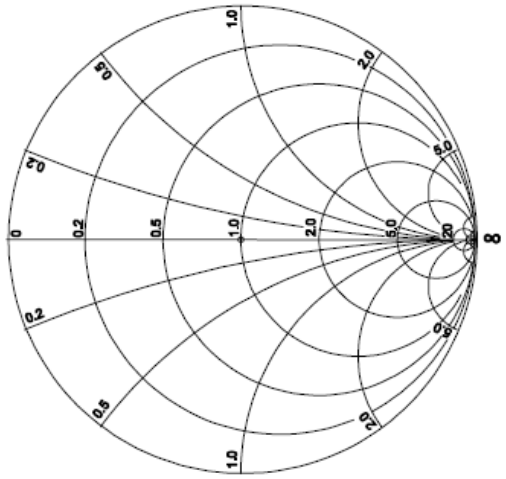
Figure E9-3