* To obtain a copy of the graphics references that are to be used with this question pool, see the downloadable PDF graphic on our web page directly below this pool, or send a business sized SASE to the ARRL/VEC, 225 Main St, Newington CT 06111. Request the "2000 Extra class Question Pool Graphics". For $1.50 the ARRL VEC will supply a hardcopy of this pool without receiving an SASE.

* The questions contained within this pool must be used in all Extra class examinations beginning April 15, 2000, and is intended to be used up through June 30, 2002.

* The correct answer position A,B,C,D appears in parenthesis following each question number [eg, in E1A01 (B), position B contains the correct answer text].

Question Pool
ELEMENT 4 - EXTRA CLASS
as released by
Question Pool Committee
National Conference of
Volunteer Examiner Coordinators
February 1, 2000

SUBELEMENT E1 -- COMMISSION'S RULES [7 Exam Questions -- 7 Groups]

E1A Operating standards: frequency privileges for Extra class amateurs; emission standards; message forwarding; frequency sharing between ITU Regions; FCC modification of station license; 30-meter band sharing; stations aboard ships or aircraft; telemetry; telecommand of an amateur station; authorized telecommand transmissions; definitions of image, pulse and test

E1A01 @E1A01 (B) [97.301b]
What exclusive frequency privileges in the 80-meter band are authorized to Extra class control operators?
A. 3525-3775 kHz
B. 3500-3525 kHz
C. 3700-3750 kHz
D. 3500-3550 kHz

E1A02 @E1A02 (C) [97.301b]
What exclusive frequency privileges in the 75-meter band are authorized to Extra class control operators?
A. 3775-3800 kHz
B. 3800-3850 kHz
C. 3750-3775 kHz
D. 3800-3825 kHz

E1A03 @E1A03 (A) [97.301b]
What exclusive frequency privileges in the 40-meter band are authorized to Extra class control operators?
A. 7000-7025 kHz
B. 7000-7050 kHz
C. 7025-7050 kHz
D. 7100-7150 kHz

E1A04 @E1A04 (D) [97.301b]
What exclusive frequency privileges in the 20-meter band are authorized to Extra class control operators?
A. 14.100-14.175 MHz and 14.150-14.175 MHz
B. 14.000-14.125 MHz and 14.250-14.300 MHz
C. 14.025-14.050 MHz and 14.100-14.150 MHz
D. 14.000-14.025 MHz and 14.150-14.175 MHz

E1A05 @E1A05 (C) [97.301b]
What exclusive frequency privileges in the 15-meter band are authorized to Extra class control operators?
A. 21.000-21.200 MHz and 21.250-21.270 MHz
B. 21.050-21.100 MHz and 21.150-21.175 MHz
C. 21.000-21.025 MHz and 21.200-21.225 MHz
D. 21.000-21.025 MHz and 21.250-21.275 MHz

E1A06 @E1A08 (D) [97.307c]
What must an amateur licensee do if a spurious emission from his or her station causes harmful interference to the reception of another radio station?
A. Pay a fine each time it happens
B. Submit a written explanation to the FCC
C. Forfeit the station license if it happens more than once
D. Eliminate or reduce the interference

E1A07 @A1A08 (A) [97.307d]
What is the maximum mean power permitted for any spurious emission from a transmitter or external RF power amplifier transmitting on a frequency below 30 MHz?
A. 50 mW
B. 100 mW
C. 10 mW
D. 10 W

E1A08 @A1A09 (B) [97.307d]
How much below the mean power of the fundamental emission must any spurious emissions from a station transmitter or external RF power amplifier transmitting on a frequency below 30 MHz be attenuated?
A. At least 10 dB
B. At least 40 dB
C. At least 50 dB
D. At least 100 dB

E1A09 @A1A10 (C) [97.307e]
How much below the mean power of the fundamental emission must any spurious emissions from a transmitter or external RF power amplifier transmitting on a frequency between 30 and 225 MHz be attenuated?
A. At least 10 dB
B. At least 40 dB
C. At least 60 dB
D. At least 100 dB

E1A10 @A1A11 (D) [97.307e]
What is the maximum mean power permitted for any spurious emission from a transmitter having a mean power of 25 W or less on frequencies between 30 and 225 MHz?

A. 5 microwatts
B. 10 microwatts
C. 20 microwatts
D. 25 microwatts

E1A11 @E1A06 (B) [97.219b&d]
If a packet bulletin board station in a message forwarding system inadvertently forwards a message that is in violation of FCC rules, who is accountable for the rules violation?
A. The control operator of the packet bulletin board station
B. The control operator of the originating station and conditionally the first forwarding station
C. The control operators of all the stations in the system
D. The control operators of all the stations in the system not authenticating the source from which they accept communications

E1A12 @E1A07 (A) [97.219c]
If your packet bulletin board station inadvertently forwards a communication that violates FCC rules, what is the first action you should take?
A. Discontinue forwarding the communication as soon as you become aware of it
B. Notify the originating station that the communication does not comply with FCC rules
C. Notify the nearest FCC Field Engineer's office
D. Discontinue forwarding all messages

E1A13 @E1A11 (D) [97.27]
Why might the FCC modify an amateur station license?
A. To relieve crowding in certain bands
B. To better prepare for a time of national emergency
C. To enforce a radio quiet zone within one mile of an airport
D. To promote the public interest, convenience and necessity

E1A14 @E1A12 (A) [97.11a]
If an amateur station is installed on board a ship or aircraft and is separate from the main radio installation, what condition must be met before the station is operated?
A. Its operation must be approved by the master of the ship or the pilot in command of the aircraft
B. Its antenna must be separate from the main ship or aircraft antennas, transmitting only when the main radios are not in use
C. It must have a power supply that is completely independent of the main ship or aircraft power supply
D. Its operator must have an FCC Marine or Aircraft endorsement on his or her amateur license

E1A15 @E1A13 (B) [97.11]
What type of FCC-issued license or permit is required to transmit amateur communications from a vessel registered in the US while in international waters?
A. Any amateur license with an FCC Marine or Aircraft endorsement
B. Any amateur license or reciprocal permit for alien amateur licensee
C. Any General class or higher license
D. An Extra class license

E1A16 @E1A14 (D) [97.211b]
When may a station use special codes intended to obscure the meaning of messages?
A. Never under any circumstances
B. Only when a Special Temporary Authority has been obtained from the FCC
C. Only when an Extra class operator is controlling the station
D. When sending telecommand messages to a station in space operation

E1B Station restrictions: restrictions on station locations; restricted operation; teacher as control operator; station antenna structures; definition and operation of remote control and automatic control; control link

E1B01 @E1B01 (A) [97.13a]
Which of the following factors might restrict the physical location of an amateur operator's station equipment or antenna structure?
A. The land may have environmental importance; or it is significant in American history, architecture or culture
B. The location's political or societal importance
C. The location's geographical or horticultural importance
D. The location's international importance, requiring consultation with one or more foreign governments before installation

E1B02 @E1B02 (A) [97.13b]
Outside of what distance from an FCC monitoring facility may an amateur station be located without concern for protecting the facility from harmful interference?
A. 1 mile
B. 3 miles
C. 10 miles
D. 30 miles

E1B03 @E1B03 (C) [97.13a]
What must be done before an amateur station is placed within an officially designated wilderness area or wildlife preserve, or an area listed in the National Register of Historical Places?
A. A proposal must be submitted to the National Park Service
B. A letter of intent must be filed with the National Audubon Society
C. An Environmental Assessment must be submitted to the FCC
D. A form FSD-15 must be submitted to the Department of the Interior

E1B04 @E1B04 (A) [97.121a]
If an amateur station interferes with the reception of broadcast stations on a well-engineered receiver, during what hours shall the amateur station NOT be operated on the interfering frequencies?
A. Daily from 8 PM to 10:30 PM local time and additionally from 10:30 AM to 1 PM on Sunday
B. Daily from 6 PM to 12 AM local time and additionally from 8 AM to 5 PM on Sunday
C. Daily for any continuous span of at least 2.5 hours and for at least 5 continuous hours on Sunday
D. Daily for any continuous span of at least 6 hours and for at least 9 continuous hours on Sunday

E1B05 @E1B05 (D) [97.121a]
If an amateur station causes interference to the reception of a

domestic broadcast station with a receiver of good engineering design, on what frequencies may the operation of the amateur station be restricted?
A. On the frequency used by the domestic broadcast station
B. On all frequencies below 30 MHz
C. On all frequencies above 30 MHz
D. On the interfering amateur frequency or frequencies

E1B06 @E1B06 (C) [97.113c]
When may a paid professional teacher be the control operator of an amateur station used in the teacher's classroom?
A. Only when the teacher is not paid during periods of time when an amateur station is used
B. Only when the classroom is in a correctional institution
C. Only when the station is used by that teacher as a part of classroom instruction at an educational institution
D. Only when the station is restricted to making contacts with similar stations at other educational institutions

E1B07 @E1B07 (B) [97.113c]
Who may accept compensation when acting as a control operator in a classroom?
A. Any licensed amateur
B. Only teachers at educational institutions
C. Only teachers at correctional institutions
D. Only students at educational or correctional institutions

E1B08 @E1B08 (D) [97.15b]
*Modified Rules citation for Rules changes
What limits must state and local authorities observe when legislating height and dimension restrictions for amateur antenna structures?
A. FAA regulations specify a minimum height for amateur antenna structures located near airports
B. FCC regulations specify a 200 foot minimum height for amateur antenna structures
C. State and local restrictions of amateur antenna structures are not allowed
D. PRB-1 specifies that authorities must reasonably accommodate the installation of amateur antenna structures

E1B09 @E1B09 (B) [97.15]
If an amateur antenna structure is located in a valley or canyon, what height restrictions apply?
A. The structure must not extend more that 200 feet above average height of the terrain
B. The structure must be no higher than 200 feet above ground level at its site
C. There are no height restrictions since the structure would not be a hazard to aircraft in a valley or canyon
D. The structure must not extend more that 200 feet above the top of the valley or canyon

E1B10 @E1B11 (D) [97.15]
*Modified Rules citation for Rules changes.
What kind of approval is required before erecting an amateur antenna located near an airport as defined in the FCC rules?
A. The FAA and FCC both must approve any type of antenna structure

located near an airport
B. Approval must be obtained from the airport manager
C. Approval must be obtained from the local zoning authorities
D. The FCC must approve an antenna structure that is higher than 20 feet above any natural or existing man made structure

E1B11 @E1B12 (C) [97.15]
What special restrictions does the FCC impose on amateur antennas mounted on motor vehicles?
A. Such antennas may not extend more than 15 feet above the roof of the vehicle
B. Complex antennas, such as a Yagi or quad beam, may not be installed on motor vehicles
C. None
D. Such antennas must comply with the recommendations of the vehicle manufacturer

E1B12 @A1E10 (C) [97.15a]
What must an amateur obtain before installing an antenna structure more than 200 feet high?
A. An environmental assessment
B. A Special Temporary Authorization
C. Prior FCC approval
D. An effective radiated power statement

E1B13 @A1B01 (D) [97.3a38]
*Modified Rules citation for Rules changes
What is meant by a remotely controlled station?
A. A station operated away from its regular home location
B. Control of a station from a point located other than at the station transmitter
C. A station operating under automatic control
D. A station controlled indirectly through a control link

E1B14 @A1B03 (A) [97.201d,97.203d,97.205d]
Which kind of station operation may not be automatically controlled?
A. Control of a model craft
B. Beacon operation
C. Auxiliary operation
D. Repeater operation

E1B15 @A1B05 (A) [97.3a6]
What is meant by automatic control of a station?
A. The use of devices and procedures for control so that a control operator does not have to be present at a control point
B. A station operating with its output power controlled automatically
C. Remotely controlling a station such that a control operator does not have to be present at the control point at all times
D. The use of a control link between a control point and a locally controlled station

E1B16 @A1B06 (B) [97.3a6]
How do the control operator responsibilities of a station under automatic control differ from one under local control?
A. Under local control there is no control operator
B. Under automatic control a control operator is not required to be present at a control point

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

E1B17 @A1B14 (C) [97.3a38]
*Modified Rules citation for Rules changes
What is a control link?
A. A device that automatically controls an unattended station
B. An automatically operated link between two stations
C. The means of control between a control point and a remotely controlled station
D. A device that limits the time of a station's transmission

E1B18 @A1B15 (D) [97.3a38]
*Modified Rules citation for Rules changes
What is the term for apparatus to effect remote control between a control point and a remotely controlled station?
A. A tone link
B. A wire control
C. A remote control
D. A control link

E1C Reciprocal operating: definition of reciprocal operating permit; purpose of reciprocal agreement rules; alien control operator privileges; identification; application for reciprocal permit; reciprocal permit license term (Note: This includes CEPT and IARP.)

E1C01 @E1C01 (A) [97.5c, d, e, 97.107]
*Modified Rules citation, Q for Rules changes.
What is an FCC authorization for alien reciprocal operation?
A. An FCC authorization to a holder of an amateur license issued by certain foreign governments to operate an amateur station in the US
B. An FCC permit to allow a US licensed amateur to operate in a foreign nation, except Canada
C. An FCC permit allowing a foreign licensed amateur to handle third-party traffic between the US and the amateur's own nation
D. An FCC agreement with another country allowing the passing of third-party traffic between amateurs of the two nations

E1C02 @E1C02 (B) [97.107]
*Modified Rule Citation and Q, B, C for new rules.
Who is eligible for an FCC authorization for alien reciprocal operation?
A. Anyone holding a valid amateur license issued by a foreign government
B. Any non-US citizen holding an amateur license issued by a foreign government with which the US has a reciprocal operating arrangement
C. Anyone holding a valid amateur license issued by a foreign government with which the US has a reciprocal operating arrangement
D. Any non-US citizen holding a valid amateur or shortwave listener's license issued by a foreign government

E1C03 @E1C03 (C) [97.107]
*Modified Rule Citation and Q, A for new rules.
What operator frequency privileges are authorized by an FCC authorization for alien reciprocal operation?

A. Those authorized to a holder of the equivalent US amateur license, unless the FCC specifies otherwise by endorsement on the authorization
B. Those that the holder of the permit would have in their own country
C. Those authorized to US amateurs that the holder of the permit would have in their own country, unless the FCC specifies otherwise
D. Only those frequencies approved by the International Amateur Radio Union, unless the FCC specifies otherwise

E1C04 @E1C04 (D) [97.119g]
*Modified Rule Citation and Q for new rules.
What additional station identification, in addition to his or her own call sign, does an alien operator supply when operating in the US under an FCC authorization for alien reciprocal operation?
A. No additional identification is required
B. The grid-square locator closest to his or her present location is included before the call
C. The serial number of the permit and the call-letter district number of the station location is included before the call
D. The letter-numeral indicating the station location in the US is included before their own call and closest city and state

E1C05 @E1C05 (A) [97.107]
*Modified Rule Citation and Q for new rules.
When may a US citizen holding a foreign amateur license obtain an FCC authorization for alien reciprocal operation?
A. Never; US citizens are not eligible
B. When the citizen has imported his or her equipment from the foreign country
C. When the citizen has never held a US amateur license
D. When the citizen has no current US amateur license

E1C06 @E1C07 (A) [97.107]
*Modified Rule Citation and Q for new rules.
Which of the following would disqualify a foreign amateur from being eligible for a US authorization for alien reciprocal operation?
A. Holding only an amateur license issued by a country but not being a citizen of that country
B. Citizenship in their own country but not US citizenship
C. Holding only an amateur license issued by their own country but holding no US amateur license
D. Holding an amateur license issued by their own country granting them frequency privileges beyond US Extra class privileges

E1C07 @E1C08 (B) [97.107a]
*Modified Rule Citation and Q, A for new rules.
What special document is required before a Canadian citizen holding a Canadian amateur license may operate in the US?
A. All aliens, including Canadians, must obtain an FCC authorization for alien reciprocal operation
B. No special document is required
C. The citizen must have an FCC-issued validation of their Canadian license
D. The citizen must have an FCC-issued Certificate of US License Grant without Examination to operate for a period longer than 10 days

E1C08 @New (C) [97.107b]
What operating privileges does a properly licensed alien amateur have in the US, if the US and the alien amateur's home country have a multilateral or bilateral reciprocal operating agreement?
A. All privileges of their home license
B. All privileges of a US Amateur Extra license
C. Those granted by their home license that match US privileges, not to exceed the operating privileges of an Amateur Extra license
D. Those granted by their home license that match US privileges authorized to amateurs operating in ITU Region 1

E1C09 @New (D) [97.5c]
From which locations may a licensed alien amateur be a control operator?
A. Only locations within the boundaries of the 50 United States
B. Only locations listed as the primary station location on a US amateur license
C. Only locations on ground within the US and its territories; no shipboard or aeronautical mobile operation is permitted
D. Any location where the amateur service is regulated by the FCC

E1C10 @New (A) [97.5d]
Which of the following multilateral or bilateral operating arrangements allow US amateurs to operate in many European countries and alien amateurs from many European countries to operate in the US?
A. CEPT agreement
B. IARP agreement
C. ITU agreement
D. All these choices are correct

E1C11 @New (B) [97.5e]
Which of the following multilateral or bilateral operating arrangements allow US amateurs and many Central and South American amateurs to operate in each others' countries?
A. CEPT agreement
B. IARP agreement
C. ITU agreement
D. All of these choices are correct

E1D Radio Amateur Civil Emergency Service (RACES): definition; purpose; station registration; station license required; control operator requirements; control operator privileges; frequencies available; limitations on use of RACES frequencies; points of communication for RACES operation; permissible communications

E1D01 @E1D01 (B) [97.3a37]
*Modified Rules citation for Rules changes.
What is RACES?
A. An amateur network for providing emergency communications during athletic races
B. The Radio Amateur Civil Emergency Service
C. The Radio Amateur Corps for Engineering Services
D. An amateur network for providing emergency communications during boat or aircraft races

E1D02 @E1D02 (A) [97.3a37]
*Modified Rules citation for Rules changes.

What is the purpose of RACES?
A. To provide civil-defense communications during emergencies
B. To provide emergency communications for boat or aircraft races
C. To provide routine and emergency communications for athletic races
D. To provide routine and emergency military communications

E1D03 @E1D03 (C) [97.407a]
*Modified Q for apparent typo. RACES registration changed to RACES operation
With what other organization must an amateur station be registered before RACES operation is permitted?
A. The Amateur Radio Emergency Service
B. The US Department of Defense
C. A civil defense organization
D. The FCC Field Operations Bureau

E1D04 @E1D04 (C) [97.407a]
*Modified B, D to change Novice to Technician.
Which amateur stations may be operated in RACES?
A. Only Extra class amateur stations
B. Any licensed amateur station (except a station licensed to a Technician)
C. Any licensed amateur station certified by the responsible civil defense organization
D. Any licensed amateur station (except a station licensed to a Technician) certified by the responsible civil defense organization

E1D05 @E1D05 (D) [97.21a1]
*Modified A, B, C, D for Rules changes.
Application for modification of a RACES license must be made on what FCC form, and sent to what FCC office?
A. Form 605, sent to Washington, DC
B. Form 605, sent to Gettysburg, PA
C. Form 610-A, sent to Washington, DC
D. A Club Call Sign Administrator must submit the information to the FCC in an electronic batch file

E1D06 @E1D06 (D) [97.407a]
Who may be the control operator of a RACES station?
A. Anyone who holds an FCC-issued amateur license other than Novice
B. Only an Extra class licensee
C. Anyone who holds an FCC-issued amateur license other than Novice and is certified by a civil defense organization
D. Anyone who holds an FCC-issued amateur license and is certified by a civil defense organization

E1D07 @E1D07 (A) [97.407b]
What additional operator privileges are granted to an Extra class operator registered with RACES?
A. None
B. CW operations on 5167.5 kHz
C. Unattended HF packet-radio station operations
D. 237-MHz civil defense band operations

E1D08 @E1D08 (D) [97.407b]
What frequencies are normally available for RACES operation?
A. Only those frequencies authorized to civil defense organizations

B. Only those frequencies authorized to emergency military communications
C. Only the top 25 kHz of each amateur frequency band
D. All frequencies available to the amateur service

E1D09 @E1D09 (A) [97.407b]
What type of emergency can cause limits to be placed on the frequencies available for RACES operation?
A. An emergency in which the President invokes the War Emergency Powers under the provisions of the Communications Act of 1934
B. An emergency in only one state in the US would limit RACES operations to a single HF frequency band
C. An emergency confined to a 25-mile area would limit RACES operations to a single VHF band
D. An emergency involving no immediate danger of loss of life

E1D10 @E1D10 (B) [97.407c,d]
*Modified A to change "Novices" to "Technician class operators."
With what stations may amateur RACES stations communicate?
A. Any RACES stations and any amateur stations except stations licensed to Technician class operators
B. Any RACES stations and certain other stations authorized by the responsible civil defense official
C. Any amateur station or a station in the Disaster Communications Service
D. Any amateur station and any military emergency station

E1D11 @E1D11 (C) [97.407e]
What are permissible communications in RACES?
A. Any type of communications when there is no emergency
B. Any Amateur Radio Emergency Service communications
C. National defense or immediate safety of people and property and communications authorized by the area civil defense organization
D. National defense and security or immediate safety of people and property communications authorized by the President

E1E Amateur Satellite Service: definition; purpose; station license required for space station; frequencies available; telecommand operation: definition; eligibility; telecommand station (definition); space telecommand station; special provisions; telemetry: definition; special provisions; space station: definition; eligibility; special provisions; authorized frequencies (space station); notification requirements; earth operation: definition; eligibility {97.209(a)}; authorized frequencies (Earth station)

E1E01 @E1E01 (C) [97.3a3]
What is the Amateur Satellite Service?
A. A radio navigation service using stations on earth satellites for the same purposes as those of the amateur service
B. A radio communication service using stations on earth satellites for weather information gathering
C. A radio communication service using stations on earth satellites for the same purpose as those of the amateur service
D. A radio location service using stations on earth satellites for amateur radar experimentation

E1E02 @E1E02 (A) [97.207]

Which HF amateur bands have frequencies available for space operation?
A. Only 40 m, 20 m, 17 m, 15 m, 12 m and 10 m
B. Only 40 m, 30 m, 20 m, 15 m and 10 m
C. Only 40 m, 30 m, 20 m, 15 m, 12 m and 10 m
D. All HF bands, but only in the Extra class segments

E1E03 @New (D) [97.207]
*New question to replace previous possibly defective question.
Which of the following types of communications may space stations transmit?
A. Automatic retransmission of signals from Earth stations and other space stations
B. One way communications
C. Telemetry consisting of specially coded messages
D. All of these choices are correct

E1E04 @E1E04 (B) [97.3a44]
*Modified Rules citation for Rules changes.
What type of amateur station operation transmits communications used to initiate, modify or terminate the functions of a space station?
A. Space operation
B. Telecommand operation
C. Earth operation
D. Control operation

E1E05 @E1E05 (D) [97.211a]
*Modified A to replace Novice with Technician.
Which amateur stations are eligible to be telecommand stations?
A. Any except those of Technician licensees
B. Only those of Extra class licensees
C. Only a station operated by the space station licensee
D. Any station designated by the space station licensee

E1E06 @E1E06 (C) [97.207f]
What term does the FCC use for space-to-earth transmissions used to communicate the results of measurements made by a space station?
A. Data transmission
B. Frame check sequence
C. Telemetry
D. Telecommand

E1E07 @E1E07 (B) [97.3a40]
*Modified Rules citation for Rules changes.
What is the term used to describe the operation of an amateur station that is more than 50 km above the earth's surface?
A. EME station operation
B. Space station operation
C. Downlink station operation
D. Ionospheric station operation

E1E08 @E1E08 (D) [97.207a]
*Modified A to change Novice to Technician.
Which amateur stations are eligible for space operation?
A. Any except those of Technician licensees
B. Only those of General, Advanced or Extra class licensees
C. Only those of Extra class licensees
D. Any amateur station

E1E09 @E1E09 (D) [97.207g]
Before initiating space station transmissions, by when must the licensee of the station give the FCC prior written pre-space notification?
A. Before 3 months and before 72 hours
B. Before 6 months and before 3 months
C. Before 12 months and before 3 months
D. Before 27 months and before 5 months

E1E10 @E1E10 (C) [97.207h]
After space station transmissions are initiated, by when must the licensee of the station give the FCC written in-space notification?
A. Within 24 hours
B. Within 72 hours
C. Within 7 days
D. Within 30 days

E1E11 @E1E11 (D) [97.207i]
After space station transmissions are terminated, by when must the licensee of the station normally give the FCC written post-space notification?
A. No later than 48 hours
B. No later than 72 hours
C. No later than 7 days
D. No later than 3 months

E1E12 @E1E12 (B) [97.3a16]
*Modified Rules citation for Rules changes.
What term describes an amateur station located on or within 50 km of earth's surface intended for communications with space stations?
A. Telecommand station
B. Earth station
C. Telemetry station
D. Auxiliary station

E1F Volunteer Examiner Coordinators (VECs): definition; VEC qualifications; VEC agreement; scheduling examinations; coordinating VEs; reimbursement for expenses {97.527}; accrediting VEs; question pools; Volunteer Examiners (VEs): definition; requirements; accreditation; reimbursement for expenses; VE conduct; preparing an examination; examination elements; definition of code and written elements; preparation responsibility; examination requirements; examination credit; examination procedure; examination administration; temporary operating authority

E1F01 @E1F01 (C) [97.521]
What is a Volunteer Examiner Coordinator?
A. A person who has volunteered to administer amateur license examinations
B. A person who has volunteered to prepare amateur license examinations
C. An organization that has entered into an agreement with the FCC to coordinate amateur license examinations given by Volunteer Examiners
D. An organization that has entered into an agreement with the FCC to coordinate the preparation of amateur license examinations

E1F02 @E1F02 (A) [97.519, 97.521, 97.523]
*Modified B for Rules changes
Which of the following is NOT among the functions of a VEC?
A. Prepare and administer amateur operator license examinations, grade examinee's answers and inform examinees of their pass/fail results
B. Collect FCC Forms 605 documents and test results from the administering VEs
C. Assure that all desiring an amateur operator license examination are registered without regard to race, sex, religion or national origin
D. Cooperate in maintaining a pool of questions for each written amateur examination element

E1F03 @E1F03 (B) [97.521]
Which of the following is NOT among the qualifying requirements to be a VEC?
A. Be an organization that exists for the purpose of furthering the amateur service
B. Be engaged in the manufacture and/or sale of amateur station equipment or amateur license preparation materials
C. Agree to coordinate examinations for all classes of amateur operator licenses
D. Agree to administer amateur operator license examinations in accordance with FCC Rules throughout at least one call-letter district

E1F04 @E1F06 (B) [97.519a]
*Modified Q for awkward sentence (preparing to preparation)
What organization coordinates the preparation and administration of amateur license examinations?
A. The FCC
B. A VEC
C. A group of three or more volunteers
D. A local radio club

E1F05 @E1F09 (A) [97.525a4]
Under what circumstances may a VEC refuse to accredit a person as a Volunteer Examiner?
A. If the VEC determines that questions of the person's integrity or honesty could compromise amateur license examinations
B. If the VEC determines that the person is a Volunteer Examiner for another VEC
C. If the prospective VE is not a member of a club actively engaged in the preparation and administration of amateur license examinations
D. If the prospective VE is a citizen of a foreign country

E1F06 @E1F11 (C) [97.523]
Where are the questions listed that must be used in all written US amateur license examinations?
A. In the instructions each VEC gives to their VEs
B. In an FCC-maintained question pool
C. In the VEC-maintained question pool
D. In the appropriate FCC Report and Order

E1F07 @E1G01 (B) [97.525]
What is an accredited VE?
A. An amateur operator who is approved by three or more fellow VEs to

administer amateur license examinations
B. An amateur operator who is approved by a VEC to administer amateur operator license examinations
C. An amateur operator who administers amateur license examinations for a fee
D. An amateur operator who is approved by an FCC staff member to administer amateur license examinations

E1F08 @E1G02 (D) [97.509b1, 97.525]
What is the VE accreditation process?
A. General and higher class licensees are automatically allowed to conduct amateur license examinations once their license is granted
B. The FCC tests volunteers who wish to conduct amateur license examinations
C. A prospective VE requests permission from three or more already accredited VEs to administer amateur license examinations
D. Each VEC ensures its Volunteer Examiner applicants meet FCC requirements to serve as VEs

E1F09 @E1G04 (C) [97.509b4]
Which persons seeking to be VEs cannot be accredited?
A. Persons holding less than an Advanced class license
B. Persons less than 21 years of age
C. Persons who have ever had their amateur licenses suspended or revoked
D. Persons who are employees of the federal government

E1F10 @E1G08 (A) [97.527a]
For what type of services may a VE be reimbursed for out-of-pocket expenses?
A. Preparing, processing or administering amateur license examinations
B. Teaching and administering amateur license study courses
C. None; a VE cannot be reimbursed for out-of-pocket expenses
D. Purchasing and distributing amateur license preparation materials

E1F11 @E1G09 (A) [97.509e, 97.527b]
How much money beyond reimbursement for out-of-pocket expenses may a person accept for serving as a VE?
A. None
B. Up to the national minimum hourly wage times the number of hours spent serving as a VE
C. Up to the maximum fee per applicant set by the FCC each year
D. As much as applicants are willing to donate

E1F12 @E1G10 (B) [97.507a, b, c]
*Modified Q, B for Rules changes
Who may prepare an Element 2 amateur operator license examination?
A. A VEC that selects questions from the appropriate FCC bulletin
B. A Technician, General, Advanced, or Extra class VE or a qualified supplier that selects questions from the appropriate VEC question pool
C. An Extra class VE who selects questions from the appropriate FCC bulletin
D. The FCC, which selects questions from the appropriate VEC question pool

E1F13 @E1G11 (C) [97.507a, b, c]
*Modified Q, A for Rules changes
Who may prepare an Element 3 amateur operator license examination?
A. Only an Extra class VE who selects questions from the appropriate FCC bulletin
B. A VEC that selects questions from the appropriate FCC bulletin
C. An Advanced or Extra class VE or a qualified supplier that selects questions from the appropriate VEC question pool
D. The, FCC which selects questions from the appropriate VEC question pool

E1F14 @E1G12 (D) [97.507a, b, c]
*Modified Q for Rules changes
Who may prepare an Element 4 amateur operator license examination?
A. The FCC, which selects questions from the appropriate VEC question pool
B. A VEC that selects questions from the appropriate FCC bulletin
C. An Extra class VE that selects questions from the appropriate FCC bulletin
D. An Extra class VE or a qualified supplier who selects questions from the appropriate VEC question pool

E1F15 @E1H01 (C) [97.505a6]
What amateur operator license examination credit must be given for a valid Certificate of Successful Completion of Examination (CSCE)?
A. Only the written elements the CSCE indicates the examinee passed
B. Only the telegraphy elements the CSCE indicates the examinee passed
C. Each element the CSCE indicates the examinee passed
D. No credit

E1F16 @E1H02 (A) [97.509c]
Where must Volunteer Examiners be while they are conducting an amateur license examination?
A. They must all be present and observing the candidate(s) throughout the entire examination
B. They must all leave the room after handing out the exams to allow the candidate(s) to concentrate on the exam material
C. They may be anywhere as long as at least one VE is present and is observing the candidate(s) throughout the entire examination
D. They may be anywhere as long as they are listed as having participated in the examination

E1F17 @E1H03 (C) [97.509c]
Who is responsible for the proper conduct and necessary supervision during an amateur operator license examination session?
A. The VEC coordinating the session
B. The FCC
C. The administering Volunteer Examiners
D. The Volunteer Examiner in charge of the session

E1F18 @E1H04 (B) [97.509c]
What should a VE do if a candidate fails to comply with the examiner's instructions during an amateur operator license examination?
A. Warn the candidate that continued failure to comply will result in termination of the examination
B. Immediately terminate the candidate's examination

C. Allow the candidate to complete the examination, but invalidate the results
D. Immediately terminate everyone's examination and close the session

E1F19 @E1H05 (C) [97.509h]
What must be done with the test papers of each element completed by the candidates(s) at an amateur operator license examination?
A. They must be collected and graded by the administering VEs within 10 days of the examination
B. They must be collected and sent to the coordinating VEC for grading within 10 days of the examination
C. They must be collected and graded immediately by the administering VEs
D. They must be collected and sent to the FCC for grading within 10 days of the examination

E1F20 @E1H06 (A) [97.509j]
What must the VEs do if an examinee for an amateur operator license does not score a passing grade on all examination elements needed for an upgrade?
A. Return the application document to the examinee and inform the examinee of the grade(s)
B. Return the application document to the examinee and inform the examinee which questions were incorrectly answered
C. Simply inform the examinee of the failure(s)
D. Inform the examinee which questions were incorrectly answered and show how the questions should have been answered

E1G Type acceptance of external RF power amplifiers and external RF power amplifier kits; Line A; National Radio Quiet Zone; business communications; definition and operation of spread spectrum; auxiliary station operation

E1G01 @A1C01 (D) [97.315a]
How many external RF amplifiers of a particular design capable of operation below 144 MHz may an unlicensed, non-amateur build or modify in one calendar year without obtaining a grant of Certification?
A. 1
B. 5
C. 10
D. None

E1G02 @A1C02 (B) [97.315c]
If an RF amplifier manufacturer was granted Certification for one of its amplifier models for amateur use, what would this allow the manufacturer to market?
A. All current models of their equipment
B. Only that particular amplifier model
C. Any future amplifier models
D. Both the current and any future amplifier models

E1G03 @A1C03 (A) [97.315b5]
Under what condition may an equipment dealer sell an external RF power amplifier capable of operation below 144 MHz if it has not been granted FCC certification?
A. If it was purchased in used condition from an amateur operator and is sold to another amateur operator for use at that operator's station

B. If it was assembled from a kit by the equipment dealer
C. If it was imported from a manufacturer in a country that does not require type acceptance of RF power amplifiers
D. If it was imported from a manufacturer in another country, and it was type accepted by that country's government

E1G04 @A1C04 (D) [97.317a1]
Which of the following is one of the standards that must be met by an external RF power amplifier if it is to qualify for a grant of FCC Certification?
A. It must produce full legal output when driven by not more than 5 watts of mean RF input power
B. It must be capable of external RF switching between its input and output networks
C. It must exhibit a gain of 0 dB or less over its full output range
D. It must satisfy the spurious emission standards when operated at its full output power

E1G05 @A1C05 (D) [97.317a2]
Which of the following is one of the standards that must be met by an external RF power amplifier if it is to qualify for a grant of Certification?
A. It must produce full legal output when driven by not more than 5 watts of mean RF input power
B. It must be capable of external RF switching between its input and output networks
C. It must exhibit a gain of 0 dB or less over its full output range
D. It must satisfy the spurious emission standards when placed in the "standby" or "off" position, but is still connected to the transmitter

E1G06 @A1C06 (C) [97.317b]
Which of the following is one of the standards that must be met by an external RF power amplifier if it is to qualify for a grant of Certification?
A. It must produce full legal output when driven by not more than 5 watts of mean RF input power
B. It must exhibit a gain of at least 20 dB for any input signal
C. It must not be capable of operation on any frequency between 24 MHz and 35 MHz
D. Any spurious emissions from the amplifier must be no more than 40 dB stronger than the desired output signal

E1G07 @A1C07 (B) [97.317a3]
Which of the following is one of the standards that must be met by an external RF power amplifier if it is to qualify for a grant of Certification?
A. It must have a time-delay circuit to prevent it from operating continuously for more than ten minutes
B. It must satisfy the spurious emission standards when driven with at least 50 W mean RF power (unless a higher drive level is specified)
C. It must not be capable of modification by an amateur operator without voiding the warranty
D. It must exhibit no more than 6 dB of gain over its entire operating range

E1G08 @A1C08 (A) [97.317c1]
Which of the following would disqualify an external RF power amplifier

from being granted Certification?
A. Any accessible wiring which, when altered, would permit operation of the amplifier in a manner contrary to FCC Rules
B. Failure to include a schematic diagram and theory of operation manual that would permit an amateur to modify the amplifier
C. The capability of being switched by the operator to any amateur frequency below 24 MHz
D. Failure to produce 1500 watts of output power when driven by at least 50 watts of mean input power

E1G09 @A1C09 (C) [97.317c8]
Which of the following would disqualify an external RF power amplifier from being granted Certification?
A. Failure to include controls or adjustments that would permit the amplifier to operate on any frequency below 24 MHz
B. Failure to produce 1500 watts of output power when driven by at least 50 watts of mean input power
C. Any features designed to facilitate operation in a telecommunication service other than the Amateur Service
D. The omission of a schematic diagram and theory of operation manual that would permit an amateur to modify the amplifier

E1G10 @A1C10 (D) [97.317c3]
Which of the following would disqualify an external RF power amplifier from being granted Certification?
A. The omission of a safety switch in the high-voltage power supply to turn off the power if the cabinet is opened
B. Failure of the amplifier to exhibit more than 15 dB of gain over its entire operating range
C. The omission of a time-delay circuit to prevent the amplifier from operating continuously for more than ten minutes
D. The inclusion of instructions for operation or modification of the amplifier in a manner contrary to the FCC Rules

E1G11 @A1C11 (B) [97.317b2]
Which of the following would disqualify an external RF power amplifier from being granted Certification?
A. Failure to include a safety switch in the high-voltage power supply to turn off the power if the cabinet is opened
B. The amplifier produces 3 dB of gain for input signals between 26 MHz and 28 MHz
C. The inclusion of a schematic diagram and theory of operation manual that would permit an amateur to modify the amplifier
D. The amplifier produces 1500 watts of output power when driven by at least 50 watts of mean input power

SUBELEMENT E2 -- OPERATING PROCEDURES [4 Exam Questions -- 4 Groups]

E2A Amateur Satellites: Orbital mechanics; Frequencies available for satellite operation; Satellite hardware; Operating through amateur satellites

E2A01 @E2A01 (C)
What is the direction of an ascending pass for an amateur satellite?
A. From west to east
B. From east to west
C. From south to north

D. From north to south

E2A02 @E2A02 (A)
What is the direction of a descending pass for an amateur satellite?
A. From north to south
B. From west to east
C. From east to west
D. From south to north

E2A03 @E2A03 (C)
What is the period of an amateur satellite?
A. The point of maximum height of a satellite's orbit
B. The point of minimum height of a satellite's orbit
C. The amount of time it takes for a satellite to complete one orbit
D. The time it takes a satellite to travel from perigee to apogee

E2A04 @E2A04 (D)
What are the receiving and retransmitting frequency bands used for Mode A in amateur satellite operations?
A. Satellite receiving on 10 meters and retransmitting on 2 meters
B. Satellite receiving on 70 centimeters and retransmitting on 2 meters
C. Satellite receiving on 70 centimeters and retransmitting on 10 meters
D. Satellite receiving on 2 meters and retransmitting on 10 meters

E2A05 @E2A05 (B)
What are the receiving and retransmitting frequency bands used for Mode B in amateur satellite operations?
A. Satellite receiving on 10 meters and retransmitting on 2 meters
B. Satellite receiving on 70 centimeters and retransmitting on 2 meters
C. Satellite receiving on 70 centimeters and retransmitting on 10 meters
D. Satellite receiving on 2 meters and retransmitting on 10 meters

E2A06 @E2A06 (C)
What are the receiving and retransmitting frequency bands used for Mode J in amateur satellite operations?
A. Satellite receiving on 70 centimeters and retransmitting on 2 meters
B. Satellite receiving on 2 meters and retransmitting on 10 meters
C. Satellite receiving on 2 meters and retransmitting on 70 centimeters
D. Satellite receiving on 70 centimeters and transmitting on 10 meters

E2A07 @E2A07 (D)
What are the receiving and retransmitting frequency bands used for Mode L in amateur satellite operations?
A. Satellite receiving on 70 centimeters and retransmitting on 10 meters
B. Satellite receiving on 10 meters and retransmitting on 70 centimeters
C. Satellite receiving on 70 centimeters and retransmitting on 23 centimeters
D. Satellite receiving on 23 centimeters and retransmitting on 70

centimeters

E2A08 @E2A08 (B)
What is a linear transponder?
A. A repeater that passes only linear or CW signals
B. A device that receives and retransmits signals of any mode in a certain passband
C. An amplifier that varies its output linearly in response to input signals
D. A device which responds to satellite telecommands and is used to activate a linear sequence of events

E2A09 @E2A09 (D)
What is the name of the effect which causes the downlink frequency of a satellite to vary by several kHz during a low-earth orbit because the distance between the satellite and ground station is changing?
A. The Kepler effect
B. The Bernoulli effect
C. The Einstein effect
D. The Doppler effect

E2A10 @E2A10 (A)
Why does the received signal from a Phase 3 amateur satellite exhibit a fairly rapid pulsed fading effect?
A. Because the satellite is rotating
B. Because of ionospheric absorption
C. Because of the satellite's low orbital altitude
D. Because of the Doppler effect

E2A11 @E2A11 (B)
What type of antenna can be used to minimize the effects of spin modulation and Faraday rotation?
A. A nonpolarized antenna
B. A circularly polarized antenna
C. An isotropic antenna
D. A log-periodic dipole array

E2B Television: fast scan television (FSTV) standards; slow scan television (SSTV) standards; facsimile (fax) communications

E2B01 @E2B01 (A)
How many times per second is a new frame transmitted in a fast-scan television system?
A. 30
B. 60
C. 90
D. 120

E2B02 @E2B02 (C)
How many horizontal lines make up a fast-scan television frame?
A. 30
B. 60
C. 525
D. 1050

E2B03 @E2B03 (D)
How is the interlace scanning pattern generated in a fast-scan

television system?
A. By scanning the field from top to bottom
B. By scanning the field from bottom to top
C. By scanning from left to right in one field and right to left in the next
D. By scanning odd numbered lines in one field and even numbered ones in the next

E2B04 @E2B04 (B)
What is blanking in a video signal?
A. Synchronization of the horizontal and vertical sync pulses
B. Turning off the scanning beam while it is traveling from right to left and from bottom to top
C. Turning off the scanning beam at the conclusion of a transmission
D. Transmitting a black and white test pattern

E2B05 @E2B06 (D)
What is the bandwidth of a vestigial sideband AM fast-scan television transmission?
A. 3 kHz
B. 10 kHz
C. 25 kHz
D. 6 MHz

E2B06 @E2B07 (C)
What is the standard video level, in percent PEV, for black?
A. 0%
B. 12.5%
C. 70%
D. 100%

E2B07 @E2B09 (C)
What is the standard video level, in percent PEV, for blanking?
A. 0%
B. 12.5%
C. 75%
D. 100%

E2B08 @E2B11 (A)
Which of the following is NOT a common method of transmitting accompanying audio with amateur fast-scan television?
A. Amplitude modulation of the video carrier
B. Frequency-modulated sub-carrier
C. A separate VHF or UHF audio link
D. Frequency modulation of the video carrier

E2B09 @A2A01 (D)
What is facsimile?
A. The transmission of characters by radioteletype that form a picture when printed
B. The transmission of still pictures by slow-scan television
C. The transmission of video by amateur television
D. The transmission of printed pictures for permanent display on paper

E2B10 @A2A02 (A)
What is the modern standard scan rate for a facsimile picture

transmitted by an amateur station?
A. 240 lines per minute
B. 50 lines per minute
C. 150 lines per second
D. 60 lines per second

E2B11 @A2A03 (B)
What is the approximate transmission time per frame for a facsimile picture transmitted by an amateur station at 240 lpm?
A. 6 minutes
B. 3.3 minutes
C. 6 seconds
D. 1/60 second

E2B12 @A2A05 (C)
In facsimile, what device converts variations in picture brightness and darkness into voltage variations?
A. An LED
B. A Hall-effect transistor
C. A photodetector
D. An optoisolator

E2C Contest and DX operating; spread-spectrum transmissions; automatic HF forwarding.

E2C01 @E2C01 (A)
What would be the ideal operating strategy for a worldwide DX contest during a solar minimum instead of a solar maximum?
A. 160-40 meters would be emphasized during the evening; 20 meters during daylight hours
B. There would be little to no strategic difference
C. 80 meters would support worldwide communication during mid-day hours
D. 10 and 15 meters should be tried one hour before sunset

E2C02 @E2C02 (A)
When operating during a contest, which of these standards should you generally follow?
A. Always listen before transmitting, be courteous and do not cause harmful interference to other communications
B. Always reply to other stations calling CQ at least as many times as you call CQ
C. When initiating a contact, always reply with the call sign of the station you are calling followed by your own call sign
D. Always include your signal report, name and transmitter power output in any exchange with another station

E2C03 @E2C03 (B)
What is one of the main purposes for holding on-the-air operating contests?
A. To test the dollar-to-feature value of station equipment during difficult operating circumstances
B. To enhance the communicating and operating skills of amateurs in readiness for an emergency
C. To measure the ionospheric capacity for refracting RF signals under varying conditions
D. To demonstrate to the FCC that amateur station operation is

possible during difficult operating circumstances

E2C04 @E2C04 (C)
Which of the following is typical of operations during an international amateur DX contest?
A. Calling CQ is always done on an odd minute and listening is always done on an even minute
B. Contacting a DX station is best accomplished when the WWV K index is above a reading of 8
C. Some DX operators use split frequency operations (transmitting on a frequency different from the receiving frequency)
D. DX contacts during the day are never possible because of known band attenuation from the sun

E2C05 @E2C05 (D)
If a DX station asks for your grid square locator, what should be your reply?
A. The square of the power fed to the grid of your final amplifier and your current city, state and country
B. The DX station's call sign followed by your call sign and your RST signal report
C. The subsection of the IARU region in which you are located based upon dividing the entire region into a grid of squares 10 km wide
D. Your geographic "Maidenhead" grid location (e.g., FN31AA) based on your current latitude and longitude

E2C06 @E2C06 (A)
What does a "Maidenhead" grid square refer to?
A. A two-degree longitude by one degree latitude square, as part of a world wide numbering system
B. A one-degree longitude by one degree latitude square, beginning at the South Pole
C. An antenna made of wire grid used to amplify low-angle incoming signals while reducing high-angle incoming signals
D. An antenna consisting of a screen or grid positioned directly beneath the radiating element

E2C07 @E2C08 (C)
During a VHF/UHF contest, in which band section would you expect to find the highest level of contest activity?
A. At the top of each band, usually in a segment reserved for contests
B. In the middle of each band, usually on the national calling frequency
C. At the bottom of each band, usually in the weak signal segment
D. In the middle of the band, usually 25 kHz above the national calling frequency

E2C08 @E2C09 (D)
Which of the following frequency ranges is reserved by "gentlemen's agreement" for DX contacts during international 6-meter contests?
A. 50.000 to 50.025 MHz
B. 50.050 to 50.075 MHz
C. 50.075 to 50.100 MHz
D. 50.100 to 50.125 MHz

E2C09 @E2C10 (C)

If you are in the US calling a station in Texas on a frequency of 1832 kHz and a station replies that you are "in the window," what does this mean?
A. You are operating out of the band privileges of your license
B. You are calling at the wrong time of day to be within the window of frequencies that can be received in Texas at that time
C. You are transmitting in a frequency segment that is reserved for international DX contacts by "gentlemen's agreement"
D. Your modulation has reached an undesirable level and you are interfering with another contact

E2C10 @A2A10 (A)
Why are received spread-spectrum signals so resistant to interference?
A. Signals not using the spectrum-spreading algorithm are suppressed in the receiver
B. The high power used by a spread-spectrum transmitter keeps its signal from being easily overpowered
C. The receiver is always equipped with a special digital signal processor (DSP) interference filter
D. If interference is detected by the receiver it will signal the transmitter to change frequencies

E2C11 @A2A11 (D)
How does the spread-spectrum technique of frequency hopping (FH) work?
A. If interference is detected by the receiver it will signal the transmitter to change frequencies
B. If interference is detected by the receiver it will signal the transmitter to wait until the frequency is clear
C. A pseudo-random binary bit stream is used to shift the phase of an RF carrier very rapidly in a particular sequence
D. The frequency of an RF carrier is changed very rapidly according to a particular pseudo-random sequence

E2C12 @A2A12 (C)
What is the most common data rate used for HF packet communications?
A. 48 bauds
B. 110 bauds
C. 300 bauds
D. 1200 bauds

E2D Digital Operating: HF digital communications (ie, PacTOR, CLOVER, AMTOR, PSK31, HF packet); packet clusters; HF digital bulletin boards

E2D01 @E2D01 (B)
What is the most common method of transmitting data emissions below 30 MHz?
A. DTMF tones modulating an FM signal
B. FSK (frequency-shift keying) of an RF carrier
C. AFSK (audio frequency-shift keying) of an FM signal
D. Key-operated on/off switching of an RF carrier

E2D02 @E2D02 (A)
What do the letters "FEC" mean as they relate to AMTOR operation?
A. Forward Error Correction
B. First Error Correction
C. Fatal Error Correction
D. Final Error Correction

E2D03 @E2D03 (C)
How is Forward Error Correction implemented?
A. By transmitting blocks of 3 data characters from the sending station to the receiving station which the receiving station acknowledges
B. By transmitting a special FEC algorithm which the receiving station uses for data validation
C. By transmitting each data character twice, since there is no specific acknowledgment of reception
D. By varying the frequency shift of the transmitted signal according to a predefined algorithm

E2D04 @E2D04 (B)
What does "CMD:" mean when it is displayed on the video monitor of a packet station?
A. The TNC is ready to exit the packet terminal program
B. The TNC is in command mode, ready to receive instructions from the keyboard
C. The TNC will exit to the command mode on the next keystroke
D. The TNC is in KISS mode running TCP/IP, ready for the next command

E2D05 @E2D05 (D)
What is the Baudot code?
A. A code used to transmit data only in modern computer-based data systems using seven data bits
B. A binary code consisting of eight data bits
C. An alternate name for Morse code
D. The "International Telegraph Alphabet Number 2" (ITA2) which uses five data bits

E2D06 @E2D06 (A)
If an oscilloscope is connected to a TNC or terminal unit and is displaying two crossed ellipses, one of which suddenly disappears, what would this indicate about the observed signal?
A. The phenomenon known as "selective fading" has occurred
B. One of the signal filters has saturated
C. The receiver should be retuned, as it has probably moved at least 5 kHz from the desired receive frequency
D. The mark and space signal have been inverted and the receiving equipment has not yet responded to the change

E2D07 @E2D07 (D)
Which of the following systems is used to transmit high-quality still images by radio?
A. AMTOR
B. Baudot RTTY
C. AMTEX
D. Facsimile

E2D08 @E2D08 (C)
What special restrictions are imposed on facsimile (fax) transmissions?
A. None; they are allowed on all amateur frequencies
B. They are restricted to 7.245 MHz, 14.245 MHz, 21.345, MHz, and 28.945 MHz
C. They are allowed in phone band segments if their bandwidth is no

greater than that of a voice signal of the same modulation type
D. They are not permitted above 54 MHz

E2D09 @E2D09 (D)
What is the name for a bulletin transmission system that includes a special header to allow receiving stations to determine if the bulletin has been previously received?
A. ARQ mode A
B. FEC mode B
C. AMTOR
D. AMTEX

E2D10 @E2D10 (A)
What is a Packet Cluster Bulletin Board?
A. A packet bulletin board devoted primarily to serving a special interest group
B. A group of general-purpose packet bulletin boards linked together in a "cluster"
C. A special interest cluster of packet bulletin boards devoted entirely to packet radio computer communications
D. A special interest telephone/modem bulletin board devoted to amateur DX operations

E2D11 @E2D11 (C)
Which of the following statements comparing HF and 2-meter packet operations is NOT true?
A. HF packet typically uses an FSK signal with a data rate of 300 bauds; 2-meter packet uses an AFSK signal with a data rate of 1200 bauds
B. HF packet and 2-meter packet operations use the same code for information exchange
C. HF packet is limited to Extra class amateur licensees; 2 meter packet is open to all but Novice class amateur licensees
D. HF packet operations are limited to "CW/Data"-only band segments; 2-meter packet is allowed wherever FM operations are allowed

SUBELEMENT E3 -- RADIO WAVE PROPAGATION [3 Exam Questions -- 3 Groups]

E3A Earth-Moon-Earth (EME or moonbounce) communications; meteor scatter

E3A01 @E3A01 (D)
What is the maximum separation between two stations communicating by moonbounce?
A. 500 miles maximum, if the moon is at perigee
B. 2000 miles maximum, if the moon is at apogee
C. 5000 miles maximum, if the moon is at perigee
D. Any distance as long as the stations have a mutual lunar window

E3A02 @E3A02 (B)
What characterizes libration fading of an earth-moon-earth signal?
A. A slow change in the pitch of the CW signal
B. A fluttery, rapid irregular fading
C. A gradual loss of signal as the sun rises
D. The returning echo is several hertz lower in frequency than the transmitted signal

E3A03 @E3A03 (A)
What are the best days to schedule EME contacts?
A. When the moon is at perigee
B. When the moon is full
C. When the moon is at apogee
D. When the weather at both stations is clear

E3A04 @E3A04 (D)
What type of receiving system is required for EME communications?
A. Equipment with very low power output
B. Equipment with very low dynamic range
C. Equipment with very low gain
D. Equipment with very low noise figures

E3A05 @E3A05 (A)
What transmit and receive time sequencing is normally used on 144 MHz when attempting an earth-moon-earth contact?
A. Two-minute sequences, where one station transmits for a full two minutes and then receives for the following two minutes
B. One-minute sequences, where one station transmits for one minute and then receives for the following one minute
C. Two-and-one-half minute sequences, where one station transmits for a full 2.5 minutes and then receives for the following 2.5 minutes
D. Five-minute sequences, where one station transmits for five minutes and then receives for the following five minutes

E3A06 @E3A06 (C)
What transmit and receive time sequencing is normally used on 432 MHz when attempting an EME contact?
A. Two-minute sequences, where one station transmits for a full two minutes and then receives for the following two minutes
B. One-minute sequences, where one station transmits for one minute and then receives for the following one minute
C. Two and one half minute sequences, where one station transmits for a full 2.5 minutes and then receives for the following 2.5 minutes
D. Five minute sequences, where one station transmits for five minutes and then receives for the following five minutes

E3A07 @E3A07 (B)
What frequency range would you normally tune to find EME stations in the 2-meter band?
A. 144.000 - 144.001 MHz
B. 144.000 - 144.100 MHz
C. 144.100 - 144.300 MHz
D. 145.000 - 145.100 MHz

E3A08 @E3A08 (D)
What frequency range would you normally tune to find EME stations in the 70-cm band?
A. 430.000 - 430.150 MHz
B. 430.100 - 431.100 MHz
C. 431.100 - 431.200 MHz
D. 432.000 - 432.100 MHz

E3A09 @E3A09 (A)
When the earth's atmosphere is struck by a meteor, a cylindrical region of free electrons is formed at what layer of the ionosphere?

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

E3A10 @E3A10 (C)
Which range of frequencies is well suited for meteor-scatter communications?
A. 1.8 - 1.9 MHz
B. 10 - 14 MHz
C. 28 - 148 MHz
D. 220 - 450 MHz

E3A11 @E3A11 (C)
What transmit and receive time sequencing is normally used on 144 MHz when attempting a meteor-scatter contact?
A. Two-minute sequences, where one station transmits for a full two minutes and then receives for the following two minutes
B. One-minute sequences, where one station transmits for one minute and then receives for the following one minute
C. 15-second sequences, where one station transmits for 15 seconds and then receives for the following 15 seconds
D. 30-second sequences, where one station transmits for 30 seconds and then receives for the following 30 seconds

E3B Transequatorial; long path; gray line

E3B01 @E3B01 (A)
What is transequatorial propagation?
A. Propagation between two points at approximately the same distance north and south of the magnetic equator
B. Propagation between two points at approximately the same latitude on the magnetic equator
C. Propagation between two continents by way of ducts along the magnetic equator
D. Propagation between two stations at the same latitude

E3B02 @E3B02 (C)
What is the approximate maximum range for signals using transequatorial propagation?
A. 1000 miles
B. 2500 miles
C. 5000 miles
D. 7500 miles

E3B03 @E3B03 (C)
What is the best time of day for transequatorial propagation?
A. Morning
B. Noon
C. Afternoon or early evening
D. Late at night

E3B04 @E3B04 (A)
What type of propagation is probably occurring if a beam antenna must be pointed in a direction 180 degrees away from a station to receive the strongest signals?
A. Long-path

B. Sporadic-E
C. Transequatorial
D. Auroral

E3B05 @E3B05 (D)
On what amateur bands can long-path propagation provide signal enhancement?
A. 160 to 40 meters
B. 30 to 10 meters
C. 160 to 10 meters
D. 160 to 6 meters

E3B06 @E3B06 (B)
What amateur band consistently yields long-path enhancement using a modest antenna of relatively high gain?
A. 80 meters
B. 20 meters
C. 10 meters
D. 6 meters

E3B07 @E3B07 (D)
What is the typical reason for hearing an echo on the received signal of a station in Europe while directing your HF antenna toward the station?
A. The station's transmitter has poor frequency stability
B. The station's transmitter is producing spurious emissions
C. Auroral conditions are causing a direct and a long-path reflected signal to be received
D. There are two signals being received, one from the most direct path and one from long-path propagation

E3B08 @E3B08 (D)
What type of propagation is probably occurring if radio signals travel along the earth's terminator?
A. Transequatorial
B. Sporadic-E
C. Long-path
D. Gray-line

E3B09 @E3B09 (A)
At what time of day is gray-line propagation most prevalent?
A. Twilight, at sunrise and sunset
B. When the sun is directly above the location of the transmitting station
C. When the sun is directly overhead at the middle of the communications path between the two stations
D. When the sun is directly above the location of the receiving station

E3B10 @E3B10 (B)
What is the cause of gray-line propagation?
A. At midday the sun, being directly overhead, superheats the ionosphere causing increased refraction of radio waves
B. At twilight solar absorption drops greatly while atmospheric ionization is not weakened enough to reduce the MUF
C. At darkness solar absorption drops greatly while atmospheric ionization remains steady

D. At midafternoon the sun heats the ionosphere, increasing radio wave refraction and the MUF

E3B11 @E3B11 (C)
What communications are possible during gray-line propagation?
A. Contacts up to 2,000 miles only on the 10-meter band
B. Contacts up to 750 miles on the 6- and 2-meter bands
C. Contacts up to 8,000 to 10,000 miles on three or four HF bands
D. Contacts up to 12,000 to 15,000 miles on the 10- and 15-meter bands

E3C Auroral propagation; selective fading; radio-path horizon; take-off angle over flat or sloping terrain; earth effects on propagation

E3C01 @A3A05 (D)
What effect does auroral activity have upon radio communications?
A. The readability of SSB signals increases
B. FM communications are clearer
C. CW signals have a clearer tone
D. CW signals have a fluttery tone

E3C02 @A3A06 (C)
What is the cause of auroral activity?
A. A high sunspot level
B. A low sunspot level
C. The emission of charged particles from the sun
D. Meteor showers concentrated in the northern latitudes

E3C03 @A3A08 (D)
Where in the ionosphere does auroral activity occur?
A. At F-region height
B. In the equatorial band
C. At D-region height
D. At E-region height

E3C04 @A3A09 (A)
Which emission modes are best for auroral propagation?
A. CW and SSB
B. SSB and FM
C. FM and CW
D. RTTY and AM

E3C05 @A3B01 (B)
What causes selective fading?
A. Small changes in beam heading at the receiving station
B. Phase differences between radio-wave components of the same transmission, as experienced at the receiving station
C. Large changes in the height of the ionosphere at the receiving station ordinarily occurring shortly after either sunrise or sunset
D. Time differences between the receiving and transmitting stations

E3C06 @A3B03 (B)
Which emission modes suffer the most from selective fading?
A. CW and SSB
B. FM and double sideband AM
C. SSB and AMTOR
D. SSTV and CW

E3C07 @A3B04 (A)
How does the bandwidth of a transmitted signal affect selective fading?
A. It is more pronounced at wide bandwidths
B. It is more pronounced at narrow bandwidths
C. It is the same for both narrow and wide bandwidths
D. The receiver bandwidth determines the selective fading effect

E3C08 @A3B06 (A)
How much farther does the VHF/UHF radio-path horizon distance exceed the geometric horizon?
A. By approximately 15% of the distance
B. By approximately twice the distance
C. By approximately one-half the distance
D. By approximately four times the distance

E3C09 @A3B07 (B)
For a 3-element Yagi antenna with horizontally mounted elements, how does the main lobe takeoff angle vary with height above flat ground?
A. It increases with increasing height
B. It decreases with increasing height
C. It does not vary with height
D. It depends on E-region height, not antenna height

E3C10 @A3B09 (B)
What is the name of the high-angle wave in HF propagation that travels for some distance within the F2 region?
A. Oblique-angle ray
B. Pedersen ray
C. Ordinary ray
D. Heaviside ray

E3C11 @A3B11 (C)
What effect is usually responsible for propagating a VHF signal over 500 miles?
A. D-region absorption
B. Faraday rotation
C. Tropospheric ducting
D. Moonbounce

E3C12 @A3B12 (A)
What happens to an electromagnetic wave as it encounters air molecules and other particles?
A. The wave loses kinetic energy
B. The wave gains kinetic energy
C. An aurora is created
D. Nothing happens because the waves have no physical substance

SUBELEMENT E4 -- AMATEUR RADIO PRACTICES [5 Exam Questions -- 5 Groups]

E4A Test equipment: spectrum analyzers (interpreting spectrum analyzer displays; transmitter output spectrum); logic probes (indications of high and low states in digital circuits; indications of pulse conditions in digital circuits)

E4A01 @E4A01 (C)
How does a spectrum analyzer differ from a conventional time-domain oscilloscope?
A. A spectrum analyzer measures ionospheric reflection; an oscilloscope displays electrical signals
B. A spectrum analyzer displays signals in the time domain; an oscilloscope displays signals in the frequency domain
C. A spectrum analyzer displays signals in the frequency domain; an oscilloscope displays signals in the time domain
D. A spectrum analyzer displays radio frequencies; an oscilloscope displays audio frequencies

E4A02 @E4A02 (D)
What does the horizontal axis of a spectrum analyzer display?
A. Amplitude
B. Voltage
C. Resonance
D. Frequency

E4A03 @E4A03 (A)
What does the vertical axis of a spectrum analyzer display?
A. Amplitude
B. Duration
C. Frequency
D. Time

E4A04 @E4A04 (A)
Which test instrument is used to display spurious signals from a radio transmitter?
A. A spectrum analyzer
B. A wattmeter
C. A logic analyzer
D. A time-domain reflectometer

E4A05 @E4A05 (B)
Which test instrument is used to display intermodulation distortion products from an SSB transmitter?
A. A wattmeter
B. A spectrum analyzer
C. A logic analyzer
D. A time-domain reflectometer

E4A06 @E4A06 (C)
Which of the following is NOT something you would determine with a spectrum analyzer?
A. The degree of isolation between the input and output ports of a 2-meter duplexer
B. Whether a crystal is operating on its fundamental or overtone frequency
C. The speed at which a transceiver switches from transmit to receive when being used for packet radio
D. The spectral output of a transmitter

E4A07 @E4A07 (B)
What is an advantage of using a spectrum analyzer to observe the output from a VHF transmitter?
A. There are no advantages; an inexpensive oscilloscope can display

the same information
B. It displays all frequency components of the transmitted signal
C. It displays a time-varying representation of the modulation envelope
D. It costs much less than any other instrumentation useful for such measurements

E4A08 @E4A08 (D)
What advantage does a logic probe have over a voltmeter for monitoring the status of a logic circuit?
A. It has many more leads to connect to the circuit than a voltmeter
B. It can be used to test analog and digital circuits
C. It can read logic circuit voltage more accurately than a voltmeter
D. It is smaller and shows a simplified readout

E4A09 @E4A09 (C)
Which test instrument is used to directly indicate high and low digital states?
A. An ohmmeter
B. An electroscope
C. A logic probe
D. A Wheatstone bridge

E4A10 @E4A10 (D)
What can a logic probe indicate about a digital logic circuit?
A. A short-circuit fault
B. An open-circuit fault
C. The resistance between logic modules
D. The high and low logic states

E4A11 @E4A11 (A)
Which test instrument besides an oscilloscope is used to indicate pulse conditions in a digital logic circuit?
A. A logic probe
B. An ohmmeter
C. An electroscope
D. A Wheatstone bridge

E4B Frequency measurement devices (i.e., frequency counter, oscilloscope Lissajous figures, dip meter); meter performance limitations; oscilloscope performance limitations; frequency counter performance limitations

E4B01 @A4A01 (B)
What is a frequency standard?
A. A frequency chosen by a net control operator for net operations
B. A device used to produce a highly accurate reference frequency
C. A device for accurately measuring frequency to within 1 Hz
D. A device used to generate wide-band random frequencies

E4B02 @A4A02 (A)
What does a frequency counter do?
A. It makes frequency measurements
B. It produces a reference frequency
C. It measures FM transmitter deviation
D. It generates broad-band white noise

E4B03 @A4B04 (B)
What factors limit the accuracy, frequency response and stability of a frequency counter?
A. Number of digits in the readout, speed of the logic and time base stability
B. Time base accuracy, speed of the logic and time base stability
C. Time base accuracy, temperature coefficient of the logic and time base stability
D. Number of digits in the readout, external frequency reference and temperature coefficient of the logic

E4B04 @A4B05 (C)
How can the accuracy of a frequency counter be improved?
A. By using slower digital logic
B. By improving the accuracy of the frequency response
C. By increasing the accuracy of the time base
D. By using faster digital logic

E4B05 @A4B06 (C)
If a frequency counter with a time base accuracy of +/- 1.0 ppm reads 146,520,000 Hz, what is the most the actual frequency being measured could differ from the reading?
A. 165.2 Hz
B. 14.652 kHz
C. 146.52 Hz
D. 1.4652 MHz

E4B06 @A4B07 (A)
If a frequency counter with a time base accuracy of +/- 0.1 ppm reads 146,520,000 Hz, what is the most the actual frequency being measured could differ from the reading?
A. 14.652 Hz
B. 0.1 MHz
C. 1.4652 Hz
D. 1.4652 kHz

E4B07 @A4B08 (D)
If a frequency counter with a time base accuracy of +/- 10 ppm reads 146,520,000 Hz, what is the most the actual frequency being measured could differ from the reading?
A. 146.52 Hz
B. 10 Hz
C. 146.52 kHz
D. 1465.20 Hz

E4B08 @A4B09 (D)
If a frequency counter with a time base accuracy of +/- 1.0 ppm reads 432,100,000 Hz, what is the most the actual frequency being measured could differ from the reading?
A. 43.21 MHz
B. 10 Hz
C. 1.0 MHz
D. 432.1 Hz

E4B09 @A4B10 (A)
If a frequency counter with a time base accuracy of +/- 0.1 ppm reads 432,100,000 Hz, what is the most the actual frequency being measured

could differ from the reading?
A. 43.21 Hz
B. 0.1 MHz
C. 432.1 Hz
D. 0.2 MHz

E4B10 @A4B11 (C)
If a frequency counter with a time base accuracy of +/- 10 ppm reads 432,100,000 Hz, what is the most the actual frequency being measured could differ from the reading?
A. 10 MHz
B. 10 Hz
C. 4321 Hz
D. 432.1 Hz

E4B11 @A4A03 (C)
If a 100 Hz signal is fed to the horizontal input of an oscilloscope and a 150 Hz signal is fed to the vertical input, what type of Lissajous figure should be displayed on the screen?
A. A looping pattern with 100 loops horizontally and 150 loops vertically
B. A rectangular pattern 100 mm wide and 150 mm high
C. A looping pattern with 3 loops horizontally and 2 loops vertically
D. An oval pattern 100 mm wide and 150 mm high

E4B12 @A4A04 (C)
What is a dip-meter?
A. A field-strength meter
B. An SWR meter
C. A variable LC oscillator with metered feedback current
D. A marker generator

E4B13 @A4A05 (D)
What does a dip-meter do?
A. It accurately indicates signal strength
B. It measures frequency accurately
C. It measures transmitter output power accurately
D. It gives an indication of the resonant frequency of a circuit

E4B14 @A4A06 (B)
How does a dip-meter function?
A. Reflected waves at a specific frequency desensitize a detector coil
B. Power coupled from an oscillator causes a decrease in metered current
C. Power from a transmitter cancels feedback current
D. Harmonics from an oscillator cause an increase in resonant circuit Q

E4B15 @A4A07 (D)
What two ways could a dip-meter be used in an amateur station?
A. To measure resonant frequency of antenna traps and to measure percentage of modulation
B. To measure antenna resonance and to measure percentage of modulation
C. To measure antenna resonance and to measure antenna impedance
D. To measure resonant frequency of antenna traps and to measure a

tuned circuit resonant frequency

E4B16 @A4A08 (B)
What types of coupling occur between a dip-meter and a tuned circuit being checked?
A. Resistive and inductive
B. Inductive and capacitive
C. Resistive and capacitive
D. Strong field

E4B17 @A4A09 (A)
For best accuracy, how tightly should a dip-meter be coupled with a tuned circuit being checked?
A. As loosely as possible
B. As tightly as possible
C. First loosely, then tightly
D. With a jumper wire between the meter and the circuit to be checked

E4B18 @A4B02 (A)
What factors limit the accuracy, frequency response and stability of an oscilloscope?
A. Accuracy and linearity of the time base and the linearity and bandwidth of the deflection amplifiers
B. Tube face voltage increments and deflection amplifier voltage
C. Accuracy and linearity of the time base and tube face voltage increments
D. Deflection amplifier output impedance and tube face frequency increments

E4C Receiver performance characteristics (i.e., phase noise, desensitization, capture effect, intercept point, noise floor, dynamic range {blocking and IMD}, image rejection, MDS, signal-to-noise-ratio); intermodulation and cross-modulation interference

E4C01 @A4C01 (D)
What is the effect of excessive phase noise in a receiver local oscillator?
A. It limits the receiver ability to receive strong signals
B. It reduces the receiver sensitivity
C. It decreases the receiver third-order intermodulation distortion dynamic range
D. It allows strong signals on nearby frequencies to interfere with reception of weak signals

E4C02 @A4C02 (A)
What is the term for the reduction in receiver sensitivity caused by a strong signal near the received frequency?
A. Desensitization
B. Quieting
C. Cross-modulation interference
D. Squelch gain rollback

E4C03 @A4C03 (B)
What causes receiver desensitization?
A. Audio gain adjusted too low
B. Strong adjacent-channel signals
C. Squelch gain adjusted too high

D. Squelch gain adjusted too low

E4C04 @A4C04 (A)
What is one way receiver desensitization can be reduced?
A. Shield the receiver from the transmitter causing the problem
B. Increase the transmitter audio gain
C. Decrease the receiver squelch gain
D. Increase the receiver bandwidth

E4C05 @A4C05 (C)
What is the capture effect?
A. All signals on a frequency are demodulated by an FM receiver
B. All signals on a frequency are demodulated by an AM receiver
C. The strongest signal received is the only demodulated signal
D. The weakest signal received is the only demodulated signal

E4C06 @A4C06 (C)
What is the term for the blocking of one FM-phone signal by another stronger FM-phone signal?
A. Desensitization
B. Cross-modulation interference
C. Capture effect
D. Frequency discrimination

E4C07 @A4C07 (A)
With which emission type is capture effect most pronounced?
A. FM
B. SSB
C. AM
D. CW

E4C08 @A4C08 (D)
What is meant by the noise floor of a receiver?
A. The weakest signal that can be detected under noisy atmospheric conditions
B. The amount of phase noise generated by the receiver local oscillator
C. The minimum level of noise that will overload the receiver RF amplifier stage
D. The weakest signal that can be detected above the receiver internal noise

E4C09 @A4C09 (B)
What is the blocking dynamic range of a receiver that has an 8-dB noise figure and an IF bandwidth of 500 Hz if the blocking level (1-dB compression point) is -20 dBm?
A. -119 dBm
B. 119 dB
C. 146 dB
D. -146 dBm

E4C10 @E4B11 (C)
What is meant by the dynamic range of a communications receiver?
A. The number of kHz between the lowest and the highest frequency to which the receiver can be tuned
B. The maximum possible undistorted audio output of the receiver, referenced to one milliwatt

C. The ratio between the minimum discernible signal and the largest tolerable signal without causing audible distortion products
D. The difference between the lowest-frequency signal and the highest-frequency signal detectable without moving the tuning knob

E4C11 @E4B12 (A)
What type of problems are caused by poor dynamic range in a communications receiver?
A. Cross modulation of the desired signal and desensitization from strong adjacent signals
B. Oscillator instability requiring frequent retuning, and loss of ability to recover the opposite sideband, should it be transmitted
C. Cross modulation of the desired signal and insufficient audio power to operate the speaker
D. Oscillator instability and severe audio distortion of all but the strongest received signals

E4C12 @A4C10 (B)
What part of a superheterodyne receiver determines the image rejection ratio of the receiver?
A. Product detector
B. RF amplifier
C. AGC loop
D. IF filter

E4C13 @A4C11 (B)
If you measured the MDS of a receiver, what would you be measuring?
A. The meter display sensitivity (MDS), or the responsiveness of the receiver S-meter to all signals
B. The minimum discernible signal (MDS), or the weakest signal that the receiver can detect
C. The minimum distorting signal (MDS), or the strongest signal the receiver can detect without overloading
D. The maximum detectable spectrum (MDS), or the lowest to highest frequency range of the receiver

E4C14 @A4D02 (B)
How does intermodulation interference between two repeater transmitters usually occur?
A. When the signals from the transmitters are reflected out of phase from airplanes passing overhead
B. When they are in close proximity and the signals mix in one or both of their final amplifiers
C. When they are in close proximity and the signals cause feedback in one or both of their final amplifiers
D. When the signals from the transmitters are reflected in phase from airplanes passing overhead

E4C15 @A4D03 (B)
How can intermodulation interference between two repeater transmitters in close proximity often be reduced or eliminated?
A. By using a Class C final amplifier with high driving power
B. By installing a terminated circulator or ferrite isolator in the feed line to the transmitter and duplexer
C. By installing a band-pass filter in the antenna feed line
D. By installing a low-pass filter in the antenna feed line

E4C16 @A4D09 (A)
If a receiver tuned to 146.70 MHz receives an intermodulation-product signal whenever a nearby transmitter transmits on 146.52 MHz, what are the two most likely frequencies for the other interfering signal?
A. 146.34 MHz and 146.61 MHz
B. 146.88 MHz and 146.34 MHz
C. 146.10 MHz and 147.30 MHz
D. 73.35 MHz and 239.40 MHz

E4D Noise suppression: ignition noise; alternator noise (whine); electronic motor noise; static; line noise

E4D01 @E4C01 (A)
What is one of the most significant problems associated with mobile transceivers?
A. Ignition noise
B. Doppler shift
C. Radar interference
D. Mechanical vibrations

E4D02 @E4C02 (A)
What is the proper procedure for suppressing electrical noise in a mobile transceiver?
A. Apply shielding and filtering where necessary
B. Insulate all plane sheet metal surfaces from each other
C. Apply antistatic spray liberally to all non-metallic surfaces
D. Install filter capacitors in series with all DC wiring

E4D03 @E4C03 (C)
Where can ferrite beads be installed to suppress ignition noise in a mobile transceiver?
A. In the resistive high-voltage cable
B. Between the starter solenoid and the starter motor
C. In the primary and secondary ignition leads
D. In the antenna lead to the transceiver

E4D04 @E4C04 (C)
How can ensuring good electrical contact between connecting metal surfaces in a vehicle reduce ignition noise?
A. It reduces the frequency of the ignition spark
B. It helps radiate the ignition noise away from the vehicle
C. It encourages lower frequency electrical resonances in the vehicle
D. It reduces static buildup on the vehicle body

E4D05 @E4C05 (B)
How can alternator whine be minimized?
A. By connecting the radio's power leads to the battery by the longest possible path
B. By connecting the radio's power leads to the battery by the shortest possible path
C. By installing a high-pass filter in series with the radio's DC power lead to the vehicle's electrical system
D. By installing filter capacitors in series with the DC power lead

E4D06 @E4C06 (D)
How can conducted and radiated noise caused by an automobile alternator be suppressed?

A. By installing filter capacitors in series with the DC power lead and by installing a blocking capacitor in the field lead
B. By connecting the radio to the battery by the longest possible path and installing a blocking capacitor in both leads
C. By installing a high-pass filter in series with the radio's power lead and a low-pass filter in parallel with the field lead
D. By connecting the radio's power leads directly to the battery and by installing coaxial capacitors in the alternator leads

E4D07 @E4C09 (B)
How can you reduce noise from an electric motor?
A. Install a ferrite bead on the AC line used to power the motor
B. Install a brute-force, AC-line filter in series with the motor leads
C. Install a bypass capacitor in series with the motor leads
D. Use a ground-fault current interrupter in the circuit used to power the motor

E4D08 @E4C07 (B)
What is a major cause of atmospheric static?
A. Sunspots
B. Thunderstorms
C. Airplanes
D. Meteor showers

E4D09 @E4C08 (C)
How can you determine if a line-noise interference problem is being generated within your home?
A. Check the power-line voltage with a time-domain reflectometer
B. Observe the AC waveform on an oscilloscope
C. Turn off the main circuit breaker and listen on a battery-operated radio
D. Observe the power-line voltage on a spectrum analyzer

E4D10 @E4C10 (A)
What type of signal is picked up by electrical wiring near a radio transmitter?
A. A common-mode signal at the frequency of the radio transmitter
B. An electrical-sparking signal
C. A differential-mode signal at the AC-line frequency
D. Harmonics of the AC-line frequency

E4D11 @E4C11 (B)
What type of equipment cannot be used to locate power line noise?
A. An AM receiver with a directional antenna
B. An FM receiver with a directional antenna
C. A hand-held RF sniffer
D. An ultrasonic transducer, amplifier and parabolic reflector

E4E Component mounting techniques (i.e., surface, dead bug {raised}, circuit board); direction finding: techniques and equipment; fox hunting

E4E01 @A4A11 (D)
What circuit construction technique uses leadless components mounted between circuit board pads?
A. Raised mounting

B. Integrated circuit mounting
C. Hybrid device mounting
D. Surface mounting

E4E02 @E4D01 (A)
What is the main drawback of a wire-loop antenna for direction finding?
A. It has a bidirectional pattern broadside to the loop
B. It is non-rotatable
C. It receives equally well in all directions
D. It is practical for use only on VHF bands

E4E03 @E4D02 (B)
What pattern is desirable for a direction-finding antenna?
A. One which is non-cardioid
B. One with good front-to-back and front-to-side ratios
C. One with good top-to-bottom and side-to-side ratios
D. One with shallow nulls

E4E04 @E4D03 (C)
What is the triangulation method of direction finding?
A. The geometric angle of ground waves and sky waves from the signal source are used to locate the source
B. A fixed receiving station plots three beam headings from the signal source on a map
C. Beam headings from several receiving stations are used to plot the signal source on a map
D. A fixed receiving station uses three different antennas to plot the location of the signal source

E4E05 @E4D04 (D)
Why is an RF attenuator desirable in a receiver used for direction finding?
A. It narrows the bandwidth of the received signal
B. It eliminates the effects of isotropic radiation
C. It reduces loss of received signals caused by antenna pattern nulls
D. It prevents receiver overload from extremely strong signals

E4E06 @E4D05 (A)
What is a sense antenna?
A. A vertical antenna added to a loop antenna to produce a cardioid reception pattern
B. A horizontal antenna added to a loop antenna to produce a cardioid reception pattern
C. A vertical antenna added to an Adcock antenna to produce a omnidirectional reception pattern
D. A horizontal antenna added to an Adcock antenna to produce a omnidirectional reception pattern

E4E07 @E4D06 (D)
What type of antenna is most useful for sky-wave reception in radio direction finding?
A. A log-periodic dipole array
B. An isotropic antenna
C. A circularly-polarized antenna
D. An Adcock antenna

E4E08 @E4D07 (C)
What is a loop antenna?
A. A large circularly-polarized antenna
B. A small coil of wire tightly wound around a toroidal ferrite core
C. Several turns of wire wound in the shape of a large open coil
D. Any antenna coupled to a feed line through an inductive loop of wire

E4E09 @E4D08 (D)
How can the output voltage of a loop antenna be increased?
A. By reducing the permeability of the loop shield
B. By increasing the number of wire turns in the loop and reducing the area of the loop structure
C. By reducing either the number of wire turns in the loop or the area of the loop structure
D. By increasing either the number of wire turns in the loop or the area of the loop structure

E4E10 EE4D09 (B)
Why is an antenna system with a cardioid pattern desirable for a direction-finding system?
A. The broad-side responses of the cardioid pattern can be aimed at the desired station
B. The deep null of the cardioid pattern can pinpoint the direction of the desired station
C. The sharp peak response of the cardioid pattern can pinpoint the direction of the desired station
D. The high-radiation angle of the cardioid pattern is useful for short-distance direction finding

E4E11 @E4D10 (C)
What type of terrain can cause errors in direction finding?
A. Homogeneous terrain
B. Smooth grassy terrain
C. Varied terrain
D. Terrain with no buildings or mountains

E4E12 @E4D11 (A)
What is the activity known as fox hunting?
A. Amateurs using receivers and direction-finding techniques attempt to locate a hidden transmitter
B. Amateurs using transmitting equipment and direction-finding techniques attempt to locate a hidden receiver
C. Amateurs helping the government track radio-transmitter collars attached to animals
D. Amateurs assemble stations using generators and portable antennas to test their emergency communications skills

SUBELEMENT E5 -- ELECTRICAL PRINCIPLES [9 Exam Questions -- 9 Groups]

E5A Characteristics of resonant circuits: Series resonance (capacitor and inductor to resonate at a specific frequency); Parallel resonance (capacitor and inductor to resonate at a specific frequency); half-power bandwidth

E5A01 @A5A01 (A)

What can cause the voltage across reactances in series to be larger than the voltage applied to them?
A. Resonance
B. Capacitance
C. Conductance
D. Resistance

E5A02 @A5A02 (C)
What is resonance in an electrical circuit?
A. The highest frequency that will pass current
B. The lowest frequency that will pass current
C. The frequency at which capacitive reactance equals inductive reactance
D. The frequency at which power factor is at a minimum

E5A03 @A5A03 (B)
What are the conditions for resonance to occur in an electrical circuit?
A. The power factor is at a minimum
B. Inductive and capacitive reactances are equal
C. The square root of the sum of the capacitive and inductive reactance is equal to the resonant frequency
D. The square root of the product of the capacitive and inductive reactance is equal to the resonant frequency

E5A04 @A5A04 (D)
When the inductive reactance of an electrical circuit equals its capacitive reactance, what is this condition called?
A. Reactive quiescence
B. High Q
C. Reactive equilibrium
D. Resonance

E5A05 @A5A05 (D)
What is the magnitude of the impedance of a series R-L-C circuit at resonance?
A. High, as compared to the circuit resistance
B. Approximately equal to capacitive reactance
C. Approximately equal to inductive reactance
D. Approximately equal to circuit resistance

E5A06 @A5A06 (A)
What is the magnitude of the impedance of a circuit with a resistor, an inductor and a capacitor all in parallel, at resonance?
A. Approximately equal to circuit resistance
B. Approximately equal to inductive reactance
C. Low, as compared to the circuit resistance
D. Approximately equal to capacitive reactance

E5A07 @A5A07 (B)
What is the magnitude of the current at the input of a series R-L-C circuit at resonance?
A. It is at a minimum
B. It is at a maximum
C. It is DC
D. It is zero

E5A08 #A5A08 (B)
What is the magnitude of the circulating current within the components of a parallel L-C circuit at resonance?
A. It is at a minimum
B. It is at a maximum
C. It is DC
D. It is zero

E5A09 @A5A09 (A)
What is the magnitude of the current at the input of a parallel R-L-C circuit at resonance?
A. It is at a minimum
B. It is at a maximum
C. It is DC
D. It is zero

E5A10 @A5A10 (C)
What is the relationship between the current through a resonant circuit and the voltage across the circuit?
A. The voltage leads the current by 90 degrees
B. The current leads the voltage by 90 degrees
C. The voltage and current are in phase
D. The voltage and current are 180 degrees out of phase

E5A11 @A5A11 (C)
What is the relationship between the current into (or out of) a parallel resonant circuit and the voltage across the circuit?
A. The voltage leads the current by 90 degrees
B. The current leads the voltage by 90 degrees
C. The voltage and current are in phase
D. The voltage and current are 180 degrees out of phase

E5A12 @A5E01 (A)
What is the half-power bandwidth of a parallel resonant circuit that has a resonant frequency of 1.8 MHz and a Q of 95?
A. 18.9 kHz
B. 1.89 kHz
C. 189 Hz
D. 58.7 kHz

E5A13 @A5E03 (C)
What is the half-power bandwidth of a parallel resonant circuit that has a resonant frequency of 7.1 MHz and a Q of 150?
A. 211 kHz
B. 16.5 kHz
C. 47.3 kHz
D. 21.1 kHz

E5A14 @A5E05 (A)
What is the half-power bandwidth of a parallel resonant circuit that has a resonant frequency of 14.25 MHz and a Q of 150?
A. 95 kHz
B. 10.5 kHz
C. 10.5 MHz
D. 17 kHz

E5A15 @A5E06 (D)

What is the half-power bandwidth of a parallel resonant circuit that has a resonant frequency of 21.15 MHz and a Q of 95?
A. 4.49 kHz
B. 44.9 kHz
C. 22.3 kHz
D. 222.6 kHz

E5A16 @A5E09 (C)
What is the half-power bandwidth of a parallel resonant circuit that has a resonant frequency of 3.7 MHz and a Q of 118?
A. 22.3 kHz
B. 76.2 kHz
C. 31.4 kHz
D. 10.8 kHz

E5A17 @A5E10 (C)
What is the half-power bandwidth of a parallel resonant circuit that has a resonant frequency of 14.25 MHz and a Q of 187?
A. 22.3 kHz
B. 10.8 kHz
C. 76.2 kHz
D. 13.1 kHz

E5B Exponential charge/discharge curves (time constants): definition; time constants in RL and RC circuits;

E5B01 @E5B01 (B)
What is the term for the time required for the capacitor in an RC circuit to be charged to 63.2% of the supply voltage?
A. An exponential rate of one
B. One time constant
C. One exponential period
D. A time factor of one

E5B02 @E5B02 (A)
What is the term for the time required for the current in an RL circuit to build up to 63.2% of the maximum value?
A. One time constant
B. An exponential period of one
C. A time factor of one
D. One exponential rate

E5B03 @E5B03 (D)
What is the term for the time it takes for a charged capacitor in an RC circuit to discharge to 36.8% of its initial value of stored charge?
A. One discharge period
B. An exponential discharge rate of one
C. A discharge factor of one
D. One time constant

E5B04 @E5B04 (C)
The capacitor in an RC circuit is charged to what percentage of the supply voltage after two time constants?
A. 36.8%
B. 63.2%
C. 86.5%

D. 95%

E5B05 @E5B05 (D)
The capacitor in an RC circuit is discharged to what percentage of the starting voltage after two time constants?
A. 86.5%
B. 63.2%
C. 36.8%
D. 13.5%

E5B06 @E5B06 (A)
What is the time constant of a circuit having two 100-microfarad capacitors and two 470-kilohm resistors all in series?
A. 47 seconds
B. 101.1 seconds
C. 103 seconds
D. 220 seconds

E5B07 @E5B07 (D)
What is the time constant of a circuit having two 220-microfarad capacitors and two 1-megohm resistors all in parallel?
A. 47 seconds
B. 101.1 seconds
C. 103 seconds
D. 220 seconds

E5B08 @E5B08 (C)
What is the time constant of a circuit having a 220-microfarad capacitor in series with a 470-kilohm resistor?
A. 47 seconds
B. 80 seconds
C. 103 seconds
D. 220 seconds

E5B09 @E5B09 (A)
How long does it take for an initial charge of 20 V DC to decrease to 7.36 V DC in a 0.01-microfarad capacitor when a 2-megohm resistor is connected across it?
A. 0.02 seconds
B. 0.08 seconds
C. 450 seconds
D. 1350 seconds

E5B10 @E5B10 (B)
How long does it take for an initial charge of 20 V DC to decrease to 0.37 V DC in a 0.01-microfarad capacitor when a 2-megohm resistor is connected across it?
A. 0.02 seconds
B. 0.08 seconds
C. 450 seconds
D. 1350 seconds

E5B11 @E5B11 (C)
How long does it take for an initial charge of 800 V DC to decrease to 294 V DC in a 450-microfarad capacitor when a 1-megohm resistor is connected across it?
A. 0.02 seconds

B. 0.08 seconds
C. 450 seconds
D. 1350 seconds

E5C Impedance diagrams: Basic principles of Smith charts; impedance of RLC networks at specified frequencies

E5C01 @E5C01 (A)
What type of graph can be used to calculate impedance along transmission lines?
A. A Smith chart
B. A logarithmic chart
C. A Jones chart
D. A radiation pattern chart

E5C02 @E5C02 (B)
What type of coordinate system is used in a Smith chart?
A. Voltage and current circles
B. Resistance and reactance circles
C. Voltage and current lines
D. Resistance and reactance lines

E5C03 @E5C03 (C)
What type of calculations can be performed 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. Circuit gain calculations

E5C04 @E5C04 (C)
What are the two families of circles that make up a Smith chart?
A. Resistance and voltage
B. Reactance and voltage
C. Resistance and reactance
D. Voltage and impedance

E5C05 @E5C05 (A)
What type of chart is shown in Figure E5-1?
A. Smith chart
B. Free-space radiation directivity chart
C. Vertical-space radiation pattern chart
D. Horizontal-space radiation pattern chart

E5C06 @E5C06 (B)
On the Smith chart shown in Figure E5-1, what is the name for the large outer circle bounding the coordinate portion of the chart?
A. Prime axis
B. Reactance axis
C. Impedance axis
D. Polar axis

E5C07 @E5C07 (D)
On the Smith chart shown in Figure E5-1, what is the only straight line shown?
A. The reactance axis
B. The current axis
C. The voltage axis

D. The resistance axis

E5C08 @E5C08 (C)
What is the process of normalizing with regard to a Smith chart?
A. Reassigning resistance values with regard to the reactance axis
B. Reassigning reactance values with regard to the resistance axis
C. Reassigning resistance values with regard to the prime center
D. Reassigning prime center with regard to the reactance axis

E5C09 @E5C10 (A)
What is the third family of circles, which are added to a Smith chart during the process of solving problems?
A. Standing-wave ratio circles
B. Antenna-length circles
C. Coaxial-length circles
D. Radiation-pattern circles

E5C10 @E5D03 (A)
In rectangular coordinates, what is the impedance of a network comprised of a 10-microhenry inductor in series with a 40-ohm resistor at 500 MHz?
A. 40 + j31,400
B. 40 - j31,400
C. 31,400 + j40
D. 31,400 - j40

E5C11 @E5D04 (C)
In polar coordinates, what is the impedance of a network comprised of a 100-picofarad capacitor in parallel with a 4,000-ohm resistor at 500 kHz?
A. 2490 ohms, /__51.5_degrees__
B. 4000 ohms, /__38.5_degrees__
C. 2490 ohms, /__-51.5_degrees__
D. 5112 ohms, /__-38.5_degrees__

E5C12 @E5D11 (D)
Which point on Figure E5-2 best represents the impedance of a series circuit consisting of a 300-ohm resistor, a 0.64-microhenry inductor and a 85-picofarad capacitor at 24.900 MHz?
A. Point 1
B. Point 3
C. Point 5
D. Point 8

E5D Phase angle between voltage and current; impedances and phase angles of series and parallel circuits; algebraic operations using complex numbers: rectangular coordinates (real and imaginary parts); polar coordinates (magnitude and angle)

E5D01 @A5G01 (A)
What is the phase angle between the voltage across and the current through a series R-L-C circuit if XC is 25 ohms, R is 100 ohms, and XL is 100 ohms?
A. 36.9 degrees with the voltage leading the current
B. 53.1 degrees with the voltage lagging the current
C. 36.9 degrees with the voltage lagging the current
D. 53.1 degrees with the voltage leading the current

E5D02 @A5G03 (C)
What is the phase angle between the voltage across and the current through a series R-L-C circuit if XC is 500 ohms, R is 1 kilohm, and XL is 250 ohms?
A. 68.2 degrees with the voltage leading the current
B. 14.1 degrees with the voltage leading the current
C. 14.1 degrees with the voltage lagging the current
D. 68.2 degrees with the voltage lagging the current

E5D03 @A5G05 (D)
What is the phase angle between the voltage across and the current through a series R-L-C circuit if XC is 50 ohms, R is 100 ohms, and XL is 25 ohms?
A. 76 degrees with the voltage lagging the current
B. 14 degrees with the voltage leading the current
C. 76 degrees with the voltage leading the current
D. 14 degrees with the voltage lagging the current

E5D04 @A5G07 (A)
What is the phase angle between the voltage across and the current through a series R-L-C circuit if XC is 100 ohms, R is 100 ohms, and XL is 75 ohms?
A. 14 degrees with the voltage lagging the current
B. 14 degrees with the voltage leading the current
C. 76 degrees with the voltage leading the current
D. 76 degrees with the voltage lagging the current

E5D05 @A5G09 (D)
What is the phase angle between the voltage across and the current through a series R-L-C circuit if XC is 50 ohms, R is 100 ohms, and XL is 75 ohms?
A. 76 degrees with the voltage leading the current
B. 76 degrees with the voltage lagging the current
C. 14 degrees with the voltage lagging the current
D. 14 degrees with the voltage leading the current

E5D06 @A5G10 (D)
What is the relationship between the current through and the voltage across a capacitor?
A. Voltage and current are in phase
B. Voltage and current are 180 degrees out of phase
C. Voltage leads current by 90 degrees
D. Current leads voltage by 90 degrees

E5D07 @A5G11 (A)
What is the relationship between the current through an inductor and the voltage across an inductor?
A. Voltage leads current by 90 degrees
B. Current leads voltage by 90 degrees
C. Voltage and current are 180 degrees out of phase
D. Voltage and current are in phase

E5D08 @E5E01 (B)
In polar coordinates, what is the impedance of a network comprised of a 100-ohm-reactance inductor in series with a 100-ohm resistor?
A. 121 ohms, /__35_degrees__

B. 141 ohms, /__45_degrees__
C. 161 ohms, /__55_degrees__
D. 181 ohms, /__65_degrees__

E5D09 @E5E02 (D)
In polar coordinates, what is the impedance of a network comprised of a 100-ohm-reactance inductor, a 100-ohm-reactance capacitor, and a 100-ohm resistor all connected in series?
A. 100 ohms, /__90_degrees__
B. 10 ohms, /__0_degrees__
C. 10 ohms, /__100_degrees__
D. 100 ohms, /__0_degrees__

E5D10 @E5E04 (A)
In polar coordinates, what is the impedance of a network comprised of a 300-ohm-reactance capacitor, a 600-ohm-reactance inductor, and a 400-ohm resistor, all connected in series?
A. 500 ohms, /__37_degrees__
B. 400 ohms, /__27_degrees__
C. 300 ohms, /__17_degrees__
D. 200 ohms, /__10_degrees__

E5D11 @E5E06 (B)
In rectangular coordinates, what is the impedance of a network comprised of a 1.0-millihenry inductor in series with a 200-ohm resistor at 30 kHz?
A. 200 - j188
B. 200 + j188
C. 188 - j200
D. 188 + j200

E5D12 @E5E07 (C)
In rectangular coordinates, what is the impedance of a network comprised of a 10-millihenry inductor in series with a 600-ohm resistor at 10 kHz?
A. 628 + j600
B. 628 - j600
C. 600 + j628
D. 600 - j628

E5D13 @E5E08 (B)
In rectangular coordinates, what is the impedance of a network comprised of a 0.1-microfarad capacitor in series with a 40-ohm resistor at 50 kHz?
A. 40 + j32
B. 40 - j32
C. 32 - j40
D. 32 + j40

E5E Skin effect; electrostatic and electromagnetic fields

E5E01 @A5D01 (A)
What is the result of skin effect?
A. As frequency increases, RF current flows in a thinner layer of the conductor, closer to the surface
B. As frequency decreases, RF current flows in a thinner layer of the conductor, closer to the surface

C. Thermal effects on the surface of the conductor increase the impedance
D. Thermal effects on the surface of the conductor decrease the impedance

E5E02 @A5D02 (C)
What effect causes most of an RF current to flow along the surface of a conductor?
A. Layer effect
B. Seeburg effect
C. Skin effect
D. Resonance effect

E5E03 @A5D03 (A)
Where does almost all RF current flow in a conductor?
A. Along the surface of the conductor
B. In the center of the conductor
C. In a magnetic field around the conductor
D. In a magnetic field in the center of the conductor

E5E04 @A5D04 (D)
Why does most of an RF current flow within a few thousandths of an inch of its conductor's surface?
A. Because a conductor has AC resistance due to self-inductance
B. Because the RF resistance of a conductor is much less than the DC resistance
C. Because of the heating of the conductor's interior
D. Because of skin effect

E5E05 @A5D05 (C)
Why is the resistance of a conductor different for RF currents than for direct currents?
A. Because the insulation conducts current at high frequencies
B. Because of the Heisenburg Effect
C. Because of skin effect
D. Because conductors are non-linear devices

E5E06 @A5D06 (C)
What device is used to store electrical energy in an electrostatic field?
A. A battery
B. A transformer
C. A capacitor
D. An inductor

E5E07 @A5D07 (B)
What unit measures electrical energy stored in an electrostatic field?
A. Coulomb
B. Joule
C. Watt
D. Volt

E5E08 @A5D08 (B)
What is a magnetic field?
A. Current through the space around a permanent magnet
B. The space around a conductor, through which a magnetic force acts
C. The space between the plates of a charged capacitor, through which

a magnetic force acts
D. The force that drives current through a resistor

E5E09 @A5D09 (D)
In what direction is the magnetic field oriented about a conductor in relation to the direction of electron flow?
A. In the same direction as the current
B. In a direction opposite to the current
C. In all directions; omnidirectional
D. In a direction determined by the left-hand rule

E5E10 @A5D10 (D)
What determines the strength of a magnetic field around a conductor?
A. The resistance divided by the current
B. The ratio of the current to the resistance
C. The diameter of the conductor
D. The amount of current

E5E11 @A5D11 (B)
What is the term for energy that is stored in an electromagnetic or electrostatic field?
A. Amperes-joules
B. Potential energy
C. Joules-coulombs
D. Kinetic energy

E5F Circuit Q; reactive power; power factor

E5F01 @A5F01 (A)
What is the Q of a parallel R-L-C circuit if the resonant frequency is 14.128 MHz, L is 2.7 microhenrys and R is 18 kilohms?
A. 75.1
B. 7.51
C. 71.5
D. 0.013

E5F02 @A5F03 (C)
What is the Q of a parallel R-L-C circuit if the resonant frequency is 4.468 MHz, L is 47 microhenrys and R is 180 ohms?
A. 0.00735
B. 7.35
C. 0.136
D. 13.3

E5F03 @A5F05 (D)
What is the Q of a parallel R-L-C circuit if the resonant frequency is 7.125 MHz, L is 8.2 microhenrys and R is 1 kilohm?
A. 36.8
B. 0.273
C. 0.368
D. 2.73

E5F04 @A5F07 (B)
What is the Q of a parallel R-L-C circuit if the resonant frequency is 7.125 MHz, L is 12.6 microhenrys and R is 22 kilohms?
A. 22.1
B. 39

C. 25.6
D. 0.0256

E5F05 @A5F09 (D)
What is the Q of a parallel R-L-C circuit if the resonant frequency is 3.625 MHz, L is 42 microhenrys and R is 220 ohms?
A. 23
B. 0.00435
C. 4.35
D. 0.23

E5F06 @A5F11 (C)
Why is a resistor often included in a parallel resonant circuit?
A. To increase the Q and decrease the skin effect
B. To decrease the Q and increase the resonant frequency
C. To decrease the Q and increase the bandwidth
D. To increase the Q and decrease the bandwidth

E5F07 @A5H02 (D)
What is the term for an out-of-phase, nonproductive power associated with inductors and capacitors?
A. Effective power
B. True power
C. Peak envelope power
D. Reactive power

E5F08 @A5H03 (B)
In a circuit that has both inductors and capacitors, what happens to reactive power?
A. It is dissipated as heat in the circuit
B. It goes back and forth between magnetic and electric fields, but is not dissipated
C. It is dissipated as kinetic energy in the circuit
D. It is dissipated in the formation of inductive and capacitive fields

E5F09 @A5H04 (A)
In a circuit where the AC voltage and current are out of phase, how can the true power be determined?
A. By multiplying the apparent power times the power factor
B. By subtracting the apparent power from the power factor
C. By dividing the apparent power by the power factor
D. By multiplying the RMS voltage times the RMS current

E5F10 @A5H05 (C)
What is the power factor of an R-L circuit having a 60 degree phase angle between the voltage and the current?
A. 1.414
B. 0.866
C. 0.5
D. 1.73

E5F11 @A5H08 (B)
How many watts are consumed in a circuit having a power factor of 0.2 if the input is 100-V AC at 4 amperes?
A. 400 watts
B. 80 watts

C. 2000 watts
D. 50 watts

E5F12 @A5H11 (A)
Why would the power used in a circuit be less than the product of the magnitudes of the AC voltage and current?
A. Because there is a phase angle greater than zero between the current and voltage
B. Because there are only resistances in the circuit
C. Because there are no reactances in the circuit
D. Because there is a phase angle equal to zero between the current and voltage

E5G Effective radiated power; system gains and losses

E5G01 @A5I01 (B)
What is the effective radiated power of a repeater station with 50 watts transmitter power output, 4-dB feed line loss, 2-dB duplexer loss, 1-dB circulator loss and 6-dBd antenna gain?
A. 199 watts
B. 39.7 watts
C. 45 watts
D. 62.9 watts

E5G02 @A5I02 (C)
What is the effective radiated power of a repeater station with 50 watts transmitter power output, 5-dB feed line loss, 3-dB duplexer loss, 1-dB circulator loss and 7-dBd antenna gain?
A. 79.2 watts
B. 315 watts
C. 31.5 watts
D. 40.5 watts

E5G03 @A5I03 (D)
What is the effective radiated power of a station with 75 watts transmitter power output, 4-dB feed line loss and 10-dBd antenna gain?
A. 600 watts
B. 75 watts
C. 150 watts
D. 299 watts

E5G04 @A5I04 (A)
What is the effective radiated power of a repeater station with 75 watts transmitter power output, 5-dB feed line loss, 3-dB duplexer loss, 1-dB circulator loss and 6-dBd antenna gain?
A. 37.6 watts
B. 237 watts
C. 150 watts
D. 23.7 watts

E5G05 @A5I05 (D)
What is the effective radiated power of a station with 100 watts transmitter power output, 1-dB feed line loss and 6-dBd antenna gain?
A. 350 watts
B. 500 watts
C. 20 watts
D. 316 watts

E5G06 @A5I06 (B)
What is the effective radiated power of a repeater station with 100 watts transmitter power output, 5-dB feed line loss, 3-dB duplexer loss, 1-dB circulator loss and 10-dBd antenna gain?
A. 794 watts
B. 126 watts
C. 79.4 watts
D. 1260 watts

E5G07 @A5I07 (C)
What is the effective radiated power of a repeater station with 120 watts transmitter power output, 5-dB feed line loss, 3-dB duplexer loss, 1-dB circulator loss and 6-dBd antenna gain?
A. 601 watts
B. 240 watts
C. 60 watts
D. 79 watts

E5G08 @A5I08 (D)
What is the effective radiated power of a repeater station with 150 watts transmitter power output, 2-dB feed line loss, 2.2-dB duplexer loss and 7-dBd antenna gain?
A. 1977 watts
B. 78.7 watts
C. 420 watts
D. 286 watts

E5G09 @A5I09 (A)
What is the effective radiated power 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. 2000 watts
C. 126 watts
D. 300 watts

E5G10 @A5I10 (B)
What is the effective radiated power of a repeater station with 200 watts transmitter power output, 2-dB feed line loss, 2.8-dB duplexer loss, 1.2-dB circulator loss and 7-dBd antenna gain?
A. 159 watts
B. 252 watts
C. 632 watts
D. 63.2 watts

E5G11 @A5I11 (C)
What term describes station output (including the transmitter, antenna and everything in between), when considering transmitter power and system gains and losses?
A. Power factor
B. Half-power bandwidth
C. Effective radiated power
D. Apparent power

E5H Replacement of voltage source and resistive voltage divider with equivalent voltage source and one resistor (Thevenin's Theorem).

E5H01 @A5J01 (B)
In Figure A5-1, what values of V2 and R3 result in the same voltage and current as when V1 is 8 volts, R1 is 8 kilohms, and R2 is 8 kilohms?
A. R3 = 4 kilohms and V2 = 8 volts
B. R3 = 4 kilohms and V2 = 4 volts
C. R3 = 16 kilohms and V2 = 8 volts
D. R3 = 16 kilohms and V2 = 4 volts

E5H02 @A5J02 (C)
In Figure A5-1, what values of V2 and R3 result in the same voltage and current as when V1 is 8 volts, R1 is 16 kilohms, and R2 is 8 kilohms?
A. R3 = 24 kilohms and V2 = 5.33 volts
B. R3 = 5.33 kilohms and V2 = 8 volts
C. R3 = 5.33 kilohms and V2 = 2.67 volts
D. R3 = 24 kilohms and V2 = 8 volts

E5H03 @A5J03 (A)
In Figure A5-1, what values of V2 and R3 result in the same voltage and current as when V1 is 8 volts, R1 is 8 kilohms, and R2 is 16 kilohms?
A. R3 = 5.33 kilohms and V2 = 5.33 volts
B. R3 = 8 kilohms and V2 = 4 volts
C. R3 = 24 kilohms and V2 = 8 volts
D. R3 = 5.33 kilohms and V2 = 8 volts

E5H04 @A5J04 (D)
In Figure A5-1, what values of V2 and R3 result in the same voltage and current as when V1 is 10 volts, R1 is 10 kilohms, and R2 is 10 kilohms?
A. R3 = 10 kilohms and V2 = 5 volts
B. R3 = 20 kilohms and V2 = 5 volts
C. R3 = 20 kilohms and V2 = 10 volts
D. R3 = 5 kilohms and V2 = 5 volts

E5H05 @A5J05 (C)
In Figure A5-1, what values of V2 and R3 result in the same voltage and current as when V1 is 10 volts, R1 is 20 kilohms, and R2 is 10 kilohms?
A. R3 = 30 kilohms and V2 = 10 volts
B. R3 = 6.67 kilohms and V2 = 10 volts
C. R3 = 6.67 kilohms and V2 = 3.33 volts
D. R3 = 30 kilohms and V2 = 3.33 volts

E5H06 @A5J06 (A)
In Figure A5-1, what values of V2 and R3 result in the same voltage and current as when V1 is 10 volts, R1 is 10 kilohms, and R2 is 20 kilohms?
A. R3 = 6.67 kilohms and V2 = 6.67 volts
B. R3 = 6.67 kilohms and V2 = 10 volts
C. R3 = 30 kilohms and V2 = 6.67 volts
D. R3 = 30 kilohms and V2 = 10 volts

E5H07 @A5J07 (B)
In Figure A5-1, what values of V2 and R3 result in the same voltage

and current as when V1 is 12 volts, R1 is 10 kilohms, and R2 is 10 kilohms?
A. R3 = 20 kilohms and V2 = 12 volts
B. R3 = 5 kilohms and V2 = 6 volts
C. R3 = 5 kilohms and V2 = 12 volts
D. R3 = 30 kilohms and V2 = 6 volts

E5H08 @A5J08 (B)
In Figure A5-1, what values of V2 and R3 result in the same voltage and current as when V1 is 12 volts, R1 is 20 kilohms, and R2 is 10 kilohms?
A. R3 = 30 kilohms and V2 = 4 volts
B. R3 = 6.67 kilohms and V2 = 4 volts
C. R3 = 30 kilohms and V2 = 12 volts
D. R3 = 6.67 kilohms and V2 = 12 volts

E5H09 @A5J09 (C)
In Figure A5-1, what values of V2 and R3 result in the same voltage and current as when V1 is 12 volts, R1 is 10 kilohms, and R2 is 20 kilohms?
A. R3 = 6.67 kilohms and V2 = 12 volts
B. R3 = 30 kilohms and V2 = 12 volts
C. R3 = 6.67 kilohms and V2 = 8 volts
D. R3 = 30 kilohms and V2 = 8 volts

E5H10 @A5J10 (A)
In Figure A5-1, what values of V2 and R3 result in the same voltage and current as when V1 is 12 volts, R1 is 20 kilohms, and R2 is 20 kilohms?
A. R3 = 10 kilohms and V2 = 6 volts
B. R3 = 40 kilohms and V2 = 6 volts
C. R3 = 40 kilohms and V2 = 12 volts
D. R3 = 10 kilohms and V2 = 12 volts

E5H11 @A5J11 (D)
What circuit principle describes the replacement of any complex two-terminal network of voltage sources and resistances with a single voltage source and a single resistor?
A. Ohm's Law
B. Kirchhoff's Law
C. Laplace's Theorem
D. Thevenin's Theorem

E5I Photoconductive principles and effects

E5I01 @E5A01 (B)
What is photoconductivity?
A. The conversion of photon energy to electromotive energy
B. The increased conductivity of an illuminated semiconductor junction
C. The conversion of electromotive energy to photon energy
D. The decreased conductivity of an illuminated semiconductor junction

E5I02 @E5A02 (A)
What happens to the conductivity of a photoconductive material when light shines on it?
A. It increases
B. It decreases

C. It stays the same
D. It becomes temperature dependent

E5I03 @E5A03 (D)
What happens to the resistance of a photoconductive material when light shines on it?
A. It increases
B. It becomes temperature dependent
C. It stays the same
D. It decreases

E5I04 @E5A04 (C)
What happens to the conductivity of a semiconductor junction when light shines on it?
A. It stays the same
B. It becomes temperature dependent
C. It increases
D. It decreases

E5I05 @E5A05 (D)
What is an optocoupler?
A. A resistor and a capacitor
B. A frequency modulated helium-neon laser
C. An amplitude modulated helium-neon laser
D. An LED and a phototransistor

E5I06 @E5A06 (A)
What is an optoisolator?
A. An LED and a phototransistor
B. A P-N junction that develops an excess positive charge when exposed to light
C. An LED and a capacitor
D. An LED and a solar cell

E5I07 @E5A07 (B)
What is an optical shaft encoder?
A. An array of neon or LED indicators whose light transmission path is controlled by a rotating wheel
B. An array of optocouplers whose light transmission path is controlled by a rotating wheel
C. An array of neon or LED indicators mounted on a rotating wheel in a coded pattern
D. An array of optocouplers mounted on a rotating wheel in a coded pattern

E5I08 @E5A08 (D)
What characteristic of a crystalline solid will photoconductivity change?
A. The capacitance
B. The inductance
C. The specific gravity
D. The resistance

E5I09 @E5A09 (C)
Which material will exhibit the greatest photoconductive effect when visible light shines on it?
A. Potassium nitrate

B. Lead sulfide
C. Cadmium sulfide
D. Sodium chloride

E5I10 @E5A10 (B)
Which material will exhibit the greatest photoconductive effect when infrared light shines on it?
A. Potassium nitrate
B. Lead sulfide
C. Cadmium sulfide
D. Sodium chloride

E5I11 @E5A11 (A)
Which material is affected the most by photoconductivity?
A. A crystalline semiconductor
B. An ordinary metal
C. A heavy metal
D. A liquid semiconductor

E5I12 @New (B)
What characteristic of optoisolators is often used in power supplies?
A. They have a low impedance between the light source and the phototransistor
B. They have a very high impedance between the light source and the phototransistor
C. They have a low impedance between the light source and the LED
D. They have a very high impedance between the light source and the LED

E5I13 @New (C)
What characteristic of optoisolators makes them suitable for use with a triac to form the solid-state equivalent of a mechanical relay for a 120 V AC household circuit?
A. Optoisolators provide a low impedance link between a control circuit and a power circuit
B. Optoisolators provide impedance matching between the control circuit and power circuit
C. Optoisolators provide a very high degree of electrical isolation between a control circuit and a power circuit
D. Optoisolators eliminate (isolate) the effects of reflected light in the control circuit

SUBELEMENT E6 -- CIRCUIT COMPONENTS [5 Exam Questions -- 5 Groups]

E6A Semiconductor material: Germanium, Silicon, P-type, N-type; Transistor types: NPN, PNP, junction, unijunction, power; field-effect transistors (FETs): enhancement mode; depletion mode; MOS; CMOS; N-channel; P-channel

E6A01 @A6A02 (C)
In what application is gallium arsenide used as a semiconductor material in preference to germanium or silicon?
A. In bipolar transistors
B. In high-power circuits
C. At microwave frequencies
D. At very low frequencies

E6A02 @A6A05 (A)
What type of semiconductor material contains more free electrons than pure germanium or silicon crystals?
A. N-type
B. P-type
C. Bipolar
D. Insulated gate

E6A03 @A6A07 (D)
What type of semiconductor material might be produced by adding some indium atoms to germanium crystals?
A. J-type
B. MOS-type
C. N-type
D. P-type

E6A04 @A6A09 (C)
What are the majority charge carriers in P-type semiconductor material?
A. Free neutrons
B. Free protons
C. Holes
D. Free electrons

E6A05 @A6A12 (C)
What is the name given to an impurity atom that adds holes to a semiconductor crystal structure?
A. Insulator impurity
B. N-type impurity
C. Acceptor impurity
D. Donor impurity

E6A06 @A6D02 (C)
What is the alpha of a bipolar transistor?
A. The change of collector current with respect to base current
B. The change of base current with respect to collector current
C. The change of collector current with respect to emitter current
D. The change of collector current with respect to gate current

E6A07 @A6D06 (A)
In Figure A6-2, what is the schematic symbol for a PNP transistor?
A. 1
B. 2
C. 4
D. 5

E6A08 @A6D07 (D)
What term indicates the frequency at which a transistor grounded base current gain has decreased to 0.7 of the gain obtainable at 1 kHz?
A. Corner frequency
B. Alpha rejection frequency
C. Beta cutoff frequency
D. Alpha cutoff frequency

E6A09 @A6D12 (D)
In Figure A6-2, what is the schematic symbol for a unijunction transistor?

A. 3
B. 4
C. 5
D. 6

E6A10 @A6D13 (C)
What are the elements of a unijunction transistor?
A. Gate, base 1 and base 2
B. Gate, cathode and anode
C. Base 1, base 2 and emitter
D. Gate, source and sink

E6A11 @E6A01 (D)
What is an enhancement-mode FET?
A. An FET with a channel that blocks voltage through the gate
B. An FET with a channel that allows a current when the gate voltage is zero
C. An FET without a channel to hinder current through the gate
D. An FET without a channel; no current occurs with zero gate voltage

E6A12 @E6A02 (A)
What is a depletion-mode FET?
A. An FET that has a channel with no gate voltage applied; a current flows with zero gate voltage
B. An FET that has a channel that blocks current when the gate voltage is zero
C. An FET without a channel; no current flows with zero gate voltage
D. An FET without a channel to hinder current through the gate

E6A13 @E6A05 (B)
In Figure E6-1, what is the schematic symbol for an N-channel dual-gate MOSFET?
A. 2
B. 4
C. 5
D. 6

E6A14 @E6A09 (A)
In Figure E6-1, what is the schematic symbol for a P-channel junction FET?
A. 1
B. 2
C. 3
D. 6

E6A15 @E6A10 (D)
Why do many MOSFET devices have built-in gate-protective Zener diodes?
A. To provide a voltage reference for the correct amount of reverse-bias gate voltage
B. To protect the substrate from excessive voltages
C. To keep the gate voltage within specifications and prevent the device from overheating
D. To prevent the gate insulation from being punctured by small static charges or excessive voltages

E6A16 @E6A11 (C)
What do the initials CMOS stand for?

A. Common mode oscillating system
B. Complementary mica-oxide silicon
C. Complementary metal-oxide semiconductor
D. Complementary metal-oxide substrate

E6A17 @E6A12 (C)
How does the input impedance of a field-effect transistor compare with that of a bipolar transistor?
A. They cannot be compared without first knowing the supply voltage
B. An FET has low input impedance; a bipolar transistor has high input impedance
C. An FET has high input impedance; a bipolar transistor has low input impedance
D. The input impedance of FETs and bipolar transistors is the same

E6B Diodes: Zener, tunnel, varactor, hot-carrier, junction, point contact, PIN and light emitting; operational amplifiers (inverting amplifiers, noninverting amplifiers, voltage gain, frequency response, FET amplifier circuits, single-stage amplifier applications); phase-locked loops

E6B01 @A6B01 (B)
What is the principal characteristic of a Zener diode?
A. A constant current under conditions of varying voltage
B. A constant voltage under conditions of varying current
C. A negative resistance region
D. An internal capacitance that varies with the applied voltage

E6B02 @A6B03 (C)
What is the principal characteristic of a tunnel diode?
A. A high forward resistance
B. A very high PIV
C. A negative resistance region
D. A high forward current rating

E6B03 @A6B04 (C)
What special type of diode is capable of both amplification and oscillation?
A. Point contact
B. Zener
C. Tunnel
D. Junction

E6B04 @A6B06 (A)
What type of semiconductor diode varies its internal capacitance as the voltage applied to its terminals varies?
A. Varactor
B. Tunnel
C. Silicon-controlled rectifier
D. Zener

E6B05 @A6B07 (D)
In Figure A6-1, what is the schematic symbol for a varactor diode?
A. 8
B. 6
C. 2
D. 1

E6B06 @A6B08 (D)
What is a common use of a hot-carrier diode?
A. As balanced mixers in FM generation
B. As a variable capacitance in an automatic frequency control circuit
C. As a constant voltage reference in a power supply
D. As VHF and UHF mixers and detectors

E6B07 @A6B09 (B)
What limits the maximum forward current in a junction diode?
A. Peak inverse voltage
B. Junction temperature
C. Forward voltage
D. Back EMF

E6B08 @A6B11 (A)
Structurally, what are the two main categories of semiconductor diodes?
A. Junction and point contact
B. Electrolytic and junction
C. Electrolytic and point contact
D. Vacuum and point contact

E6B09 @A6B12 (C)
What is a common use for point contact diodes?
A. As a constant current source
B. As a constant voltage source
C. As an RF detector
D. As a high voltage rectifier

E6B10 @A6B15 (B)
In Figure A6-1, what is the schematic symbol for a light-emitting diode?
A. 1
B. 5
C. 6
D. 7

E6B11 @E7D01 (A)
What is the phase relationship between the input and output signals of an inverting op-amp circuit?
A. 180 degrees out of phase
B. In phase
C. 90 degrees out of phase
D. 60 degrees out of phase

E6B12 @E7D06 (C)
What voltage gain can be expected from the circuit in Figure E7-1 when R1 is 10 ohms and RF is 47 kilohms?
A. 0.00021
B. 9400
C. 4700
D. 2350

E6B13 @E7D07 (D)
How does the gain of a theoretically 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

E6B14 @E7D09 (A)
What essentially determines the output impedance of a FET common-source amplifier?
A. The drain resistor
B. The input impedance of the FET
C. The drain supply voltage
D. The gate supply voltage

E6B15 @E7D11 (D)
What will be the voltage of the circuit shown in Figure E7-1 if R1 is 1000 ohms and RF is 10,000 ohms and 2.3 volts is applied to the input?
A.   2.3 volts
B.   23 volts
C. -2.3 volts
D.   -23 volts

E6B16 @E6B10 (B)
What is the name of a circuit that compares the difference of the output from a voltage-controlled oscillator (VCO) to a frequency standard and produces an error voltage that changes the VCO's frequency?
A. A doubly balanced mixer
B. A phase-locked loop
C. A differential voltage amplifier
D. A variable frequency oscillator

E6B17 @E6B11 (A)
What is the capture range of a phase-locked loop circuit?
A. The frequency range over which the circuit can lock
B. The voltage range over which the circuit can lock
C. The input impedance range over which the circuit can lock
D. The range of time it takes the circuit to lock

E6C TTL digital integrated circuits; CMOS digital integrated circuits; gates

E6C01 @E6C01 (C)
What is the recommended power supply voltage for TTL series integrated circuits?
A. 12 volts
B. 1.5 volts
C. 5 volts
D. 13.6 volts

E6C02 @E6C02 (A)
What logic state do the inputs of a TTL device assume if they are left open?
A. A high-logic state
B. A low-logic state
C. The device becomes randomized and will not provide consistent high or low-logic states

D. Open inputs on a TTL device are ignored

E6C03 @E6C03 (A)
What level of input voltage is high in a TTL device operating with a 5-volt power supply?
A. 2.0 to 5.5 volts
B. 1.5 to 3.0 volts
C. 1.0 to 1.5 volts
D. -5.0 to -2.0 volts

E6C04 @E6C04 (C)
What level of input voltage is low in a TTL device operating with a 5-volt power-supply?
A. -2.0 to -5.5 volts
B.   2.0 to 5.5 volts
C.   0.0 to 0.8 volts
D. -0.8 to 0.4 volts

E6C05 @E6C05 (B)
What is one major advantage of CMOS over other devices?
A. Small size
B. Low power consumption
C. Low cost
D. Ease of circuit design

E6C06 @E6C06 (C)
Why do CMOS digital integrated circuits have high immunity to noise on the input signal or power supply?
A. Larger bypass capacitors are used in CMOS circuit design
B. The input switching threshold is about two times the power supply voltage
C. The input switching threshold is about one-half the power supply voltage
D. Input signals are stronger

E6C07 @E6C07 (A)
In Figure E6-2, what is the schematic symbol for an AND gate?
A. 1
B. 2
C. 3
D. 4

E6C08 @E6C08 (B)
In Figure E6-2, what is the schematic symbol for a NAND gate?
A. 1
B. 2
C. 3
D. 4

E6C09 @E6C09 (B)
In Figure E6-2, what is the schematic symbol for an OR gate?
A. 2
B. 3
C. 4
D. 6

E6C10 @E6C10 (D)

In Figure E6-2, what is the schematic symbol for a NOR gate?
A. 1
B. 2
C. 3
D. 4

E6C11 @E6C11 (C)
In Figure E6-2, what is the schematic symbol for a NOT gate?
A. 2
B. 4
C. 5
D. 6

E6D Vidicon and cathode-ray tube devices; charge-coupled devices (CCDs); liquid crystal displays (LCDs); toroids: permeability, core material, selecting, winding

E6D01 @E6D02 (D)
How is the electron beam deflected in a vidicon?
A. By varying the beam voltage
B. By varying the bias voltage on the beam forming grids inside the tube
C. By varying the beam current
D. By varying electromagnetic fields

E6D02 @E6D04 (D)
What is cathode ray tube (CRT) persistence?
A. The time it takes for an image to appear after the electron beam is turned on
B. The relative brightness of the display under varying conditions of ambient light
C. The ability of the display to remain in focus under varying conditions
D. The length of time the image remains on the screen after the beam is turned off

E6D03 @E6D05 (A)
If a cathode ray tube (CRT) is designed to operate with an anode voltage of 25,000 volts, what will happen if the anode voltage is increased to 35,000 volts?
A. The image size will decrease and the tube will produce X-rays
B. The image size will increase and the tube will produce X-rays
C. The image will become larger and brighter
D. There will be no apparent change

E6D04 @E6D06 (B)
Exceeding what design rating can cause a cathode ray tube (CRT) to generate X-rays?
A. The heater voltage
B. The anode voltage
C. The operating temperature
D. The operating frequency

E6D05 @E6D08 (C)
Which of the following is true of a charge-coupled device (CCD)?
A. Its phase shift changes rapidly with frequency
B. It is a CMOS analog-to-digital converter

C. It samples an analog signal and passes it in stages from the input to the output
D. It is used in a battery charger circuit

E6D06 @E6D09 (A)
What function does a charge-coupled device (CCD) serve in a modern video camera?
A. It stores photogenerated charges as signals corresponding to pixels
B. It generates the horizontal pulses needed for electron beam scanning
C. It focuses the light used to produce a pattern of electrical charges corresponding to the image
D. It combines audio and video information to produce a composite RF signal

E6D07 @E6D10 (B)
What is a liquid-crystal display (LCD)?
A. A modern replacement for a quartz crystal oscillator which displays its fundamental frequency
B. A display that uses a crystalline liquid to change the way light is refracted
C. A frequency-determining unit for a transmitter or receiver
D. A display that uses a glowing liquid to remain brightly lit in dim light

E6D08 @A6C01 (D)
What material property determines the inductance of a toroidal inductor with a 10-turn winding?
A. Core load current
B. Core resistance
C. Core reactivity
D. Core permeability

E6D09 @A6C02 (B)
By careful selection of core material, over what frequency range can toroidal cores produce useful inductors?
A. From a few kHz to no more than several MHz
B. From DC to at least 1000 MHz
C. From DC to no more than 3000 kHz
D. From a few hundred MHz to at least 1000 GHz

E6D10 @A6C03 (A)
What materials are used to make ferromagnetic inductors and transformers?
A. Ferrite and powdered-iron toroids
B. Silicon-ferrite toroids and shellac
C. Powdered-ferrite and silicon toroids
D. Ferrite and silicon-epoxy toroids

E6D11 @A6C04 (B)
What is one important reason for using powdered-iron toroids rather than ferrite toroids in an inductor?
A. Powdered-iron toroids generally have greater initial permeabilities
B. Powdered-iron toroids generally have better temperature stability
C. Powdered-iron toroids generally require fewer turns to produce a

given inductance value
D. Powdered-iron toroids are easier to use with surface-mount technology

E6D12 @A6C06 (B)
What would be a good choice of toroid core material to make a common-mode choke (such as winding telephone wires or stereo speaker leads on a core) to cure an HF RFI problem?
A. Type 61 mix ferrite (initial permeability of 125)
B. Type 43 mix ferrite (initial permeability of 850)
C. Type 6 mix powdered iron (initial permeability of 8)
D. Type 12 mix powdered iron (initial permeability of 3)

E6D13 @A6C07 (C)
What devices are commonly used as parasitic suppressors at the input and output terminals of VHF and UHF amplifiers?
A. Electrolytic capacitors
B. Butterworth filters
C. Ferrite beads
D. Steel-core toroids

E6D14 @A6C08 (A)
What is a primary advantage of using a toroidal core instead of a linear core in an inductor?
A. Toroidal cores contain most of the magnetic field within the core material
B. Toroidal cores make it easier to couple the magnetic energy into other components
C. Toroidal cores exhibit greater hysteresis
D. Toroidal cores have lower Q characteristics

E6D15 @A6C10 (C)
How many turns will be required to produce a 1-mH inductor using a ferrite toroidal core that has an inductance index (A sub L) value of 523?
A. 2 turns
B. 4 turns
C. 43 turns
D. 229 turns

E6D16 @A6C11 (A)
How many turns will be required to produce a 5-microhenry inductor using a powdered-iron toroidal core that has an inductance index (A sub L) value of 40?
A. 35 turns
B. 13 turns
C. 79 turns
D. 141 turns

E6E Quartz crystal (frequency determining properties as used in oscillators and filters); monolithic amplifiers (MMICs)

E6E01 @A6F01 (B)
For single-sideband phone emissions, what would be the bandwidth of a good crystal lattice band-pass filter?
A. 6 kHz at -6 dB
B. 2.1 kHz at -6 dB

C. 500 Hz at -6 dB
D. 15 kHz at -6 dB

E6E02 @A6F02 (C)
For double-sideband phone emissions, what would be the bandwidth of a good crystal lattice band-pass filter?
A. 1 kHz at -6 dB
B. 500 Hz at -6 dB
C. 6 kHz at -6 dB
D. 15 kHz at -6 dB

E6E03 @A6F03 (D)
What is a crystal lattice filter?
A. A power supply filter made with interlaced quartz crystals
B. An audio filter made with four quartz crystals that resonate at 1-kHz intervals
C. A filter with wide bandwidth and shallow skirts made using quartz crystals
D. A filter with narrow bandwidth and steep skirts made using quartz crystals

E6E04 @A6F04 (D)
What technique is used to construct low-cost, high-performance crystal filters?
A. Choose a center frequency that matches the available crystals
B. Choose a crystal with the desired bandwidth and operating frequency to match a desired center frequency
C. Measure crystal bandwidth to ensure at least 20% coupling
D. Measure crystal frequencies and carefully select units with less than 10% frequency difference

E6E05 @A6F05 (A)
Which factor helps determine the bandwidth and response shape of a crystal filter?
A. The relative frequencies of the individual crystals
B. The center frequency chosen for the filter
C. The gain of the RF stage preceding the filter
D. The amplitude of the signals passing through the filter

E6E06 @A6F06 (A)
What is the piezoelectric effect?
A. Physical deformation of a crystal by the application of a voltage
B. Mechanical deformation of a crystal by the application of a magnetic field
C. The generation of electrical energy by the application of light
D. Reversed conduction states when a P-N junction is exposed to light

E6E07 @A6F07 (C)
Which of the following devices would be most suitable for constructing a receive preamplifier for 1296 MHz?
A. A 2N2222 bipolar transistor
B. An MRF901 bipolar transistor
C. An MSA-0135 monolithic microwave integrated circuit (MMIC)
D. An MPF102 N-junction field-effect transistor (JFET)

E6E08 @A6F08 (A)
Which device might be used to simplify the design and construction of

a 3456-MHz receiver?
A. An MSA-0735 monolithic microwave integrated circuit (MMIC).
B. An MRF901 bipolar transistor
C. An MGF1402 gallium arsenide field-effect transistor (GaAsFET)
D. An MPF102 N-junction field-effect transistor (JFET)

E6E09 @A6F09 (D)
What type of amplifier device consists of a small "pill sized" package with an input lead, an output lead and 2 ground leads?
A. A gallium arsenide field-effect transistor (GaAsFET)
B. An operational amplifier integrated circuit (OAIC)
C. An indium arsenide integrated circuit (IAIC)
D. A monolithic microwave integrated circuit (MMIC)

E6E10 @A6F10 (B)
What typical construction technique do amateurs use when building an amplifier containing a monolithic microwave integrated circuit (MMIC)?
A. Ground-plane "ugly" construction
B. Microstrip construction
C. Point-to-point construction
D. Wave-soldering construction

E6E11 @A6F11 (A)
How is the operating bias voltage supplied to a monolithic microwave integrated circuit (MMIC)?
A. Through a resistor and RF choke connected to the amplifier output lead
B. MMICs require no operating bias
C. Through a capacitor and RF choke connected to the amplifier input lead
D. Directly to the bias-voltage (VCC IN) lead

SUBELEMENT E7 -- PRACTICAL CIRCUITS [7 Exam Questions -- 7 Groups]

E7A Digital logic circuits: Flip flops; Astable and monostable multivibrators; Gates (AND, NAND, OR, NOR); Positive and negative logic

E7A01 @E7A01 (C)
What is a bistable multivibrator circuit?
A. An "AND" gate
B. An "OR" gate
C. A flip-flop
D. A clock

E7A02 @E7A02 (C)
How many output level changes are obtained for every two trigger pulses applied to the input of a "T" flip-flop circuit?
A. None
B. One
C. Two
D. Four

E7A03 @E7A03 (B)
The frequency of an AC signal can be divided electronically by what type of digital circuit?
A. A free-running multivibrator

B. A bistable multivibrator
C. An OR gate
D. An astable multivibrator

E7A04 @E7A04 (B)
How many flip-flops are required to divide a signal frequency by 4?
A. 1
B. 2
C. 4
D. 8

E7A05 @E7A05 (D)
What is the characteristic function of an astable multivibrator?
A. It alternates between two stable states
B. It alternates between a stable state and an unstable state
C. It blocks either a 0 pulse or a 1 pulse and passes the other
D. It alternates between two unstable states

E7A06 @E7A06 (A)
What is the characteristic function of a monostable multivibrator?
A. It switches momentarily to the opposite binary state and then returns after a set time to its original state
B. It is a "clock" that produces a continuous square wave oscillating between 1 and 0
C. It stores one bit of data in either a 0 or 1 state
D. It maintains a constant output voltage, regardless of variations in the input voltage

E7A07 @E7A07 (B)
What logical operation does an AND gate perform?
A. It produces a logic "0" at its output only if all inputs are logic "1"
B. It produces a logic "1" at its output only if all inputs are logic "1"
C. It produces a logic "1" at its output if only one input is a logic "1"
D. It produces a logic "1" at its output if all inputs are logic "0"

E7A08 @E7A08 (D)
What logical operation does a NAND gate perform?
A. It produces a logic "0" at its output only when all inputs are logic "0"
B. It produces a logic "1" at its output only when all inputs are logic "1"
C. It produces a logic "0" at its output if some but not all of its inputs are logic "1"
D. It produces a logic "0" at its output only when all inputs are logic "1"

E7A09 @E7A09 (A)
What logical operation does an OR gate perform?
A. It produces a logic "1" at its output if any input is or all inputs are logic "1"
B. It produces a logic "0" at its output if all inputs are logic "1"
C. It only produces a logic "0" at its output when all inputs are logic "1"
D. It produces a logic "1" at its output if all inputs are logic "0"

E7A10 @E7A10 (C)
What logical operation does a NOR gate perform?
A. It produces a logic "0" at its output only if all inputs are logic "0"
B. It produces a logic "1" at its output only if all inputs are logic "1"
C. It produces a logic "0" at its output if any input is or all inputs are logic "1"
D. It produces a logic "1" at its output only when none of its inputs are logic "0"

E7A11 @E7A11 (C)
What is a truth table?
A. A table of logic symbols that indicate the high logic states of an op-amp
B. A diagram showing logic states when the digital device's output is true
C. A list of input combinations and their corresponding outputs that characterize the function of a digital device
D. A table of logic symbols that indicates the low logic states of an op-amp

E7A12 @E7A12 (D)
In a positive-logic circuit, what level is used to represent a logic 1?
A. A low level
B. A positive-transition level
C. A negative-transition level
D. A high level

E7A13 @E7A13 (A)
In a negative-logic circuit, what level is used to represent a logic 1?
A. A low level
B. A positive-transition level
C. A negative-transition level
D. A high level

E7B Amplifier circuits: Class A, Class AB, Class B, Class C, amplifier operating efficiency (ie, DC input versus PEP), transmitter final amplifiers; amplifier circuits: tube, bipolar transistor, FET

E7B01 @A7A03 (A)
For what portion of a signal cycle does a Class AB amplifier operate?
A. More than 180 degrees but less than 360 degrees
B. Exactly 180 degrees
C. The entire cycle
D. Less than 180 degrees

E7B02 @A7A06 (C)
Which class of amplifier provides the highest efficiency?
A. Class A
B. Class B
C. Class C
D. Class AB

E7B03 @A7A07 (A)
Where on the load line should a solid-state power amplifier be operated for best efficiency and stability?
A. Just below the saturation point
B. Just above the saturation point
C. At the saturation point
D. At 1.414 times the saturation point

E7B04 @A7A09 (C)
How can parasitic oscillations be eliminated from a power amplifier?
A. By tuning for maximum SWR
B. By tuning for maximum power output
C. By neutralization
D. By tuning the output

E7B05 @A7A11 (B)
How can even-order harmonics be reduced or prevented in transmitter amplifiers?
A. By using a push-push amplifier
B. By using a push-pull amplifier
C. By operating Class C
D. By operating Class AB

E7B06 @A7A12 (D)
What can occur when a nonlinear amplifier is used with a single-sideband phone transmitter?
A. Reduced amplifier efficiency
B. Increased intelligibility
C. Sideband inversion
D. Distortion

E7B07 @A7B01 (C)
How can a vacuum-tube power amplifier be neutralized?
A. By increasing the grid drive
B. By feeding back an in-phase component of the output to the input
C. By feeding back an out-of-phase component of the output to the input
D. By feeding back an out-of-phase component of the input to the output

E7B08 @A7B03 (B)
What tank-circuit Q is required to reduce harmonics to an acceptable level?
A. Approximately 120
B. Approximately 12
C. Approximately 1200
D. Approximately 1.2

E7B09 @A7B05 (B)
In Figure A7-1, what is the purpose of R1 and R2?
A. Load resistors
B. Fixed bias
C. Self bias
D. Feedback

E7B10 @A7B07 (D)
In Figure A7-1, what is the purpose of C3?

A. AC feedback
B. Input coupling
C. Power supply decoupling
D. Emitter bypass

E7B11 @A7B08 (D)
In Figure A7-1, what is the purpose of R3?
A. Fixed bias
B. Emitter bypass
C. Output load resistor
D. Self bias

E7B12 @A7B10 (A)
In Figure A7-2, what is the purpose of R?
A. Emitter load
B. Fixed bias
C. Collector load
D. Voltage regulation

E7B13 @A7B12 (A)
In Figure A7-2, what is the purpose of C2?
A. Output coupling
B. Emitter bypass
C. Input coupling
D. Hum filtering

E7B14 @A7B14 (B)
What is the purpose of D1 in the circuit shown in Figure A7-3?
A. Line voltage stabilization
B. Voltage reference
C. Peak clipping
D. Hum filtering

E7B15 @A7B15 (C)
What is the purpose of Q1 in the circuit shown in Figure A7-3?
A. It increases the output ripple
B. It provides a constant load for the voltage source
C. It increases the current-handling capability
D. It provides D1 with current

E7B16 @A7B17 (A)
What is the purpose of C2 in the circuit shown in Figure A7-3?
A. It bypasses hum around D1
B. It is a brute force filter for the output
C. To self resonate at the hum frequency
D. To provide fixed DC bias for Q1

E7C Impedance-matching networks: Pi, L, Pi-L; filter circuits: constant K, M-derived, band-stop, notch, crystal lattice, pi-section, T-section, L-section, Butterworth, Chebyshev, elliptical; filter applications (audio, IF, digital signal processing {DSP})

E7C01 @A7C03 (D)
How are the capacitors and inductors of a low-pass filter pi-network arranged between the network's input and output?
A. Two inductors are in series between the input and output and a capacitor is connected between the two inductors and ground

B. Two capacitors are in series between the input and output and an inductor is connected between the two capacitors and ground
C. An inductor is in parallel with the input, another inductor is in parallel with the output, and a capacitor is in series between the two
D. A capacitor is in parallel with the input, another capacitor is in parallel with the output, and an inductor is in series between the two

E7C02 @A7C04 (B)
What is an L-network?
A. A network consisting entirely of four inductors
B. A network consisting of an inductor and a capacitor
C. A network used to generate a leading phase angle
D. A network used to generate a lagging phase angle

E7C03 @A7C07 (C)
A T-network with series capacitors and a parallel (shunt) inductor has which of the following properties?
A. It transforms impedances and is a low-pass filter
B. It transforms reactances and is a low-pass filter
C. It transforms impedances and is a high-pass filter
D. It transforms reactances and is a high-pass filter

E7C04 @A7C08 (A)
What advantage does a pi-L-network have over a pi-network for impedance matching between the final amplifier of a vacuum-tube type transmitter and a multiband antenna?
A. Greater harmonic suppression
B. Higher efficiency
C. Lower losses
D. Greater transformation range

E7C05 @A7C11 (C)
How does a network transform one impedance to another?
A. It introduces negative resistance to cancel the resistive part of an impedance
B. It introduces transconductance to cancel the reactive part of an impedance
C. It cancels the reactive part of an impedance and changes the resistive part
D. Network resistances substitute for load resistances

E7C06 @A7D02 (B)
What value capacitor would be required to tune a 20-microhenry inductor to resonate in the 80-meter band?
A. 150 picofarads
B. 100 picofarads
C. 200 picofarads
D. 100 microfarads

E7C07 @A7D09 (D)
Which filter type is described as having ripple in the passband and a sharp cutoff?
A. A Butterworth filter
B. An active LC filter
C. A passive op-amp filter
D. A Chebyshev filter

E7C08 @A7D10 (C)
What are the distinguishing features of an elliptical filter?
A. Gradual passband rolloff with minimal stop-band ripple
B. Extremely flat response over its passband, with gradually rounded stop-band corners
C. Extremely sharp cutoff, with one or more infinitely deep notches in the stop band
D. Gradual passband rolloff with extreme stop-band ripple

E7C09 @A7H07 (B)
What kind of audio filter would you use to attenuate an interfering carrier signal while receiving an SSB transmission?
A. A band-pass filter
B. A notch filter
C. A pi-network filter
D. An all-pass filter

E7C10 @A7H08 (D)
What characteristic do typical SSB receiver IF filters lack that is important to digital communications?
A. Steep amplitude-response skirts
B. Passband ripple
C. High input impedance
D. Linear phase response

E7C11 @A7H09 (A)
What kind of digital signal processing audio filter might be used to remove unwanted noise from a received SSB signal?
A. An adaptive filter
B. A notch filter
C. A Hilbert-transform filter
D. A phase-inverting filter

E7C12 @A7H10 (C)
What kind of digital signal processing filter might be used in generating an SSB signal?
A. An adaptive filter
B. A notch filter
C. A Hilbert-transform filter
D. An elliptical filter

E7C13 @A7H11 (B)
Which type of filter would be the best to use in a 2-meter repeater duplexer?
A. A crystal filter
B. A cavity filter
C. A DSP filter
D. An L-C filter

E7D Oscillators: types, applications, stability; voltage-regulator circuits: discrete, integrated and switched mode

E7D01 @A7F01 (D)
What are three major oscillator circuits often used in Amateur Radio equipment?
A. Taft, Pierce and negative feedback
B. Colpitts, Hartley and Taft

C. Taft, Hartley and Pierce
D. Colpitts, Hartley and Pierce

E7D02 @A7F02 (C)
What condition must exist for a circuit to oscillate?
A. It must have a gain of less than 1
B. It must be neutralized
C. It must have positive feedback sufficient to overcome losses
D. It must have negative feedback sufficient to cancel the input

E7D03 @A7F03 (A)
How is the positive feedback coupled to the input in a Hartley oscillator?
A. Through a tapped coil
B. Through a capacitive divider
C. Through link coupling
D. Through a neutralizing capacitor

E7D04 @A7F04 (C)
How is the positive feedback coupled to the input in a Colpitts oscillator?
A. Through a tapped coil
B. Through link coupling
C. Through a capacitive divider
D. Through a neutralizing capacitor

E7D05 @A7F05 (D)
How is the positive feedback coupled to the input in a Pierce oscillator?
A. Through a tapped coil
B. Through link coupling
C. Through a neutralizing capacitor
D. Through capacitive coupling

E7D06 @A7F08 (B)
Which type of oscillator circuits are commonly used in a VFO?
A. Pierce and Zener
B. Colpitts and Hartley
C. Armstrong and deForest
D. Negative feedback and Balanced feedback

E7D07 @A7F11 (B)
Why must a very stable reference oscillator be used as part of a phase-locked loop (PLL) frequency synthesizer?
A. Any amplitude variations in the reference oscillator signal will prevent the loop from locking to the desired signal
B. Any phase variations in the reference oscillator signal will produce phase noise in the synthesizer output
C. Any phase variations in the reference oscillator signal will produce harmonic distortion in the modulating signal
D. Any amplitude variations in the reference oscillator signal will prevent the loop from changing frequency

E7D08 @A7E01 (D)
What is one characteristic of a linear electronic voltage regulator?
A. It has a ramp voltage as its output
B. The pass transistor switches from the "off" state to the "on"

state
C. The control device is switched on or off, with the duty cycle proportional to the line or load conditions
D. The conduction of a control element is varied in direct proportion to the line voltage or load current

E7D09 @A7E02 (C)
What is one characteristic of a switching electronic voltage regulator?
A. The conduction of a control element is varied in direct proportion to the line voltage or load current
B. It provides more than one output voltage
C. The control device is switched on or off, with the duty cycle proportional to the line or load conditions
D. It gives a ramp voltage at its output

E7D10 @A7E03 (A)
What device is typically used as a stable reference voltage in a linear voltage regulator?
A. A Zener diode
B. A tunnel diode
C. An SCR
D. A varactor diode

E7D11 @E7E04 (B)
What type of linear regulator is used in applications requiring efficient utilization of the primary power source?
A. A constant current source
B. A series regulator
C. A shunt regulator
D. A shunt current source

E7D12 @A7E05 (D)
What type of linear voltage regulator is used in applications requiring a constant load on the unregulated voltage source?
A. A constant current source
B. A series regulator
C. A shunt current source
D. A shunt regulator

E7D13 @A7E06 (C)
To obtain the best temperature stability, approximately what operating voltage should be used for the reference diode in a linear voltage regulator?
A. 2 volts
B. 3 volts
C. 6 volts
D. 10 volts

E7D14 @A7E09 (B)
What are the important characteristics of a three-terminal regulator?
A. Maximum and minimum input voltage, minimum output current and voltage
B. Maximum and minimum input voltage, maximum output current and voltage
C. Maximum and minimum input voltage, minimum output current and maximum output voltage

D. Maximum and minimum input voltage, minimum output voltage and maximum output current

E7D15 @A7E10 (A)
What type of voltage regulator limits the voltage drop across its junction when a specified current passes through it in the reverse-breakdown direction?
A. A Zener diode
B. A three-terminal regulator
C. A bipolar regulator
D. A pass-transistor regulator

E7D16 @A7E11 (C)
What type of voltage regulator contains a voltage reference, error amplifier, sensing resistors and transistors, and a pass element in one package?
A. A switching regulator
B. A Zener regulator
C. A three-terminal regulator
D. An op-amp regulator

E7E Modulators: reactance, phase, balanced; detectors; mixer stages; frequency synthesizers

E7E01 @A7G02 (B)
How is an F3E FM-phone emission produced?
A. With a balanced modulator on the audio amplifier
B. With a reactance modulator on the oscillator
C. With a reactance modulator on the final amplifier
D. With a balanced modulator on the oscillator

E7E02 @A7G03 (C)
How does a reactance modulator work?
A. It acts as a variable resistance or capacitance to produce FM signals
B. It acts as a variable resistance or capacitance to produce AM signals
C. It acts as a variable inductance or capacitance to produce FM signals
D. It acts as a variable inductance or capacitance to produce AM signals

E7E03 @A7G05 (C)
How does a phase modulator work?
A. It varies the tuning of a microphone preamplifier to produce FM signals
B. It varies the tuning of an amplifier tank circuit to produce AM signals
C. It varies the tuning of an amplifier tank circuit to produce FM signals
D. It varies the tuning of a microphone preamplifier to produce AM signals

E7E04 @A7G08 (A)
How can a single-sideband phone signal be generated?
A. By using a balanced modulator followed by a filter
B. By using a reactance modulator followed by a mixer

C. By using a loop modulator followed by a mixer
D. By driving a product detector with a DSB signal

E7E05 @A7G10 (D)
What audio shaping network is added at a transmitter to proportionally attenuate the lower audio frequencies, giving an even spread to the energy in the audio band?
A. A de-emphasis network
B. A heterodyne suppressor
C. An audio prescaler
D. A pre-emphasis network

E7E06 @A7G11 (A)
What audio shaping network is added at a receiver to restore proportionally attenuated lower audio frequencies?
A. A de-emphasis network
B. A heterodyne suppressor
C. An audio prescaler
D. A pre-emphasis network

E7E07 @A7I01 (D)
What is the mixing process?
A. The elimination of noise in a wideband receiver by phase comparison
B. The elimination of noise in a wideband receiver by phase differentiation
C. The recovery of the intelligence from a modulated RF signal
D. The combination of two signals to produce sum and difference frequencies

E7E08 @A7I02 (C)
What are the principal frequencies that appear at the output of a mixer circuit?
A. Two and four times the original frequency
B. The sum, difference and square root of the input frequencies
C. The original frequencies and the sum and difference frequencies
D. 1.414 and 0.707 times the input frequency

E7E09 @A7I04 (A)
What occurs in a receiver when an excessive amount of signal energy reaches the mixer circuit?
A. Spurious mixer products are generated
B. Mixer blanking occurs
C. Automatic limiting occurs
D. A beat frequency is generated

E7E10 @A7I05 (C)
What type of frequency synthesizer circuit uses a stable voltage-controlled oscillator, programmable divider, phase detector, loop filter and a reference frequency source?
A. A direct digital synthesizer
B. A hybrid synthesizer
C. A phase-locked loop synthesizer
D. A diode-switching matrix synthesizer

E7E11 @A7I06 (A)
What type of frequency synthesizer circuit uses a phase accumulator,

lookup table, digital to analog converter and a low-pass antialias filter?
A. A direct digital synthesizer
B. A hybrid synthesizer
C. A phase-locked loop synthesizer
D. A diode-switching matrix synthesizer

E7E12 @A7I08 (D)
What are the main blocks of a direct digital frequency synthesizer?
A. A variable-frequency crystal oscillator, phase accumulator, digital to analog converter and a loop filter
B. A stable voltage-controlled oscillator, programmable divider, phase detector, loop filter and a digital to analog converter
C. A variable-frequency oscillator, programmable divider, phase detector and a low-pass antialias filter
D. A phase accumulator, lookup table, digital to analog converter and a low-pass antialias filter

E7E13 @A7I09 (B)
What information is contained in the lookup table of a direct digital frequency synthesizer?
A. The phase relationship between a reference oscillator and the output waveform
B. The amplitude values that represent a sine-wave output
C. The phase relationship between a voltage-controlled oscillator and the output waveform
D. The synthesizer frequency limits and frequency values stored in the radio memories

E7E14 @A7I10 (C)
What are the major spectral impurity components of direct digital synthesizers?
A. Broadband noise
B. Digital conversion noise
C. Spurs at discrete frequencies
D. Nyquist limit noise

E7E15 @A7I11 (A)
What are the major spectral impurity components of phase-locked loop synthesizers?
A. Broadband noise
B. Digital conversion noise
C. Spurs at discrete frequencies
D. Nyquist limit noise

E7F Digital frequency divider circuits; frequency marker generators; frequency counters

E7F01 @E7B01 (D)
What is the purpose of a prescaler circuit?
A. It converts the output of a JK flip-flop to that of an RS flip-flop
B. It multiplies an HF signal so a low-frequency counter can display the operating frequency
C. It prevents oscillation in a low-frequency counter circuit
D. It divides an HF signal so a low-frequency counter can display the operating frequency

E7F02 @E7B02 (B)
How many states does a decade counter digital IC have?
A. 2
B. 10
C. 20
D. 100

E7F03 @E7B03 (A)
What is the function of a decade counter digital IC?
A. It produces one output pulse for every ten input pulses
B. It decodes a decimal number for display on a seven-segment LED display
C. It produces ten output pulses for every input pulse
D. It adds two decimal numbers

E7F04 @E7B04 (C)
What additional circuitry is required in a 100-kHz crystal-controlled marker generator to provide markers at 50 and 25 kHz?
A. An emitter-follower
B. Two frequency multipliers
C. Two flip-flops
D. A voltage divider

E7F05 @E7B05 (B)
If a 1-MHz oscillator is used with a divide-by-ten circuit to make a marker generator, what will the output be?
A. A 1-MHz sinusoidal signal with harmonics every 100 kHz
B. A 100-kHz signal with harmonics every 100 kHz
C. A 1-MHz square wave with harmonics every 1 MHz
D. A 100-kHz signal modulated by a 10-kHz signal

E7F06 @E7B06 (D)
What is a crystal-controlled marker generator?
A. A low-stability oscillator that "sweeps" through a ban of frequencies
B. An oscillator often used in aircraft to determine the craft's location relative to the inner and outer markers at airports
C. A high-stability oscillator whose output frequency and amplitude can be varied over a wide range
D. A high-stability oscillator that generates a series of reference signals at known frequency intervals

E7F07 @E7B07 (A)
What type of circuit does NOT make a good marker generator?
A. A sinusoidal crystal oscillator
B. A crystal oscillator followed by a class C amplifier
C. A TTL device wired as a crystal oscillator
D. A crystal oscillator and a frequency divider

E7F08 @E7B08 (C)
What is the purpose of a marker generator?
A. To add audio markers to an oscilloscope
B. To provide a frequency reference for a phase locked loop
C. To provide a means of calibrating a receiver's frequency settings
D. To add time signals to a transmitted signal

E7F09 @E7B09 (A)
What does the accuracy of a frequency counter depend on?
A. The internal crystal reference
B. A voltage-regulated power supply with an unvarying output
C. Accuracy of the AC input frequency to the power supply
D. Proper balancing of the power-supply diodes

E7F10 @E7B10 (C)
How does a frequency counter determine the frequency of a signal?
A. It counts the total number of pulses in a circuit
B. It monitors a WWV reference signal for comparison with the measured signal
C. It counts the number of input pulses in a specific period of time
D. It converts the phase of the measured signal to a voltage which is proportional to the frequency

E7F11 @E7B11 (A)
What is the purpose of a frequency counter?
A. To indicate the frequency of the strongest input signal which is within the counter's frequency range
B. To generate a series of reference signals at known frequency intervals
C. To display all frequency components of a transmitted signal
D. To compare the difference between the input and a voltage-controlled oscillator and produce an error voltage

E7G Active audio filters: characteristics; basic circuit design; preselector applications

E7G01 @E7C01 (B)
What determines the gain and frequency characteristics of an op-amp RC active filter?
A. The values of capacitances and resistances built into the op-amp
B. The values of capacitances and resistances external to the op-amp
C. The input voltage and frequency of the op-amp's DC power supply
D. The output voltage and smoothness of the op-amp's DC power supply

E7G02 @E7C02 (C)
What causes ringing in a filter?
A. The slew rate of the filter
B. The bandwidth of the filter
C. The filter shape, as measured in the frequency domain
D. The gain of the filter

E7G03 @E7C03 (D)
What are the advantages of using an op-amp instead of LC elements in an audio filter?
A. Op-amps are more rugged and can withstand more abuse than can LC elements
B. Op-amps are fixed at one frequency
C. Op-amps are available in more varieties than are LC elements
D. Op-amps exhibit gain rather than insertion loss

E7G04 @E7C04 (C)
What type of capacitors should be used in an op-amp RC active filter circuit?
A. Electrolytic

B. Disc ceramic
C. Polystyrene
D. Paper dielectric

E7G05 @E7C05 (A)
How can unwanted ringing and audio instability be prevented in a multisection op-amp RC audio filter circuit?
A. Restrict both gain and Q
B. Restrict gain, but increase Q
C. Restrict Q, but increase gain
D. Increase both gain and Q

E7G06 @E7C06 (A)
What parameter must be selected when designing an audio filter using an op-amp?
A. Bandpass characteristic
B. Desired current gain
C. Temperature coefficient
D. Output-offset overshoot

E7G07 @E7C07 (B)
The design of a preselector involves a trade-off between bandwidth and what other factor?
A. The amount of ringing
B. Insertion loss
C. The number of parts
D. The choice of capacitors or inductors

E7G08 @E7C08 (A)
When designing an op-amp RC active filter for a given frequency range and Q, what steps are typically followed when selecting the external components?
A. Standard capacitor values are chosen first, the resistances are calculated, then resistors of the nearest standard value are used
B. Standard resistor values are chosen first, the capacitances are calculated, then capacitors of the nearest standard value are used
C. Standard resistor and capacitor values are used, the circuit is tested, then additional resistors are added to make any adjustments
D. Standard resistor and capacitor values are used, the circuit is tested, then additional capacitors are added to make any adjustments

E7G09 @E7C09 (C)
When designing an op-amp RC active filter for a given frequency range and Q, why are the external capacitance values usually chosen first, then the external resistance values calculated?
A. An op-amp will perform as an active filter using only standard external capacitance values
B. The calculations are easier to make with known capacitance values rather than with known resistance values
C. Capacitors with unusual capacitance values are not widely available, so standard values are used to begin the calculations
D. The equations for the calculations can only be used with known capacitance values

E7G10 @E7C10 (D)
What are the principal uses of an op-amp RC active filter in amateur circuitry?

A. High-pass filters used to block RFI at the input to receivers
B. Low-pass filters used between transmitters and transmission lines
C. Filters used for smoothing power-supply output
D. Audio filters used for receivers

E7G11 @E7C11 (D)
Where should an op-amp RC active audio filter be placed in an amateur receiver?
A. In the IF strip, immediately before the detector
B. In the audio circuitry immediately before the speaker or phone jack
C. Between the balanced modulator and frequency multiplier
D. In the low-level audio stages

SUBELEMENT E8 -- SIGNALS AND EMISSIONS [5 Exam Questions -- 5 Groups]

E8A AC waveforms: sine wave, square wave, sawtooth wave; AC measurements: peak, peak-to-peak and root-mean-square (RMS) value, peak-envelope-power (PEP) relative to average

E8A01 @A8E02 (C)
Starting at a positive peak, how many times does a sine wave cross the zero axis in one complete cycle?
A. 180 times
B. 4 times
C. 2 times
D. 360 times

E8A02 @A8E06 (C)
What is a wave called that abruptly changes back and forth between two voltage levels and remains an equal time at each level?
A. A sine wave
B. A cosine wave
C. A square wave
D. A sawtooth wave

E8A03 @A8E07 (D)
What sine waves added to a fundamental frequency make up a square wave?
A. A sine wave 0.707 times the fundamental frequency
B. All odd and even harmonics
C. All even harmonics
D. All odd harmonics

E8A04 @A8E08 (A)
What type of wave is made up of a sine wave of a fundamental frequency and all its odd harmonics?
A. A square wave
B. A sine wave
C. A cosine wave
D. A tangent wave

E8A05 @A8E09 (B)
What is a sawtooth wave?
A. A wave that alternates between two values and spends an equal time at each level
B. A wave with a straight line rise time faster than the fall time

(or vice versa)
C. A wave that produces a phase angle tangent to the unit circle
D. A wave whose amplitude at any given instant can be represented by a point on a wheel rotating at a uniform speed

E8A06 @A8E10 (C)
What type of wave has a rise time significantly faster than the fall time (or vice versa)?
A. A cosine wave
B. A square wave
C. A sawtooth wave
D. A sine wave

E8A07 @A8E11 (A)
What type of wave is made up of sine waves of a fundamental frequency and all harmonics?
A. A sawtooth wave
B. A square wave
C. A sine wave
D. A cosine wave

E8A08 @A8F01 (B)
What is the peak voltage at a common household electrical outlet?
A. 240 volts
B. 170 volts
C. 120 volts
D. 340 volts

E8A09 @A8F02 (C)
What is the peak-to-peak voltage at a common household electrical outlet?
A. 240 volts
B. 120 volts
C. 340 volts
D. 170 volts

E8A10 @A8F03 (A)
What is the RMS voltage at a common household electrical power outlet?
A. 120-V AC
B. 340-V AC
C. 85-V AC
D. 170-V AC

E8A11 @A8F04 (A)
What is the RMS value of a 340-volt peak-to-peak pure sine wave?
A. 120-V AC
B. 170-V AC
C. 240-V AC
D. 300-V AC

E8A12 @A8F05 (C)
What is the equivalent to the root-mean-square value of an AC voltage?
A. The AC voltage found by taking the square of the average value of the peak AC voltage
B. The DC voltage causing the same heating of a given resistor as the peak AC voltage
C. The AC voltage causing the same heating of a given resistor as a

DC voltage of the same value
D. The AC voltage found by taking the square root of the average AC value

E8A13 @A8F06 (D)
What would be the most accurate way of determining the RMS voltage of a complex waveform?
A. By using a grid dip meter
B. By measuring the voltage with a D'Arsonval meter
C. By using an absorption wavemeter
D. By measuring the heating effect in a known resistor

E8A14 @A8F07 (A)
For many types of voices, what is the approximate ratio of PEP to average power during a modulation peak in a single-sideband phone signal?
A. 2.5 to 1
B. 25 to 1
C. 1 to 1
D. 100 to 1

E8A15 @A8F08 (B)
In a single-sideband phone signal, what determines the PEP-to-average power ratio?
A. The frequency of the modulating signal
B. The speech characteristics
C. The degree of carrier suppression
D. The amplifier power

E8A16 @A8F09 (C)
What is the approximate DC input power to a Class B RF power amplifier stage in an FM-phone transmitter when the PEP output power is 1500 watts?
A. 900 watts
B. 1765 watts
C. 2500 watts
D. 3000 watts

E8A17 @A8F11 (D)
What is the approximate DC input power to a Class AB RF power amplifier stage in an unmodulated carrier transmitter when the PEP output power is 500 watts?
A. 250 watts
B. 600 watts
C. 800 watts
D. 1000 watts

E8B FCC emission designators versus emission types; modulation symbols and transmission characteristics; modulation methods; modulation index; deviation ratio; pulse modulation: width; position

E8B01 @A8A01 (A)
What is emission A3C?
A. Facsimile
B. RTTY
C. ATV
D. Slow Scan TV

E8B02 @A8A02 (B)
What type of emission is produced when an AM transmitter is modulated by a facsimile signal?
A. A3F
B. A3C
C. F3F
D. F3C

E8B03 @A8A03 (C)
What does a facsimile transmission produce?
A. Tone-modulated telegraphy
B. A pattern of printed characters designed to form a picture
C. Printed pictures by electrical means
D. Moving pictures by electrical means

E8B04 @A8A08 (D)
What is emission F3F?
A. Modulated CW
B. Facsimile
C. RTTY
D. Television

E8B05 @A8A10 (D)
What type of emission is produced when an SSB transmitter is modulated by a slow-scan television signal?
A. J3A
B. F3F
C. A3F
D. J3F

E8B06 @A8B03 (B)
If the first symbol of an ITU emission designator is J, representing a single-sideband, suppressed-carrier signal, what information about the emission is described?
A. The nature of any signal multiplexing
B. The type of modulation of the main carrier
C. The maximum permissible bandwidth
D. The maximum signal level, in decibels

E8B07 @A8B07 (C)
If the second symbol of an ITU emission designator is 1, representing a single channel containing quantized, or digital information, what information about the emission is described?
A. The maximum transmission rate, in bauds
B. The maximum permissible deviation
C. The nature of signals modulating the main carrier
D. The type of information to be transmitted

E8B08 @A8B08 (D)
If the third symbol of an ITU emission designator is D, representing data transmission, telemetry or telecommand, what information about the emission is described?
A. The maximum transmission rate, in bauds
B. The maximum permissible deviation
C. The nature of signals modulating the main carrier
D. The type of information to be transmitted

E8B09 @A8C02 (A)
How can the unwanted sideband be removed from a double-sideband signal generated by a balanced modulator to produce a single-sideband phone signal?
A. By filtering
B. By heterodyning
C. By mixing
D. By neutralization

E8B10 @A8C05 (D)
How does the modulation index of a phase-modulated emission vary with RF carrier frequency (the modulated 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

E8B11 @A8C06 (A)
In an FM-phone signal having a maximum frequency deviation of 3000 Hz either side of the carrier frequency, what is the modulation index when the modulating frequency is 1000 Hz?
A. 3
B. 0.3
C. 3000
D. 1000

E8B12 @A8C07 (B)
What is the modulation index of an FM-phone transmitter producing an instantaneous carrier deviation of 6 kHz when modulated with a 2-kHz modulating frequency?
A. 6000
B. 3
C. 2000
D. 1/3

E8B13 @A8C10 (D)
What is the deviation ratio of an FM-phone signal having a maximum frequency swing of plus or minus 5 kHz and accepting a maximum modulation rate of 3 kHz?
A. 60
B. 0.16
C. 0.6
D. 1.66

E8B14 @E8A01 (A)
In a pulse-modulation system, why is the transmitter's peak power much greater than its average power?
A. The signal duty cycle is less than 100%
B. The signal reaches peak amplitude only when voice modulated
C. The signal reaches peak amplitude only when voltage spikes are generated within the modulator
D. The signal reaches peak amplitude only when the pulses are also amplitude modulated

E8B15 @E8A02 (C)
What is one way that voice is transmitted in a pulse-width modulation

system?
A. A standard pulse is varied in amplitude by an amount depending on the voice waveform at that instant
B. The position of a standard pulse is varied by an amount depending on the voice waveform at that instant
C. A standard pulse is varied in duration by an amount depending on the voice waveform at that instant
D. The number of standard pulses per second varies depending on the voice waveform at that instant

E8B16 @E8A09 (A)
What function does a pulse-width modulator perform in a switching regulator power supply?
A. It turns the switch transistor on and off at the proper time to ensure smooth regulation
B. It increases and decreases the load current at the proper time to ensure smooth regulation
C. It increases or decreases the frequency of the input voltage to ensure that AC pulses are sent at regular intervals to the rectifier
D. It turns the rectifier on and off at regular intervals to avoid overheating the power supply

E8C Digital signals: CW; baudot; ASCII; packet; AMTOR; Clover; information rate vs bandwidth

E8C01 @E8B01 (D)
What digital code consists of elements having unequal length?
A. ASCII
B. AX.25
C. Baudot
D. Morse code

E8C02 @E8B02 (B)
What are some of the differences between the Baudot digital code and ASCII?
A. Baudot uses four data bits per character, ASCII uses eight; Baudot uses one character as a shift code, ASCII has no shift code
B. Baudot uses five data bits per character, ASCII uses eight; Baudot uses one character as a shift code, ASCII has no shift code
C. Baudot uses six data bits per character, ASCII uses eight; Baudot has no shift code, ASCII uses one character as a shift code
D. Baudot uses seven data bits per character, ASCII uses eight; Baudot has no shift code, ASCII uses one character as a shift code

E8C03 @E8B03 (C)
What is one advantage of using the ASCII code for data communications?
A. It includes built-in error-correction features
B. It contains fewer information bits per character than any other code
C. It is possible to transmit both upper and lower case text
D. It uses one character as a "shift" code to send numeric and special characters

E8C04 @E8B04 (B)
What digital communications system is well suited for meteor-scatter communications?
A. ACSSB

B. Packet radio
C. AMTOR
D. Spread spectrum

E8C05 @E8B05 (D)
What type of error control system does Mode A AMTOR use?
A. Each character is sent twice
B. The receiving station checks the calculated frame check sequence (FCS) against the transmitted FCS
C. The receiving station checks the calculated frame parity against the transmitted parity
D. The receiving station automatically requests repeats when needed

E8C06 @E8B06 (A)
What type of error control system does Mode B AMTOR use?
A. Each character is sent twice
B. The receiving station checks the calculated frame check sequence (FCS) against the transmitted FCS
C. The receiving station checks the calculated frame parity against the transmitted parity
D. The receiving station automatically requests repeats when needed

E8C07 @E8B07 (C)
What is the necessary bandwidth of a 13-WPM international Morse code emission A1A transmission?
A. Approximately 13 Hz
B. Approximately 26 Hz
C. Approximately 52 Hz
D. Approximately 104 Hz

E8C08 @E8B08 (C)
What is the necessary bandwidth for a 170-hertz shift, 300-baud ASCII emission J2D transmission?
A. 0 Hz
B. 0.3 kHz
C. 0.5 kHz
D. 1.0 kHz

E8C09 @E8B09 (D)
What is the necessary bandwidth of a 1000-Hz shift, 1200-baud ASCII emission F1D transmission?
A. 1000 Hz
B. 1200 Hz
C. 440 Hz
D. 2400 Hz

E8C10 @E8B10 (A)
What is the necessary bandwidth of a 4800-Hz frequency shift, 9600-baud ASCII emission F1D transmission?
A. 15.36 kHz
B. 9.6 kHz
C. 4.8 kHz
D. 5.76 kHz

E8D Amplitude compandored single-sideband (ACSSB); spread-spectrum communications

E8D01 @E8C01 (C)
What is amplitude compandored single-sideband?
A. Reception of single-sideband signal with a conventional CW receiver
B. Reception of single-sideband signal with a conventional FM receiver
C. Single-sideband signal incorporating speech compression at the transmitter and speech expansion at the receiver
D. Single-sideband signal incorporating speech expansion at the transmitter and speech compression at the receiver

E8D02 @E8C02 (A)
What is meant by compandoring?
A. Compressing speech at the transmitter and expanding it at the receiver
B. Using an audio-frequency signal to produce pulse-length modulation
C. Combining amplitude and frequency modulation to produce a single-sideband signal
D. Detecting and demodulating a single-sideband signal by converting it to a pulse-modulated signal

E8D03 @E8C03 (A)
What is the purpose of a pilot tone in an amplitude-compandored single-sideband system?
A. It permits rapid tuning of a mobile receiver
B. It replaces the suppressed carrier at the receiver
C. It permits rapid change of frequency to escape high-powered interference
D. It acts as a beacon to indicate the present propagation characteristic of the band

E8D04 @E8C04 (D)
What is the approximate frequency of the pilot tone in an amplitude-compandored single-sideband system?
A. 1 kHz
B. 5 MHz
C. 455 kHz
D. 3 kHz

E8D05 @E8C05 (B)
How many more voice transmissions can be packed into a given frequency band for amplitude-compandored single-sideband systems over conventional FM-phone systems?
A. 2
B. 4
C. 8
D. 16

E8D06 @E8C06 (D)
What term describes a wide-bandwidth communications system in which the RF carrier varies according to some predetermined sequence?
A. Amplitude compandored single sideband
B. AMTOR
C. Time-domain frequency modulation
D. Spread-spectrum communication

E8D07 @E8C07 (A)

What spread-spectrum communications technique alters the center frequency of a conventional carrier many times per second in accordance with a pseudo-random list of channels?
A. Frequency hopping
B. Direct sequence
C. Time-domain frequency modulation
D. Frequency compandored spread-spectrum

E8D08 @E8C08 (B)
What spread-spectrum communications technique uses a very fast 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

E8D09 @E8C09 (C)
What controls the spreading sequence of an amateur spread-spectrum transmission?
A. A frequency-agile linear amplifier
B. A crystal-controlled filter linked to a high-speed crystal switching mechanism
C. A binary linear-feedback shift register
D. A binary code which varies if propagation changes

E8D10 @E8C10 (D)
Why are spread-spectrum communications so resistant to interference?
A. Interfering signals are removed by a frequency-agile crystal filter
B. Spread-spectrum transmitters use much higher power than conventional carrier-frequency transmitters
C. Spread-spectrum transmitters can "hunt" for the best carrier frequency to use within a given RF spectrum
D. Only signals using the correct spreading sequence are received

E8D11 @E8C11 (B)
Why do spread-spectrum communications interfere so little with conventional channelized communications in the same band?
A. A spread-spectrum transmitter avoids channels within the band which are in use by conventional transmitters
B. Spread-spectrum signals appear only as low-level noise in conventional receivers
C. Spread-spectrum signals change too rapidly to be detected by conventional receivers
D. Special crystal filters are needed in conventional receivers to detect spread-spectrum signals

E8E Peak amplitude (positive and negative); peak-to-peak values: measurements; Electromagnetic radiation; wave polarization; signal-to-noise (S/N) ratio

E8E01 @E8D01 (D)
What is the term for the amplitude of the maximum positive excursion of a signal as viewed on an oscilloscope?
A. Peak-to-peak voltage
B. Inverse peak negative voltage
C. RMS voltage

D. Peak positive voltage

E8E02 @E8D03 (A)
What is the easiest voltage amplitude dimension to measure by viewing a pure sine wave signal on an oscilloscope?
A. Peak-to-peak voltage
B. RMS voltage
C. Average voltage
D. DC voltage

E8E03 @E8D04 (B)
What is the relationship between the peak-to-peak voltage and the peak voltage amplitude in a symmetrical waveform?
A. 1:1
B. 2:1
C. 3:1
D. 4:1

E8E04 @E8D05 (A)
What input-amplitude parameter is valuable in evaluating the signal-handling capability of a Class A amplifier?
A. Peak voltage
B. RMS voltage
C. An average reading power output meter
D. Resting voltage

E8E05 @E8D07 (B)
What is the PEP output of a transmitter that has a maximum peak of 30 volts to a 50-ohm load as observed on an oscilloscope?
A. 4.5 watts
B. 9 watts
C. 16 watts
D. 18 watts

E8E06 @E8D09 (D)
If an RMS reading AC voltmeter reads 65 volts on a sinusoidal waveform, what is the peak-to-peak voltage?
A. 46 volts
B. 92 volts
C. 130 volts
D. 184 volts

E8E07 @E8D11 (A)
What is the advantage of using a peak-reading voltmeter to monitor the output of a single-sideband transmitter?
A. It would be easy to calculate the PEP output of the transmitter
B. It would be easy to calculate the RMS output power of the transmitter
C. It would be easy to calculate the SWR on the transmission line
D. It would be easy to observe the output amplitude variations

E8E08 @A8D01 (C)
What are electromagnetic waves?
A. Alternating currents in the core of an electromagnet
B. A wave consisting of two electric fields at right angles to each other
C. A wave consisting of an electric field and a magnetic field at

right angles to each other
D. A wave consisting of two magnetic fields at right angles to each other

E8E09 @A8D03 (C)
Why don't electromagnetic waves penetrate a good conductor for more than a fraction of a wavelength?
A. Electromagnetic waves are reflected by the surface of a good conductor
B. Oxide on the conductor surface acts as a magnetic shield
C. The electromagnetic waves are dissipated as eddy currents in the conductor surface
D. The resistance of the conductor surface dissipates the electromagnetic waves

E8E10 @A8D04 (D)
Which of the following best describes electromagnetic waves traveling in free space?
A. Electric and magnetic fields become aligned as they travel
B. The energy propagates through a medium with a high refractive index
C. The waves are reflected by the ionosphere and return to their source
D. Changing electric and magnetic fields propagate the energy across a vacuum

E8E11 @A8D06 (B)
What is meant by circularly polarized electromagnetic waves?
A. Waves with an electric field bent into a circular shape
B. Waves with a rotating electric field
C. Waves that circle the Earth
D. Waves produced by a loop antenna

E8E12 @A8D08 (D)
What is the polarization of an electromagnetic wave if its magnetic field is parallel to the surface of the Earth?
A. Circular
B. Horizontal
C. Elliptical
D. Vertical

E8E13 @A8D09 (A)
What is the polarization of an electromagnetic wave if its magnetic field is perpendicular to the surface of the Earth?
A. Horizontal
B. Circular
C. Elliptical
D. Vertical

E8E14 @A8D11 (D)
What is the primary source of noise that can be heard in an HF-band receiver with an antenna connected?
A. Detector noise
B. Man-made noise
C. Receiver front-end noise
D. Atmospheric noise

E8E15 @A8D12 (A)
What is the primary source of noise that can be heard in a VHF/UHF-band receiver with an antenna connected?
A. Receiver front-end noise
B. Man-made noise
C. Atmospheric noise
D. Detector noise

SUBELEMENT E9 -- ANTENNAS AND FEED LINES [5 Exam Questions -- 5 Groups]

E9A Isotropic radiators: definition; used as a standard for comparison; radiation pattern; basic antenna parameters: radiation resistance and reactance (including wire dipole, folded dipole), gain, beamwidth, efficiency

E9A01 @E9A02 (C)
Which of the following describes an isotropic radiator?
A. A grounded radiator used to measure earth conductivity
B. A horizontal radiator used to compare Yagi antennas
C. A theoretical radiator used to compare other antennas
D. A spacecraft radiator used to direct signals toward the earth

E9A02 @E9A03 (A)
When is it useful to refer to an isotropic radiator?
A. When comparing the gains of directional antennas
B. When testing a transmission line for standing-wave ratio
C. When directing a transmission toward the tropical latitudes
D. When using a dummy load to tune a transmitter

E9A03 @E9A06 (B)
How much gain does a 1/2-wavelength dipole have over an isotropic radiator?
A. About 1.5 dB
B. About 2.1 dB
C. About 3.0 dB
D. About 6.0 dB

E9A04 @E9A09 (D)
Which of the following antennas has no gain in any direction?
A. Quarter-wave vertical
B. Yagi
C. Half-wave dipole
D. Isotropic radiator

E9A05 @E9A10 (C)
Which of the following describes the radiation pattern of an isotropic radiator?
A. A tear drop in the vertical plane
B. A circle in the horizontal plane
C. A sphere with the antenna in the center
D. Crossed polarized with a spiral shape

E9A06 @A9A03 (A)
Why would one need to know the radiation resistance of an antenna?
A. To match impedances for maximum power transfer
B. To measure the near-field radiation density from a transmitting

antenna
C. To calculate the front-to-side ratio of the antenna
D. To calculate the front-to-back ratio of the antenna

E9A07 @A9A04 (B)
What factors determine the radiation resistance of an antenna?
A. Transmission-line length and antenna height
B. Antenna location with respect to nearby objects and the conductors' length/diameter ratio
C. It is a physical constant and is the same for all antennas
D. Sunspot activity and time of day

E9A08 @A9A05 (C)
What is the term for the ratio of the radiation resistance of an antenna to the total resistance of the system?
A. Effective radiated power
B. Radiation conversion loss
C. Antenna efficiency
D. Beamwidth

E9A09 @A9A06 (D)
What is included in the total resistance of an antenna system?
A. Radiation resistance plus space impedance
B. Radiation resistance plus transmission resistance
C. Transmission-line resistance plus radiation resistance
D. Radiation resistance plus ohmic resistance

E9A10 @A9A07 (C)
What is a folded dipole antenna?
A. A dipole one-quarter wavelength long
B. A type of ground-plane antenna
C. A dipole whose ends are connected by a one-half wavelength piece of wire
D. A hypothetical antenna used in theoretical discussions to replace the radiation resistance

E9A11 @A9A09 (A)
What is meant by antenna gain?
A. The numerical ratio relating the radiated signal strength of an antenna to that of another antenna
B. The numerical ratio of the signal in the forward direction to the signal in the back direction
C. The numerical ratio of the amount of power radiated by an antenna compared to the transmitter output power
D. The final amplifier gain minus the transmission-line losses (including any phasing lines present)

E9A12 @A9A10 (B)
What is meant by antenna bandwidth?
A. Antenna length divided by the number of elements
B. The frequency range over which an antenna can be expected to perform well
C. The angle between the half-power radiation points
D. The angle formed between two imaginary lines drawn through the ends of the elements

E9A13 @A9A11 (A)

How can the approximate beamwidth of a beam antenna be determined?
A. Note the two points where the signal strength of the antenna is down 3 dB from the maximum signal point and compute the angular difference
B. Measure the ratio of the signal strengths of the radiated power lobes from the front and rear of the antenna
C. Draw two imaginary lines through the ends of the elements and measure the angle between the lines
D. Measure the ratio of the signal strengths of the radiated power lobes from the front and side of the antenna

E9A14 @A9A12 (B)
How is antenna efficiency calculated?
A. (radiation resistance / transmission resistance) x 100%
B. (radiation resistance / total resistance) x 100%
C. (total resistance / radiation resistance) x 100%
D. (effective radiated power / transmitter output) x 100%

E9A15 @A9A13 (A)
How can the efficiency of an HF grounded vertical antenna be made comparable to that of a half-wave dipole antenna?
A. By installing a good ground radial system
B. By isolating the coax shield from ground
C. By shortening the vertical
D. By lengthening the vertical

E9B Free-space antenna patterns: E and H plane patterns (ie, azimuth and elevation in free-space); gain as a function of pattern; antenna design (computer modeling of antennas)

E9B01 @A9B01 (C)
What determines the free-space polarization of an antenna?
A. The orientation of its magnetic field (H Field)
B. The orientation of its free-space characteristic impedance
C. The orientation of its electric field (E Field)
D. Its elevation pattern

E9B02 @New (D)
Which of the following statements is true about the radiation pattern shown in Figure A9-1?
A. The pattern shows the beamwidth of the antenna
B. The pattern shows the azimuth or directional pattern of the antenna
C. The pattern shows the front to back pattern of the antenna
D. All of these choices are correct

E9B03 @A9B03 (B)
In the free-space H-Field radiation pattern shown in Figure A9-1, what is the 3-dB beamwidth?
A. 75 degrees
B. 50 degrees
C. 25 degrees
D. 30 degrees

E9B04 @A9B04 (B)
In the free-space H-Field pattern shown in Figure A9-1, what is the front-to-back ratio?
A. 36 dB

B. 18 dB
C. 24 dB
D. 14 dB

E9B05 @A9B05 (D)
What information is needed to accurately evaluate the gain of an antenna?
A. Radiation resistance
B. E-Field and H-Field patterns
C. Loss resistance
D. All of these choices

E9B06 @A9B06 (D)
Which is NOT an important reason to evaluate a gain antenna across the whole frequency band for which it was designed?
A. The gain may fall off rapidly over the whole frequency band
B. The feedpoint impedance may change radically with frequency
C. The rearward pattern lobes may vary excessively with frequency
D. The dielectric constant may vary significantly

E9B07 @A9B07 (B)
What usually occurs if a Yagi antenna is designed solely for maximum forward gain?
A. The front-to-back ratio increases
B. The feedpoint impedance becomes very low
C. The frequency response is widened over the whole frequency band
D. The SWR is reduced

E9B08 @A9B08 (A)
If the boom of a Yagi antenna is lengthened and the elements are properly retuned, what usually occurs?
A. The gain increases
B. The SWR decreases
C. The front-to-back ratio increases
D. The gain bandwidth decreases rapidly

E9B09 @A9B09 (B)
What type of computer program 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 @A9B10 (A)
What is the principle of a "Method of Moments" analysis?
A. A wire is modeled as a series of segments, each having a distinct value of current
B. A wire is modeled as a single sine-wave current generator
C. A wire is modeled as a series of points, each having a distinct location in space
D. A wire is modeled as a series of segments, each having a distinct value of voltage across it

E9B11 @A9B11 (B)
In the free-space H-field pattern shown in Figure A9-1, what is the front-to-side ratio?

A. 12 dB
B. 14 dB
C. 18 dB
D. 24 dB

E9C Phased vertical antennas; radiation patterns; beverage antennas; rhombic antennas: resonant; nonresonant; radiation pattern; antenna patterns: elevation above real ground, ground effects as related to polarization, take-off angles as a function of height above ground

E9C01 @E9B01 (D)
What is the radiation pattern of two 1/4-wavelength vertical antennas spaced 1/2-wavelength apart and fed 180 degrees out of phase?
A. Unidirectional cardioid
B. Omnidirectional
C. Figure-8 broadside to the antennas
D. Figure-8 end-fire in line with the antennas

E9C02 @E9B02 (A)
What is the radiation pattern of two 1/4-wavelength vertical antennas spaced 1/4-wavelength apart and fed 90 degrees out of phase?
A. Unidirectional cardioid
B. Figure-8 end-fire
C. Figure-8 broadside
D. Omnidirectional

E9C03 @E9B03 (C)
What is the radiation pattern of two 1/4-wavelength vertical antennas spaced 1/2-wavelength apart and fed in phase?
A. Omnidirectional
B. Cardioid unidirectional
C. Figure-8 broadside to the antennas
D. Figure-8 end-fire in line with the antennas

E9C04 @E9B04 (D)
What is the radiation pattern of two 1/4-wavelength vertical antennas spaced 1/4-wavelength apart and fed 180 degrees out of phase?
A. Omnidirectional
B. Cardioid unidirectional
C. Figure-8 broadside to the antennas
D. Figure-8 end-fire in line with the antennas

E9C05 @E9B05 (D)
What is the radiation pattern for two 1/4-wavelength vertical antennas spaced 1/8-wavelength apart and fed 180 degrees out of phase?
A. Omnidirectional
B. Cardioid unidirectional
C. Figure-8 broadside to the antennas
D. Figure-8 end-fire in line with the antennas

E9C06 @E9B06 (B)
What is the radiation pattern for two 1/4-wavelength vertical antennas spaced 1/4-wavelength apart and fed in phase?
A. Substantially unidirectional
B. Elliptical
C. Cardioid unidirectional
D. Figure-8 end-fire in line with the antennas

E9C07 @E9B07 (B)
Which of the following is the best description of a resonant rhombic antenna?
A. Unidirectional; four-sided, each side a half-wavelength long; terminated in a resistance equal to its characteristic impedance
B. Bidirectional; four-sided, each side approximately one wavelength long; open at the end opposite the transmission line connection
C. Four-sided; an LC network at each vertex except for the transmission connection; tuned to resonate at the operating frequency
D. Four-sided, each side of a different physical length; traps at each vertex for changing resonance according to band usage

E9C08 @E9B09 (A)
What are the advantages of a nonresonant rhombic antenna?
A. Wide frequency range, high gain and high front-to-back ratio
B. High front-to-back ratio, compact size and high gain
C. Unidirectional radiation pattern, high gain and compact size
D. Bidirectional radiation pattern, high gain and wide frequency range

E9C09 @E9B10 (C)
What are the disadvantages of a nonresonant rhombic antenna?
A. A large area for proper installation and a narrow bandwidth
B. A large area for proper installation and a low front-to-back ratio
C. A large area and four sturdy supports for proper installation
D. A large amount of aluminum tubing and a low front-to-back ratio

E9C10 @E9B11 (B)
What is the effect of a terminating resistor on a rhombic antenna?
A. It reflects the standing waves on the antenna elements back to the transmitter
B. It changes the radiation pattern from essentially bidirectional to essentially unidirectional
C. It changes the radiation pattern from horizontal to vertical polarization
D. It decreases the ground loss

E9C11 @A9C01 (A)
What type of antenna pattern over real ground is shown in Figure A9-2?
A. Elevation pattern
B. Azimuth pattern
C. E-Plane pattern
D. Polarization pattern

E9C12 @A9C05 (D)
How is the far-field elevation pattern of a vertically polarized antenna affected by being mounted over seawater versus rocky ground?
A. The low-angle radiation decreases
B. The high-angle radiation increases
C. Both the high- and low-angle radiation decrease
D. The low-angle radiation increases

E9C13 @A9C08 (C)
If only a modest on-ground radial system can be used with an eighth-wavelength-high, inductively loaded vertical antenna, what would be the best compromise to minimize near-field losses?

A. 4 radial wires, 1 wavelength long
B. 8 radial wires, a half-wavelength long
C. A wire-mesh screen at the antenna base, an eighth-wavelength square
D. 4 radial wires, 2 wavelengths long

E9C14 @A9C09 (C)
In the antenna radiation pattern shown in Figure A9-2, what is the elevation angle of the peak response?
A. 45 degrees
B. 75 degrees
C. 7.5 degrees
D. 25 degrees

E9C15 @A9C10 (B)
In the antenna radiation pattern shown in Figure A9-2, what is the front-to-back ratio?
A. 15 dB
B. 28 dB
C. 3 dB
D. 24 dB

E9C16 #New (D)
What is one characteristic of a Beverage antenna?
A. For best performance it must not exceed 1/4 wavelength in length at the desired frequency
B. For best performance it must be mounted more than 1 wavelength above ground at the desired frequency
C. For best performance it should be configured as four-sided loop
D. For best performance it should be as long as possible

E9D Space and satellite communications antennas: gain; beamwidth; tracking; losses in real antennas and matching: resistivity losses, losses in resonating elements (loading coils, matching networks, etc. {ie, mobile, trap}); SWR bandwidth; efficiency

E9D01 @E9C01 (A)
What factors determine the receiving antenna gain required at an amateur satellite station in earth operation?
A. Height, transmitter power and antennas of satellite
B. Length of transmission line and impedance match between receiver and transmission line
C. Preamplifier location on transmission line and presence or absence of RF amplifier stages
D. Height of earth antenna and satellite orbit

E9D02 @E9C02 (A)
What factors determine the EIRP required by an amateur satellite station in earth operation?
A. Satellite antennas and height, satellite receiver sensitivity
B. Path loss, earth antenna gain, signal-to-noise ratio
C. Satellite transmitter power and orientation of ground receiving antenna
D. Elevation of satellite above horizon, signal-to-noise ratio, satellite transmitter power

E9D03 @E9C06 (B)

What is the beamwidth of a symmetrical pattern antenna with a gain of 20 dB as compared to an isotropic radiator?
A. 10.1 degrees
B. 20.3 degrees
C. 45.0 degrees
D. 60.9 degrees

E9D04 @E9C04 (C)
How does the gain of a parabolic dish antenna change when the operating frequency is doubled?
A. Gain does not change
B. Gain is multiplied by 0.707
C. Gain increases 6 dB
D. Gain increases 3 dB

E9D05 @E9C10 (C)
How is circular polarization produced using linearly polarized antennas?
A. Stack two Yagis, fed 90 degrees out of phase, to form an array with the respective elements in parallel planes
B. Stack two Yagis, fed in phase, to form an array with the respective elements in parallel planes
C. Arrange two Yagis perpendicular to each other, with the driven elements in the same plane, fed 90 degrees out of phase
D. Arrange two Yagis perpendicular to each other, with the driven elements in the same plane, fed in phase

E9D06 @E9C05 (D)
How does the beamwidth of an antenna vary as the gain is increased?
A. It increases geometrically
B. It increases arithmetically
C. It is essentially unaffected
D. It decreases

E9D07 @E9C11 (A)
Why does a satellite communications antenna system for earth operation need to have rotators for both azimuth and elevation control?
A. In order to track the satellite as it orbits the earth
B. Because the antennas are large and heavy
C. In order to point the antenna above the horizon to avoid terrestrial interference
D. To rotate antenna polarization along the azimuth and elevate the system towards the satellite

E9D08 @A9D02 (A)
For a shortened vertical antenna, where should a loading coil be placed to minimize losses and produce the most effective performance?
A. Near the center of the vertical radiator
B. As low as possible on the vertical radiator
C. As close to the transmitter as possible
D. At a voltage node

E9D09 @A9D03 (C)
Why should an HF mobile antenna loading coil have a high ratio of reactance to resistance?
A. To swamp out harmonics
B. To maximize losses

C. To minimize losses
D. To minimize the Q

E9D10 @A9D05 (A)
What is a disadvantage of using a trap antenna?
A. It will radiate harmonics
B. It can only be used for single-band operation
C. It is too sharply directional at lower frequencies
D. It must be neutralized

E9D11 @A9D09 (A)
How must the driven element in a 3-element Yagi be tuned to use a "hairpin" matching system?
A. The driven element reactance is capacitive
B. The driven element reactance is inductive
C. The driven element resonance is higher than the operating frequency
D. The driven element radiation resistance is higher than the characteristic impedance of the transmission line

E9D12 @A9D10 (C)
What is the equivalent lumped-constant network for a "hairpin" matching system on a 3-element Yagi?
A. Pi network
B. Pi-L network
C. L network
D. Parallel-resonant tank

E9D13 @A9D11 (B)
What happens to the bandwidth of an antenna as it is shortened through the use of loading coils?
A. It is increased
B. It is decreased
C. No change occurs
D. It becomes flat

E9D14 @A9D12 (D)
What is an advantage of using top loading in a shortened HF vertical antenna?
A. Lower Q
B. Greater structural strength
C. Higher losses
D. Improved radiation efficiency

E9E Matching antennas to feed lines; characteristics of open and shorted feed lines: 1/8 wavelength; 1/4 wavelength; 3/8 wavelength; 1/2 wavelength; 1/4 wavelength matching transformers; feed lines: coax versus open-wire; velocity factor; electrical length; transformation characteristics of line terminated in impedance not equal to characteristic impedance

E9E01 @E9D01 (B)
What system matches a high-impedance transmission line to a lower impedance antenna by connecting the line to the driven element in two places, spaced a fraction of a wavelength each side of element center?
A. The gamma matching system
B. The delta matching system

C. The omega matching system
D. The stub matching system

E9E02 @E9D02 (A)
What system matches an unbalanced feed line to an antenna by feeding the driven element both at the center of the element and at a fraction of a wavelength to one side of center?
A. The gamma matching system
B. The delta matching system
C. The omega matching system
D. The stub matching system

E9E03 @E9D03 (D)
What impedance matching system uses a short perpendicular section of transmission line connected to the feed line near the antenna?
A. The gamma matching system
B. The delta matching system
C. The omega matching system
D. The stub matching system

E9E04 @E9D04 (B)
What should be the approximate capacitance of the resonating capacitor in a gamma matching circuit on a 1/2-wavelength dipole antenna for the 20-meter wavelength band?
A. 70 pF
B. 140 pF
C. 200 pF
D. 0.2 pF

E9E05 @E9D08 (A)
What kind of impedance does a 1/4-wavelength transmission line present to a generator when the line is shorted at the far end?
A. A very high impedance
B. A very low impedance
C. The same as the characteristic impedance of the transmission line
D. The same as the generator output impedance

E9E06 @E9D11 (A)
What kind of impedance does a 1/2-wavelength transmission line present to a generator when the line is open at the far end?
A. A very high impedance
B. A very low impedance
C. The same as the characteristic impedance of the line
D. The same as the output impedance of the generator

E9E07 @A9E01 (D)
What is the velocity factor of a transmission line?
A. The ratio of the characteristic impedance of the line to the terminating impedance
B. The index of shielding for coaxial cable
C. The velocity of the wave on the transmission line multiplied by the velocity of light in a vacuum
D. The velocity of the wave on the transmission line divided by the velocity of light in a vacuum

E9E08 @A9E04 (C)
What determines the velocity factor in a transmission line?

A. The termination impedance
B. The line length
C. Dielectrics in the line
D. The center conductor resistivity

E9E09 @A9E05 (D)
Why is the physical length of a coaxial cable transmission line shorter than its electrical length?
A. Skin effect is less pronounced in the coaxial cable
B. The characteristic impedance is higher in the parallel feed line
C. The surge impedance is higher in the parallel feed line
D. RF energy moves slower along the coaxial cable

E9E10 @A9E03 (B)
What is the typical velocity factor for a coaxial cable with polyethylene dielectric?
A. 2.70
B. 0.66
C. 0.30
D. 0.10

E9E11 @A9E06 (C)
What would be the physical length of a typical coaxial transmission line that is electrically one-quarter wavelength long at 14.1 MHz? (Assume a velocity factor of 0.66.)
A. 20 meters
B. 2.33 meters
C. 3.51 meters
D. 0.25 meters

E9E12 @A9E08 (C)
What is the physical length of a parallel conductor feed line that is electrically one-half wavelength long at 14.10 MHz? (Assume a velocity factor of 0.95.)
A. 15 meters
B. 20.2 meters
C. 10.1 meters
D. 70.8 meters

E9E13 @A9E10 (B)
What parameter best describes the interactions at the load end of a mismatched transmission line?
A. Characteristic impedance
B. Reflection coefficient
C. Velocity factor
D. Dielectric Constant

E9E14 @A9E11 (D)
Which of the following measurements describes a mismatched transmission line?
A. An SWR less than 1:1
B. A reflection coefficient greater than 1
C. A dielectric constant greater than 1
D. An SWR greater than 1:1

E9E15 @A9E12 (A)
What characteristic will 450-ohm ladder line have at 50 MHz, as

compared to 0.195-inch-diameter coaxial cable (such as RG-58)?
A. Lower loss in dB/100 feet
B. Higher SWR
C. Smaller reflection coefficient
D. Lower velocity factor