Element 4 Extra Class Question Pool - This Pool Takes Effect July 1, 2002

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* The questions contained within this pool must be used in all Extra class examinations beginning July 1, 2002, and is intended to be used up through June 30, 2006.

* 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].

* Questions or comments regarding this question pool can be directed to the ARRL VEC at vec@arrl.org

Question Pool
ELEMENT 4 - EXTRA CLASS
as released by the Question Pool Committee
of the National Conference of Volunteer Examiner Coordinators
November 30, 2001

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

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

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

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

C. 7025-7050 kHz
D. 7100-7150 kHz

E1A04 (D) [97.301(b)]
What exclusive frequency privileges in the 20-meter band are authorized to Amateur 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 (C) [97.301(b)]
What exclusive frequency privileges in the 15-meter band are authorized to Amateur 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 (A) [97.301(b)]
Which frequency bands contain at least one segment authorized to only control operators holding an Amateur Extra Class operator license?
A. 80, 75, 40, 20 and 15 meters
B. 80, 40, and 20 meters
C. 75, 40, 30 and 10 meters
D. 160, 80, 40 and 20 meters

E1A07 (B) [97.301(b)]
Within the 20-meter band, what is the amount of spectrum authorized to only control operators holding an Amateur Extra Class operator license?
A. 25 kHz
B. 50 kHz
C. None
D. 25 MHz

E1A08 (A) [97.301(b)]
Which frequency bands contain two segments authorized to only control operators holding an Amateur Extra Class operator license, CEPT radio-amateur Class 1 license or Class 1 IARP?
A. 80/75, 20 and 15 meters
B. 40, 30 and 20 meters
C. 30, 20 and 17 meters
D. 30, 20 and 12 meters

E1A09 (D) [97.307(c)]
What must an amateur station licensee do if a spurious emission from the 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

E1A10 (A) [97.307(d)]
What is the maximum mean power permitted for any spurious emission from a transmitter or external RF power amplifier transmitting at a mean power of 5 watts or greater on an amateur service HF band?

A. The lesser of 50 milliwatts or 40 dB below the mean power of the fundamental emission
B. 60 dB below the mean power of the fundamental emission
C. 10 microwatts
D. The lesser of 25 microwatts or 40 dB below the mean power of the fundamental emission

E1A11 (A) [97.307(d)]
What is the maximum mean power permitted for any spurious emission from a transmitter or external RF power amplifier transmitting at a mean power less than 5 watts on an amateur service HF band?
A. 30 dB below the mean power of the fundamental emission
B. 60 dB below the mean power of the fundamental emission
C. 10 microwatts
D. 25 microwatts

E1A12 (A) [97.307(e)]
What is the maximum mean power permitted to any spurious emission from a transmitter or external RF power amplifier transmitting at a mean power greater than 25 watts on an amateur service VHF band?
A. 60 dB below the mean power of the fundamental emission
B. 40 dB below the below the mean power of fundamental emission
C. 10 microwatts
D. 25 microwatts

E1A13 (A) [97.307(e)]
What is the maximum mean power permitted for any spurious emission from a transmitter having a mean power of 25 W or less on an amateur service VHF band?
A. The lesser of 25 microwatts or 40 dB below the mean power of the fundamental emission
B. The lesser of 50 microwatts or 40 dB below the mean power of the fundamental emission
C. 20 microwatts
D. 50 microwatts

E1A14 (B) [97.219(b), (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

E1A15 (A) [97.219(c)]
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 Enforcement Bureau office
D. Discontinue forwarding all messages

E1A16 (A) [97.303]

For each ITU Region, how is each frequency band allocated internationally to the amateur service designated?
A. Primary service or secondary service
B. Primary service
C. Secondary service
D. Co-secondary service

E1A17 (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

E1A18 (A) [97.303(d)]
What are the sharing requirements for an amateur station transmitting in the 30-meter band?
A. It must not cause harmful interference to stations in the fixed service authorized by other nations
B. There are no sharing requirements
C. Stations in the fixed service authorized by other nations must not cause harmful interference to amateur stations in the same country
D. Stations in the fixed service authorized by other nations must not cause harmful interference to amateur stations in another country

E1A19 (A) [97.11(a)]
If an amateur station is installed on board a ship and is separate from the ship radio installation, what condition must be met before the station may transmit?
A. Its operation must be approved by the master of the ship
B. Its antenna must be separate from the main ship 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 power supply
D. Its operator must have an FCC Marine endorsement on his or her amateur operator license

E1A20 (A) [97.3(a)(45)]
What is the definition of the term telemetry?
A. A one-way transmission of measurements at a distance from the measuring instrument
B. A two-way interactive transmission
C. A two-way single channel transmission of data
D. A one-way transmission to initiate, modify or terminate functions of a device at a distance

E1A21 (D) [97.3(a)(43)]
What is the definition of the term telecommand?
A. A one way transmission of measurements at a distance from the measuring instrument
B. A two-way interactive transmission
C. A two-way single channel transmission of data
D. A one-way transmission to initiate, modify or terminate functions of a device at a distance

E1A22 (D) [97.211(b)]
When may an amateur station transmit 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 Amateur Extra Class operator is the station control operator
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 (A) [97.13(a)]
Which of the following factors might restrict the physical location of an amateur station apparatus 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 (A) [97.13(b)]
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 (C) [97.13(a)]
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 (D) [97.121(a)]
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 frequency or frequencies used when the interference occurs

E1B05 (C) [97.113(c)]
When may an amateur operator accept compensation for serving as the control operator of an amateur station used in a classroom?
A. Only when the amateur operator does not accept pay during periods of time when the amateur station is used
B. Only when the classroom is in a correctional institution
C. Only when the amateur operator is paid as an incident of a teaching position during periods of time 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

E1B06 (B) [97.113(c)]
Who may accept compensation for serving as a control operator in a classroom at an educational institution?
A. Any licensed amateur operator
B. Only an amateur operator accepting such pay as an incident of a teaching position during times when the station is used by that teacher as a part of classroom instruction
C. Only teachers at correctional institutions
D. Only students at educational or correctional institutions

E1B07 (B)[97.15(a)
If an amateur antenna structure is located in a valley or canyon, what height restrictions apply?
A. The structure must not extend more than 200 feet above average height of terrain
B. The structure must be no higher than 200 feet above the 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 than 200 feet above the top of the valley or canyon

E1B08 (D) [97.15b]
What limits must local authorities observe when legislating height and dimension restrictions for an amateur station antenna structure?
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. Such regulation must reasonably accommodate amateur service communications and must constitute the minimum practicable regulation to accomplish the state or local authorities legitimate purpose

E1B09 (A) [97.15a]
If you are installing an amateur radio station antenna at a site within 5 miles from a public use airport, what additional rules apply?
A. You must evaluate the height of your antenna based on the FCC Part 17 regulations
B. No special rules apply if your antenna structure will be less than 200 feet in height
C. You must file an Environmental Impact Statement with the Environmental Protection Agency before construction begins
D. You must obtain a construction permit from the airport zoning authority

E1B10 (D) [97.3a38]
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

E1B11 (A) [97.109(d), 201(d), 97.203(d), 97.205(d)]
Which of the following amateur stations may not be operated under automatic control?

A. Remote control of model aircraft
B. Beacon station
C. Auxiliary station
D. Repeater station

E1B12 (A) [97.3(a)(6), 97.109(d)]
What is meant by automatic control of a station?
A. The use of devices and procedures for control so that the control operator does not have to be present at the 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

E1B13 (B) [97.3(a)(6), 97.109(d)]
How do the control operator responsibilities of a station under automatic control differ from one under local control?
A. Under local control there is no control operator
B. Under automatic control the control operator is not required to be present at the control point
C. Under automatic control there is no control operator
D. Under local control a control operator is not required to be present at a control point

E1B14 (C) [97.3(a)(38)]
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

E1B15 (D) [97.3(a)(38)]
What is the term for apparatus to effect remote control between the 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: reciprocal operating authority; purpose of reciprocal agreement rules; alien control operator privileges; identification (Note: This includes CEPT and IARP)

E1C01 (A) [97.5(c),(d), (e), 97.107]
What is an FCC authorization for alien reciprocal operation?
A. An FCC authorization to the 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 (B) [97.107]

Who is authorized for alien reciprocal operation in places where the FCC regulates the amateur service?
A. Anyone holding a valid amateur service license issued by a foreign government
B. Any non-US citizen holding an amateur service license issued by their government with which the US has a reciprocal operating arrangement
C. Anyone holding a valid amateur service license issued by a foreign government with which the US has a reciprocal operating arrangement
D. Any non-US citizen holding a valid amateur license issued by a foreign government, as long as the person is a citizen of that country

E1C03 (C) [97.107]
What are the frequency privileges authorized for alien reciprocal operation?
A. Those authorized to a holder of the equivalent US amateur operator license
B. Those that the alien has in his or her own country
C. Those authorized to the alien by his country of citizenship, but not to exceed those authorized to Amateur Extra Class operators
D. Those approved by the International Amateur Radio Union

E1C04 (D) [97.119(g)]
What indicator must a Canadian amateur station include with the assigned call sign in the station identification announcement when operating in the US?
A. No indicator is required
B. The grid-square locator number for the location of the station must be included after the call sign
C. The permit number and the call-letter district number of the station location must be included before the Canadian-assigned call sign
D. The letter-numeral indicating the station location after the Canadian call sign and the closest city and state once during the communication

E1C05 (A) [97.107]
When may a US citizen holding a foreign amateur service license be authorized for alien reciprocal operation in places where the FCC regulates the amateur service?
A. Never; US citizens are not eligible for alien reciprocal operation
B. When the US citizen also holds citizenship in the foreign country
C. When the US citizen was born in the foreign country
D. When the US citizen has no current FCC amateur service license

E1C06 (A) [97.107]
Which of the following would disqualify a foreign amateur operator from being authorized for alien reciprocal operation in places where the FCC regulates the amateur service?
A. Not being a citizen of the country that issued the amateur service license
B. Having citizenship in their own country but not US citizenship
C. Holding only an amateur license issued by their own country but holding no FCC amateur service license grant
D. Holding an amateur service license issued by their own country authorizing privileges beyond Amateur Extra Class operator privileges

E1C07 (B) [97.107(a)]
What special document is required before a Canadian citizen holding a Canadian amateur service license may reciprocal operate in the US?
A. A written 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 (C) [97.107(b)]
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 an Amateur Extra Class operator license
C. Those authorized by their home license, not to exceed the operating privileges of an Amateur Extra Class operator license
D. Those granted by the home license that match US privileges authorized to amateur operators in ITU Region 1

E1C09 (D) [97.5(c)]
From which locations may a licensed alien amateur operator be the control operator of an amateur station?
A. Only locations within the boundaries of the 50 United States
B. Only locations listed as the primary station location on an FCC amateur service 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 (A) [97.5(d)]
Which of the following operating arrangements allow an FCC licensed US citizen 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 of these choices are correct

E1C11 (B) [97.5(e)]
Which of the following multilateral or bilateral operating arrangements allow an FCC licensed US citizen and many Central and South American amateur operators to operate in each other's countries?
A. CEPT agreement
B. IARP agreement
C. ITU agreement
D. All of these choices are correct

E1C12 (D) [97.119(g)]
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 operation 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 included before their call and the closest city and state given once during the communication

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 (B) [97.3(a)(37)]
What is the Radio Amateur Civil Emergency Service (RACES)?
A. A radio service using amateur service frequencies on a regular basis for communications that can reasonably be furnished through other radio services
B. A radio service using amateur stations for civil defense communications during periods of local, regional, or national civil emergencies
C. A radio service using amateur service frequencies for broadcasting to the public
D. A radio service using local government frequencies by Amateur Radio operators for emergency communications

E1D02 (A) [97.3(a)(37)]
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 (C) [97.407(a)]
With what organization must an amateur station be registered before participating in RACES?
A. The Amateur Radio Emergency Service
B. The US Department of Defense
C. A civil defense organization
D. The FCC Enforcement Bureau

E1D04 (C) [97.407(a)]
Which amateur stations may be operated in RACES?
A. Only those licensed to Amateur Extra class operators
B. Any FCC-licensed amateur station except a station licensed to a Technician class operator
C. Any FCC-licensed amateur station certified by the responsible civil defense organization for the area served
D. Any FCC licensed amateur station participating in the Military Affiliate Radio System (MARS)

E1D05 (A) [97.407(b)]
What frequencies are authorized normally to an amateur station participating in RACES?
A. All amateur service frequencies otherwise authorized to the control operator
B. Specific segments in the amateur service MF, HF, VHF and UHF bands
C. Specific local government channels
D. Military Affiliate Radio System (MARS) channels

E1D06 (B) [97.407(b)]
What are the frequencies authorized to an amateur station participating in RACES during a period when the President's War Emergency Powers are in force?
A. All frequencies in the amateur service authorized to the control operator
B. Specific segments in the amateur service MF, HF, VHF and UHF bands
C. Specific local government channels
D. Military Affiliate Radio System (MARS) channels

E1D07 (D) [97.407(b)]
What frequencies are normally available for RACES operation?

A. Only those authorized to the civil defense organization
B. Only those authorized to federal government communications
C. Only the top 25 kHz of each amateur service band
D. All frequencies authorized to the amateur service

E1D08 (A) [97.407(b)]
What type of emergency can cause limits to be placed on the frequencies available for RACES operation?
A. An emergency during which the President's War Emergency Powers are invoked
B. An emergency in only one of the United States would limit RACES operations to a single HF 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

E1D09 (C) [97.407(a)]
Who may be the control operator of a RACES station?
A. Anyone holding an FCC-issued amateur operator license other than Novice
B. Only an Amateur Extra Class operator licensee
C. Anyone who holds an FCC-issued amateur operator license and is certified by a civil defense organization
D. Any person certified as a RACES radio operator by a civil defense organization and who hold an FCC issued GMRS license

E1D10 (B) [97.407(c), (d)]
With which stations may amateur stations participating in RACES communicate?
A. Any amateur station
B. Amateur stations participating in RACES and specific other stations authorized by the responsible civil defense official
C. Any amateur station or a station in the Disaster Communications Service
D. Any Citizens Band station that is also registered in RACES

E1D11 (C) [97.407(e)]
What communications are permissible 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; authorized frequencies (Earth station)

E1E01 (C) [97.3(a)(3)]
What is the amateur-satellite service?
A. A radio navigation service using satellites for the purpose of self-training, intercommunication and technical studies carried out by amateurs
B. A spacecraft launching service for amateur-built satellites
C. A service using amateur stations on satellites for the purpose of self-training, intercommunication and technical investigations

D. A radio communications service using stations on Earth satellites for weather information gathering

E1E02 (A) [97.3(a)(40)]
What is a space station in the amateur-satellite service?
A. An amateur station located more than 50 km above the Earth's surface
B. An amateur station designed for communications with other amateur stations by means of Earth satellites
C. An amateur station that transmits communications to initiate, modify or terminate functions of an Earth station
D. An amateur station designed for communications with other amateur stations by reflecting signals off objects in space

E1E03 (A) [97.3(a)(44)]
What is a telecommand station in the amateur-satellite service?
A. An amateur station that transmits communications to initiate, modify or terminate functions of a space station
B. An amateur station located on the Earth's surface for communications with other Earth stations by means of Earth satellites
C. An amateur station located more than 50 km above the Earth's surface
D. An amateur station that transmits telemetry consisting of measurements of upper atmosphere data from space

E1E04 (A) [97.3(a)(16)]
What is an earth station in the amateur-satellite service?
A. An amateur station within 50 km of the Earth's surface for communications with Amateur stations by means of objects in space
B. An amateur station that is not able to communicate using amateur satellites
C. An amateur station that transmits telemetry consisting of measurement of upper atmosphere data from space
D. Any amateur station on the surface of the Earth

E1E05 (D) [97.207]
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

E1E06 (D) [97.207 (a)]
Which amateur stations are eligible to operate as a space station?
A. Any except those of Technician Class operators
B. Only those of General, Advanced or Amateur Extra Class operators
C. Only those of Amateur Extra Class operators
D. Any FCC-licensed amateur station

E1E07 (A) [97.207(b)]
What special provision must a space station incorporate in order to comply with space station requirements?
A. The space station must be capable of effecting a cessation of transmissions by telecommand whenever so ordered by the FCC
B. The space station must cease all transmissions after 5 years
C. The space station must be capable of changing its orbit whenever such a change is ordered by NASA
D. The station call sign must appear on all sides of the spacecraft

E1E08 (D) [97.207(g)(1)]
When must the licensee of a space station give the FCC International Bureau the first written pre-space notification?
A. Any time before initiating the launch countdown for the spacecraft
B. No less than 3 months after initiating construction of the space station
C. No less that 12 months before launch of the space station platform
D. No less than 27 months prior to initiating space station transmissions

E1E09 (A) [97.207]
Which amateur service HF bands have frequencies authorized to space stations?
A. Only 40m, 20m, 17m, 15m, 12m and 10m
B. Only 40 m, 20 m, 17m, 15 m and 10 m bands
C. 40 m, 30 m, 20 m, 15 m, 12 m and 10 m bands
D. All HF bands

E1E10 (A) [97.207]
Which VHF amateur service bands have frequencies available for space stations?
A. 2 meters
B. 2 meters and 1.25 meters
C. 6 meters, 2 meters, and 1.25 meters
D. 6 meters and 2 meters

E1E11 (A) [97.207]
Which amateur service UHF bands have frequencies available for a space station?
A. 70 cm, 23 cm, 13 cm
B. 70 cm
C. 70 cm and 33 cm
D. 33 cm and 13 cm

E1E12 (B) [97.211 (a)]
Which amateur stations are eligible to be telecommand stations?
A. Any amateur station designated by NASA
B. Any amateur station so designated by the space station licensee
C. Any amateur station so designated by the ITU
D. All of these choices are correct

E1E13 (A) [97.211 (b)]
What unique privilege is afforded a telecommand station?
A. A telecommand station may transmit command messages to the space station using codes intended to obscure their meaning
B. A telecommand station may transmit music to the space station
C. A telecommand station may transmit with a PEP output of 5000 watts
D. A telecommand station is not required to transmit its call sign at the end of the communication

E1E14 (C) [97.207 (f)]
What is the term 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. Space-to-Earth telemetry indicator (SETI) transmissions

E1E15 (D) [97.209 (a)]
Which amateur stations are eligible to operate as Earth stations?
A. Any amateur station whose licensee has filed a pre-space notification with the FCC International Bureau

B. Only those of General, Advanced or Amateur Extra Class operators
C. Only those of Amateur Extra Class operators
D. Any amateur station, subject to the privileges of the class of operator license held by the control operator

E1F Volunteer Examiner Coordinators (VECs): definition; VEC qualifications; VEC agreement; scheduling examinations; coordinating VEs; reimbursement for expenses; 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 (D) [97.507 (a), (b), (c),97.523]
Who may prepare an Element 4 amateur operator license examination?
A. The VEC Question Pool Committee, 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

E1F02 (C) [97.507(b)]
Where are the questions listed that must be used in all written US amateur license examinations?
A. In the instructions that each VEC give 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

E1F03 (A) [97.523]
Who is responsible for maintaining the question pools from which all amateur license examination questions must be taken?
A. All of the VECs
B. The VE team
C. The VE question pool team
D. The FCC Wireless Telecommunications Bureau

E1F04 (C) [97.507(a)(1)]
Who must select from the VEC question pool the set of questions that are administered in an Element 3 examination?
A. Only a VE holding an Amateur Extra Class operator license grant
B. The VEC coordinating the examination session
C. A VE holding an FCC-issued Amateur Extra or Advanced Class operator license grant
D. The FCC Enforcement Bureau

E1F05 (B) [97.507(a)(2)]
Who must select from the VEC question pool the set of questions that are administered in an Element 2 examination?
A. The VEC coordinating the examination session
B. A VE holding an FCC-issued Technician, General, Advanced or Amateur Extra Class operator license grant
C. Only a VE holding an Amateur Extra or Advanced Class operator license grant
D. The FCC Office of Engineering and Technology

E1F06 (C) [97.503(a)]
What is the purpose of an amateur operator telegraphy examination?
A. It determines the examinee's level of commitment to the amateur service
B. All of these choices are correct
C. It proves that the examinee has the ability to send correctly by hand and to receive correctly by ear texts in the International Morse Code
D. It helps preserve the proud tradition of radiotelegraphy skill in the amateur service

E1F07 (A) [97.503(b)]
What is the purpose of an Element 4 examination?
A. It proves the examinee has the qualifications necessary to perform properly the duties of an Amateur Extra Class operator
B. It proves the examinee is qualified as an electronics technician
C. It proves the examinee is an electronics expert
D. It proves that the examinee is an expert radio operator

E1F08 (C) [97.521]
What is a Volunteer-Examiner Coordinator?
A. A person who has volunteered to administer amateur operator license examinations
B. A person who has volunteered to prepare amateur operator license examinations
C. An organization that has entered into an agreement with the FCC to coordinate amateur operator license examinations
D. The person that has entered into an agreement with the FCC to be the VE session manager

E1F09 (B) [97.3(a)(48)]
What is an accredited Volunteer Examiner?
A. An amateur operator who is approved by three or more fellow volunteer examiners 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 operator license examinations

E1F10 (A) [97.509(a)]
What is a VE Team?
A. A group of at least three VEs who administer examinations for an amateur operator license
B. The VEC staff
C. One or two VEs who administer examinations for an amateur operator license
D. A group of FCC Volunteer Enforcers who investigate Amateur Rules violations

E1F11 (C) [97.509(b)(4)]
Which persons seeking to be VEs cannot be accredited?
A. Persons holding less than an Advanced Class operator license
B. Persons less than 21 years of age
C. Persons who have ever had an amateur operator or amateur station license suspended or revoked
D. Persons who are employees of the federal government

E1F12 (D) [97.509(b)(1), 97.525]
What is the VE accreditation process?

A. Each General, Advanced and Amateur Extra Class operator is automatically accredited as a VE when the license is granted
B. The amateur operator must pass a VE examination administered by the FCC Enforcement Bureau
C. The prospective VE obtains accreditation from a VE team
D. Each VEC ensures that its Volunteer Examiner applicants meet FCC requirements to serve as VEs

E1F13 (A) [97.509(c)]
Where must the VE team be stationed while administering an examination?
A. All administering VEs must all be present and observing the examinees throughout the entire examination
B. The VEs must leave the room after handing out the exam(s) to allow the examinees to concentrate on the exam material
C. The VEs may be elsewhere provide at least one VE is present and is observing the examinees throughout the entire examination
D. The VEs may be anywhere as long as they each certify in writing that examination was administered properly

E1F14 (C) [97.509(c)]
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 VEs
D. The VE session manager

E1F15 (B) [97.509(c)]
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

E1F16 (A) [97.509(k)]
What special procedures must a VE team follow for an examinee with a physical disability?
A. A special procedure that accommodates the disability
B. A special procedure specified by the coordinating VEC
C. A special procedure specified by a physician
D. None; the VE team does not have to provide special procedures

E1F17 (A) [97.509(d)]
To which of the following examinees may a VE not administer an examination?
A. The VE's close relatives as listed in the FCC rules
B. Acquaintances of the VE
C. Friends of the VE
D. There are no restrictions as to whom a VE may administer an examination

E1F18 (A) [97.509(e)]
What may be the penalty for a VE who fraudulently administers or certifies an examination?
A. Revocation of the VE's amateur station license grant and the suspension of the VE's amateur operator license grant
B. A fine of up to $1000 per occurrence

C. A sentence of up to one year in prison
D. All of these choices are correct

E1F19 (C) [97.509(h)]
What must the VE team do with your test papers when you have finished this examination?
A. The VE team must collect them for grading at a later date
B. The VE team must collect and send them to the coordinating VEC for grading
C. The VE team must collect and grade them immediately
D. The VE team must collect and send them to the FCC for grading

E1F20 (D) [97.519(b)]
What action must the coordinating VEC complete within 10 days of collecting the information from an examination session?
A. Screen collected information
B. Resolve all discrepancies and verify that the VEs' certifications are properly completed
C. For qualified examinees, forward electronically all required data to the FCC
D. All of these choices are correct

E1F21 (D) [97.509(i)]
What must the VE team do if an examinee scores a passing grade on all examination elements needed for an upgrade or new license?
A. Photocopy all examination documents and forwards them to the FCC for processing
B. Notify the FCC that the examinee is eligible for a license grant
C. Issue the examinee the new or upgrade license
D. Three VEs must certify that the examinee is qualified for the license grant and that they have complied with the VE requirements

E1F22 (A) [97.509(j)]
What must the VE team do if the examinee does not score a passing grade on the examination?
A. Return the application document to the examinee and inform the examinee of the grade
B. Return the application document to the examinee
C. Inform the examinee that he or she did not pass
D. Explain how the incorrect questions should have been answered

E1F23 (A) [97.519(d)(3)]
What are the consequences of failing to appear for readministration of an examination when so directed by the FCC?
A. The licensee's license will be cancelled and a new license will be issued that is consistent with examination elements not invalidated
B. The licensee must pay a monetary fine
C. The licensee is disqualified from any future examination for an amateur operator license grant
D. The person may be sentenced to incarceration

E1F24 (A) [97.527]
What are the types of out-of-pocket expenses for which the FCC rules authorize a VE and VEC to accept reimbursement?
A. Preparing, processing, administering and coordinating an examination for an amateur radio license
B. Teaching an amateur operator license examination preparation course
C. None; a VE must never accept any type of reimbursement

D. Providing amateur operator license examination preparation training materials

E1F25 (A) [97.509(e), 97.527]
How much reimbursement may the VE team and VEC accept for preparing, processing, administering and coordinating an examination?
A. Actual out-of-pocket expenses
B. Up to the national minimum hourly wage times the number of hours spent providing the services
C. Up to the maximum fee per examinee announced by the FCC annually
D. As much as the examinee is willing to donate

E1F26 (C) [97.505(a)(6)]
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 with in the previous 365 days
B. Only the telegraphy elements the CSCE indicates the examinee passed within the previous 365 days
C. Each element the CSCE indicates the examinee passed within the previous 365 days
D. None

E1F27 (C) [97.301(e)]
For what period of time does a Technician class licensee, who has just been issued a CSCE for having passed a 5 WPM Morse code examination, have authority to operate on the Novice/Technician HF subbands?
A. 365 days from the examination date as indicated on the CSCE
B. 1 year from the examination date as indicated on the CSCE
C. Indefinitely, so long as the Technician license remains valid
D. 5 years plus a 5-year grace period from the examination date as indicated on the CSCE

E1F28 (A) [97.505(a)(6)]
What period of time does a Technician class licensee, who has just been issued a CSCE for having passed a 5 WPM Morse code examination, have in order to use this credit toward a license upgrade?
A. 365 days from the examination date as indicated on the CSCE
B. 15 months from the examination date as indicated on the CSCE
C. There is no time limit, so long as the Technician license remains valid
D. 5 years plus a 5-year grace period from the examination date as indicated on the CSCE

E1G Certification 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 (B) [97.315(c)]
What does it mean if an external RF amplifier is listed on the FCC database as certificated for use in the amateur service?
A. An RF amplifier of that model may be used in any radio service
B. That particular RF amplifier model may be marketed for use in the amateur service
C. All similar models of RF amplifiers produced by other manufacturers may be marketed
D. All models of RF amplifiers produced by that manufacturer may be marketed

E1G02 (B)[97.317(a)(3)]
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 to prevent it from operating continuously for more than ten minutes
B. It must satisfy the spurious emission standards when driven with at least 50W mean RF power (unless a higher drive level is specified)
C. It must not be capable of modification without voiding the warranty
D. It must exhibit no more than 6dB of gain over its entire operating range

E1G03 (A) [97.315(b)(5)]
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. 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. The equipment dealer assembled it from a kit
C. It was imported from a manufacturer in a country that does not require certification of RF power amplifiers
D. It was imported from a manufacturer in another country, and it was certificated by that country's government

E1G04 (A) [97.3(a)(32)]
Which of the following geographic descriptions approximately describes Line A?
A. A line roughly parallel to, and south of, the US-Canadian border
B. A line roughly parallel to, and west of, the US Atlantic coastline
C. A line roughly parallel to, and north of, the US-Mexican border and Gulf coastline
D. A line roughly parallel to, and east of, the US Pacific coastline

E1G05 (D) [97.303(f)(1)]
Amateur stations may not transmit in which frequency segment if they are located north of Line A?
A. 21.225-21.300 MHz
B. 53-54 MHz
C. 222-223 MHz
D. 420-430 MHz

E1G06 (C) [97.3 (a)(32)]
What is the National Radio Quiet Zone?
A. An area in Puerto Rico surrounding the Aricebo Radio Telescope
B. An area in New Mexico surrounding the White Sands Test Area
C. An Area in Maryland, West Virginia and Virginia surrounding the National Radio Astronomy Observatory
D. An area in Florida surrounding Cape Canaveral

E1G07 (A) [97.203(e)]
What type of automatically controlled amateur station must not be established in the National Radio Quiet Zone before the licensee gives written notification to the National Radio Astronomy Observatory?
A. Beacon station
B. Auxiliary station
C. Repeater station
D. Earth station

E1G08 (D) [97.113(a)(2)]
When may the control operator of a repeater accept payment for providing communication services to another party?

A. When the repeater is operating under portable power
B. When the repeater is operating under local control
C. During Red Cross or other emergency service drills
D. Under no circumstances

E1G09 (D) [97.113(a)(3)]
When may an amateur station send a message to a business?
A. When the total money involved does not exceed $25
B. When the control operator is employed by the FCC or another government agency
C. When transmitting international third-party communications
D. When neither the amateur nor his or her employer has a pecuniary interest in the communications

E1G10 (A) [97.113]
Which of the following types of amateur operator-to-amateur operator communication are prohibited?
A. Communications transmitted for hire or material compensation, except as otherwise provided in the rules
B. Communication that has a political content
C. Communication that has a religious content
D. Communication in a language other English

E1G11 (C) [97.3(c)(8)]
What is the term for emissions using bandwidth-expansion modulation?
A. RTTY
B. Image
C. Spread spectrum
D. Pulse

E1G12 (D) [97.311(a)]
FCC-licensed amateur stations may use spread spectrum (SS) emissions to communicate under which of the following conditions?
A. When the other station is in an area regulated by the FCC
B. When the other station is in a country permitting SS communications
C. When the transmission is not used to obscure the meaning of any communication
D. All of these choices are correct

E1G13 (C) [97.311(d)]
Under any circumstance, what is the maximum transmitter power for an amateur station transmitting emission type SS communications?
A. 1 W
B. 1.5 W
C. 100 W
D. 1.5 kW

E1G14 (D) [97.109(c)]
What of the following is a use for an auxiliary station?
A. To provide a point-to-point communications uplink between a control point and its associated remotely controlled station
B. To provide a point-to-point communications downlink between a remotely controlled station and its control point
C. To provide a point-to-point control link between a control point and its associated remotely controlled station
D. All of these choices are correct

SUBELEMENT E2 -- OPERATING PROCEDURES [5 Exam Questions - 5 Groups]
E2A Amateur Satellites: orbital mechanics; frequencies available for satellite operation; satellite hardware; satellite operations

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 (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 (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 (D)
What are the receiving and retransmitting frequency bands used for Mode V/H in amateur satellite operations?
A. Satellite receiving on Amateur bands in the range of 21 to 30 MHz and retransmitting on 144 to 148 MHz
B. Satellite receiving on 435 to 438 MHz and retransmitting on 144 to 148 MHz
C. Satellite receiving on 435 to 438 MHz and retransmitting on Amateur bands in the range of 21 to 30 MHz
D. Satellite receiving on 144 to 148 MHz and retransmitting on Amateur bands in the range of 21 to 30 MHz

E2A05 (B)
What are the receiving and retransmitting frequency bands used for Mode U/V in amateur satellite operations?
A. Satellite receiving on Amateur bands in the range of 21 to 30 MHz and retransmitting on 144 to 148 MHz
B. Satellite receiving on 435 to 438 MHz and retransmitting on 144 to 148 MHz
C. Satellite receiving on 435 to 438 MHz and retransmitting on Amateur bands in the range of 21 to 30 MHz
D. Satellite receiving on 144 to 148 MHz and retransmitting on Amateur bands in the range of 21 to 30 MHz

E2A06 (C)
What are the receiving and retransmitting frequency bands used for Mode V/U in amateur satellite operations?
A. Satellite receiving on 435 to 438 MHz and retransmitting on 144 to 148 MHz
B. Satellite receiving on 144 to 148 MHz and retransmitting on Amateur bands in the range of 21 to 30 MHz
C. Satellite receiving on 144 to 148 MHz and retransmitting on 435 to 438 MHz
D. Satellite receiving on 435 to 438 MHz and transmitting on 21 to 30 MHz

E2A07 (D)

What are the receiving and retransmitting frequency bands used for Mode L/U in amateur satellite operations?
A. Satellite receiving on 435 to 438 MHz and retransmitting on 21 to 30 MHz
B. Satellite receiving on Amateur bands in the range of 21 to 30 MHz and retransmitting on 435 to 438 MHz
C. Satellite receiving on 435 to 438 MHz and retransmitting on 1.26 to 1.27 GHz
D. Satellite receiving on 1.26 to 1.27 GHz and retransmitting on 435 to 438 MHz

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 that responds to satellite telecommands and is used to activate a linear sequence of events

E2A09 (D)
What is the name of the effect that causes the downlink frequency of a satellite to vary by several kHz during a low-earth orbit?
A. The Kepler effect
B. The Bernoulli effect
C. The Einstein effect
D. The Doppler effect

E2A10 (A)
Why may the received signal from an 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 (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

E2A12 (D)
How may the location of a satellite at a given time be predicted?
A. By means of the Doppler data for the specified satellite
B. By subtracting the mean anomaly from the orbital inclination
C. By adding the mean anomaly to the orbital inclination
D. By means of the Keplerian elements for the specified satellite

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

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

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 (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 (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 (C)
What is the standard video level, in percent PEV, for black in amateur fast scan television?
A. 0%
B. 12.5%
C. 70%
D. 100%

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

E2B08 (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 (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 (A)
What is the modern standard scan rate for a fax image 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 (B)
What is the approximate transmission time per frame for a fax picture transmitted by an amateur station at 240 lpm?
A. 6 minutes
B. 3.3 minutes
C. 6 seconds
D. 1/60 second

E2B12 (D)
What information is sent by slow-scan television transmissions?
A. Baudot or ASCII characters that form a picture when printed
B. Pictures for permanent display on paper
C. Moving pictures
D. Still pictures

E2B13 (C)
How many lines are commonly used in each frame on an amateur slow-scan color television picture?
A. 30 to 60
B. 60 or 100
C. 128 or 256
D. 180 or 360

E2B14 (C)
What is the audio frequency for black in an amateur slow-scan television picture?
A. 2300 Hz
B. 2000 Hz
C. 1500 Hz
D. 120 Hz

E2B15 (D)
What is the audio frequency for white in an amateur slow-scan television picture?
A. 120 Hz
B. 1500 Hz
C. 2000 Hz
D. 2300 Hz

E2B16 (B)

What is the standard video level, in percent PEV, for white in an amateur fast-scan television transmission?
A. 0%
B. 12.5%
C. 70%
D. 100%

E2B17 (A)
Which of the following is NOT a characteristic of FMTV (Frequency-Modulated Amateur Television) as compared to vestigial sideband AM television?
A. Immunity from fading due to limiting
B. Poor weak signal performance
C. Greater signal bandwidth
D. Greater complexity of receiving equipment

E2B18 (B)
What is the approximate bandwidth of a slow-scan TV signal?
A. 600 Hz
B. 2 kHz
C. 2 MHz
D. 6 MHz

E2B19 (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

E2B20 (C)
What special restrictions are imposed on 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

E2C Contest and DX operating; spread-spectrum transmissions; automatic HF forwarding; selecting your operating frequency

E2C01 (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

E2C02 (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 amateur operators in readiness for an emergency
C. To measure the ionospheres capacity for refracting RF signals under varying conditions
D. To demonstrate to the FCC that amateur station operation is possible during difficult operating circumstances

E2C03 (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

E2C04 (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

E2C05 (A)
What does a Maidenhead gridsquare 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

E2C06 (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. In the weak signal segment of the band, with most of the activity near the calling frequency
D. In the middle of the band, usually 25 kHz above the national calling frequency

E2C07 (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

E2C08 (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

E2C09 (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 the transmitted signal is changed very rapidly according to a particular sequence also used by the receiving station

E2C10 (A)
While participating in an HF contest, how should you attempt to contact a station calling CQ and stating that he is listening on another specific frequency?
A. By sending your full call sign on the listening frequency specified
B. By sending only the suffix of your call sign on the listening Frequency
C. By sending your full call sign on the frequency on which you heard the station calling CQ
D. By sending only the suffix of your call sign on the frequency on which you heard the station calling CQ

E2C11 (A)
When operating SSB in a VHF contest, how should your attempt to contact a station calling CQ while a pileup of other stations are also trying to contact the same station?
A. By sending your full call sign after the distant station transmits QRZ
B. By sending only the last letters of your call sign after the distant station transmits QRZ
C. By sending your full call sign and grid square as soon as you hear the distant station transmit QRZ
D. By sending the call sign of the distant station three times, the words "this is", then your call sign three times

E2C12 (B)
In North America during low sunspot activity, signals from Europe become weak and fluttery across an entire HF band two to three hours after sunset, what might help to contact other European DX stations?
A. Switch to a higher frequency HF band, because the MUF has increased
B. Switch to a lower frequency HF band because the MUF has decreased
C. Wait 90 minutes or so for the signal degradation to pass

D. Wait 24 hours before attempting another communication on the band

E2D Operating VHF / UHF digital modes: packet clusters; digital bulletin boards; Automatic Position Reporting System (APRS)

E2D01 (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

E2D02 (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

E2D03 (C)
In comparing HF and 2-meter packet Operations, which of the following 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 Amateur 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

E2D04 (C)
What is the purpose of a digital store and forward on an Amateur satellite?
A. To stockpile packet TNCs and other digital hardware to be distributed to RACES operators in the event of an emergency
B. To relay messages across the country via a network of HF digital stations
C. To store messages in an amateur satellite for later download by other stations
D. To store messages in a packet digipeater for relay via the Internet

E2D05 (B)
Which of the following techniques is normally used by low-earth orbiting digital satellites to relay messages around the world?
A. Digipeating
B. Store and forward
C. Multi-satellite relaying
D. Node hopping

E2D06 (B)
What is the common 2-meter APRS frequency?
A. 144.20 MHz
B. 144.39 MHz

C. 145.02 MHz
D. 146.52 MHz

E2D07 (A)
Which of the following digital protocols does APRS use?
A. AX.25
B. 802.11
C. PACTOR
D. AMTOR

E2D08 (D)
Which of the following types of packet frames is used to transmit APRS beacon data?
A. Connect frames
B. Disconnect frames
C. Acknowledgement frames
D. Unnumbered Information frames

E2D09 (D)
Under clear communications conditions, which of these digital communications modes has the fastest data throughput?
A. AMTOR
B. 170-Hz shift, 45 baud RTTY
C. PSK31
D. 300-baud packet

E2D10 (C)
How can an APRS station be used to help support a public service communications activity, such as a walk-a-thon?
A. An APRS station with an emergency medical technician can automatically transmit medical data to the nearest hospital
B. APRS stations with General Personnel Scanners can automatically relay the participant numbers and time as they pass the check points
C. An APRS station with a GPS unit can automatically transmit information to show the station's position along the course route
D. All of these choices are correct

E2D11 (D)
Which of the following data sources are needed to accurately transmit your geographical location over the APRS network?
A. The NMEA-0183 formatted data from a Global Positioning System (GPS) satellite receiver
B. The latitude and longitude of your location, preferably in degrees, minutes and seconds, entered into the APRS computer software
C. The NMEA-0183 formatted data from a LORAN navigation system
D. All of these choices are correct

E2E Operating HF digital modes

E2E01 (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

E2E02 (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

E2E03 (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 extra data that may be used to detect and correct transmission errors
D. By varying the frequency shift of the transmitted signal according to a predefined algorithm

E2E04 (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

E2E05 (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

E2E06 (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

E2E07 (B)
What is the typical bandwidth of a properly modulated MFSK16 signal?
A. 31 Hz
B. 316 Hz
C. 550 Hz
D. 2 kHz

E2E08 (B)
Which of the following HF digital modes can be used to transfer binary files?
A. Hellschreiber
B. PACTOR
C. RTTY
D. AMTOR

(This question has been withdrawn from the pool) E2E09 (A)
Which of the following HF digital modes does NOT include error detection and correction?
A. PSK31
B. PACTOR
C. CLOVER
D. G-TOR

(This question has been withdrawn from the pool) E2E10 (C)
Which of the following HF digital modes use Reed-Solomon coding?
A. AMTOR
B. RTTY
C. PSK31
D. CLOVER

E2E11 (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

E2E12 (C)
Which of these digital communications modes has the narrowest bandwidth?
A. AMTOR
B. 170-Hz shift, 45 baud RTTY
C. PSK31
D. 300-baud packet

SUBELEMENT E3 -- RADIO WAVE PROPAGATION [3 Exam Questions - 3 Groups]
E3A Earth-Moon-Earth (EME or moonbounce) communications; meteor scatter

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 (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 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 (A)
When scheduling EME contacts, which of these conditions will generally result in the least path loss?
A. When the moon is at perigee
B. When the moon is full
C. When the moon is at apogee
D. When the MUF is above 30 MHz

E3A04 (D)
What type of receiving system is desirable 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 (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 (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 (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 (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 (A)
When a meteor strikes the earth's atmosphere, a cylindrical region of free electrons is formed at what layer of the ionosphere?
A. The E layer
B. The F1 layer
C. The F2 layer
D. The D layer

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 (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 (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 (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 (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 (A)
What type of propagation is probably occurring if an HF 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 (C)
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. 6 meters to 2 meters

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 (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 (D)
What type of propagation is probably occurring if radio signals travel along the terminator between daylight and darkness?
A. Transequatorial
B. Sporadic-E
C. Long-path
D. Gray-line

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 (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 mid afternoon the sun heats the ionosphere, increasing radio wave refraction and the MUF

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 2 meter and 70 centimeter bands

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

E3C01 (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 (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 (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 (A)
Which emission mode is best for auroral propagation?
A. CW
B. SSB
C. FM
D. RTTY

E3C05 (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 (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

E3C07 (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

E3C08 (B)

For a 3-element beam 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

E3C09 (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

E3C10 (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

E3C11 (B)
For a 3-element beam antenna with horizontally mounted elements, how does the main lobe takeoff angle vary with the downward slope of the ground (moving away from the antenna)?
A. It increases as the slope gets steeper
B. It decreases as the slope gets steeper
C. It does not depend on the ground slope
D. It depends of the F-region height

E3C12 (B)
In the northern hemisphere, in which direction should a directional antenna be pointed to take maximum advantage of auroral propagation?
A. South
B. North
C. East
D. West

E3C13 (B)
As the frequency of a signal is increased, how does its ground wave propagation change?
A. It increases
B. It decreases
C. It stays the same
D. Radio waves don't propagate along the earth's surface

E3C14 (A)
What type of polarization does ground-wave propagation have?
A. Vertical
B. Horizontal
C. Circular
D. Elliptical

E3C15 (D)
Why does the radio-path horizon distance exceed the geometric horizon?

A. E-region skip
B. D-region skip
C. Auroral skip
D. Radio waves may be bent

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

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

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

E4A06 (C)
Which of the following is NOT something that could be determined 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 (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 (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 (C)
Which test instrument is used to directly indicate high and low digital voltage states?
A. An ohmmeter
B. An electroscope
C. A logic probe
D. A Wheatstone bridge

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 (A)
Which of the following test instruments can be used to indicate pulse conditions in a digital logic circuit?
A. A logic probe
B. An ohmmeter
C. An electroscope
D. A Wheatstone bridge

E4A12 (B)
Which of the following procedures should you follow when connecting a spectrum analyzer to a transmitter output?
A. Use high quality coaxial lines
B. Attenuate the transmitter output going to the spectrum analyzer
C. Use a signal divider
D. Match the antenna to the load

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

E4B01 (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 (B)
What factors limit the accuracy, frequency response and stability of a frequency counter?
A. Phase comparator slew rate, 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 reactance
D. Number of digits in the readout, external frequency reference and temperature coefficient of the logic

E4B03 (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

E4B04 (C)
If a frequency counter with a specified 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

E4B05 (A)
If a frequency counter with a specified 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

E4B06 (D)
If a frequency counter with a specified 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

E4B07 (D)
If a frequency counter with a specified 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

E4B08 (A)
If a frequency counter with a specified 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

E4B09 (C)
If a frequency counter with a specified 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

E4B10 (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 will 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

E4B11 (C)
What is a dip-meter?
A. A field-strength meter
B. An SWR meter
C. A device consisting of a variable frequency LC oscillator and an indicator showing the metered feedback current
D. A marker generator

E4B12 (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 nearby circuit

E4B13 (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

E4B14 (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

E4B15 (A)
For best accuracy, how tightly should a dip-meter be coupled with the LC 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

E4B16 (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

E4B17 (B)
What happens in a dip-meter when it is too tightly coupled with a tuned circuit being checked?
A. Harmonics are generated
B. A less accurate reading results
C. Cross modulation occurs
D. Intermodulation distortion occurs

E4B18 (B)
What factors limit the accuracy, frequency response and stability of a D'Arsonval-type meter?
A. Calibration, coil impedance and meter size
B. Calibration, mechanical tolerance and coil impedance
C. Coil impedance, electromagnetic voltage and movement mass
D. Calibration, series resistance and electromagnet current

E4B19 (D)
How can the frequency response of an oscilloscope be improved?
A. By using a triggered sweep and a crystal oscillator as the time base
B. By using a crystal oscillator as the time base and increasing the vertical sweep rate
C. By increasing the vertical sweep rate and the horizontal amplifier frequency response
D. By increasing the horizontal sweep rate and the vertical amplifier frequency response

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 (D)
What is the effect of excessive phase noise in the local oscillator section of a receiver?
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 (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 (B)
Which of the following can cause receiver desensitization?
A. Audio gain adjusted too low
B. Strong adjacent-channel signals
C. Audio bias adjusted too high
D. Squelch gain adjusted too low

E4C04 (A)
Which of the following is one way receiver desensitization can be reduced?
A. Improve the shielding between the receiver and the transmitter causing the problem
B. Increase the transmitter audio gain
C. Decrease the receiver squelch level
D. Increase the receiver bandwidth

E4C05 (C)
What is the FM 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 (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 (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

E4C08 (B)
What is the blocking dynamic range for a receiver that has an 8-dB noise figure and an IF bandwidth of 500 Hz when the blocking level (1-dB compression point) is -20 dBm?
A. -119 dBm

B. 119 dB
C. 146 dB
D. -146 dBm

E4C09 (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 frequency control

E4C10 (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

E4C11 (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

E4C12 (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

E4C13 (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

E4C14 (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

E4C15 (D)
If the signals of two transmitters mix together in one or both of their final amplifiers and unwanted signals at the sum and difference frequencies of the original signals are generated, what is this called?
A. Amplifier desensitization
B. Neutralization
C. Adjacent channel interference
D. Intermodulation interference

E4C16 (D)
What is cross-modulation interference?
A. Interference between two transmitters of different modulation type
B. Interference caused by audio rectification in the receiver preamp
C. Harmonic distortion of the transmitted signal
D. Modulation from an unwanted signal is heard in addition to the desired signal

E4C17 (C)
What causes intermodulation in an electronic circuit?
A. Too little gain
B. Lack of neutralizaton
C. Nonlinear circuits or devices
D. Positive feedback

E4C18 (D)
What two factors determine the sensitivity of a receiver?
A. Dynamic range and third-order intercept
B. Cost and availability
C. Intermodulation distortion and dynamic range
D. Bandwidth and noise figure

E4C19 (A)
What is the limiting condition for sensitivity in a communications receiver?
A. The noise floor of the receiver
B. The power-supply output ripple
C. The two-tone intermodulation distortion
D. The input impedance to the detector

E4C20 (C)
Selectivity can be achieved in the front-end circuitry of a communications receiver by using what means?
A. An audio filter
B. An additional RF amplifier stage
C. A preselector
D. An additional IF amplifier stage

E4C21 (B)
What degree of selectivity is desirable in the IF circuitry of an amateur RTTY receiver?
A. 100 Hz
B. 300 Hz
C. 6000 Hz
D. 2400 Hz

E4C22 (B)
What degree of selectivity is desirable in the IF circuitry of a single-sideband phone receiver?
A. 1 kHz
B. 2.4 kHz
C. 4.2 kHz
D. 4.8 kHz

E4C23 (D)
What is an undesirable effect of using too wide a filter bandwidth in the IF section of a receiver?
A. Output-offset overshoot
B. Filter ringing
C. Thermal-noise distortion
D. Undesired signals will reach the audio stage

E4C24 (A)
How should the filter bandwidth of a receiver IF section compare with the bandwidth of a received signal?
A. It should be slightly greater than the received-signal bandwidth
B. It should be approximately half the received-signal bandwidth
C. It should be approximately twice the received-signal bandwidth
D. It should be approximately four times the received-signal bandwidth

E4C25 (D)
What degree of selectivity is desirable in the IF section of an FM phone receiver?
A. 1 kHz
B. 2.4 kHz
C. 4.2 kHz
D. 15 kHz

E4C26 (B)
In a receiver, if the third-order intermodulation products have a power of-70 dBm when using two test tones at -30 dBm, what is the third-order intercept point?
A. -20 dBm
B. -10 dBm
C. 0 dBm
D +10 dBm

E4C27 (D)
In a receiver, if the second-order intermodulation products have a power of-70 dBm when using two test tones at -30 dBm, what is the second-order intercept point?
A. -20 dBm
B. -10 dBm
C. 0 dBm
D. +10 dBm

E4D Noise suppression: vehicular system noise; electronic motor noise; static; line noise

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

E4D02 (A)
What is the proper procedure for suppressing electrical noise in a mobile transceiver?
A. Follow the vehicle manufacturer's recommended procedures
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 (C)
Where should 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 (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

E4D05 (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

E4D06 (B)
How can noise from an electric motor be suppressed?
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

E4D07 (B)
What is a major cause of atmospheric static?
A. Sunspots
B. Thunderstorms
C. Airplanes
D. Meteor showers

E4D08 (C)
How can it be determined if line-noise interference is being generated within your home?
A. By checking the power-line voltage with a time-domain reflectometer
B. By observing the AC power line waveform with an oscilloscope
C. By turning off the AC power line main circuit breaker and listening on a battery-operated radio
D. By observing the AC power line voltage with a spectrum analyzer

E4D09 (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 power line frequency
D. Harmonics of the AC power line frequency

E4D10 (B)
Which of the following types of equipment would be least useful in locating 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 (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 (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 (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 ratio
C. One with good top-to-bottom and side-to-side ratio
D. One with shallow nulls

E4E04 (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 antenna 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 (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 (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 (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

E4E08 (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

E4E09 (B)
Why is an antenna 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

E4E10 (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

E4E11 (A)
What is the amateur station activity known as fox hunting?
A. Attempting to locate a hidden transmitter by using receivers and direction-finding techniques
B. Attempting to locate a hidden receiver by using receivers and direction-finding techniques
C. Assisting government agents with tracking transmitter collars worn by foxes
D. Assembling stations using generators and portable antennas to test 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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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

E5A18 (C)
What is the resonant frequency of a series RLC circuit if R is 47 ohms, L is 50 microhenrys and C is 40 picofarads?
A. 79.6 MHz
B. 1.78 MHz
C. 3.56 MHz
D. 7.96 MHz

E5A19 (B)
What is the resonant frequency of a series RLC circuit if R is 47 ohms, L is 40 microhenrys and C is 200 picofarads?
A. 1.99 kHz
B. 1.78 MHz

C. 1.99 MHz
D. 1.78 kHz

E5A20 (D)
What is the resonant frequency of a series RLC circuit if R is 47 ohms, L is 50 microhenrys and C is 10 picofarads?
A. 3.18 MHz
B. 3.18 kHz
C. 7.12 kHz
D. 7.12 MHz

E5A21 (A)
What is the resonant frequency of a series RLC circuit if R is 47 ohms, L is 25 microhenrys and C is 10 picofarads?
A. 10.1 MHz
B. 63.7 MHz
C. 10.1 kHz
D. 63.7 kHz

E5A22 (B)
What is the resonant frequency of a series RLC circuit if R is 47 ohms, L is 3 microhenrys and C is 40 picofarads?
A. 13.1 MHz
B. 14.5 MHz
C. 14.5 kHz
D. 13.1 kHz

E5A23 (D)
What is the resonant frequency of a series RLC circuit if R is 47 ohms, L is 4 microhenrys and C is 20 picofarads?
A. 19.9 kHz
B. 17.8 kHz
C. 19.9 MHz
D. 17.8 MHz

E5A24 (C)
What is the resonant frequency of a series RLC circuit if R is 47 ohms, L is 8 microhenrys and C is 7 picofarads?
A. 2.84 MHz
B. 28.4 MHz
C. 21.3 MHz
D. 2.13 MHz

E5A25 (A)
What is the resonant frequency of a series RLC circuit if R is 47 ohms, L is 3 microhenrys and C is 15 picofarads?
A. 23.7 MHz
B. 23.7 kHz
C. 35.4 kHz
D. 35.4 MHz

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

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(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 (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 (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 (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 (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 (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 (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 (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 (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 (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; PC based impedance analysis (including Smith Charts)

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

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 (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 (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 (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 (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 (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 impedance values with regard to the prime center
D. Reassigning prime center with regard to the reactance axis

E5C09 (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 (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 (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 (This question has been formally withdrawn by the QPC) (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

E5C13 (D)
What are the curved lines on a Smith chart?
A. Portions of current circles
B. Portions of voltage circles
C. Portions of resistance circles
D. Portions of reactance circles

E5C14 (B)
How are the wavelength scales on a Smith chart calibrated?
A. In portions of transmission line electrical frequency
B. In portions of transmission line electrical wavelength
C. In portions of antenna electrical wavelength
D. In portions of antenna electrical frequency

E5D Phase angle between voltage and current; impedances and phase angles of series and parallel circuits;

E5D01 (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 (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. 14.0 degrees with the voltage leading the current
C. 14.0 degrees with the voltage lagging the current
D. 68.2 degrees with the voltage lagging the current

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

E5D09 (B)
What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 75 ohms, R is 100 ohms, and XL is 100 ohms?
A. 76 degrees with the voltage leading the current
B. 14 degrees with the voltage leading the current
C. 14 degrees with the voltage lagging the current
D. 76 degrees with the voltage lagging the current

E5D10 (C)
What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 75 ohms, R is 100 ohms, and XL is 50 ohms?
A. 76 degrees with the voltage lagging the current
B. 14 degrees with the voltage leading the current
C. 14 degrees with the voltage lagging the current
D. 76 degrees with the voltage leading the current

E5D11 (D)
What is the phase angle between the voltage across and the current through a series RLC circuit if XC is 250 ohms, R is 1 kilohm, and XL is 500 ohms?
A. 81.47 degrees with the voltage lagging the current
B. 81.47 degrees with the voltage leading the current
C. 14.04 degrees with the voltage lagging the current
D. 14.04 degrees with the voltage leading the current

E5E Algebraic operations using complex numbers: rectangular coordinates (real and imaginary parts); polar coordinates (magnitude and angle)

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__

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__

E5E03 (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__

E5E04 (D)
In polar coordinates, what is the impedance of a network comprised of a 400-ohm-reactance capacitor in series with a 300-ohm resistor?
A. 240 ohms, /__36.9_degrees__
B. 240 ohms, /__-36.9_degrees__
C. 500 ohms, /__53.1_degrees__
D. 500 ohms, /__-53.1_degrees__

E5E05 (A)
In polar coordinates, what is the impedance of a network comprised of a 400-ohm-reactance inductor in parallel with a 300-ohm resistor?
A. 240 ohms, /__36.9_degrees__
B. 240 ohms, /__-36.9_degrees__
C. 500 ohms, /__53.1_degrees__
D. 500 ohms, /__-53.1_degrees__

E5E06 (D)
In polar coordinates, what is the impedance of a network comprised of a 100-ohm-reactance capacitor in series with a 100-ohm resistor?
A. 121 ohms, /__-25_degrees__
B. 191 ohms, /__-85_degrees__
C. 161 ohms, /__-65_degrees__
D. 141 ohms, /__-45_degrees__

E5E07 (C)
In polar coordinates, what is the impedance of a network comprised of a 100-ohm-reactance capacitor in parallel with a 100-ohm resistor?
A. 31 ohms, /__-15_degrees__

B. 51 ohms, /__-25_degrees__
C. 71 ohms, /__-45_degrees__
D. 91 ohms, /__-65_degrees__

E5E08 (B)
In polar coordinates, what is the impedance of a network comprised of a 300-ohm-reactance inductor in series with a 400-ohm resistor?
A. 400 ohms, /__27_degrees__
B. 500 ohms, /__37_degrees__
C. 500 ohms, /__47_degrees__
D. 700 ohms, /__57_degrees__

E5E09 (A)
When using rectangular coordinates to graph the impedance of a circuit, what does the horizontal axis represent?
A. The voltage or current associated with the resistive component
B. The voltage or current associated with the reactive component
C. The sum of the reactive and resistive components
D. The difference between the resistive and reactive components

E5E10 (B)
When using rectangular coordinates to graph the impedance of a circuit, what does the vertical axis represent?
A. The voltage or current associated with the resistive component
B. The voltage or current associated with the reactive component
C. The sum of the reactive and resistive components
D. The difference between the resistive and reactive components

E5E11 (C)
What do the two numbers represent that are used to define a point on a graph using rectangular coordinates?
A. The horizontal and inverted axes
B. The vertical and inverted axes
C. The coordinate values along the horizontal and vertical axes
D. The phase angle with respect to its prime center

E5E12 (D)
If you plot the impedance of a circuit using the rectangular coordinate system and find the impedance point falls on the right side of the graph on the horizontal line, what do you know about the circuit?
A. It has to be a direct current circuit
B. It contains resistance and capacitive reactance
C. It contains resistance and inductive reactance
D. It is equivalent to a pure resistance

E5E13 (B)
Why would you plot the impedance of a circuit using the polar coordinate system?
A. To display the data on an XY chart
B. To give a visual representation of the phase angle
C. To graphically represent the DC component
D. To show the reactance which is present

E5E14 (D)
What coordinate system can be used to display the resistive, inductive, and/or capacitive reactance components of an impedance?
A. Maidenhead grid
B. National Bureau of Standards

C. Faraday
D. Rectangular

E5E15 (D)
What coordinate system can be used to display the phase angle of a circuit containing resistance, inductive and/or capacitive reactance?
A. Maidenhead grid
B. National Bureau of Standards
C. Faraday
D. Polar

E5E16 (A)
In polar coordinates, what is the impedance of a circuit of 100 -j100 ohms impedance?
A. 141 ohms, /__-45_degrees__
B. 100 ohms, /__45_degrees__
C. 100 ohms, /__-45_degrees__
D. 141 ohms, /__45_degrees__

E5E17 (B)
In polar coordinates, what is the impedance of a circuit that has an admittance of 7.09 millisiemens at 45 degrees?
A. 5.03 x 10(-5) ohms, /__45_degrees__
B. 141 ohms, /__-45_degrees__
C. 19,900 ohms, /__-45_degrees__
D. 141 ohms, /__45_degrees__

E5E18 (C)
In rectangular coordinates, what is the impedance of a circuit that has an admittance of 5 millisiemens at -30 degrees?
A. 173 - j100 ohms
B. 200 + j100 ohms
C. 173 + j100 ohms
D. 200 - j100 ohms

E5E19 (A)
In rectangular coordinates, what is the admittance of a circuit that has an impedance of 240 ohms at 36.9 degrees?
A. 3.33 x 10(-3) - j2.50 x 10(-3) siemens
B. 3.33 x 10(-3) + j2.50 x 10(-3) siemens
C. 192 + j144 siemens
D. 3.33 - j2.50 siemens

E5E20 (B)
In polar coordinates, what is the impedance of a series circuit consisting of a resistance of 4 ohms, an inductive reactance of 4 ohms, and a capacitive reactance of 1 ohm?
A. 6.4 ohms, /__53_degrees__
B. 5 ohms, /__37_degrees__
C. 5 ohms, /__45_degrees__
D. 10 ohms, /__-51_degrees__

E5E21 (B)
Which point on Figure E5-2 best represents that impedance of a series circuit consisting of a 400 ohm resistor and a 38 picofarad capacitor at 14 MHz?
A. Point 2
B. Point 4

C. Point 5
D. Point 6

E5E22 (B)
Which point in Figure E5-2 best represents the impedance of a series circuit consisting of a 300 ohm resistor and an 18 microhenry inductor at 3.505 MHz?
A. Point 1
B. Point 3
C. Point 7
D. Point 8

E5E23 (A)
Which point on Figure E5-2 best represents the impedance of a series circuit consisting of a 300 ohm resistor and a 19 picofarad capacitor at 21.200 MHz?
A. Point 1
B. Point 3
C. Point 7
D. Point 8

E5F Skin effect; electrostatic and electromagnetic fields

E5F01 (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

E5F02 (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

E5F03 (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

E5F04 (D)
Why does most of an RF current flow near the surface of a conductor?
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

E5F05 (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

E5F06 (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

E5F07 (B)
What unit measures electrical energy stored in an electrostatic field?
A. Coulomb
B. Joule
C. Watt
D. Volt

E5F08 (B)
What is a magnetic field?
A. Current through the space around a permanent magnet
B. The space 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

E5F09 (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

E5F10 (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

E5F11 (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

E5G Circuit Q; reactive power; power factor

E5G01 (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

E5G02 (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

E5G03 (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. 2.72

E5G04 (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

E5G05 (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

E5G06 (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

E5G07 (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

E5G08 (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

E5G09 (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

E5G10 (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

E5G11 (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

E5G12 (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

E5G13 (B)
What is the Q of a parallel RLC circuit if the resonant frequency is 14.128 MHz, L is 4.7 microhenrys and R is 18 kilohms?
A. 4.31
B. 43.1
C. 13.3
D. 0.023

E5G14 (D)
What is the Q of a parallel RLC circuit if the resonant frequency is 14.225 MHz, L is 3.5 microhenrys and R is 10 kilohms?
A. 7.35
B. 0.0319
C. 71.5
D. 31.9

E5G15 (A)
What is the Q of a parallel RLC circuit if the resonant frequency is 7.125 MHz, L is 10.1 microhenrys and R is 100 ohms?
A. 0.221
B. 4.52
C. 0.00452
D. 22.1

E5G16 (B)
What is the Q of a parallel RLC circuit if the resonant frequency is 3.625 MHz, L is 3 microhenrys and R is 2.2 kilohms?
A. 0.031
B. 32.2
C. 31.1
D. 25.6

E5H Effective radiated power; system gains and losses

E5H01 (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

E5H02 (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

E5H03 (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

E5H04 (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

E5H05 (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

E5H06 (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

E5H07 (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

E5H08 (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

E5H09 (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

E5H10 (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

E5H11 (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

E5H12 (A)
What is reactive power?
A. Wattless, nonproductive power
B. Power consumed in wire resistance in an inductor

C. Power lost because of capacitor leakage
D. Power consumed in circuit Q

E5H13 (D)
What is the power factor of an RL circuit having a 45 degree phase angle between the voltage and the current?
A. 0.866
B. 1.0
C. 0.5
D. 0.707

E5H14 (C)
What is the power factor of an RL circuit having a 30 degree phase angle between the voltage and the current?
A. 1.73
B. 0.5
C. 0.866
D. 0.577

E5H15 (D)
How many watts are consumed in a circuit having a power factor of 0.6 if the input is 200V AC at 5 amperes?
A. 200 watts
B. 1000 watts
C. 1600 watts
D. 600 watts

E5H16 (B)
How many watts are consumed in a circuit having a power factor of 0.71 if the apparent power is 500 watts?
A. 704 W
B. 355 W
C. 252 W
D. 1.42 mW

E5I Photoconductive principles and effects

E5I01 (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 (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 unstable

E5I03 (D)
What happens to the resistance of a photoconductive material when light shines on it?
A. It increases
B. It becomes unstable

C. It stays the same
D. It decreases

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

E5I05 (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 (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 (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 (D)
What characteristic of a crystalline solid will photoconductivity change?
A. The capacitance
B. The inductance
C. The specific gravity
D. The resistance

E5I09 (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 (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 (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 (B)
What characteristic of optoisolators is often used in power supplies?
A. They have low impedance between the light source and the phototransistor
B. They have very high impedance between the light source and the phototransistor
C. They have low impedance between the light source and the LED
D. They have very high impedance between the light source and the LED

E5I13 (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, power; field-effect transistors (FETs): enhancement mode; depletion mode; MOS; CMOS; N-channel; P-channel

E6A01 (C)
In what application is gallium arsenide used as a semiconductor material in preference to germanium or silicon?
A. In high-current rectifier circuits
B. In high-power audio circuits
C. At microwave-frequency frequencies
D. At very low frequency RF circuits

E6A02 (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 (C)
What are the majority charge carriers in P-type semiconductor material?
A. Free neutrons
B. Free protons
C. Holes
D. Free electrons

E6A04 (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

E6A05 (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

E6A06 (A)
In Figure E6-1, what is the schematic symbol for a PNP transistor?
A. 1
B. 2
C. 4
D. 5

E6A07 (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

E6A08 (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

E6A09 (B)
In Figure E6-2, what is the schematic symbol for an N-channel dual-gate MOSFET?
A. 2
B. 4
C. 5
D. 6

E6A10 (A)
In Figure E6-2, what is the schematic symbol for a P-channel junction FET?
A. 1
B. 2
C. 3
D. 6

E6A11 (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

E6A12 (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

E6A13 (C)
How does DC input impedance on the gate of a field-effect transistor compare with the DC input impedance 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

E6A14 (B)
What two elements widely used in semiconductor devices exhibit both metallic and nonmetallic characteristics?
A. Silicon and gold
B. Silicon and germanium
C. Galena and germanium
D. Galena and bismuth

E6A15 (B)
What type of semiconductor material contains fewer free electrons than pure germanium or silicon crystals?
A. N-type
B. P-type
C. Superconductor-type
D. Bipolar-type

E6A16 (B)
What are the majority charge carriers in N-type semiconductor material?
A. Holes
B. Free electrons
C. Free protons
D. Free neutrons

E6A17 (D)
What are the three terminals of a field-effect transistor?
A. Gate 1, gate 2, drain
B. Emitter, base, collector
C. Emitter, base 1, base 2
D. Gate, drain, source

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

E6B04 (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 (D)
In Figure E6-3, what is the schematic symbol for a varactor diode?
A. 8
B. 6
C. 2
D. 1

E6B06 (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 (B)
What limits the maximum forward current rating in a junction diode?
A. Peak inverse voltage
B. Junction temperature
C. Forward voltage
D. Back EMF

E6B08 (A)
Structurally, what are the two main categories of semiconductor diodes?
A. PN junction and metal-semiconductor junction
B. Electrolytic and PN junction
C. CMOS-field effect and metal-semiconductor junction
D. Vacuum and point contact

E6B09 (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 (B)
In Figure E6-3, what is the schematic symbol for a light-emitting diode?
A. 1
B. 5
C. 6
D. 7

E6B11 (C)
What voltage gain can be expected from the circuit in Figure E6-4 when R1 is 10 ohms and RF is 470 ohms?
A. 0.21
B. 94
C. 47
D. 24

E6B12 (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

E6B13 (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

E6B14 (D)
What will be the voltage of the circuit shown in Figure E6-4 if R1 is 1000 ohms and RF is 10,000 ohms and 0.23 volts is applied to the input?
A. 0.23 volts
B. 2.3 volts
C. -0.23 volts
D. -2.3 volts

E6B15 (C)
What voltage gain can be expected from the circuit in Figure E6-4 when R1 is 1800 ohms and RF is 68 kilohms?
A. 1
B. 0.03
C. 38
D. 76

E6B16 (B)
What voltage gain can be expected from the circuit in Figure E6-4 when R1 is 3300 ohms and RF is 47 kilohms?

A. 28
B. 14
C. 7
D. 0.07

(This question has been withdrawn from the pool) E6B17 (A)
What will be the voltage at the output in the circuit shown in Figure E6-4, if R1 is 1,000 ohms and RF is 1,000 ohms when 10 millivolts is applied to the input?
A. 10 millivolts
B. 100 millivolts
C. 10 millivolts
D. 100 millivolts

E6B18 (B)
Which of the following circuits is used to recover audio from an FM voice signal?
A. A doubly balanced mixer
B. A phase-locked loop
C. A differential voltage amplifier
D. A variable frequency oscillator

E6B19 (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

E6B20 (D)
How are junction diodes rated?
A. Maximum forward current and capacitance
B. Maximum reverse current and PIV
C. Maximum reverse current and capacitance
D. Maximum forward current and PIV

E6B21 (C)
What is one common use for PIN diodes?
A. As a constant current source
B. As a constant voltage source
C. As an RF switch
D. As a high voltage rectifier

E6B22 (B)
What type of bias is required for an LED to produce luminescence?
A. Reverse bias
B. Forward bias
C. Zero bias
D. Inductive bias

E6B23 (A)
What is an operational amplifier?
A. A high-gain, direct-coupled differential amplifier whose characteristics are determined by components external to the amplifier
B. A high-gain, direct-coupled audio amplifier whose characteristics are determined by components external to the amplifier

C. An amplifier used to increase the average output of frequency modulated amateur signals to the legal limit
D. A program subroutine that calculates the gain of an RF amplifier

E6B24 (C)
What is meant by the term op-amp input-offset voltage?
A. The output voltage of the op-amp minus its input voltage
B. The difference between the output voltage of the op-amp and the input voltage required in the following stage
C. The potential between the amplifier input terminals of the op-amp in a closed-loop condition
D. The potential between the amplifier input terminals of the op-amp in an open-loop condition

E6B25 (D)
What is the input impedance of a theoretically ideal op-amp?
A. 100 ohms
B. 1000 ohms
C. Very low
D. Very high

E6B26 (A)
What is the output impedance of a theoretically ideal op-amp?
A. Very low
B. Very high
C. 100 ohms
D. 1000 ohms

E6B27 (C)
What is a phase-locked loop circuit?
A. An electronic servo loop consisting of a ratio detector, reactance modulator, and voltage-controlled oscillator
B. An electronic circuit also known as a monostable multivibrator
C. An electronic servo loop consisting of a phase detector, a low-pass filter and voltage-controlled oscillator
D. An electronic circuit consisting of a precision push-pull amplifier with a differential input

E6B28 (D)
What functions are performed by a phase-locked loop?
A. Wide-band AF and RF power amplification
B. Comparison of two digital input signals, digital pulse counter
C. Photovoltaic conversion, optical coupling
D. Frequency synthesis, FM demodulation

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

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 (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 (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 (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 (D)
What is NOT a major advantage of CMOS over other devices?
A. Small size
B. Low power consumption
C. Low cost
D. Differential output

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 (A)
In Figure E6-5, what is the schematic symbol for an AND gate?
A. 1
B. 2
C. 3
D. 4

E6C08 (B)
In Figure E6-5, what is the schematic symbol for a NAND gate?
A. 1
B. 2
C. 3
D. 4

E6C09 (B)
In Figure E6-5, what is the schematic symbol for an OR gate?
A. 2
B. 3
C. 4
D. 6

E6C10 (D)
In Figure E6-5, what is the schematic symbol for a NOR gate?
A. 1
B. 2
C. 3
D. 4

E6C11 (C)
In Figure E6-5, what is the schematic symbol for the NOT operation (inverter)?
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 (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 (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 (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 (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 (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 (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 (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 (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 (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 100 Hz to at least 1000 MHz
C. From 100 Hz to no more than 3000 kHz
D. From a few hundred MHz to at least 1000 GHz

E6D10 (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

E6D11 (C)
What devices are commonly used as VHF and UHF parasitic suppressors at the input and output terminals of transistorized HF amplifiers?
A. Electrolytic capacitors
B. Butterworth filters
C. Ferrite beads
D. Steel-core toroids

E6D12 (A)
What is a primary advantage of using a toroidal core instead of a solenoidal 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

E6D13 (C)
How many turns will be required to produce a 1-mH inductor using a ferrite toroidal core that has an inductance index (A L) value of 523 millihenrys/1000 turns?
A. 2 turns
B. 4 turns
C. 43 turns
D. 229 turns

E6D14 (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 L) value of 40 microhenrys/100 turns?
A. 35 turns
B. 13 turns
C. 79 turns
D. 141 turns

E6D15 (D)
What type of CRT deflection is better when high-frequency waves are to be displayed on the screen?
A. Electromagnetic
B. Tubular
C. Radar
D. Electrostatic

E6D16 (C)
Which is NOT true of a charge-coupled device (CCD)?
A. It uses a combination of analog and digital circuitry
B. It can be used to make an audio delay line
C. It can be used as an analog-to-digital converter
D. It samples and stores analog signals

E6D17 (A)
What is the principle advantage of liquid-crystal display (LCD) devices?
A. They consume low power
B. They can display changes instantly
C. They are visible in all light conditions
D. They can be easily interchanged with other display devices

E6D18 (C)
What is one important reason for using ferrite toroids rather than powdered-iron toroids in an inductor?
A. Ferrite toroids generally have lower initial permeabilities
B. Ferrite toroids generally have better temperature stability
C. Ferrite toroids generally require fewer turns to produce a given inductance value
D. Ferrite toroids are easier to use with surface mount technology

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

E6E01 (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 (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 (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 (D)
What technique is used to construct low-cost, high-performance crystal ladder filters?
A. Obtain a small quantity of custom-made 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 a frequency variation of less than 10% of the desired filter bandwidth

E6E05 (A)
Which of the following factors has the greatest effect in helping determine the bandwidth and response shape of a crystal ladder filter?
A. The relative frequencies of the individual crystals
B. The DC voltage applied to the quartz crystal
C. The gain of the RF stage preceding the filter
D. The amplitude of the signals passing through the filter

E6E06 (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 (A)
What is the characteristic impedance of circuits in which MMICs are designed to work?
A. 50 ohms
B. 300 ohms
C. 450 ohms
D. 10 ohms

E6E08 (B)
What is the typical noise figure of a monolithic microwave integrated circuit (MMIC) amplifier?
A. Less than 1 dB
B. Approximately 3.5 to 6 dB
C. Approximately 8 to 10 dB
D. More than 20 dB

E6E09 (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 junction field-effect transistor (JFET)
B. An operational amplifier integrated circuit (OAIC)
C. An indium arsenide integrated circuit (IAIC)
D. A monolithic microwave integrated circuit (MMIC)

E6E10 (B)
What typical construction technique do amateurs use when building an amplifier for the microwave bands 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 (A)
How is the operating bias voltage supplied to a monolithic microwave integrated circuit (MMIC) that uses four leads?
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

E6E12 (D)
How is the DC power from a voltage source fed to a monolithic microwave integrated circuits (MMIC)?
A. Through a coupling capacitor
B. Through a PIN diode
C. Through a silicon-controlled rectifier
D. Through a resistor

E6E13 (B)
What supply voltage do monolithic microwave integrated circuits (MMIC) amplifiers typically require?
A. 1 volt DC
B. 12 volts DC
C. 20 volts DC
D. 120 volts DC

E6E14 (C)
What is the most common package for inexpensive monolithic microwave integrated circuit (MMIC) amplifiers?
A. Beryllium oxide packages
B. Glass packages
C. Plastic packages
D. Ceramic packages

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

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

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 (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 (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 (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 (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 (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 (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 (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 (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 (i.e., DC input versus PEP), transmitter final amplifiers; amplifier circuits: tube, bipolar transistor, FET

E7B01 (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 (C)
Which class of amplifier provides the highest efficiency?
A. Class A
B. Class B
C. Class C
D. Class AB

E7B03 (A)
Where on the load line should a bipolar-transistor, common-emitter Class A power amplifier be operated for best efficiency and stability?
A. Below the saturation region
B. Above the saturation region
C. At the zero bias point
D. Just below the thermal runaway point

E7B04 (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 (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 (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 (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 (D)
What is the procedure for tuning a vacuum-tube power amplifier having an output pi-network?
A. Adjust the loading capacitor to maximum capacitance and then dip the plate current with the tuning capacitor
B. Alternately increase the plate current with the tuning capacitor and dip the plate current with the loading capacitor
C. Adjust the tuning capacitor to maximum capacitance and then dip the plate current with the loading capacitor

D. Alternately increase the plate current with the loading capacitor and dip the plate current with the tuning capacitor

E7B09 (B)
In Figure E7-1, what is the purpose of R1 and R2?
A. Load resistors
B. Fixed bias
C. Self bias
D. Feedback

E7B10 (D)
In Figure E7-1, what is the purpose of C3?
A. AC feedback
B. Input coupling
C. Power supply decoupling
D. Emitter bypass

E7B11 (D)
In Figure E7-1, what is the purpose of R3?
A. Fixed bias
B. Emitter bypass
C. Output load resistor
D. Self bias

E7B12 (C)
What type of circuit is shown in Figure E7-1?
A. Switching voltage regulator
B. Linear voltage regulator
C. Common emitter amplifier
D. Emitter follower amplifier

E7B13 (D)
In Figure E7-1, what is the purpose of C1?
A. Decoupling
B. Output coupling
C. Self bias
D. Input coupling

E7B14 (A)
In Figure E7-2, what is the purpose of R?
A. Emitter load
B. Fixed bias
C. Collector load
D. Voltage regulation

E7B15 (A)
In Figure E7-2, what is the purpose of C2?
A. Output coupling
B. Emitter bypass
C. Input coupling
D. Hum filtering

E7B16 (B)
What is the purpose of D1 in the circuit shown in Figure E7-3?
A. Line voltage stabilization
B. Voltage reference
C. Peak clipping

D. Hum filtering

E7B17 (C)
What is the purpose of Q1 in the circuit shown in Figure E7-3?
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

E7B18 (A)
What is the purpose of C2 in the circuit shown in Figure E7-3?
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

E7B19 (C)
What type of circuit is shown in Figure E7-3?
A. Switching voltage regulator
B. Grounded emitter amplifier
C. Linear voltage regulator
D. Emitter follower

E7B20 (D)
What is the purpose of C1 in the circuit shown in Figure E7-3?
A. It resonates at the ripple frequency
B. It provides fixed bias for Q1
C. It decouples the output
D. It filters the supply voltage

E7B21 (A)
What is the purpose of C3 in the circuit shown in Figure E7-3?
A. It prevents self-oscillation
B. It provides brute force filtering of the output
C. It provides fixed bias for Q1
D. It clips the peaks of the ripple

E7B22 (C)
What is the purpose of R1 in the circuit shown in Figure E7-3?
A. It provides a constant load to the voltage source
B. It couples hum to D1
C. It supplies current to D1
D. It bypasses hum around D1

E7B23 (D)
What is the purpose of R2 in the circuit shown in Figure E7-3?
A. It provides fixed bias for Q1
B. It provides fixed bias for D1
C. It decouples hum from D1
D. It provides a constant minimum load 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 (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 (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 (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 narrow bandwidth notch filter

E7C04 (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 (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 (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

E7C07 (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

E7C08 (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

E7C09 (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

E7C10 (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 crystal-lattice filter
C. A Hilbert-transform filter
D. A phase-inverting filter

E7C11 (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

E7C12 (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

E7C13 (D)
What is a pi-network?
A. A network consisting entirely of four inductors or four capacitors
B. A Power Incidence network
C. An antenna matching network that is isolated from ground
D. A network consisting of one inductor and two capacitors or two inductors and one capacitor

E7C14 (B)
What is a pi-L-network?
A. A Phase Inverter Load network
B. A network consisting of two inductors and two capacitors
C. A network with only three discrete parts
D. A matching network in which all components are isolated from ground

E7C15 (C)
Which type of network provides the greatest harmonic suppression?
A. L-network
B. Pi-network
C. Pi-L-network
D. Inverse Pi network

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

E7D01 (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 (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 (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 (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 (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 a quartz crystal

E7D06 (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 (B)
Why is very stable reference oscillator normally 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 (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 load current to maintain a constant output voltage

E7D09 (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 automatically adjusted to maintain a constant average output voltage
D. It gives a ramp voltage at its output

E7D10 (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 (B)
What type of linear regulator is used in applications requiring efficient use of the primary power source?
A. A constant current source
B. A series regulator
C. A shunt regulator
D. A shunt current source

E7D12 (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 (C)
Which of the following Zener diodes voltages will result in the best temperature stability for a voltage reference?
A. 2.4 volts
B. 3.0 volts
C. 5.6 volts

D. 12.0 volts

E7D14 (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 and minimum output current and maximum output 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 input and output current

E7D15 (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

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

E7E01 (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 (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 (C)
How does a phase modulator work?
A. It varies the tuning of a microphone preamplifier to produce PM 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 PM signals
D. It varies the tuning of a microphone preamplifier to produce AM signals

E7E04 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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

E7E16 (B)
What is the process of detection?
A. The masking of the intelligence on a received carrier
B. The recovery of the intelligence from a modulated RF signal
C. The modulation of a carrier
D. The mixing of noise with a received signal

E7E17 (A)
What is the principle of detection in a diode detector?
A. Rectification and filtering of RF
B. Breakdown of the Zener voltage
C. Mixing with noise in the transition region of the diode
D. The change of reactance in the diode with respect to frequency

E7E18 (C)
What does a product detector do?
A. It provides local oscillations for input to a mixer
B. It amplifies and narrows bandpass frequencies
C. It mixes an incoming signal with a locally generated carrier
D. It detects cross-modulation products

E7E19 (B)
How are FM-phone signals detected?
A. With a balanced modulator
B. With a frequency discriminator
C. With a product detector

D. With a phase splitter

E7E20 (D)
What is a frequency discriminator?
A. An FM generator
B. A circuit for filtering two closely adjacent signals
C. An automatic band-switching circuit
D. A circuit for detecting FM signals

E7E21 (C)
How can an FM-phone signal be produced?
A. By modulating the supply voltage to a Class-B amplifier
B. By modulating the supply voltage to a Class-C amplifier
C. By using a reactance modulator on an oscillator
D. By using a balanced modulator on an oscillator

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

E7F01 (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 (B)
How many states does a decade counter digital IC have?
A. 2
B. 10
C. 20
D. 100

E7F03 (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 (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 (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 (D)
What is a crystal-controlled marker generator?
A. A low-stability oscillator that sweeps through a band 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 (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 (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 (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 (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 (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 (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 (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 (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 (C)
What type of capacitors should be used in a high-stability op-amp RC active filter circuit?
A. Electrolytic
B. Disc ceramic
C. Polystyrene
D. Paper dielectric

E7G05 (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 (A)
What parameter must be selected when selecting the resistor and capacitor values for an RC active filter using an op-amp?
A. Filter bandwidth
B. Desired current gain
C. Temperature coefficient
D. Output-offset overshoot

E7G07 (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 (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 (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 (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 (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 [4 Exam Questions -- 4 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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 (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 in a given resistor as the peak AC voltage
C. The DC voltage causing the same heating in a given resistor as the RMS AC voltage of the same value
D. The AC voltage found by taking the square root of the average AC value

E8A13 (D)
What would be the most accurate way of measuring 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 (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 (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 (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. 4500 watts

E8A17 (C)
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. 1000 watts
D. 1500 watts

E8A18 (A)
What is the period of a wave?
A. The time required to complete one cycle
B. The number of degrees in one cycle
C. The number of zero crossings in one cycle
D. The amplitude of the wave

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

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

E8B02 (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 (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 (D)
What is emission F3F?
A. Modulated CW
B. Facsimile
C. RTTY
D. Television

E8B05 (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 (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 (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 (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

Question E8B09: Question was omitted, delete number from pool. Do not renumber subsequent questions.

E8B10 (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 (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 (B)
What is the modulation index of an FM-phone transmitter producing a maximum carrier deviation of 6 kHz when modulated with a 2-kHz modulating frequency?
A. 6000
B. 3
C. 2000
D. 1/3

E8B13 (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. 0.167
C. 0.6
D. 1.67

E8B14 (A)

In a pulse width-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 (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

Question E8B16: Question was omitted, delete number from pool. Do not renumber subsequent questions.

E8B17 (C)
Which of the following describe the three most-used symbols of an ITU emission designator?
A. Type of modulation, transmitted bandwidth and modulation code designator
B. Bandwidth of the modulating signal, nature of the modulating signal and transmission rate of signals
C. Type of modulation, nature of the modulating signal and type of information to be transmitted
D. Power of signal being transmitted, nature of multiplexing and transmission speed

E8B18 (D)
If the first symbol of an ITU emission designator is G, representing a phase-modulated signal, what information about the emission is described?
A. The nature of any signal multiplexing
B. The maximum permissible deviation
C. The nature of signals modulating the main carrier
D. The type of modulation of the main carrier

E8B19 (D)
In a pulse-position modulation system, what parameter does the modulating signal vary?
A. The number of pulses per second
B. Both the frequency and amplitude of the pulses
C. The duration of the pulses
D. The time at which each pulse occurs

E8B20 (B)
In a pulse-width modulation system, what parameter does the modulating signal vary?
A. Pulse frequency
B. Pulse duration
C. Pulse amplitude
D. Pulse intensity

E8B21 (A)
How are the pulses of a pulse-modulated signal usually transmitted?
A. A pulse of relatively short duration is sent; a relatively long period of time separates each pulse
B. A pulse of relatively long duration is sent; a relatively short period of time separates each pulse
C. A group of short pulses are sent in a relatively short period of time; a relatively long period of time separates each group
D. A group of short pulses are sent in a relatively long period of time; a relatively short period of time separates each group

E8B22 (D)
In an FM-phone signal, what is the term for the ratio between the deviation of the frequency modulated signal and the modulating frequency?
A. FM compressibility
B. Quieting index
C. Percentage of modulation
D. Modulation index

E8B23 (B)
What is meant by deviation ratio?
A. The ratio of the audio modulating frequency to the center carrier frequency
B. The ratio of the maximum carrier frequency deviation to the highest audio modulating frequency
C. The ratio of the carrier center frequency to the audio modulating frequency
D. The ratio of the highest audio modulating frequency to the average audio modulating frequency

E8B24 (A)
What is the deviation ratio of an FM-phone signal having a maximum frequency swing of plus or minus 7.5 kHz and accepting a maximum modulation rate of 3.5 kHz?
A. 2.14
B. 0.214
C. 0.47
D. 47

E8C Digital signals: including CW; digital signal information rate vs bandwidth; spread-spectrum communications

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

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

D. Baudot uses seven data bits per character, ASCII uses eight; Baudot has no shift code, ASCII uses two characters as shift codes

E8C03 (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 (B)
What digital communications system is well suited for meteor-scatter Communications at times other than during meteor showers?
A. ACSSB
B. Computerized high speed CW (HSCW)
C. AMTOR
D. Spread spectrum

E8C05 (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 (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 computer-sequencing clock
D. The receiving station automatically requests repeats when needed

E8C07 (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 (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 (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 (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

E8C11 (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

E8C12 (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

E8C13 (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

E8C14 (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

E8C15 (D)
What makes spread-spectrum communications 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

E8C16 (B)
What reduces interference from spread-spectrum transmitters to conventional 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

E8D Peak amplitude (positive and negative); peak-to-peak values: measurements; Electromagnetic radiation; wave polarization; signal-to-noise (S/N) ratio

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

E8D02 (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

E8D03 (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

E8D04 (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

E8D05 (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

E8D06 (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

E8D07 (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

E8D08 (C)
What is an electromagnetic wave?
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

E8D09 (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

E8D10 (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

E8D11 (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

E8D12 (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

E8D13 (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. Induction motor noise
C. Receiver front-end noise
D. Atmospheric noise

E8D14 (A)
At approximately what speed do electromagnetic waves travel in free space?
A. 300 million meters per second
B. 468 million meters per second
C. 186,300 feet per second
D. 300 million miles per second

E8D15 (D)
To ensure you do not exceed the maximum allowable power, what kind of meter would you use to monitor the output signal of a properly adjusted single-sideband transmitter?
A. An SWR meter reading in the forward direction
B. A modulation meter
C. An average reading wattmeter
D. A peak-reading wattmeter

E8D16 (A)
What is the average power dissipated by a 50-ohm resistive load during one complete RF cycle having a peak voltage of 35 volts?
A. 12.2 watts
B. 9.9 watts
C. 24.5 watts
D. 16 watts

E8D17 (D)
If an RMS reading voltmeter reads 34 volts on a sinusoidal waveform, what is the peak voltage?
A. 123 volts
B. 96 volts
C. 55 volts
D. 48 volts

SUBELEMENT E9 -- ANTENNAS [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 (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 (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 (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 (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 (C)
Which of the following describes the radiation pattern of an isotropic radiator?
A. A teardrop 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 (A)
Why would one need to know the feed point impedance 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 (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 (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 (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 (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 (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 (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 (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 (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 (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

E9A16 (D)
What theoretical reference antenna provides a comparison for antenna measurements?
A. Quarter-wave vertical
B. Yagi
C. Bobtail curtain
D. Isotropic radiator

E9A17 (A)
How much gain does an antenna have over a 1/2-wavelength dipole when it has 6 dB gain over an isotropic radiator?
A. About 3.9 dB
B. About 6.0 dB
C. About 8.1 dB

D. About 10.0 dB

E9A18 (B)
How much gain does an antenna have over a 1/2-wavelength dipole when it has 12 dB gain over an isotropic radiator?
A. About 6.1 dB
B. About 9.9 dB
C. About 12.0 dB
D. About 14.1 dB

E9A19 (D)
Which of the following describes the directivity of an isotropic radiator?
A. Directivity in the E plane
B. Directivity in the H plane
C. Directivity in the Z plane
D. No directivity at all

E9A20 (C)
What is meant by the radiation resistance of an antenna?
A. The combined losses of the antenna elements and feed line
B. The specific impedance of the antenna
C. The equivalent resistance that would dissipate the same amount of power as that radiated from an antenna
D. The resistance in the atmosphere that an antenna must overcome to be able to radiate a signal

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

E9B01 (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 (B)
In the free-space H-Field radiation pattern shown in Figure E9-1, what is the 3-dB beamwidth?
A. 75 degrees
B. 50 degrees
C. 25 degrees
D. 30 degrees

E9B03 (B)
In the free-space H-Field pattern shown in Figure E9-1, what is the front-to-back ratio?
A. 36 dB
B. 18 dB
C. 24 dB
D. 14 dB

E9B04 (B)
In the free-space H-field pattern shown in Figure E9-1, what is the front-to-side ratio?
A. 12 dB

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

E9B05 (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 (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 feed-point impedance may change radically with frequency
C. The rearward pattern lobes may vary excessively with frequency
D. The dielectric constant may vary significantly

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

E9B08 (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 (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 (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

E9C Phased vertical antennas; radiation patterns; beverage antennas; rhombic antennas: resonant; terminated; 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 (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 (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 (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 (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 (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 (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 (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 (A)
What are the advantages of a terminated 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 (C)
What are the disadvantages of a terminated rhombic antenna for the HF bands?
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 (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 (A)
What type of antenna pattern over real ground is shown in Figure E9-2?
A. Elevation pattern
B. Azimuth pattern
C. E-Plane pattern
D. Polarization pattern

E9C12 (C)
In the H field antenna radiation pattern shown in Figure E9-2, what is the elevation angle of the peak response?
A. 45 degrees
B. 75 degrees
C. 7.5 degrees
D. 25 degrees

E9C13 (B)
In the H field antenna radiation pattern shown in Figure E9-2, what is the front-to-back ratio?
A. 15 dB
B. 28 dB
C. 3 dB
D. 24 dB

E9C14 (A)
In the H field antenna radiation pattern shown in Figure E9-2, how many elevation lobes appear in the forward direction?
A. 4
B. 3
C. 1
D. 7

E9C15 (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

E9C16 (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

E9C17 (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 a four-sided loop
D. For best performance it should be longer than one wavelength

E9C18 (B)
How would the electric field be oriented for a Yagi with three elements mounted parallel to the ground?
A. Vertically
B. Horizontally
C. Right-hand elliptically
D. Left-hand elliptically

E9C19 (A)
What strongly affects the shape of the far-field, low-angle elevation pattern of a vertically polarized antenna?
A. The conductivity and dielectric constant of the soil
B. The radiation resistance of the antenna
C. The SWR on the transmission line
D. The transmitter output power

E9C20 (B)
Why are elevated-radial counterpoises popular with vertically polarized antennas?
A. They reduce the far-field ground losses
B. They reduce the near-field ground losses, compared to on-ground radial systems using more radials
C. They reduce the radiation angle
D. None of these choices is correct

E9C21 (C)
What is a terminated rhombic antenna?
A. An antenna resonant at approximately double the frequency of the intended band of operation
B. An open-ended bidirectional antenna

C. A unidirectional antenna terminated in a resistance equal to its characteristic impedance
D. A horizontal triangular antenna consisting of two adjacent sides and the long diagonal of a resonant rhombic antenna

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. {i.e., mobile, trap}); SWR bandwidth; efficiency

E9D01 (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 (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 (B)
What is the approximate beamwidth of a symmetrical pattern antenna with a gain of 20 dB as compared to an isotropic radiator?
A. 10 degrees
B. 20 degrees
C. 45 degrees
D. 60 degrees

E9D04 (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 (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 (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 (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 (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 (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 (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 (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 lower than the operating frequency
D. The driven element radiation resistance is higher than the characteristic impedance of the transmission line

E9D12 (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 (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 (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

E9D15 (A)
What is the approximate input terminal impedance at the center of a folded dipole antenna?
A. 300 ohms
B. 72 ohms
C. 50 ohms
D. 450 ohms

E9D16 (D)
Why is a loading coil often used with an HF mobile antenna?
A. To improve reception
B. To lower the losses
C. To lower the Q
D. To tune out the capacitive reactance

E9D17 (D)
What is an advantage of using a trap antenna?
A. It has high directivity in the higher-frequency bands
B. It has high gain
C. It minimizes harmonic radiation
D. It may be used for multi-band operation

E9D18 (B)
What happens at the base feed-point of a fixed length HF mobile antenna as the frequency of operation is lowered?
A. The resistance decreases and the capacitive reactance decreases
B. The resistance decreases and the capacitive reactance increases
C. The resistance increases and the capacitive reactance decreases
D. The resistance increases and the capacitive reactance increases

E9D19 (B)
What is the beamwidth of a symmetrical pattern antenna with a gain of 30 dB as compared to an isotropic radiator?
A. 3.2 degrees
B. 6.4 degrees
C. 37 degrees
D. 60 degrees

E9D20 (C)
What is the beamwidth of a symmetrical pattern antenna with a gain of 15 dB as compared to an isotropic radiator?
A. 72 degrees
B. 52 degrees

C. 36 degrees
D. 3.6 degrees

E9D21 (D)
What is the beamwidth of a symmetrical pattern antenna with a gain of 12 dB as compared to an isotropic radiator?
A. 34 degrees
B. 45 degrees
C. 58 degrees
D. 51 degrees

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

E9E01 (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 (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 (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 (B)
What should be the approximate capacitance of the resonating capacitor in a gamma matching circuit on a Yagi beam antenna for the 20-meter band?
A. 14 pF
B. 140 pF
C. 1400 pF
D. 0.14 pF

E9E05 (D)
What should be the approximate capacitance of the resonating capacitor in a gamma matching circuit on a Yagi beam antenna for the 10-meter band?
A. 0.2 pF
B. 0.7 pF
C. 700 pF

D. 70 pF

E9E06 (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

E9E07 (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

E9E08 (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 a parallel feed line
C. The surge impedance is higher in a parallel feed line
D. RF energy moves slower along the coaxial cable

E9E09 (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

E9E10 (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. 2.3 meters
C. 3.5 meters
D. 0.2 meters

E9E11 (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 meters
C. 10 meters
D. 71 meters

E9E12 (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

E9E13 (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

E9E14 (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

E9E15 (A)
What is the term for the ratio of the actual velocity at which a signal travels through a transmission line to the speed of light in a vacuum?
A. Velocity factor
B. Characteristic impedance
C. Surge impedance
D. Standing wave ratio

E9E16 (B)
What would be the physical length of a typical coaxial transmission line that is electrically one-quarter wavelength long at 7.2 MHz? (Assume a velocity factor of 0.66.)
A. 10 meters
B. 6.9 meters
C. 24 meters
D. 50 meters

E9E17 (C)
What kind of impedance does a 1/8-wavelength transmission line present to a generator when the line is shorted at the far end?
A. A capacitive reactance
B. The same as the characteristic impedance of the line
C. An inductive reactance
D. The same as the input impedance to the final generator stage

E9E18 (C)
What kind of impedance does a 1/8-wavelength transmission line present to a generator when the line is open at the far end?
A. The same as the characteristic impedance of the line
B. An inductive reactance
C. A capacitive reactance
D. The same as the input impedance of the final generator stage

E9E19 (B)
What kind of impedance does a 1/4-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 input impedance to the final generator stage

E9E20 (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

E9E21 (B)
What kind of impedance does a 1/2-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 line
D. The same as the output impedance of the generator

E9E22 (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