OFFICER-ENLISTED

CORRESPONDENCE COURSE

NAVAL ELECTRONICS, PART 1A

Published by the

NAVAL EDUCATION AND TRAINING

PROGRAM DEVELOPMENT CENTER

for the

CHIEF OF NAVAL EDUCATION AND TRAINING

NAVEDTRA 10445-D

8109

NAVAL ELECTRONICS, PART 1A

NAVEDTRA 10445-D

Prepared by the Naval Education and Training Program Development Center, Pensacola, Florida

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This OCC-ECC contains a set of assignments and perforated answer sheets. The Rate Training Manual, Basic Electronics, Vol. 1, NAVEDTRA 10087-C, is your textbook for the OCC-ECC. If an errata sheet comes with the OCC-ECC, make all indicated changes or corrections. Do not change or correct the textbook or assignments in any other way.

HOW TO COMPLETE THIS COURSE SUCCESSFULLY

Study the textbook pages given at the beginning of each assignment before trying to answer the items. Pay attention to tables and illustrations as they contain a lot of information. Making your own drawings can help you understand the subject matter. Also, read the learning objectives that precede the sets of items. The learning objectives and items are based on the subject matter or study material in the textbook. The objectives tell you what you should be able to do by studying assigned textual material and answering the items.

At this point you should be ready to answer the items in the assignment. Read each item carefully. Select the BEST ANSWER for each item, consulting your textbook when necessary. Be sure to select the BEST ANSWER from the subject matter in the textbook. You may discuss difficult points in the course with others. However, the answer you select must be your own. Remove a perforated answer sheet from the back of this text, write in the proper assignment number, and enter your answer for each item.

This OCC-ECC will be administered by your command or, in the case of small commands, by the Naval Education and Training Program Development Center. No matter who administers your course you can complete it successfully by earning a 3.4 for each assignment. The unit breakdown of the course, if any, is shown later under Naval Reserve Retirement Credit.

WHEN YOUR COURSE IS ADMINISTERED BY LOCAL COMMAND

As soon as you have finished an assignment, submit the completed answer sheet to the officer designated to grade it. The graded answer sheet will not be returned to you.

If you are completing this OCC-ECC to become eligible to take the fleetwide advancement examination, follow a schedule that will enable you to complete all assignments in time. Your schedule should call for the completion of at least one assignment per month.

Although you complete the course successfully, the Naval Education and Training Program Development Center will not issue you a letter of satisfactory completion. Your command will make an entry in your service record, giving you credit for your work.

WHEN YOUR COURSE IS ADMINISTERED BY THE NAVAL EDUCATION AND TRAINING PROGRAM DEVELOPMENT CENTER

After finishing an assignment, go on to the next. Retain each completed answer sheet until you finish all the assignments in a unit (or in the course if it is not divided into units). Using the envelopes provided, mail your completed answer sheets to the Naval Education and Training Program Development Center where they will be graded and the score recorded. Make sure all blanks at the top of each answer sheet are filled in. Unless you furnish all the information required, it will be impossible to give you credit for your work. The graded answer sheets will not be returned.

The Naval Education and Training Program Development Center will issue a letter of satisfactory completion to certify successful completion of the course (or a creditable unit of the course). To receive a course-completion letter, follow the directions given on the course-completion form in the back of this OCC-ECC.

You may keep the textbook and assignments for this course. Return them <u>only</u> in the event you disenroll from the course or otherwise fail to complete the course. Directions for returning the textbook and assignments are given on the book-return form in the back of this OCC-ECC.

PREPARING FOR YOUR ADVANCEMENT EXAMINATION

Your examination for advancement is based on the Occupational Standards for your rating as found in the MANUAL OF NAVY ENLISTED MANPOWER AND PERSONNEL CLASSIFICATIONS AND OCCUPATIONAL STANDARDS (NAVPERS 18068). These Occupational Standards define the minimum tasks required of your rating. The sources of questions in your advancement examination are listed in the BIBLIOGRAPHY FOR ADVANCEMENT STUDY (NAVEDTRA 10052). For your convenience, the Occupational Standards and the sources of questions for your rating are combined in a single pamphlet for the series of examinations for each year. These OCCUPATIONAL STANDARDS AND BIBLIOGRAPHY SHEETS (called Bib Sheets), are available from your ESO. Since your textbook and OCC-ECC are among the sources listed in the bibliography, be sure to study both as you take the course. The qualifications for your rating may have changed since your course and textbook were printed, so refer to the latest edition of the Bib Sheets.

NAVAL RESERVE RETIREMENT CREDIT

The course is evaluated at 36 Naval Reserve retirement points. Points for satisfactory completion of each creditable unit will be assigned as of the date the last assignment of the unit is mailed. Points for creditable units will be assigned as follows:

Unit	Points	Assignment
1	12	1 through 8
2	12	9 through 16
3	12	17 through 24

These points are creditable to personnel eligible to receive them under current directives governing the retirement of Naval Reserve personnel. Credit cannot be given again for this course if the student has previously received credit for completing another Naval Electronics, Part 1 OCC-ECC or NRCC.

COURSE OBJECTIVE

In completing this OCC-ECC, you will demonstrate a knowledge of the subject matter by correctly answering questions on the following:

introduction to electronics equipments such as
  communication, navigation, radar and sonar;
safety, to include
  electric shock, electrical fires, warning signs and grounding of equipments;
basic test equipment such as
  meters, signal generators, cathode-ray oscilloscopes and transistor testers;
characteristics of mass and energy including
  particles of matter, impurity donors and acceptors and PN junctions;
PN junction power supplies including diodes,
  rectifier circuits, power transformers and combinational voltage supplies;
transistors, to include
  transistor amplifiers, operating limits, feedback, biasing and various configurations such as compound connected, unijunction, field effect, integrated circuits, rectifiers and testing;
electron tubes such as
  diodes, triodes, tetrodes, pentodes as well as multielectrode and multiunit tubes, classes of amplifiers, biasing and coupling;
electronic voltage regulators and meters;
fundamentals of communication theory including
  frequency spectrum, AM transmitters, superheterodyne receivers, antenna multicouplers, multiplexing and frequency standards;
tuned circuits covering the
  expression of vectors algebraically, series circuit resonance and parallel RLC circuits;
introduction to receivers such as the
  crystal and TRF receiver;
detectors
  the ICO concept;
audio amplifiers such as
  audio voltage and power amplifiers;
radio frequency amplifiers including
  common emitter, pentode and field effect transistor amplifiers;

> While working on this correspondence course, you may refer freely to the text. You may seek advice and instruction from others on problems arising in the course, but the solutions submitted must be the result of your own work and decisions. You are prohibited from referring to or copying the solutions of others, or giving completed solutions to anyone else taking the same course.

oscillators, to include
desired characteristics, LC, crystal and tunnel diode oscillators and their coupling methods;
mixers and convertors with emphasis on their characteristics as well as heterodyning;
intermediate frequency amplifiers including transistor and electron tube IF amplifiers and their failure analysis;
receiver control circuits such as
band spreaders, manual gain and volume controls, multiple conversion, frequency synthesis, noise limiters, silencers and automatic frequency control;
receiver alignment including
IF section, local oscillator, RF stages and alignment of modular receivers;
introduction to transmitters;
radio frequency power amplifiers
covering classes of operation, frequency multiplication, coupling and neutralization;
amplitude modulation principles with consideration given to microphones; principles of frequency modulation; receiver and transmitter trouble-shooting;
single sideband
receivers and transmitters as well as their advantages and disadvantages;
continuous wave
transmission, reception and demodulation and frequency modulation receivers;
logical, six-step troubleshooting procedures;
transmission lines
types, characteristic impedance, nonresonant lines and wavelength measurements; and
antennas and wave propagation.

The answer key has a page number, figure number, or study hint (abbreviated "SH") relating to the correct answer for each question. (The study hint precedes one or more questions and is indicated by a black dot.) These "helps" should be used by you in determining correct answers for those questions you answered incorrectly.

Naval courses may include a variety of questions -- multiple-choice, true-false, matching, etc. The questions are not grouped by type; regardless of type, they are presented in the same general sequence as the textbook material upon which they are based. This presentation is designed to preserve continuity of thought, permitting step-by-step development of ideas. Some courses use many types of questions, others only a few. The student can readily identify the type of each question (and the action required) through inspection of the samples given below.

MULTIPLE-CHOICE QUESTIONS

Each question contains several alternatives, one of which provides the best answer to the question. Select the best alternative, and blacken the appropriate box on the answer sheet.

SAMPLE

s-1. The first person to be appointed Secretary of Defense under the National Security Act of 1947 was
1. George Marshall
2. James Forrestal
3. Chester Nimitz
4. William Halsey

Indicate in this way on the answer sheet:

	1 T	2 F	3	4	
s-1	□	■	□	□	___

TRUE-FALSE QUESTIONS

Mark each statement true or false as indicated below. If any part of the statement is false the statement is to be considered false. Make the decision, and blacken the appropriate box on the answer sheet.

SAMPLE

s-2. Any naval officer is authorized to correspond officially with any systems command of the Department of the Navy without his commanding officer's endorsement.

Indicate in this way on the answer sheet:

	1 T	2 F	3	4	
s-2	□	■	□	□	___

MATCHING QUESTIONS

Each set of questions consists of two columns, each listing words, phrases or sentences. The task is to select the item in column B which is the best match for the item in column A that is being considered. Items in column B may be used once, more than once, or not at all. Specific instructions are given with each set of questions. Select the numbers identifying the answers and blacken the appropriate boxes on the answer sheet.

SAMPLE

In questions s-3 through s-6, match the name of the shipboard officer in column A by selecting from column B the name of the department in which the officer functions.

A	B
s-3. Damage Control Assistant	1. Operations Department
s-4. CIC Officer	2. Engineering Department
s-5. Disbursing Officer	3. Supply Department
s-6. Communications Officer	

Indicate in this way on the answer sheet:

	1 T	2 F	3	4	
s-3	□	■	□	□	___
s-4	■	□	□	□	___
s-5	□	□	■	□	___
s-6	■	□	□	□	___

Assignment 1

Introduction to Electronic Equipment; Safety

Textbook Assignment: Pages 1 through 29

Learning Objective: Recognize the frequency bands into which the radio frequency spectrum is divided and the purposes for which the frequency bands are used in Navy electronic equipment. Text pages 1 and 2.

1-1. The physical and electrical requirements of the equipment used in the VLF and LF bands restrict the use of these bands to
1. shipboard installations
2. shore installations
3. airborne installations
4. mobile installations

1-2. Which frequency band is used by the Navy for long range, ship-to-shore communications?
1. LF, 30 - 300 kHz
2. HF, 3000 - 30,000 kHz
3. VHF, 30 - 300 MHz
4. UHF, 300 - 3000 MHz

1-3. Which frequency ranges are used by the Navy for (A) VHF and (B) UHF communication purposes?
1. (A) 30 MHz to 100 MHz, (B) 300 MHz to 500 MHz
2. (A) 40 MHz to 300 MHz, (B) 300 MHz to 500 MHz
3. (A) 225 MHz to 300 MHz, (B) 300 MHz to 400 MHz
4. (A) 500 MHz to 800 MHz, (B) 300 MHz to 3000 MHz

1-4. Which radio frequency band consists of frequencies over 30,000 MHz?
1. VHF
2. UHF
3. SHF
4. EHF

Learning Objective: Determine the types, characteristics, and the operation of representative radio communications equipment used by the Navy. Text pages 5 through 8.

1-5. What is the approximate distance value, in miles, used to designate long range transmission of a radio transmitter operating in the medium or high frequency band?
1. Less than 200 miles
2. 200 to 1500 miles
3. 1000 to 1500 miles
4. More than 1500 miles

1-6. What approximate distance (in miles) designates the medium radio signal transmission range?
1. Less than 200 miles
2. 200 miles to 1500 miles
3. 1500 miles to 3000 miles
4. 3000 miles to 5000 miles

1-7. Your radio transmitter is operating in the high frequency band. The factors that affect the transmitter signal propagation, such as terrain, atmospheric conditions, and transmission frequencies cause a variation in the
1. output current in the transmitting antenna
2. maximum propagation range of the transmitted signal
3. degree of modulation in the transmitted signal
4. speed of signal propagation

1-8. The normal transmission range of VHF equipment is restricted to
1. 1500 miles
2. 400 miles
3. 225 miles
4. line of sight distance

1-9. Simultaneous reception and transmission of radio signals is possible with a Navy transmitter-receiver by the use of
1. separate power supplies
2. different modes of modulation
3. a single antenna
4. separate antennas

1-10. Simultaneous transmission and reception of radio signals is not possible with a transceiver because
1. the receiver and transmitter sections operate on different modes of modulation
2. the receiver and transmitter sections operate on the same frequency
3. some of the same electronic circuits in the equipment are used for both transmit and receive
4. the receiver and transmitter sections operate on different frequencies

1-11. Which teletype system is used by the Navy in afloat installations for long-range operations?
1. Amplitude-modulated system
2. Pulse-modulated system
3. Carrier frequency-shift system
4. Tone-modulation system

1-12. The teletype messages that are sent or received on a radio communication system may be increased in number by the use of a
1. teletype control unit
2. teletype terminal
3. tone-shift converter
4. multiplex terminal

1-13. Multiplex equipment operates to send several messages simultaneously over
1. a single frequency channel
2. several different transmitters
3. one landline circuit
4. a number of frequency channels

1-14. Weather charts and photographs are examples of materials transmitted by
1. landline teletype
2. CW telegraphy
3. FAX (facsimile)
4. RATT (radioteletype)

Learning Objective: Determine the purpose and the basic characteristics of analog and digital computers. Text pages 8 and 9.

1-15. The purpose of analog and digital computers used by the Navy is to provide
1. approximate solutions to mechanical problems
2. approximate solutions to fire control problems
3. rapid transmission of radio signals
4. rapid and accurate analysis of various operations

1-16. The problem solving procedure used in analog computers involves the translation of
1. discrete values into continuous quantities
2. high frequency signals into modulation equivalents
3. physical conditions into electrical quantities
4. electrical quantities into mechanical movement

1-17. To solve problems, the digital computer uses repeated ___(A)___ low, high speed arithmetic processes that are expressed in ___(B)___ distinct, abstract quantities.
1. (A) high, (B) abstract
2. (A) high, (B) distinct
3. (A) low, (B) abstract
4. (A) low, (B) distinct

. . . .
Learning Objective: Give the purpose of electronic navigation equipment used by the Navy, identify the types used by surface and air units, and describe briefly the operating functions and characteristics of each type. Text pages 11 and 12.
. . . .

1-18. The purpose of the electronic navigational equipment used by the Navy is to
1. serve as the principle source of navigation information during the hours of darkness
2. determine own position by electronic means
3. determine atmospheric conditions that could interfere with navigation
4. identify surface obstacles that could interfere with navigation

1-19. A feature of electronic navigation that is not possessed by nonelectronic piloting is the use, as a reference for bearing, of
1. nonvisible objects
2. more than one object simultaneously
3. land-based objects
4. airborne objects

1-20. Basically an RDF consists of a
1. transmitter and a receiver
2. transmitter and a directional antenna
3. receiver and a directional antenna
4. directional antenna

1-21. The radio direction finder is used in the Navy principally for
1. range determination
2. surface navigation
3. air navigation
4. true north determination

1-22. One of the present day uses of RDF is to
1. locate shipwreck survivors equipped with a radio transmitter
2. locate targets for the purpose of directing fire of large caliber guns
3. provide other ships with a fix
4. establish accurate range data

1-23. An accurate navigation fix may be obtained with radio compass equipment by using signals from radio beacons to indicate automatically the
1. relative bearing of the aircraft to the beacon
2. position of magnetic north
3. relative range of the aircraft to the beacon
4. range and bearing of the aircraft to a predetermined geographic location

1-24. What information does a tacan radio beacon transmitter at a ground station or aboard a ship supply to an aircraft?
1. Relative air speed and range of the aircraft from the beacon transmitter
2. Bearing and range of the aircraft from the beacon transmitter
3. Altitude and range of the aircraft from the beacon transmitter
4. Altitude and attitude of the aircraft

1-25. What type of signals are used in the loran system to obtain accurate navigational fixes?
1. FM radio signals
2. Constant frequency radio
3. Pulsed radio signals
4. Modulated audio signals

1-26. Given optimum conditions, what is the approximate maximum distance from the transmitter station that loran fixes may be made?
1. 3,000 miles
2. 1,500 miles
3. 200 miles
4. 100 miles

Learning Objective: Recognize the types, functions, and operating characteristics of radar equipment used by the Navy. Text pages 12 through 15.

1-27. The effective range of radar is approximately the same on a clear day as it is under conditions of
1. rain
2. fog
3. darkness
4. hail

1-28. The function of surface-search radars is to use 360° search to detect surface targets and low-altitude aircraft and to determine accurate target
1. altitude and range
2. size and range
3. range and bearing
4. bearing and speed

1-29. The air-search radar is used to detect aircraft located at
1. long range and high altitude
2. medium range and low altitude
3. short range and high altitude
4. short range and low altitude

1-30. The targets that are acquired by a fire control radar system usually are detected and designated initially by
1. an aircraft fire control radar
2. a search radar
3. a lookout aboard ship
4. an altitude determining radar

1-31. The purpose of an aircraft fire-control radar is to enable the aircraft to attain accurate
1. aim of its fire power
2. target detection at long range (50 miles)
3. wide search beam for target determination
4. elevation resolution for target detection

Learning Objective: Identify classifications of electronic countermeasures. Text page 18.

1-32. Electronic warfare (EW) is divided into what two classifications?
1. Electric and mechanical
2. Offensive and defensive
3. Direct and indirect
4. Passive and active

1-33. The purpose of the receiving equipment used with passive ESM is to
1. jam enemy transmission
2. intercept enemy transmission
3. permanently record all enemy transmission
4. receive signals from friendly units

1-34. The chief function of active ECM is to
1. analyze captured equipment
2. intercept enemy transmission
3. interfere with enemy transmission
4. reduce the effect of enemy jamming

Learning Objective: Determine the purpose and some uses of sonar equipment. Text page 18.

1-35. The purpose of sonar used by the Navy is to detect enemy
1. aircraft
2. shore based targets
3. submarines
4. radar transmissions

1-36. Which of the following functions may be accomplished by the use of sonar equipment?
1. Target detection and tracking
2. Underwater target display
3. Navigation
4. All of the above

Learning Objective: Recognize the danger of electrical shock and some of the procedures recommended for rescue and care of shock victims. Text pages 19 through 22.

1-37. On which factor or factors does the extent of body damage caused by electrical shock depend?
1. Size of the body
2. Value of voltage touched by the body
3. Amount and duration of current flow through the body
4. Whether the current was a.c. or d.c.

1-38. When the hands are sweaty, contact resistance may drop so low that body resistance may be only 300 ohms. How small a voltage would be sufficient to send a current through the body great enough to cause death in one second?
1. 30 v.
2. 60 v.
3. 110 v.
4. 220 v.

1-39. An individual has received an electrical shock and is still in contact with the circuit. Which of the following actions may cause you to become a shock victim also?
1. Securing the voltage at once
2. Quickly grasping the victim by the wrist and pulling him to a safe place
3. Pushing or dragging the victim from the wire with a nonconductor
4. Cutting the wire with a wooden-handle ax

● Information for items 1-40 through 1-44: Assume that a technician is accidentally grounded while making emergency repairs on a power line. He sustains a severe shock and falls unconscious across a "hot" line. His assistant promptly moves the body away from the "hot" line.

1-40. The safest method of moving the body of the technician in the preceding information off the "hot" line is to use a
1. length of lead pipe
2. crowbar
3. length of damp rope
4. long-handled wooden broom

1-41. Which of the following disabilities is the technician in the preceding information most likely to sustain as a direct result of the shock?
1. Chronic anemia due to bone marrow damage
2. Blindness due to electric flash
3. Shortness of breath due to muscle damage
4. Muscle weakening due to nerve damage

1-42. Breathing is not apparent after the technician is moved from danger and you administer mouth-to-mouth artificial resuscitation. Approximately how many breathing repetitions should you make, per minute, until the technician begins to breath normally?
1. 5 to 10
2. 10 to 20
3. 20 to 25
4. 25 to 30

1-43. What is the minimum time you should continue artificial respiration unless the victim begins to breathe normally or is declared dead by a medical officer?
1. Two hours
2. Four hours
3. Eight hours
4. Twelve hours

● You are helping EM3 Carter repair an electric motor. Carter receives a severe electrical shock due to short circuit in the wiring. You immediately disconnect the motor and notice that Carter is unconscious. Your quick examination reveals that Carter's heart has stopped and he has stopped breathing. You tell a bystander to administer mouth-to-mouth resuscitation to Carter while you give him closed chest cardiac massage.

1-44. To prevent irrepairable damage to Carter's brain and other vital organs, you must begin cardiac massage within

1. 4 minutes
2. 5 minutes
3. 6 minutes
4. 7 minutes

Learning Objective: Determine some of the basic safety procedures you should follow when working with electrical equipment. Text pages 22 through 24.

1-45. When it is necessary to work on energized equipment, good safety practices require the worker to

1. wear rubber gloves at all times
2. work with both hands
3. work alone
4. insulate himself from ground

1-46. The first step to take when required to make a voltage measurement that is anticipated to be in excess of 300 volts is to

1. short circuit all components capable of retaining an electrical charge
2. connect the meter leads to the points to be measured
3. ground all components capable of retaining an electrical charge
4. turn off the equipment power

1-47. Which of the following materials is suitable for covering grounded metal to keep a worker from coming in contact with the metal?

1. Dry canvas that has holes in it
2. Dry phenolic material that has a conductor imbeded in it
3. Dry insulating material that contains no holes or conductors
4. Damp plywood

1-48. A safety shorting probe is used to discharge ____(A)____ in
capacitors, inductors
____(B)____ circuits
energized, deenergized
____(C)____ to working on the
subsequent, prior
the circuit.

1. (A) capacitors, (B) energized, (C) subsequent
2. (A) capacitors, (B) deenergized, (C) prior
3. (A) inductors, energized, (C) prior
4. (A) inductors, (B) deenergized, (C) subsequent

1-49. You want to be sure that a capacitor in a deenergized high voltage circuit is discharged fully. To use a shorting probe for this purpose, you first need to

1. apply power to the circuit
2. touch the copper probe to a grounded conductor
3. place the probe across both terminals of the capacitor
4. connect the alligator clip to a grounded structure

1-50. Which of the following fuses must not be removed from a circuit until after the circuit is deenergized?

1. 5-ampere fuse
2. 10-ampere fuse
3. 15-ampere fuse
4. Any of the above

1-51. If a 28-volt, 6-ampere fuse blows, the proper procedure is to replace it with a

1. fuse rated 20 percent lower than the blown fuse
2. copper strap until the cause of the overload has been determined
3. larger fuse until the cause of the overload has been determined
4. fuse of the same voltage and current ratings

1-52. If electrical equipment is to be repaired, what should be done before the actual work is begun?

1. The fuse for the associated circuits should be repaired.
2. The main supply switches should be shorted out.
3. The power switches should be secured open and properly tagged.
4. A man should be stationed nearby with a fire extinguisher.

1-53. Whenever circuit breakers, power switches, or other controls are secured in the open position and tagged, the tag should be removed by

1. the job inspector
2. the repair crew leader
3. the person who placed it
4. any member of the repair crew

Learning Objective: Recognize the three general classes of fires and some of the methods employed when extinguishing electrical fires. Text pages 24 and 25.

1-54. A rubbish container filled with scrap lumber and paper has accidentally caught on fire. What is the class of this fire?

1. Class A
2. Class B
3. Class C
4. Either class A or class C depending on the type of wood involved

1-55. Class B fires are normally associated with ______(A)______ materials
volatile, non-volatile
and class C fires are normally associated with
______(B)______
electrical/electronic, non-electrical material.

1. (A) volatile, (B) electrical/electronic
2. (A) volatile, (B) non-electrical
3. (A) non-volatile, (B) electrical/electronic
4. (A) non-volatile, (B) non-electrical

1-56. Which of the following agents should be your first choice to extinguish a fire of an electrical nature?

1. CO_2
2. Foam
3. Water
4. CO_2 and foam mixture

1-57. If carbon dioxide fails to control an electrical fire, you can apply

1. a stream of water directed at the base of the fire
2. a stream of water directed at the upper part of the flames
3. water fog
4. salt water spray

1-58. In case of an electrical fire, you should

1. make a report to the OOD if afloat
2. call the fire department when ashore
3. deenergize the circuit
4. do all of the above

Learning Objective: Determine some of the types of dangers that are included on warning signs, the format for these signs, and where they are to be displayed. Text pages 25 and 26.

1-59. Warning signs are used to caution personnel of dangerous conditions or circumstances that may cause injury. What are some of the dangers that are included on these signs?

1. Dangerous voltages or radiation hazards
2. Radiation hazards or explosive vapors
3. Explosive vapors or poisonous stack gases
4. All the above dangers

● Items 1-60 and 1-61 are to be judged True or False.

1-60. High voltage warning signs are located only where personnel can make direct contact with a high voltage source of power.

1-61. The NavShips Drawing No. RE 10 AA 529A must be posted at both the top and the bottom of ladders that lead through an area that may contain smoke pipe exhaust.

1-62. On board a small craft where there is the possibility that explosive vapors may accumulate, how long should you run the ventilation blowers before energizing any other electrical equipment?
1. A minimum of 3 minutes
2. A minimum of 5 minutes
3. A minimum of 10 minutes
4. A minimum of 15 minutes

Learning Objective: Indicate some of the safety precautions associated with working aloft. Text pages 26 and 27.

Information for items 1-63 and 1-64: A storm damaged some of the rigging associated with the antenna system of your ship. Your organize a working party to go aloft to repair the damage.

1-63. Before sending the working party aloft, you should obtain permission to do so from the
1. commanding officer, the CIC watch officer, and the officer of the deck (OOD)
2. OOD, the communication watch officer (CWO), and the CIC watch officer
3. CWO and the executive officer (XO)
4. XO and the operations officer

1-64. Even slight electrical discharges are dangerous aloft as they can cause a man working to lose his grip. Before the working party goes aloft what precaution should you take to reduce the possibility of electrical discharge?
1. Having the men ground themselves with lengths of flexible cable
2. Having the men wear rubber gloves
3. Making certain that all receivers are deenergized
4. Making certain that all transmitters are deenergized

Learning Objective: Determine some of the electron tubes that are manufactured with potentially hazardous radioactive materials and the precautions to be taken to ensure proper handling of these tubes while their seals are intact and if accidentally broken. Text pages 28 and 29.

1-65. All of the following electron tubes are listed in your textbook as possibly manufactured with some type of dangerous radioactive material except
1. spark-gap tubes
2. voltage-regulator tubes
3. triode amplifier tubes
4. gas-switching tubes

Items 1-66 through 1-68 are to be judged True or False.

1-66. An intact TR tube containing radioactive material presents a radiation hazard at all times.

1-67. The manual that prescribes radiation safety precautions and procedures is a NavMed publication.

1-68. Proper handling procedures of radioactive electron tubes dictates that these tubes should be removed from their cartons immediately upon receipt and stored in a cushioned tube transport and storage container.

1-69. If you break a tube containing radioactive material, you should immediately

1. isolate the area
2. inform the operations officer
3. wash your hands and arms with soap
4. remove contaminated clothing

1-70. If you cut your finger while picking up the broken pieces of a tube containing radioactive material, you should

1. suck the wound to clean it out
2. stop all bleeding as soon as possible
3. wash the wound with soap and water and stimulate mild bleeding
4. apply directly to the wound a solution containing Cesium-Barium 137

1-71. The maximum allowable emission from a tool that has been used to handle a radioactive substance and has been decontaminated is

1. 10.0 MR/HR
2. 1.0 MR/HR
3. 0.1 MR/HR
4. 0.01 MR/HR

● NOTE: On page 28, left column, the first paragraph after figure 2-15 should be replaced with the following:

4. The linemen's-type safety belt is dangerous if you fall and is not approved for any shipboard application involving climbing or working aloft. Wear a parachute-type safety harness with all the straps fastened snugly. When you reach the working area, working and safety lines can be attached to the waist, shoulder, or back D-rings. This safety harness could save your life. USE IT.

Assignment 2

Safety; Basic Test Equipment

Textbook Assignment: Pages 29 through 48

Learning Objective: Ascertain why cathode-ray tubes (CRTs) must be handled with caution and some of the proper handling and siposal techniques applicable to CRTs and replacing electron tubes. Text page 29.

● The terms explosion and implosion as applied to electronic parts differ in that an explosion is a violent burst normally caused by pressure from within the part while an implosion is an inward collapse of any evacuated container.

2-1. A danger that you may be subjected to if a CRT is broken during replacement is
1. shock from the electrodes
2. shock from an electrical charge stored in the tube
3. RF radiation from a charge stored in the tube
4. poisoning from the coating on the CRT face

2-2. Where is the glass seal located on the typical CRT?
1. On the face of the tube
2. Near the high voltage connection on the side of the tube
3. Underneath the high voltage connection on the side of the tube
4. Underneath the locating pin on the tube's base

● Items 2-3 through 2-5 are to be judged True or False.

2-3. The proper and safest way to carry a CRT that has been removed from its carton is by the tube's neck.

2-4. The possibility of breaking electron tubes is minimized if you observe the safety precaution that dictates that the only approved tube puller is the human fingers.

2-5. When you are replacing a high voltage tube you should always ensure that the anode cap has been properly charged.

. . . .

Learning Objective: Determine some of the more common safety precautions associated with grounding of power tools and equipment, cleaning solvents, and aerosol dispensers. Text pages 30 and 31.

. . . .

2-6. The purpose of the grounding cable attached to the frame of a generator aboard ship is to
1. create a potential difference between the frame and the ship
2. conduct power to the generator under emergency conditions
3. maintain the same potential in the frame and in the ship
4. break the circuit between the frame and the power supply under emergency conditions

Item 2-7 is to be judged True or False.

2-7. Ground straps on electronic equipment reduce shock hazards and improve operations of the equipment.

2-8. Which of the following resistance values for the ground connections between the metal case of a portable electric drill and the steel structure of a ship should protect the drill operator from electric shock?
1. 0.9 ohms or less
2. 1.0 ohm to 5 ohms
3. 5 ohms or more
4. All of the above

2-9. Which step should you take to help ensure that metal-case test instruments are safe to use?
1. Energize the instruments
2. Ground the metal cases
3. Insulate the metal cases from ground
4. Connect all metal cases to a common lead

2-10. Under which circumstances, if any, should gasoline be used for cleaning aluminum?
1. When liberal ventilation is provided
2. When use of a chlorinated solvent would damage aluminum
3. When inhibited methyl chloroform is unavailable
4. Under no circumstances

2-11. Which step can maintenance personnel take safely when cleaning equipment with solvents?
1. Work alone
2. Inhale their vapors directly
3. Apply them in the presence of an open flame
4. Wear rubber gloves

2-12. Where can you find the best source of safety precautions for handling and use of industrial type aerosol dispensers?
1. In chapter 9670 of the NAVSHIPS Technical Manual NS 0901-000-0001
2. In the Radiation, Health, and Protection Manual, NAVMED P-5055
3. In chapter 9600 of the NAVSHIPS Technical Manual NS 0901-000-0001
4. In the material supplied or printed on the dispenser by the aerosol manufacturer

Learning Objective: Determine the components, operation, and basic characteristics of galvanometers and D'Arsonval meters. Text pages 32 through 35.

2-13. What are the two basic components of a galvanometer?
1. A movable permanent magnet and a movable coil
2. A stationary permanent magnet and a stationary coil
3. A stationary coil and a movable coil
4. A stationary permanent magnet and a movable coil

2-14. The coil in the galvanometer is caused to rotate and permit measurement of current by the reaction between the
1. current flow in opposite directions through two coils
2. tension of the hair spring and the magnetic force produced by the permanent magnetism
3. magnetism produced by current flow in the movable coil and the tension of the hair spring
4. magnetic field of the permanent magnet and magnetism produced by current in the movable coil

2-15. What are two purposes of the phosphor bronze ribbons in the galvanometer?
1. To provide an opposing force to the rotation of the coil and provide a conducting path for the current to flow through the coil
2. To provide a conducting path for the magnetic force of the permanent magnet and support the movable coil
3. To reduce the current through the coil and provide mechanical support for the meter pointer
4. To support the permanent magnet and provide electrical connections to the coil

2-16. In a galvanometer that contains a light and mirror arrangement to indicate the value of the current being measured, the mirror is mounted on the
1. fixed iron core
2. phosphor bronze ribbon
3. permanent magnet
4. movable coil

2-17. Which component in the D'Arsonval meter serves the same purpose as the phosphor bronze ribbon in the galvanometer?
1. Movable coil
2. Hairspring
3. Permanent magnet
4. Fixed iron core

2-18. What characterisitc of the current applied to the coil determines the direction that the D'Arsonval meter pointer will deflect?
1. Phase
2. Frequency
3. Polarity
4. Amplitude

2-19. Damping of the D'Arsonval meter movement is obtained by inducing into the bobbin
1. a low frequency current
2. a high frequency current
3. an EMF to aid the movement of the coil
4. a counter EMF (electromotive force) to oppose the movement of the coil

2-20. The weight of the rotating coil assembly and the type of bearings used in the D'Arsonval meter are factors that affect the
1. accuracy and linearity of the meter scales
2. amount of restraining force required from the hairspring
3. maximum current that can be measured by the meter
4. ability of the meter to measure small currents (sensitivity)

2-21. The linearity of the scale divisions on the meter face is improved by the use of
1. a permanent magnet with curved pole faces
2. jeweled bearings in the meter movement
3. an additional coil in the meter
4. a long and lightweight meter pointer

Learning Objective: Determine the use of meter shunts to extend the measuring range of d.c. ammeters, the proper shunt and ammeter characteristics, ranges, and connections used to measure direct current, and the effects of ammeter sensitivity on d.c. measurements. Text pages 35 through 39.

2-22. The purpose of a shunt in a meter is to increase the
1. sensitivity of the meter
2. linearity of the meter movement
3. current measuring range of the meter
4. meter damping factor

2-23. A D'Arsonval meter that has a full-scale current reading of 1 milliampere can be made to have a full-scale reading of 100 milliamperes by the use of a
1. low value resistance in series with the meter terminals
2. high value resistance in series with the meter terminals
3. movable coil composed of larger size wire
4. resistance in parallel with the meter terminals

2-24. Assume that the full-scale range of a basic D'Arsonval meter movement is 1 milliampere. You add a shunt to permit you to use the meter to measure 10 milliamperes full-scale. At the full-scale reading, how much current flows through (A) the meter movement and (B) the shunt resistance?
1. (A) 1 ma, (B) 9 ma
2. (A) 10 ma, (B) 1 ma
3. (A) 9 ma, (B) 1 ma
4. (A) 1 ma, (B) 10 ma

2-25. Ordinary carbon resistance material is unsuitable for use as the shunt in a meter designed to measure heavy current because
1. the physical size of the shunt would be too large
2. the resultant magnetism will interfere with meter accuracy
3. heat due to current flow causes the resistance of the material to vary
4. the physical size of the shunt would be too small

2-26. One reason for choosing a meter shunt that provides a current meter indication near half-scale deflection is that the meter reading is most accurate in this part of the scale. What is another reason?
1. Meter switching is easier for mid-scale deflection
2. Meter shielding against magnetic interference is greatest near mid-scale
3. Minimum loading effect will be experienced in the circuit under test
4. The meter is protected from unexpected current surges

2-27. Generally, for what current measurement ranges do you use a meter that contains (A) an internal shunt and (B) an external shunt?
1. (A) 1 ampere and above, (B) 1 ampere and below
2. (A) 1 ampere and below, (B) 1 ampere and above
3. (A) 50 amperes and below, (B) 50 amperes and above
4. (A) Above 50 amperes, (B) below 50 amperes

● In items 2-28 through 2-31, you have a 1 milliampere (.001 ampere) D'Arsonval meter that has an internal resistance of 10 ohms. You want to calculate the shunt resistor needed to measure line currents up to 5 amperes.

2-28. What is the voltage drop across the basic meter coil?
1. .01 volt
2. .005 volt
3. .0001 volt
4. .0005 volt

2-29. What will be the voltage drop across the shunt resistance?
1. .01 volt
2 .005 volt
3. .0001 volt
4. .0005 volt

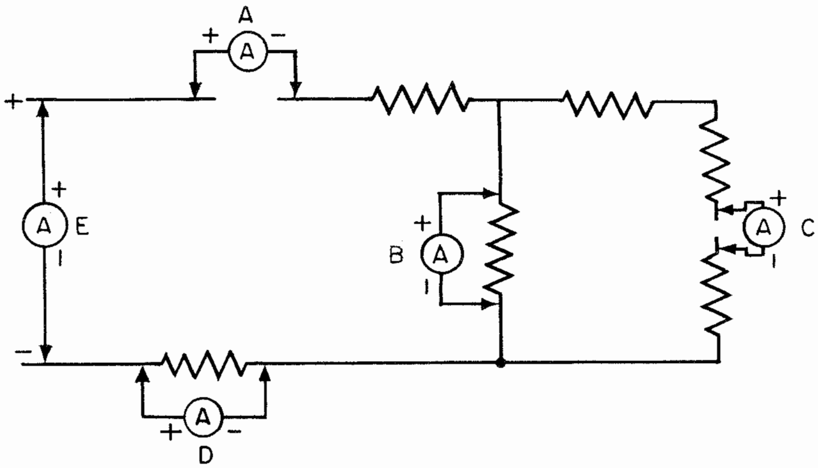
2-30. When the voltage drop across the meter coil is .01 volt, what is the approximate value of the shunt resistance?
1. .10 ohm
2 .05 ohm
3. .002 ohm
4. .005 ohm

2-31. How much current will flow through the shunt at full-scale meter deflection?
1. .05 ampere
2. 4.99 amperes
3. 4.999 amperes
4. 5 amperes

2-32. A simple range switching arrangement for a current meter is composed of individual resistors for the various ranges, with each resistor connected in series to the terminals of a rotary switch. This switching method is less satisfactory than other methods because in the simpler method a change in the switch position may cause
1. meter damage or inaccurate readings
2. resistor damage or present a safety hazard
3. meter damage or present a safety hazard
4. resistor damage or inaccurate readings

2-33. In which meter measurement range does the computation accuracy of the shunt resistance have the most effect on the accuracy of the measured value?
1. 0 - 5 ma
2. 1 - 10 amperes
3. 50 - 100 amperes
4. 100 - 200 amperes

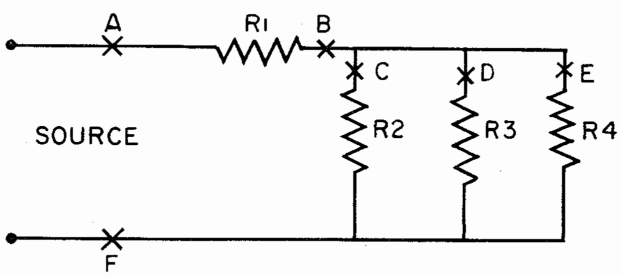
2-34. What will be the probable result of connecting an ammeter (or milliammeter) in parallel with a source of voltage or a circuit component?
1. A lower than normal meter reading
2. A higher than normal meter reading
3. A burned-out meter
4. A damaged circuit component



D-1-39

Figure 2A. -Ammeter connections.

2-35. Which ammeters in figure 2A are connected properly into the circuit and connected so as to observe the correct meter polarity?
1. A and E
2. A, B, and D
3. A and C
4. E only



D-1-40

Figure 2B. -Series-parallel circuit.

2-36. At which points in the circuit in figure 2B do you connect a current meter to measure the total circuit current?
1. A only
2. B or C
3. C, D, or E
4. A, B, or F

2-37. You can measure the current flow through resistor R2 only in figure 2B by opening the circuit and connecting the meter at point
1. A
2. B
3. C
4. F

2-38. What factor determines the sensitivity of a meter?
1. The current required to obtain full-scale deflection of the basic meter movement
2. The ohmic value of the shunt resistor used with the meter
3. The full-scale values printed on the meter face
4. The voltage applied to the meter terminals to achieve half-scale deflection of the meter pointer

2-39. In which electronic circuits does low meter sensitivity have the greatest loading effect?
1. High voltage circuits
2. Low current circuits
3. High resistance circuits
4. High gain circuits

2-40. Meter loading will occur when a low sensitivity, high resistance ammeter is connected into a low resistance circuit. The effect of the loading is to cause

1. a change in the electrical conditions in the circuit
2. the circuit current to drop to zero
3. a change in the voltage applied to the circuit input
4. the circuit current to increase

Learning Objective: Recognize the circuits required to permit the measurement of d. c. voltage using a D'Arsonval meter, the circuits used to extend voltage measuring ranges, the proper meter connections to use, the effects of voltmeter connections on circuit operation, meter sensitivity, and meter accuracy. Text pages 40 through 42.

2-41. A basic D'Arsonval meter is used to measure voltage by connecting a

1. coil in parallel with the meter coil
2. high value resistor in parallel with the meter coil
3. resistor in series with the meter coil
4. low resistance in series and a high resistance in parallel with the meter coil

2-42. What is the purpose of the series multiplier resistor in a basic voltmeter?

1. To permit a higher than normal current to flow through the meter coil
2. To increase the current sensitivity of the meter
3. To provide damping of the meter movement
4. To act as the voltage dropping resistor in the meter circuit

2-43. Which two quantities are needed to compute the total value of the series resistance used to extend the range of a voltmeter?

1. The full-scale meter current and the full-scale voltage to be measured
2. The resistance of the meter movement and the full-scale voltage drop across the meter
3. The full-scale meter current and the resistance of the meter movement
4. The full-scale voltage drop across the meter and the resistance value of the shunt resistor

2-44. You want to measure the plate voltage of a vacuum tube amplifier stage. You do not know the voltage value to expect at the plate terminal. Your voltmeter has four voltage ranges: 3V, 30V, 300V, and 600V. To which range do you set the voltmeter initially?

1. 3V
2. 30V
3. 300V
4. 600V

2-45. In which circuit does the shunting action of the voltmeter (loading) have the greatest effect on circuit operation?

1. High resistance circuits
2. Low resistance circuits
3. Low voltage circuits
4. High current circuits

2-46. The voltage across a circuit resistor is exactly 200 volts. You measure the voltage with a voltmeter that has an accuracy of $\pm$ 5%. Which voltmeter reading is within the accuracy range of of the voltmeter?

1. 180 volts
2. 192 volts
3. 214 volts
4. 225 volts

Learning Objective: Recognize the operation, characteristics, and measurement capabilities of meter circuits used to measure resistance. Text pages 42 through 45.

2-47. Which adjustment must you make initially before you can make an accurate resistance measurement with an ohmmeter?

1. The current flow through the meter circuit to obtain full-scale meter deflection
2. The voltage value applied to the meter circuit to obtain full-scale meter deflection
3. The polarity of the voltage applied to the meter leads
4. The meter pointer to mid-scale deflection

2-48. When the ohmmeter leads are connected across a resistor, the resistor becomes a part of the series circuit in the meter. The meter pointer moves to the left of its full scale position because the additional resistor causes the

1. battery voltage to increase
2. current in the meter circuit to increase
3. total meter resistance to decrease
4. current through the meter coil to decrease

2-49. With an unknown resistance connected to the ohmmeter leads and the multiplication switch set to R X 100, the meter pointer deflects to 850. What is the value of the unknown resistance?

1. 8,500 ohms
2. 85,000 ohms
3. 850,000 ohms
4. 8.5 megohms

2-50. Which of the following settings, if any, will allow the most current to flow in the moving coil of an ohmmeter?

1. Measuring 50 kilohms on the R X 1 scale
2. Measuring 500 kilohms on the R X 10 scale
3. Measuring 5 megohms on the R X 100 scale
4. None of the above, they all allow the same current to flow

2-51. Which deflection of the meter pointer will permit you to more accurately read the resistance value shown on the meter scale?

1. To the far left side of the scale
2. To the far right side of the scale
3. Near the center of the scale
4. In either the far right or far left sides of the scale

2-52. An ordinary ohmmeter is unsuitable for measuring insulation resistance because

1. voltage is present in the conductor attached to the insulating material
2. the insulation resistance value is too great
3. the ohmmeter current will damage the insulation
4. the accuracy of the ohmmeter is too low to measure insulation resistance

2-53. Which component in the megger circuit in figure 3-15 of the textbook prevents leakage current from affecting the ohmmeter reading?

1. The guard ring
2. The generator
3. Coil A
4. Resistor R3

2-54. When an unknown resistance is connected to the leads of a megger, what circuit operation causes the meter pointer to come to rest at the correct position?

1. The current flow in coil B
2. The interaction between the retaining springs of the meter and the current in coil A
3 The current flow in coil A
4. The interaction of the currents in coils A and B

Learning Objective: Determine the operation of the electrodynamometer type meter, the difference in the galvanometer and electrodynamometer circuits, and the circuit characteristics of the wattmeter in which the electrodynamometer is used. Text pages 45 through 48.

2-55. The construction of the electrodynamometer differs from the D'Arsonval meter movement in that the former uses
1. two sets of coils only
2. two sets of permanent magnets
3. one movable and one fixed coil
4. one movable and one fixed permanent magnet

2-56. The fixed coils in the electrodynamometer are wound with large size wire to enable the instrument to measure large
1. a.c. voltages
2. d.c. voltages
3. d.c. currents
4. high-frequency voltages

2-57. An advantage that the electrodynamometer has over the standard galvanometer in measuring a.c. is that the electrodynamometer requires
1. no rectifying device to convert the current to d.c.
2. less current to obtain a full-scale deflection
3. a less complicated rectifying device
4. fewer multiplier resistors to cover the measurement range

2-58. With the wattmeter connected into a circuit, the meter deflection is proportional to the
1. instantaneous values of the current through the stationary coils and the voltage across the movable coils
2. current flow in the load and the resistance of the load circuit
3. voltage value of the source and the resistance of the load
4. direct current in the movable coil and the alternating current in the stationary coil

2-59. The reading on a wattmeter is dependent upon which of the following?
1. The power factor of the circuit
2. The current in the circuit
3. The voltage in the circuit
4. All of the above

Learning Objective: Determine the operating characteristics of a representative audio frequency generator. Text page 48.

2-60. You set up the audio frequency generator to apply an input signal of 8,000 Hz having an amplitude of 0.3 volt to a piece of electronic equipment. To what positions do you set (A) the main tuning dial, (B) the range switch, and (C) the output attenuator?
1. (A) 80, (B) X1, (C) X.10
2. (A) 80, (B) X10, (C) X.1
3. (A) 80, (B) X100, (C) X.1
4. (A) 80, (B) X100, (C) X.01

2-61. You want the amplitude of the signal from the audio signal generator to be 0.05 volt. What adjustments do you make to the controls on the front panel of the generator?

1. Set the output attenuator switch to X.1, and adjust the output level control to get a reading of 0.5 on the output level meter
2. Set the range switch to X1, and adjust the output level control to get a reading of 0.5 on the output level meter
3. Set the main tuning dial to 50 and the output attenuator switch to X.1
4. Set the output attenuator switch to X1, and adjust the output level control to get a reading of 0.5 on the output level meter

2-62. What device is used to check the calibration of the representative signal generator shown in figure 3-20 of the textbook?

1. An electronic voltmeter
2. A grid-dip meter
3. An electrodynamometer
4. A frequency meter

Assignment 3

Basic Test Equipment; Characteristics of Matter and Energy

Textbook Assignment: Pages 51 through 73

Learning Objective: Recognize the operating principles, the functional controls, and the measurement capabilities of cathode-ray oscilloscopes, and recognize the transistor characteristics that may be measured by a basic transistor tester. Text pages 51 through 61.

3-1. Which signal amplitude value may be measured by an oscilloscope?
1. RMS
2. Average
3. Peak-to-peak
4. Peak

3-2. The time factor in the voltage waveform presented on an oscilloscope screen is obtained by using a
1. sawtooth voltage
2. high frequency voltage
3. slowly varying voltage
4. sine wave voltage

3-3. Which voltage normally is applied to the vertical plates of an oscilloscope?
1. The sawtooth voltage
2. The reference voltage
3. The acceleration voltage
4. The signal voltage being observed

3-4. Which voltage normally is applied to the horizontal plates of an oscilloscope?
1. The signal voltage being observed
2. The sawtooth voltage
3. The sine wave reference voltage
4. The acceleration voltage

3-5. You want two cycles of a 1000 Hz signal to appear on the CRT. To what frequency should you adjust the sweep generator on the oscilloscope?
1. 200 Hz
2. 500 Hz
3. 1000 Hz
4. 2000 Hz

3-6. What characteristic of a waveform may be determined by measuring the distance along the horizontal axis of the screen?
1. Frequency
2. Amplitude
3. Phase
4. Polarity

3-7. What does a large number of controls on the panel of an oscilloscope indicate regarding the capability of the instrument?
1. Narrow specialization
2. General purpose
3. High versatility
4. Specific purpose

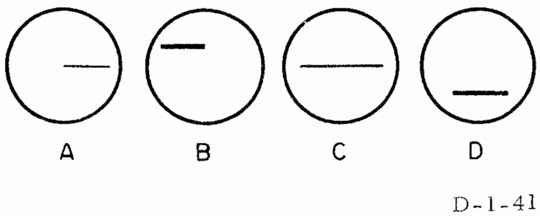


Figure 3A. -CRT traces.

3-8. Which trace on the CRT in figure 3A should you correct by adjusting the HORIZONTAL POSITION control?
1. A
2. B
3. C
4. D

3-9. In figure 3A, the FOCUS and the VERTICAL POSITION controls should be adjusted to correct the trace shown in
1. A
2. B
3. C
4. D

3-10. Which trace in figure 3A should be corrected by adjusting the FOCUS, HORIZONTAL POSITION, and VERTICAL POSITION controls?
1. A
2. B
3. C
4. D

3-11. What is the purpose of the deflection amplifiers in a CRO?
1. To isolate the input signal from the deflection plates
2. To increase the amplitude of the signal applied to the deflection plates
3. To eliminate distortion of the CRT beam
4. To properly position the beam on the CRT

3-12. Which control on the front panel of a CRO limits the input signal amplitude and allows the CRO to be used with a wide range of signals?
1. TIME BASE
2. TRIGGERING
3. TIME/CM
4. ATTENUATOR

3-13. The time base in a CRO is made variable to permit the instrument to
1. measure low and high amplitude input signal voltages
2. operate over wide ranges of input frequencies
3. make accurate measurements of signal amplitudes
4. accurately position the presentation on the CRT screen

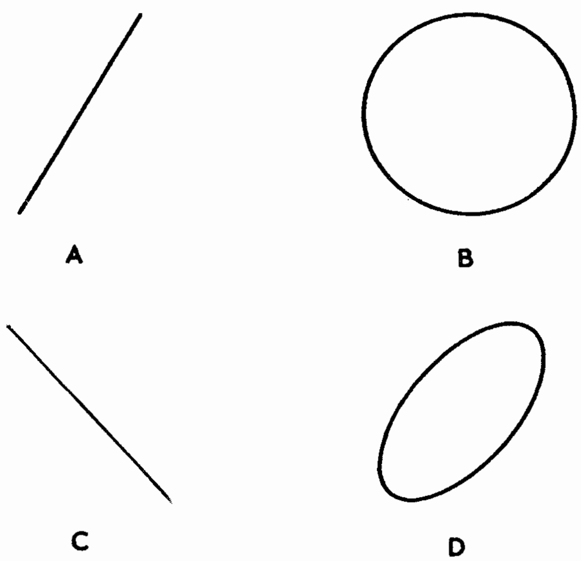
3-14. To obtain several complete cycles of the input signal on the CRT, what should be the relationship of the input frequency as compared to the sweep frequency?
1. Higher
2. Lower
3. Equal
4. Ten times lower

3-15. What advantages does the operation of the triggered oscilloscope have over the basic oscilloscope?
1. Higher input voltage handling ability and lower distortion
2. Lower distortion and more accurate time measurements
3. Higher input voltage handling ability and greater stability
4. More accurate time measurements and greater stability

3-16. In which position of the time base controls does the input signal frequency to the oscilloscope serve as the trigger signal frequency?
1. LINE
2. INT
3. EXT
4. AUTO

3-17. What incorrect operation of a CRO will cause damage to the CRT?
1. Applying a high amplitude voltage to the deflection plates
2. Removing the trigger signal from the CRO circuits
3. Allowing a high intensity beam to remain as a spot on the screen for a period of time
4. Applying a low amplitude signal to the triggering circuit

3-18. What characteristics of a signal may be compared by using lissajous figures on a CRO?
1. Phase and amplitude
2. Amplitude and wave shape
3. Frequency and amplitude
4. Frequency and phase



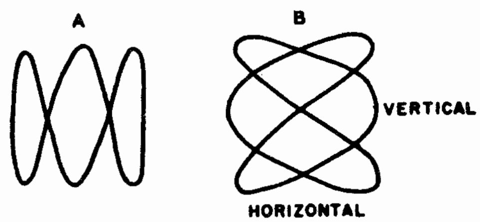
D-1-42

Figure 3B. - Lissajous patterns for various phase angles at a frequency ratio of 1 : 1.

3-19. What pattern in figure 3B shows that the horizontal and vertical signals are 90° out of phase?
1. A
2. B
3. C
4. D

3-20. If pattern A in figure 3B indicates an inphase condition of the horizontal and vertical signals, which pattern, if any, indicates that the vertical signal is leading by 180°?
1. B
2. C
3. D
4. None of the above

● Study Hint: In the Lissajous pattern in figure 3-44 of the textbook, the vertical portion of the ratio (horizontal to vertical) is measured along the horizontal line, and the horizontal portion of the ratio is measured along the vertical line on the CRO.



D-1-43

Figure 3C. - Lissajous patterns.

3-21. What is the ratio of the horizontal to vertical frequencies indicated by the lissajous pattern in part A of figure 3C?
1. 1 : 2
2. 1 : 3
3. 1 : 4
4. 2 : 3

3-22. The output frequency of a piece of equipment is supposed to be 8000 Hz. You check it with an oscilloscope and obtain the pattern shown in part B of figure 3C when a frequency of 15,000 Hz is applied to the horizontal input of the scope. This lissajous pattern indicates that the output frequency of the equipment is

1. exactly the specified frequency
2. higher than the specified frequency
3. less than the specified frequency
4. exactly 15,000 Hz

3-23. What control is used to prevent the trace from shifting vertically when the VARIABLE VOLTS/CM control is varied over its entire range?

1. The STABILITY control
2. The DC BAL control
3. The VOLTAGE CALIB control
4. The LEVEL control

3-24. The 5X MAG on the CRO causes the visual presentation on the screen to "magnify" a section of the trace by increasing the

1. level of the input signal
2. signal frequency applied to the vertical amplifier
3. sweep speed
4. attenuation of the input signal

3-25. Which of the following transistor characteristics may be measured by a basic transistor tester?

1. Current gain
2. Collector current
3. Resistances between element leads
4. All of the above

Learning Objective: Solve problems that involve exponent notation of whole numbers and fractions. Textbook pages 62 and 63.

3-26. What is the number 27,000 in exponent notation?

1. 2.7×10^{2}
2. 2.7×10^{4}
3. 2.7×10^{8}
4. 2.7×10^{10}

3-27. What is the number 0.00000543 in exponent notation?

1. 5.43×10^{-6}
2. 5.43×10^{-3}
3. 5.43×10^{-1}
4. 5.43×10^{5}

3-28. What is $6 \times 10^{12} \times 4 \times 10^{-5}$?

1. 24.0
2. 2.4×10^{8}
3. 2.4×10^{12}
4. 2.4×10^{18}

3-29. What is $\dfrac{4.2 \times 10^{-4}}{7.0 \times 10^{5}}$

1. 6.0×10^{-10}
2. 6.0×10^{-7}
3. 6.0×10^{-3}
4. 6.0

3-30. What is 1,800 x 0.000015 x 300 x 0.0048?

1. 3.888
2. 3.888×10^{-1}
3. 3.888×10^{-2}
4. 3.888×10^{-3}

3-31. What is $\dfrac{98,100}{0.0025 \times 180 \times 1,090,000}$?

1. 2×10^{-5}
2. 2×10^{-3}
3. 2×10^{-1}
4. 2

3-32. What is the value of T if $W = AT^4$?

1. 2.5
2. AW/4
3. $(W/A)^{1/4}$
4. $\sqrt{AW}$

3-33. Which of the following expressions is equal to $x^{1/2}$?
1. $x^{1/2} \cdot x$
2. $x^{-1/2} \cdot x^{-1}$
3. $x^{-1/2} \cdot x$
4. $x^{1/2} \cdot x^{-1}$

Learning Objective: Determine some of the characteristics of matter and energy and the basic particles of matter which are of primary concern in the study of electricity and electronics. Text pages 64 through 71, and 528

3-34. Matter and energy are closely associated, but only energy
1. has mass
2. is the ability to do work
3. occupies space
4. exists of solids

The meanings of the various terms in the mass-energy equation developed by Albert Einstein for interconversion of mass and energy, written as $E = MC^2$, are as follows:

E is the energy in ergs. An erg is the absolute centimeter-gram-second (cgs) unit of energy and work. It is the work done when a force of 1 dyne (the unit of force in the cgs system equal to the force that would give a free mass of one gram an acceleration of one centimeter per second per second) is applied through a distance of 1 centimeter. One foot pound is equal to 13,560,000 ergs.

M is the mass in grams.

C is the velocity of light in centimeters per second. The velocity of light computed from the generally accepted speed of light at 186,283 miles per second, or 161,800 nautical miles per second, is equal to 29,496,539,635.20 centimeters per second.

The formula, $E = MC^2$, from Einstein's theory of relativity is sometimes misunderstood. It arises from certain very general laws relating to matter and light, and states that any object, while standing still, has a "rest energy" of MC^2, and the creation of such an object requires this amount of energy. Any object, or system of many objects that increases in mass, must absorb energy, and if it decreases in mass, it will give off energy. Conversely, any object or system that gives off energy must lose mass. This does not merely apply to nuclear reactions; if a chemical reaction gives off heat, the mass of the final products is less than the mass of the substances that went into the reaction.

The important distinction, energy-wise, between nuclear and chemical reactions is that chemical reactions, which involve only the electrons in the atom, give off energies of a few electron-volts per atom, which corresponds to a reduction in mass of about one part in a billion, too small to be detected by ordinary laboratory means. (The destruction of one atomic mass unit gives 930 million electron-volts of energy.) Nuclear reactions involve energies of millions of electron-volts per atom, and thus result in mass changes of a few parts in a thousand, which are easily measured by sensitive instruments.

The best way to look at $E = MC^2$ is that it is sort of a "bookkeeping" rule for keeping track of mass and energy.

Any system of particles in a "bound" state, i.e., a state of negative energy such as an electron in an orbit around a nucleus or the earth in its orbit around the sun, weighs less combined than the total weight of the individual constituents before combining. This is self-evident when you remember that the particles, as discussed above, had to give off energy to get into the combined negative energy state, and thus had to lose mass. In this way, the binding energy of a nucleus can be measured by measuring how much its mass is less than the combined mass of the neutrons and protons that go into it.

3-35. What factor is represented by the "C" term in Einstein's equation, $E = MC^2$?
1. A time constant
2. A time variable
3. A quantity of ergs
4. A quantity of grams

● If two charges have opposite signs their potential energy is negative. This means that if they are brought close together from an initially large separation, they will give up energy. For example: If the electron in a hydrogen atom, shown on figures 4-2 and 4-3 in your textbook, moves from a large orbit to a small one, a photon is given off.

However, kinetic energy is always positive, since it is proportional to the velocity squared. For any particle bound in an orbit, its potential energy is negative and larger than its kinetic energy, so that the net energy (kinetic plus potential) is also negative.

3-36. The amount of rest energy or potential energy that is possessed by a particle is dependent upon the particle's
1. temperature
2. velocity
3. volume
4. mass

3-37. **An increase to which of the following properties of a particle in motion will produce an increase in the particle's kinetic energy?**
1. Temperature
2. Velocity
3. Mass
4. Any of the above

● Items 3-38 through 3-40 are to be judged True or False.

3-38. The effective mass of an electron increases with a gain in speed.

3-39. An increase in a particle's mass and velocity produces a resultant decrease in the particle's energy.

3-40. A positively charged ION will always attract another positively charged ION.

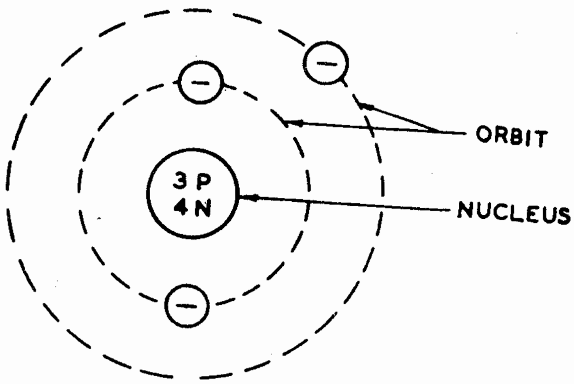
3-41. What is the smallest quantity of a chemical compound that retains the basic properties of the compound?
1. A gram
2. A mole
3. An atom
4. A molecule

3-42. What is the distinction between an atom and a molecule?
1. Atoms actually exist while molecules are theoretical objects invented for the purpose of explaining the properties of gases.
2. Solids and liquids are composed of atoms, while gases are composed of molecules.
3. Atoms are the smallest consituent parts of chemical elements while molecules are the smallest constituents of any substance and contain one or more atoms.
4. Atoms are made up of electrons, while molecules are made up of protons.

3-43. Which of the following significant facts in the Rutherford experiment made it apparent that the positive charge in the atom was concentrated in a small region?
1. Alpha particles were unable to penetrate the gold foil.
2. Alpha particles were deflected through larger angles than could be explained by J. J. Thompson's model of the atom.
3. Alpha particles were shown to be helium nuclei.
4. Electrons were finally proved to be light and mobile.

3-44. An approximate equality exists between the masses of an atom's
______(A)______
protons and electrons, neutrons and protons
which is about 1845 times greater than the mass of the atom's
______(B)______
neutrons, electrons
1. (A) protons and electron, (B) neutrons
2. (A) neutrons and protons, (B) electrons
3. (A) neutrons and protons, (B) neutrons
4. (A) protons and electrons, (B) electrons

3-45. The net electrical charge of a normal atom is always ______(A)______
positive, negative, zero
because the number of orbital electrons will always be
______(B)______ the
greater than, equal to, less than
number of ______(C)______ in the
protons, neutrons
atom's nucleus.
1. (A) positive, (B) greater than, (C) protons
2. (A) negative, (B) greater than, (C) neutrons
3. (A) zero, (B) equal to, (C) protons
4. (A) positive, (B) less than, (C) neutrons



D-1-44

Figure 3D. - The structure of an atom.

3-46. What prevents the electrons shown in figure 3D from being drawn toward the nucleus?
1. Electrical repulsion
2. Centrifugal force
3. Atomic weight
4. Centripetal force

3-47. According to the photon theory described in your textbook (known as the Bohr theory), under what circumstances does an electron emit light?
1. Only when an electron jumps to an orbit closer to the nucleus than when it was in its excited state
2. Only when an electron jumps to an orbit farther from the nucleus than its original orbit
3. Only when an electron jumps to a new orbit in either direction
4. At all times

● Quantum mechanics mentioned in your textbook is the study of atomic structure and related problems in terms of quantities that can actually be measured. A quantum (plural quanta) is the smallest quantity of energy that can be associated with a given phenomenon. The quantum of electromagnetic radiation is the photon.

3-48. Which of the following statements properly describes a quantum jump?
1. An electron spirals into the nucleus and jumps out again.
2. A quantum of light jumps from one orbit to another in an atom.
3. An electron quickly jumps from one orbit to another, giving off or absorbing a quantum of light in the process.
4. An atom slowly gives off radiation until it has given up exactly one quantum, at which time the electron quickly jumps to a new orbit.

3-49. What is the approximate atomic weight of the element shown in figure 3D?
1. One
2. Two
3. Five
4. Seven

3-50. What is the name and symbol of the element shown in figure 3D?
1. Hydrogen (H)
2. Helium (He)
3. Lithium (Li)
4. Beryllium (Be)

3-51. The number above each element in the periodic table is the
1. valence of the element
2. weight of the atom to the nearest atomic mass unit (a.m.u.)
3. atomic number of the element
4. number of neutrons in the nucleus of the atom

● As discussed in your textbook, valence is the term applied to the ability of an atom to gain or lose an electron, which determines its chemical and electrical properties. Chemical valence is the tendency of the atoms to combine with certain numbers of atoms of other elements when forming molecules. For example, when hydrogen and oxygen combine to form water, the water molecules always contain two hydrogen atoms and one oxygen atom. Hence water is designated by the chemical symbol H_2O.

Modern atomic theory explains chemical valence in the following manner. Not all of the electrons in orbits about the atomic nucleus are held equally tightly. The outermost electrons are easiest to remove from the atom, and chemical reactions involve exchanges of the outer, or valence, electrons between atoms.

Elements with the same number of valence electrons are arranged in vertical columns in the periodic table. They have similar chemical properties, which was initially noticed by the Russian chemist Mendeleev when he constructed the first periodic table.

The valence number of elements that tend to give up electrons is positive and equal to the number of electrons they readily give up, while elements that take electrons have a negative valence. Thus sodium has a valence of +1, neon valence is 0, fluorine valence is -1, and oxygen valence is -2. Chemically similar elements usually have the same valence and are arranged in vertical columns in the periodic table.

1	2	3	4
5	6	7	8

D-1-45

Figure 3E.-Section of periodic table.

● Assume that figure 3E represents a section of the periodic table (shown in appendix 1) with numbers substituted for the names of the elements.

3-52. Which of the following pairs of elements from figure 3E are most likely to have similar chemical properties?
1. 1 and 4
2. 3 and 7
3. 4 and 5
4. 6 and 8

3-53. Which of the elements in figure 3E would normally have the highest atomic weight?
1. 1
2. 4
3. 5
4. 8

3-54. If the valence of element 1 in figure 3E is +1, the valence of element 5 is probably
1. +5
2. +1
3. -1
4. -5

3-55. Assume that element 2 in figure 3E tends to give up two electrons when combining with other elements. What is its valence?
1. +2
2. +1
3. 0
4. -2

3-56. Assume that an atom has 15 orbital electrons. How many protons will it normally have?
1. 40
2. 30
3. 15
4. 7

3-57. The chemical and electrical characteristics of an atom depend upon the numbers of electrons in its
1. nucleus
2. ionic core
3. inner shells
4. outer shell

3-58. Assume that the atom of an element has 4 shells. The number of electrons in each shell, beginning with the shell closest to the nucleus, is 2 electrons, 8 electrons, 18 electrons, and 2 electrons, respectively. What is the valence of the element?
1. +2
2. -2
3. -4
4. +4

3-59. How many electrons are there in the component n = 2 shell according to the Pauli principle and the rules regulating possible values of quantum numbers?
1. One
2. Two
3. Eighteen
4. Eight

● According to the electronic conception of valence, a valence null is a condition in which an element has no valence because, in its normal state, it has a complete outer electronic shell, as in the case of the inert gases of the atmosphere and the element Radon.

3-60. Which of the following elements is considered to be inert?
1. Oxygen
2. Hydrogen
3. Helium
4. Carbon

3-61. An atom in an element becomes a negative ion when it
1. loses a proton from its nucleus
2. gains an electron in its outer shell
3. loses an electron from its nucleus
4. loses an electron from its outer shell

3-62. The energy necessary for ionization decreases with increasing atomic numbers because the
1. electrons in the outermost orbits are not attracted to the nucleus so strongly in atoms of high atomic number
2. nucleons are less well bound together in atoms of high atomic number
3. diameter of the nucleus increases with the atomic number
4. atomic radius decreases with the atomic number

Learning Objective: Recognize some of the characteristics associated with crystal structure, conductors, semiconductors, insulators and the two kinds of current used in electronics. Text pages 70 through 73.

3-63. The valence bonds that hold atoms in place in their lattice sites in a crystalline substance result from the interaction of their
1. outer shell electrons
2. inner shell electrons
3. cores
4. protons

3-64. What determines whether a material is a conductor, a semiconductor, or an insulator?
1. The ability of the material to reduce its atomic weight to less than one
2. The atomic weight of the material
3. The number of shells surrounding the nuclei of the material's atoms
4. The relative difficulty of dislodging planetary electrons from the outermost shell

3-65. Copper is a good conductor because its outer shell has
1. 1 electron
2. 5 electrons
3. 7 electrons
4. 4 electrons

3-66. Pure silicon and germanium semiconductor materials will act as conductors when
1. the net charge on the material is zero
2. their outer shells are complete
3. external energy is applied to the material
4. the atoms of the materials combine to complete the outer shell of each atom

3-67. What is a "hole" in a semiconductor?
1. A space between two electrons that form a covalent bond
2. A missing atom in a crystal structure
3. An unfilled electron location in a crystal structure
4. A space between two atoms

3-68. The two currents created by freeing of an electron in a block of pure semiconductor material ordinarily travel at
1. different velocities in the opposite direction
2. different velocities in the same directions
3. the same velocity in opposite directions
4. the same velocity in the same direction

3-69. A semiconductor material may be classified as an intrinsic semiconductor when it
1. is made of either all N-type material or all P-type material
2. is made of silicon material with donor impurities added
3. has an excess of electrons or holes
4. has an equal number of holes and free electrons

Assignment 4

Characteristics of Matter and Energy; PN Junction Power Supplies

Textbook Assignment: Pages 74 through 103

Learning Objective: Determine some of the properties attributed to semiconductor impurities and basic PN junctions. Text pages 74 through 79.

4-1. How many valence electrons must an atom of an impurity have to serve as a donor in a germanium semiconductor?
1. 2
2. 3
3. 4
4. 5

4-2. Which of the following chemical elements is classified as a trivalent impurity?
1. Antimony
2. Bismuth
3. Gallium
4. Phosphorous

4-3. How many valence electrons does an acceptor atom normally have in a germanium semiconductor?
1. 2
2. 3
3. 4
4. 5

4-4. Hole carriers are created in P-type semiconductor materials when an impurity atom that has
1. 5 valence electrons enters into covalent bonds with semiconductor atoms that have 4 valence electrons
2. 3 valence electrons enters into covalent bonds with semiconductor atoms that have 5 valence electrons
3. 3 valence electrons enters into covalent bonds with semiconductor atoms that have 4 valence electrons
4. 5 valence electrons enters into covalent bonds with semiconductor atoms that have 3 valence electrons

4-5. The addition of impurities to semiconductor materials produce both positively and negatively charged areas in the crystals. What is the net (total) charge on (A) an N-type germanium crystal and (B) a P-type germanium crystal?
1. (A) negative, (B) positive
2. (A) negative, (B) zero
3. (A) zero, (B) positive
4. (A) zero, (B) zero

Table 4A summarizes some of the important points that your textbook makes about semiconductor materials.

Type of semi-conductor	Main Conducting Medium	Impurity Added	Impurity's Valence Electrons
P	Holes(+)	Boron Indium Gallium	3
N	Electrons (-)	Phosphorus Arsenic Antimony	5

Table 4A.-Properties of semiconductors made with silicon or germanium.

4-6. What is the relationship between the holes and the electrons in N-type material?
1. The electrons are the minority carriers and the holes are the majority carriers.
2. Both electrons and holes are majority carriers.
3. The electrons are the majority carriers and the holes are the minority carriers.
4. Both the holes and the electrons are minority carriers.

4-7. What is the effect on the resistance of N-type semiconductor material and copper when their temperatures are increased?
1. The resistance in both will increase.
2. The resistance in both will decrease.
3. The resistance of the semiconductor material will decrease and the resistance of the copper will increase.
4. The resistance of the semiconductor material will increase and the resistance of the copper will decrease.

4-8. Current flow through an N-type material differs from current flow through a P-type material in that in the N-type material ____(A)____ (electrons, holes) move toward the ____(B)____ (positive, negative) terminal while in the P-type material ____(C)____ (electrons, holes) move toward the ____(D)____ (positive, negative) terminal.
1. (A) electrons, (B) positive, (C) electrons, (D) negative
2. (A) electrons, (B) positive (C) holes, (D) negative
3. (A) holes, (B) negative, (C) electrons, (D) positive
4. (A) holes, (B) negative, (C) holes, (D) positive

Items 4-9 through 4-12 are to be judged True or False.

4-9. Semiconductors are elements whose atoms contain six valence electrons.

4-10. Impurity elements added to semiconductor materials are either those with five valence electrons or those with three valence electrons.

4-11. N-type and P-type semiconductor materials are electrically neutral.

4-12. Doped semiconductor material will always result in N-type material.

4-13. What is a "junction" in a PN semiconductor device?
1. A fused crystal
2. A crystal that contains an equal number of free electrons and holes
3. A region where P-type material meets N-type material
4. The area of contact between a wire and a crystal

4-14. Diffusion of holes and electrons across a PN junction ceases when

1. the atoms in the P and N material become neutralized
2. a layer of charged ions, or a potential barrier, is built up on each side of the PN junction
3. all of the excess electrons have moved across the PN junction
4. all of the excess holes have moved across the PN junction

4-15. Which of the following definitions best describes the potential barrier in a junction diode?

1. The voltage required to cause the diode to cutoff
2. The charge areas where the P and N materials meet
3. The maximum voltage that can be applied to the diode
4. The external charge, provided by the supply voltage, developed between the P and N type material

4-16. The P-type material in a PN junction contains

1. both acceptor and donor impurity atoms
2. acceptor impurity atoms only
3. either acceptor or donor impurity atoms
4. donor impurity atoms only

4-17. What is the direction of electron flow when an external voltage is applied to a PN junction in the direction of low resistance?

1. From the P material, to combine with holes in the N material
2. From the N material, to combine with holes in the P material
3. From the junction, to combine with holes in the N material
4. From the junction, to combine with holes in the P material

4-18. When reverse bias is applied to a PN junction in a semiconductor diode, current flow is reduced to almost zero because the

1. increased barrier potential limits the current flow to reverse current
2. holes and free electrons combine with each other to prevent any current flow
3. direction of current flow in the diode is opposite to that of the supply voltage
4. potential of the free electrons in the N-type material and the holes in the P-type material is greater than the potential of the electric field

4-19. Avalanche breakdown occurs in a semiconductor diode as the result of a

1. small reverse bias
2. large reverse bias
3. small forward bias
4. larger forward bias

Learning Objective: Recognize common types of PN junction diodes by differentiating between forward and reverse bias and matching the type of diode with its characteristic or application. Text pages 80 through 84.

4-20. PN junction diodes are well suited for use in portable electronic power supplies because of their

1. low operating temperature, low internal voltage drop, and small physical size
2. short warmup period, low reverse current, and high current carrying capacity
3. low internal voltage drop, long warmup period, and small physical size
4. constant internal voltage drop, substantially free of load current; low operating temperature; and low reverse current

4-21. The difference in potential between the P and N type material of a PN junction diode is referred to as the
1. forward bias
2. reverse bias
3. bias
4. breakdown potential

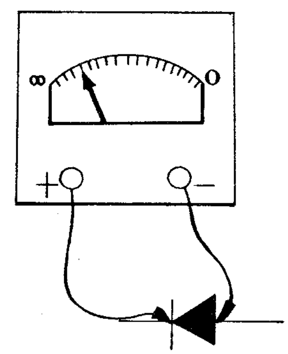
4-22. If a voltage is applied to a PN junction diode with the polarity such that the N material becomes more negative with respect to the P material, the diode is said to be
1. reverse biased
2. forward biased
3. polarized
4. reverse polarized

In terms 4-23 through 4-26 select the phrase or characteristic from column B which is the best match for the diode in column A

	A. Diode	B. Characteristic
4-23.	zener	1. operates reversed biased
4-24.	varactor	2. operates at a constant voltage over wide temperature range
4-25.	reference	3. operates as mixer, detector, and switch
4-26.	signal	4. operates capacitance ratio

4-27. What happens to the capacitance of a varactor diode as the reverse voltage is increased?
1. It decreases
2. It remains the same
3. It increases
4. It depends upon the diode current

4-28. What characteristics of a PN junction diode enable it to function as a switch?
1. A low resistance when conducting and a high resistance when nonconducting
2. A high resistance when conducting and a low resistance when nonconducting
3. A high resistance in both the conducting and nonconducting state
4. A low resistance in both the conducting and nonconducting state



D-1-46

Figure 4A.-Testing a PN junction diode with an ohmmeter

● To answer item 4-29 assume that you are testing a PN junction diode with an ohmmeter as shown in figure 4A.

4-29. Which of the following resistance readings indicate that the diode is good?
1. A low reading as shown and a high reading when the ohmmeter leads are reversed
2. A high reading as shown and a low reading when the ohmmeter leads are reversed
3. A low reading as shown and a low reading when the ohmmeter leads are reversed
4. A high reading as shown and a high reading when the ohmmeter leads are reversed

. . . .

Learning Objective: Identify PN junction diode rectifier circuits by differentiating between the half-wave, full-wave, and bridge configurations. Text pages 85 through 87.

. . . .

4-30. Heavy current flows through the PN junction diode of a half-wave rectifier during
1. three-fourths of the a.c. cycle
2. the complete a.c. cycle
3. the period when the anode is positive with respect to the cathode
4. the period when the cathode is positive with respect to the anode

4-31. Which of the following could cause a low output from the half-wave rectifier shown in figure 5-10 of your textbook?
1. High forward resistance reading across CR1
2. L2 open circuited
3. L1 short circuited
4. High reverse reading across CR1

4-32. The polarity of the center tap on the secondary of a transformer is
1. always negative
2. negative when the top half of the winding is positive
3. of one polarity with respect to one end of the winding, and the opposite polarity with respect to the other end of the winding
4. always positive

4-33. A full-wave rectifier produces
1. one pulse of d.c. out for each input cycle
2. an output voltage whose amplitude is twice that produced by the half-wave rectifier
3. two pulses of d.c. out for each input cycle
4. an output voltage whose amplitude is one-half that produced by the half-wave rectifier

● Items 4-34 through 4-37 are to be judged True or False. (Refer to figure 5-12 in your textbook.)

4-34. The top of RL is positive when CR2 and CR4 are conducting.

4-35. The top of the secondary of T1 is positive when CR1 and CR3 are conducting.

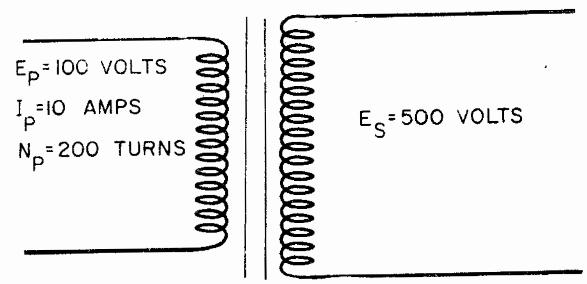
4-36. The top of RL is positive when CR1 and CR3 are conducting.

4-37. During the negative half-cycle of the input, CR2 and CR4 are forward biased.

. . . .

Learning Objective: Compute the secondary current, primary volts per turn, and secondary turns in a power transformer. Text page 89.

. . . .



D-1-47

Figure 4B.-Step-up power transformer

● Items 4-38 through 4-40 are to be answered by referring to figure 4B.

4-38. What is the secondary current?
1. 2 amps
2. 1 amp
3. 5 amps
4. 10 amps

4-39. What are the primary volts per turn?
1. 200
2. 0.5
3. 100
4. 10

4-40. What are the number of turns in the secondary?
1. 1,000
2. 10,000
3. 5,000
4. 100

Learning Objective: Identify power supply filters by differentiating between the capacitor input, choke input, and pi types. Text pages 89 through 93.

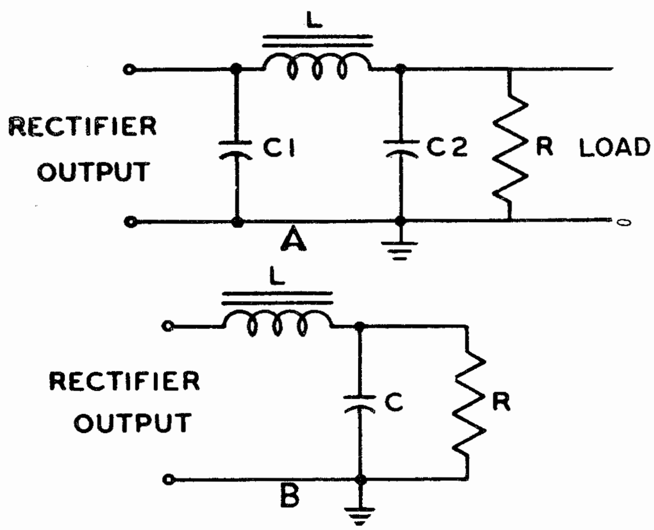
4-41. What is the output ripple frequency of a bridge rectifier that operates from a 60 Hz source?
1. 30 Hz
2 60 Hz
3. 120 Hz
4. 240 Hz

4-42. The filtering action of a capacitor depends primarily on the property of the capacitor to
1. store electrical energy
2. increase the flow of alternating current
3. permit the flow of electrons more easily in one direction than in the other
4. discharge rapidly across a load

4-43. A simple capacitance filter should not be used when the load demands
1. high voltage
2. low voltage
3. high current
4. low current

4-44. The filtering action of an inductor depends primarily on the property of the inductor to
1. increase the flow of alternating current
2. oppose a change in the magnitude of the current
3. permit the flow of electrons more easily in one direction than in the other
4. permit the flow of electrons in only one direction

4-45. How will an increase in the values of C1 and RL effect the RC time constant and effectiveness of the filter in figure 5-14 of your textbook?
1. The RC time constant will increase and the filter effectiveness will decrease
2. The RC time constant will decrease and the filter effectiveness will increase
3. The RC time constant and filter effectiveness will increase
4. The RC time constant and filter effectiveness will decrease



D-1-48

Figure 4C. -Filter circuits.

4-46. Most of the ripple current in filter circuit A in figure 4C flows to ground through
1. C1
2. C2
3. R
4. L

4-47. The filter shown in part B of figure 4C is sometimes referred to as
1. L-section filter
2. capacitor input filter
3. Pi filter
4. inductance-capacitance filter

4-48. What effect would replacing the inductor with a resistor have on the filter circuit shown in part A of figure 4C?
1. Smoother output voltage
2. Lower ripple factor
3. Higher output voltage
4. Lower output voltage

4-49. The resistor shown in part A of figure 4C
1. provides a discharge path for the capacitors when the power is turned off
2. may be used as a voltage divider network
3. reduces the possibility of electrical shock to maintenance personnel
4. does all of the above

Learning Objective: Solve resistance and current problems related to a voltage divider network. Text page 93.

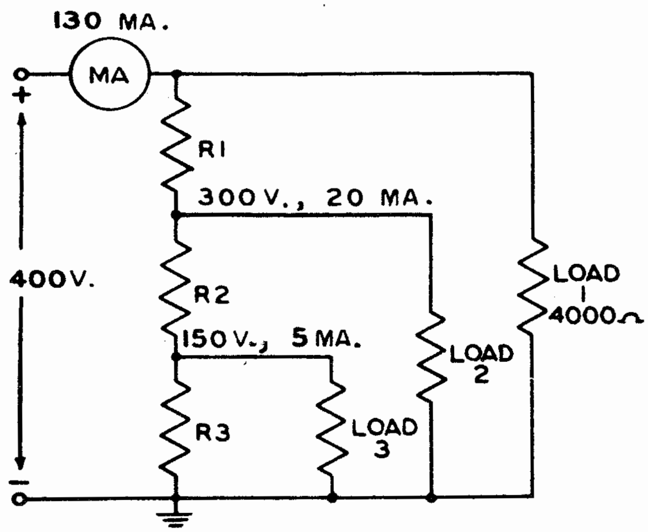


Figure 4D. -Voltage divider.

● Prior to completing items 4-50 through 4-52 based on figure 4D the student should review Ohms Law and Kirchhoff's current law.

4-50. What is the resistance of R3 in figure 4D?
1. 5,000 ohms
2. 15,000 ohms
3. 30,000 ohms
4. 33,000 ohms

4-51. What is the approximate resistance of R1 in figure 4D?
1. 3,300 ohms
2. 4,000 ohms
3. 5,000 ohms
4. 10,000 ohms

4-52. What is the approximate bleeder current with all loads removed from the supply in figure 4D?
1. 5 ma
2. 8 ma
3. 13 ma
4. 30 ma

Learning Objective: Compare the simple series voltage regulator circuit with the simple shunt voltage regulator circuit. Text pages 95 through 97.

4-53. Assuming that the input voltage increases, what action must take place in the circuit shown in figure 5-21 of your text for the circuit to function properly as a voltage regulator?
1. The value of RL must be decreased so as to keep the voltage drop across the load constant
2. The value of RL must be increased so as to keep the voltage drop across the load constant
3. The value of R must be decreased so as to cause the voltage drop across R to increase
4. The value of R must be increased so as to cause the voltage drop across R to increase

4-54. Which of the following is true concerning the simple shunt voltage regulator?
1. The resistance in series with the load must increase as the input voltage increases
2. The resistance in parallel with the load must decrease as the input voltage increases
3. The resistance in series with the load must be decreased as the input voltage increases
4. The resistance in parallel with the load must be decreased as the input voltage decreases

4-55. All of the following statements are true concerning the regulator circuit shown in figure 5-23 of your textbook except
1. as the input voltage increases, the resistance of VR1 decreases
2. as the load current increases, the current through VR1 decreases
3. when the input voltage increases or decreases, the voltage across VR1 will remain constant (within its operating limits)
4. electron flow through VRL is from the cathode to the anode

4-56. What will happen if the load is removed from the regulator shown in figure 5-23 of your text?
1. The current through VR1 and R_S will increase slightly
2. The current through VR1 will increase to the point where the diode may be damaged
3. The current through R_S will increase to the point where the resistor may be damaged
4. The current through VR1 will decrease

4-57. Which of the following could cause a loss of output in the regulator shown in figure 5-23 of your text?
1. Decrease in value of R_S
2. VR1 open
3. VR1 shorted
4. R_S shorted

Learning Objective: Differentiate between the full wave bridge and full wave-full wave combinational power supplies. Text page 97 and 98.

4-58. Which diodes provide the full wave output in the combination power supply shown in figure 5-24 of your text?
1. CR1 and CR3
2. CR3 and CR4
3. CR1 and CR2
4. CR2 and CR4

● NOTE: On page 97, right column, the fourth sentence in the second paragraph under the heading "FULL-WAVE BRIDGE" should be changed as follows:

"CR1 through CR4 form the bridge rectifier circuit with L1, R2, C1A and C1B doing the filtering; R3 is a bleeder resistor and assures that the bridge has a minimum load."

4-59. Which of the following is true concerning the power supply shown in figure 5-25 of your textbook?
1. CR4 is conducting in the positive power supply at the same time that CR3 is conducting in the negative power supply
2. CR3 is conducting in the negative power supply at the same time that CR4 is conducting in the positive power supply
3. CR2 is conducting in the negative power supply at the same time that CR4 is conducting in the positive power supply
4. CR1 is conducting in the negative power supply at the same time that CR4 is conducting in the positive power supply

Learning Objective: Identify doubler, tripler, and quadrupler voltage multiplier circuits. Text pages 99 through 103.

4-60. Which of the following is true in relation to voltage multiplier circuits?
1. They cannot produce an output voltage greater than the peak input voltage without utilizing a transformer
2. Transformers and rectifiers are used to increase the output voltage
3. The charge stored on capacitors is used to increase the output voltage
4. Capacitors are charged on one half-cycle of the input, and discharged in parallel with the output voltage on the next half-cycle

4-61. Assuming a 60 Hz input, what is the ripple frequency of a half-wave voltage doubler circuit?
1. 60 Hz
2. 30 Hz
3. 240 Hz
4. 120 Hz

4-62. 100 volts peak is applied to the input of a voltage multiplier consisting of a half-wave voltage doubler circuit connected in series with the output of a half-wave rectifier circuit. What is the multiplier output?
1. 70.7 volts
2. 200 volts
3. 300 volts
4. 400 volts

4-63. The initial charge path for C1 in figure 5-30A of your textbook is through
1. CR3, Load, and CR1
2. CR3, R2, R1, and CR1
3. CR2, and the transformer secondary
4. CR1, R1, and the transformer secondary

4-64. The voltage across R1 in figure 5-31 of your text is approximately equal to
1. 1/2 the peak value from A to B
2. the voltage from A to B
3. twice the peak value from A to B
4. 1/4 the voltage across the load

Assignment 5

Transistors

Textbook Assignment: Pages 104 through 122

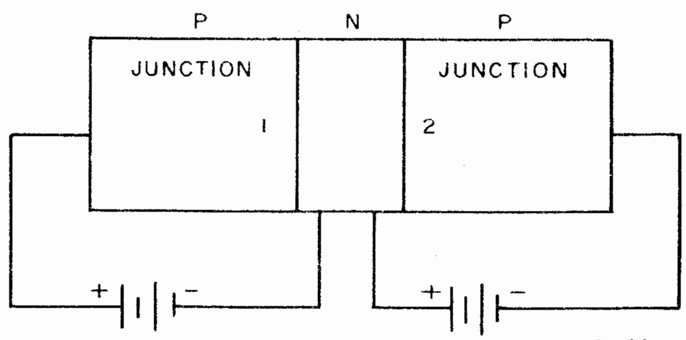
Learning Objective: Determine some of the characteristics associated with biasing, current paths, base lead current and current gain in two junction transistors. Text pages 104 through 108.

5-1. What type of transistor is a semi-conductor device with a configuration of an N-type material sandwiched between two P-type materials?

1. PPN
2. NPN
3. NPP
4. PNP

5-2. The fundamental junction transistor has ______(A)______ (one PN junction, two PN junctions) which must be properly ____(B)____ (biased, heated) for the transistor to operate.

1. (A) one PN junction, (B) biased
2. (A) two PN junctions, (B) biased
3. (A) two PN junctions, (B) heated
4. (A) one PN junction, (B) heated



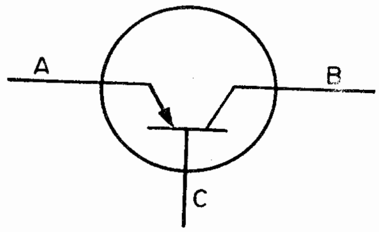
D-1-50

Figure 5A. -PNP transistor.

5-3. In the PNP transistor shown in figure 5A, the majority of the current ______(A)______ (will, will not) flow across PN junction 1 and ______(B)______ (will, will not) flow across PN junction 2.

1. (A) will, (B) will
2. (A) will, (B) will not
3. (A) will not, (B) will
4. (A) will not, (B) will not

● The schematic symbol for a transistor differentiates between a NPN and a PNP type by the direction of the emitter arrow. A PNP transistor is representated by the arrow pointing in toward the base. The NPN type has the arrow pointing away from the base.



D-1-51

Figure 5B. -A transistor.

5-4. What type of transistor is shown in figure 5B?
1. PNP
2. NPP
3. PNN
4. NPN

5-5. What nomenclatures should be applied to the parts of the transistor shown in figure 5B that are labeled A, B, and C?
1. A-emitter, B-base, and C-collector
2. A-base, B-emitter, and C-collector
3. A-emitter, B-collector, and C-base
4. A-collector, B-base, and C-emitter

5-6. Assume that the collector voltage in a common-base circuit using a PNP junction transistor is held constant at -15 volts. When the emitter current is increased from 2 milliamperes to 5 milliamperes, the collector current varies from 1.9 milliamperes to 4.6 milliamperes. What is the current gain, α, of the circuit?
1. 0.67
2. 0.90
3. 2.6
4. 3.5

● Information for item 5-7: The collector voltage in a common-emitter circuit using a PNP junction transistor is held constant at -15 volts. When the base current increases from 50μa., to 100μa., the collector current varies from 1 ma. to 4 ma.

5-7. What is the current gain, β, of the common-emitter transistor circuit described in the preceding information?
1. 4
2. 10
3. 20
4. 60

5-8. Transistor current gain is computed using the expression - current gain is equal to the output current divided by the input current. Which configuration is being used when the current gain is computed by the emitter to base ratio?
1. Common base
2. Common emitter
3. Common collector
4. Common base-emitter

5-9. Current gain in a common base transistor is the ratio of a change in
1. collector current to base current with the emitter to base voltage held constant
2. emitter current to base current with the collector to base voltage held constant
3. base current to collector current with the emitter to base voltage held constant
4. collector current to emitter current with the collector to base voltage held constant

5-10. A class A transistor amplifier differs from a class B transistor amplifier in that the class A amplifier has collector current flowing

1. for approximately one-half of each cycle when an alternating signal voltage is applied to its emitter-base junction
2. at all times when an alternating signal voltage is applied to its input
3. for more than one-half but less than the entire electrical cycle when an alternating signal voltage is applied to its input
4. for much less than one-half of each cycle when an alternating signal voltage is applied to its emitter-base junction

Learning Objective: Recognize some of the characteristics associated with the operation of basic transistor amplifiers. Text pages 109 through 113.

● Information for items 5-11 through 5-13: A positive going signal is applied to the input of the PNP circuit shown in figure 6-11 of your textbook.

5-11. What is the effect on the emitter bias and the collector current of the PNP common-base amplifier under the conditions established in the preceding information?

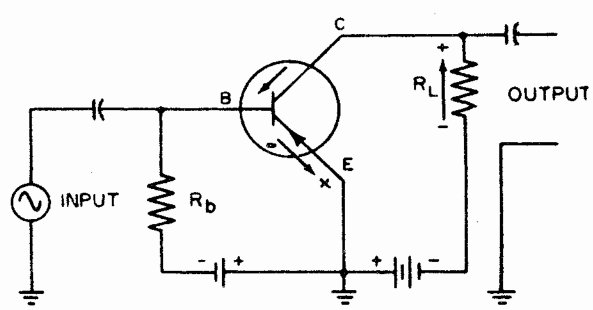
1. The emitter bias decreases and the collector current increases.
2. Both the emitter bias and the collector current decrease.
3. Both the emitter bias and the collector current increase.
4. The emitter bias increases and the collector current decreases.

5-12. What is the effect on the collector voltage of the circuit described in the preceding information?

1. It will increase and become more negative
2. It will decrease and become more negative
3. It will decrease and become more positive
4. It will increase and become more positive

5-13. (A) What is the polarity of the output of the circuit described in the preceding information and (B) what is the output of the NPN circuit shown in figure 6-11 of your textbook if the same signal is applied to its input?

1. (A) The output is a positive-going signal, (B) the output is a negative-going signal.
2. Both (A) and (B) would have positive-going outputs.
3. (A) The output is a negative-going signal, (B) the output is a positive-going signal.
4. Both (A) and (B) would have negative-going outputs.



D-1-52

Figure 5C. -Common-emitter PNP transistor amplifier.

5-14. Across what two points in the transistor circuit of figure 5C is the input signal applied?

1. B and C
2. B and E
3. C and E
4. C and ground

5-15. A positive-going signal applied to the input of the amplifier in figure 5C results in
1. an increase in base-emitter voltage
2. a decrease in base-emitter voltage
3. an increase in the voltage drop across R_L
4. a decrease in the collector-to-ground voltage

5-16. What effect does a positive-going signal at the input of the common-emitter transistor amplifier in figure 5C have on (A) the collector current and (B) the voltage drop across R_L?
1. (A) Increases, (B) decreases
2. (A) Decreases, (B) increases
3. Both (A) and (B) decrease
4. Both (A) and (B) increase

5-17. An NPN common-emitter circuit is similar to the PNP common-emitter circuit in that
1. output signals for both circuits are 180° out of phase with the inputs
2. both circuits realize an increase in forward bias with a positive-going input
3. both circuits have decreased collector current flow with a positive-going input
4. output signals for both circuits are in phase with the input

5-18. Which of the following transistor amplifier stages may be used to match a high impedance source to a low impedance load?
1. Common-emitter
2. Common-base
3. Common-collector
4. Both common-emitter and common-base

5-19. When a positive going signal is applied to the circuit in figure 6-14 of the textbook, the bias will ______(A)______ and the
increase, decrease
current through R_E will
______(B)______.
increase, decrease
1. (A) increase, (B) increase
2. (A) increase, (B) decrease
3. (A) decrease, (B) increase
4. (A) decrease, (B) decrease

. . . .

Learning Objective: Determine some of the factor relating to transistor gain and operating limits. Text pages 113 and 114.

. . . .

● Items 5-20 through 5-22 are to be judged True or False.

5-20. The current gain for a specific transistor is the same in any circuit configuration.

5-21. A transistor circuit that has a high output impedance will usually provide a voltage gain.

5-22. Collector cutoff (leakage) current is a transistor rating that influences the operating limits of the device.

5-23. The cutoff current of a transistor will ______(A)______ with an increase
increase, decrease
in collector voltage and will
______(B)______ with an increase in
increase, decrease
its operating temperature.
1. (A) increase, (B) decrease
2. (A) decrease, (B) increase
3. (A) decrease, (B) decrease
4. (A) increase, (B) increase

5-24. What is the peak collector power dissipation (Pc) rating of a power transistor that is designed to operate with a collector voltage of -20 volts and a collector current of -0.5 ampere?

1. 1.0 watt
2. 5.0 watts
3. 10.0 watts
4. 20.0 watts

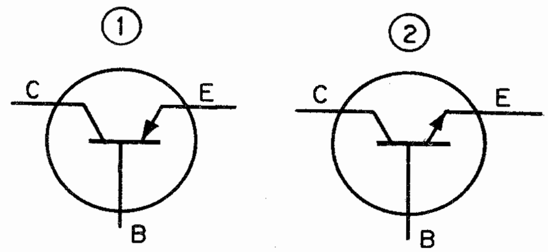
5-25. What factor determines the Pc of a transistor?

1. The maximum value of a.c. that can flow through the device's collector without destroying it
2. The maximum value of d.c. that can flow through a device's collector without destroying it
3. The maximum value of a.c. that can flow through a device's emitter without destroying it
4. The maximum amount of d.c. that can flow through a device's emitter without destroying it

Learning Objective: Recognize some of the variables and their characteristics that establish transistor current and methods used to identify transistor leads. Text pages 114 through 116.

5-26. Transistor or base lead current flow is dependent upon

1. the type of bias used and the configuration of the transistor circuit
2. the input signal's amplitude and the type of transistor used
3. whether forward or reverse current is flowing in the base lead
4. all of the above



D-1-53

Figure 5D. -Two transistors.

5-27. If base lead current is flowing out of the base material into the base lead of transistor 1 in figure 5D and into the base material in transistor 2 in the same figure, the majority of current is flowing in the transistors'

1. base
2. collector in 1 and base in 2
3. collector
4. base in 1 and collector in 2

5-28. Reverse current in transistors is that part of the electron ____(A)____ opposition, flow that takes place across a ____(B)____ biased junction. forward, reverse

1. (A) opposition, (B) forward
2. (A) flow, (B) reverse
3. (A) flow, (B) forward
4. (A) opposition, (B) reverse

5-29. The usual value assigned to a transistor's reverse current is in the range of

1. picoamperes
2. microamperes
3. milliamperes
4. amperes

● Items 5-30 through 5-34 are to be judged True or False.

5-30. Reverse current (I_{CBO}) of sufficient magnitude can result in a reduction of or a reversal of base current (I_B).

5-31. To have any amount of I_{CBO} the emitter lead must be open.

5-32. Most transistor amplifiers use only one battery to establish biasing.

5-33. All transistors are constructed to terminal identification standards.

5-34. The only approved method for identifying transistor leads is to consult the equipment manual or a transistor manual that depicts the specifications for the transistor being used.

Learning Objective: Determine some characteristics of the factors that establish transistor frequency limitations. Text pages 116 through 121.

5-35. The inherent parameters that determine the useful operational frequencies of a specific transistor are established by the transistor's

1. application
2. bias
3. weight
4. manufacturer

5-36. The common base current cut-off frequency (f_{ab}) is the frequency at which the transistor's ___(A)___ is 3 db
α, β
___(B)___ its common base a.c.
above, below
short circuit forward current gain at a frequency of ___(C)___.
1 kHz, 10 kHz

1. (A) α, (B) below, (C) 1 kHz
2. (A) β, (B) above, (C) 10 kHz
3. (A) β, (B) above, (C) 1 kHz
4. (A) α, (B) below, (C) 10 kHz

5-37. Which of the following common emitter parameters corresponds to the common base parameter f_{ab}?

1. h_{fbo}
2. h_{feo}
3. f_{ae}
4. h_{fe}

5-38. A transistor's transit time parameter is that time required for an electron to travel from the transistor's ___(A)___ to the ___(B)___
base, emitter   collector, ground

1. (A) emitter, (B) ground
2. (A) emitter, (B) collector
3. (A) base, (B) ground
4. (A) base, (B) collector

5-39. The frequency limit of a transistor is said to be exceeded when the input frequency

1. changes slower than the electrons can dislodge and travel from the collector to the base
2. changes faster than the electrons can dislodge and travel from the base to the collector
3. changes slower than the electrons can dislodge and travel from the emitter to the collector
4. changes faster than the electrons can dislodge and travel from the emitter to the collector

5-40. When the frequency limit of a specific transistor is exceeded the output will always be

1. reduced
2. negative
3. increased
4. positive

5-41. One way that manufacturers increase the frequency limit of transistors is by
1. decreasing the physical distance between collector and base
2. increasing the physical distance between emitter and collector
3. making the base thinner without reducing the power gain
4. making the emitter smaller without reducing the power gain

5-42. The interelement capacitance of a transistor is ____(A)____ (increased, decreased) when the reverse bias voltage is increased and it is ____(B)____ (increased, decreased) when the emitter current flow is increased.
1. (A) decreased, (B) increased
2. (A) decreased, (B) decreased
3. (A) increased, (B) decreased
4. (A) increased, (B) increased

5-43. The interelement capacitance of a resistance coupled transistor amplifier may be decreased in a number of ways. Which of the following methods should be used if it is necessary to keep the overall voltage gain static?
1. Eliminate the circuit's collector resistor
2. Increase the value of the circuit's collector resistor
3. Reduce the value of the circuit's collector resistor
4. Change the design of the transistor

5-44. A series high frequency compensation circuit can be identified by the ____(A)____ (inductor, rheostat) that is wired in ____(B)____ (parallel, series) with the circuit's signal path.
1. (A) rheostat, (B) series
2. (A) inductor, (B) series
3. (A) rheostat, (B) parallel
4. (A) inductor, (B) parallel

5-45. What property of which components in a series high frequency compensation circuit provides for increased current flow?
1. The capacitive reactance of the collector resistor and the output terminal, a.c. input open emitter capacitance
2. The resonance of the peaking coil and the output terminal, a.c. input open emitter capacitance
3. The capacitive reactance of the collector resistor and the input emitter capacitance
4. The resonance of the peaking coil and the input emitter capacitance

5-46. Which of the following faults may be the cause of a reduced output with an increase in the applied frequency to a series high frequency compensation circuit?
1. A shorted peaking coil
2. An open coupling capacitor
3. A shorted collector resistor
4. An open peaking coil

5-47. The high frequency gain of a wide band transistor amplifier using shunt compensation is about ____(A)____ (60, 50) percent ____(B)____ (more, less) than a series high frequency compensation circuit.
1. (A) 60, (B) less
2. (A) 50, (B) less
3. (A) 50, (B) more
4. (A) 60, (B) more

5-48. What troubleshooting symptom should be observed when the inductor in a shunt compensation circuit is open?
1. The same symptom as for a shorted inductor in a series peaking circuit
2. A reduced output
3. The same as for a shorted load resistor
4. No output

● Items 5-49 through 5-52 are to be judged True or False.

5-49. Series shunt compensation will provide a greater gain than a circuit using shunt peaking alone.

5-50. Only the input interelectrode capacitance has any effect on low frequency response in a wide band transistor amplifier.

5-51. The use of an RC compensating filter is recommended to prevent phase distortion and loss of low frequency response in a transistor wide band amplifier.

5-52. In a typical wide band amplifier such as that shown in figure 6-26 of your textbook the low and high frequency compensation networks operate independently.

Learning Objective: Determine the effects produced by transistor internal feedback and how some of these undesirable effects may be controlled. Text pages 121 and 122.

5-53. What characteristic of a transistor is responsible for internal feedback?
1. Its interelement resistances
2. Its negative temperature coefficient
3. Its positive bias levels
4. Its interelement capacitances

5-54. Regenerative feedback in a transistor configuration is the same as ____(A)____ feedback since the
positive, negative
voltage ____(B)____ the input signal
aids, opposes
voltage.
1. (A) positive, (B) aids
2. (A) negative, (B) aids
3. (A) negative, (B) opposes
4. (A) positive, (B) opposes

5-55. Which of the following conditions would alter the input impedance of an electronic device?
1. A positive feedback is applied to the device's input circuit.
2. A negative feedback is applied to the device's input circuit.
3. A positive feedback is applied to the device's output circuit.
4. All of the above conditions would alter the device's input impedance.

5-56. A transistor that is unilateralized has its ____(A)____ circuitry cancel
internal, external
out the
____________(B)____________
resistive only, resistive and reactive
internal feedback to the circuit's input.
1. (A) internal, (B) resistive only
2. (A) internal, (B) resistive and reactive
3. (A) external, (B) resistive and reactive
4. (A) external, (B) resistive only

● Items 5-57 through 5-62 are to be judged True or False.

5-57. Oscillations are prevented in either a unilaterialized or a neutralized amplifier.

5-58. Regenerative feedback has the disadvantage of reducing amplifier gain.

5-59. Base spreading resistance is nothing more than the resistance of a transistor's collector-base junction.

5-60. With the proper input applied to a circuit such as that shown in figure 6-27 of your textbook the forward bias would be aided and the emitter would go more positive.

5-61. With a very high frequency input signal applied to a circuit such as that shown in figure 6-27 of your textbook the part that is labeled R_{n2} may be eliminated.

5-62. An input signal to a circuit such as that shown in figure 6-27 of your textbook that aids the forward bias will neutralize the circuit when opposing voltages across R_b and R_{n1} are equal.

Assignment 6

Transistors

Textbook Assignment: Pages 122 through 140

> Learning Objective: Recognize the advantage of single source biasing and some of the operational characteristics of various biasing configurations. Textbook pages 122 through 128.

6-1. What, in addition to simplifying circuit wiring, is one of the advantages of single source biasing?
1. Elimination of a power supply
2. Reduction of bias battery size
3. Reduction of collector voltage
4. Elimination of a separate power supply

6-2. A simplified schematic of an NPN transistor would be represented by
1. two resistors separated by a capacitor with all parts in series
2. three resistors in parallel
3. three capacitors in series
4. three resistors in series

6-3. The transistor base shown in figure 6-28C of your textbook is shown as a variable ______(A)______ to
capacitor, resistor
illustrate that an increase in forward bias would ______(B)______ the value
increase, decrease
of this part.
1. (A) capacitor, (B) increase
2. (A) resistor, (B) decrease
3. (A) capacitor, (B) decrease
4. (A) resistor, (B) increase

6-4. Refer to figure 6-28C in your textbook. What is the relationship between the voltage potentials at points A, B, and D when the forward bias to the circuit is decreased?
1. Point B will be more positive than point D with respect to point A
2. Point B will be at the same potential as points D and A
3. Point B will be less positive than points D and A
4. Point B will be less positive than point D with respect to point A

6-5. Refer to figure 6-29 in your textbook. What is the relationship between points A, B, and D when a positive source is applied to the emitter source terminal?
1. Point A is more positive than point B and less positive than point D
2. Point A is less positive than points B and D
3. Point A is less positive than point B and more positive than point D
4. Point A is more positive than points B and D

6-6. The purpose of resistor R_B shown in figure 6-30 of your textbook is to
1. shunt the base-emitter junction increasing its resistance
2. bypass the base-collector junction increasing its resistance
3. shunt the base-emitter junction decreasing its resistance
4. bypass the base-collector junction decreasing its resistance

6-7. What would be the result if resistor R_B and R_E in figure 6-30 of your textbook should become shorted?
1. No current would flow and the signal input would appear without change at the output
2. A large amount of current would flow and the signal input would appear without change at the output
3. No current would flow and all of the input signal would be lost
4. A large amount of current would flow and all of the input signal would be lost

● Items 6-8 and 6-9 are to be judged True or False.

6-8. A forward biased NPN transistor will have its base positive with respect to its emitter.

6-9. A forward biased PNP transistor will have its base negative with respect to its emitter.

6-10. What type of bias is applied to transistors Q1 and Q2 shown in figure 6-32 of your textbook?
1. Both Q1 and Q2 are reverse biased.
2. Q1 is forward biased and Q2 is reverse biased.
3. Q1 is reverse biased and Q2 is forward biased.
4. Both Q1 and Q2 are forward biased.

6-11. The purpose of C1 shown on figure 6-32 of your textbook is to provide ______(A)______ between Q1 and Q2 which ______(B)______ the feedback of d.c. variations to the base of Q1.

(A): isolation, a current path
(B): allows, prevents

1. (A) isolation, (B) allows
2. (A) a current path, (B) allows
3. (A) isolation, (B) prevents
4. (A) a current path, (B) prevents

6-12. What would happen to the transistor currents in figure 6-32 of your textbook if the value of R_{E1} increased slightly?
1. The current flow through Q1 would increase then decrease while the current flow through Q2 would decrease
2. The current flow through Q1 will increase and the current flow through Q2 will decrease
3. The current flow through Q1 would decrease then increase while the current flow through Q2 would increase
4. The current flow through Q1 and Q2 will decrease

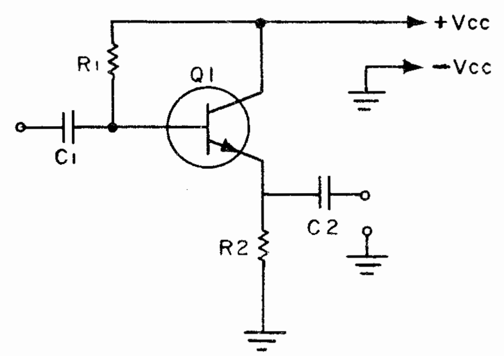
6-13. What is the effect on the potential at the base of the transistors shown in figure 6-34 of your textbook when the current flow through the transistors (A) increases and (B) decreases?
1. Both (A) and (B) decrease
2. (A) increases, (B) decreases
3. Both (A) and (B) increase
4. (A) decreases and (B) increases

6-14. What is the result of adding a decoupling capacitor to a shunt feedback circuit?
1. Decreased transistor gain by elimination of the d. c. component from the collector potential.
2. Decreased transistor gain by elimination of the a. c. component from the collector potential.
3. Increased transistor gain by elimination of the d. c. component from the collector potential.
4. Increased transistor gain by elimination of the a. c. component from the collector potential.

● Class B amplifiers can be biased either for collector current cutoff or for zero collector voltage. They are always operated push-pull, as shown in figure 6-40 of your textbook, to avoid serious audio distortion. The best power efficiency is obtained when they are biased for collector current cutoff, since collector current will flow only during that half-cycle of the input voltage that aids the forward bias. When biased for zero collector voltage, a heavy current flows when no signal is present, and practically all the collector voltage is dissipated across the load. Although heavy current flows, the power dissipation in the transistor is very low because power is the product of both current and voltage, and the voltage is practically zero (due to the small voltage drop across the very low impedance of the transistor). The collector current varies only during that portion of the cycle when the input voltage opposes the forward bias. Under these conditions low efficiency is obtained and the current gain is appreciably reduced.

6-15. The circuit shown in figure 6-35 and 6-36 of your textbook both perform the same function. (A) which is the more efficient circuit and (B) why is it more efficient?
1. (A) 6-35, (B) because it has less resistive absorbing power
2. (A) 6-35, (B) because it has more resistive absorbing power
3. (A) 6-36, (B) because it has less resistive absorbing power
4. (A) 6-36, (B) because it has more resistive absorbing power

6-16. What electronic characteristic establishes the forward bias for the NPN transistor shown in figure 6-37 of your textbook?
1. Capacitive coupling
2. Inductive reactance
3. Direct coupling
4. Voltage division



D-1-54
Figure 6A. -Forward biased NPN transistor.

6-17. The value of which part in figure 6A sets the voltage level on Q1's base?
1. C1
2. C2
3. R1
4. R2

6-18. What is the approximate voltage on the emitter of the circuit shown in figure 6-39?

1. 15 volts
2. 6 volts
3. More than 6 but less than 15 volts
4. Less than 6 volts

6-19. A class B transistor amplifier produces its best power efficiency when biased for

1. zero collector voltage for less than a half-cycle
2. collector current cutoff
3. zero collector voltage for more than a half-cycle
4. continuous collector flow

6-20. In which of the following circuits could you best use a transistor amplifier biased at a point that keeps collector current at zero for a period in excess of a half-cycle?

1. Phase inverter
2. IF amplifier
3. Oscillator
4. Audio amplifier

Learning Objective: Determine some operational characteristics and uses of transistor circuit temperature compensation devices, and compound-connected transistor amplifiers. Text pages 128 through 131.

6-21. One of the purposes of connecting a resistor in the emitter circuit of either an NPN or a PNP transistor amplifier is to

1. decrease collector current flow when the transistor's temperature increases
2. provide temperature compensation by controlling collector-base current flow
3. increase collector current flow when the transistor's temperature decreases
4. provide temperature compensation by controlling base-emitter current flow

6-22. In a circuit such as that shown in figure 6-42 of your textbook an increase in temperature will result in an ____(A)____ (increase, decrease) in collector current flow which will cause ____(B)____ (more, less) voltage drop across the emitter resistor.

1. (A) decrease, (B) more
2. (A) decrease, (B) less
3. (A) increase, (B) less
4. (A) increase, (B) more

6-23. The reactance value of a bypass capacitor in a circuit using emitter biasing for an NPN transistor is selected to equal approximately

1. 90% of the bypassed resistor at the lowest amplified frequency
2. 90% of the bypassed resistor at the highest amplified frequency
3. 10% of the bypassed resistor at the lowest amplified frequency
4. 10% of the bypassed resistor at the highest amplified frequency

6-24. Which of the following devices can be used to minimize the effects of temperature drifts in transistor circuits?

1. Thermistors
2. Varistors
3. Diodes
4. All of the above

6-25. What type of transistor amplifier connection would you normally expect to find in the output stage of a public address system?

1. Hybrid feedback
2. Common-base
3. Compound
4. Common-collector

6-26. What type of bias is being supplied to the circuit shown in figure 6-45 of your textbook?

1. Fixed class A
2. Variable class B
3. Fixed class B
4. Variable class A

6-27. The common-emitter configuration shown in figure 6-45 of your textbook has the ______(A)______ (emitter, collector) leads of both transistors connected to a common point and the output load resistor, RC, is connected in ______(B)______ (series, parallel) with the two transistors.

1. (A) collector, (B) parallel
2. (A) collector, (B) series
3. (A) emitter, (B) parallel
4. (A) emitter, (B) series

6-28. What is the phase relationship between positive and negative input signals to the output signals produced by a compound-connected common emitter audio amplifier circuit?

1. A positive input signal will produce a negative output signal and a negative input signal will produce a positive output signal
2. Both positive and negative input signals will produce negative output signals
3. A positive input signal will produce a positive output signal and a negative input signal will produce a negative output signal
4. Both positive and negative input signals will produce positive output signals

- Items 6-29 through 6-32 are to be judged True or False.

6-29. The current gain of two transistors connected in cascade is less than the current gain of two transistors that are compound-connected.

6-30. A disadvantage of the compound-connected amplifier is deterioration of frequency response.

6-31. A conventional amplifier has a higher dynamic output impedance when compared with the compound connected amplifier.

6-32. A compound-connected, common-collector amplifier has a voltage gain that is less than one and has equality between current and power gains.

Learning Objective: Recognize some operational characteristics of unijunction and field effect transistors. Textbook pages 131 through 135.

6-33. Some of the features associated with the unijunction transistor (UJT) include all of the following except

1. a high pulse current capability
2. a negative resistance characteristic
3. a very high value of firing current
4. a stable triggering voltage

6-34. Inspection of a UJT schematic indicates that the materials used in construction of the device would classify the device as

1. an NPN transistor
2. a PN transistor
3. a PNP transistor
4. an NP transistor

6-35. What are the UJT's regions of operation?

1. Cutoff, saturation and positive resistance
2. Saturation, negative resistance and cutoff
3. Positive resistance, saturation and cutoff
4. Cutoff, positive resistance and negative resistance

- The unijunction transistor is unique in that it can be triggered by, or an output can be taken from, each of the three terminals.

6-36. Where can the output be taken from a UJT?
1. Base 1, base 2, and the emitter
2. Base, emitter, and collector
3. Base 1, base 2, and the collector
4. Base, emitter 1, and emitter 2

6-37. Both the junction field effect transistor (JFET) and the insulated gate field effect transistor (IGFET) operate on the principle of ____(A)____ voltage, current controlled by ____(B)____ an electric, a neutralizing field.
1. (A) voltage, (B) an electric
2. (A) current, (B) an electric
3. (A) voltage, (B) a neutralizing
4. (A) current, (B) a neutralizing

6-38. What basic electronic device approximates the junction of a JFET's channel?
1. An inductor
2. A capacitor
3. A resistor
4. A transformer

6-39. What designations are applied to the JFET's elements?
1. Emitter, drain and gate
2. Gate, emitter and collector
3. Drain, collector and source
4. Gate, drain and source

6-40. With the junctions of a JFET reverse biased ____(A)____ field, an electric, a magnetic or ____(B)____ region, depletion, diffusion surrounds the device's PN junction.
1. (A) an electric, (B) depletion
2. (A) an electric, (B) diffusion
3. (A) a magnetic, (B) depletion
4. (A) a magnetic, (B) diffusion

- Items 6-41 through 6-44 are to be judged True or False.

6-41. An increase to the reverse voltage applied to a JFET produces, approximately, an infinite resistance between source and drain.

6-42. Increasing the drain source voltage (V_D) to a JFET produces an increase in drain current (I_D) which is limited by the conditional "pinch-off" voltage (V_O).

6-43. The control of a JFET can be lost when V_D equals V_O.

6-44. Reverse bias (V_{GS}) applied to a JFET's gate channel causes "pinch-off" to occur at a much higher level of I_D.

6-45. What is the composition of the main body of an N channel depletion mode IGFET?
1. An N substrate
2. Doped silicon
3. A P substrate
4. Insulating oxide

6-46. The primary function of an IGFET's main body is to provide ____(A)____ thermal diffusion, mechanical support and ____(B)____ direct, indirect contact between gate, source and drain.
1. (A) thermal diffusion, (B) direct
2. (A) mechanical support, (B) direct
3. (A) mechanical support, (B) indirect
4. (A) thermal diffusion, (B) indirect

6-47. What electrical requirement must be met in order for current to flow in an IGFET?
1. Application of a potential between the gate and the drain with a zero source voltage
2. Application of a potential between the gate and ground
3. Application of a potential between the source and ground
4. Application of a potential between the drain and the source with a zero gate voltage

6-48. A negative voltage applied at the gate of an N channel IGFET causes
_______(A)_______ in the
an increase, a decrease
channel's depletion which results in a lowered I_D and
_______(B)_______ of the
a decrease, an increase
channel's resistance.

1. (A) an increase, (B) a decrease
2. (A) a decrease, (B) a decrease
3. (A) a decrease, (B) an increase
4. (A) an increase, (B) an increase

● Items 6-49 through 6-53 are to be judged True or False.

6-49. An electric field is set up across the insulating oxide material of an IGFET when the gate voltage is at some positive potential.

6-50. An IGFET's N channel and oxide material act as a capacitor with the gate contact acting as the dielectric.

6-51. To increase the strength of the electric field shown in figure 6-57 of your textbook you would need to increase the reverse bias.

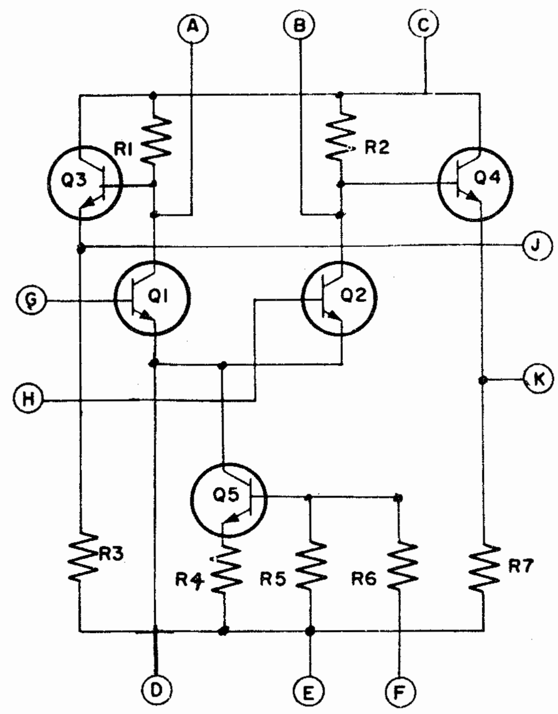
6-52. IGFETs are used in the input of electronic voltmeters.

6-53. A low value of reverse bias applied to an IGFET's gate produces a greater drain current than a high value of reverse bias.

Learning Objective: Determine some characteristics associated with the construction and operation of integrated circuits, printed circuit boards, modular circuitry and silicon controlled rectifiers. Textbook pages 136 through 140.

6-54. An integrated circuit is the equivalent of

1. connecting several circuits together on one plug-in board
2. connecting discrete electronic components together in one small package
3. molding parts together into several small units
4. using thin metal strips to replace wires



D-1-55

Figure 6B.-Differential amplifier, integrated circuit device.

6-55. In the differential amplifier, integrated circuit device shown in figure 6B, transistors Q3 and Q4 are operated as

1. input emitter followers
2. constant current sources for Q5
3. by-pass transistors for the control of stage gain
4. output emitter followers

6-56. The gain of the differential amplifier depicted in figure 6B is controlled by the application of a proper signal to the base of

1. Q5 from terminal F
2. Q4 from terminal C
3. Q2 from terminal D
4. Q3 from terminal C

● Items 6-57 through 6-60 are to be judged True or False.

6-57. An integrated circuit device such as that shown in figure 6-60 of your textbook requires no external connections for any of its operational conditions.

6-58. Printed circuit boards are normally constructed of ferrous metals.

6-59. The configuration of printed circuit boards may be standardized by molding.

6-60. The function of a printed circuit board is to replace as many passive circuit components as possible.

6-61. What is the basic building block for modular circuits?

1. A metal disk
2. A ceramic wafer
3. A glass rod
4. A cube of N or P material

6-62. To what extent will the average technician service defective modular circuits?

1. Replacing subminiature components
2. Rebuilding entire modules
3. Replacing entire modules
4. Resoldering printed portions of modules

6-63. What type of device is the typical silicon controlled rectifier (SCR)?

1. A two junction semiconductor diode
2. A three junction semiconductor diode
3. An RC net
4. An LC net

6-64. An SCR's breakdown voltage differs from its forward blocking voltage in that the breakdown voltage will cause the SCR to

1. switch on
2. switch off
3. enter its avalanche condition
4. reach a point just under its conduction state

6-65. When is an SCR's forward blocking region largest?

1. When its gate current is negative
2. When its gate current is zero
3. When it reaches its maximum reverse voltage
4. When it reaches its maximum reverse avalanche region

6-66. An increase of an SCR's gate current _____(A)_____ forward bias and
increases, decreases
causes breakdown voltage to occur ____(B)____ than without the increase.
later, sooner

1. (A) increases, (B) later
2. (A) decreases, (B) later
3. (A) increases, (B) sooner
4. (A) decreases, (B) sooner

6-67. What is one way to turn off an SCR that has reached its highest conduction region?

1. Increase its gate current
2. Apply a voltage to its anode that will make it positive with respect to the cathode
3. Decrease its gate current
4. Apply a voltage to its anode that will make it negative with respect to the cathode

6-68. What is the maximum phase angle conducting point that is allowed by the circuit shown in figure 6-64 of your textbook?

1. 0 electrical degrees
2. 90 electrical degrees
3. 180 electrical degrees
4. 270 electrical degrees

6-69. What are the limits of phase angle conduction provided by the R CONTROL shown in figure 6-64 of your textbook?

1. 0 to 90 electrical degrees
2. 90 to 180 electrical degrees
3. 180 to 270 electrical degrees
4. 270 to 360 electrical degrees

6-70. The purpose of the diode shown in figure 6-64 of your textbook is to

1. cause breakover
2. prevent breakover
3. prevent reverse avalanche
4. cause conduction past 90 electrical degrees

Assignment 7

Transistors; Electron Tubes

Textbook Assignment: Pages 140 through 162

Learning Objective: Recognize some logical steps used in troubleshooting transistor circuits and determine the use of an ohmmeter in testing transistors. Textbook pages 140 through 142.

7-1. The first step that should be performed when making a resistance measurement of a transistor circuit is to

1. connect a common ground between the test equipment and the circuit
2. disconnent all power to the circuit and discharge all of the circuit's capacitors
3. remove all of the circuit's transistors
4. short out all of the circuit's transistors

7-2. An RF signal generator that has a transformerless power supply may be used on a transistor circuit only when

1. a common ground is attached between the generator and the circuit
2. the transistor circuit has an isolated power supply
3. an isolation transformer is connected between the power line and the generator
4. both 1 and 3 above are observed

Items 7-3 through 7-7 are to judged True or False.

7-3. Excessive collector leakage current in a transistor may be the result of normal aging.

7-4. I_{CO} tests may be performed with the transistor either in or out of its associated circuit.

7-5. The only device needed to test all transistor characteristics is an ohmmeter.

7-6. When testing transistors, damage may occur to the transistor if you use either the highest or the lowest resistance ranges of an ohmmeter.

7-7. **Only ohmmeters that draw one milliampere of current, or less, should be used for transistor testing.**

Learning Objective: Recognize the characteristics of diode components and their functions. Text pages 143 through 147.

7-8. Material, such as tungsten, which will emit electrons easily and rapidly would be used in construction of which tube element?

1. Anode
2. Cathode
3. Control grid
4. Screen grid

7-9. Normally, in a heated cathode tube, when will the first emission of electrons from the cathode occur?
1. When the anode is positive with respect to the cathode
2. When the cathode is positive with respect to the anode
3. When the anode is heated
4. When the cathode is heated

7-10. What is the relative rate of emission in an indirectly heated cathode under conditions of mildly fluctuating heater current?
1. Oscillating
2. Decreasing
3. Increasing
4. Constant

7-11. What is one disadvantage in using a directly heated cathode when compared to an indirectly heated cathode within the range of their capabilities under the conditions of current fluctuation?
1. Excessive ionization
2. Varying filament temperature
3. Excessive space charge
4. Plate overheating

7-12. What causes the initial emission in a cold cathode electron tube?
1. Thermal agitation of the anode
2. Potential difference between the anode and cathode
3. Gas ionization within the envelope of the tube
4. Thermionic emission of the cathode

7-13. Normally what features of the following two characteristics are considered in the selection of the material to be used in the construction of the anode of vacuum tubes?
1. Low electron emission and low heat dissipation
2. Low electron emission and high heat dissipation
3. High electron emission and low heat dissipation
4. High electron emission and high heat dissipation

7-14. The number of electrons attracted from the heated cathode to the plate of a diode tube, at a given operating temperature, is determined by the
1. current flow in the cathode
2. current flow in the plate
3. amount of positive space charge
4. potential difference between plate and cathode

7-15. When does plate current flow in a diode?
1. Only when the plate is negative with respect to the cathode
2. Only when the plate is positive with respect to the cathode
3. Only when the plate is at the same potential as the cathode
4. At all times when the plate is heated

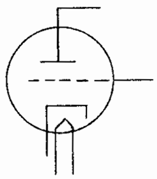
7-16. The presence of what gas in the envelope of the electron tube would encourage the rapid burnout of the heater?
1. Xenon
2. Oxygen
3. Argon
4. Neon

7-17. What is the highest plate negative-cathode positive voltage that an electron tube can withstand without breaking down the anode-cathode dielectric?
1. Peak inverse voltage
2. Maximum peak plate current
3. Maximum average current
4. Plate dissipation

7-18. What is the "dielectric" of the electron tube?
1. The non-emitting material of the anode
2. The heating material of the filament
3. The condition of vacuum of the envelope
4. The emitting material of the cathode

7-19. Which of the following schematic symbols depicts an indirectly heated diode?

1.



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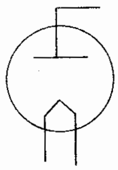

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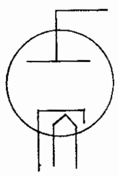

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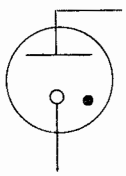
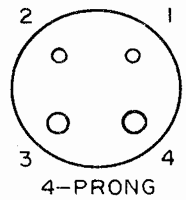


7-20. Which of the following electron circuit components normally has the shortest life expectancy?

1. Resistors
2. Capacitors
3. Tubes
4. Transistors

7-21. Which of the following schematics of tube bases is numbered correctly?

1.



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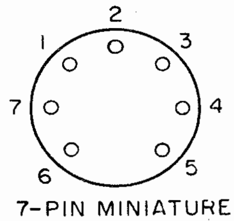

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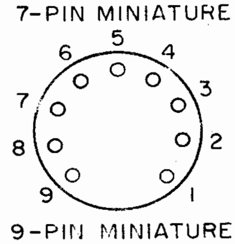

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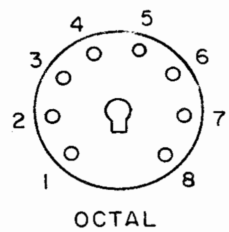


7-22. What area of the E_b - I_b characteristic curve in figure 7-7 of your textbook is essentially linear?

1. O to A
2. A to B
3. B to C
4. A to C

7-23. Saturation voltage is reached when an increase in plate voltage does not produce a corresponding increase in
1. heater voltage
2. grid current
3. cathode temperature
4. plate current

7-24. What is the opposition to current flow from cathode to plate of an electron tube?
1. Plate resistance
2. Vacuum resistance
3. Filament resistance
4. Cathode resistance

Learning Objective: Identify the functions and characteristics of the control grid and tube constants. Text pages 148 through 153.

7-25. What electrode gives a triode tube the ability to amplify?
1. Grid
2. Plate
3. Filament
4. Cathode

7-26. The voltage applied between the grid and cathode of a triode to control the level of conduction is known as the
1. accelerating potential
2. static characteristic
3. bias
4. space charge

7-27. The purpose of the grid in a triode is to
1. neutralize eddy currents
2. increase secondary emission
3. reduce the voltage of the cathode
4. control the plate current

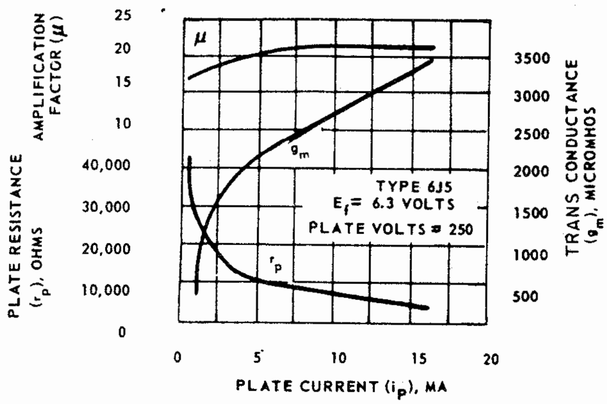
7-28. A small change in the input signal to the grid of a triode results in
1. cutoff of grid current
2. a comparatively large change to the output signal
3. a comparatively small change to the output signal
4. no change to the output signal

7-29. With a constant cathode temperature, the characteristics of an electron tube with cathode, grid, and plate elements involve the relationship between
1. plate current, grid current, and plate voltage
2. grid current, secondary emission, and plate voltage
3. grid voltage, plate resistance, and the resulting plate voltage
4. grid voltage, plate voltage, and the resulting plate current

● Although the amplification factor (μ), dynamic plate resistance (r_p), and transconductance (g_m) are called tube constants, these quantities do not remain constant over the operating range of an electron tube. The graph in figure 7A shows that as the plate current is varied, the value of μ remains almost constant, but g_m increases and r_p decreases.

Tube manuals give values of μ, r_p, and g_m for most tube types, but it must be remembered that these values hold true only for a particular set of operating conditions. If any of the operating voltages are changed, the values of the tube constants will change. The general relationships between the curves will be similar to those shown in the graph.

Of the three tube constants, g_m is the most important in indicating the amplifying properties of the tube. Tubes having a high g_m are capable of passing high currents and so are used in power amplifier stages. Voltage amplifier stages require tubes having low values of g_m. The plate current in this type of tube is low; but because the plate load resistance is high, there is a large output voltage.



D-1-56

Figure 7A.-Variation of μ r_p, and g_m over the operating range of an electron tube.

7-30. The amplification factor (mu) of an electron tube is the
1. emission of electrons knocked loose from the plate, grid, or screen by the impact of electrons arriving from the cathode
2. condition existing when the source of voltage is in series with an inductor and capacitor whose reactances cancel each other at the applied frequency reducing the impedance to a minimum
3. ratio of a change in plate voltage to a change in grid voltage, with all other electrode voltages constant, required to produce the same change in plate current
4. internal resistance to the flow of alternating current between the cathode and plate

7-31. What change in the physical construction of a vacuum tube would increase the a.c. plate resistance?
1. Decreasing the number of grid turns
2. Decreasing the distance between the grid and plate
3. Increasing the distance between the grid and plate
4. Increasing the size of the cathode

7-32. What operating values of grid bias and plate voltage cause the highest variation of a.c. plate resistance?
1. High negative grid bias and high plate voltage
2. High negative grid bias and low plate voltage
3. Low negative grid bias and high plate voltage
4. Low negative grid bias and low plate voltage

7-33. What type of tube would normally be used as a voltage amplifier?
1. One low in transconductance and having a low plate load resistance
2. One low in transconductance and having a high plate load resistance
3. One high in transconductance and having a low plate load resistance
4. One high in transconductance and having a high plate load resistance

7-34. What change in the physical construction of an electron tube would increase the transconductance of the tube?
1. Decreasing the number of grid turns
2. Decreasing the distance between the grid and plate
3. Increasing the distance between the grid and plate
4. Increasing the size of the cathode

Learning Objective: Recognize the characteristics of a typical triode amplifier circuit. Text pages 153 through 156.

7-35. What is the location of the plate load resistor in a typical triode amplifier circuit?
1. In parallel with the a.c. plate resistance
2. In series with th a.c. plate resistance
3. In parallel with the grid signal resisto
4. In series with the grid signal resistor

7-36. What is the relationship of the three voltages found in the plate circuit of a triode amplifier?
1. $E_b = E_{RL} + E_{bb}$
2. $E_{RL} = E_b - E_{bb}$
3. $E_{bb} = E_b + E_{RL}$
4. $E_b = E_{RL} - E_{bb}$

7-37. What will be the value of e_{RL} and e_b in figure 7-20 of your textbook when E_{cc} is a negative 3 volts and i_b is 5 ma?
1. e_{RL} = 350 volts ; e_b = 125 volts
2. e_{RL} = 225 volts ; e_b = 125 volts
3. e_{RL} = 350 volts ; e_b = 225 volts
4. e_{RL} = 125 volts ; e_b = 225 volts

● For questions 7-38 to 7-42 use figure 7-22 A and B of your textbook with the following changes, e_g equal to 5 volts peak to peak, with maximum current of 12 ma and minimum current of 2 ma.

7-38. What is the operating point or Q point of this circuit?
1. -1 volt
2. -3.5 volts
3. -5 volts
4. -6 volts

7-39. What is the peak to peak bias level of this circuit?
1. + 1.5 to -3.5
2. - 2 to -5
3. - 1 to -6
4. - 3.5 to -6.5

7-40. What is the maximum plate voltage of this circuit?
1. 50 volts
2. 175 volts
3. 300 volts
4. 350 volts

7-41. What is the maximum variation of plate voltage in this circuit?
1. 100 volts
2. 150 volts
3. 200 volts
4. 250 volts

7-42. What is the amplification factor of this circuit?
1. 20
2. 30
3. 40
4. 50

Learning Objective: Recognize the functions and characteristics of screen grids. Text pages 156 through 158.

7-43. An electron tube that contains 4 electrodes is referred to as a
1. diode
2. tetrode
3. triode
4. rectifier

7-44. What is one of the primary functions of the screen grid in a four-electrode tube?
1. To control plate current
2. To reduce plate-to-control grid capacitance
3. to increase plate-to-control grid feedback
4. To suppress secondary emission

7-45. What effect on cathode current does variations in plate voltage have in tetrodes?
1. Cathode current increases
2. Cathode current decreases
3. Cathode current changes very little
4. Cathode current varies

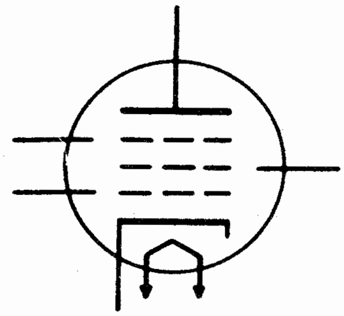
7-46. In figure 7-27 of your textbook when i_b increases on the linear portion of the curve, what happens to i_k?
1. i_k decreases
2. i_k remains constant
3. i_k increases
4. i_k oscillates

7-47. In figure 7-28 of your textbook, if i_{c2} is 2 ma and i_k is 12 ma, what is the value of i_b?
1. 6 ma
2. 8 ma
3. 10 ma
4. 14 ma

7-48. As the plate voltage increases in regions of negative resistance, the plate current of a tetrode decreases because of the
1. decreased voltage on the control grid
2. decreased emission from the cathode
3. increased shielding effect of the screen grid
4. increased secondary emission from the plate

7-49. In a tetrode, the main electrostatic force that draws electrons from the cathode is the
1. control grid
2. plate
3. screen grid
4. accelerator grid

Learning Objective: Recognize the characteristics of both normal and variable mu pentodes. Text pages 158 and 159.



D-1-57

Figure 7B. - A multi-element tube.

7-50. What type of electron tube does figure 7B represent?
1. Tetrode
2. Triode
3. Pentode
4. Twin-diode

7-51. What two elements of the electron tube in figure 7B are commonly connected together?
1. Cathode and control grid
2. Cathode and supressor grid
3. Control grid and supressor grid
4. Screen grid and plate

7-52. One of the supressor grid functions of the electron tube in figure 7B is to
1. reduce the secondary emission space charge
2. reduce the grid-to-plate capacitance
3. increase the screen current
4. increase the negative feedback

7-53. In which of the e_b - i_b curves shown in figure 7-30 of your textbook do we find the dynatron region?
1. Tetrodes but not pentodes
2. Both pentodes and tetrodes
3. Pentodes but not tetrodes
4. Only pentodes with e_g of a negative 3 volts

7-54. What spacing is used between the grid turns in a variable mu tube?
1. Equally throughout the length of the grid
2. Close at the center, and wide at the ends
3. Wide at the center, and close at the ends
4. Close at the top and wide at the bottom

7-55. What is the main difference between a sharp-cutoff tube and a remote-cutoff tube?
1. The sharp-cutoff tube requires a greater negative grid voltage to interrupt plate current.
2. The output signal of a sharp-cutoff tube is almost independent of the strength of the input signal.
3. The remote-cutoff tube requires a much greater value of bias to interrupt plate current.
4. The remote-cutoff tube has a reduced range of signal-handling capability.

7-56. An automatic-gain-control circuit uses the special characteristics of the
1. remote cutoff tube
2. beam-power tube
3. conventional pentode
4. conventional triode

7-57. The cutoff bias for the conventional tube in figure 7-33 is approximately
1. 0 V
2. -6 V
3. -8 V
4. -20 V

7-58. In a tetrode power amplifier, the electron beams are directed to
1. increase the effects of secondary emission
2. the screen grid instead of the plate
3. increase its power handling capabilities
4. the beam forming plates

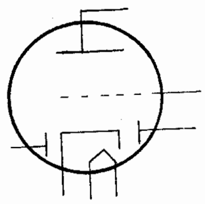
7-59. A change of the grid voltage from -6 volts to -10 volts on the remote-cutoff tube curve in figure 7-33 will cause the value of the amplification factor to
1. increase
2. remain constant
3. decrease
4. vary from 3 to 100

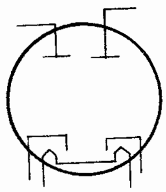
Learning Objective: Recognize structural characteristics of beam power and other speciality tubes. Text pages 160 and 161.

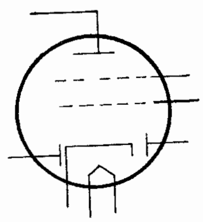
7-60. What accounts for reduction of secondary emission in a beam-power tube?
1. The reduced plate current
2. The beam-forming plates
3. The space charge
4. The decreased plate voltage

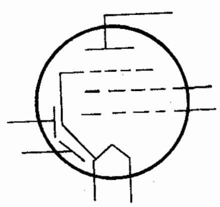
7-61. In the power pentode, what tube element replaces the beam forming plates of the beam power tetrode?
1. Plate
2. Screen grid
3. Control grid
4. Supressor grid

7-62. Which of the following schematics of multi-unit tubes represents a twin-diode tetrode?

1. 

2. 

3. 

4. 

. . . .

. Learning Objective: Identify the characteristics of various types of amplifiers. Text pages 161 through 163.

. . . .

7-63. Which of the following statements applies to class-A_1 voltage amplifiers?
1. The grid is driven positive at some time during the input-signal cycle.
2. Plate current flows during the entire input-signal cycle.
3. Plate efficiency exceeds 60 percent.
4. Grid current flows during part of the input-signal cycle.

7-64. Which of the following types of amplifiers produces an output waveform that most nearly resembles the grid input waveform?
1. Class-A
2. Class-AB_1
3. Class-AB_2
4. Class-C

7-65. How does class-AB_2 operation of an amplifier differ from class-AB_1 operation?
1. Grid current flows during positive input peaks in the class-AB_1 amplifier.
2. Grid current flows during positive input peaks in the class-AB_2 amplifier.
3. Plate current flows for less than half the input cycle in the class-AB_1 amplifier.
4. Plate current flows for less than half the input cycle in the class-AB_2 amplifier.

7-66. Which class of amplifier is biased approximately at cutoff?
1. A
2. AB
3. B
4. C

7-67. In which class of amplifiers does plate current flow during less than half of each cycle?
1. A
2. AB
3. B
4. C

7-68. What are the impedance characteristics of the grounded cathode amplifier?
1. Low input and low output
2. High input and low output
3. Low input and high output
4. High input and high output

7-69. In which of the following types of basic amplifiers does phase reversal of the signal occur?
1. Grounded cathode
2. Grounded grid
3. Grounded screen
4. Grounded plate

Assignment 8

Electron Tubes; Electronic Voltage Regulators and Meters; Fundamentals of Communication Theory

Textbook Assignment: Pages 162 through 184

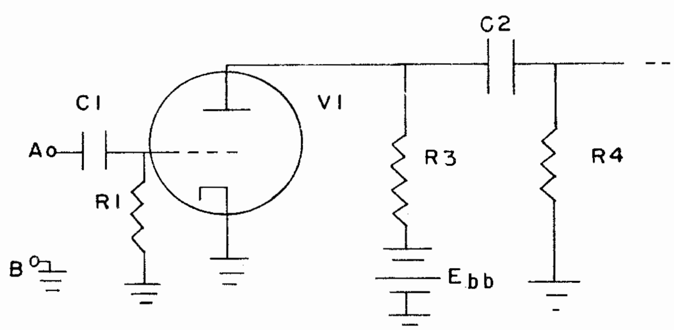
Learning Objective: Recognize the characteristics of self biasing circuits and the value of the circuits components. Text pages 164 through 165.

8-1. What is the normal bias condition in an electron tube amplifier?
1. Cathode negative in respect to the control grid
2. Control grid negative in respect to the cathode
3. Plate negative in respect to the cathode
4. Plate negative in respect to the control grid

8-2. In figure 7-40 of your textbook, which component keeps the cathode bias constant under conditions of varying plate current?
1. R_g
2. R_k
3. C_k
4. R_L

8-3. In figure 7-40 of your textbook, what percentage of the bias resistance should the reactance of C_k have at the lowest frequencies for which the circuit is designed?
1. 5%
2. 10%
3. 20%
4. 40%

8-4. In figure 7-40 of your textbook, what is the value of R_k when plate current is 10 ma and the desired cathode biasing is 6 volts?
1. 6 ohms
2. 60 ohms
3. 600 ohms
4. 6, 000 ohms



D-1-58

Figure 8A. -An RC Coupled Amplifier.

8-5. What is the function of R1 in figure 8A?
1. To develop cathode bias
2. To increase inductance in the plate circuit
3. To control the charge potential of C2
4. To develop grid-leak bias

8-6. When a positive input is applied to the circuit shown in figure 8A, the coupling capacitor C1 will ____(A)____ and when the charge, discharge input swings negative, C1 will ____(B)____. charge, discharge

1. (A) charge, (B) charge
2. (A) charge, (B) discharge
3. (A) discharge, (B) charge
4. (A) discharge, (B) discharge

8-7. What is the discharge path of C1 in figure 8A?

1. Cathode to plate to R3
2. R1 to cathode to C1
3. R3 to C2 to R4
4. C1 to R1 to point B

8-8. If the lowest input frequency is 100 hertz what should be the discharge time of R1 - C1 in figure 8A?

1. 0.01 sec.
2. 0.07 sec.
3. 0.10 sec.
4. 0.70 sec.

Learning Objective: Recognize the characteristics of amplifier coupling circuits. Text pages 167 through 170.

8-9. The low-frequency response of an RC coupled amplifier can be varied by

1. decreasing the size of the plate load resistor
2. increasing the size of the cathode bypass capacitor
3. decreasing the size of the grid resistor
4. increasing the size of the coupling capacitor

8-10. The middle-frequency equivalent-load circuit of a resistance-coupled amplifier appears to the generator as a

1. complex a.c. network
2. complex impedance
3. simple reactance
4. simple resistance

8-11. What should be the middle frequency value of R_g in figure 7-45 of your textbook to ensure no shunting of a plate load resistor whose value is 200,000 ohms?

1. 0.1 - 0.4 megohms
2. 0.4 - 0.8 megohms
3. 1.0 - 4.0 megohms
4. 4.0 - 8.0 megohms

8-12. The high-frequency gain of impedance-coupled amplifiers tends to fall more sharply than that of resistance-coupled stages because of the rapid

1. decrease of incremental inductance
2. increase of load impedance
3. rise of coupling reactance
4. increase in the effect of shunt capacitance

8-13. The high-frequency limits of a transformer-coupled amplifier is determined by the effective shunt capacitance and the

1. primary inductance of the transformer
2. secondary inductance of the transformer
3. transformer impedance
4. total leakage reactance of the transformer

8-14. At what point on the voltage divider shown as part of the direct-coupled amplifier in figure 7-51 of the textbook would the greatest positive voltage be obtained?

1. Point B
2. Point C
3. Point D
4. Point E

8-15. The factors that determines the proper grid bias for V2 in figure 7-51 of your textbook includes the value of resistor R_{L1} and the voltage value at point

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

- Use the following alternatives for items 8-16 through 8-19:
  1. Resistor-capacitor coupling
  2. Impedance coupling
  3. Transformer coupling
  4. Direct coupling

8-16. Which type of coupling produces additional gain beyond tube characteristics?

8-17. Which type of coupling produces no phase distortion?

8-18. Which type of coupling combines small size and economy?

8-19. Which type of coupling does not isolate the grid from the plate voltage of the preceeding circuit?

> Learning Objective: Recognize characteristics of the cold cathode voltage regulator. Text pages 171 through 172.

8-20. What does the presence of a small black dot inside the circle of a tube schematic indicate?
1. Inner metal shield
2. Socketless
3. Grounded connection
4. Gas-filled

8-21. In a 105 volt VR tube, which of the following would be a possible firing voltage?
1. 83 volts
2. 107 volts
3. 123 volts
4. 147 volts

8-22. As the input voltage increases, what happens to the voltage drop across R_s in figure 7-53 of your textbook?
1. Increases
2. Decreases
3. Remains the same
4. Fluctuates

8-23. What happens to the current through a cold cathode voltage regulator tube when the load current increases?
1. It increases
2. It decreases
3. It remains the same
4. It fluctuates

> Learning Objective: Recognize the purpose of voltage regulators and compare equivalent resistive networks of shunt and series regulators. Text pages 173 through 175, table 8A and associated study hint.

8-24. One purpose for using transistors and electron tubes in voltage regulators is to
1. decrease current capabilities
2. decrease voltage capabilities
3. increase current capabilities
4. increase voltage capabilities

8-25. What would be a valid statement about the regulation efficiency of shunt and series voltage regulators?
1. Shunt regulators are more efficient and least used
2. Shunt regulators are more efficient and most used
3. Series regulators are more efficient and least used
4. Series regulators are more efficient and most used

8-26. In ____(A)____ regulators the total
shunt, series
current is divided between the regulator and the load while in
____(B)____ regulators the total
shunt, series
current passes through both the regulator and load.
1. (A) shunt, (B) shunt
2. (A) shunt, (B) series
3. (A) series, (B) shunt
4. (A) series, (B) series

8-27. In what manner do shunt and series regulators function?

1. Both series and shunt regulate by current division
2. Both series and shunt regulate by voltage division
3. Series regulate by voltage division and shunt by current division
4. Series regulates current division and shunt by voltage division

● In order to understand the operation and differences of the shunt (parallel) and series voltage regulators, an understanding of the equivalent resistive networks is important. The following formulas will be helpful in answering questions 8-28 through 8-38.

Shunt (parallel) voltage regulators:

$I_{R_s} = I_{R_V} + I_{R_L}$ - The current through the dropping resistor is the sum of the current through both the regulator and the load.

$I_{R_L} = \frac{E_{out}}{R_L}$ - The current through the load is the regulated output voltage divided by the resistance of the load.

$E_{R_s} = E_{in} - E_{out}$ - The voltage drop across the dropping resistor is the difference between the unregulated input voltage and the regulated output voltage.

Series voltage regulators:

$I_{R_s} = I_{R_L}$ - In the series circuit the current through the load and regulator are the same. (In this circuit the regulator also acts as a dropping resistor).

$I_{R_L} = \frac{E_{out}}{R_L}$ - The same as found in the shunt circuit.

$I_{R_s} = \frac{E_{R_s}}{R_s}$ - The same as found in the shunt circuit.

● To answer items 8-28 through 8-38 refer to the Circuit/Component values listed in Table 8A, which are applicable to figures 8-1 and 8-4 in your textbook.

	Figure 8-1	Figure 8-4
R_L	10,000 ohms	10,000 ohms
Regulated Output Voltage	100 volts	100 volts
Unregulated Input Voltage	120 volts	120 volts
R_s	800 ohms	0 to 50,000
R_V	0 to 50,000 ohms	

Table 8A- Circuit/Component Values

8-28. What is the current through R_S in figure 8-1 of your textbook when R_V is set to its minimum value and no load is attached?

1. 100 ma
2. 150 ma
3. 200 ma
4. 250 ma

8-29. What is the current through R_s in figure 8-4 of your textbook?

1. 10 ma
2. 15 ma
3. 20 ma
4. 25 ma

8-30. What is the current flow through R_V in figure 8-1 of your textbook when the value of R_L is decreased to 5,000 ohms?

1. 5 ma
2. 10 ma
3. 20 ma
4. 25 ma

8-31. What is the current flow through Rs in figure 8-4 of your textbook when the value of R_L is increased to 15,000 ohms?

1. 0.067 ma
2. 0.67 ma
3. 6.7 ma
4. 67.0 ma

8-32. Shunt regulators have an advantage over series regulators because they

1. are highly efficient under low load conditions
2. will not overload when the load current is high
3. draw maximum current during full load conditions
4. respond only to large changes in load requirements

8-33. The unregulated input voltage in figure 8-1 of your textbook increases to 140 volts. What is the current flow through R_V?

1. 10 ma
2. 20 ma
3. 30 ma
4. 40 ma

8-34. The unregulated input voltage in figure 8-4 increases to 140 volts. What is the current flow through R_S?

1. 10 ma
2. 20 ma
3. 30 ma
4. 40 ma

8-35. **In figure 8-1 of the text, what will happen to the current flow through Rv, when the load impedance increases and the input voltage remains constant?**

1. **Current decreases**
2. **Current increases**
3. **Current will remain the same**

8-36. The resistance of R_L in figure 8-1 of your textbook is decreased to zero ohms. What is the current flow through R_V?

1. 0 ma
2. 20 ma
3. 40 ma
4. 60 ma

8-37. The resistance of R_L in figure 8-4 of your textbook decreases to ten ohms. What is the current flow through R_S?

1. 10 a
2. 20 a
3. 40 a
4. 60 a

8-38. What is the purpose of the zener diode used in the shunt voltage regulator in figure 8-2 of your textbook?

1. To limit the current through R_S
2. To maintain a constant voltage at the load
3. To maintain a constant voltage at the emitter of Q_1
4. To keep the current through R_1 constant

Learning Objective: Recognize the operational characteristics of the circuit elements found in shunt, series, and shunt detected series voltage regulators. Text pages 174 through 178.

8-39. What effect, if any, will an increase in output voltage have on the current flow through R_S in figure 8-2 of your textbook?
1. It will increase
2. It will decrease
3. It will not be affected
4. It will remain the same

8-40. Which of the following elements associated with figure 8-2 of your textbook is used to adjust the regulated output voltage?
1. CR_1
2. R_1
3. R_2
4. R_S

8-41. A fixed base voltage is maintained on Q_1 in figure 8-5 of your textbook by the elements that are designated
1. CR_1 and RL
2. R_1 and CR_1
3. Q_1 and CR_1
4. R_1 and R_L

8-42. What would happen to the internal resistance of Q_1 in figure 8-5 in your textbook if the line voltage decreased?
1. It would not be affected
2. It would decrease
3. It would increase
4. It would remain the same

8-43. Refer to figures 8-4 and 8-5 in your textbook. Which part of the solid state series regulator performs the same function of varying resistance as R_S does in the series regulator?
1. R_L
2. CR_1
3. Q_1
4. R_1

8-44. What functions are performed by transistors Q1 and Q2 shown on figure 8-8 of your textbook?
1. Q1 provides control and Q2 provides series regulation
2. Both Q1 and Q2 provide control
3. Q1 provides series regulation and Q2 provides control
4. Both Q1 and Q2 provide series regulation

8-45. What element in figure 8-8 of your textbook is used to adjust the regulated output voltage?
1. R_1
2. R_2
3. R3
4. R_4

8-46. To which of the following components can tube V1 in figure 8-6 of the textbook be compared?
1. A variable resistance
2. A variable inductance
3. A fixed resistance
4. A constant current generator

8-47. An increase in the load resistance in the voltage regulator in figure 8-6 of the textbook will cause the grid bias of tube V1 to
1. remain constant
2. drop to zero
3. decrease
4. increase

8-48. What is the function of R_2 in the regulator circuit in figure 8-9 of the textbook?
1. To limit the amount of current drawn by V_3
2. To provide a path for the initial ionization potential for V_3
3. To limit the flow of cathode current in V_2
4. To keep the cathode of V_2 at a constant potential

8-49. Which element in figure 8-9 of your textbook acts as a series regulator?
1. V_1
2. V_2
3. V_3
4. R_2

8-50. A pentode is used in the regulator circuit of figure 8-9 of the textbook because of its
1. stable operation
2. high amplification factor
3. low internal impedance
4. high peak-inverse voltage rating

8-51. Resistor R_4 in figure 8-9 of your textbook is used to maintain the
1. sensitivity of the VR tube
2. magnitude of the output voltage
3. required load current to a minimum
4. percentage of output ripple at a high value

8-52. What is the advantage, if any, of using a pentode instead of a triode as the control tube in the circuit shown in figure 8-9 of your textbook?
1. It provides for better regulation
2. Its high sensitivity permits a higher fluxation of load voltages
3. Its high amplification factor does not permit any changes
4. There is no advantage

Learning Objective: Recognize the adaptations needed in voltage regulators to permit them to carry out special functions. Text page 178.

8-53. Which of the following will increase the current capabilities of the solid state shunt detected series voltage regulator in figure 8-8 of your textbook?
1. Adding a transistor in series with Q_2
2. Adding a transistor in parallel with Q_2
3. Adding a transistor in series with Q_1
4. Adding a transistor in parallel with Q_1

8-54. You can improve the sensitivity of a shunt detected series voltage regulator as found in figure 8-7 of your textbook by the addition of an additional
1. regulator circuit
2. d.c. amplifier stage
3. control circuit
4. detector stage

Learning Objective: Determine the primary advantage of an electron-tube voltmeter over a conventional multimeter and some of the electron-tube voltmeter's characterisitics. Text pages 179 through 182.

8-55. The primary advantage of an electron-tube voltmeter over a conventional multimeter is its
1. wide voltage range
2. low input impedance
3. high sensitivity
4. high indicator accuracy

8-56. The conventional nonelectronic voltmeter is not suitable for accurate d.c. voltage measurements in many circuits because of its
1. poor frequency response
2. nonlinear scale
3. high input resistance
4. low input resistance

● Items 8-57 through 8-62 refer to the the electron-tube voltmeter sections of a representative electronic mulitmeter shown in figure 8-13 of your textbook.

8-57. What type of input circuit is used in the d.c. electron-tube voltmeter in figure 8-13 (B)?
1. RC pi-filter
2. Resistive voltage divider
3. Capacitive voltage divider
4. Open grid circuit

8-58. To which of the following parts of the tube is the meter connected in the electron-tube voltmeter?
1. Plate
2. Cathode
3. Control grid
4. Screen grid

8-59. The meter of the electron-tube voltmeter is actuated by a direct current on
1. the a.c. ranges only
2. the d.c. ranges only
3. both the a.c. and the d.c. ranges
4. neither the a.c. nor the d.c. ranges

8-60. What type of operating bias is supplied to the bridge tubes of the electron-tube voltmeter?
1. Grid-leak bias
2. Contact-potential bias
3. Cathode self bias
4. Regulated fixed bias

8-61. Appreciable errors may result when the electron-tube voltmeter is used for voltage measurements at high frequencies because of the
1. low input resistance
2. high input capacitance
3. attenuation of the signal by the bridge
4. low efficiency of the diode rectifier

8-62. The meter in the electron-tube voltmeter indicates the
1. current through the multiplier resistor
2. plate current of the d.c. amplifier
3. plate current of a rectifier
4. unbalance current of a d.c. bridge

8-63. Assume the galvanometer shown in figure 8-14 of your textbook reads zero volts, the reference voltage is 50 volts, the value of resistor R1 is 30,000 ohms, and the value of resistor R2 is 10,000 ohms. What is the value of the input voltage?
1. 18.75 volts
2. 37.5 volts
3. 50.0 volts
4. 75.0 volts

Learning Objective: Identify the term radio, the most common methods of communications used by the Navy, and the broad categories of radio equipment used in communications. Text page 183.

8-64. Radio can be defined in several ways. Briefly, radio can be described as the ______ (A) ______ flight, transmission

of signals through space by means of ______ waves.
electromagnetic, air

1. (A) transmission (B) electromagnetic
2. (A) flight (B) air
3. (A) flight (B) electromagnetic
4. (A) transmission (B) air

8-65. Radio equipment is divided into the following broad categories

1. receivers and power supplies
2. transmitters and receivers
3. transmitters and oscillators
4. power supplies and oscillators

Items 8-66 through 8-69 are to be judged True or False.

8-66. Radioteletype (FSK) is the sending and receiving of messages from a teletype writer or coded tape over a radio frequency channel.

8-67. Radiofacsimile (FAX) is the transmission of still images such as photographs and weather maps over a radio frequency channel.

8-68. Radiotelegraphy (CW) is the sending and receiving of intelligence coded radio frequencies in the form of dots and dashes.

8-69. Radiotelephone is the transmission of audible signals by means of radio frequency waves.

Learning Objective: Recognize some of the frequency bands in the frequency spectrum and how these frequency bands are used in Naval communications. Text pages 183 through 184.

Band No.	Band	Frequency (MHz)				ABBR
1	Very low frequency	0. 01	to	0. 03	MHz	VLF
2	Low frequency	0. 03	to	0. 3	MHz	LF
3	Medium frequency	0. 3	to	3	MHz	MF
4	High frequency	3	to	30	MHz	HF
5	Very high frequency	30	to	300	MHz	VHF
6	Ultra high frequency	300	to	3, 000	MHz	UHF
7	Super high frequency	3,000	to	30, 000	MHz	SHF
8	Extremely high frequency	30, 000	to	300, 000	MHz	EHF

Table 8-B- Frequency Spectrum

- To answer items 8-70 through 8-72 refer to Table 8 B.

8-70. Most shipboard radio communications equipment is designed to operate on band 4 which is suitable for long range communications. This band is composed of the

1. ultra high frequencies
2. very low frequencies
3. medium frequencies
4. high frequencies

8-71. Two of the requisites for effective transmission in the VLF and LF bands are sufficient power and long antennas. The Navy uses these bands for

1. shipboard communications
2. landline communications
3. shore station communications
4. shipboard and shore communications

8-72. For Navy purposes, UHF communications are conducted in a frequency range between 225 MHz and 400 MHz. In addition to the UHF frequencies, which bands in the higher frequency spectrums are used to operate radar and special equipment?

1. UHF, EHF
2. EHF, SHF
3. SHF, HF
4. HF, MF

Assignment 9

Fundamentals of Communication Theory; Tuned Circuits

Textbook Assignment: Pages 184 through 201

Learning Objective: Define an antenna and radio waves, and recognize some of their functions. Textbook page 184.

- Items 9-1 and 9-2 are to be judged True or False.

9-1. Antennas in their simplest forms and as most people know them may be just a length of elevated wire.

9-2. A communications antenna can be a conductor or a system of conductors that either radiate or intercept energy in the form of electromagnetic waves.

9-3. Which of the following components make up the ground portion of a radio wave?
1. Surface wave and sky wave
2. Surface wave and direct wave
3. Space wave and sky wave
4. Sky wave and direct wave

9-4. Ground waves are used for both long-range and short-range communications depending on the frequencies and power utilized; however, for long-range daylight communications in the high frequencies, the Navy utilizes the
1. skip wave
2. sky wave
3. surface wave
4. direct wave

9-5. Which portion of the ground wave is used for all VHF and UHF communications?
1. Sky wave
2. Skip wave
3. Direct wave
4. Surface wave

Learning Objective: Recognize a simple AM transmitter and some of its components, the function of the mixer stage and the purpose of the RF stage in a superheterodyne receiver. Textbook pages 184 through 185.

9-6. A very simple transmitter has been designed to operate on voice communications. This radio transmitting equipment is classified as
1. an FAX transmitter
2. a CW transmitter
3. an AM transmitter
4. an FSK transmitter

9-7. A basic transmitter used to produce audio signal intelligence has two power components consisting of power amplifier and a power supply. Name two other major components of this transmitter.
1. Detector and IF amplifier
2. RF amplifier and Detector
3. Mixer and Master Oscillator
4. Master Oscillator and modulator

9-8. The RF signal received by a superheterodyne receiver is converted to the intermediate frequency by the
1. local oscillator
2. mixer
3. IF amplifier
4. second detector

9-9. What is an important purpose of using an RF amplifier in the superheterodyne receiver?
1. To increase image reception
2. To increase antenna sensitivity
3. To isolate the internally generated signals from the antenna system
4. To eliminate the intermediate frequencies

Learning Objective: Recognize some of the limitations of transmitter/receivers, transceivers, and some of the factors that must be considered in designing shipboard radio equipment. Textbook page 186.

● Items 9-10 and 9-11 are to be judged True or False.

9-10. A transmitter/receiver unit coupled to one antenna is limited in that it cannot send and receive simultaneously.

9-11. A transceiver is similarly limited like a transmitter/receiver in that it cannot send and receive simultaneously, although a transceiver can be operated as two separate units.

Learning Objective: Recognize the function of an antenna multicoupling device, one important purpose for using multiplexing, and some of the methods of multiplexing used in radio communications. Textbook page 186.

9-12. The multicoupling device ____(A)____ the number of
increases, decreases

____(B)____ that have to be
antennas, transceivers

carried aboard ship.
1. (A) increases (B) transceivers
2. (A) decreases (B) antennas
3. (A) increases (B) antennas
4. (A) decreases (B) transceivers

9-13. To prevent further congestion of the frequency spectrum, an increase in message handling can be attained through
1. duplexing
2. multimetering
3. multicoupling
4. multiplexing

● In items 9-14 and 9-15 select from column B the description that shows the type of multiplexing in column A.

	A. Multiplexing-Types	B. Descriptions
9-14.	Frequency Division	1. slightly displaced in time
9-15.	Time Division	2. slightly displaced in time and frequency
		3. slightly displaced in frequency

Learning Objective: Recognize the general categories of frequency standards, location of radio stations that provide primary frequency standards, and the method of using frequency standards as a reference. Textbook pages 186 through 187.

9-16. The communications officer instructs you to get a frequency check on WWV. You immediately think of a big radio station in
1. Washington, D. C.
2. Hawaii
3. Colorado
4. New York

9-17. Naval Communications installations use frequency standards that are very reliable. The National Bureau of Standards classifies these frequencies as
1. secondary
2. substandard
3. permanent
4. primary

9-18. Frequency standards provide a very reliable and accurate frequency by which communicators or technicians may compare other
1. ships
2. operators
3. signals
4. messages

Learning Objective: Recognize some of the effects on communications caused by weather and atmospheric conditions, two methods used to counteract these conditions, and the effect on communications of a temperature increase in some regions of the troposphere. Textbook page 187.

9-19. Changes in a radio signal's received signal strength due to atmospheric or weather conditions is referred to as
1. baiting
2. fading
3. ducting
4. boating

- In items 9-20 through 9-22 select from column B the descriptions that define the methods in column A.

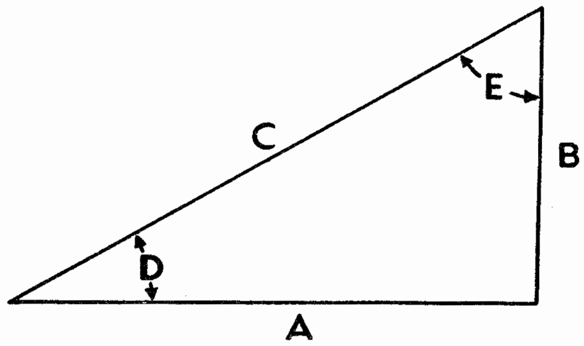
	A. Methods	B. Descriptions
9-20.	Frequency diversity	1. Combination of two or more sources of signal energy
9-21.	Space diversity	2. Two different carrier frequencies with similar modulation
9-22.	Diversity reception	3. Two different frequencies and two different antennas for each frequency
		4. Two or more antennas on same frequency feeding into individual receivers

---

9-23. In some regions of the troposphere, an increase in altitude will result in an increase in temperature. This condition is referred to as
1. temperature inversion
2. ionospheric conditions
3. tropospheric ducting
4. tropospheric decreases

9-24. Tropospheric ducting, a result of temperature inversion, affects radio waves with an increase in
1. height
2. distance
3. temperature
4. depth

Learning Objective: Recognize the various parts of an impedance triangle. Textbook page 188.



D-1-59

Figure 9A- Impedance triangle.

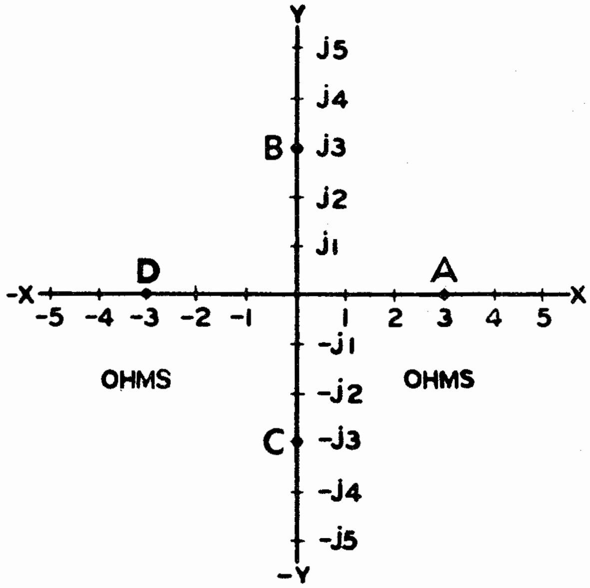
9-25. What part of the impedance triangle in figure 9A represents the resistance component of the circuit?
1. A
2. B
3. C
4. D

9-26. What part of the impedance triangle in figure 9A represents the reactive component of the circuit?
1. A
2. B
3. C
4. D

9-27. What part of the impedance triangle in figure 9A represents the phase angle between the voltage across the impedance and the current flowing through it?
1. B
2. C
3. D
4. E

Learning Objective: Determine the use of the j operator in electronic calculations and solve some problems using the j operator. Textbook pages 190 through 193.

9-28. What method is used in mathematics to represent a 90° clockwise rotation of vector quantity?
1. Dividing the vector quantity by + j
2. Multiplying the vector quantity +j
3. Dividing the vector quantity by - j
4. Multiplying the vector quantity by - j



D-1-60

Figure 9B-Rectangular coordinate axes.

9-29. What point in figure 9B represents a resistance of 3 ohms?
1. A
2. B
3. C
4. D

9-30. What point in figure 9B represents an inductive reactance of 3 ohms?
1. D
2. C
3. B
4. A

9-31. What point in figure 9B represents a capacitive reactance of 3 ohms?
1. D
2. C
3. B
4. A

9-32. What two points in figure 9B represent imaginary numbers in mathematics?
1. A and D
2. C and D
3. B and C
4. A and B

9-33. What is the sum of (1 + j3) and (2 + j5)?
1. (0 + j11)
2. (3 + j2)
3. (4 + j7)
4. (3 + j8)

9-34. What is the value of (-9 + j0) - (5 - j2)?
1. (-4 + j2)
2. (-14 + j2)
3. (-9 - j2)
4. (9 - j7)

● To answer item 9-35, remember that -(-1)6 = +6.

9-35. What is the product of (-4 + j1) and (1 - j2)?
1. (-6 + j9)
2. (-2 + j9)
3. (-5 + j3)
4. (-3 - j1)

● To answer item 9-36, remember that 3 + j0 = 3 and 0 + j = j.

9-36. What is the value of (9 + j3) ÷ (3 + j0)?
1. (3 + j1)
2. (3 + j0)
3. (3 - j3)
4. (3 + j3)

9-37. What is the value of (1 -j3) ÷ (-1 - j3)?
1. (0.8 - j0.6)
2. (0.8 + j0.6)
3. (0 - j)
4. (-1 + j0)

● Information for item 9-38:
tan 45°=1.00; sin 45°=.707
tan 53°=1.33; sin 53°=.799

9-38. What is the polar form of a vector whose rectangular form is 5 - j5?
1. 7.07 ∠ -45°
2. 7.07 ∠ +45°
3. 5.00 ∠ +53°
4. 5.00 ∠ -53°

9-39. What is the rectangular form of the vector 3∠ + 60?
1. 3 + j60
2. 3 sin 60° + j3 cos 60°
3. 3 + j4
4. 3 cos 60° + j3 sin 60°

9-40. What is the result of multiplying (2 ∠ + 5°) and (-3 ∠ + 15°)?
1. -6 ∠ + 20°
2. -6 ∠ + 75°
3. -1 ∠ + 20°
4. -1 ∠ + 75°

Learning Objective: Determine the relationship of voltage and current in a series RLC circuit and compute the impedance of some typical series RLC circuits. Textbook pages 194 through 195.

● Items 9-41 and 9-42 are to be judged True or False.

9-41. Voltage is the common reference for all three element currents in a series RLC circuit.

9-42. The vector sum of IR, IX_L and IX_C for a series RLC circuit equals the total voltage.

● Information for items 9-43 and 9-44:
A series RLC circuit has the following component values:

$R = 10$ ohms
$X_C = 20$ ohms
$X_L = 30$ ohms

9-43. What is the approximate impedance of the circuit?
1. 14.1 ohms
2. 28.2 ohms
3. 141.4 ohms
4. 282.8 ohms

9-44. If the reactances are both 20 ohms then the net reactance is ___(A)___ (0, 40), and the impedance becomes equal to the ___(B)___ (inductance, resistance).

1. (A) 0, (B) inductance
2. (A) 40, (B) resistance
3. (A) 40, (B) inductance
4. (A) 0, (B) resistance

Learning Objective: Recognize the relationship of current and impedance in a series RLC circuit at resonance and solve some problems involving series resonant RLC circuits. Textbook pages 195 through 196.

● Information for item 9-45:
A. The circuit impedance will be maximum
B. The circuit current will be minimum
C. The circuit impedance will be minimum
D. The circuit current will be maximum

9-45. Which of the above information correctly describes a series resonant RLC circuit (the inductive reactance equals the capactive reactance)?
1. A and B
2. B and C
3. A and D
4. C and D

● Mechanical resonance is a property of clock pendulums, tuning forks, and other mechanical systems. When the pendulum of a clock is set in motion, it swings back and forth at a specific rate. The rate of swing, which can be considered to be the resonant frequency of the pendulum, is determined by the mechanical properties of the device. As the pendulum swings back and forth, the energy it contains alternately changes from potential form when the pendulum is momentarily at rest at the extremes of its swing to kinetic form when the pendulum is in motion.

In principle, an electronic circuit composed of L, C, and R is similar to a pendulum. Such a circuit is said to be tuned to resonance when it responds to a particular frequency or band of frequencies, the resonant frequency being determined by the value of L times C. The circuit also has the property of storing energy which regularly changes from potential form (electric field, when the capacitor is charged) to kinetic form (magnetic field, when current flows through the coil). This change of energy in the circuit takes place at a frequency called the natural resonant frequency.

The LC components in the resonant circuit may be connected in series with the voltage source to form a series-resonant circuit or in parallel with the source to produce a parallel-resonant circuit. The two circuits have considerably different characteristics and so are discussed separately in this assignment.

9-46. In a series RLC circuit at frequencies above resonance the inductive reactance is ___(A)___ (greater, less) than the capactive reactance and the circuit is said to be ___(B)___ (capacitive, inductive).

1. (A) greater, (B) capacitive
2. (A) greater, (B) inductive
3. (A) less, (B) capacitive
4. (A) less, (B) inductive

9-47. In a series RLC circuit at frequencies below resonance the capacitive reactance is ______(A)______ than the
greater, less

inductive reactance and the circuit is said to be ______(B)______.
capacitive, inductive

1. (A) greater, (B) capactive
2. (A) less, (B) capacitive
3. (A) less, (B) inductive
4. (A) greater, (B) inductive

9-48. A series circuit consisting of a capacitance inductor and resistor is said to be resonant when
1. $X_L - X_C = R$
2. $X_L = X_C$
3. $X_L + X_C = R$
4. $R = 0$

9-49. At resonance, a series-resonant circuit has the characteristics of
1. a resistor
2. a capacitor plus a resistor
3. an inductor plus a resistor
4. a capacitor plus an inductor

● The "total impedance" mentioned on page 196 of your textbook is a complex quantity; its amplitude, or absolute value, is obtained in the same way as that of any other complex number. For the total impedance,

$$Z = R + j(X_L - X_C),$$

the magnitude of the impedance in ohms is given by

$$Z = \sqrt{R^2 + (X_L - X_C)^2}.$$

See also page 195 of the textbook.

● The term pico (P) means the same as micromicro, or 10^{-12}.

9-50. What is the resonant frequency of a series-tuned circuit that has a resistance of 2 ohms, a capacitance of 20 PF and an inductance of 5μH?
1. 0.016 MHz
2. 1.59 MHz
3. 15.1 MHz
4. 15.9 MHz

9-51. What is the relative impedance of a series-tuned circuit at resonance?
1. Zero
2. Less than at any other frequency
3. Greater than at any other frequency
4. The same as at any other frequency

9-52. The behavior of a series-tuned circuit at frequencies above resonance is similar to that of
1. a resistor
2. a capacitor plus a resistor
3. an inductor plus a resistor
4. a capacitor plus an inductor

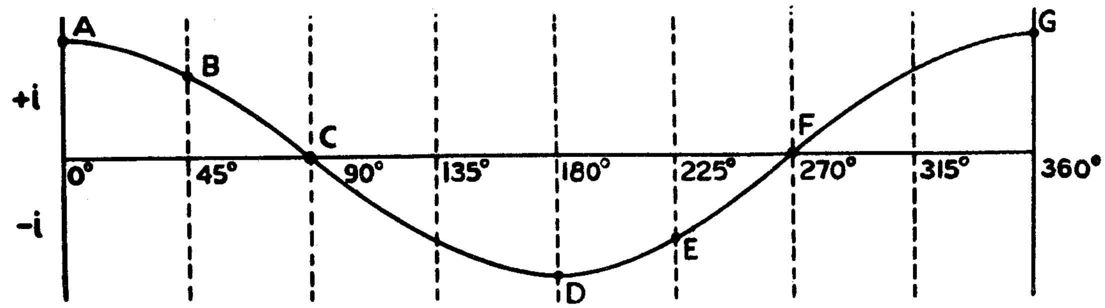


Figure 9C. - Current changes during one complete cycle in a series-resonant circuit.

9-53. At what point or points on the graph in figure 9C is the voltage across the inductor at a minimum?
1. C
2. B and E
3. A, D, and G
4. C and F

9-54. In what intervals on the graph in figure 9C is the capacitor acting as a power source?
1. A to C and D to F
2. A to C and F to G
3. A to D
4. C to D and F to G

Learning Objective: Identify the expression representing the quality of inductors and capacitors and the means for increasing the Q and resultant voltage gain in series-resonant circuits. Textbook pages 197 through 198.

9-55. Which of the following expressions represents the Q of a coil?
1. $\frac{R}{Z}$
2. $\frac{X_L}{R}$
3. $\frac{X_L}{Z}$
4. $\frac{R}{X_L}$

9-56. The Q of an inductor is also known as the
1. permeance
2. figure of merit
3. inductive reactance
4. conductance

9-57. The Q of an inductor may be increased by
1. reducing the resistive losses in the inductor
2. increasing the resistance of the inductor
3. reducing the inductance of the inductor
4. increasing the distributed capacitance of the inductor

9-58. Which of the following expressions represents the Q of a capacitor?
1. $\frac{R}{Z}$
2. $\frac{X_C}{R}$
3. $\frac{X_C}{Z}$
4. $\frac{R}{X_C}$

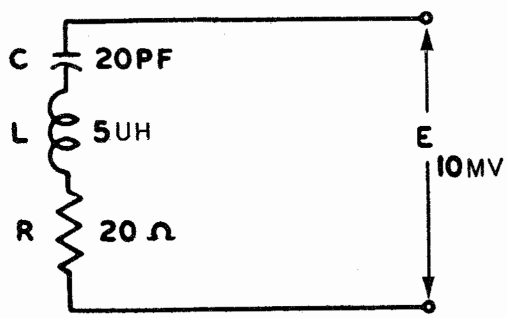
9-59. Which of the following types of capacitors has the highest Q?
1. Mica
2. Oil
3. Air
4. Paper

9-60. The voltage gain of a resonant circuit increases as the
1. Q decreases
2. Q increases
3. ratio of resistance to capacitance increases
4. ratio of resistance to inductance decreases

. . . .

Learning Objective: Demonstrate your knowledge of series-resonant circuits by solving some typical RLC circuit problems and determine phase relationships between circuit current and applied voltage in series-tuned circuits. Text pages 198 through 201.

. . . .



D-1-62

Figure 9D. - Series RLC circuit.

9-61. What is X_L at resonance in the circuit in figure 9D?
1. 0 ohms
2. 500 ∠ + 90° ohms
3. 500 ∠ - 90° ohms
4. 500 ∠ 0° ohms

9-62. What is the amplitude of the current flowing through the circuit in figure 9D if the applied a.c. voltage is at the resonant frequency of the circuit?
1. 0.05 ma
2. 0.50 ma
3. 0.63 ma
4. 0.75 ma

9-63. What is the amplitude of the voltage at resonance across the capacitor in figure 9D?
1. 0 v
2. 0.25 v
3. 0.50 v
4. 250 v

9-64. What is the Q at resonance of the circuit in figure 9D?
1. 0.5
2. 2
3. 25
4. 250

9-65. What is the amplitude of the current flowing through the circuit in figure 9D if the voltage is applied at a frequency 636 kHz lower than the resonant frequency?
1. 0.22 ma
2. 0.35 ma
3. 0.44 ma
4. 0.50 ma

9-66. What is the voltage gain (V.G.), at resonance for the circuit in figure 9D?
1. 0.25
2. 2.50
3. 25.0
4. 250.0

9-67. The input frequency to the circuit in figure 9-D is decreased by an amount $\frac{1}{2Q}$ times the resonant frequency. What approximate percentage of the resonant voltage is felt across (A) the inductor and (B) the capacitor?
1. (A) 30%, (B) 70%
2. (A) 70%, (B) 30%
3. (A) 70%, (B) 70%
4. (A) 30%, (B) 30%

9-68. The frequency of the applied voltage in figure 9-D is decreased by an amount 1/Q times the resonant frequency, the current decreases to ____(A)____ (0.707, 0.447) of its resonant value and ____(B)____ (lags, leads) the applied voltage by ____(C)____ (45°, 63.4°).

1. (A) 0.447, (B) leads, (C) 63.4°
2. (A) 0.707, (B) lags, (C) 45°
3. (A) 0.447, (B) leads, (C) 45°
4. (A) 0.707, (B) lags, (C) 63.4°

9-69. What is the phase relationship between circuit current and applied voltage in a series-tuned circuit at frequencies above resonance?

1. The current and applied voltage are 180° out of phase
2. The current lags the applied voltage
3. The current leads the applied voltage
4. The current and applied voltage are in phase

9-70. The response curve of a series resonant circuit may be made more sharply peaked and the output voltage may be increased at the resonant frequency by reducing the circuit

1. Q
2. resistance
3. inductance
4. capacitance

9-71. What is the typical range of Q for resonant circuits using iron-core coils?

1. 30,000 to 100,000
2. 10,000 to 30,000
3. 100 to 500
4. 20 to 100

9-72. For maximum voltage amplification, a resonant circuit must use an inductor with a high value of

1. distributed capacitance
2. inductance
3. resistance
4. Q

Learning Objective: Determine the method used to compute the bandwidth for series RLC circuits. Textbook pages 201 through 202.

9-73. A series RLC circuit resonates at 10KHz and has a Q of 100. What is the circuit's bandwidth?

1. 10 KHz
2. 1 KHz
3. 100 Hz
4. 10 Hz

9-74. (A) What is the highest frequency and (B) the lowest frequency a series RLC circuit will pass when the resonant frequency is 675 KHz and the Q is 15?

1. (A) 697.5 KHz, (B) 652.5 KHz
2. (A) 675.0 KHz, (B) 652.5 KHz
3. (A) 675.0 KHz, (B) 675.0 KHz
4. (A) 697.5 KHz, (B) 675.0 KHz

9-75. What is the bandwidth of a series-tuned circuit for 70 percent response if the resonant frequency is 2.8 MHz and the circuit Q is 20?

1. 560 KHz
2. 280 KHz
3. 140 KHz
4. 70 KHz

Assignment 10

Tuned Circuits; Introduction to Receivers

Textbook Assignment: Pages 202 through 226

Learning Objective: Recognize the way to differentiate between parallel and series RLC circuits and solve problems for typical RLC parallel resonant circuits. Text pages 202 through 208.

● When a tuned resonant circuit is a part of a more complex circuit, it is often difficult to determine whether it is a series or a parallel type. Examples of several resonant circuits are shown in heavy lines in figure 10A.

The circuit in part A of figure 10A is easily recognized as being a series resonant circuit. In part B of figure 10A the two resonant circuits of the RF transformer appear to be parallel resonant circuits. Actually, circuit 1 is considered to be a parallel-resonant circuit and circuit 2 is considered to be a series-resonant circuit.

Circuit 1 is a parallel-resonant circuit because it receives its electrical energy from the plate of tube V1 to which it is connected--the resonant circuit components are connected in parallel with the source. Circuit 2 is considered a series-resonant circuit because no separate voltage is applied directly to the inductor and capacitor.

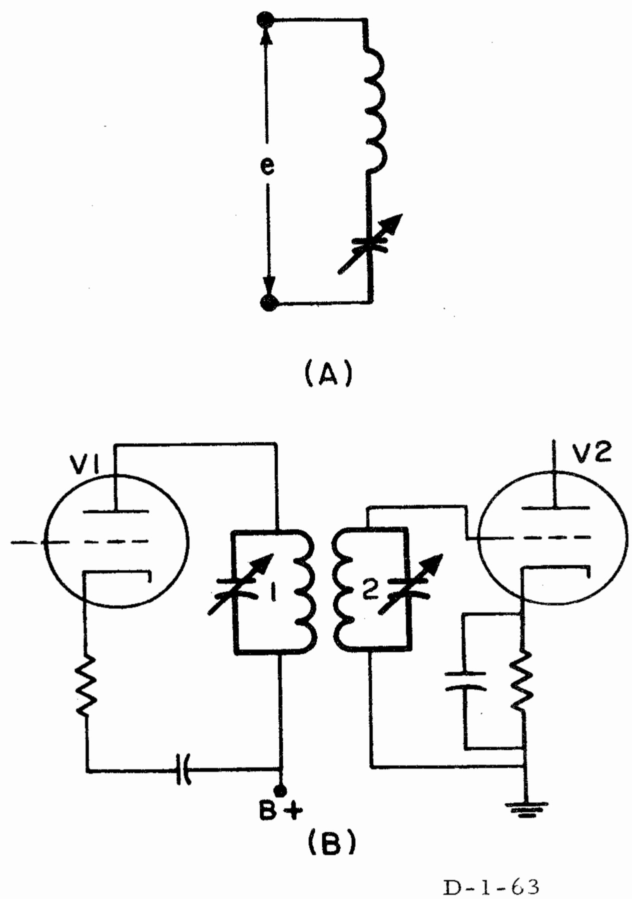


Figure 10A. -Series- and parallel-resonant circuits.

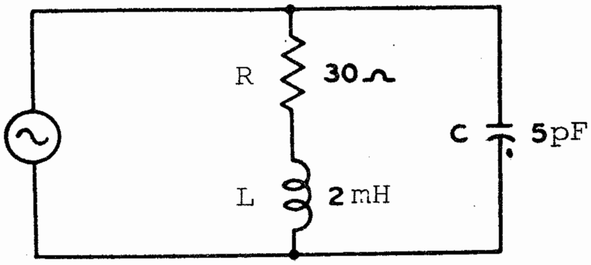


Figure 10B. - Parallel RLC circuit.

● The following procedure will help you to determine whether a circuit should be classed as parallel or series: (1) Locate the inductive and capacitive components forming the resonant circuit. (2) Locate the source of the alternating (or signal) voltage for these components. (3) Then, determine whether the components are in series or parallel with the source of voltage.

10-1. The line current flowing to a parallel-tuned circuit at resonance may be much smaller than the current flowing through either the capacitive branch or the inductive branch of the circuit because the currents through the branches are
1. in phase
2. 45° out of phase
3. 90° out of phase
4. 180° out of phase

10-2. What is the resonant frequency of the circuit in figure 10B?
1. 0.372 MHz
2. 1.59 MHz
3. 17.3 MHz
4. 535 MHz

10-3. What is the Q of the coil in figure 10B at the resonant frequency of the circuit?
1. 15.9
2. 100
3. 159
4. 667

10-4. At resonance the parallel LC circuit appears ______(A)______ to the
inductive, resistive
source and the phase angle is ___(B)___ .
90°, 0°

1. (A) inductive, (B) 90°
2. (A) inductive, (B) 0°
3. (A) resistive, (B) 90°
4. (A) resistive, (B) 0°

10-5. What is the impedance of a parallel-tuned circuit at frequencies above and below resonance?
1. Zero
2. Less than at resonance
3. Greater than at resonance
4. The same as at resonance

● Information for items 10-6 through 10-13: A parallel resonant circuit, with parallel resistance, has the following component values:

E_a = 10 volts at 1 kHz

X_C = 20 ohms

X_L = 20 ohms

R = 40 ohms

The inductive and capacitive components forming the tank of this circuit constitute an ideal parallel resonant network.

10-6. What is the capacitive branch current?
1. 0 + j 250 ma
2. 0 - j 250 ma
3. 0 +j 500 ma
4. 0 - j 500 ma

10-7. What is the inductive branch current?

1. 0 - j 500 ma
2. 0 - j 250 ma
3. 0 + j 250 ma
4. 0 + j 500 ma

10-8. What is the resistive branch current?

1. 500 + j 0 ma
2. 250 + j 0 ma
3. 375 + j 0 ma
4. 375 + j 0 ma

10-9. What is the circuit's line current?

1. 375 - j 0
2. 250 + j 0
3. 500 - j 0
4. 500 + j 0

10-10. What is the amount of current flowing through the circuit's tank?

1. 0.50 ma
2. 5.00 ma
3. 50.0 ma
4. 500 ma

10-11. What is the impedance of the circuit?

1. 4 ohms
2. 40 ohms
3. 400 ohms
4. 4000 ohms

10-12. What is the Q of the circuit?

1. 0.2
2. 2
3. 20
4. 200

10-13. Which of the following expressions is used to determine the bandpass of the circuit?

1. $\frac{f_o \times X_L}{R} = BW$
2. $\frac{R}{f_o \times X_L} = BW$
3. $\frac{Q}{f_o} = BW$
4. $\frac{R \times X_L}{f_o} = BW$

. . . .

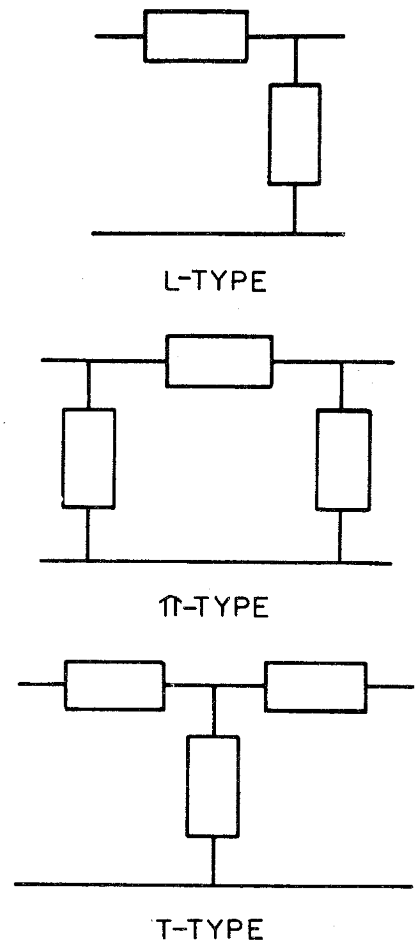
Learning Objective: Determine a use for tuned circuits, the function of band-elimination filters, and the solutions for typical bandpass filter circuit problems. Text pages 209 through 212.

. . . .

● The series-and parallel-resonant circuits that form bandpass and band-elimination filters may be arranged in three different ways, as illustrated in figure 10C. (Note that the resonant circuits are indicated by blocks.)

The filters discussed in the textbook are examples of "L" type filters in which the positions of the resonant circuits in the diagrams resemble the letter L. Filter circuits also may be arranged so that the circuit diagram resembles the Greek letter π (pi-type) or the letter T (T-type).

An important point to remember is that the L-type circuit is the basic arrangement from which the more complicated pi- and T-type filter circuits are derived. The modifications of the L-type produce filter circuits that have sharper frequency cutoff characteristics.



D-1-65

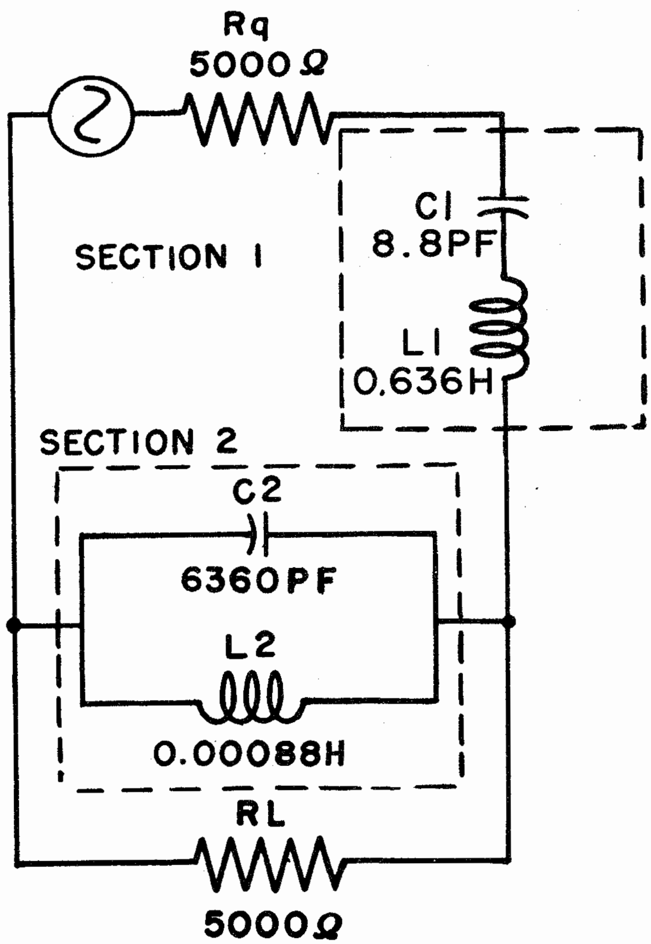
Figure 10C. - Filter circuit arrangements.

10-14. The circuit in figure 10D can be used as a
1. bandpass filter
2. band-elimination filter
3. current multiplier
4. low-impedance power supply

10-15. The parallel-tuned circuit in figure 10D acts as a high impedance to frequencies
1. above the passband
2. within the passband
3. below the passband
4. above and below the passband

10-16. At which of the following input signal frequencies applied to the circuit in figure 10D is there maximum transfer of energy to the load?
1. At frequencies above the resonant frequency of the series-tuned circuit
2. At frequencies above the resonant frequency of the parallel-tuned circuit
3. At the resonant frequency of the series-tuned circuit
4. At frequencies below the resonant frequency of the parallel-tuned circuit

10-17. What is the current through R_g and R_L in figure 10D if the source voltage is 100 volts at the resonant frequency?
1. 2 ma
2. 10 ma
3. 20 ma
4. 100 ma



D-1-66

Figure 10D. - Series-parallel filter circuit.

10-18. At the lower frequency limit of the bandpass filter shown in figure 10-15 of the textbook, what expression describes the parallel impedance of the load and the impedance at terminals AB?

1. $Z_{AB34} = \frac{Z_{AB}\ R_L}{R_L + Z_{AB}}$
2. $Z_{1A} = \frac{X_{L1}\ X_{C1}}{X_{L1}\ \Phi\ X_{C1}}$
3. $Z+ = R_g\ \Theta Z_{1A}\ \Theta Z_{AB34}$
4. $Z_{AB} = \frac{X_{L2}\ X_{C2}}{+jX_{L2} - jX_{C2}}$

10-19. The function of a band - elimination filter is to
1. attenuate all a.c. voltages applied to the load
2. isolate the source from the load
3. pass a selected band of frequencies to the load
4. block a selected band of frequencies from the load

10-20. Whether a filter circuit, consisting of a series and a parallel-resonant circuit is a bandpass or a band-elimination filter depends upon the
1. resonant frequencies of the series- and parallel-resonant circuits
2. frequency and amplitude of the applied signal
3. connections of the series and parallel LC circuits with respect to the source and the load
4. values of L and C in the two circuits

10-21. The function of the parallel-tuned circuit in a band-elimination filter is to
1. provide a high impedance in series with the line at its resonant frequency
2. provide a high impedance across the line at its resonant frequency
3. shunt signals at its resonant frequency around the load
4. couple signals at its resonant frequency to the load

Learning Objective: Identify the purpose and functions of a simple AM receiver. Text page 213.

10-22. In what order does the AM receiver process the original signal that modulated the RF carrier at the transmitter?
1. Selection, reception, detection, reproduction
2. Reception, selection, detection, reproduction
3. Detection, reception, selection, reproduction
4. Reception, detection, selection, reproduction

In items 10-23 through 10-26, select from column B the function of an AM receiver that is described in column A.

	A. Description	B. Function
10-23.	Induces voltage in the antenna	1. Selection
		2. Reproduction
10-24.	Converts electrical signals to sound waves	3. Detection
		4. Reception
10-25.	Separates low frequency intelligence from high frequency carrier	
10-26.	Chooses a station's frequency from all transmitted signals	

Learning Objective: Recognize on a block diagram level some of the functional components of a basic receiver. Text pages 213 and 214.

● Items 10-27 through 10-30 refer to the block diagram of a basic receiver shown on figure 11-1 of your textbook.

10-27. What electronic component does the receiver use to convert the signal voltage to sound waves?
1. The antenna
2. The reproducer
3. The detector
4. The selector

10-28. What stage in the receiver requires a tuned tank circuit?
1. Selection
2. Reproduction
3. Detection
4. Reception

10-29. Small a.c. voltages are induced at the reception stage of the receiver. What other component operates with the antenna in the reception process?
1. The input transformer secondary
2. The output transformer secondary
3. The input transformer primary
4. The output transformer primary

10-30. The tuned tank circuit in the receiver is made up of the input transformer secondary and a variable
1. tube
2. capacitor
3. transistor
4. resistor

Learning Objective: Recognize some of the functions of a tuned tank circuit. Text pages 213 and 214.

10-31. The frequency selection circuit in a receiver performs properly when the circuit is able to pass the
1. carrier frequency and lower sideband
2. carrier frequency and upper sideband
3. carrier frequency and both sidebands
4. carrier frequency only

10-32. In a tuned tank circuit the term "Q" refers to the circuit's ability to
1. detect internal noise
2. select a band of frequencies
3. heterodyne frequencies
4. reproduce sound

Learning Objective: Identify some of the factors that determine the characteristics of sensitivity and selectivity in a receiver. Text page 215.

10-33. The reproduction of signals from a very weak station is a characteristic of a receiver that is classified as having very good
1. noise rejection
2. fidelity
3. selectivity
4. sensitivity

10-34. The selectivity of a receiver is determined by the Q of the
1. tuned tank circuit
2. antenna circuit
3. tuned transformer circuit
4. reproducer circuit

10-35. A specific receiver is referred to as having "poor sensitivity-good selectivity". This reference indicates that while this receiver is not able to reproduce signals from a weak station, it is still able to
1. select very weak signals
2. reject unwanted signals
3. select clear channel signals
4. reject wanted signals

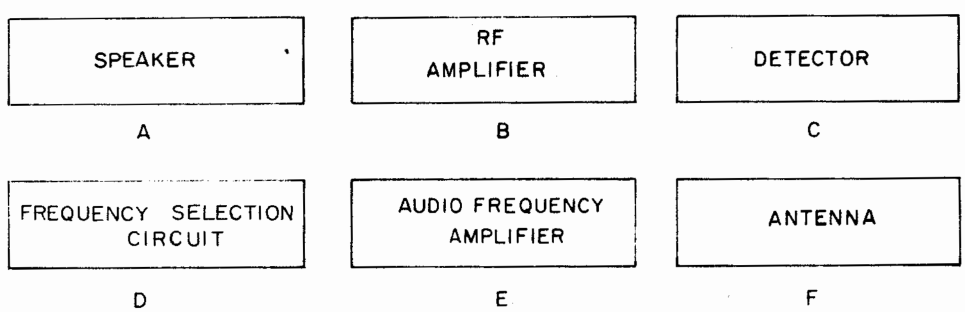
Learning Objective: Determine the meaning of "TRF" as applied to receivers, a signal path through the receiver's stages, and the selectivity and sensitivity characteristics of a TRF receiver. Text pages 216 through 218.

10-36. In radio communication equipment classification, the term "TRF" refers to a
1. crystal receiver
2. transceiver
3. tuned radio frequency receiver
4. twilight reception frequency receiver

● To answer items 10-37 and 10-38 refer to figure 10E.

10-37. In what order does a radio signal proceed through the first three stages of the typical TRF receiver?
1. C, D, B
2. F, C, B
3. C, E, B
4. F, D, B

10-38. In what order does a received signal proceed through the final three stages of the typical TRF receiver?
1. C, B, D
2. C, D, E
3. C, D, A
4. C, E, A



D-1-67

Figure 10E. - Stages of a TRF receiver.

10-39. Increased selectivity and sensitivity in a TRF receiver is obtained by increasing the number of

1. AF stages
2. RF stages
3. IF stages
4. decoupling circuits

10-40. The TRF receiver has several characteristics that classify it as a good receiver; however, one of its characteristics, selectivity, is weakened because selectivity does not

1. appear on all TRF receivers
2. remain constant throughout the receiver's tuning range
3. use ganged tuning capacitors
4. cover a wide range of frequencies

Learning Objective: Recognize the essential difference between TRF receivers and superheterodyne receivers and some of the operational characteristics of superheterodyne receivers. Text page 218.

● Items 10-41 through 10-45 are to be judged True or False.

10-41. The amplifiers that precede the detector stage in a TRF receiver are set to a fixed frequency.

10-42. The amplifiers that precede the detector stage in a superheterodyne receiver are set to a fixed frequency.

10-43. The superheterodyne receiver works on the principle that a desired frequency is converted to a fixed intermediate frequency before the audio signal component is detected.

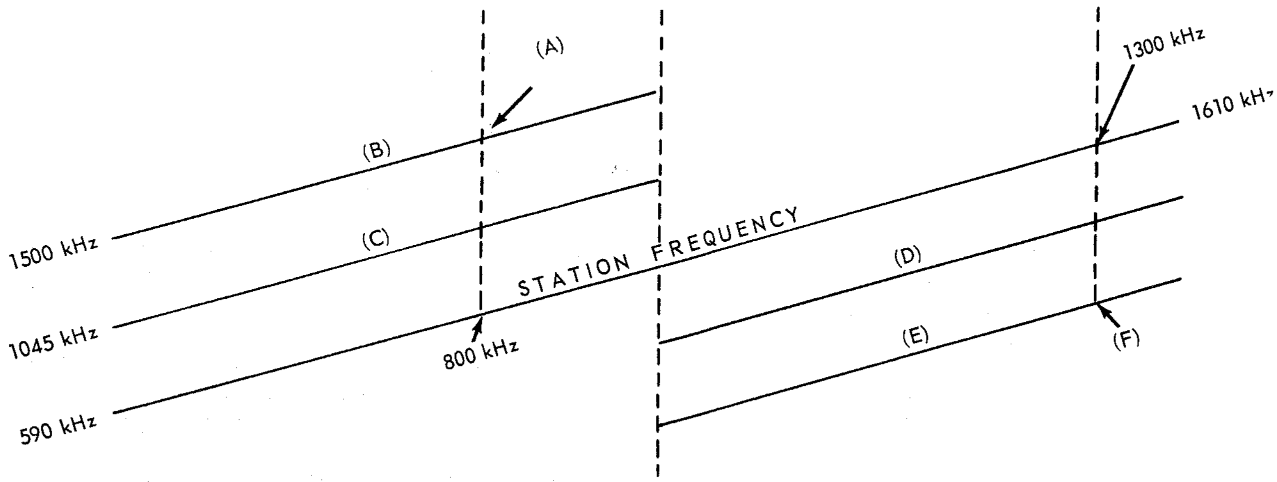
10-44. An intermediate frequency signal retains all of the modulation characteristics of the original signal.

10-45. The mixer in the superheterodyne receiver recovers the audio signal which is later amplified by the speaker.

Learning Objective: Determine some of the purposes of the RF amplifier stages in a superheterodyne receiver, the difference between image and station frequency, and how image frequency is produced. Text page 219.

10-46. The RF amplifier stage on a superheterodyne receiver is used to amplify the input __(A)__ signal and isolate
IF, RF
the __________(B)__________
IF amplifier, local oscillator
from the ____(C)________.
mixer, antenna

1. (A) IF, (B) IF amplifier, (C) mixer
2. (A) RF, (B) local oscillator, (C) antenna
3. (A) IF, (B) IF amplifier, (C) antenna
4. (A) RF, (B) local oscillator, (C) mixer



D-1-68

Figure 10F. - Superheterodyne receiver frequency relationships.

10-47. Connecting a receiver's mixer stage directly to the antenna produces
_______(A)_______ signals referred
modulated, unwanted
to as _______________
envelopes, images

1. (A) modulated, (B) envelopes
2. (A) unwanted, (B) images
3. (A) modulated, (B) images
4. (A) unwanted, (B) envelopes

10-48. The superheterodyne receiver associated with figure 10F is tuned to receive a station frequency of 800 kHz. What is the frequency at point (A)?

1. 1255 kHz
2. 1600 kHz
3. 1710 kHz
4. 2855 kHz

10-49. To complete figure 10F what nomenclatures should you apply to the frequency lines that are designated (B) and (C)?

1. (B) Image, (C) LO
2. (B) LO, (C) Image
3. (B) Image, (C) IF
4. (B) IF, (C) LO

10-50. What nomenclatures should be applied to the frequency lines on figure 10F that are designated (D) and (E)?

1. (D) Image, (E) Station
2. (D) LO, (E) Station
3. (D) LO, (E) Image
4. (D) IF, (E) Image

10-51. What is the frequency at point (F) on figure 10F?

1. 390 kHz
2. 910 kHz
3. 1300 kHz
4. 2210 kHz

Learning Objective: Recognize some of the characteristics of a typical superheterodyne receiver and some of the functions performed by the receiver's local oscillator, mixer, and IF amplifier. Text pages 220 and 221.

● The following list represents some of the functions performed by various stages in a superheterodyne receiver.

A. Producing a constant sine wave output.
B. Converting RF and LO signals to an IF signal.
C. Operating at the difference frequency.
D. Operating, normally, above the station frequency.
E. Producing the detector's stages input.
F. Producing a modulated IF signal output.

10-52. Which functions are associated with the receiver's IF amplifier?

1. A and B
2. C and E
3. B and F
4. A and E

10-53. What are the functions performed by the receiver's mixer?

1. A and D
2. C and F
3. D and E
4. B and F

10-54. What functions are related to the receiver's local oscillator?

1. E and F
2. A and D
3. B and C
4. A and F

● Items 10-55 through 10-58 are to be judged True or False.

10-55. A superheterodyne receiver may employ more tuned stages than does the TRF receiver.

10-56. Most of the stages in a superheterodyne receiver are tuned to one frequency, making tracking and alignment easier.

10-57. Operating at one frequency provides better selectivity and sensitivity over the entire broadcast band, but provides poorer gain per stage in the receiver.

10-58. Image frequency reception is an asset rather than a liability in a superheterodyne receiver.

Learning Objective: Recognize that the terms BEL and DECIBEL are units used to express the magnitude of change in signal level. Text page 221.

10-59. The bel is primarily a measure of a gain or a loss in

1. voltage
2. current
3. resistance
4. power

10-60. The decibel is more commonly used because a bel is too large for general use. What part of a bel is a decibel?

1. $\frac{1}{10,000}$

2. $\frac{1}{1000}$

3. $\frac{1}{100}$

4. $\frac{1}{10}$

10-61. Which of the following expressions is used to compute the comparitive value of output power to input power?

1. Decibel $= 10 \log \frac{P_1}{P_2}$

2. Decibel $= 20 \log \frac{P_2}{P_1}$

3. Decibel $= 10 \log \frac{P_2}{P_1}$

4. Decibel $= 20 \log \frac{P_1}{P_2}$

Learning Objective: Solve for unknowns using logarithms and a table of logarithms. Text pages 222 through 226.

● A table of logarithms appears in the Appendix of your textbook.

10-62. What is the characteristic of 406,000?
1. Three
2. Four
3. Five
4. Six

10-63. What is the logarithm of 36?
1. 0.5560
2. 1.5563
3. 15.6612
4. 36.0000

10-64. What is the logarithm of 200?
1. 0.003
2. 1.7
3. 2.3
4. 30

10-65. What is the logarithm of 4×10^{-8}?
1. 2.602 - 10
2. 3.602 - 10
3. -8.398
4. -9.398

10-66. What is the sum of 5.6990 and $\bar{5}.8513$?
1. 1.5503
2. 8.5503
3. 10.5503
4. 11.5503

10-67. The logarithm of 4×10^8 is
1. 2.602 - 10
2. 8.206
3. 8.602
4. 9.602

10-68. What is the fifth root of 7772?
1. 72
2. 16
3. 14
4. 6

10-69. What is the quotient of 635.6 divided by 25.4?

1. log 1.4004
2. 2.54×10^4
3. 25.02
4. 0.0254

10-70. The value of $(43.7)^4$ is

1. 3.65×10^5
2. 36.5×10^6
3. 36,500
4. 3.65×10^6

10-71. The product of 788 and 125 is

1. log 3.9934
2. 9.85×10^4
3. antilog 9.85
4. 3,993,400

Assignment 11

Introduction to Receivers; Detectors; Audio Amplifiers

Textbook Assignment: Pages 228 through 256

Learning Objective: Recognize how decibels as a unit for expressing the ratio of two amounts of electric power is applied to problems concerning receiver amplifiers. Text pages 228 through 231.

● To answer items 11-1 through 11-3 refer to figure 11-11 in your textbook and the following information.

A. Amplifier #1 has a 50 watt output from a 5 watt input.

B. Amplifier #2 has a 300 watt input and delivers a 3 watt output.

11-1. What is the decibel gain of amplifier #1?
1. 5 db
2. 10 db
3. 50 db
4. 250 db

11-2. Amplifier #2 should be classified as having a definite power
1. gain
2. loss
3. stability
4. loss and gain

11-3. The power loss or gain for amplifier #2 is
1. 20 db
2. -10 db
3. -20 db
4. 10 db

11-4. What is the amount of decibels gained by an amplifier that delivers 100,000 watts with an input of 100 watts?
1. 10 db
2. 20 db
3. 30 db
4. 40 db

11-5. What is the power gain of an amplifier that has a power output of 10 watts with an input signal power of one milliwatt?
1. 4 db
2. 10 db
3. 14 db
4. 40 db

11-6. Mathematical theory has proven that when working with decibels the doubling or cutting of power in half will result in a change of
1. ± 3 db
2. ± 6 db
3. ± 10 db
4. ± 15 db

11-7. Gain and attenuation can be added by algebraic process. Voltages or current changes may be summed similarly. Assuming that $Z_{in} = Z_{out}$, the appropriate expression used to solve for a voltage change in an amplifier is

1. $P = (10)^{\frac{2}{10}}$

2. $db = 10 \log \frac{P_2}{P_1}$

3. $db = 20 \log \frac{E_2}{E_1}$

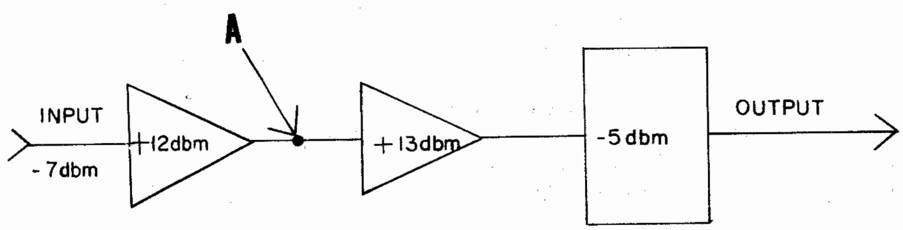
4. $P = 20 \log \frac{P_2}{P_1}$

● To answer items 11-8 through 11-10 refer to Table 11-2 in your textbook as an aid in converting dbm to mw.

11-8. What is the output, in dbm, of the three stage amplifier shown on figure 11A?
1. 5 dbm
2. 12 dbm
3. 13 dbm
4. 25 dbm

11-9. What is the output of the three stage amplifier shown on figure 11A when measured in milliwatts?
1. 12 mw
2. 13 mw
3. 20 mw
4. 25 mw

11-10. What is the power level at point "A" as shown on figure 11A?
1. -19 dbm
2 - 5 dbm
3. 5 dbm
4. 19 dbm



D-1-69

Figure 11A. - Three stage amplifier.

Learning Objective: Recognize some of the characteristics of input waveforms and some functions of filters in detector circuits. Text pages 232 through 236.

11-11. Detection of the original intelligence in a composite IF signal takes place in a device that has a

1. low distortion characteristic
2. constant impedance characteristic
3. nonlinear characteristic
4. linear characteristic

11-12. A composite IF signal contains the IF carrier and the sideband frequencies. If the IF frequency is 456 kHz and the modulating frequency is 3 kHz, the composite waveform would contain which of the following?

1. 453 kHz
2. 456 kHz
3. 459 kHz
4. All of the above

11-13. Which of the following statements correctly describes the average value of a composite IF signal?

1. The average value of a composite IF signal may be a positive or a negative voltage depending upon the characteristics of the original modulating frequency
2. The average value of a composite IF signal is always zero
3. The average value of a composite IF signal is always a negative voltage
4. The average value of a composite IF signal is always a positive voltage

11-14. Which of the following statements correctly describes the average composite value of the distorted output signal produced in a detector circuit?

1. The average value of a detector output signal may be a positive or negative voltage depending upon the characteristics of the original modulating frequency
2. The average value of a detector output signal is always zero
3. The average value of a detector output signal is always a negative voltage
4. The average value of a detector output signal is always a positive voltage

11-15. The demodulation products of an amplitude modulated signal before filtering include

1. RF and IF components only
2. IF and d.c. components only
3. audio, IF, and d.c. components
4. audio, RF, and IF components

11-16. What is the output of a detector circuit such as that shown in figure 12-3 of your textbook?

1. An a.c. voltage varying at a d.c. level
2. A negative d.c. voltage
3. A positive d.c. voltage
4. A d.c. voltage varying at an IF rate

11-17. What is one purpose of the bandpass filter in a typical receiver's detector circuit?

1. To eliminate the IF carrier's sidebands
2. To increase the receiver's selectivity
3. To pass all input frequencies
4. To increase the receiver's sensitivity

11-18. What portion of the IF frequency spectrum carries the intelligence?
1. The carrier frequency
2. The upper sideband only
3. The lower sideband only
4. Both upper and lower sidebands

11-19. What part of the signal will pass with little attenuation in a bandpass filter?
1. The IF carrier frequency only
2. Only frequencies above the resonant frequency
3. Only frequencies below the resonant frequency
4. Both frequencies above and below the resonant frequency

Learning Objective: Identify some of the operational characteristics of diode detectors in various configurations. Text pages 236 through 242.

11-20. The unfiltered output of a series detector consists of
1. a constant-amplitude square wave
2. a series of AF pulses
3. a series of RF pulses
4. an audio waveform

11-21. What are the resistance characteristics of a diode detector?
1. High when conducting and high when nonconducting
2. High when conducting and low when nonconducting
3. Low when conducting and high when nonconducting
4. Low when conducting and low when nonconducting

11-22. The rectified voltage in a diode detector is divided between the load resistance and the
1. diode resistance
2. input tuned-circuit impedance
3. coupling capacitance
4. filter capacitance

11-23. The efficiency of an unfiltered diode detector circuit can be improved by selecting a capacitor of proper value and inserting it in the circuit. How should this capacitor be connected in the circuit?
1. Between the load resistor and ground
2. Instead of the load resistor
3. In series with the load resistor
4. In parallel with the load resistor

11-24. What is the result of capacitor C1, shown on figure 12-6 of your textbook, losing only a small percentage of its charge when the top of T-1's secondary is negative?
1. The output voltage follows the peak value of the rectified voltage
2. The output voltage is cut-off
3. The output voltage increases to a high level
4. The output voltage drops to a low level

11-25. In a detector circuit similar to figure 12-6 of your textbook, which part acts as a voltage source when the diode is not conducting?
1. The load resistance
2. The filter capacitor
3. The secondary of the coupling transformer
4. The primary of the coupling transformer

11-26. What is the rectification efficiency of a series diode detector that has an output of 3 V d.c. and a peak input of 4 volts.

1. 55%
2. 65%
3. 75%
4. 85%

11-27. The value of R_L shown in figure 12-6 of your textbook increases. What is the effect on (A) the circuit's rectification efficiency and (B) the circuit's quality of reproduction?

1. (A) It increases, (B) it decreases
2. (A) It decreases, (B) it increases
3. (A) and (B) both increase
4. (A) and (B) both decrease

11-28. An oscilloscope is properly adjusted and connected to the filtered output of a detector circuit such as that shown on figure 12-6 of your textbook and the audio signal shows the presence of a high frequency component. What is one source of the trouble?

1. A short in the primary of T-1
2. A loss of forward bias on CR_1
3. An increase of resistance in R_L
4. A decrease of capacitance in C_1

11-29. When selecting a capacitor and resistor to be used in the output of a detector circuit, values should be selected so that the time constant for the discharge of the capacitor will be ___(A)___ (short, long) at the carrier frequency but relatively ___(B)___ (short, long) at the modulating frequency.

1. (A) short, (B) short
2. (A) short, (B) long
3. (A) long, (B) short
4. (A) long, (B) long

11-30. What is the proper relationship between the discharge RC time constant of a detector circuit and the IF and modulating frequency?

1. Long in respect to both the IF and modulating frequency
2. Long in respect to the IF and short in respect to the modulating frequency
3. Short in respect to the IF and long in respect to the modulating frequency
4. Short in respect to both IF and modulating frequency

11-31. In figure 12-6 of your textbook, the current path for charging C_1 is through ___(A)___ (CR_1, R_L), and the current path for discharging C_1 is through ___(B)___ (CR_1, R_L).

1. (A) CR_1, (B) CR_1
2. (A) CR_1, (B) R_L
3. (A) R_L, (B) CR_1
4. (A) R_L, (B) R_L

11-32. Which of the following factors determines the maximum sensitivity and fidelity that may be obtained from a diode detector?

1. The amplitude of the input signal voltage
2. The RC time constant of the output circuit
3. The modulation percentage contained in the carrier
4. The interelectrode capacitance of the electron tube used in the detector

11-33. One of the differences between the output of series and shunt detectors is that shunt detectors contain elements of

1. only positive voltage
2. only negative voltage
3. both positive and negative voltage
4. either positive or negative voltage depending on the input signal

11-34. In a circuit similar to that shown in figure 12-12 of your textbook, CR_1 is conducting. What is the direction of current flow from the collapsing field around L_1?

1. From the right side of L_1 through R_L and CR_1 to the left side of L_1
2. From the left side of L_1 through the transformer secondary and R_L to the right side of L_1
3. From the left side of L_1 through CR_1 and R_L to the right side of L_1
4. From the left side of L_1 through CR_1 and the secondary of the transformer to point A

11-35. An oscilloscope is properly adjusted and connected to the filtered output of a detector circuit such as that shown on figure 12-12 of your textbook and the audio signal shows diagonal clipping. What is one source of the trouble?

1. A short in the primary of T-1
2. A stoppage in the resistance of CR_1
3. A decrease in the resistance of R_L
4. A decrease in the inductance of L_1

11-36. An oscilloscope is properly adjusted and connected to the filtered output of a detector circuit such as that shown on figure 12-13 of your textbook and the output signal shows both polarities of voltage in equal amplitude. What is one source of the trouble?

1. A short in the primary of T-1
2. A nonconducting electron tube
3. A short in the load resistor
4. An opening in the inductance

Learning Objective: Recognize some of the characteristics associated with the property of non-linearity in diodes and the operational characteristics of diode detectors under normal as well as abnormal operating conditions. Text pages 242 through 244.

11-37. In what type of a device may heterodyning occur?

1. Both lineary and non-linear devices
2. Either linear or non-linear devices depending on the input signal
3. Only linear devices
4. Only non-linear devices

11-38. A doubling of the input voltage to a linear rectifier circuit causes a doubling of the output current. What is the circuit's diode operating level?

1. A level above maximum current level
2. At maximum current level
3. At mid current level
4. At zero current level

11-39. A doubling of the input voltage to a rectifier circuit causes a quadrupling of output current. What is the circuit's diode operating level?

1. A level above maximum current level
2. At maximum current level
3. At mid current level
4. At zero current level

11-40. What determines when a diode is operating as a linear or square law detector?
1. The diode is an electron tube or semiconductor
2. The diode is in a shunt circuit
3. The design of the circuit
4. The level of the input signal

11-41. The output of a diode detector is distorted but of proper amplitude. Which of the following procedures would most quickly locate the trouble?
1. Current check of input and output
2. Resistance check of components
3. Voltage check of input and output
4. Oscilloscope waveform check of output

11-42. Detector trouble is indicated when the loss of output signal amplitude falls below what percentage of the input amplitude?
1. 10%
2. 30%
3. 60%
4. 90%

Learning Objective: Recognize some characteristics of detectors other than the diode type, and identify some possible failures that may occur in them. Text pages 245 through 249.

11-43. Transistors used as detectors operate on the principle of
1. clipping the positive IF pulses
2. clipping the negative IF pulses
3. unequal amplification of the positive and negative pulses
4. equal amplification of the positive and negative pulses

Items 11-44 and 11-45 are to be judged True or False.

11-44. A diode detector has the ability of producing a useable output signal with an input signal below the operating range of a transistor detector.

11-45. Transistor detectors have an advantage over diode detectors in that they can handle larger input signals.

11-46. An open load resistor such as R_4 shown on figure 12-18 of your textbook produces which of the following results?
1. No output
2. Diagonal clipping
3. Lack of IF filtering
4. Peak clipping

11-47. Detection in a grid-leak detector occurs in the
1. triode plate circuit
2. triode grid circuit
3. oscillator
4. diode

11-48. What are the characteristics of a grid leak detector when reacting to a low amplitude signal?
1. Moderate high sensitivity and selectivity
2. Low sensitivity and selectivity
3. Moderate sensitivity low selectivity
4. Low sensitivity and high selectivity

11-49. What function is performed by the triode plate circuit of a grid-leak detector?
1. Detection
2. Rectification
3. Oscillation
4. Amplification

11-50. In a circuit such as that shown on figure 12-20 of your textbook the time constant of Rd-Cd should be ___(A)___ (long, short) with respect to the RF cycle and ___(B)___ (long, short) with respect to the AF cycle.

1. (A) long, (B) long
2. (A) short, (B) short
3. (A) long, (B) short
4. (A) short, (B) long

11-51. Which of the following actions opposes a rapid variation of plate voltage in a grid leak detector such as that shown in figure 12-20 of your textbook?

1. The flow of grid current
2. The discharge of C_1
3. The charge of C_1
4. The voltage drop across R_L

● Review "Effects on Q caused by loading a parallel circuit" in chapter 10, pages 206 through 208 of your textbook, before attempting to answers items 11-52 through 11-55.

11-52. What effects on Q and bandwidth are produced by a low resistance being placed parallel to a tuned circuit?

1. Lower Q and narrower bandwidth
2. Lower Q and wider bandwidth
3. Higher Q and narrower bandwidth
4. Higher Q and wider bandwidth

11-53. A characteristic of both the diode detector and the grid-leak detector is that they

1. operate only on low amplitude input signals
2. load the input tuned circuits
3. require input signals having high percentages of modulation
4. require low value load resistance

11-54. To maintain a plate detector approximately at cutoff it is essential to select the correct value of the circuit's

1. cathode bias resistor
2. plate load resistor
3. demodulation capacitor
4. coupling capacitor

11-55. What is the relationship between the output of two circuits similar to those shown on parts A and B of figure 12-22 in your textbook when signals of equal amplitude are applied to their inputs?

1. The outputs of both the standard and the bridge circuits are the same in frequency and amplitude
2. The output of the standard circuit has the same frequency as the output of the bridge circuit but only half of the bridge circuit's amplitude
3. The output of the standard circuit has the same amplitude as the output of the bridge circuit but only half of the bridge circuit's frequency
4. The output of the standard circuit has half the frequency and half the amplitude as the output of the bridge circuit

. . . .

Learning Objective: Recognize some of the characteristics of R C and transformer couplers as they are used in detector circuits. Text page 251.

. . . .

11-56. The loss in response at low audio frequencies in an R C coupler is caused by ______(A)______
capacitive, inductive
reactance and by ______(B)______
capacitive, inductive
reactance in transformer couplers.

1. (A) capacitive, (B) inductive
2. (A) capacitive, (B) capacitive
3. (A) inductive, (B) inductive
4. (A) inductive, (B) capacitive

11-57. The loss of response at high audio frequencies in an R C coupler is caused by ______(A)______
capacitive, inductive
shunting and by ______(B)______
capacitive, inductive
shunting in transformer couplers.

1. (A) capacitive, (B) inductive
2. (A) capacitive, (B) capacitive
3. (A) inductive, (B) inductive
4. (A) inductive, (B) capacitive

. . . .

Learning Objective: Determine the frequency range of the audio frequency spectrum, some types of amplifying devices used in audio amplifiers, and the resultant change to an input signal passing through a voltage amplifier. Text page 254.

. . . .

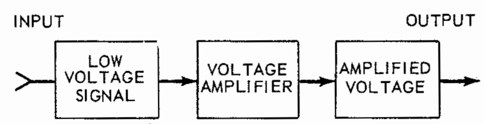
11-58. What frequency range is normally considered to be the audio frequency spectrum?

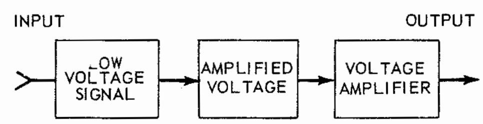
1. 3 to 5,000 Hz
2. 3 to 10,000 Hz
3. 30 to 10,000 Hz
4. 20 to 20,000 Hz

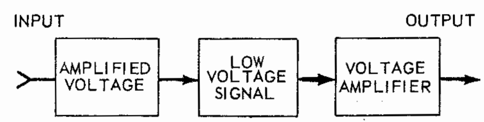
11-59. To ensure that signals within the audio frequency spectrum obtain sufficient power amplification, both transistor and electron tube audio amplifiers have been designed to operate in the frequency range from ___(A)___ to 100,000 ___(B)___.
10, 100 Hz, KHz

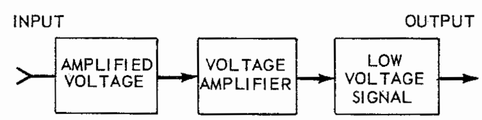
1. (A) 10, (B) Hz
2. (A) 10, (B) KHz
3. (A) 100, (B) Hz
4. (A) 100, (B) KHz

11-60. Which of the following block diagrams shows the path taken by a signal as it travels through an audio voltage amplifier?

1. 

2. 

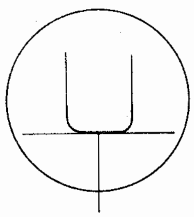
3. 

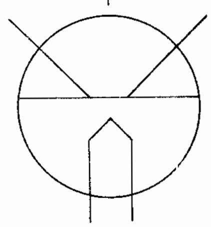
4. 

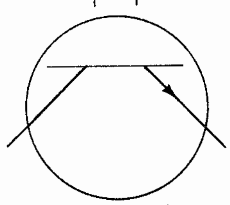
Learning Objective: Recognize some of the devices used as amplifiers, their symbols, characteristics, value in degree of phase inversion, and the effect of collector voltage supply on an audio amplifier circuit. Text pages 254 through 256.

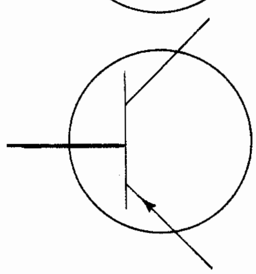
11-61. Which symbol indicates that the amplifier in figure 13-2 of your textbook is transistorized?
1. C1
2. Q1
3. R_L
4. C2

11-62. Which of the following symbols represents a PNP transistor?

1. 

2. 

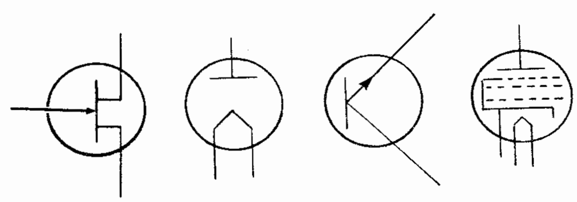
3. 

4. 

11-63. During the positive alternation of the input signal shown in figure 13-2 of your textbook, the forward bias on Q_1 will ______(A)______ resulting in a
increase, decrease
more ______(B)______ collector
negative, positive
voltage.
1. (A) increase, (B) negative
2. (A) increase, (B) positive
3. (A) decrease, (B) negative
4. (A) decrease, (B) positive

11-64. During the negative alternation of the input signal the bias effect on the circuit shown in figure 13-2 of your textbook will be ______(A)______ thus making
increased, decreased
the output signal at the collector more ______(B)______.
positive, negative
1. (A) decreased, (B) negative
2. (A) decreased, (B) positive
3. (A) increased, (B) positive
4. (A) increased, (B) negative

● Information for item 11-65:



A B C D

11-65. Which of the symbols in the above information are similar in characteristics when used in an amplifying device?
1. B and D
2. A and C
3. A and D
4. B and C

11-66. What degree of phase inversion is produced by the common source configuration circuit shown in figure 13-3 of your textbook?
1. 45^{o}
2. 90^{o}
3. 120^{o}
4. 180^{o}

11-67. The amplifying device shown in figure 13-4 of your textbook is a
1. transistor
2. pentode
3. triode
4. tetrode

11-68. Why is a pentode generally unsuitable as an amplifier for small signals?
1. It generates too low a signal
2. It has too high a noise level
3. It does not have sufficient power amplification
4. For all of the above reasons

Assignment 12

Audio Amplifiers

Textbook Assignment: Pages 254 through 281

Learning Objective: Recognize some of the considerations that must be made regarding the matching of impedances in audio amplifiers, methods of coupling and their functions, characteristics and limitations. Text pages 254, 255 and 257 through 259.

12-1. Which coupling method would you select as the most desirable to match source impedance to transistor impedance?
1. RC
2. Transformer
3. Direct
4. Transistor

12-2. If the most desirable method of matching transistor circuit impedance is considered not to be practical, what type of configuration is normally considered the most common one for general purpose audio amplification?
1. CE
2. CB
3. CC
4. CR

12-3. A transistor amplifier fed from a 500 Ω source without transformer coupling would best use the common-emitter configuration because this configuration provides greater ____(A)____ than (band-pass, gain) the common-collector configuration and has a satisfactory ____(B)____ (frequency, phase) response for audio amplification.
1. (A) band-pass, (B) frequency
2. (A) band-pass, (B) phase
3. (A) gain, (B) phase
4. (A) gain, (B) frequency

Items 12-4 through 12-9 are to be judged True or False.

12-4. Impedance coupling is the coupling method that is least used in audio amplifiers.

12-5. The electron tube direct-coupled audio amplifier has the plate voltage of the first stage applied directly to the grid of the second stage.

12-6. A disadvantage of RC coupling in audio amplifiers is the large physical size of circuit parts used in this method.

12-7. Transformer coupling can be used in audio amplifiers, although it is normally limited in use to the output power stages of receivers.

12-8. RC coupling is limited in operation to the use of electron tubes which makes the method impractical.

12-9. Transformer coupling is useful in portable equipments where a battery is used as the source of power.

Learning Objective: Recognize some of the different feedback methods used in audio amplifiers, the effects of this feedback on the circuits, and the functions of decoupling networks in audio amplifiers. Text pages 260 through 263.

12-10. Motorboating that occurs at the ____(A)____ of a receiver is usually
input, output
the effect of low frequency ____(B)____
oscillations,
______ that frequently affect high gain
nulls
amplifiers.
1. (A) input, (B) oscillations
2. (A) input, (B) nulls
3. (A) output, (B) nulls
4. (A) output, (B) oscillations

12-11. The function of decoupling networks in audio amplifiers is to
1. disconnect the power supply from the amplifiers
2. disconnect the amplifier stages from each other
3. isolate the amplifiers from power supply variations
4. isolate resistors from capacitors in the amplifier circuit

12-12. Degenerative feedback has been achieved in the circuit shown in figure 13-11 by the
1. elimination of shunt capacitors from the transistor's emitter circuits
2. addition of shunt capacitors to the transistor's collector circuits
3. addition of shunt capacitors to the transistor's emitter circuits
4. elimination of shunt capacitors from the transistor's collector circuits

12-13. What effect does negative feedback have, in an audio amplifier, on (A) the gain of the amplifier and (B) the accuracy of the amplifier's reproduced signal?
1. (A) The gain is limited, (B) the fidelity is impaired
2. (A) The gain is increased, (B) the fidelity is impaired
3. (A) The gain is increased, (B) the fidelity is improved
4. (A) The gain is limited, (B) the fidelity is improved

12-14. Transformer action can be used to provide feedback but this method is not commonly used in audio amplifiers because audio amplifiers are usually
1. direct coupled
2. RC coupled
3. d.c. coupled
4. a.c. coupled

12-15. What factors control the amplitude of feedback voltage in a transformer action circuit?
1. The turns ratio of the input windings and the polarity of the output
2. The turns ratio of the feedback windings and the polarity of the feedback loop
3. The polarity of the input/output circuits and the turns ratio of the output windings
4. The polarity of the input/output circuits and the polarity of the feedback loop

In items 12-16 through 12-18 select the type of feedback from column B that describes the feedback method listed in column A.

A. Method	B. Type
12-16. Unbypassed emitter resistor	1. Voltage
12-17. Transformer action network	2. Current
12-18. Resistive network	

Learning Objective: Recognize some of the operational characteristics, advantages and disadvantages of a common-emitter configuration when used as an impedance matching device, and the function of a frequency sensitive feedback circuit. Text pages 263 through 266.

12-19. The common-collector configuration operates on Ohm's law that low current drawn from a high voltage indicates high
1. saturation
2. impedance
3. signal
4. voltage

12-20. The advantages of the common-emitter configuration when used as an impedance matching device are best described by
1. good frequency response, easier impedance matching, and high power gain
2. small loss, current gain, large resistance in base, and possible poor bias stability
3. good frequency response, easier impedance matching, and possible poor bias stability
4. small loss, current gain, good frequency response, and large resistance in base

12-21. Which of the following operational characteristics indicates some of the weaknesses of the common-emitter configuration when used as an impedance matching device?
1. Good frequency response, possible poor bias stability, and high power gain
2. Large resistance in the base, easier impedance matching, and possible poor bias stability
3. Small loss in current gain, large resistance in the base, and possible poor bias stability
4. Easier impedance matching, possible poor bias stability, and high power gain

12-22. The degenerated common-emitter (CE) configuration circuit shown on figure 13-17 of your textbook indicates that an unbypassed resistor has been inserted in the
1. PNP emitter circuit
2. NPN collector circuit
3. PNP collector circuit
4. NPN emitter circuit

12-23. Figure 13-16 in your textbook shows that a series resistor has been added to the
1. NPN's base lead
2. PNP's collector circuit
3. PNP's base lead
4. NPN's collector circuit

12-24. Frequency sensitive feedback circuits such as the one shown on figure 13-19 of your textbook, when used in conjunction with amplifiers will provide a
1. wider bandpass with a flatter response curve
2. wider bandpass with a higher response curve
3. narrow bandpass with a flatter response curve
4. narrow bandpass with a higher response curve

. . . .
Learning Objective: Identify some of the operational malfunctions of audio amplifiers and the possible failure analysis that may be performed to determine the cause of such malfunctions. Text page 266.
. . . .

List 12A. - Partial list of failure analysis for a malfunctioning audio amplifier

A. Loss of source voltage
B. Reduced load impedance
C. Open load resistor
D. Open bias resistor
E. Faulty amplifying device
F. Excessive regenerative feedback
G. Excessive degenerative feedback

Use List 12A to answer items 12-25 through 12-27.

12-25. The audio amplifier on a receiver is producing a distorted output. Which failure analysis should you consider as a possible cause of this malfunction?

1. C, D, or E
2. D, E, or G
3. D, E, or F
4. B, C, or E

12-26. On a routine preventive maintenance check, you find that the audio amplifier in a receiver indicates a "no output" malfunction. What will your immediate superior ask you to check for in the audio amplifier?

1. A, C, or E
2. A, D, or F
3. C, E, or F
4. D, E, or F

12-27. Which failure analysis would help a technician determine the cause for a reduced output on the audio amplifier section of a receiver?

1. B, C, or G
2. C, F, or G
3. B, E, or G
4. C, D, or E

. . . .
Learning Objective: Recognize some of the parts, functions, methods of coupling and impedance matching for transistor and single-ended electron tube audio power amplifiers and failure analysis procedures associated with such amplifiers. Text pages 266 through 268.
. . . .

12-28. At what point in the schematic, figure 13-22 in your textbook, does a magnetic field expand and collapse, thus inducing the voltage necessary to operate the speaker?

1. C1
2. R1
3. V1
4. T1

12-29. What power device is used to drive the speaker shown in figure 13-22 of your textbook?

1. Transistor
2. Pentode
3. Triode
4. Tetrode

12-30. The high power transistor shown in figure 13-21 of your textbook must introduce as little ___(A)___ (gain, distortion) of audio wave forms as possible, thus this transistor should be operated as ___(B)___ (class A, class B)

1. (A) gain, (B) class A
2. (A) gain, (B) class B
3. (A) distortion, (B) class A
4. (A) distortion, (B) class B

12-31. What may be a problem in using a single ended power amplifier with transformer coupling?

1. A.c. core saturation
2. D.c. core saturation
3. A.c. core variation
4. D.c. core variation

12-32. In transformer impedance matching, the transformer matches the impedance of the ___(A)___ (source, speaker) to the impedance of the ___(B)___ (line, load).

1. (A) source, (B) line
2. (A) source, (B) load
3. (A) speaker, (B) line
4. (A) speaker, (B) load

List 12B. - Partial failure analysis list for power amplifiers.

A. Open in primary or secondary of T1
B. Preamplifiers inadequately decoupled
C. Shorted turns in primary or secondary of T1
D. Leaky input capacitors
E. Open emitter/cathode resistor
F. Insufficient power supply regulation

Use List 12B to answer items 12-33 and 12-34.

12-33. Which failure analysis may cause motorboating or distortion of the signal in a power amplifier?

1. A, B, C, or F
2. A, D, E, or F
3. A, C, E, or F
4. B, C, D, or F

12-34. Which failure analysis may indicate no output from a power amplifier?

1. A, E, or F
2. B, C, or D
3. A, C, or E
4. D, E, or F

12-35. Reduced output in a power amplifier could be caused by all of the following except

1. an open in the emitter/cathode resistor
2. improper soldering of the emitter/cathode bypass capacitor
3. a reduced input
4. shorted turns in the primary of T1

Learning Objective: Recognize some of the parts of phase splitter and inverter circuits, their functions and disadvantages when used as a driver stage for a push-pull power amplifier circuit. Text pages 268 through 271.

Items 12-36 through 12-38 are to be judged True or False.

12-36. A phase inverter or phase splitter is a driver whose function is to supply two equal amplitude output signals differing in phase by 180° in relation to each other.

12-37. The driver stage is that device or stage which reproduces audible intelligence from the input signal of the detector stage.

12-38. Push-pull circuits are used to compensate for the disadvantages of single-ended power amplifiers.

12-39. What component in the schematic shown on figure 13-23 of your textbook is used for phase splitting and impedance matching?
1. T1
2. R1
3. V1
4. Q1

● Refer to figure 13-24 in your textbook to answer items 12-40 and 12-41.

12-40. Which of the following parts is not essential to a proper output from a transistorized split-load phase inverter?
1. C1
2. R1
3. Q1
4. T1

12-41. What would be the reason for adding a series resistor between C2 and the top of R2 in figure 13-24 of your textbook?
1. To balance the resistance between R1 and R4
2. To balance output impedance between the emitter and collector of Q1
3. To balance capacitance between C2 and C3
4. To balance impedance between R1 and R2

12-42. What is one of the disadvantages of a single stage phase inverter?
1. It requires a large transistor
2. It requires a series resistor
3. It requires a large signal to drive
4. It requires a transformer

12-43. You should remember that a two-stage inverter is also referred to as a
1. paraphase splitter
2. paraphase amplifier
3. paraphase converter
4. preamplifier

12-44. Where is the positive signal (A) obtained and (B) where is this signal coupled through in a two-stage paraphase amplifier such as that shown on figure 13-26?
1. (A) Q2, (B) C5
2. (A) Q2, (B) C4
3. (A) Q1, (B) C5
4. (A) Q1, (B) C4

12-45. A ____(A)____ going signal will
positive, negative
appear at the collector of Q2 shown in figure 13-26 of your textbook. This signal will be coupled through ____(B)____
C2, C5
to the final output stage.
1. (A) negative, (B) C2
2. (A) positive, (B) C2
3. (A) negative, (B) C5
4. (A) positive, (B) C5

. . . .

Learning Objective: Determine how to identify the part or parts of a single phase splitter or a two stage inverter circuit that may be functioning improperly. Text pages 272 and 273.

● To answer item 12-46 refer to figure 13-24 in your textbook.

12-46. The following condition exists in a single-stage phase splitter that you are checking: "Loss of one output." What areas of the circuit should you check to locate the possible cause of the trouble?
1. C1 and C2
2. R2 and R3
3. Q1 and R1
4. Q1 and R2

12-47. Where should you look for a malfunction if a paraphase amplifier like the one shown on figure 13-26 of your textbook indicates a no output condition?
1. R4
2. Q2
3. C3
4. Q1

12-48. A reduced output of the circuit shown in figure 13-26 of your textbook could be the result of the weakened condition of the part that is labeled
1. R1
2. C2
3. Q1
4. R2

Learning Objective: Recognize some of the characteristics, functions, advantages, component circuits such as balancing networks, and trouble-shooting analysis for transistorized and electron tube class A push-pull amplifiers. Text pages 273 through 278.

12-49. What device shown on figure 13-29 of your textbook is used to produce the signals that will drive the speaker?
1. Single end amplifier
2. Split load phase splitter
3. Electron tube phase splitter
4. Transformer phase splitter

12-50. What is one advantage of a push-pull output stage over a single-ended output stage in a power amplifier?
1. High d.c. transformer-core saturation
2. Amplification of in-phase ripple voltages
3. Low current amplification
4. Cancellation of even-order harmonics

Item 12-51 is to be judged True or False.

12-51. The transistors or electron tubes used in push-pull amplifiers should be matched.

12-52. An electron tube push-pull amplifier operates much like a transistorized push-pull amplifier. In a properly matched class A push-pull power amplifier, what is the phase relationship of the signals between the plates of the tubes?
1. 180°
2. 90°
3. 45°
4. 0°

12-53. If the tubes in a class A push-pull amplifier are matched, equal current flow through both tubes when
1. no signal is applied to the grids
2. any signal is applied to the grids
3. an unsymmetrical signal is applied to the grids
4. an out-of-phase sine-wave signal is applied to the grids

12-54. What happens if a distorted signal is contained in the input signal to a push-pull amplifier?
1. The distorted signal is matched
2. The distorted signal is eliminated
3. The distorted signal is rejected
4. The distorted signal is amplified

12-55. What type of balancing network is shown in the electron tube version of figure 13-32 in your textbook?
1. Base
2. Collector
3. Cathode
4. Plate

12-56. What type of balancing network, other than the emitter type, may be used in a transistorized push-pull amplifier?
1. Grid
2. Collector
3. Base
4. Transistor

12-57. What is the effect on the amplifier outputs when the center tap of T2 shown on figure 13-29 of your textbook is not physically on the center of the winding?
1. The amplifier outputs are unequal.
2. The amplifier outputs are equal.
3. The amplifier outputs are reduced.
4. The amplifier outputs are quiescent.

● Items 12-58 through 12-61 are to be judged True or False.

12-58. Push-pull amplifiers eliminate odd-order and internally created harmonics by cancellation.

12-59. A hum can be detected in the output loudspeaker of a single-ended power amplifier which is caused by the power supply.

12-60. A decoupling network is necessary with a push-pull amplifier when the circuit is balanced.

12-61. There is no hum in the output of a push-pull amplifier.

List 12C. - Partial list of failure analysis for a malfunctioning push-pull amplifier.
A. Power supply failure
B. One amplifier device open
C. Emitter/Cathode resistor open
D. No input signal
E. Change in value of balancing resistors
F. Improper biasing in one of the amplifiers
G. Improper balancing

● Use List 12C to answer items 12-62 through 12-64.

12-62. Which of the following failures might you find in a push-pull amplifier that produces a distorted signal?
1. A or B
2. B or C
3. D or E
4. F or G

12-63. In trouble-shooting a push-pull amplifier for "no output," what failure analysis may indicate your source of trouble?
1. A, F, or G
2. A, C, or D
3. A, D, or E
4. A, B, or C

12-64. From List 12C what may be the cause of reduced output in a push-pull amplifier?
1. B, D, or E
2. A, B, or E
3. B, E, or F
4. A, F, or G

Learning Objective: Recognize some of the classes of operation, components such as complementary symmetry circuits, and functions of class B push-pull amplifiers. Text pages 278 through 282.

In items 12-65 through 12-67 select from column B the class of operation that is described by the definition in column A.

	A. Definition	B. Class
12-65.	High degree of distortion-never used	1. Class A 2. Class B
12-66.	Used when plate efficiency is not essential	3. Class C 4. Class D
12-67.	Used when high efficiency from an audio amplifier is desired	

12-68. Adding a bypass capacitor to the circuit shown in figure 13-37A of your textbook may result in a

1. distorted class C operation output
2. distorted class A operation output
3. distorted class C operation input
4. distorted class A operation input

12-69. As the incoming signal applied to the circuit in figure 13-40 of your textbook goes positive, what is the state of Q1 and Q2?

1. Both Q1 and Q2, nonconducting
2. Q1 conducting and Q2 nonconducting
3. Q1 nonconducting and Q2 conducting
4. Both Q1 and Q2, conducting

12-70. Which of the following statements describes the normal function of the variable resistor arms shown in figure 13-41 of your textbook?

1. When the arm of variable resistor R_1 moves toward point 2, the arm of variable resistor R_2 will be moving toward point 4
2. When the arm of variable resistor R_1 moves toward point 2, the arm of variable resistor R_2 will be moving toward point 3
3. A constant negative-going input will result in the arm of variable resistor R_1 moving toward point 1, and the arm of variable resistor R_2 moving toward point 4
4. The movement of the two arms of variable resistors R_1 and R_2 are independent of each other

12-71. Refer to figures 13-40 and 13-41 in your textbook. The incoming signal is going positive, Q2 is conducting and Q1 is nonconducting. What is the action taken by the variable resistors, R1 and R2?

1. R1 moves to the OFF position while R2 moves to point 3.
2. R1 moves to the ON position while R2 remains stationary.
3. R1 moves to the ON position while R2 moves to point 3.
4. R1 moves to the OFF position while R2 remains stationary.

12-72. Which of the following paths will bias current in the output of a complementary symmetry circuit take during class A operation?

1. $-V_{CC2} \rightarrow \pm V_{CC1} \rightarrow R1 \rightarrow R2 \rightarrow \pm V_{CC2}$
2. $R1 \rightarrow \pm V_{CC1} \rightarrow \pm V_{CC2} \rightarrow R2$
3. $R2 \rightarrow R1 \rightarrow -V_{CC1} \rightarrow +V_{CC2}$
4. $R_L \rightarrow \pm V_{CC1} \rightarrow \pm V_{CC2} \rightarrow R2 \rightarrow R1$

12-73. In class A or class B operation no resultant d.c. current flows through the load resistor. Which part of figure 13-41 in your textbook could be directly substituted for a voice coil?

1. R2
2. Q2
3. R_L
4. V_{CC2}

Assignment 13

Audio Amplifiers; RF Amplifiers; Oscillators

Textbook Assignment: Pages 282 through 309

Learning Objective: Recognize some of the characteristics associated with audio frequency reproduction devices that are most commonly used by the Navy. Text pages 282 and 283.

13-1. Most permanent magnet speakers are considered low impedance reproduction devices and receive their input signals through
1. RC coupling
2. transformer coupling
3. direct coupling
4. impedance coupling

13-2. What are the commonly recognized impedance values for a permanent magnet speaker?
1. 4, 10, 15, or 20 Ω
2. 4, 6, 8, or 12 Ω
3. 4, 8, 12, or 16 Ω
4. 4, 8, 16, or 32 Ω

13-3. Loudspeakers differ in basic design from headphones primarily in their use of a
1. fixed magnetic field
2. moving coil
3. moving diaphragm
4. separate power supply

Learning Objective: Identify some of the characteristics and purposes of RF amplifiers and their parts. Text pages 284 through 287.

13-4. Untuned amplifiers are characterized by
1. amplification over a narrow frequency range
2. amplification over a broad frequency range
3. high amplification over a narrow frequency range with little selectivity
4. high amplification over a broad frequency range with great selectivity

13-5. The nunber of IF amplifier stages in a superheterodyne receiver is generally based on the desired
1. fidelity
2. gain
3. image rejection
4. frequency stability

13-6. The RF signal received by a superheterodyne receiver is converted to the intermediate frequency in the
1. local oscillator
2. mixer
3. IF amplifier
4. second detector

13-7. Pentodes are used in the RF amplifiers of receivers instead of triodes because of their
1. more linear i_p-e_g curves
2. higher grid-plate capacitance
3. higher gain
4. lower plate resistance

13-8. Triode electron tubes used in an RF stage produce ____(A)____ noise and
less, more
have ____(B)____ interelectrode
less, greater
capacitance than pentode electron tubes used in an RF stage.
1. (A) less, (B) less
2. (A) less, (B) greater
3. (A) more, (B) less
4. (A) more, (B) greater

13-9. A triode electron tube has ____(A)____ isolation between the
greater, less
local oscillator and the antenna in an RF stage in comparison to a pentode electron tube used in an RF stage and ____(B)____ create feedback for
always, may
oscillation.
1. (A) greater, (B) always
2. (A) less, (B) always
3. (A) less, (B) may
4. (A) greater, (B) may

● Information for items 13-10 through 13-14. The following parts are associated with a typical RF amplifier.
A. Neutralizing capacitor
B. Input tank
C. Transistor (or electron tube)
D. Output tank

13-10. Which of the above parts provides for stage isolation?
1. A
2. B
3. C
4. D

13-11. The amplitude of the signal fed to the mixer stage is increased by the action of part
1. A
2. B
3. C
4. D

13-12. Signal selection is the function of which of the above parts?
1. A
2. B
3. C
4. D

13-13. The external signal to noise ratio is improved by
1. A and B
2. B and D
3. A and C
4. A and D

13-14. Which of the above parts functions to prevent oscillations?
1. A
2. B
3. C
4. D

Learning Objective:
Recognize some of the circuit parts associated with and characteristics of common emitter, pentode, and field effect transistor (FET) RF amplifiers. Text pages 286 through 289.

To answer items 13-15 through 13-20 refer to figure 14-3 in your textbook.

13-15. The RF amplifier shown on figure 14-3 of your textbook is an example of ____(A)____ transistor used
a PNP, an NPN
in the common, ____(B)____
collector, emitter
configuration which provides for greater gain than other configurations and ____(C)____
elimination of, simpler
biasing.
1. (A) an NPN, (B) collector
   (C) elimination of
2. (A) an NPN, (B) emitter,
   (C) simpler
3. (A) a PNP, (B) emitter,
   (C) simpler
4. (A) a PNP, (B) collector,
   (C) simpler

13-16. What parts of the RF amplifier are used as the input tank circuit?
1. Secondary of T2 and C5
2. Primary of T2 and C6
3. Secondary of T1 and C2
4. Primary of T1 and C1

13-17. What type of impedance is presented by the RF amplifier's input tank circuit?
1. Low to the tank's resonant frequency only
2. Low to all frequencies
3. High to the tank's resonant frequency only
4. High to all frequencies

13-18. What is the impedance of a parallel-tuned circuit at frequencies above and below resonance?
1. The same as at resonance
2. Greater than at resonance
3. Less than at resonance
4. Zero

13-19. Which part of the RF amplifier returns part of the output to suppress oscillations?
1. C7
2. C5
3. C4
4. C2

13-20. What is the phase difference of the signal at the top of the secondary of T2 in respect to the base of Q1?
1. 270°
2. 180°
3. 90°
4. 0°

13-21. What feature associated with the electron tube shown on figure 14-5 of your textbook permits the circuit to be constructed without a neutralizing capacitor?
1. High amplification factor
2. Low grid to plate capacitance
3. Low amplification factor
4. High transconductance

13-22. The quality of the tuning tank used in a pentode RF amplifier may be made more sharply peaked and the output voltage may be increased at the resonant frequency by reducing the circuit

1. Q
2. resistance
3. inductance
4. capacitance

13-23. The voltage gain of a resonant circuit increases as the

1. ratio of resistance to inductance decreases
2. ratio of resistance to capacitance increases
3. Q increases
4. Q decreases

13-24. Which of the following types of amplifiers produces an output waveform that most nearly resembles the grid input waveform?

1. Class C
2. Class AB_2
3. Class AB_1
4. Class A

13-25. What relative values of inductance and capacitance will produce a tuning tank with a high Q?

1. High inductance and low capacitance
2. Low inductance and high capacitance
3. Low inductance and low capacitance
4. High inductance and high capacitance

13-26. What function, other than providing the tuned circuit's inductance, is performed by transformers T1 and T2 shown on figure 14-6 in your textbook?

d. Voltage amplification
2. Impedance matching
3. Antenna isolation
4. D.c. blockage

. . . .

Learning Objective: Recognize some of the characteristics and functions of RF amplifiers such as tuning, tracking, coupling, and automatic gain control. Text pages 289 through 294.

. . . .

13-27. A permeability-tuned RF stage is tuned by adjustment of the position of the

1. plates on a padder capacitor
2. plates on a trimmer capacitor
3. slotted leaves on a variable capacitor
4. iron core in the inductance

13-28. Where is a trimmer capacitor electrically connected in a receiver circuit?

1. In parallel with the tone control
2. In parallel with the tuning capacitor
3. In series with the tone control
4. In series with the tuning capacitor

13-29. At what frequency within the range of an RF amplifier are the trimmer capacitors adjusted?

1. High
2. Medium
3. Low
4. One high and one low

13-30. Varying the capacitance of a trimmer capacitor will affect the percentage of tank capacitance to a much greater extent at the ___(A)___ end than at the
high, low
___(B)___ end.
high, low

1. (A) low, (B) high
2. (A) low, (B) low
3. (A) high, (B) low
4. (A) high, (B) high

13-31. The requirements of a particular RF stage are a wide bandwidth and a high degree of selectivity. Which of the following coupling methods would satisfy these requirements?

1. Tuned primary, untuned secondary
2. Untuned primary, tuned secondary
3. Tuned primary, tuned secondary
4. Untuned primary, untuned secondary

13-32. The tuned circuits used in conventional double-tuned amplifier stages are normally connected to the

1. plate circuits only
2. grid circuits only
3. plate and grid circuits
4. cathode and grid circuits

13-33. What is one of the most common uses of the tuned-primary tuned-secondary type of coupling circuit?

1. Attenuating a narrow band of frequencies
2. Passing a wide band of frequencies
3. Passing a narrow band of frequencies
4. Selecting a harmonic of the applied frequency

13-34. What is the correct expression of the relationship between the impedance and the transformer turns for figure 14-13A in your textbook?

1. $\frac{\text{input impedance}}{\text{output impedance}} = \frac{(\text{primary turns})^2}{(\text{secondary turns})^2}$
2. $\frac{\text{input impedance}}{\text{output impedance}} = \frac{(\text{secondary turns})^2}{(\text{primary turns})^2}$
3. $\frac{(\text{input impedance})^2}{(\text{output impedance})^2} = \frac{\text{primary turns}}{\text{secondary turns}}$
4. $\frac{(\text{input impedance})^2}{(\text{output impedance})^2} = \frac{\text{secondary turns}}{\text{primary turns}}$

13-35. Which of the following methods can be used to achieve a high Q in a coupling circuit?

1. By increasing the inductance and decreasing the resistance
2. By decreasing the inductance and increasing the resistance
3. By increasing the resistance while holding the inductance constant
4. By decreasing the inductance while holding the resistance constant

13-36. Automatic gain control (AGC) in a receiver keeps the audio output essentially constant when the amplitude of the received signal increases by
1. reducing the gain of the preceding RF stage and increasing the gain of the preceding IF amplifier stage
2. reducing the gain of the preceding RF and IF amplifier stages
3. increasing the gain of the preceding RF stage and reducing the gain of the preceding IF amplifier stage
4. increasing the gain of the preceding RF and IF amplifier stages

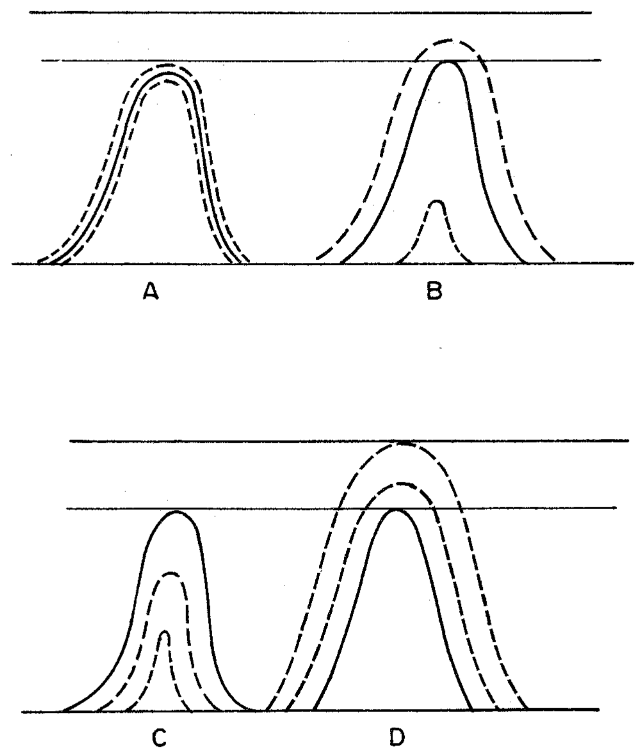
13-37. In a receiver employing a detector circuit like the one shown in figure 14-14 of your textbook, the voltage for the AGC is obtained across
1. an RC network
2. the amplifier's power supply
3. an LC network
4. the amplifier's local oscillator

Learning Objective: Recognize some of the different types of transistor oscillators, some of their components, characteristics, functions, methods of operation, and procedures used in failure analysis. Text pages 295 through 302.

13-38. Why does one definition of an oscillator specify that an oscillator is a non-rotating device?
1. To include generators as oscillators
2. To exclude alternators as oscillators
3. To include transistors as oscillators
4. To exclude electron tubes as oscillators

13-39. Which of the following methods is used to obtain feedback between the output and input circuits of an electron-tube oscillator?
1. Capacitance or resistive coupling only
2. Inductive or resistive coupling only
3. Inductive, capacitive, or resistive coupling
4. Resistive coupling only

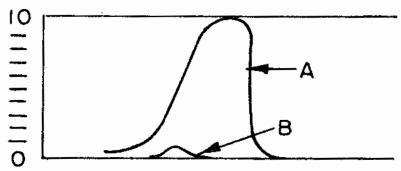
13-40. A maintenance check reveals that the oscillator of a superheterodyne receiver is operating within a tolerance of ± 0.0001. This indicates that the receiver has a good frequency
1. deviation
2. stability
3. hum
4. distortion



D-1-70

Figure 13A. - Waveforms

13-41. Which waveform on figure 13A suggests that it is produced by an oscillator that has a desirable stability characteristic?
1. (A)
2. (B)
3. (C)
4. (D)



D-1-71

Figure 13B.-Waveforms

13-42. Waveform (B) in figure 13B indicates that waveform (A) has decreased in amplitude. This output waveform is often referred to as a
1. dampened wave
2. half-wave
3. sinusoidal wave
4. quarter-wave

13-43. Oscillation in an LC oscillator is accomplished by the application of ______(A)______ feedback from the negative, positive ______(B)______ circuit. output to input, input to output
1. (A) negative, (B) output to input
2. (A) negative, (B) input to output
3. (A) positive, (B) output to input
4. (A) positive, (B) input to output

● Items 13-44 through 13-47 refer to figure 15-3 in your textbook.

13-44. What parts make up the tuned circuit of the oscillator?
1. RFC, C1 and L2
2. L2, L1, and C2
3. L1 and C2 only
4. L2 and C2 only

13-45. What parts provide a bias stability network for the transistor, Q1?
1. C2 and C1
2. RE and C2
3. RFC and C2
4. RE and CE

13-46. What may result if a resistor of a large value is placed at point RB?
1. Insufficient bias
2. Detuning of the tank
3. Reduction of the tank's Q
4. Blocking of oscillations

13-47. What part of the circuit provides a source for regenerative feedback?
1. Q_1
2. C_1
3. L_1
4. S_1

13-48. Application of a positive potential to the base of Q1 in figure 15-4 in your textbook results in
1. an increase of collector and emitter current
2. a decrease of collector and emitter current
3. a decrease of feedback coil current
4. a decrease of forward bias

13-49. What action takes place during the negative cycle when a negative potential is applied to the base of Q1 in figure 15-4 in your textbook?
1. Collector current is increased
2. Emitter current is increased
3. Forward bias is reduced
4. Resistance is reduced

13-50. What is the most commonly used class of operation for a transistor series-fed Hartley oscillator?
1. Class-A
2. Class-AB
3. Class-B
4. Class-C

13-51. What is the total bias voltage for the circuit shown in figure 15-4 of your textbook?
1. 11.8 volts
2. 7.2 volts
3. 2.4 volts
4. 0.2 volts

13-52. What is one of the functions of the RF choke in the transistor shunt-fed Hartley oscillator shown in figure 15-5 of your textbook?
1. To act as a collector load for Q1
2. To act as an emitter load for Q1
3. To act as a decoupler between L1 and Q1
4. To act as a decoupler between RE and Q1

13-53. Which part of the circuit in figure 15-5 of your textbook is an isolation factor that prevents the d.c. voltage component from flowing through the feedback coil?
1. RB
2. C3
3. RE
4. C2

13-54. What is the initial path of charge for C3 in figure 15-5?
1. $-V_{CC} \rightarrow R_E$, Q1, $R_B \rightarrow +V_{CC}$
2. $+V_{CC} \rightarrow$ RFC, R_B, C3 $\rightarrow -V_{CC}$
3. -VCC $\rightarrow$ L1, C3, RFC $\rightarrow +V_{CC}$
4. $+V_{CC} \rightarrow$ L1, C3, RFC $\rightarrow -V_{CC}$

13-55. A transistor Hartley oscillator is not producing an output. What part of the circuit shown in figure 15-5 of your textbook would you ordinarily check first?
1. L1
2. C1
3. Q1
4. C2

13-56. Before making a continuity check on a circuit similar to the one shown in figure 15-5 of your textbook, you must disconnect the tank coil from
1. R_B
2. C_E
3. RFC
4. C_2

13-57. A change in the values of C1 and C2 and L1 and L2 in the circuit in figure 15-5 will definitely result in a
1. reduced output condition
2. frequency instability condition
3. no output condition
4. amplitude instability condition

Learning Objective:
Recognize some of the types of grid leak bias circuits, their parts, use, advantages and disadvantages, and the theory of time constants and operation. Text pages 302 through 306.

13-58. Grid leak bias, although used in other circuits, is used almost universally in
1. PNP transistor oscillators
2. triode oscillators
3. NPN transistor oscillators
4. all of the above

13-59. What does the mathematical symbol 5TC represent when employed with capacitors or capacitor circuits?
1. The capacitor has recharged 5 times
2. The capacitor has 5 color code tinted bands
3. The capacitor is fully charged to 5 times its value
4. The capacitor is fully charged after 5 time constants

13-60. When is a time constant reached in a series resistor-capacitor combination?
1. At the time that the circuit is within 36.8% of its full charge
2. At the time when the circuit is within 0.7% of its full charge
3. At the time when the circuit is within 76% of its full charge
4. At the time when the circuit is within 92.7% of its full load

13-61. A point to remember regarding grid leak bias is that it will maintain bias
1. as close to the peak output as possible
2. at one half the input signal
3. as close to the peak input signal as possible
4. at one half of its output signal

13-62. Which part of the circuit in figure 15-11 indicates the type of bias used?
1. C_{g1}
2. R_{g1}
3. C1
4. L2

13-63. One of the advantages of series grid leak bias is that the circuit is
1. non-oscillating
2. self-starting
3. non-adjusting
4. self-maintaining

Learning Objective: Recognize the parts, class of operation and malfunction analysis of the series fed electron tube Hartley oscillator. Text pages 306 through 309.

13-64. What parts in figure 15-13 make up the tuned circuit of the oscillator?
1. RFC, C1, and L2
2. L2, L1, and C2
3. L1 and C2 only
4. L2 and C2 only

13-65. Which parts of the circuit in figure 15-13 act similar to "L" filters?
1. L1 and L2
2. C1 and C2
3. C3 and RFC
4. C2 and Rg

13-66. It can be assumed that a circuit as shown in figure 15-13 will normally operate as
1. class A
2. class B
3. class C
4. class AB

13-67. What is one of the functions of the RF choke in the electron tube shunt-fed Hartley oscillator?
1. To remove harmonics from the oscillator output
2. To short RF energy to ground
3. To act as a plate load device for Q1
4. To act as a plate load device for V1

13-68. What condition may cause "motor-boating" in an electron tube Hartley oscillator?
1. A non-operating tube
2. Too high a value of grid leak resistance
3. A non-operating tank circuit
4. Too low a value of grid leak resistance

13-69. A reduced or no output from a Hartley oscillator may result from which of the following?
1. A defective RFC
2. A leaky C_3
3. A leaky C_2
4. Each of the above

13-70. What factors may influence the output frequency of an electron tube Hartley oscillator?
1. Circuit wiring and temperature
2. Temperature and physical location of the oscillator
3. Circuit wiring and physical location of the oscillator
4. Temperature and atmospheric humidity

Assignment 14

Oscillators

Textbook Assignment: Pages 310 through 332

Learning Objective: Recognize transistor and electron tube Colpitts oscillators, their parts and functions, their failure analysis, and the selection of transistor Colpitts oscillators. Textbook pages 310 through 312.

14-1. What class of operation is normally associated with a transistorized Colpitts oscillator?
1. AB
2. A
3. B
4. C

14-2. Which parts of the circuit shown in figure 15-15 in your textbook provide isolation from the tank coil?
1. R_E and C_E
2. C1 and C2
3. C1 and C3
4. R_B and RFC

14-3. What effect, if any, would a shorted C_1 have on the circuit shown in figure 15-15 of your textbook?
1. The oscillating frequency would increase
2. The oscillating frequency would decrease
3. Oscillations would cease
4. It would have no effect on the circuit

14-4. Changes in the value of what components may result in reduced output from a transistorized Colpitts oscillator?
1. R_B and R_E
2. C1 and C2
3. L1 and C3
4. R_B and RFC

- In items 14-5 through 14-7 select from column B the transistor configuration that best fits the definition listed in column A.

	A. Definition	B. Configuration
14-5.	Very seldom used in oscillator circuits	1. Common base (CB)
14-6.	Most often used in receiver oscillators	2. Common emitter (CE)
14-7.	Can give satisfactory operation in an oscillator	3. Common collector (CC)

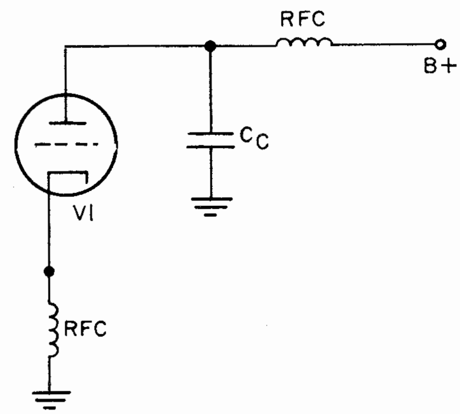
14-8. What type of feedback is used by the Colpitts electron tube oscillator?
1. Inductive
2. Capacitive
3. Negative
4. Resistive

Learning Objective: Determine some of the uses of transistorized Clapp oscillators, factors determining the frequency of operation, malfunctions, and variations of the electron tube version of a Clapp oscillator from a partial schematic. Textbook pages 313 through 315.

14-9. What circuit design in a transistorized Clapp oscillator determines the circuit's frequency of operation?
1. Loose inductive coupling
2. Class C operational bias
3. Series-resonant LC
4. Parallel-resonant LC

14-10. How is a transistorized Clapp oscillator circuit normally used?
1. As a signal source for a MF transmitter
2. As a signal source for a VLF transmitter
3. As a signal source for a signal generator
4. As a signal source for TTY operations

14-11. A transistorized Clapp oscillator indicates an unstable frequency output. What component might be directly connected to the malfunction?
1. The tank circuit
2. The bias circuit
3. The emitter circuit
4. The collector load circuit



D1-72

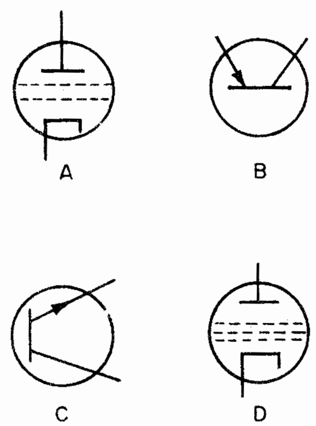
Figure 15A. -Variation of Clapp oscillator.

4-12. Which part of figure 15A represents a variation to an electron tube Clapp oscillator and is not essential to the circuit's operation?
1. The RF choke coupled to the plate of V1
2. The coupling capacitor
3. The RF choke coupled to the cathode of V1
4. The coupling capacitor ground

Learning Objective: Recognize some of the advantages of electron coupled oscillators over other oscillators and the procedures for operation and failure analysis used with electron coupled oscillators. Textbook pages 316 through 319.

14-13. What is one advantage of the electron-coupled oscillator over other types of coupled oscillators?
1. Frequency stability
2. Improved high-frequency response
3. Economy of construction
4. High power output

14-14. The screen grid of an electron coupled oscillator tube functions as an
1. electric plate
2. amplifier cathode
3. control grid
4. oscillator plate



D1-73

Figure 14B. -Electronic device symbols.

14-15. Which of the symbols in figure 14B represents an electronic part that may be used as the oscillating device in an electron coupled oscillator?
1. A and C
2. B and D
3. A and D
4. B and C

● Items 14-16 through 14-21 are to be judged True or False based on the functional operation of an electron coupled oscillator (ECO) such as the one shown on figure 15-19 of your textbook.

14-16. The first operational function when power is applied to the ECO is that charging current flows from ground through L_1, C_2, R_1, and RFC_1 to E_{bb}.

14-17. The build up of the charging current causes the magnetic field surrounding L1 to collapse.

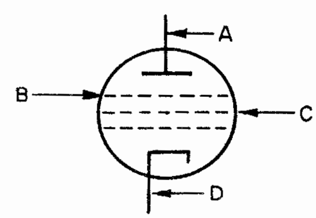
14-18. When the charging current reaches its peak value and ceases to build up any further a magnetic field is created around L1.

14-19. The collapse of L1's magnetic field starts oscillations in the tank circuit composed of L1, L2, and C1.

14-20. Oscillations in the ECO's tank circuit causes R_g and C_g to build up a grid leak bias.

14-21. When grid leak bias is created in the ECO the circuit is fully operational.

14-22. The electron tube in an ECO is treated as a ___(A)___ section
two, three
tube and checked first for ___(B)___
oscillations, plate continuity
when troubleshooting for a no output condition.
1. (A) two, (B) plate continuity
2. (A) three, (B) oscillations
3. (A) two, (B) oscillations
4. (A) three, (B) plate continuity



D1-74

Figure 14C. -Electron tube.

14-23. In addition to conditions previously mentioned in the malfunctioning of other oscillators, what part of the electron tube shown on figure 14C could you check for a decreased output in an ECO?
1. A
2. B
3. C
4. D

Learning Objective: Recognize some of the functions of the parts in a tuned-plate tuned-grid (TPTG) oscillator and some of the effects that are a result of defective parts. Textbook pages 319 through 322.

14-24. Which property of the electron tube serves as the feedback path for the TPTG oscillator?
1. Grid-to-cathode interelectrode capacitance
2. Plate-to-cathode interelectrode capacitance
3. Grid-to-plate interelectrode capacitance
4. A. c. plate resistance

● Items 14-25 through 14-27 are to be judged True or False.

14-25. Reduced output in a TPTG oscillator may be the result of several malfunctions among which may be a leaky coupling capacitor.

14-26. Loss of oscillation may be traced to a defective electron tube, RF choke or a tank circuit.

14-27. Temperature is the main factor that may be used to determine the cause of incorrect output frequency.

Learning Objective: Recognize some of the characteristics and functions associated with Rochelle, Tourmaline, and quartz crystal oscillators. Textbook pages 323 through 325.

14-28. The Y axes of quartz crystals are known as the
1. optical axes
2. electrical axes
3. imaginary axes
4. mechanical axes

14-29. A voltage applied across a crystal of Rochelle salt causes
1. a counter e. m. f.
2. an a. c. voltage
3. a negative resistance effect
4. mechanical distortion of the salt

14-30. Tourmaline is a good piezoelectric substance both electrically and mechanically but it has one disadvantage of being
1. hard to handle
2. very expensive
3. hard to maintain
4. cheaply constructed

14-31. From what substance are most oscillator crystals constructed?
1. Quartz
2. Marble
3. Rochelle salt
4. Tourmaline

● Items 14-32 through 14-39 are to be judged True or False.

14-32. Low frequency is a characteristic of a square crystal.

14-33. A thin crystal is associated with high resonance characteristics.

14-34. High frequency is a characteristic of a rectangular crystal.

14-35. Spurious frequencies is a characteristic associated with crystals of uniform thickness.

14-36. Precision test work requires the use of flat ring crystals.

14-37. A characteristic of crystals that have been crudely cut and ground is inaccurate frequency generation.

14-38. A positive temperature coefficient is assigned a crystal cut that produces an increase in frequency with a decrease in temperature.

14-39. A negative temperature coefficient is given a crystal cut that decreases its natural resonant frequency with an increase in temperature.

14-40. How, briefly, may frequency drift be described?

1. A quick shift in the physical location of a quartz crystal
2. A slow shift in the resonant frequency of a quartz crystal due to heat
3. An electrical breakdown of a crystal
4. A mechanical distortion of the salt in a quartz crystal

14-41. What is the purpose of operating a crystal in a temperature-controlled chamber?

1. To obtain higher output frequencies
2. To lower the Q of the crystal
3. To stabilize the frequency of the crystal
4. To raise the Q of the crystal

14-42. Inductance L in figure 15-25 of your textbook represents the

1. crystal mass that causes mechanical vibration
2. inductance of the crystal holders
3. compliance of the crystal
4. reactance of the crystal to alternating current flow

Learning Objective: Determine the functions of some of the parts associated with Colpitts, Miller and Pierce oscillators and some of the operational characteristics and failure analysis for these circuits. Textbook pages 326 through 331.

14-43. What is the function of capacitor C3 in the transistor common-emitter (CE) Colpitts oscillator shown in figure 15-26 of your textbook?

1. To establish the operational class of the oscillator and couple the output capacitively
2. To provide a path for thermal runaway
3. To couple a positive potential to the base of the transistor through the crystal
4. To provide a.c. isolation and to bypass the transistor's base

14-44. Regenerative action will stop during the normal operation of a CE Colpitts oscillator when the

______(A)______ current
emitter, collector, base

reaches the ______(B)______
deficiency, saturation

level.

1. (A) collector, (B) deficiency
2. (A) base, (B) saturation
3. (A) collector, (B) saturation
4. (A) emitter, (B) deficiency

14-45. A CE Colpitts oscillator such as the one shown in figure 15-26 of your textbook is not producing an output. A check indicates that bias and supply voltages and the resistive values for R_B, the RFC and the XTAL are all normal. What part of the circuit is probably the cause of this malfunction?

1. R_E
2. Q1
3. C2
4. C1

14-46. In a CE Colpitts oscillator circuit designed specifically to operate at a low frequency, all of the following faults may result in a reduction of output except

1. a change to a lower supply voltage
2. a reduction of bias from class B to class A
3. a dirty XTAL container
4. a change of parts wiring during a repair

14-47. Your equipment uses a CE Colpitts oscillator and you have been experiencing frequency shifts during, otherwise, normal operation. You have been able to compensate for these abrupt changes by adjusting the tuning of the oscillator's tank. What is the probable cause of this malfunction?

1. A dirty XTAL
2. A dirty XTAL container
3. A reduction of the bias voltage
4. A variation in the supply voltage

14-48. The Miller crystal oscillator provides a greater power output for a given amount of crystal excitation than the other types of electron tube oscillators because the basic feed-back occurs between the

1. grid of the circuit's triode and the crystal
2. grid and plate of the circuit's triode
3. plate of the circuit's triode and the crystal
4. plate and cathode of the circuit's triode

14-49. What part of a TPTG oscillator circuit is replaced by the crystal in a Miller crystal oscillator?

1. The grid tank circuit
2. The grid leak resistor
3. The plate tank circuit
4. The RF choke

14-50. Why is a grid leak capacitor unnecessary in a crystal-controlled oscillator such as the Miller crystal oscillator shown in figure 15-27 of your textbook?

1. In the crystal-controlled oscillator, the variable plate tank capacitor in conjunction with the grid resistor develops the grid leak bias
2. In the crystal-controlled oscillator, the crystal holder acts as a capacitor in conjunction with the RF choke to develop grid leak bias
3. In the crystal-controlled oscillator, the RF choke acts as a capacitor in conjunction with the grid resistor to develop grid leak bias
4. In the crystal controlled oscillator, the crystal holder acts as a capacitor in conjunction with the grid resistor and the crystal shunt capacitance to develop grid leak bias

14-51. What are the functional characteristics normally associated with a Miller crystal oscillator?

1. A low Q circuit equivalency resonating over a broad range of frequencies with linear tuning
2. A high Q circuit equivalency resonating over a narrow range of frequencies with sharp tuning
3. A low Q circuit equivalency resonating over a narrow range of frequencies with sharp tuning
4. A high Q circuit equivalency resonating over a broad range of frequencies with linear tuning

14-52. The crystal in a typical Miller crystal oscillator represents a Q circuit that is ____(A)____ by at least 100
higher, lower

times than a conventional
____(B)____ oscillator.
LC tank, RF choke

1. (A) lower, (B) LC tank
2. (A) lower, (B) RF choke
3. (A) higher, (B) RF choke
4. (A) higher, (B) LC tank

14-53. The end result of increasing the bias or the plate voltage on a Miller crystal oscillator beyond a predetermined level will normally result in
1. a reduced output
2. a shattered crystal
3. a lower frequency
4. a triode casualty

14-54. The design characteristics of the crystal used in a Miller crystal oscillator require that the cut of tne crystal produces
1. a positive temperature coefficient
2. a negative temperature coefficient
3. a zero temperature coefficient
4. either a positive or a negative temperature coefficient

14-55. A Pierce crystal oscillator differs from a Miller crystal oscillator in
1. method of controlling the operational frequency
2. output power only
3. both output power and frequency applications
4. frequency applications only

14-56. A Pierce crystal oscillator may be operated class A by the use of
1. fixed-bias only
2. self-bias only
3. no bias
4. a combination of fixed and self-bias

● Items 14-57 through 14-63 are to be judged True or False.

14-57. The plate load for a Pierce oscillator is reactive and consists of a tapped inductance.

14-58. The Pierce oscillator is sometimes considered the inverse of a Miller oscillator.

14-59. In the Pierce oscillator, conventional grid leak bias is developed by the grid leak capacitor and the plate load resistor.

14-60. To operate the Pierce oscillator at a single fixed frequency the plate load resistor is normally replaced by an RF choke.

14-61. To maintain the proper phase oscillation relationship in the Pierce oscillator the crystal is connected between the electron tube's plate and cathode.

14-62. An unstable output from either a Miller or a Pierce oscillator can only be caused by defective crystals.

14-63. Small variations in the output frequency from either a Pierce or Miller oscillator can be attributed to the aging of the crystals or electron tubes.

Learning Objective: Determine some of the uses of overtone oscillators and their operational characteristics. Textbook pages 331 through 332.

14-64. Some of the uses of overtone oscillators are in receivers and test equipments where ____(A)____ (high, low) frequency operation at an ____(B)____ (even, odd) harmonic of its crystal's fundamental frequency is required for stable operation.
1. (A) high, (B) even
2. (A) low, (B) even
3. (A) low, (B) odd
4. (A) high, (B) odd

14-65. The most widely used overtone oscillator is designated the
1. Colpitts
2. Butler
3. Miller
4. Pierce

14-66. A cathode-coupled two-stage oscillator has the characteristics of being
1. simple and versatile
2. stable
3. reliable
4. all of the above

14-67. A cathode-coupled two-stage oscillator has ___(A)___ power
more, less

output than the Miller circuit for the same amount of crystal excitation and ___(B)___ the Pierce circuit's
has, does not have

broad bandwidth of operation without tuning.
1. (A) more, (B) has
2. (A) more, (B) does not have
3. (A) less, (B) does not have
4. (A) less, (B) has

● Items 14-68 through 14-72 are based on the schematic shown in figure 15-29 of your textbook.

14-68. The cathode bias for V1 and V2 is developed across
1. R1 and C1 for V1 and R2 and C4 for V2
2. R1 and R3 for both V1 and V2
3. R1 and C4 for V1 and R2 and C4 for V2
4. R1 for V1 and R2 for V2

14-69. The functions of resistor R4 and capacitor C2 are
1. plate dropping and decoupling for V2
2. plate dropping and decoupling for V1
3. capacitive feedback coupling for V2
4. capacitive feedback coupling for V1

14-70. With a positive going signal on the grid of V2, the plate current of V2 will ___(A)___ and the plate voltage
increase, decrease

will ___(B)___.
increase, decrease

1. (A) increase (B) increase
2. (A) increase (B) decrease
3. (A) decrease (B) increase
4. (A) decrease (B) decrease

14-71. Oscillations in the tuned tank circuit are supported by variations in the
1. plate voltage of V1
2. grid current of V2
3. plate voltage of V2
4. grid current of V1

14-72. A Butler oscillator has the capability of oscillating without a ___(A)___
tube, crystal

provided the part is replaced with a ___(B)___.
resistor, capacitor

1. (A) tube, (B) resistor
2. (A) tube, (B) capacitor
3. (A) crystal, (B) capacitor
4. (A) crystal, (B) resistor

Assignment 15

Oscillators; Mixers and Converters

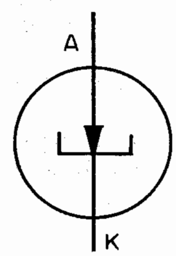
Textbook Assignment: Pages 333 through 344

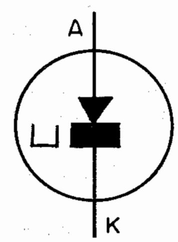
> Learning Objective: Recognize some of the characteristics associated with tunnel diode oscillators and their construction and operation. Textbook pages 333 through 335.

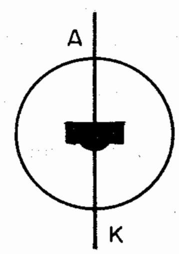
15-1. High speed switching is one of the desirable characteristics of tunnel diodes. What is one of this device's disadvantages?
1. Large mass
2. Instability
3. Lack of isolation
4. Ineffective amplification

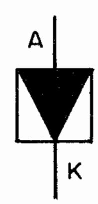
15-2. The PN junction of a tunnel diode differs from the other PN junction diodes in that it has
1. three leads
2. semiconductor materials that use less doping
3. lower frequency capability
4. an extremely thin barrier region at its junction

15-3. Which of the following is the MIL-STD symbol for a tunnel diode?

1. 

2. 

3. 

4. 

Items 15-4 through 15-6 are to be judged True or False.

15-4. The "offset" voltage and "breakdown" region for a tunnel diode are much less than for a standard PN diode.

15-5. The "valley point voltage" for the typical tunnel diode is approximately 300 millivolts.

15-6. The characteristic of a tunnel diode that enables it to be used as an oscillator is the negative resistance property between its peak voltage point and its "valley point voltage."

15-7. What characteristic of a tunnel diode enables it to easily feel charge differences across the junction when junction voltage is applied?
1. A thick and narrow potential barrier
2. A thin and narrow potential barrier
3. A thick and broad potential barrier
4. A thin and broad potential barrier

15-8. What characteristic prevents a standard diode from exhibiting negative resistance?
1. The diode's dopping level
2. The diode's biasing
3. The diode's narrow junction barrier
4. The diode's wide junction barrier

Learning Objective: Determine some of the operational characteristics of tunnel diode circuits and methods of coupling oscillator circuits to other circuits. Textbook pages 335 and 336.

15-9. The purpose of R_b and R1 shown on figure 15-33 of your textbook is to
1. adjust the operation of the diode to either the beginning or the end of its negative resistance area
2. adjust the operation of the diode at the center of its negative resistance area
3. adjust the operation of the diode to a point that is well above its negative resistance area
4. adjust the operation of the diode to a point that is well below its negative resistance area

15-10. The level of surge current in the tunnel diode oscillator circuit shown on figure 15-33 of your textbook is limited by the action of
1. R_b
2. L
3. C1
4. R1

15-11. What parts of the circuit in figure 15-33 of your textbook are used to establish the voltage applied across the tunnel diode?
1. R1 and C1-L
2. R_b and C1
3. R_b and C1-L
4. R_b and R1

15-12. What characteristic of the tunnel diode maintains oscillations in its associated tank circuit?
1. Positive resistance
2. Reverse bias
3. Negative resistance
4. All of the above depending on input

15-13. Which parts of the tunnel diode oscillator shown in figure 15-33 of your textbook control the frequency of operation?
1. L and R1
2. C1 and L
3. R1 and R_b
4. The diode and R1

15-14. The two methods in common use to couple an oscillator to another stage are
1. resistor and transformer
2. inductor and resistor
3. capacitive and inductive
4. transformer and capacitor

15-15. What part is added to the secondary winding of an inductive coupled oscillator to form a tuned secondary?
1. A diode
2. A capacitor
3. A resistor
4. An inductor

15-16. To obtain the highest possible output amplitude from inductive coupling it is necessary to have ____(A)____ (tight, loose) coupling where the primary and secondary windings are spaced ____(B)____ (close together, far apart).
1. (A) loose, (B) far apart
2. (A) loose, (B) close together
3. (A) tight, (B) far apart
4. (A) tight, (B) close together

15-17. An oscillator with tight inductive coupling has ____(A)____ (a disadvantage, an advantage) in having a loaded tank circuit which results in a ____(B)____ (lowered, raised) Q.
1. (A) a disadvantage, (B) raised
2. (A) an advantage, (B) raised
3. (A) an advantage, (B) lowered
4. (A) a disadvantage, (B) lowered

15-18. The characteristics of using capacitive coupling with an oscillator circuit are similar to those of loose inductive coupling except that the
1. frequency of operation may be changed
2. reflected losses are low
3. tank is not loaded
4. Q is unaffected

Learning Objective: Recognize some of the characteristics of amplitude and frequency stability and tuning and tracking that are associated with various types of oscillator circuits. Textbook pages 336 and 337.

15-19. Which of the following factors may affect the amplitude stability of an oscillator?
1. A change in bias or a change in the gain of the oscillator's amplifying device
2. A change in the gain of the oscillator's amplifying device or a change in the supply voltage
3. A change in the supply voltage or a change in the reflected impedance
4. All of the above

15-20. What is the result, in most oscillator circuits of (A) decreasing the circuit's bias and (B) increasing the gain of the circuit's amplifying device?
1. (A) An increase in feedback amplitude, (B) an increase in circuit gain
2. (A) A decrease in feedback amplitude, (B) an increase in circuit gain
3. (A) An increase in feedback amplitude, (B) a decrease in circuit gain
4. (A) A decrease in feedback amplitude, (B) a decrease in circuit gain

- Items 15-21 through 15-24 are to be judged True or False.

15-21. Amplitude stability in a transistor circuit can be improved by using base-leak bias.

15-22. Temperature changes will affect the frequency stability of a circuit by causing the inter-element capacitance in an electron tube to vary.

15-23. Mechanical vibration creates frequency drift at a much lower rate than temperature changes.

15-24. Reflected impedance may be composed of both reactive and resistive components.

15-25. What is the local oscillator frequency in a superheterodyne receiver when the receiver is tuned to a station frequency of 900 kHz and has an intermediate frequency of 455 kHz?
1. 445 kHz
2. 455 kHz
3. 900 kHz
4. 1355 kHz

15-26. The local oscillator in the normal superheterodyne receiver using an intermediate frequency of 455 kHz can vary from ___(A)___ kHz to ___(B)___ kHz.
540, 995 1600,2055
1. (A) 540, (B) 1600
2. (A) 540, (B) 2055
3. (A) 995, (B) 1600
4. (A) 995, (B) 2055

15-27. A trimmer capacitor associated with an oscillator's tuning capacitor will
1. provide better tracking of the IF stage(s)
2. adjust for electrical differences in the local oscillator tuning capacitor
3. set the station frequency
4. establish the intermediate frequency

- Items 15-28 through 15-30 are to be judged True or False.

15-28. A varactor is sometimes used to tune a Hartley oscillator.

15-29. Tracking is made easy when a Colpitts oscillator uses variable tank capacitors.

15-30. One method of overcoming the loss of feedback in a Colpitts oscillator is by using a variable tank capacitor in conjunction with the fixed tank capacitors.

Learning Objective: Determine why the superheterodyne receiver is preferred over the TRF receiver for use in most applications and describe the essential differences in circuitry which have provided it with these desired characteristics. Textbook page 338.

15-31. The primary difference between a TRF receiver and a superheterodyne receiver is that the latter makes use of

1. a frequency conversion and fixed tuned RF circuits to provide the desired selectivity and RF gain.
2. variable tuned RF circuits to provide the desired selectivity and RF gain.
3. a demodulator and fixed tuned RF circuits to provide the desired selectivity and gain.
4. a frequency conversion and variable tuned RF circuits to provide the desired selectivity and gain.

15-32. For most applications the superheterodyne receiver is preferred over the TRF receiver because of certain characteristics which are inherent in its design. Some of these characteristics are

1. single frequency high gain operation with low distortion.
2. low distortion, high gain, and multiple frequency operation.
3. uniform selectivity and gain over the desired operating range.
4. low distortion and less subject to interference, both internal and external.

15-33. The RF signal received by a superheterodyne receiver is converted to the intermediate frequency in the

1. local oscillator
2. mixer
3. IF amplifier
4. second detector

15-34. The local oscillator in a superheterodyne receiver is usually tuned to

1. a fixed proportion of the received frequency
2. a fixed proportion of the IF frequency
3. the difference of the received frequency and the IF frequency
4. the sum of the received frequency and the IF frequency

Learning Objective: Define the principles of heterodyning and determine how they are applied to provide frequency conversion in the superheterodyne receiver. Textbook pages 338 through 341.

15-35. Heterodyning is one of the many names given the process whereby

1. two or more frequencies are mixed in a linear device producing new frequencies in the output.
2. demodulation is accomplished in the superheterodyne receiver.
3. two or more frequencies are mixed in a nonlinear device producing new frequencies in the output.
4. the local oscillator signal is modulated in the superheterodyne receiver.

● Based on your textbook discussion regarding the simultaneous generation of two audio signals, items 15-36 through 15-41 should be judged as True or False.

15-36. If the two frequencies are of the same frequency an audio beat note will be produced.

15-37. The compressions and rarifications of the atmosphere produced by the two signal sources periodically augment and counteract each other resulting in a periodic variation in the intensity of the resultant sound.

15-38. The amplitude variations occur at a rate which is equal to the sum of the two audio frequencies.

15-39. While the amplitude variation exists it is not detectable as an audio beat note until applied to a nonlinear device such as the human ear.

15-40. Since electron tubes and transistors are incapable of directly detecting this audio beat note, they must be linear devices.

15-41. The response curve for a nonlinear device may be used to demonstrate why such a device is necessary if the heterodyning process is to occur.

15-42. Which of the following beat frequencies results from the heterodyning of a 465 kHz signal and a 1000 kHz signal?

1. 70 kHz
2. 535 kHz
3. 765 kHz
4. 1435 kHz

15-43. If the inputs to the mixer stage of a superheterodyne receiver consist of a 795 kHz RF signal and a 1250 kHz oscillator signal, (A) what major frequencies are present in the output of the mixer and (B) what is the value of the difference frequency?

1. (A) 795 kHz, 1250 kHz, 455 kHz, and 2045 kHz, (B) 795 kHz.
2. (A) 795 kHz, 495 kHz, 1250 kHz, and 1290 kHz, (B) 495 kHz
3. (A) 795 kHz, 455 kHz, 1250 kHz, and 2045 kHz, (B) 455 kHz
4. (A) 1250 kHz, 2045 kHz, 2840 kHz, and 455 kHz, (B) 455 kHz

15-44. In figure 16-4 of your textbook, assume that a 1250 kHz carrier signal modulated by a 2 kHz audio signal is combined with the 1705 kHz local oscillator signal in the mixer stage. What major frequencies are present in the output of the mixer stage?

1. 1707, 1705, 1703, 1257, 1250, 1253, 2955, 457, 455, and 453 kHz
2. 2504, 2500, 2496, 1705, 2957, 2955, 2953, 457, 455, and 453 kHz
3. 1705, 1252, 1250, 1248, 455, 2957, 2955, 2953, 3410, and 2500 kHz
4. 1252, 1250, 1248, 2957, 2955, 2953, 457, 455, 453, and 1705 kHz

15-45. The resonant tank circuit in the output of the mixer stage acts as a filter network. Its purpose is to

1. reject all frequencies except for a narrow band of frequencies which are centered around the local oscillator frequency.
2. reject all frequencies except for a narrow band of frequencies which are centered around the incoming RF carrier frequency.
3. reject all frequencies except for a narrow band of frequencies which are centered around the desired IF frequency.
4. pass all frequencies except for a narrow band of frequencies which are centered around the desired IF frequency.

15-46. The response curve for the resonant tank circuit in the output of the mixer stage indicates that the design of the circuit is such that
1. frequency response will drop off rather sharply at the half power (.707) points when moving in either direction from the center frequency.
2. the circuit will have uniform response over a very wide band of frequencies.
3. circuit response rises rather sharply on either side of the center frequency.
4. only those frequencies closely associated with the resonant frequency will be rejected.

15-47. Assuming the same conditions exist as in item 44, what are the frequencies that will appear at the input to the IF amplifier?
1. 1707, 1705, and 1703 kHz.
2. 2957, 2955, and 2953 kHz.
3. 1252, 1250, and 1248 kHz.
4. 457, 455, and 453 kHz.

Learning Objective: Describe some of the desired mixer/converter characteristics and some of the methods whereby the RF and local oscillator signals are applied or injected. Textbook pages 341 through 343.

15-48. Conversion transconductance is defined as the
1. ratio of IF output voltage to RF input voltage.
2. ratio of signal to noise.
3. ratio of RF signal current to IF output current.
4. ratio of IF output current to RF input voltage.

15-49. What is the relationship between conversion transconductance and converter stage gain?
1. Gain is inversely proportional to the conversion transconductance.
2. Gain is directly proportional to the conversion transconductance.
3. Conversion transconductance is directly dependent on converter stage gain.
4. Neither factor is dependent on the other.

● Items 15-50 through 15-53 should be evaluated as True or False.

15-50. Conversion gain is defined as the ratio of IF output voltage to RF input voltage.

15-51. The converter stage has no effect on the overall signal to noise ratio of the superheterodyne receiver.

15-52. There should be a minimum of interaction between the incoming RF signal and the local oscillator.

15-53. Where and how the RF and local oscillator signals are to be applied to a mixer stage is dependent on many factors, among which are circuit configuration and design considerations.

15-54. In a transformer coupled mixer stage using a transistor (grounded emitter configuration) or a triode electron tube, the local oscillator signal may be coupled to
1. the transistor base or the electron tube grid.
2. the transistor emitter or the electron tube cathode.
3. the transistor collector or the electron tube plate.
4. all of the above are correct.

15-55. Why, if at all, is it considered undesirable to couple the local oscillator signal to the base of a transistor mixer or the grid of a vacuum tube mixer?

1. **The local oscillator signal will be radiated**
2. It will cause interaction between the local oscillator signal and the incoming RF signal
3. Both 1 and 2 are correct
4. It is not undesirable

● In items 15-56 through 15-59 refer to 16-8A and 16-8B in your textbook and match the components listed in column B with the function they perform in column A. (Note: Items in column B may be used more than once.)

A. Function	B. Component
15-56. In figure 16-8A, the local oscillator is coupled to the emitter of Q1 by ________.	1. C1 2. C2 3. C3
15-57. In figure 16-8B, the local oscillator is coupled to the base of Q1 by ________.	
15-58. In figure 16-8A, ____ serves as an RF shunt, bypassing the RF signal to ground.	
15-59. In both figures, _____ in conjunction with the primary of T1 form a parallel resonant tank circuit whose resonant frequency may be varied over a limited range.	

Learning Objectives: Evaluate the operation of the mixer stages illustrated in figures 16-10 and 16-11 of your textbook. Textbook pages 343 and 344.

15-60. In figure 16-10 of your textbook, C1 and the primary of T1 form a resonant tank circuit which is normally tuned to

1. the IF frequency.
2. the local oscillator frequency.
3. the sum of the local oscillator and IF frequencies.
4. the desired RF carrier frequency.

15-61. The operating point for the transistor in figure 16-10 of your textbook is established by

1. R2 and C3.
2. R1 and R4.
3. R1 and R2.
4. R1 and C4.

15-62. In figure 16-10 of your textbook, bias stabilization is provided by

1. R2.
2. C4.
3. C2.
4. R1.

15-63. The collector current in a transistorized mixer stage is controlled primarily by the oscillator signal because

1. the oscillator signal is coupled into the emitter circuit of the transistor.
2. the RF carrier signal is coupled into the base circuit of the transistor.
3. the oscillator signal is usually much greater in amplitude than the RF carrier signal.
4. the RF carrier signal is not amplified.

15-64. In figure 16-10 of your textbook, the signal developed across the ________ is a complex waveform and is the result of heterodyning or mixing the local oscillator signal with the selected RF signal.
1. collector-base junction
2. emitter-base junction
3. collector-emitter junction
4. secondary of T2

15-65. In figure 16-10 the tank circuit consisting of C5 and the primary of T3 will normally be designed to oscillate at
1. the incoming RF frequency.
2. the local oscillator frequency.
3. the difference between the local oscillator and incoming RF frequencies.
4. the sum of the local oscillator and incoming RF frequencies.

15-66. In figure 16-10 of your textbook, why is stage gain much less than it would be if stage was used as an amplifier?
1. Peak collector current is much less.
2. Average collector current is much less.
3. Collector current is a complex waveform and the useful frequencies (sum frequencies) are only a component part of the total.
4. Collector current is a complex waveform and the useful frequencies (difference frequencies) are only a component part of the total.

● Items 15-67 through 15-71 should be evaluated as True or False.

15-67. In figure 16-11 of your textbook, the electron tube serves as a nonlinear device wherein the heterodyning action takes place.

15-68. The RF signal is injected at the grid and the local oscillator signal is injected at the cathode.

15-69. The plate current is a complex waveform resulting from heterodyning or mixing the RF and local oscillator signals.

15-70. The plate tank circuit consisting of C3 and the primary of T2 is tuned to resonate at the IF frequency.

15-71. Due to the tuning of the plate tank, only the sum of the local oscillator and RF input frequencies will be passed on to the IF amplifier in the circuit illustrated in figure 16-11 of your textbook.

Assignment 16

Mixers and Converters; IF Amplifiers; Receiver Control Circuits

Textbook Assignment: Pages 344 through 366

Learning Objectives:
Differentiate between a mixer stage and a converter stage and describe the characteristics of the latter. Textbook pages 344 through 347.

16-1. The primary difference between a mixer stage and a converter stage is that
1. in the latter the functions of a local oscillator and mixer are combined in a single stage.
2. only the latter uses a pentagrid electron tube.
3. the former requires only one input, the RF signal.
4. the former requires fewer components to accomplish frequency conversion.

16-2. When the functions of local oscillator and mixer are combined in a single stage, why will the local oscillator be less stable than when these functions are performed by separate stages?
1. Efficient heterodyning action requires that the transistor be operated on the nonlinear portion of its dynamic transfer curve.
2. Stable oscillator operation requires that the transistor be operated on the linear portion of its dynamic transfer curve.
3. Circuit operation requires that a compromise be made.
4. All of the above are true.

16-3. Which circuit component provides the necessary feedback to excite the local oscillator tank circuit consisting of C4, C5, and L2 in figure 16-12 of your textbook?
1. C3.
2. T3 primary.
3. R3.
4. Q1.

16-4. Referring to figure 16-12 in your textbook, how is the local oscillator signal injected?

1. It is injected into the collector circuit via the transformer action of T3.
2. It is injected into the base circuit via the coupling that exists between C1 and C4.
3. It is coupled into the emitter circuit via the capacitive action of C3.
4. It is not necessary that the local oscillator signal be injected into the transistor since the mixing action takes place in the tank circuit consisting of C6 and T1 primary.

16-5. Referring to figure 16-12 of your textbook, the tank circuit formed by C_6 and the primary of T_2 serves as a resonant circuit which is designed to pass

1. the incoming radiofrequency only
2. the incoming radiofrequency and a small band of frequencies on each side of the radiofrequency
3. the intermediate frequency and a narrow band of frequencies on either side of the intermediate frequency
4. all frequencies except the intermediate frequency

16-6. Which of the following types of oscillator-mixer coupling is used in pentagrid mixer/converter stages?

1. Capacitive coupling
2. Direct coupling
3. Electron coupling
4. Inductive coupling

16-7. What are two primary advantages to be gained through the use of a pentagrid mixer/converter?

1. Isolation of the oscillator circuit and less oscillator pulling
2. Decreased plate resistance and gain of the tube
3. Modulation of the oscillator on grid 2 and decreased plate resistance
4. Less gain than an ordinary pentode and better linearity

- Evaluate items 16-8 and 16-9 as True or False.

16-8. A pentagrid electron tube may serve as a combination local oscillator/mixer in certain receivers with good results.

16-9. Whether used as a mixer or converter, the incoming RF signal will always be injected at grid number one of the pentagrid electron tube.

Learning Objective: Recognize IF amplifiers in a superheterodyne receiver and compare the transistor and electron tube types. Textbook pages 349 through 351.

16-10. Which of the following does not apply to IF amplifier stages in a superheterodyne receiver?

1. The signals being amplified are of a lower frequency than those of the RF stages
2. The tuned circuits are variable over a wide range
3. The first IF amplifier output may be fed to a detector or another IF amplifier
4. The tuned circuits are adjustable

16-11. Which of the following is true in relation to the value of the IF for a particular receiver?
1. A high IF provides better selectivity
2. A low IF causes image-frequency reception
3. A high IF provides an increase in gain
4. A low IF decreases selectivity

● Items 16-12 through 16-16 are to be judged True or False. Refer to figure 17-2 and the associated information in your textbook.

16-12. The secondary of T1 is tuned to 455 kHz.

16-13. Regeneration is prevented in the circuit shown in figure 17-2 of your textbook by C2.

16-14. The operating point of Q1 is established by resistor R2.

16-15. A negative-going signal on the base of Q1 will increase the forward bias and thus the collector current of Q1.

16-16. One stage of IF amplification is sufficient for most receiver applications.

● To answer items 16-17 through 16-19 refer to figure 17-3 and the associated information in your textbook.

16-17. The current through the primary of output IF transformer T2 flows for
1. one-half of the input cycle
2. the entire input cycle
3. less than one-half the input cycle
4. more than one-half the input cycle

16-18. IF transformers may be
1. permeability double tuned only
2. capacitor double tuned only
3. capacitor or permeability, single or double tuned
4. permeability single tuned only

16-19. Which of the following applies to the double tuned bandpass coupling?
1. The primary current decreases at frequencies slightly outside the passband
2. The response is uniform within the passband
3. The secondary current decreases at frequencies slightly outside the passband
4. The secondary voltage decreases at frequencies slightly outside the passband

Learning Objective: Identify IF transformers by differentiating between the IF and AF types. Textbook pages 351 and 352.

16-20. Increasing the permeability of the core of an IF transformer
1. increases the inductance and the Q
2. increases the inductance and decreases the Q
3. decreases the inductance and the Q
4. decreases the inductance and increases the Q

16-21. Which of the following does not apply to IF transformers?
1. They provide selectivity
2. They match impedances between IF stages
3. They are tuned to the local oscillator frequency
4. They are usually shielded

. . . .

Learning Objective: Identify sideband frequencies and bandwidth. Recognize series and parallel tuned circuits. Textbook pages 352 and 353.

. . . .

16-22. A carrier frequency of 100 kHz is amplitude modulated by a 2 kHz tone. What are the frequencies of the two sidebands?
1. 80 kHz and 120 kHz
2. 90 kHz and 110 kHz
3. 98 kHz and 102 kHz
4. 99 kHz and 101 kHz

16-23. The bandwidth required for a particular AM transmitter depends upon the
1. highest modulating amplitude
2. highest modulating frequency
3. minimum carrier swing
4. ratio of carrier to modulation frequency

● When a tuned resonant circuit is a part of a more complex circuit, it is often difficult to determine whether it is a series or a parallel type.

The following procedure will help you to determine whether a circuit should be classed as parallel or series: (1) Locate the inductive and capacitive components forming the resonant circuit. (2) Locate the source of the alternating (or signal) voltage for these components. (3) Then, determine whether the components are in series or parallel with the source of voltage.

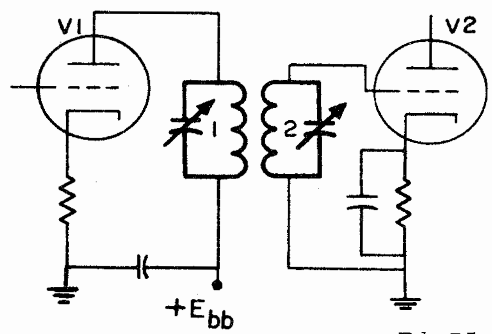


Figure 16A.-Series and parallel resonant circuits.

16-24. Which of the following is true concerning figure 16A?
1. Circuits 1 and 2 are parallel resonant circuits
2. Circuit 1 is a series resonant circuit and circuit 2 is parallel resonant circuit
3. Circuits 1 and 2 are series resonant circuits
4. Circuit 1 is a parallel resonant circuit and circuit 2 is a series resonant circuit

. . . .

Learning Objective: Differentiate between single tuned, double tuned, and stagger tuned IF amplifier stages. Textbook pages 353 through 357.

. . . .

16-25. Which of the following best describes a single tuned IF transformer circuit?
1. High Q, high voltage, narrow bandwidth
2. Low Q, high voltage, wide bandwidth
3. High Q, low voltage, narrow bandwidth
4. Low Q, low voltage, narrow bandwidth

16-26. When 2 or more IF stages are connected in series, the overall bandwidth will be
1. wider than the bandwidth of any individual stage
2. narrower than the bandwidth of any individual stage
3. narrower than the individual stage with the widest bandwidth
4. wider than the individual stage with the narrowest bandwidth

16-27. Which of the following is not an advantage of a double tuned IF transformer stage over that of a single tuned stage?
1. Wider bandwidth
2. Higher gain
3. More uniform amplification
4. Better selectivity

16-28. The bandpass characteristic of a tuned-primary tuned-secondary circuit depends on
1. the Q of the circuits
2. the resistance of the circuits
3. the coefficient of coupling
4. both the Q of the circuits and the coefficient of coupling

16-29. Increasing the coefficeint of coupling in a transformer coupled circuit will increase the
1. coupled impedance in the primary
2. induced voltage in the secondary
3. mutual inductance of the circuit
4. all of the above

16-30. Which of the following conditions result when you increase the coefficient of coupling in a tuned-primary tuned-secondary coupling circuit?
1. The bandpass increases.
2. The secondary current decreases.
3. The mutual inductance decreases.
4. The primary and secondary resistance increase.

16-31. Which of the following is true concerning loose coupling of a double tuned IF transformer?
1. The induced secondary voltage is low because the mutual inductance is low
2. The mutual inductance is low because the coefficient of coupling is high
3. The coupled impedance is low because the mutual inductance is high
4. The mutual inductance is low because the secondary voltage is low

16-32. The highest voltage gain at the resonant frequency of a tuned-primary tuned-secondary circuit is achieved at
1. critical coupling
2. less than critical coupling
3. optimum coupling
4. greater than optimum coupling

16-33. Compared with critical coupling in a tuned circuit, optimum coupling provides a
1. wide passband
2. narrow passband
3. high secondary current at the resonant frequency
4. high primary current at the resonant frequency

16-34. What is the effect on the response of a tuned-primary tuned-secondary coupling circuit of an increase in k beyond optimum coupling?
1. The bandpass is reduced.
2. The gain across the passband becomes more uniform.
3. The gain across the passband becomes less uniform.
4. The gain at the center of the passband is increased.

16-35. Assuming that the overall passband of the two types of circuits are the same, what is the gain relationship between a three-stage single tuned and a three-stage double tuned IF circuit?

1. The overall gain of the double tuned stages is three times greater than that for the single tuned stages
2. The gain per stage is approximately the same for both circuits
3. The gain per stage for the double tuned stages is greater than the gain per stage for the single tuned stages
4. The overall gain of the single tuned stages is greater than the overall gain of the double tuned stages

16-36. Which of the following does not apply to two stagger tuned IF stages?

1. The stages are isolated from each other by 1 to 1 ratio transformers
2. Each stage functions essentially as a single tuned stage
3. There is no mutual inductance between stages
4. One stage is tuned slightly above, and the other slightly, below the receiver IF

● Items 16-37 through 16-40 are to be judged True or False. Refer to figure 17-10 and the associated information in your textbook.

16-37. The maximum gain of tuned circuit No. 1 occurs at the IF.

16-38. The overall bandwidth of tuned circuits 1 and two is 28 kHz.

16-39. The gain of tuned circuit No. 2 decreases with frequency increases above 457 kHz.

16-40. The overall response curve shown in figure 17-10B of your textbook is similar to the critical coupling curve for a double tuned IF stage.

Learning Objective: Identify IF amplifier troubles with associated symptoms. Textbook page 358.

● Based on the IF amplifier failure analysis information contained in your textbook, items 16-41 through 16-44 are to be judged True or False.

16-41. Troubles in IF amplifiers are similar to those encountered in RF amplifiers.

16-42. An open bias resistor will result in a loss of output.

16-43. Transistor or tube interelement capacitance has little effect on the operation of IF amplifiers.

16-44. Detuning can cause a low output in IF stages.

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. Learning Objective: Define the need for bandspreading and bandswitching, and describe some of the means whereby these functions are accomplished. Textbook pages 359 and 360.
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. . . .

16-45. If made a variable, which of the following will have little or no effect on the resonant frequency of a given LCR (tank) circuit?
1. The ratio of inductance to capacitance
2. Inductance
3. Resistance
4. Capacitance

16-46. If circuit loading is held constant, what occurs as the resonant frequency of a given tank circuit is varied?
1. Circuit "Q" or quality factor increases with frequency
2. The bandwidth or range of frequencies to which the circuit will respond decreases with a frequency increase
3. The ratio of L to C increases with frequency
4. All of the above occur

16-47. What is the effect on circuit response of increasing the L to C ratio of a given tank circuit?
1. The frequency at which the circuit responds decreases
2. Circuit response decreases, while the range of frequency to which the circuit will respond increases
3. Changing the ratio of L to C has no effect on circuit response
4. Circuit response increases, while the range of frequencies to which the circuit will respond decreases

16-48. The range of frequencies tunable by a tank circuit consisting of a variable capacitance and a fixed inductance is dependent on which of the following values?
1. The value of the inductance
2. The maximum value of capacitance
3. The minimum value of capacitance
4. All of the above

16-49. Which of the following, if any, determine the tuning range of a tank circuit?
1. The minimum and maximum value of the capacitor and the inductance of the coil
2. The size of the inductor only
3. The size of the capacitor only
4. None of the above

16-50. If the main tuning capacitor in an electrical bandspreading circuit is large enough to cover a 2 to 1 frequency range, the bandspreading capacitor will
1. 'cover three-fourths the range
2. cover more than twice the range
3. cover less than half the range
4. cover the same range

16-51. How can the tuning rate of a given LCR circuit be decreased without changing its tunable range?
1. By reducing the ratio of maximum to minimum inductance
2. By reducing the ratio of maximum to minimum capacitance
3. By reducing the L to C ratio
4. By means of a bandspreader which may be either mechanical or electrical in nature

16-52. Why may it become necessary to resort to bandswitching, if a given receiver is required to cover a relatively wide range of frequencies?
1. Tuning range is limited by circuit Q
2. Tuning capacitors or coils are designed to cover only a 2 to 1 frequency range
3. A point is reached beyond which it becomes impractical to extend the ratio of maximum to minimum inductance or capacitance in a given LCR circuit
4. In any given LCR circuit, there is a practical limit as to how far its tuning range may be extended by means of bandspreading

● Items 16-53 and 16-54 relate to the effects that occur as a result of the change in Q that occurs as the resonant frequency of a tunable LCR circuit is varied and should be evaluated as True or False.

16-53. Due to the increase of Q, tuning may become critical as the high frequency limit of a given LCR circuit's tuning range is approached.

16-54. When a receiver is designed to cover a relatively wide range of frequencies, bandswitching and/or bandspreading will be used to cover the frequency range.

Learning Objective: Determine why high sensitivity and gain may become liabilities and describe some of the methods used to overcome these liabilities. (This objective is continued in assignment #17.) Textbook pages 360 through 366.

16-55. Although high sensitivity is considered to be a desirable characteristic of a good receiver in what instance could this same characteristic become a liability?
1. When the emitter/cathode bias for the amplifier is maximum
2. When amplification is maximum
3. When receiver selectivity is high
4. When the audio signal is being distorted as the result of a strong signal being received

16-56. Referring to the previous question, why is this true?
1. The emitter/cathode current of the RF amplifier stages will be minimum when a strong signal is received
2. Amplification and thus sensitivity is maximum
3. The RF stages become overloaded
4. The audio stages become overloaded

16-57. Receiver gain and thus sensitivity may be controlled by manually varying the bias on
1. the detector
2. the frequency converter
3. one or more of the AF amplifier stages
4. one or more of the RF amplifier stages

16-58. What is the standard method used for manually controlling receiver volume?
1. Varying the signal level at the input to the detector
2. Varying the signal level at the input to the AF amplifier section
3. Varying the signal level at the input to the frequency converter
4. Varying the signal level at the input to the RF amplifier section

16-59. Due to changing conditions (atmospheric, etc.) signal strength at the input to a receiver will vary, which in turn will cause

1. unwanted variations in receiver gain
2. unwanted variations in receivier output level
3. unwanted variations in receiver bandwidth
4. unstable receiver operation

● Evaluate items 16-60 through 16-66 as True or False.

16-60. Automatic gain/volume controls compensate for variations in receiver signal strength by varying the bias (and thus the gain) of one or more stages preceding the detector.

16-61. The AGC/AVC voltage is developed in the output of the demodulator stage, and will be directly proportional to the average value of the signal applied at the detector input.

16-62. **The polarity of the AGC/AVC voltage in a transistor circuit is dependent on the type of transistor used and the element to which the voltage is applied.**

16-63. The AGC/AVC circuit will normally be designed to respond to instantaneous changes in signal level.

16-64. In figure 18-6 of your textbook, only a fraction of the d.c. component of signal present in the output of the detector is used as the AGC voltage.

16-65. In figure 18-6 of your textbook, the polarity of the AGC voltage is independent of the connection of CR1.

16-66. Since the AGC voltage is used as bias for the RF and IF amplifier stages of a superheterodyne receiver other methods of biasing these stages are not necessary.

16-67. Referring to figure 18-8 of your textbook, "no signal" bias for the transistor is provided by

1. the voltage divider consisting of R1 and R4
2. the action of R3 and C1
3. the voltage divider consisting of R1 and R2
4. contact bias

16-68. Refer to figure 18-8 in your textbook (A) What type of transistor is used in the emitter-controlled AGC circuit shown and (B) What is the effect of applying a positive AGC control voltage to this transistor?

1. (A) NPN, (B) regenerative feedback
2. (A) NPN, (B) degenerative feedback
3. (A) PNP, (B) degenerative feed-back
4. (A) PNP, (B) regenerative feed-back

16-69. The term forward AGC becomes applicable when the AGC voltage is applied in such a fashion that

1. an increase in AGC voltage will shift the amplifier operating point towards cutoff
2. a decrease in AGC voltage will shift the amplifier operating point towards cutoff
3. a decrease in AGC voltage will shift the amplifier operating point towards saturation
4. an increase in AGC voltage will shift the amplifier operating point towards saturation

16-70. The term reverse AGC becomes applicable when the AGC voltage is applied in such a fashion that

1. an increase in AGC voltage will shift the amplifier operating point towards saturation
2. a decrease in AGC voltage will shift the amplifier operating point towards saturation
3. an increase in AGC voltage will shift the amplifier operating point towards cutoff
4. a decrease in AGC voltage will shift the amplifier operating point towards cutoff

16-71. While either forward or reverse AGC may be used, reverse AGC is generally preferred because

1. it is simple to use
2. it causes less loading of tuned circuits
3. it causes less change in amplifier input/output capacitances
4. all of the above are true

16-72. What is the principal disadvantage of all AGC/AVC circuits discussed up to this point?

1. They do not respond to rapid changes in signal level.
2. Even weak signals will produce some AGC/AVC voltage and thus a reduction in receiver gain and sensitivity.
3. On strong signals, sufficient AGC/AVC voltage is generated to bias the amplifiers at or beyond cutoff thus causing distortion.
4. They cause undue loading effects on the detector.

Assignment 17

Receiver Control Circuits; Receiver Alignment; Introduction to Transmitters

Textbook Assignment: Pages 366 through 384

Learning Objective (continued): Determine why high sensitivity and gain may become liabilities and describe some of the methods used to overcome these liabilities. Textbook pages 336 through 372.

17-1. What is the purpose of delayed AGC/AVC?
1. To reduce or eliminate the loss of receiver sensitivity occurring as a result of normal AGC/AVC action on weak signals
2. To reduce or eliminate the loss of receiver sensitivity occurring as a result of normal AGC/AVC action on strong signals
3. To delay for a predetermined period, any change in AGC/AVC voltage occurring as a result of a change in signal strength
4. To delay for a predetermined period, any change in receiver output level occurring as a result of changes in input signal strength

17-2. In what manner does the delayed AGC circuit react, when relatively strong signals are received?
1. It reacts in much the same manner as does the ordinary AGC circuit.
2. It will be disabled since its purpose is to improve weak signal reception.
3. It will decrease signal attenuation.
4. Its reaction is much the same as for weak signals.

17-3. In a superheterodyne receiver that uses delayed AGC and a duodiode-triode tube, the sensitivity is not reduced until the signal at the detector exceeds the
1. cathode bias on the first audio amplifier
2. bias on the grid of the first audio amplifier
3. bias on the IF amplifier
4. voltage across the manual volume control

● For items 17-4 and 17-5 refer to figure 18-11 of your textbook.

17-4. What is the purpose of C1?
1. The charge on C1 establishes the level at which the AGC diode will conduct and AGC action begins.
2. It couples the AGC diode to the tank circuit.
3. It serves as a blocking capacitor to prevent the AGC voltage from being applied to the detector diode which would interfere with normal detector action.
4. It serves all of the above purposes.

17-5. How is the initial charge on C1 established?

1. Since C1 is in series with the AGC diode and the tank circuit, it will charge positive at the top, to the average level of the voltage present in the tank circuit.
2. Since C1 is effectively in parallel with the cathode bias network, it will charge to the no signal level established by the bias network at the time the receiver was energized.
3. Since it is connected between the two diode plates, it will charge to the difference in potential between them.
4. Since it is connected between diode plate #1 and ground, it will charge to the average level of voltage present at this plate.

17-6. Why are two diodes required in the second detector stage of a superheterodyne receiver utilizing delayed AVC?

1. To reduce distortion, since the bias required for delayed AVC action will interfere with proper operation of the circuit as a detector if a single diode is used
2. If a single diode is used as both AVC diode and detector, there would be no output from the receiver until the incoming signal level exceeds the bias required for delayed AVC action
3. Because the AVC diode is used to select the d.c. component of signal while the detector diode selects the audio component
4. For most signal levels, circuit operation is the same for both normal AVC and delayed AVC; thus, there appears to be no valid reason for using two diodes

● Referring to figure 18-17 of your textbook, the input resistor in conjunction with the blocking capacitor forms a decoupling network preventing interaction from occurring between stages should more than one stage be tied to the same AGC line. That is, the possibility of signal degeneration and/or circuit oscillation occurring as a result of feedback between stages is minimized. Also, a short in one stage will have little or no effect on the operation of the other stages.

● Items 17-7 through 17-13 relate to the sections on amplified AGC and methods of feed in chapter 18 of your textbook and should be evaluated as True or False.

17-7. The AGC voltage produced by the AGC circuits discussed previously may, due to large variations in signal level, be insufficient to maintain the receiver output level within the desired limits.

17-8. Amplified AGC provides better control at low signal levels than does unamplified AGC.

17-9. The AGC amplifier is connected to amplify the signal prior to detection.

17-10. By making the gain of the AGC amplifier variable, any level of AGC voltage desired may be obtained.

17-11. Delayed AGC cannot be used in conjunction with amplified AGC.

17-12. The AGC voltage may be applied to an RF amplifier either in series or in parallel with the input tank circuit.

17-13. Referring to figure 18-17 of your textbook, the blocking capacitor in conjunction with the input resistor prevents a short in one stage from effecting the other stages.

17-14. Why is it necessary to filter the AGC/AVC voltage?

1. To prevent undesirable effects that would occur if the RF and AF components of signal present in the output of the AGC diode were applied to the preceding amplifier stages
2. To provide the decoupling necessary between amplifier stages since the bases/grids of these stages are tied together by the AGC line and would otherwise cause undesirable effects
3. To provide as additional bias for the amplifier stages to which applied, a d.c. voltage whose level will vary as the average level of the incoming signal varies
4. All of the above

17-15. For satisfactory circuit operation the values for the RC network, used as the AGC filter, must be carefully selected so that the bias voltage can

1. vary with changes in the input signal level of the RF carrier signal
2. vary with random noise frequencies impressed on the RF carrier signal
3. be independent of any amplitude change in the RF carrier signal
4. vary with any change in the frequency of the RF carrier signal

17-16. Why is a means provided for varying the AGC time constant in certain communications type receivers?

1. To allow the AGC circuit to be effective regardless of the type of modulation used
2. To allow the AGC circuit to compensate for variations in amplitude of strong signals
3. To allow the AGC circuit to compensate for various forms of fading
4. To allow the AGC circuit to compensate for changes in amplitude of weak signals

17-17. Why, if at all, are AGC circuits such as those previously discussed ineffective for single sideband operation?

1. In all of these circuits, operation depends on the average level of the carrier signal which in the case of the single sideband receiver does not vary at the same frequency as the transmitted signal
2. In all these circuits, operation depends on the average level of the carrier signal which in the case of single sideband operation does not vary since it is a form of frequency modulation
3. In all these circuits, operation depends on the average level of the carrier signal which in the case of single sideband operation is not transmitted
4. None of the above are true

17-18. In SSB receivers, the AGC voltage is commonly derived from which section of the receiver?

1. 1st detector
2. 2nd detector
3. RF
4. AF

17-19. For proper operation, the AGC filter used in a single sideband receiver will normally have a discharge/charge ratio on the order of
1. 1/.001
2. 1/.01
3. 1/.1
4. 1/1

17-20. Although a common practice, why is using the AGC voltage to vary stage bias considered to be an unsatisfactory method of automatically controlling stage gain?
1. As the AGC voltage increases due to an increase in the average level of incoming signal, stage linearity will decrease.
2. As the AGC voltage increases due to an increase in the average level of incoming signal, stage linearity will increase.
3. It requires a large shift in bias in order to effect a small change in gain.
4. Circuit operation is critical; that is, circuit bias must be maintained within certain limits otherwise the stage will be driven into saturation or cutoff.

17-21. One method used to preserve or even improve stage linearity while automatically controlling stage gain is to use the AGC voltage to control
1. the amount of regenerative feedback applied to the stage
2. the amount of degenerative feedback applied to the stage
3. the amplitude of the signal applied to the stage
4. base circuit impedance

Items 17-22 and 17-23 refer to figure 18-19 of your textbook.

17-22. Q_1 acts like a variable attenuator whose impedance is a function of the incoming signal amplitude. (A) in what manner does its impedance vary and (B) what is its purpose?
1. (A) its impedance is directly proportional to the signal amplitude applied to the base of Q_3, and (B) it is used to control the amplitude of the signal applied to the base of Q_3.
2. (A) its impedance is inversely proportional to the signal applied to the base of Q_3, and (B) it is used to control the amplitude of the signal applied to the base of Q_3.
3. (A) its impedance is directly proportional to the signal amplitude, and (B) it is used to amplify the AGC voltage.
4. (A) its impedance is inversely proportional to the signal amplitude, and (B) it is used to amplify the AGC voltage.

17-23. Q_2 acts like a variable attenuator whose impedance is a function of the incoming signal amplitude. (A) in what manner does the voltage applied to its base vary in respect to the input signal, and (B) what is its purpose?
1. (A) the voltage applied to its base is directly proportional to the input signal, and (B) it is used to control the amount of REGENERATIVE feedback applied to Q_3.
2. (A) the voltage applied to its base is directly proportional to the input signal, and (B) it is used to control the amount of DEGENERATIVE feedback applied to Q_3.
3. (A) the voltage applied to its base is inversely proportional to the input signal, and (B) it is used to control the amount of REGENERATIVE feedback applied to Q_3.
4. (A) the voltage applied to its base is inversely proportional to the input signal, and (B) it is used to control the amount of DEGENERATIVE feedback applied to Q_3.

17-24. Referring to figure 18-20 in your textbook, the H-pad is so designed that an increase in input signal level will
1. be followed by a corresponding increase in output signal level
2. be followed by a corresponding decrease in output signal level
3. have little or no effect on output signal level
4. disable the output

Learning Objective: In addition to AGC/AVC, broadcast and/or communications type receivers make use of certain other control circuits such as automatic frequency control, silencer circuits, and limiters. Define the need for such circuits and describe in general terms how the more commonly used circuits of this type operate. Textbook pages 373 through 379.

17-25. Two or more frequency conversion stages may be used in certain VHF/UHF receivers for the purpose of
1. improving the image rejection ratio
2. improving selectivity
3. increasing receiver stability
4. accomplishing all of the above

● Refer to figure 18-21 in your textbook and evaluate items 17-26 through 17-29 as True or False.

17-26. In most receivers employing double conversion, the frequency of the local oscillator signal applied to the first mixer stage will be fixed and that applied to the second mixer stage will be variable.

17-27. A fixed frequency difference will be maintained between the first IF frequency and the second local oscillator frequency.

17-28. Receiver stability is dependent primarily on the stability of the first local oscillator.

17-29. The second IF is the primary factor in determining receiver selectivity and the first IF is the primary factor in determining the receiver's image rejection ratio.

17-30. How is the long term stability and accuracy required of modern communications type receivers attained?
1. Through the use of a single crystal controlled oscillator, as the local oscillator
2. Through the use of an electron coupled oscillator, as the local oscillator
3. Through a process of automatic frequency control
4. Through a process known as frequency synthesis

17-31. When using the frequency synthesis process, a signal of the desired accuracy and stability is produced by which, if any, of the following?
1. Automatic frequency control, that is, by sensing the difference between the oscillator frequency and the desired frequency and automatically compensating for this difference
2. Using a crystal controlled oscillator to produce a stable high frequency, and through the process of frequency division selecting a subharmonic of this frequency as the desired frequency
3. The heterodyning and selection of frequencies which may or may not be harmonically related to each other
4. None of the above

17-32. What is the purpose of connecting a limiter in the output of the second detector circuit as is commonly found in Navy receivers?
1. To establish a reference level for the desired signal
2. To limit signal amplitude in order to prevent the AF amplifier section from being overloaded
3. To limit the detector output to a predetermined level, thus eliminating undesired noise pulses which may be riding on the desired signal
4. To limit the RF signal to a predetermined level, thus eliminating unwanted noise pulses which may be riding on the desired signal

17-33. In a series limiter circuit such as the one shown in figure 18-24 of your textbook, the signal applied to the AF amplifier will be interrupted whenever the
1. movable contact on R4 is moved to the far right
2. movable contact on R4 is moved to the far left
3. signal appearing at the junction of C1 and R2 is more negative than the cathode of CR1
4. signal appearing at the junction of C1 and R2 is more positive than the cathode of CR1

17-34. In a parallel limiter circuit such as the one shown in figure 18-25 of your textbook, signal amplitude will be limited whenever the
1. movable contact on R4 is moved to the far right
2. movable contact on R4 is moved to the far left
3. signal at the junction of C1 and R2 is more positive than the anode of CR1
4. signal at the junction of C1 and R2 is more positive than the anode of CR1

17-35. What is the purpose of a silencer circuit such as the one shown in figure 18-26 of your textbook?
1. To limit the output of the first AF amplifier to a level as determined by the AVC voltage
2. To interrupt the signal path of the receiver, thus eliminating background noise when tuning between stations
3. To reduce receiver gain on strong signals
4. To reduce receiver sensitivity, thus eliminating background noise when tuning between stations

17-36. Referring to figure 18-26 of your textbook, how is the circuit adjusted so it will function properly?
1. With no signal present, R9 is adjusted until Q1 just starts to conduct
2. With no signal present, R9 is adjusted until Q1 draws sufficient current to reduce the anode voltage of CR1 to a level below that of its cathode
3. With a signal present, R9 is adjusted until Q1 just starts to conduct
4. With a signal present, R9 is adjusted until Q1 draws sufficient current to reduce the anode voltage of CR1 to a level below that of its cathode

17-37. What causes a silencer to enable a receiver?
1. The adjustment of the AVC potentiometer
2. The voltage dropped across the silencer's cathode to ground circuit
3. The receipt of an input signal by the receiver
4. A signal from the AVC line to the silencer's output

17-38. When used, what is the purpose of automatic frequency control?
1. To correct for oscillator frequency drift
2. To automatically tune receivers to the desired frequency
3. To automatically tune transmitters to the desired frequency
4. To adjust the gain of the IF amplifiers

● Items 17-39 through 17-41 refer to the section on AFC in chapter 18 of your textbook and should be evaluated as True or False.

17-39. AFC may only be used with sinusoidal type oscillators.

17-40. The AFC circuit will sense the difference between the actual oscillator frequency and the desired frequency and produce a control voltage.

17-41. The AFC circuit will generate a voltage which is proportional to the error sensed and will apply this voltage in such a fashion that the oscillator will be forced to shift frequency in the direction of the desired frequency.

● For items 17-42 through 17-45 refer to the block diagram, figure 18-27 of your textbook.

17-42. What circuit will produce a d.c. voltage, whose amplitude and polarity are functions of the error existing between the actual and desired local oscillator frequencies?
1. Detector
2. Varicap or reactance tube
3. Mixer
4. Discriminator

17-43. The circuit labeled varicap or reactance tube will exhibit an apparent reactance which is primarily
1. inductive and whose value is a function of the applied voltages
2. capacitive and whose value is a function of the applied voltages
3. inductive and has a value which is inversely proportional to the voltage appearing at the input
4. capacitive and has a value which is inversely proportional to the voltage appearing at the input

17-44. Varicaps or reactance tubes are so connected that the apparent reactance they exhibit is effectively placed in parallel with the local oscillator tank circuit. What effect does this have on local oscillator operation?
1. Any change in apparent reactance will cause a shift in local oscillator frequency which is directly proportional to such change.
2. Any change in apparent reactance will cause a shift in local oscillator frequency which is inversely proportional to such change.
3. Any change in apparent reactance will cause a proportionate change in the amplitude of oscillator output.
4. Any change in apparent reactance will cause an inversely proportionate change in the amplitude of the oscillator output.

17-45. Local oscillator drift could be caused by a fault in which of the following stages of the receiver?
1. Automatic frequency control
2. Video amplifiers
3. Radio-frequency amplifiers
4. Intermediate-frequency amplifiers

Learning Objective: Recognize procedures for aligning receivers. Text pages 380 through 382.

17-46. A receiver should be aligned when
1. circuit parts are replaced
2. sensitivity measurements are unsatisfactory
3. frequencies other than those to which the receiver is tuned are received
4. any of the above is true

17-47. In receiver alignment, what stage is usually the first to be aligned?
1. The RF stage
2. The stage farthest from the antenna
3. The mixer stage
4. The stage nearest to the antenna

17-48. Referring to figure 17A, which of the following is the correct procedure for alignment of the IF section of a receiver?
1. Inject a signal at point 4, adjust the output of D for maximum E output, then inject a signal at point 3
2. Inject a signal at point 3, adjust the output of C for maximum E output, then inject a signal at point 4
3. Inject a signal at point 4, adjust the output of C for maximum E output, then inject a signal at point 3
4. Inject a signal at point 2, adjust the output of D for maximum E output, then inject a signal at point 3

17-49. At what point(s) in figure 17A would you inject a signal to align the input transformer of the first IF stage, and to check the overall alignment of the IF section?
1. 1 and 2
2. 2
3. 1
4. 2 and 3

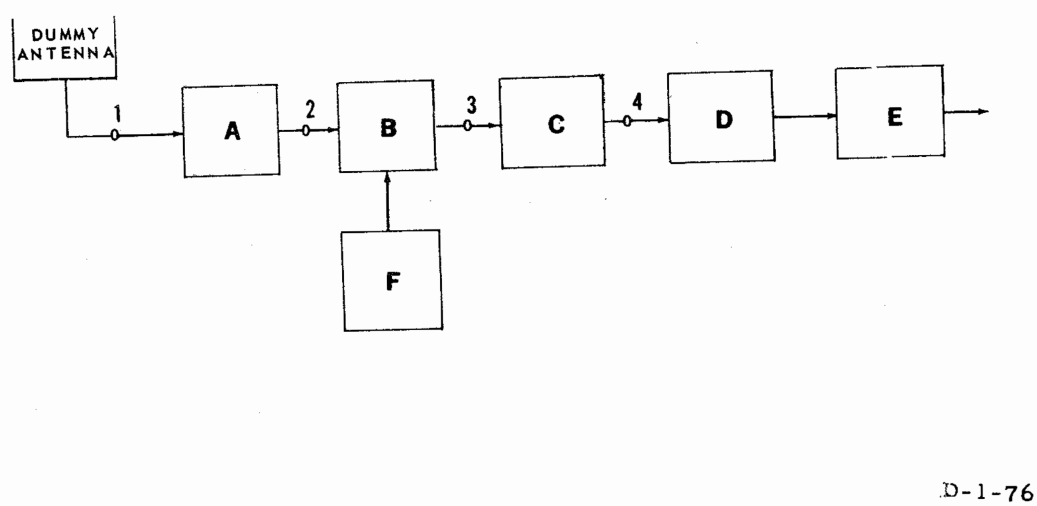

Figure 17A. --Receiver alignment.

17-50. The passband of the IF section of a receiver is from 450 kHz to 460 kHz. Normally, what would the frequency of the test signal used to align the IF section be?

1. 460 kHz
2. 450 kHz
3. 10 kHz
4. 455 kHz

17-51. At what point in figure 17A would you inject a signal to align the local oscillator?

1. 3
2. 2
3. 1
4. 4

Items 17-52 through 15-55 are to be judged True or False.

17-52. Alignment of the local oscillator requires the injection of two test signals of different frequencies.

17-53. Aligning the IF section of a receiver requires the use of a dummy antenna.

17-54. Test equipment used to align modular receivers must be impedance matched with the modules being aligned.

17-55. The fine alignment for a modular receiver must be made by aligning each module separately.

17-56. To align the RF section (fig. 17A), you would inject

1. two signals of the same frequency at point 1
2. a signal of the upper and lower alignment frequencies at point 1
3. a signal of the upper and lower alignment frequencies at point 2
4. a signal equal to the band-center of the RF at point 1

Learning Objective: Recognize the functions of the major units of a basic communications system and relate various frequency bands to types of transmissions. Text page 383.

17-57. In a basic communications system the receiver

1. generates the RF carrier
2. separates the intelligence from the carrier
3. radiates electromagnetic energy
4. modulates the carrier

In items 17-58 through 17-61 match the frequency band listed in column B with the type of transmission listed in column A.

	A. Type of Transmission	B. Frequency
17-58.	early warning radar	1. UHF
17-59.	communications between ships	2. VHF
		3. MF
17-60.	radio telegraph	4. VLF
17-61.	international distress signals	

Learning Objective: Match frequency bands with the associated frequency. Text page 383.

In items 17-62 through 17-65 match the frequency band listed in column B with the appropriate frequency listed in column A.

	A. Appropriate Frequency	B. Frequency Band
17-62.	300 to 3,000 kHz	1. VLF
17-63.	30 to 300 kHz	2. LF
17-64.	10 to 30 kHz	3. MF
17-65.	3 to 30 MHz	4. HF

Learning Objective: Identify the common types of radio transmitters. Text pages 384 and 385.

17-66. The function of the buffer stage shown in figure 20-2 of your textbook is to
1. isolate the oscillator from the load
2. isolate the oscillator from the power supply when the key is closed
3. separate the intelligence from the carrier
4. all of the above

17-67. Which of the following applies to the CW transmitter?
1. Used for short range communications
2. The buffer stage is turned on and off to transmit the intelligence
3. A modulator is used to amplify the audio signal
4. The oscillator is turned on and off to transmit the intelligence

17-68. In the AM transmitter shown in figure 20-3 of your textbook, which of the following is varied in accordance with modulating signal?
1. The power amplifier output
2. The oscillator output
3. The buffer output
4. The buffer input

17-69. The filter in the SSB transmitter shown in figure 20-4 of your textbook functions to
1. produce the two sidebands
2. filter the output of the SSB generator
3. pass the desired sideband
4. suppress the carrier

17-70. Which of the following best describes the FM transmitter?
1. The amplitude of the carrier varies in proportion to the frequency of the modulating signal
2. The amplitude of the oscillator output varies in proportion to the amplitude of the modulating signal
3. The frequency of the combined waveform varies in proportion to the amplitude of the modulating signal
4. The frequency of the carrier waveform varies in proportion to the amplitude of the oscillator output

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In items 17-71 through 17-73 select from column B the type of transmitter that best fits the characteristic listed in column A.

	A. Characteristic	B. Transmitter
17-71.	long range communications	1. SSB
		2. AM
17-72.	suppressed carrier	3. FM
17-73.	variable amplitude output	4. CW

Assignment 18

RF Power Amplifiers; Amplitude Modulation

Textbook Assignment: Pages 386 through 418

Learning Objective: Identify the RF stages of a basic transmitter, and recognize the various classes of amplifier operation. Text pages 386 through 389.

18-1. Connecting a buffer between an oscillator and the output amplifier in a transmitter will increase the

1. frequency range
2. frequency stability
3. oscillator input
4. power stability

In items 18-2 through 18-5, select from colum B the class of operation that best fits the characteristic listed in column A.

	A. Characteristic	B. Class of Operation
18-2.	Plate or collector current flows for approximately 1/2 the input cycle	1. A
18-3.	Plate or collector current flows for the entire input cycle	2. B
18-4.	Plate or collector current flows for less than 1/2 the input cycle	3. AB
18-5.	Plate or collector current flows for more than 1/2 but less than the entire input cycle	4. C

18-6. Which of the following types of amplifiers produces an output waveform that most nearly resembles the grid input waveform?

1. Class-A
2. Class-AB_1
3. Class-AB_2
4. Class-C

18-7. In comparison with class-A amplifiers, class-B amplifiers have a
1. lower plate efficiency
2. higher power output
3. lower power amplification
4. higher average plate current

18-8. Which of the following types of amplifiers is the most efficient?
1. Class-A
2. Class-AB_2
3. Class-B
4. Class-C

18-9. Which class of operation should be used for an amplifier if maximum output power is the only consideration to be made?
1. AB
2. A
3. B
4. C

Learning Objective: Recognize the requirements for frequency multiplication with class C RF amplifiers. Text pages 389 through 391.

18-10. Which of the following applies when Q1 in the RF amplifier shown in figure 21-3A of your textbook stops conducting?
1. C2 is charged to a polarity opposite to that when Q1 was conducting and maintains this charge until Q1 again conducts
2. C2 discharges through Q1
3. C2 charges to a polarity opposite to that when Q1 was conducting, and when fully charged discharges through the primary of T2
4. C2 charges to a polarity opposite to that when Q1 was conducting and when fully charged discharges through Q1

18-11. Which of the following is not a requirement for a class C amplifier to operate as a frequency multiplier?
1. High grid or base driving voltage
2. Increased plate or collector conduction angle
3. Plate or collector tank circuit tuned to the desired harmonic
4. High negative grid or reverse base bias

18-12. How does an RF stage that is operated as a frequency doubler differ from one that is operated as a conventional class-C amplifier?
1. The plate current cutoff point in the doubler stage is one-half that in the conventional circuit.
2. The plate voltage in the doubler stage is one-half that in the conventional circuit.
3. The plate tank circuit in the doubler stage is tuned to the second harmonic of the applied signal frequency
4. The grid tank circuit in the doubler stage is tuned to the second harmonic of the applied signal frequency.

18-13. If a buffer amplifier is operated as a tripler, (A) what is the range of plate current flow angle and (B) what is the relative output efficiency of such an amplifier compared with that of a class-C amplifier?
1. (A) 90°, to 120°, (B) 25 percent
2. (A) 80°, to 120°, (B) 40 percent
3. (A) 90°, to 120°, (B) 72 percent
4. (A) 80°, to 120°, (B) 80 percent

18-14. To what frequency do you tune the plate coil and capacitor shown in figure 21-5B of your textbook?
1. The input frequency
2. The second harmonic frequency
3. The third harmonic frequency
4. The fifth harmonic frequency

18-15. When the base of Q1 in figure 21-5A of your textbook is driven above cut-off, energy is supplied to
1. the collector circuit of Q1 at the same frequency as the input signal
2. the base circuit of Q1 at twice the frequency of the input signal
3. the emitter circuit of Q1 at twice the frequency of the input signal
4. the collector circuit of Q1 at twice the frequency of the input signal

18-16. What action takes place when the grid of V1 in figure 21-5B of your textbook is driven below cutoff?
1. C4 discharges through L
2. C discharges through V1
3. C discharges through L
4. C4 discharges through the load

Learning Objective: Recognize linear RF power amplifiers. Text pages 391 through 393.

18-17. In a linear RF power amplifier the plate or collector current flows for
1. the entire input cycle
2. at least 1/2 the input cycle
3. less than 1/2 the input cycle
4. 120° of each input cycle

18-18. In a class AB_1 and AB_2 amplifier, what do the suffixes 1 and 2 indicate?
1. The 2 indicates that grid current flows for some part of the input cycle, and the 1 indicates that grid current does not flow
2. The 1 indicates that plate current flows for 1/2 of the input cycle, and the 2 indicates that plate current flows for the entire input cycle
3. The 1 indicates that plate current flows for the entire input cycle and the 2 indicates that plate current flows for 1/2 of the input cycle
4. The 2 indicates that grid current does not flow, and the 1 indicates that grid current flows for some part of the input cycle

● Items 18-19 through 18-22 are to be judged True or Flase.

18-19. Compared with class B, class A RF amplifiers are more efficient.

18-20. When the input signal goes positive on the base of Q1 (figure 21-6A in your textbook), Q1 stops conducting and C2 discharges through the primary of T2.

18-21. When the input signal goes negative on the grid of V1 (figure 21-6B in your textbook), the voltage across the plate tank circuit increases.

18-22. In the class B_2 linear RF power amplifier, grid current is usually drawn during the positive part of the input cycle.

Learning Objective: Identify the common methods for coupling RF amplifier stages. Text pages 394 through 396.

● Items 18-23 and 18-24 are to be judged True or False.

18-23. One of the most widely used types of coupling for RF amplifiers is the RC coupling.

18-24. Compared to RC coupling, untuned impedance coupling produces more uniform amplification.

In items 18-25 through 18-28, select from column B the coupling that best fits the characteristic listed in column A.

	A. Characteristic	B. Coupling
18-25.	Widely used in voltage amplifiers	1. RC
18-26.	Widely used in transmitter RF amplifier stages	2. untuned impedance
18-27.	Load resistor replaced by an inductor	3. tuned impedance
18-28.	Single or double tuned	4. transformer

Learning Objective: Identify three common methods of neutralizing RF amplifier stages. Text pages 396 through 400.

18-29. Proper neutralization of an RF amplifier requires the elimination or cancellation of grid to plate or collector to base coupling that occurs through

1. interelectrode capacitance only
2. mutual inductance only
3. common impedance only
4. all signal paths

In items 18-30 through 18-33, select from column B the type of neutralization that best fits the characteristic listed in column A.

	A. Characteristic	B. Neutralization circuit
18-30.	neutralizing capacitor couples a portion of the output signal back to the split-coil input tank	1. collector/plate
18-31.	feedback capacitance is canceled by equal inductance	2. base/grid
18-32.	neutralizing capacitor is in the output tank circuit	3. coil
18-33.	parallel resonant circuit exists across collector and base or plate and grid	4. emitter/base

18-34. Neutralization adjustments are usually checked by measurement of the

1. energy transfer from the grid to the plate circuit
2. plate current with full grid drive
3. interelectrode capacitance with the amplifier deenergized
4. plate voltage with no grid drive

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. .
. Learning Objective: Identify .
. parasitic oscillations in RF .
. amplifier stages and methods .
. of keying transmitters. Text .
. pages 400 through 404. .
. . . .

18-35. Parasitic oscillations in a transmitter stage produce an increase in the circuit
1. output power
2. efficiency
3. losses
4. stability

18-36. High frequency parasitic oscillations are usually suppressed by
1. changing the frequency of the plate/or grid circuit
2. reduction of the amplifier load impedance
3. reduction of the grid and plate potentials
4. use of tetrode tubes

18-37. Which of the following is not a method of suppressing high frequency parasitic oscillations?
1. Increasing the Q of the parasitic circuit
2. Connecting a small RF choke in the plate lead
3. Connecting low value resistors in the grid and plate leads
4. Changing the inductance of the plate lead

18-38. The primary advantage of amplifier keying over oscillator keying is that amplifier keying provides
1. greater safety to personnel
2. improved frequency stability
3. reduced keying currents
4. eliminates shielding of the oscillator

18-39. Why are relays sometimes used in keying circuits?
1. To eliminate shock hazards, and provide sufficient contact area for the interruption of high currents
2. To provide a smoother keying
3. To eliminate the need for RF chokes
4. To prevent current surges in the keyed circuit

18-40. What is meant by the term "key clicks"?
1. Interference in adjacent receivers caused by rapid current surges
2. The tones produced by oscillator keying
3. The unmodulated portion of a continuous carrier
4. The rate of charge and discharge in the keyed circuit's filter network

18-41. Which of the following applies to the blocked base/grid method of keying when the key is closed?
1. A reverse bias voltage is removed from the base
2. A positive voltage is removed from the base
3. A negative voltage is applied to the grid
4. A positive voltage is applied to the base

Learning Objective:
Recognize ALC circuits and methods of tuning RF amplifier stages. Text pages 405 through 407.

18-42. Which of the following applies to the ALC circuit shown in figure 21-23 of your textbook?
1. Peaks from the output of the power amplifier are rectified and used to vary the gain of two amplifier stages
2. Peaks from the input of the power amplifier are rectified and used to vary the gain of two amplifier stages
3. Peaks from the output of the SSB generator are rectified and used to vary the gain of two amplifier stages
4. Peaks from the input of the SSB generator are rectified and used to vary the gain of two amplifier stages

● Items 18-43 through 18-46 are to be judged True or False.

18-43. When the plate tank circuit of the final power amplifier of a transmitter is tuned to the input signal frequency, the plate current is minimum and the power output is maximum.

18-44. When the plate tank circuit of an RF amplifier stage is tuned to the frequency of the input signal, a reduction in current occurs in the plate circuit of the stage being tuned and in the grid circuit of the following stage.

18-45. Proper operation of a transmitter requires close coupling between the plate tank circuit of the final power amplifier stage and the antenna.

18-46. Replacing the antenna with a dummy load will prevent the transmission of signals while tuning a transmitter.

Learning Objective: Recognize common types of microphones, and differentiate between types. Text pages 408 through 411.

18-47. The use of high microphone output levels is desirable in an AF amplifier system to
1. improve frequency response
2. improve signal-to-noise ratio
3. provide greater directivity
4. overcome losses in long lines

18-48. Which of the following is true concerning the impedance of a microphone?
1. It must be matched to the amplifier output
2. It must be high if a long microphone cable is used
3. It must be matched to the microphone cable
4. It must equal the resistance of the microphone cable

18-49. The carbon microphone functions in its associated circuit as a
1. generator
2. transformer
3. variable resistor
4. voltage divider

18-50. What is the impedance of a typical carbon microphone?
1. 200,000 ohms
2. 20,000 ohms
3. 50 to 200 ohms
4. 20 ohms

18-51. Which of the following types of microphones has the highest output?
1. Magnetic
2. Dynamic
3. Crystal
4. Carbon

18-52. Crystal microphones are seldom used in military equipments because of their
1. poor frequency response
2. nondirectional character
3. low output
4. fragile character

18-53. Unlike the dynamic microphones, the magnetic microphone uses a
1. movable diaphragm
2. permanent magnetic field
3. low-impedance output
4. fixed coil

In items 18-54 through 18-57, select from column B the type of microphone that best fits the characteristics listed in column A.

	A. Characteristics	B. Microphones
18-54.	Generates a voltage proportional to mechanical stress	1. Carbon
18-55.	Voltage generated by movement of a coil in a magnetic field	2. Crystal
18-56.	Requires an external voltage source	3. Dynamic
18-57.	Vibrating armature induces a voltage in a coil	4. Magnetic

Learning Objective: Define modulation, and recognize common AM modulation systems. Text pages 411 through 419.

18-58. What process is used to impress intelligence on an RF carrier?
1. Regeneration
2. Detection
3. Demodulation
4. Modulation

18-59. When the intelligence of an audio signal is superimposed on an RF carrier, which results in changes in the amplitude of the RF carrier, the resulting modulation is referred to as
1. grid modulation
2. phase modulation
3. amplitude modulation
4. frequency modulation

18-60. A carrier frequency of 100 kHz is amplitude modulated by a 2 kHz tone. What are the frequencies of the two sidebands?
1. 99 kHz and 101 kHz
2. 98 kHz and 102 kHz
3. 90 kHz and 110 kHz
4. 80 kHz and 120 kHz

18-61. The bandwidth required for a particular AM transmitter depends upon the
1. ratio of carrier to modulation frequency
2. maximum carrier swing
3. highest modulating frequency
4. highest modulating amplitude

18-62. Assume that an AM transmitter has an unmodulated carrier voltage of 600 volts, and a modulating signal of 400 volts. What is the approximate percentage of modulation if the modulating signal is an undisturbed sine wave?
1. 166%
2. 120%
3. 66%
4. 40%

18-63. Modulation of an AM transmitter greater than 100 percent results in
1. generation of unequal sideband amplitudes
2. reduced carrier frequency stability
3. generation of fewer sideband frequencies
4. interference and distortion

18-64. A conventional AM transmitter has a degree of modulation of .6 and a carrier power of 800 watts. What is the total power radiated by the transmitter?
1. 944 watts
2. 1200 watts
3. 1600 watts
4. 9440 watts

18-65. Grid-modulation of RF amplifiers is accomplished by variation of the amplifier
1. plate impedance
2. grid impedance
3. plate voltage
4. bias voltage

18-66. High-level modulation takes place when the modulating signal is applied to the
1. plate circuit of the final stage of the transmitter
2. plate circuit of the first RF amplifier stage
3. screen grid of the final stage of the transmitter
4. antenna

18-67. Which of the following applies when comparing high level modulation to low level modulation?
1. Low level modulation produces a greater power output, but is less efficient
2. High level modulation produces a greater power output, but is less efficient
3. Low level modulation requires more audio stages, and is more efficient
4. High level modulation requires more audio stages, and is more efficient

18-68. In what stage does modulation take place in an AM system?
1. In the final power amplifier
2. In the buffer
3. In any intermediate power amplifier
4. In any of the above

18-69. What type of modulation would be used in a transistor amplifier for 100% modulation?
1. Collector
2. Emitter
3. Base or emitter
4. Base

18-70. Assuming a polarity reversal across transformer T3 in figure 22-13 in your textbook, what happens to the effective collector voltage of Q1 when a low amplitude modulating signal is applied to the primary of T3?

1. It increases on positive swings of the modulating signal, and decreases on negative swings
2. It decreases on positive swing of the modulating signal, and increases on negative swings
3. It increases on positive swings of the modulating signal, and is cutoff on negative swings
4. It decreases on positive swings of the modulating signal, and is cutoff on negative swings

18-71. Assuming a polarity reversal across transformers T1 and T2 (figure 22-14 of your textbook), which of the following takes place when a negative-going signal is applied to the primary of T1?

1. V2 plate current decreases, V2 plate voltage increases, T2 output opposes E_{bb}, and V3 plate current increases
2. V2 plate current increases, V2 plate voltage decreases, T2 output opposes E_{bb}, and V3 plate current increases
3. V2 plate current increases, V2 plate voltage decreases, T2 output aids E_{bb}, and V3 plate current increases
4. V2 plate current increases, V2 plate voltage increases, T2 output aids E_{bb}, and V3 plate current increases

18-72. Screen voltage is supplied in plate/screen grid modulation from which of the following?

1. Direct from the plate supply voltage
2. Through a large choke in the screen circuit
3. Through a resistor from the filament supply voltage
4. A separate power supply or through a dropping resistor in the plate supply

18-73. In plate/screen grid modulation, 100% modulation is achieved by varying

1. the plate voltage
2. the plate and screen voltage simultaneously
3. the screen voltage
4. either the plate or screen voltage

Assignment 19

Frequency Modulation; Receiver and Transmitter Troubleshooting; Single Sideband

Textbook Assignment: Pages 420 through 443

Learning Objective: Define frequency modulation (FM) and recognize common FM systems. Text pages 420 through 422.

19-1. In an FM system, what determines the amount of carrier deviation (A) and rate of carrier deviation (B)?
1. (A) depends upon the frequency of the modulating signal and (B) depends upon the amplitude of the modulating signal
2. (A) depends upon the amplitude of the modulating signal and (B) depends upon the frequency of the modulating signal
3. Both (A) and (B) depend upon the frequency of the modulating signal
4. Both (A) and (B) depend upon the amplitude of the modulating signal

19-2. Reactance-tube frequency modulation and phase-angle modulation differ primarily in the
1. amount of multiplication required
2. percentage of modulation that can be obtained
3. type of microphone used
4. type of stage modulated

19-3. In the frequency modulator shown in figure 23-1 of your textbook, the microphone is used to
1. control frequency multiplication in a transmitter stage
2. provide audio voltage to a speech amplifier
3. provide audio voltage to a tank circuit
4. vary the resonant frequency of a tank circuit

19-4. Varying the amplitude of the modulating signal in an FM system will
1. vary the degree of compression or rarefaction of the rest frequency
2. vary the degree of deviation of the rest frequency
3. vary the rate of deviation of the rest frequency
4. do both 1 and 2

19-5. In the oscillator circuit shown in figure 23-5 of your textbook, which of the following takes place as the Q2 collector voltage increases?
1. C_{ce} increases, decreasing the resonant frequency of the Q1 tank
2. C_{ce} decreases, increasing the resonant frequency of the Q1 tank
3. C_{ce} increases, increasing the resonant frequency of the Q1 tank
4. C_{ce} decrease, decreasing the resonant frequency of the Q1 tank

Learning Objective: Identify sideband generation and bandwidth in FM systems. Text pages 422 and 423.

19-6. Compared to AM, FM systems produce
1. fewer sideband frequencies
2. slightly more sideband frequencies
3. approximately the same number of sideband frequencies
4. many more sideband frequencies

19-7. What are the first three upper and lower sideband frequencies of a 100 MHz carrier modulated by a 5 kHz signal?

1. 100.005 MHz, 100.010 MHz, and 100.015 MHz, and 99.995 MHz, 99.990 MHz, and 99.985 MHz
2. 100.005 MHz, 100.006 MHz, and 100.007 MHz, and 99.995 MHz, 99.994 MHz, and 99.993 MHz
3. 100.05 MHz, 100.10 MHz, and 100.15 MHz, and 99.95 MHz, 99.90 MHz, and 99.85 MHz
4. 100.05 MHz, 100.10 MHz, and 100.15 MHz, and 99.995 MHz, 99.990 MHz, and 99.985 MHz

19-8. In an FM system, which of the following modulating signals will produce the greatest number of significant sideband frequencies?
1. Large amplitude and high frequency
2. Small amplitude and low frequency
3. Large amplitude and low frequency
4. Small amplitude and high frequency

19-9. In an FM system, sideband power is derived from
1. the carrier and modulating signal
2. the deviation rate of the carrier
3. the deviation frequency of the carrier
4. all of the above

19-10. Bandwidth in an FM system includes
1. all sideband frequencies
2. only the significant upper and lower sideband frequencies
3. all frequencies between the carrier and modulation frequency regardless of their amplitude
4. only the first upper and first lower sideband frequencies

Learning Objective: Define and compute the modulation index and bandwidth in FM systems. Text pages 424 and 425.

19-11. What is the modulation index of an FM system with sideband frequencies as shown in figure 23-6 of your textbook? (The carrier deviation is 70 kHz and the modulating signal is 10 kHz.)
1. 0.5
2. 4.0
3. 5.0
4. 7.0

19-12. Referring to table 23-1 in your textbook, what is the bandwidth of the system described in item 19-11.
1. 220 kHz
2. 140 kHz
3. 22 kHz
4. 11 kHz

Learning Objective: Define percentage of modulation, and differentiate between significant and insignificant sidebands in FM systems. Text pages 423 through 426.

19-13. In FM communication systems, percentage of modulation refers to the ratio of frequency deviation to
1. bandwidth
2. maximum permissible deviation
3. modulating frequency
4. operating frequency

● Item 19-14 is to be judged True or False.

19-14. In an FM system, those sideband frequencies with amplitudes of less than 1% of the unmodulated carrier amplitude are considered significant sidebands.

Learning Objective: Differentiate between "wide band" and "narrow band" FM systems, and identify the Bessel Zero method of determining modulation index. Text page 424.

● Items 19-15 through 19-18 are to be judged True or False.

19-15. A wideband FM system requires higher carrier frequencies than an AM system carrying the same intelligence.

19-16. One method of reducing interference between radio waves is by reducing bandwidth.

19-17. Overmodulating an FM carrier reduces the bandwidth.

19-18. The "Bessel Zero" method of determining modulation index is primarily concerned with sideband spacing.

Learning Objective: Define the need for a logical system of troubleshooting and describe in general terms the basic steps involved in such a system. Textbook page 427.

● In addition to saving time, a logical approach to troubleshooting will reduce the possibility of inadvertent equipment damage due to improper maintenance techniques and the amount of labor involved in localizing the cause of the malfunction.

19-19. From the above study hint it is fairly obvious that all of this will result in
1. a savings in maintenance costs.
2. a reduction in equipment down time.
3. an overall savings in operational costs.
4. all of the above.

19-20. In what order are the six basic steps in a logical approach to troubleshooting normally applied?

1. Symptom analysis; equipment inspection; signal tracing or substitution; voltage and resistance measurements; tube and/or transistor testing; and basic tests
2. Basic tests; tube and/or transistor checkings; voltage and resistance measurements; signal tracing or substitution; equipment inspection; and symptom analysis
3. Voltage and resistance measurements; signal tracing or subsititution; equipment inspection; basic tests, tube and/or transistor testing; and symptom analysis
4. Basic tests; symptom analysis; equipment inspection; signal tracing or substitution; tube and/or transistor testing; and voltage and resistance measurements

● Item 19-21 should be judged True or False.

19-21. Symptom Analysis is a study of trouble symptoms used to isolate the trouble to components in an equipment.

19-22. If in the process of troubleshooting a faulty receiver, you noticed a discolored resistor or smelled burned insulation, you would probably be conducting which of the following troubleshooting steps?

1. Symptom analysis
2. Equipment inspection
3. Voltage and resistance measurement
4. Basic tests

19-23. To locate a defective component in a transmitter, you may have to

1. signal trace the equipment
2. conduct voltage and resistance measurements
3. make basic tests
4. all of the above

● Items 19-24 through 19-26 should be evaluated as True or False.

19-24. When used as a troubleshooting aid, any measurement or observation that compares present equipment operation with previously established operating standards for that equipment is designated a basic test.

19-25. Efficient troubleshooting of malfunctioning equipment requires extensive use of technical diagrams such as functional block diagrams, servicing block diagrams, wiring diagrams, and equipment schematics.

19-26. A servicing block diagram includes the proper voltages and test points for an equipment.

Learning Objective: Describe how the six basic troubleshooting steps previously described may be applied in correcting a malfunction in a typical radio receiver. Textbook pages 428 through 430.

19-27. Since a defective component in any part of the receiver could cause the symptom indicated in the text, the cause of the malfunction cannot be isolated through the use of

1. equipment inspection
2. voltage and resistance measurement
3. signal tracing or substitution
4. symptom analysis

19-28. Assume you are troubleshooting a receiver and during the "Equipment Inspection" step you notice a definite odor of varnish. The component most likely to be defective is

1. a vacuum tube
2. a capacitor
3. a selenium rectifier
4. a resistor

19-29. Functional block diagrams may be used to provide information necessary to effectively utilize signal tracing to localize the cause of the malfunction such as

1. the number of stages
2. the function of each stage
3. the signal path
4. all of the above

Items 19-30 and 19-31 should be evaluated as True or False.

19-30. Effective use of signal tracing as a means of isolating the cause of a malfunction may require the use of a servicing block diagram, and/or equipment schematics since they will indicate the proper voltages and waveforms to be found at various points within the receiver.

19-31. In addition to indicating the proper voltages and waveforms to be found at various points within the equipment, block diagrams, wiring diagrams, and equipment schematics also will indicate the proper points and methods for connecting test equipment (signal generators, oscilloscopes, voltmeters, ammeters, etc.) as is necessary for proper analysis of the operation of each stage.

19-32. Since neither of the first two troubleshooting steps has been effective in isolating the cause of the malfunction; the logical place to inject a signal when first applying signal tracing techniques is at which, if any, of the following points?

1. At the input and work toward the output
2. At the output and work toward the input
3. At some point near the middle of the signal path through the receiver
4. None of the above

19-33. Since the net result of any signal tracing procedure is to isolate the cause of the malfunction why is one procedure considered to be more logical than another?

1. No logic is involved; the choice of procedure is left to the convenience of the technician.
2. In most cases only a single stage will be defective; thus, the time and effort involved in locating this stage will be reduced by a considerable factor.
3. Since there is no output the logical place to start is at the output.
4. When a signal is injected at the input and is heard in the output, the receiver is probably functioning normally, and the cause of no output is no input.

19-34. If a signal is injected at the midpoint of the signal path in the suspected area of the receiver and this results in an output, what assumptions may be made?

1. The cause of the malfunction is in some stage preceding the point at which the signal is injected.
2. The output device and the stages subsequent to the point of signal injection are functioning normally.
3. The power supply or at least the portion of the power supply supplying power to the stages subsequent to the point of signal injection is functioning normally.
4. All of the above assumptions may be made.

19-35. Once the cause of the malfunction has been traced to a specific area or stage, the next step is to determine which components within that area or stage are defective. This may be best accomplished through which, if any, of the following?

1. Voltage and resistance measurements
2. Inspection using the senses of sight, touch, and smell
3. Testing the tubes and/or transistors
4. None of the above

19-36. Having determined that the audio amplifier in a receiver is defective, which of the following would you normally use when conducting voltage and resistance checks?

1. Wiring diagram
2. Servicing block diagram
3. Stage schematic diagram
4. Overall block diagram

19-37. Using a logical approach to troubleshooting, when, if ever, would you test tubes and/or transistors?

1. When voltage and resistance measurements indicate that a tube or transistor may be defective
2. When voltage and resistance measurements are ineffective in determining which components are defective
3. When an equipment inspection indicates that a tube may not be functioning properly (the tube is too cold or hot, does not light up, is arcing, etc.)
4. All of the above

● The following item should be evaluated as True or False.

19-38. Once the necessary repairs are made after an equipment malfunction, equipment performance tests should be performed in order to determine that the repairs were properly effected and that equipment performance has not suffered as a result of the malfunction.

19-39. When troubleshooting transmitters, why aren't signal tracing and visual checks performed in the same manner as when troubleshooting receivers?

1. Because the high voltages present in transmitter circuitry, when energized, makes it hazardous to open equipment cabinets to work on the circuitry
2. Because incorporated into the transmitter circuitry are interlocks which will remove power whenever an access door or panel is opened
3. Because such test equipment as is necessary to perform these checks is permanently wired into the transmitter circuitry and equipment conditions will be indicated by front panel meters making it unnecessary to open the equipment cabinets
4. All of the above

Learning Objective: Discuss the reasons for altering this logical approach to troubleshooting when applying it to transmitter circuits and describe the additional safety precautions and features applicable when dealing with such circuitry. Textbook pages 430 and 431.

19-40. When troubleshooting transmitters, the cause of the malfunction may be localized and in many cases the defective component pinpointed through

1. proper analysis of front panel meter readings
2. equipment inspections
3. signal injection and tracing
4. none of these

19-41. To aid you in the interpretation of the front panel meter readings, equipment technical manuals normally will include charts which list

1. indications to be expected when equipment is operating normally
2. possible causes when meter readings are low or zero
3. possible causes when meter readings are high
4. all of the above

Items 19-42 through 19-44 refer to the section in your textbook on safety precautions applicable when troubleshooting transmitters and should be evaluated as True or False.

19-42. Navy transmitters, or for that matter, most other Navy electrical and electronic equipment utilizing lethal voltages, are equipped with interlocks which have the primary function of automatically disconnecting and/or disabling the power source when ever the equipment doors or panels are opened to gain access to the circuitry.

19-43. Without proper authorization, defeating the purpose of an interlock is not permitted under any circumstances.

19-44. Although interlocks are operative and/or the power source has been manually disconnected or disabled, all capacitors in equipment utilizing lethal voltages should be discharged, using an approved type shorting bar, prior to reaching into the equipment.

. . . .
. .
. Learning Objective: Differentiate between SSB and conventional AM systems. Text pages 432 and 433. .
. . . .

19-45. Single Sideband Suppressed Carrier transmission consists of
1. suppressing the carrier and the upper sideband, and transmitting only the lower sideband
2. suppressing the carrier and either the upper or lower sideband, and transmitting the remaining sideband
3. suppressing the carrier and the lower sideband, and transmitting only the upper sideband
4. suppressing the upper or lower sideband, and transmitting the remaining sideband and the carrier.

19-46. From the point of view of obtaining the most efficient use of the space in the RF spectrum that is used for communications, the principal advantage of single-sideband is the
1. improved efficiency of transmitters
2. improved gain in receivers
3. reduced bandwidth of a communications channel
4. reduced distortion in long-range communications

● When a conventional double-sideband transmitter is modulated 100 percent, the power in the sidebands is equal to one-half of the power in the carrier wave. In terms of total radiated power, the power in the sidebands is only one-third of the total, or one-sixth of the total power appears in each sideband. This is only true at 100 percent modulation. If the modulation is less than 100 percent, the carrier power remains the same but the power in the sidebands drop and the efficiency of the system drops correspondingly.

19-47. At 100-percent modulation a conventional AM transmitter is radiating 200 watts in each sideband. What is the total power radiated by the transmitter?
1. 400 w
2 800 w
3. 1,200 w
4. 1,600 w

19-48. The output stages of a single sideband transmitter may be operated as a class
1. A amplifier
2. AB amplifier
3. B amplifier
4. Both 2 and 3 are correct

● A conventional AM transmitter operates on a carrier frequency of 15 mHz with a bandwidth of 8 kHz. Item 19-49 deals with converting the AM transmitter to a single sideband suppressed-carrier transmitter.

19-49. If the conventional AM transmitter is converted to single-sideband using the lower-sideband, what is the approximate frequency coverage of the converted transmitter?
1. 14,090 kHz to 14,098 kHz
2. 14,996 kHz to 15,000 kHz
3. 14,996 kHz to 15,004 kHz
4. 15,000 kHz to 15,008 kHz

19-50. Which circuits in an SSB receiver differ from those in a conventional AM receiver?
1. Oscillator and detector
2. RF amplifier and mixer
3. AFC and mixer
4. AF and IF amplifier

Learning Objective: Identify the major sections and circuits of a basic SSB receiver. Text pages 433 through 435.

19-51. What section of the SSB receiver shown in figure 25-3 of your textbook functions to reject unwanted SSB signals and interference?
1. Mixer
2. Filter
3. Detector
4. Oscillator

19-52. What is the main reason that both single-sideband transmitters and receivers must have high-frequency stability?
1. To reduce the bandwidth required by the system
2. To permit rapid frequency changes
3. To obtain correct demodulation in the receiver
4. To increase range of transmission

● Items 19-53 through 19-56 are to be judged True or False.

19-53. The reinserted carrier frequency in the SSB receiver is dependent upon the local oscillator frequency.

19-54. Referring to the product detector shown in figure 25-4 of your textbook, in-phase signals are applied to the base of transistors Q1 and Q2.

19-55. Capacitors C4 and C5 (fig. 25-4 in your textbook), function to bypass all frequencies to ground except the difference frequency of the IF and reinserted carrier.

19-56. In SSB reception the amplitude of the sideband IF must be greater than that of the carrier.

19-57. What signal component(s) is/are contained on the plate of V_1 in figure 25-5 of your textbook?
1. The sum of the carrier reinsertion and IF signals
2. The difference between the carrier reinsertion and IF signals
3. The carrier reinsertion and IF signals
4. All of the above

Learning Objective: Identify the major sections and circuits of a basic SSB transmitter. Text pages 435 through 444.

19-58. What determines the audio frequency range developed by an SSB transmitter?
1. An RC network in the audio amplifier
2. A filter network in the SSB generator
3. The AFC network in the linear power amplifier
4. An RC network in the audio amplifier and an AFC network in the linear power amplifier

19-59. What device is used to maintain stable thermal control of the crystal oscillator shown in figure 25-6 of your textbook?
1. A filament circuit
2. A thermistor
3. A semiconductor bridge
4. A thermostat

19-60. What is the purpose of the 100 kHz frequency standard shown in figure 25-6 of your textbook?
1. It is used to calibrate the SMO
2. It provides a means of checking the SMO and carrier generator frequency
3. It provides frequency stability for the system
4. It is used in making frequency measurements

● To answer items 19-61 and 19-62, refer to figure 25-7 in your textbook. You are to assume a 3 MHz signal output from the SMO, and a 400 kHz signal output from the SSB generator.

19-61. With switch S1 in position 2, what is the frequency of the input signal to the linear RF amplifier?
1. 2.6 MHz
2. 3.3 MHz
3. 3.4 MHz
4. 5.6 MHz

19-62. With switch S1 in position 3, what are the frequencies of the input signals to the additive mixer (A), and the linear RF amplifier (B)?
1. (A) 3 and 11.6 MHz; (B) 14.6 MHz
2. (A) 2.6 and 9 MHz; (B) 11.6 MHz
3. (A) 3 and 9 MHz; (B) 12 MHz
4. (A) 2.6 and 11.6 MHz; (B) 14.2 MHz

19-63. Referring to figure 35-8 of your textbook, what happens to the reverse bias (A) and capacitance (B) of CR10 when the frequency of the V2 output increases?
1. Both A and B decrease
2. Both A and B increase
3. B decreases and A increases
4. A decreases and B increases

19-64. The frequency of a magnetostriction oscillator is determined by the
1. strength of the magnetic field
2. number of turns of wire on the coil
3. length of the metal rod
4. interelectrode capacitance of the electron tube

19-65. Which characteristics inhibit oscillations of the circuit shown in figure 25-9 of your textbook prior to the insertion of a magnetostrictive rod?
1. Degenerative feedback and RC coupling
2. Degenerative feedback and no coupling
3. Regenerative feedback and no coupling
4. Regenerative feedback and RC coupling

19-66. (A) What is the polarity of current produced by the grid coil of a magnetostrictive oscillator, and (B) where is this current applied?
1. (A) Negative (B) to the grid circuit
2. (A) Negative (B) to the cathode circuit
3. (A) Positive (B) to the grid circuit
4. (A) Positive (B) to the plate circuit

19-67. An output from a magnetostriction oscillator that is operating at the fundamental frequency of the metal rod is obtained by
1. increasing the plate voltage on the oscillator
2. inserting a magnetized bar in the coil
3. adjusting the coils in the tuned circuit
4. inserting an unpolarized bar in the coil

● To answer items 19-68 through 19-70 refer to figures 25-8, 25-10, and the associated text in your textbook.

19-68. With the SMO in a stable condition, what is the relationship between the currents through R2 and R3?

1. Unequal magnitudes and subtractive
2. Equal magnitudes and additive
3. Equal magnitudes and in opposite directions
4. Unequal magnitudes and in opposite directions

19-69. What is the phase relationship of E_o to E_s1 and E_s2 when the output frequency of the SMO drifts to a higher frequency?

1. 180^o out of phase with E_s1 and E_s2
2. 90^o out of phase with E_s1 and E_s2
3. More nearly in phase with E_s2
4. More nearly in phase with E_s1

19-70. What happens to the voltage across R2 or R3 when the output frequency of the SMO drifts to a lower frequency?

1. It decreases across R3
2. It increases across R3
3. It remains the same across R2
4. It increases across R2

● Items 19-71 through 19-73, refer to figure 25-11 of your textbook.

19-71. With the master oscillator generating a 3 MHz signal and oscillator number 1 set to 27.5 MHz, at what frequency must oscillator number 2 be set?

1. 2.392 mHz
2. 2.496 mHz
3. 2.500 mHz
4. 2.946 mHz

19-72. To increase the 3 MHz master oscillator output referred to in item 19-71 by .5 kHz, oscillator number 2 must be set to

1. 2.392 MHz
2. 2.396 MHz
3. 2.492 MHz
4. 2.496 MHz

19-73. What change must be made to the setting of oscillator number 1 in order to increase the master oscillator output by 25 kHz?

1. Increase by 200 kHz
2. Decrease by 100 kHz
3. Increase by 100 kHz
4. Decrease by 200 kHz

Assignment 20

Single Sideband; CW and FM Reception

Textbook Assignment: Pages 445 through 461.

Learning Objective: Identify the common types of balanced modulators and bandpass filters used in SSB systems. Text pages 445 through 451.

Items 20-1 through 20-[illegible] refer to figure 25-12 of your textbook.

20-1. The function of the balanced modulator is to
1. suppress the carrier
2. provide a double sideband AM signal
3. pass the desired sideband
4. do both 1 and 2

20-2. Which of the following best describes the output from the SSB exciter?
1. Low power, high frequency, SSB signal
2. Low power, low frequency, SSB signal
3. Low power, low frequency, DSB signal
4. High power, high frequency, SSB signal

20-3. The output frequency of the linear amplifier to the antenna is
1. the sum of the HF oscillator and SSB exciter frequencies
2. the difference between the HF oscillator and SSB exciter frequencies
3. the frequency of the HF oscillator
4. either the sum or difference frequency of the HF oscillator and the SSB exciter

20-4. How is the carrier wave cancelled out in the push-pull modulator circuit shown in figure 25-13 of your textbook?
1. The carrier is applied with opposite polarity to both transistors between the base and emitter
2. The carrier is filtered out by R_4 and C_5
3. The carrier appears with opposite polarity on the collectors
4. The carrier is cancelled out in the primary of T2

20-5. How is the audio modulating signal eliminated from the output of the modulator circuit shown in figure 25-13 of your textbook?
1. It is applied with opposite polarity to the bases of both transistors
2. It is cancelled out in the collector circuits
3. It is not coupled to the output due to the low reactance of T2 to audio frequencies
4. It is applied with the same polarity to the bases of both transistors

● Items 20-6 through 20-9 are to be judged True or False.

20-6. In an SSB balanced modulator system, the amplitude of the RF carrier signal is generally 8 to 10 times that of the modulating signal.

20-7. Capacitors C1 and C2 (shown in figure 25-14 of your textbook) are charged simultaneously by the carrier signal to opposite polarities.

20-8. Equal and opposing voltages are developed in the primary of T2 (figure 25-14) on the positive and negative half cycles of the carrier input.

20-9. The sideband outputs of the SSB balanced modulator are in phase.

● Items 20-10 and 20-11 refer to the balanced ring modulator shown in figure 25-15 of your textbook.

20-10. Assuming that only the carrier signal is applied to the modulator, which of the following occurs on the first half-cycle of the input?
1. Diodes CR2 and CR4 conduct
2. Opposing currents flow in the primary of T1
3. Diodes CR1 and CR3 conduct
4. Diodes CR2 and CR4 are reverse biased

20-11. Assuming that the carrier and modulating signal are applied to the modulator, which of the following occurs on the second half-cycle of the input?
1. Current increases through CR2 and decreases through CR4
2. Equal and opposite currents flow through T1 and T3
3. Current increases through CR3 and decreases through CR1
4. Current increases through CR4 and decreases through CR2

Items 20-12 through 20-14 refer to the mechanical filter shown in figure 25-17 of your textbook.

20-12. Filter selectivity is determined by the
1. number of coupling (connector) rods
2. resonant frequency of the disks
3. number of disks
4. design of the coupling rods

20-13. The filter passband is determined by the
1. area of the coupling rods
2. number of disks
3. design of the disks
4. resonant frequency of the disks

20-14. What effect would increasing the size of the coupling rods have on the filter?
1. Better selectivity
2. Wider passband
3. Narrower passband
4. Reduced selectivity

20-15. In a crystal lattice filter, which of the following applies to the resonant frequency of the crystals?
1. Higher for the parallel crystals
2. The same for both series and parallel crystals
3. Higher for the series crystals
4. Higher for either series or parallel crystals depending upon the design of the filter

20-16. In the bridge circuit shown in figure 25-21 of your textbook, which of the following represents a balanced condition?

1. Y1, Y2 inductive, and Y3, Y4 capacitive and of equal amplitude to Y1, Y2
2. Y1, Y2 inductive, and Y3, Y4 inductive and of equal amplitude to Y1, Y2
3. Y1, Y3 inductive, and Y2, Y4 inductive and of equal amplitude to Y1, Y3
4. Y1, Y3 inductive, and Y2, Y4 capacitive and of equal amplitude to Y1, Y3

Learning Objective: Recognize common methods for making frequency measurements. Text pages 451 through 454.

20-17. What is the purpose of a frequency standard?

1. To generate precision frequencies
2. To minimize the effects of standing waves
3. To standardize the frequencies of oscillators
4. To eliminate synthesizers

20-18. How often are the time ticks (A), and time announcements (B) transmitted by the NBS?

1. (A) every second, (B) every five minutes
2. (A) every five minutes, (B) every second
3. (A) every five seconds, (B) every five minutes
4. (A) every second, (B) every minute

20-19. Which of the following does not apply to the calibrated receiver method of determining a transmitter's frequency?

1. The receiver is tuned to the transmitted frequency with the beat frequency oscillator off
2. The transmitted frequency should be unmodulated
3. The receiver's antenna should always be connected during the test
4. The receiver is tuned to the transmitted frequency and the receiver tuning dial read to determine the transmitter frequency

20-20. An absorption wavemeter should be used to check radio frequencies only when

1. no other type of meter is available
2. extreme accuracy is required
3. accuracy is not needed
4. speed is essential

● Items 20-21 through 20-25 are to be judged True or False.

20-21. Oscillators used to calibrate the frequency output of other oscillators may be referred to as secondary frequency standards.

20-22. A secondary frequency standard should be allowed to warm up for at least six hours before being used to measure a frequency.

20-23. The calibrated receiver method is a highly accurate method of measuring frequency.

20-24. For best results, the absorption wavemeter is adjusted so that the indicator lamp glows brightly at resonance.

20-25. To measure a frequency with the heterodyne frequency meter shown in figure 25-26 of your textbook, the frequency to be measured is applied to the detector section with the calibrate switch in the off position.

Learning Objective: Define continuous wave transmission and indicate its applications. Additionally, describe how CW reception differs from AM reception and its primary advantages and disadvantages. Textbook pages 455 and 456.

20-26. Which, if any, of the following was the first means used to impress intelligence on a radio frequency carrier signal?
1. By causing the frequency of the RF carrier signal to shift in accordance with the frequency and amplitude of another signal which contains the intelligence to be transmitted
2. By causing the amplitude of the RF carrier signal to vary in accordance with the frequency and amplitude of another signal which contains the intelligence to be transmitted
3. By interrupting the transmission of the RF carrier signal in such a manner as to form the dots and dashes of a code such as the international Morse code
4. None of the above

20-27. When compared to AM transmission, CW transmission has several advantages. These include which of the following?
1. Due to the narrow bandwidth required as a result of single frequency transmission, several CW transmissions could occupy the same frequency band as required for a single AM transmission
2. CW transmissions are less subject to fading and disturbances due to atmospheric conditions
3. Due to their narrow bandwidth, CW transmissions are less subject to adjacent channel interference
4. All of the above are advantages

● Since the intelligence to be transmitted must be manually encoded on transmission and manually decoded on receipt, efficient CW operation requires that the operators be specially trained and develop special skills.

20-28. Referring to the above study hint and to the section on CW transmission in your text, which (if any) of the following is considered to be a major disadvantage of such a system when compared to other systems of radio communications presently in use?
1. The cost of training CW operators is prohibitive
2. The type of intelligence to be transmitted must be restricted to that which may be easily encoded and decoded
3. The rate of transfer of intelligence is relatively slow, being limited by the skill and speed of both the sending and receiving operators
4. None of the above are disadvantages

20-29. All receivers designed for CW reception incorporate an additional stage whose function is to generate a
1. fixed frequency RF signal that is heterodyned with the incoming RF signal in order to produce an IF signal in the output of the mixer
2. fixed frequency RF signal that is heterodyned with the incoming RF signal in order to produce an audio signal in the detector output
3. variable frequency RF signal that is heterodyned with the incoming RF signal in order to produce an IF signal in the mixer output
4. variable frequency RF signal that is heterodyned with the incoming RF signal in order to produce an audio signal in the detector output

20-30. Heterodyning of the output of the variable or beat-frequency oscillator and the incoming RF signal will normally take place in which stage of a receiver designed for CW reception?
1. Detector
2. Mixer
3. IF amplifier
4. RF amplifier

20-31. The operating frequency of the beat-frequency oscillator of a communications receiver is approximately equal to the frequency of the
1. RF signal
2. local oscillator signal
3. IF signal
4. AF signal

20-32. Why is it necessary to shield the BFO?
1. To differentiate between it and other oscillator circuits found in receivers
2. To protect it from physical damage
3. To prevent it from radiating any electromagnetic fields which might interfere with the operation of other circuitry within the receiver or the circuitry of other electronic equipment in its vicinity
4. To provide more stable operation by preventing stray electromagnetic fields from interfering with its operation

20-33. Which of the following is a true statement regarding the use of a single diode as both signal and AGC detector in a CW receiver?
1. The AGC voltage developed as a result of the BFO output is normally used to provide no signal bias for the RF and IF amplifier stages
2. The AGC voltage developed as a result of the BFO output may be ignored since it has little or no effect on overall receiver operation
3. The effects of the AGC voltage developed due to the BFO output may be overcome by increasing RF and IF gain
4. Due to the BFO output an AGC voltage is developed that will interfere with normal operation of the AGC circuit

20-34. A crystal filter is sometimes used in an IF amplifier stage to increase the
1. band spread of the receiver
2. fidelity of the output signal
3. selectivity of the receiver
4. sensitivity of the receiver

20-35. In the circuit arrangement shown in figure 26-5 of your textbook the crystal forms one arm of a bridge network. When used in this arrangement the crystal acts like a
1. high "Q" parallel resonant circuit
2. high "Q" series resonant circuit
3. low "Q" parallel resonant circuit
4. low "Q" series resonant circuit

20-36. What is the function of the phasing capacitor in a crystal filter?
1. To match the impedance of the output circuit to the crystal
2. To tune the input inductance of the crystal
3. To neutralize the shunt capacitance of the crystal holder
4. To adjust the resonant frequency of the crystal

Learning Objective: Define FM transmission and specify its applications. Additionally, discuss how FM reception differs from AM reception and its primary advantages and disadvantages. Textbook pages 457 through 460.

20-37. While, in general, the circuit arrangement and operation of AM and FM superheterodyne receivers is the same, the two will differ in accordance with which of the following?
1. The RF and IF stages of the FM receiver will have a wider bandpass.
2. The principles involved and the circuitry used for demodulation are quite different
3. Depending on the type of demodulator used the last IF stage of the FM receiver may or may not incorporate a limiter circuit
4. All of the above are differences

- Items 20-38 through 20-45 should be evaluated True or False.

20-38. The primary purpose of making an FM antenna resonant at some predetermined frequency is to provide a signal at the input to the FM receiver of sufficient strength or amplitude to drive the first RF amplifier.

20-39. The type of antenna most commonly used for FM reception is the dipole whose total length is made equal to one-half the wavelength of the frequency at which it is to resonate.

20-40. The resistance at the center (between the two halves) of a dipole is a nominal 300 ohms.

20-41. An antenna designed to receive a band of frequencies is cut so that it will be resonant near the center of the band of frequencies.

20-42. To prevent standing waves and reduce transmission line losses the characteristic impedance of the transmission line coupling the antenna to the receiver should be made equal to the impedance of the antenna at the point where the antenna and transmission line are joined.

20-43. As in AM receivers the primary purpose of the RF amplifier (preselector) stages is to discriminate against image frequencies and improve the overall signal-to-noise ratio.

20-44. In an AM/FM superheterodyne receiver it will be necessary to switch IF stages since the same IF stage cannot be used for both AM and FM reception.

20-45. The operation of the frequency converter or mixer in a superhetrodyne receiver is the same for AM, FM, and CW reception.

20-46. Double tuned IF transformers are commonly used in FM superheterodyne receivers to provide which of the following?
1. The desired bandpass
2. Relatively even response for all the frequencies within the bandpass
3. Good discrimination against frequencies outside the bandpass
4. All of the above

20-47. More IF stages are used in an FM receiver than in an AM receiver because the
1. FM receiver uses more degenerative feedback
2. gain of each IF stage is less in the FM receiver
3. gain of the AF stages in the FM receiver is lower
4. coupling between stages is greater in the FM receiver

20-48. What are some of the factors that must be considered when selecting an intermediate frequency for an FM receiver?
1. Image response and harmonic frequencies
2. Receiver gain and cutoff limiting
3. Image response and stability of the local oscillator
4. Image response and nonlinearity of slope detection

20-49. Which of the following is employed in FM receivers to minimize or eliminate interference from unwanted signals?
1. Selecting an IF frequency which is higher than the entire FM bandwidth
2. Designing the preselector stages to adequately discriminate against such signals
3. Both 1 and 2 are correct
4. By using high gain IF amplifiers

20-50. Higher than normal loading on the local oscillator of an FM receiver results in
1. insufficient output for heterodyning
2. production of harmonics and interfering signals
3. decreased gain of the IF stages
4. faulty action of the limiter stage

20-51. A limiter is required in most FM receivers because of the
1. sensitivity of the detector to amplitude modulation
2. instability of the local oscillator
3. danger of overloading the discriminator
4. nonlinearity of the detector on weak signals

● Items 20-52 through 20-53 refer to the section on limiters in chapter 26 of the text and should be evaluated True or False.

20-52. The primary purpose of a limiter is to limit the amplitude of the signal applied to the detector to a predetermined level thus precluding the possibility of the detector responding to amplitude variations in signal.

20-53. For efficient operation of a saturation-cutoff limiter, sufficient gain must be provided ahead of the limiter in order to drive the limiter into saturation and cutoff when an input signal is applied.

Learning Objective: In general terms, point out how the principles involved in the demodulation of AM and FM signals differ, and describe some of the more commonly used methods for demodulating FM signals. (This objective is continued in Assignment #21.) Textbook pages 460 and 461.

● Refer to the section on demodulation in your text and evaluate items 20-54 through 20-59 True or False.

20-54. Demodulation of an AM signal occurs when the amplitude of the carrier wave is detected while demodulation of an FM signal requires the frequency variation of the carrier to be interpreted.

20-55. The demodulation process for FM reception is much more complex than for AM reception since the demodulator must produce an output voltage which is a function of the change in frequency, not amplitude, of the carrier signal.

20-56. Since certain types of FM demodulators will respond to both amplitude and frequency variations, the amplitude of the signal applied to such a demodulator must be held relatively constant for proper operation.

20-57. When an FM demodulator is sensitive to amplitude variations, the last IF stage must incorporate a limiter circuit in order to limit signal amplitude to a predetermined level.

20-58. Since the Foster-Seeley discriminator is relatively insensitive to amplitude changes, it need not be preceded by a limiter circuit.

20-59. The Foster-Seeley discriminator employs a transformer of special design to convert the FM signal into an AM signal which is then demodulated in much the same manner as other AM signals.

Assignment 21

CW and FM Reception; Six-Step Troubleshooting

Textbook Assignment: Pages 461 through 491

Learning Objective (continued): In general terms, point out how the principles involved in the demodulation of AM and FM signals differ, and describe some of the more commonly used methods for demodulating FM signals. Textbook pages 461 through 466.

- For items 21-1 through 21-3, refer to figure 26-11 in your textbook.

21-1. Which of the following is the primary purpose of L3, the tertiary winding?
1. To boost the signal developed across L2 and C3
2. To improve coupling between L1 and L2
3. To cancel out the resting frequency
4. All of the above

21-2. Which of the following voltages normally appear at the output during demodulation of an FM signal?
1. AF only
2. RF only
3. AF and RF
4. RF and d.c.

21-3. Since the voltage appearing across R1 and R2 are of equal amplitude and opposite polarity, producing a zero output at the rest frequency, what occurs as the frequency increases from the rest frequency?
1. The IR drop across R1 increases while the IR drop across R2 decreases causing a negative going voltage to appear at the output.
2. The IR drop across R1 increases while the IR drop across R2 decreases causing a positive going voltage to appear at the output.
3. The IR drop across R1 decreases while the IR drop across R2 increases causing a negative going voltage to appear at the output.
4. The IR drop across R1 decreases while the IR drop across R2 increases causing a positive going voltage to appear at the output.

● For items 21-4 through 21-8, refer to figure 26-15 of your textbook.

21-4. Using the R1/R2 junction as a reference point, e_6, the voltage applied to the CR1 anode is equal to the vector sum of

1. E_{L4} + E_{L2}
2. E_{L2} + E_{L3} + E_{R1}
3. E_{L2} + E_{L3} + E_{L4}
4. E_{L4} + E_{R1}

21-5. Using the R1/R2 junction as a reference point, e_7, the voltage applied to the CR2 anode, is equal to the vector sum of

1. E_{L1} + E_{L2}
2. E_{L3} + E_{L2} + E_{R2}
3. E_{L2} + E_{L3} + E_{L4}
4. E_{L4} + E_{L3}

21-6. Why is e_{10} (the output voltage) equal to zero at the rest frequency?

1. At the rest frequency e_2 and i_2 will be in phase causing voltages of equal amplitude and the same polarity to appear across R1 and R2
2. At the rest frequency e_2 and i_2 will be out of phase causing voltages of equal amplitude and the same polarity to appear at the cathodes of CR1 and CR2
3. At the rest frequency e_2 and i_2 will be out of phase causing voltages of equal amplitude and opposite polarity to appear at the cathodes of CR1 and CR2
4. At the rest frequency e_2 and i_2 will be in phase causing voltages of equal amplitude and opposite polarity to appear across R1 and R2

21-7. When the signal frequency decreases from the rest point the circuit becomes capacitive and i_2 will lead e_2 which causes CR2 conduction to increase and CR1 conduction to decrease. What is the net effect on the output?

1. An increase to e_9 while e_8 decreases causing e_{10} to increase and point A to become positive with respect to point B.
2. An increase to e_9 while e_8 decreases causing e_{10} to increase and point A to become negative with respect to point B.
3. A decrease to e_9 while e_8 increases causing e_{10} to increase with respect to point B.
4. A decrease to e_9 while e_8 increases causing e_{10} to increase and point A to become negative with respect to point B.

21-8. When the signal frequency increases from the rest point the circuit becomes predominately inductive, and i_2 will lag e_2 which causes CR1 conduction to increase and CR2 conduction to decrease. What is the net effect on the output?

1. An increase to e_9 while e_8 decreases causing e_{10} to increase and point A to become positive with respect to point B
2. An increase to e_8 while e_9 decreases causing e_{10} to decrease and point A to become negative with respect to point B
3. A decrease to e_9 while e_8 increases causing e_{10} to increase and point A to become positive with respect to point B
4. A decrease to e_9 while e_8 increases causing e_{10} to increase and point A to become negative with respect to point B

● For items 21-9 through 21-17, refer to figure 26-16 and the section in your textbook describing the operation of the circuit shown.

21-9. What is the principal advantage of this circuit over the one shown in figure 26-11?
1. Improved fidelity
2. Increased frequency response
3. Insensitivity to changes in signal amplitude
4. Increased selectivity

21-10. When, if ever, will the diodes conduct equally?
1. At frequencies above the center frequency
2. At the center frequency
3. At frequencies below the center frequency
4. Never

21-11. (A) When do the diodes conduct, and (B) what is the conduction path?
1. (A) When the top of L2 is negative (B) from the top of L2, through CR1, R1, R2, and CR2 to the bottom of L2.
2. (A) When the top of L2 is positive (B) from the top of L2 through CR1, R1, R2 and CR2 to the bottom of L2.
3 (A) When the bottom of L2 is negative (B) from the bottom of L2 through CR2, R2, R1, and CR1 to the top of L2.
4. (A) When the bottom of L2 is positive (B) from the bottom of L2, through CR2, R2, R1 and CR1 to the top of L2.

21-12. (A) when will C4 charge, and (B) to what value does it charge?
1. (A) during diode conduction, (B) to the average value of the output signal
2. (A) during the time the diodes are cutoff, (B) to the peak value of the output signal
3. (A) during diode conduction, (B) to the peak value of the input signal
4. (A) during the time the diodes are cutoff, (B) to the average value of the input signal

21-13. At the center frequency the charge on C4 will be equal to which of the following?
1. The charge on C5 plus the charge on C6
2. The charge on C5 minus the charge on C6
3. The charge on C5 plus the charge on C7
4. The charge on C6 plus the charge on C7

● Items 21-14 through 21-17, are to be judged True or False.

21-14. The total voltage applied to the bridge network consisting of R1, R2, C5, and C6 is determined by the charge on C4 which keeps the total voltage fairly constant.

21-15. When the carrier amplitude rises, the output voltage tends to rise and the Q of the transformer becomes higher.

21-16. When the frequency shifts either above or below the center frequency one of the diodes will increase conduction while the other decreases, causing like changes in the charges on their corresponding capacitors. This upsets the bridge balance (the voltages at the R1/R2 and C5/C6 junctions will no longer be equal) and produces an output.

21-17. Changes in the charges on C5 and C6 due to frequency shifts will cause the charge on C4 to change.

● For items 21-18 through 21-22, refer to figure 26-18 of your textbook.

21-18. The RF voltage (E5) which is effectively applied between the anode and ground of CR1 is equal to the vector sum of
1. e_4 and e_1
2. e_7 and e_8
3. e_3 and e_1
4. e_9 and e_{10}

21-19. The RF voltage (e_6) which is effectively applied between the anode of CR2 and ground is equal to the vector sum of
1. e_4 and e_1
2. e_7, e_1, and e_4
3. e_5, e_8, and e_4
4. e_9, e_{10}, and e_4

● Items 21-20 through 21-22 should be judged True and False.

21-20. I_2 and e_2 are in phase at the center or rest frequency causing e_5 and e_6 to be equal, and when e_5 and e_6 are equal e_8 and e_9 will also be equal, and the potential difference between points A and B will be zero.

21-21. Below the center frequency the circuit becomes capacitive causing i_2 to lead e_2 which in turn causes e_6 to increase and e_5 to decrease; CR1 conduction decreases and CR2 conduction increases causing e_8 to decrease and e_9 to increase and point B to swing negative with respect to point A.

21-22. Above the center frequency the circuit becomes inductive causing i_2 to lag e_2 which in turn causes e_5 to increase and e_6 to decrease; CR1 conduction increases and CR2 conduction decreases causing e_8 to increase and e_9 to decrease and point B to swing positive with respect to point A.

Learning Objective: Identify the terms "logical troubleshooting", "trouble symptom", and "symptom elaboration", and recognize trouble symptoms in electronic systems and methods of elaboration. Text pages 467 through 473.

21-23. Which of the following would not be considered a maintenance action?
1. Testing
2. Repair
3. Inspection
4. Routine operation

21-24. Logical troubleshooting is a procedure in which the technician systematically
1. replaces all units of the equipment that might be at fault
2. singles out the faulty component
3. substitutes known good components for suspect ones, one at a time
4. makes continuity checks of all wiring

21-25. For the technician to recognize a trouble symptom in a piece of electronic equipment he must
1. compare the present equipment performance with the normal
2. be able to repair the equipment
3. possess skill in the use of test equipment
4. be able to operate the equipment

21-26. Which of the following would be classified as a trouble symptom?
1. Open resistor
2. Defective wiring
3. Loose connections
4. Low output

21-27. The easiest trouble symptom to recognize is
1. degraded performance
2. equipment failure
3. improper output
4. low volume

21-28. To effectively evaluate the performance of an electronic system, the technician must rely on
1. his own knowledge of the system
2. system handbooks and instruction books
3. audible and/or visual displays
4. all of the above

21-29. Symptom elaboration is the process that you must accomplish to obtain
1. information about the test equipment required to repair the equipment
2. a list of the functional units in the equipment
3. voltage and resistance readings in the suspected faulty circuit
4. more information about a trouble symptom

21-30. An equipment operator has reported a very low sound level on the ship's superhetrodyne receiver. After you go to the radio shack to verify the symptom, you should
1. remove the receiver from its enclosure.
2. determine from the technical manual the test equipment required to make the repair.
3. vary the volume control.
4. check the antenna system connected to the defective receiver.

21-31. Which of the following selections best describes the reason for checking and manipulating the operating controls when a trouble symptom has been récognized?
1. To check for a possible maladjustment of the controls and to observe the effect that adjusting the control has on the operation of the equipment
2. To check for a possible maladjustment of the controls and to identify the purpose of each control knob
3. To enable you to locate each functional unit on the equipment diagrams
4. To enable you to decide whether to eliminate steps 3 and 4 from the troubleshooting procedure

● Items 21-32 through 21-38 are to be judged True or False.

21-32. When using operating controls, care must be exercised to ensure that the controls are operated in the proper sequence.

21-33. Operating controls should be set so as to allow the meters to indicate values above their maximum ratings.

21-34. When manipulating operating controls, the technician must observe all safety precautions relating to electronic equipment in general, and any special precautions that may apply to the particular equipment concerned.

21-35. It is not necessary for the technician to know what circuit changes take place as a result of a control adjustment.

21-36. An apparent trouble symptom may be caused by an incorrect control setting.

21-37. If all control settings are correct, the trouble symptom is not caused by a control.

21-38. Additional information concerning a trouble symptom may sometimes be gained by manipulating the controls so as to further aggravate the symptom.

21-39. When using the operating controls to gain further information concerning a trouble symptom, the control indications must be evaluated in relation to each other, and to the overall operation of the equipment. An effective method of doing this is by

1. recording the meter indications or other changes at the various control positions
2. close observation of meter indications as the controls are manipulated
3. making a mental note of the meter indications as the controls are manipulated
4. operating only one control at a time

Learning Objective: Recognize the methods by which a functional unit in an electronic system may be identified as being faulty, and method for isolating the faulty unit. Text pages 474 through 479.

21-40. What does the third step, Listing the Probable Faulty Functions, accomplish?

1. This step enables you to locate immediately the defective circuit in the equipment.
2. This step pinpoints the probable trouble areas so that you can proceed efficiently.
3. This step enables you to eliminate guessing as one of the elements in the troubleshooting procedure.
4. This step enables you to employ test equipment in troubleshooting the equipment.

21-41. To what does the term "function" refer in step 3, Listing the Probable Faulty Functions?

1. The units that are always located in one specific area
2. A major section or unit of a piece of electronic equipment
3. A single circuit in an operational unit of the electronic equipment
4. The symptom produced in the faulty equipment

21-42. Which of the following would not be shown by a functional block diagram for an electronic system?

1. The signal paths between units
2. Test points for troubleshooting
3. Individual units
4. Signal flow direction

21-43. Which of the following terms best describes the approach you should take in performing steps 1, 2, and 3 of the troubleshooting procedure?
1. Observation, circuit isolation, and circuit testing
2. Observation, operational evaluation, and mental decisions
3. Operational evaluation, circuit isolation and mental decisions
4. Observation, circuit isolation, and tube testing

21-44. Under what condition may some of the steps be eliminated in the troubleshooting procedure?
1. Step 3 may be omitted when the trouble is a distorted output signal
2. Steps 3 and 4 may be omitted when the equipment being repaired is a radar set
3. Steps 1 and 2 may be omitted when the equipment is obviously dead
4. Steps 3 and 4 may be omitted when the equipment is composed of one functional unit

21-45. In which of the six steps of the troubleshooting procedure is it recommended that you first use test equipment?
1. Step 5
2. Step 2
3. Step 3
4. Step 4

21-46. What is the primary purpose of step 4, Localizing the Faulty Function?
1. To isolate the trouble to one particular functional unit in the equipment
2. To isolate the defective unit in the equipment without employing test equipment
3. To isolate the trouble to the defective part in the equipment
4. To determine the amplitudes of the signals at each test point

21-47. In locating the faulty function, the use of test equipment should be restricted to
1. testing parts in the suspected circuits
2. checking the input signal in the suspected unit and the a-c power input to the equipment
3. checking the input and output signals of the suspected units
4. testing each tube in the suspected unit

21-48. In localizing the faulty function, which of the following would not be considered in selecting the first unit to be tested?
1. Test point accessibility
2. Number of signal paths
3. Past experience with the equipment and history of failures
4. The number of units to be eliminated by the test

21-49. Which of the following would apply if the final test in localizing the faulty function indicates that the unit is satisfactory?
1. You have misinterpreted the results of one or more tests
2. Your list of faulty units was not accurate
3. You have made an error in making one or more tests
4. All of the above

Learning Objective: Recognize methods for isolating faulty electronic circuits by using the servicing block diagram. Text pages 480 through 486.

21-50. Which of the following statements best describes step 5, Localizing the Faulty Circuit, in the troubleshooting procedure?
1. It provides you an opportunity to identify each circuit according to function
2. It permits you to locate the defective unit by test-point to test-point checking
3. It permits you to determine which circuit contains the parts that must be repaired to return the equipment to optimum operation
4. It permits you to find the faulty parts and perform repairs which will return the equipment to optimum operation

21-51. The star test points on a servicing block diagram for an electronic system would normally be used to test
1. functional unit groups
2. individual functional units
3. circuit groups
4. individual circuits

21-52. Which of the following statements best describes the term "bracketing" as employed in step 5 of the troubleshooting procedure?
1. Bracketing permits you to begin at the output of a unit and check, circuit by circuit, toward the input
2. Bracketing permits you to divide the suspected units according to size
3. Bracketing is a procedure that permits you to inject a test signal and evaluate a suspected circuit
4. Bracketing is a technique that permits you to isolate a trouble between a satisfactory input signal and a faulty output signal

21-53. At the beginning of step 5, you should place brackets around the
1. faulty functional unit
2. possible faulty stage
3. possible faulty circuit
4. possible faulty part

21-54. In carrying out the bracketing procedure to localize the faulty function in step 5, you should perform tests
1. only when the faulty circuit has been isolated
2. only when the bracket at the input is moved
3. only when the bracket at the output is moved
4. each time a bracket is moved

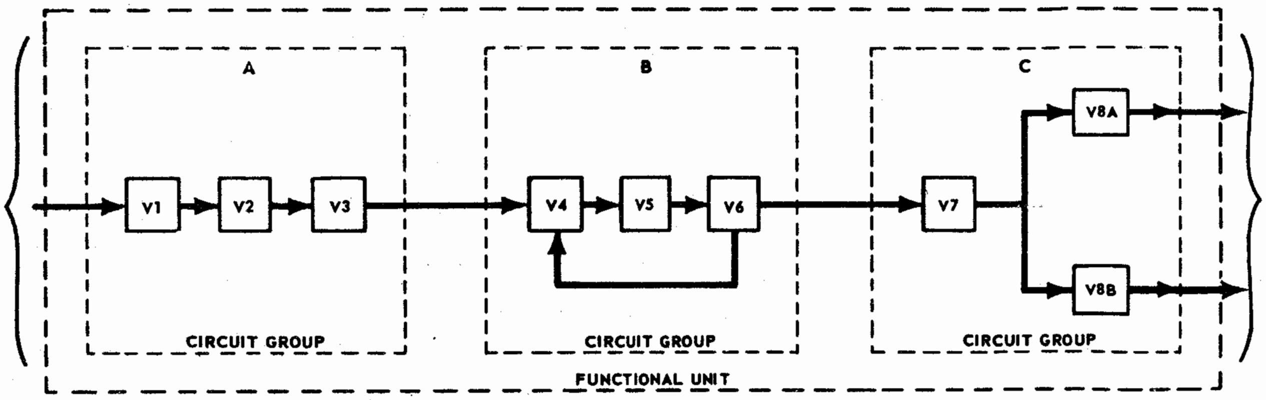

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Figure 21A. -Block diagram showing functional unit and functional circuit groups.

21-55. Which terms are correctly applied to the signal path arrangements in figure 21A?
1. (A) linear; (B) divergent; (C) feedback
2. (A) linear; (B) divergent; (C) convergent
3. (A) linear; (B) feedback; (C) divergent
4. (A) linear; (B) feedback; (C) convergent

● To answer item 21-56 refer to figure 21A and assume that you are using the bracketing procedure to localize trouble to the faulty circuit.

21-56. What would be your next action if, after injecting a signal at the input of V1, the output of V6 is satisfactory?
1. Place the input bracket between B and C, inject a signal at the input of V7, and check the V8 outputs
2. Place the output bracket between B and C, inject a signal at the V4 input, and check the V6 output
3. Disable the group B feedback loop, inject a signal at the V4 input, and check the V6 output
4. Place the input bracket between B and C, disable the group B feedback loop, inject a signal at the V7 input, and check the V8 outputs

21-57. The output of V6 (fig. 21A) is normal with feedback, and low with the feedback loop disabled. This indicates that
1. the feedback is degenerative
2. the feedback is regenerative
3. the feedback loop is defective
4. V6 is defective

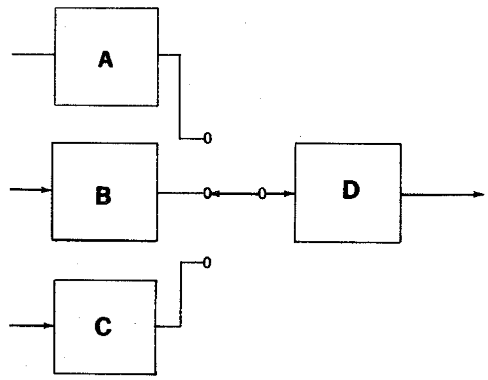

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Figure 21B. -Switching circuits.

21-58. Referring to figure 21B, which of the following is the correct procedure for isolating a faulty circuit?
1. Test the outputs of A, B, and C, then test the output of D
2. Test the output of D, then the outputs of A, B, and C
3. Test the inputs of A, B, and C, then the output of D
4. Test the input of D, then the outputs of A, B, and C

Learning Objective: Recognize methods for isolating faulty parts in electronic circuits by using the schematic diagram. Text pages 487 through 490.

21-59. At what point in the troubleshooting procedure do you make the actual repair on a piece of electronic equipment?
1. Step 3
2. Step 4
3. Step 5
4. Step 6

21-60. Which of the following statement best describes step 6, Failure Analysis, of the troubleshooting procedure?
1. This step enables you to systematically replace each part in the circuit with parts that are known to be in good condition.
2. This step enables you to replace the defective part and then determine the cause of the part failure.
3. This step helps you locate and verify all faulty parts in the equipment being tested.
4. This step enables you to employ test equipment for the first time in the troubleshooting procedure.

21-61. Which of the following would you use to locate a defective part in an electronic circuit?
1. Servicing block diagram
2. Schematic diagram
3. Functional block diagram
4. Pictorial diagram

21-62. Which of the following is the correct step-by-step procedure used to locate a defective part in an electronic circuit?

1. Analyze the circuit output, make a visual inspection, then test the individual parts
2. Analyze the individual parts, test the circuit output, then make a visual inspection
3. Make a visual inspection, analyze the circuit output, then test the individual parts
4. Test the individual parts, make a visual inspection, then analyze the circuit output

● Items 21-63 through 21-66 are to be judged True or False.

21-63. When making voltage checks to isolate a defective part, the lowest circuit voltages are checked first.

21-64. Subtitution of parts is always good practice in troubleshooting electronic equipment.

21-65. The accuracy of the test equipment used must be considered when making tests on certain circuits.

21-66. Critical electronic circuits will not function properly if the voltages are not within the tolerances specified in the manufacturer's technical manual.

21-67. **Referring to figure 27-12 in the text, a resistance reading of 2,000 ohms from pin 1 of V2 to ground is obtained. Which of the following would be the next logical step?**

1. **Measure the in circuit resistance of R6**
2. **Disconnect one side of R6 and measure its resistance**
3. **Disconnect one side of C9, remove the tube, and measure the resistance of R6**
4. **Either 2 or 3 above are correct procedures**

21-68. Suppose you have isolated a trouble to a part and then discover that a failure to this part would not result in all the symptoms and irregularities in your test data. Which of the following conclusions is most appropriate at this point?

1. The defect is located in another functional unit of the equipment.
2. There is another defective part in the circuit.
3. Each part in the circuit must be replaced.
4. The test equipment is probably defective.

Learning Objective: Match the troubleshooting step of the six step troubleshooting procedure with the appropriate action by the technician Text page 491.

In items 21-69 through 21-72, match the troubleshooting step listed in colum B with the appropriate action listed in column A.

	A. Action	B. Troubleshooting step
21-69.	using a signal generator to test a circuit group	1. 2
21-70.	checking a capacitor	2. 4
21-71.	using an oscilloscope to check a unit output	3. 5
21-72.	checking position of operating controls	4. 6

Assignment 22

Transmission Lines ; Wave Propagation and Antennas

Textbook Assignment: Pages 492 through 508

Learning Objective: Identify the common types of transmission lines and their applications. Textbook pages 492 through 494.

22-1. Assuming that a transmission line of the type shown in figure 28-1A of your textbook is used on VHF (30 to 300 mHz), what would be the spacing between conductors?
1. 7 inches
2. 6 inches
3. 5 inches
4. 4 inches

22-2. What separation between a parallel two-wire transmission line affords the best cancellation of radiation?
1. Between 2 to 6 inches
2. Less than 2 inches
3. 0. 25 wavelength
4. Less than 0. 01 wavelength

22-3. What is the primary disadvantage of the use of parallel two-wire lines at high frequencies?
1. High radiation loss
2. Low characteristic impedance
3. Physical construction problems
4. Variability of the characteristic impedance

22-4. What is the primary function of the shield on a shielded-pair transmission line?
1. To prevent physical damage to the line
2. To prevent unbalance of the conductor currents
3. To restrict the magnetic field around the conductors
4. To short radiated energy to ground

● In items 22-5 through 22-8 match the type of transmission line listed in column B with the associated characteristic listed in column A.

	A. Characteristic	B. Transmission Line
22-5.	Used as an untuned line on low frequencies	1. Two-wire air dielectric
22-6.	Wide TV use	2. Two-wire ribbon
22-7.	Conductors held apart by spacers or insulators	3. Twisted pair
22-8.	Uniform capacitance between each conductor and ground	4. Shielded pair

22-9. Power losses in a properly terminated coaxial line are due to
1. resistance and dielectric losses
2. radiation losses
3. dielectric losses
4. resistance losses

22-10. What type of material is used to support the inner conductor in type RG-8/U coaxial cable?
1. Ceramic
2. Teflon
3. Polyethylene
4. Copper braid

22-11. What determines the frequency that may be effectively transmitted by a waveguide?
1. The characteristic impedance of the guide
2. The shape and size of the guide
3. The effective impedance of the guide
4. The effective resistance of the guide

Learning Objective: Differentiate between distributed impedance and characteristic impedance in transmission lines. Textbook pages 495 and 496.

22-12. The leakage resistance of a two-wire transmission line is effectively that of a
1. resistance in series with the distributed inductance
2. resistance in series with the distributed capacitance
3. parallel resistance across the lines
4. series resistance in each line

22-13. The intensity of the electric field between the lines of a two-wire transmission line is a measure of the line's distributed
1. reactance
2. resistance
3. inductance
4. capacitance

22-14. The characteristic impedance of a two-wire transmission line is established by the relationship of the distributed capacitance to the
1. terminating resistance
2. distributed inductance
3. dielectric constant
4. conductor resistance

22-15. The characteristic impedance of a two-wire transmission line is increased by an increase in the
1. terminating resistance
2. spacing between the conductors
3. diameter of the conductors
4. dielectric constant

22-16. A transmission line of finite length appears at the source to have infinite length when it is terminated with
1. a short circuit
2. a resistance equal to its characteristic impedance
3. a parallel-resonant circuit
4. an open circuit

Learning Objective: Recognize the characteristics of voltage and current waves in an infinite transmission line. Textbook pages 496 and 497.

22-17. What is the wavelength in meters of a signal that has a frequency of 15 MHz?
1. 20 M
2. 15 M
3. 10 M
4. 5 M

22-18. In a transmission line of infinite length, what is the phase relationship between the voltage and current at any point along the line?
1. In phase
2. 180° out of phase
3. Voltage leads by 90°
4. Current leads by 90°

22-19. In a transmission line, the currents in the two conductors at any point along the line have
1. unequal amplitudes and opposite phases
2. unequal amplitudes and like phases
3. equal amplitudes and opposite phases
4. equal amplitudes and like phases

Learning Objective: Recognize the characteristics and applications of resonant and nonresonant transmission lines. Textbook pages 497 through 501.

22-20. Which of the following applies to nonresonant transmission lines?
1. Reflections are present
2. They are of finite length
3. The characteristic impedance is always inductive
4. The voltage and current waves are in phase

22-21. A resonant transmission line is characterized by
1. absence of termination at the characteristic impedance
2. zero resistive impedance
3. absence of standing waves
4. infinite length

22-22. Maximum current and minimum impedance are found in an open-ended resonant line of any length at
1. even quarter-wavelengths from the source end
2. odd quarter-wavelengths from the source end
3. even quarter-wavelengths from the open end
4. odd quarter-wavelengths from the open end

22-23. At even quarter-wavelength points the open end transmission line acts as a
1. parallel resonant circuit
2. series resonant circuit
3. parallel capacitive circuit
4. parallel inductive circuit

22-24. At even quarter-wavelength points the closed and resonant transmission line acts as a
1. parallel resonant circuit
2. series resonant circuit
3. parallel capacitive circuit
4. parallel inductive circuit

22-25. What are the relative values of current and voltage at the shorted end of a quarter-wavelength transmission-line section?
1. Current and voltage are minimum
2. Current is maximum and voltage is minimum
3. Voltage is maximum and current is minimum
4. Voltage and current are maximum

22-26. Which of the following line sections provides a practical and effective insulator at ultra-high frequencies?
1. Full-wavelength
2. Half-wavelength
3. Third-wavelength
4. Quarter-wavelength

22-27. Why can a quarter-wave section of transmission line be used as an impedance matching device?

1. Because the line has an impedance value that varies widely over its entire length
2. Because the line has an impedance value that remains uniform over its entire range
3. Because the shorting of one end of the line produces a device with high impedance at the shorted end
4. Because the shorting of one end of the line produces a device with low impedance at the open end

22-28. A quarter-wave shorted line section placed across a nonresonant transmission line produces almost complete attenuation of

1. even harmonics
2. even subharmonics
3. odd harmonics
4. odd subharmonics

22-29. Referring to the quarter-wave filter shown in figure 28-12 of your textbook, which of the following applies to the impedance offered to (A) the fundamental frequency, and (B) the even harmonics?

1. Low at (B) and high at (A)
2. Low at (A) and (B)
3. Low at (A) and high at (B)
4. High at (A) and (B)

Learning Objective: Recognize the characteristics of standing waves of voltage and current on open and closed transmission lines. Textbook pages 501 through 503.

22-30. The amount of reflection in a transmission line depends upon

1. the characteristic impedance of the line
2. the termination impedance
3. the input impedance
4. the mismatch between the characteristic impedance and the termination impedance

22-31. The initial voltage and current waves in the transmission line in figure 28-13A of your textbook are in phase at all points along the line except at point

1. a
2. b
3. d
4. e

Items 22-32 and 22-23 refer to figure 28-13 of your textbook.

22-32. What is the phase relationship between the incident and reflected voltage wave in an open-end line at (A) 90°, and (B) 270°?

1. In phase at (A) and (B)
2. In phase at (A) and 180° out of phase at (B)
3. 180° out of phase at (A) and in phase at (B)
4. 180° out of phase at (A) and (B)

22-33. What is the phase relationship between the incident and reflected current waves in an open-end line at (A) 0°, and (B) 270°?

1. In phase at (A) and (B)
2. 180° out of phase at (A) and (B)
3. In phase at (A) and 180° out of phase at (B)
4. 180° out of phase at (A) and in phase at (B)

Learning Objective: Identify the open and shorted Lecher-wire methods of measuring frequency. Textbook pages 505 through 507.

22-34. While using the Lecher-wire system shown in figure 28-14 of your textbook, minimum meter indications are obtained .5 meters apart. What is the frequency of the signal?
1. 300 kHz
2. 150 MHz
3. 300 MHz
4. 75 MHz

● Items 22-35 through 22-39 are to be judged True or False.

22-35. The length of a Lecher-wire used for frequency measurements must be at least one wavelength.

22-36. The distance between peaks or nodes in the Lecher-wire is equal to one wavelength.

22-37. Generally, greater accuracy is obtained with Lecher-wire measurements by measuring between peaks rather than nodes.

22-38. Accurate measurements with the open and shorted Lecher-wire requires loose coupling to the source of current.

22-39. In a transmission line, the ratio of the termination resistance to the characteristic impedance of the line is known as the standing wave ratio (SWR).

Learning Objective: Define the term "wave propagation." In addition, describe how it is affected by environmental conditions (atmospherics, etc.) and what may be done in order to overcome these effects and thus provide reliable long range communications. This objective is continued in Assignment 23. Textbook pages 29-1 through 29-6.

● As applied in the field of electronics the term "propagation" may be defined as the travel of electromagnetic or sound waves through a medium. Since radio waves are electromagnetic in nature the term "radio wave propagation" may be defined as the transfer of energy by electromagnetic radiation at frequencies below 3000 gigahertz. The term "electromagnetic radiation" may be defined as the radiation associated with any periodically varying electromagnetic field that is traveling at the speed of light and includes radio waves, light waves, x-rays, gamma rays, and cosmic rays. An electromagnetic field actually consists of two fields, an electric (E) field and a magnetic (H) field, that are always perpendicular to each other and to the line of travel.

● To answer items 22-40 through 22-42 refer to the above study hint and the section on wave propagation in chapter 29 of your textbook.

● Items 22-40 through 22-42 are to be judged True or False.

22-40. Radio waves may be classified as a form of radiant energy since they exhibit many of the characteristics of light and heat.

22-41. The portion of the frequency spectrum normally used for radio communications covers a range of 0.01 to 30,000 megahertz.

22-42. Because of the speed at which they travel, radio waves provide almost instantaneous communication between stations relatively remote from one another.

22-43. In an electromagnetic wave, the electric field and the magnetic field are always
1. perpendicular to each other and parallel to the line of travel
2. parallel to each other and perpendicular to the line of travel
3. perpendicular to each other and the line of travel
4. parallel to each other and the line of travel

22-44. As indicated by figure 29-1 of your textbook, the field pattern of a vertically mounted antenna is such that little or no radiation will be detected from such an antenna at a point which is
1. directly above the antenna
2. due east of the antenna
3. due west of the antenna
4. due south of the antenna

22-45. That portion of the electromagnetic wavefront that is in contact with the earth's surface as it leaves the antenna is most commonly known as the
1. sky wave
2. ground wave
3. electric wave
4. magnetic wave

22-46. That portion of the electormagnetic wavefront that leaves the antenna at such an angle as not to touch the earth's surface is most commonly known as the
1. sky wave
2. ground wave
3. electric wave
4. magnetic wave

22-47. The ground wave is used in which of the following cases?
1. To provide reliable long range communications at low frequencies and very high power
2. To provide reliable short range communications at high frequencies and low power
3. To provide commercial broadcast coverage at medium frequencies
4. To do all of the above

22-48. The sky wave is primarily used for
1. long range communications at low frequencies during daylight hours
2. long range communications at high frequencies during daylight hours
3. short range communications at low frequencies at night
4. short range communications at high frequencies during daylight hours

22-49. Energy transfer via the ground wave will become increasingly inefficient as the frequency increases due to
1. increased absorption by the ground
2. increased absorption by the ionosphere
3. decreased absorption by the ground
4. decreased absorption by the ionosphere

22-50. Why will the signal strength from a station at any given point in areas having different wet and dry seasons fluctuate?
1. During the dry season, soil conductivity decreases resulting in an increase in absorption.
2. During the dry season, soil conductivity increases resulting in an increase in absorption.
3. During the wet season, soil conductivity decreases resulting in an increase in absorption.
4. During the wet season, soil conductivity increases resulting in an increase in absorption.

22-51. Why are low frequency high power transmitters normally placed as near as practical to the edge of the ocean?
1. Absorption losses are decreased because salt water makes a better conductor than dry earth.
2. Since the ocean's surface is relatively smooth there is less scattering of the signal.
3. The conductivity of salt water is relatively unaffected by seasonal variations; therefore, transmission losses due to absorption remain essentially constant.
4. All of the above are true.

22-52. What happens to the energy contained in the sky wave?
1. Part of the energy is refracted by the ionosphere causing strong signals to be induced in receiving antennas that are far beyond the range of the ground wave.
2. Part of the energy is dissipated in the various layers of the atomosphere.
3. Part of the energy is radiated into space and lost.
4. All of the above happen to the energy in the sky wave.

● Items 22-53 through 22-55 refer to the section on the ionosphere in chapter 29 of your textbook and should be judged True or False.

22-53. The ionosphere, which commences at an altitude of about 40 miles, consists of a number of layers of ionized particles.

22-54. These layers of ionized particles are thought to be created as a result of solar radiation bombardment in the ultraviolet range.

22-55. The number of layers and their thickness and density are affected by such factors as sunspot activity, the rotation of the earth on its axis, the annual course of the earth around the sun, the density of the atmosphere at the various levels and variations in the earth's magnetic field.

22-56. What is the lowest layer that has any effect on the range of sky wave communications?
1. D layer
2. E layer
3. F_1 layer
4. F_2 layer

22-57. At which of the following times is the E layer of the ionosphere normally most dense?
1. 0000
2. 0600
3. 1200
4. 1800

22-58. By what process do the layers of the ionosphere return sky wave radio signals to the earth's surface?
1. Reflection
2. Induction
3. Refraction
4. Inversion

22-59. During the day the F layer will often separate into two layers (F1 and F2). When will the F2 layer usually attain maximum density?

1. In the early morning hours when the sun is low
2. In the late morning hours when the sun is high
3. In the early afternoon hours when the sun is high.
4. In the late afternoon hours when the sun is low

22-60. When do the F1 and F2 layers recombine?

1. Just after dawn
2. Just after noon
3. Just after sunset
4. Just after midnight

22-61. Erratic particles of ionization often appear at "E" layer heights. Known as the sporadic E layer, these particles of ionization, if of sufficient number and intensity, will greatly extend the range of

1. VHF transmissions
2. MHF transmissions
3. UHF transmissions
4. LF transmissions

22-62. The sporadic E layer that appears

1. are too weak to effect any frequencies except MHF transmissions
2. are effective only during the night time
3. are very strong and are beneficial to all electronic transmissions
4. often provide for good VHF transmission

22-63. The ability of the ionosphere to return (refract) an electromagnetic wave back to earth is dependent on many factors among which are

1. the angle at which the sky wave strikes the ionosphere
2. the frequency of transmission
3. the density of ionization
4. all of the above

Assignment 23

Wave Propagation and Antennas

Textbook Assignment: Pages 508 through 516

Learning Objective (continued): Define the term "wave propagation." In addition, describe how it is affected by environmental conditions (atmospherics, etc.) and what may be done in order to overcome these effects and thus provide reliable long range communications. Textbook pages 508 through 516.

● Items 23-1 through 23-9 refer to the section on the effects of the ionosphere on the sky wave in chapter 29 of your textbook and should be judged True or False.

23-1. Group one rays have an angle of elevation which is too great to allow them to be returned to earth.

23-2. If the angle of elevation exceeds the critical angle (θ), the rays will penetrate the ionosphere.

23-3. Group two includes those rays which are at the critical angle for a given frequency.

23-4. In addition to the critical angle above which no rays are returned to earth there is also a minimum angle below which no rays are returned to earth.

23-5. Group three includes those rays which are below the minimum angle at which the rays may be returned to earth.

23-6. Included in the sky wave is a group of waves whose angle of radiation is such that they can neither penetrate the ionosphere nor be refracted back to earth.

23-7. Just as there is a critical angle for each frequency, there also is a critical frequency which is the highest frequency that can be vertically radiated and still be refracted back to earth.

23-8. The critical frequency for a given locality is dependent on the locality, the time of day, the seasons and the sunspot cycle.

23-9. Since the critical angle (θ) decreases with an increase in frequency, a point is eventually reached at which the frequency is so high that none of the energy contained in the sky wave will be refracted back to the earth by the ionosphere.

23-10. Because of the variance in critical frequency, nomograms and frequency charts have been compiled which will predict the maximum usable frequency (MUF) for any given locality at any given hour of the day. Which of the following is the process used to accumulate the data necessary to compile these charts and nomograms?
1. Measurements are obtained by experimentation at the station for which a given nomogram or chart is prepared
2. Measurements are taken under actual working conditions at the station for which a given nomogram or chart is prepared
3. Measurements are obtained by experimentation at stations all over the world
4. Measurements are taken under actual working conditions at stations all over the world

23-11. The area known as a skip zone receives transmissions by
1. neither the sky wave nor the ground wave
2. both the sky wave and the ground wave
3. only the ground wave
4. only the sky wave

23-12. What is one disadvantage of sky wave transmission?
1. Special antennas are required
2. Transmission over long ranges is impossible
3. The erratic skip distance cannot be avoided
4. Suitable frequencies are difficult to generate

23-13. The size of the skip zone will vary in accordance with which of the following factors?
1. Changes in frequency
2. Changes in the ionosphere
3. Seasonal variations in the earth's conductivity
4. All of the above

23-14. What phenomena of radio-wave propagation does multiple-hop transmission use?
1. Refraction and reflection
2. Reflection and cancellation
3. Refraction only
4. Reflection only

23-15. When compared to single hop transmission, it can generally be said of multihop transmission that which of the following is/are true?
1. The signal strength at a given point will be weaker
2. The range attainable is greater
3. The signal strength is subject to ground absorption as well as atmospheric absorption
4. All of the above are true

● Because of reflections and/or refractions, all portions of a given signal may not arrive at the point of reception at exactly the same time, resulting in multiple signal voltages that are out of phase with each other being induced in the receiving antenna. Since out of phase voltages tend to cancel each other the end result is a received signal strength that is less than could be expected if the given signal were received by direct radiation only.

Since the characteristics of the ionosphere are not fixed, but vary in accordance with the hour of the day, the seasons of the year, and sunspot activity, its ability to refract radio waves will also vary. This, in turn, will cause the strength of the signal being induced in the receiving antenna to vary. Such short term variations in signal strength are a form of fading that is particularly prevalent and troublesome in areas that must rely on the sky wave for communications.

Reflections as a cause of fading normally will not present a problem except in the following cases: (1) Either or both the sending and receiving antenna are made mobile and are in motion relative to each other, in which case reflections from fixed objects become a problem.

(2) Both sending and receiving antennas are fixed and a relatively large object moves through either or both antenna fields, in which case the reflections from such an object become a problem. (3) In multihop transmissions the angle of refraction changes with changes in the ionosphere which in turn will change the point at which such waves return to earth and thus their angle of reflection from the earth.

● Items 23-16 through 23-23 refer to the above study hint and the section on fading in your textbook and should be judged True or False.

23-16. A particularly troublesome problem encountered in radio communications is known as fading and is the result of short term variations in signal strength at the point of reception.

23-17. Due to reflections and refractions the signal will take multiple paths in traveling between the sending and receiving antennas, and because these paths vary in length, the various portions of the signal will arrive at the receiving antenna at different times causing out of phase voltages to be induced in the receiving antenna.

23-18. Since out of phase voltages tend to aid each other, the net result is that the received signal will be of greater amplitude than could be expected if the entire signal had traveled via direct radiation only.

23-19. Since the characteristics of the ionosphere vary with time, its ability to refract radio waves will also vary causing short term variations in received signal amplitude (fading).

23-20. Fading as the result of variations in ionospheric characteristics is particularly troublesome in areas which rely on the sky wave for communications.

23-21. A system known as diversity reception may be used to minimize the effects of fading resulting from variations in the ionosphere.

23-22. Fading also results when the lengths of the reflection paths between the receiving and sending antennas are caused to vary as a result of relative motion between the two antennas.

23-23. Fading will also result when the lengths of the reflection paths between the sending and receiving antennas are affected by the movement of relatively large objects through either or both antenna fields.

23-24. When using VHF and UHF ranges, the most probable cause of contacts occurring at greater than expected ranges is

1. ionospheric disturbances
2. abnormal atmospheric conditions
3. unusual sunspot activity
4. seasonal changes in the earth's conductivity

23-25. Temperature inversion is an atmospheric abnormality wherein

1. a warm layer of air occurs at a higher altitude than a cool layer
2. the air gradually gets warmer as the altitude increases
3. there is a sudden change in temperature from hot to cold as the altitude increases
4. all of the above are true

23-26. A phenomenon known as "ducting" is primarily responsible for contacts at extended (unusually long) ranges in the VHF and UHF bands. Ducts may be formed in the atmosphere as the result of which of the following?

1. Unusual sunspot activity
2. Stormy weather
3. Temperature inversion
4. None of the above

23-27. If during a temperature inversion a signal is injected into one of the layers of air, which of the following will occur?

1. The layer of air may act in much the same manner as a physical waveguide and, depending on the extent of the layer, will conduct the signal over great distances.
2. The layer of air will absorb the signal causing it to rapidly die out.
3. The signal will be trapped in the layer and if the layer does not touch the earth at some point the signal will be lost.
4. None of the above will occur.

23-28. When "ducting" occurs as the result of temperature inversion, which of the following statements is most correct regarding the propagation of energy within the duct?

1. Cold air is much denser than warm air; therefore, a greater portion of the energy injected into such a layer of air will be absorbed by the air.
2. When injected into a duct, much of the energy injected into the duct will be trapped and thus will be lost unless the duct touches the earth at some point.
3. There is an abrupt change in the index of refraction between layers of air with different temperatures, and the points at which this change occurs define the boundaries of a given duct and any energy injected into this duct will be propagated throughout the duct.
4. None of the above are correct.

23-29. At sea, which of the following is an indication that a temperature inversion may have occurred?

1. Wind is blowing from the land.
2. High pressure, clear skies, and little wind
3. Smoke, haze, or dust fails to rise.
4. All of the above are indications.

23-30. As indicated by figure 29-10 of your textbook even though an obstacle has been interposed between a sending and receiving antenna the receiving antenna may not be entirely shielded from the sending antenna due to a phenomenon known as

1. refraction
2. reflection
3. diffraction
4. diffusion

Learning Objective: Define the term antenna and describe in general terms the mechanics of radiation, the effects of antenna length on impedance, introduction of energy into the antenna, and wave polarization. Textbook pages 510 through 517.

Items 23-31 throught 23-34 are to be judged True or False.

23-31. An antenna is any conductor or system of conductors used to radiate electromagnetic energy into space or receive electromagnetic energy from space.

23-32. The primary purpose of the antenna is to convert electrical energy into electromagnetic energy at the transmitter and electromagnetic energy to electrical energy at the receiver.

23-33. In most cases an antenna used to transmit a given signal will work with equal efficiency when used to receive this signal.

23-34. Antenna reciprocity is possible because the antenna characteristics remain essentially the same whether transmitting or receiving providing the same frequency is used in each case.

● Wavelength (λ) may be defined as the distance between corresponding points on two successive cycles of a periodic wave as illustrated in figure 23A.

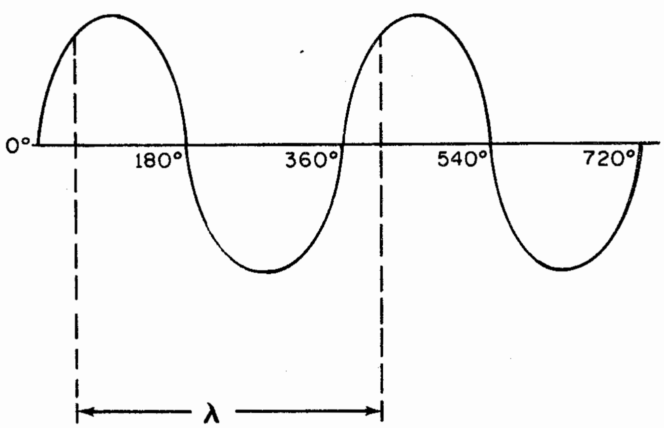

Figure 23A-. Wavelength

● The approximate free space wavelength in meters of any frequency may be computed by dividing 300 by the frequency in megahertz (λ (m.) = $\frac{300}{f(MHz}$). To obtain the approximate wavelength in feet all that is necessary is to multiply the results of the above division by the factor 3.28.

23-35. The fundamental element of any antenna system is the
1. quarter-wave grounded section
2. half-wave dipole
3. whip antenna
4. long wire antenna

23-36. A half-wave dipole antenna is actually a quarter-wave open end section of a two wire transmission line, the two wires having been rotated and placed end-to-end. What effect, if any, does this reorientation of the wires have on the standing waves existing on the two wires?
1. None, because the direction and amount of current flow in each wire remain the same.
2. The standing waves increase because the currents in the two wires are now flowing in the same direction and their effects are cumulative.
3. The standing waves increase because the currents in the two wires are now flowing in opposite directions and their effects are subtractive.
4. The standing waves increase because the electromagnetic fields surrounding the two wires aid each other.

23-37. The strength of the induction fields (that is, the fields associated with the energy stored in the antenna) is
1. inversely proportional to the distance from the antenna
2. directly proportional to the distance from the antenna
3. inversely proportional to the square of the distance from the antenna
4. directly proportional to the square of the distance from the antenna

23-38. The strength of the radiated fields (that is, the fields that become detached from the antenna and travel through space) is
1. directly proportional to the distance from the antenna
2. inversely proportional to the distance from the antenna
3. directly proportional to the square of the distance from the antenna
4. inversely proportional to the square of the distance from the antenna

● The electrical wavelength of a given frequency is about 5% less than its free space wavelength. The primary reason for this anomaly is that the speed of the signal while traveling through a wire is less than it would be in free space. As a result, if a half-wave dipole antenna is cut so that its physical length is exactly equal to one-half the free space wavelength of the applied frequency it will resonate not at this frequency but at a slightly lower frequency. Since the electrical wave-length of the applied signal is less than the physical length of the antenna, the antenna impedance is no longer purely resistive but will exhibit an inductive component as well. Thus, if an antenna is to resonate at a given frequency it should be cut so that its physical length is equal to the electrical wavelength of this frequency or some fraction thereof. If this is not practical as in the case of a tunable antenna, sufficient capacitance or inductance must be added in series with the antenna so that its apparent physical length will be equal to the electrical wavelength of the desired resonant frequency or a fraction thereof.

23-39. The difference between the electrical and physical lengths of an antenna is due to the
1. production of standing waves in the antenna
2. capacitive coupling of the antenna to ground
3. dissipation of power by the antenna
4. lower velocity of the wave in the antenna than in space

23-40. In the case of a tunable antenna, what can be done so that the antenna will operate efficiently at all frequencies?
1. Capacitance can be added in series with the antenna to change its apparent physical length
2. Inductance can be added in series with the antenna to change its apparent physical length
3. Both 1 and 2 are correct
4. Resistance can be added in series with the antenna to increase its apparent physical length

23-41. When the frequency of the signal applied is a dipole antenna is the frequency at which the antenna was cut to resonate, the antenna will exhibit an input impedance which is
1. a combination of resistance and inductance
2. primarily inductive
3. primarily capacitive
4. primarily resistive

23-42. A dipole antenna that has a physical length of 3/8 wavelengths at the operating frequency is tuned by the use of
1. series capacitance
2. series inductance
3. shunt capacitance
4. shunt inductance

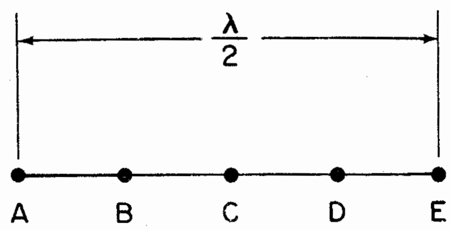

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Figure 23B. - A half-wave antenna.

23-43. At which point would you apply energy to the antenna shown in figure 23B to achieve a current fed configuration?
1. A or E
2. B
3. C
4. D

23-44. If you are required to have the antenna shown in figure 23B voltage fed, you would apply energy to point
1. A or E
2. B
3. C
4. D

23-45. The wave front of radiated energy from an antenna is always
1. perpendicular to the direction of travel of the energy
2. at right angles to the surface of the Earth
3. parallel to the direction of travel of the energy
4. perpendicular to the surface of the Earth

23-46. A wavefront or radiation field consists of electric (E) and magnetic (H) lines of force. Which, if any, of the following statements best describes the relationship between these lines of force and their direction of travel?
1. The E and H lines are at right angles to each other and to the line of travel
2. The E lines are parallel to the line of travel and at right angles to the H lines
3. The H lines are parallel to the line of travel and at right angles to the E lines
4. None of the above are correct

23-47. An electromagnetic field may be either vertically or horizontally polarized with respect to the earth's surface. The direction of polarization is determined by which, if any, of the following?
1. The direction of the magnetic lines of force
2. The direction of the electric lines of force
3. A combination of both of the above
4. None of the above

23-48. The electric lines of force are always parallel to the axis of a dipole antenna and the dipole lies within the plane of polarization of the electromagnetic field, which means that
1. the direction of polarization of the electromagnetic field will be determined by antenna orientation
2. the plane of polarization of the electromagnetic field is parallel to the axis of the antenna
3. a dipole will absorb maximum energy from an electromagnetic field if the dipole is orientated so it lies within the plane of polarization of the field
4. all of the above are true.

● Due to absorption there will be a change in polarization of an electromagnetic field which will become increasingly apparent as either or both the frequency and range are increased. For example, as the range between the sending and receiving antennas is increased an electromagnetic field which is vertically polarized as it leaves the sending antenna will be increasingly tilted towards the horizontal when it arrives at the receiving antenna and the effect will be the same if the range between antennas is held constant and the signal frequency is increased.

For small changes in frequency, or for short or medium ranges this effect is not too apparent; thus, the sending and receiving antenna will usually have the same orientation; that is, they both will be either horizontally or vertically orientated. However, at long ranges or in the case of large changes in frequency, for best results, it may be necessary to orientate the receiving antenna at a different angle with relation to the earth's surface than the sending antenna.

23-49. For maximum signal strength from a vertically orientated sending antenna, how should a receiving antenna at short range be orientated?

1. At right angles to the axis of the sending antenna
2. At about 45° with respect to the axis of the sending antenna
3. Parallel to the axis of the sending antenna
4. Parallel to the earth's surface and broadside to the sending antenna

23-50. Over short distances the polarization change in a high frequency magnetic wave will be ____(A)____ (small, large) while over a long distance the polarization change will be ____(B)____ (small, large).

1. (A) small, (B) small
2. (A) small, (B) large
3. (A) large, (B) small
4. (A) large, (B) large

Learning Objective: Describe the characteristics of some of the more commonly used antennas and indicate how these characteristics may be affected by changes in environmentals conditions. This objective is continued in Assignment 24. Textbook pages 516 through 525.

23-51. An antenna system which consists of a quarter-wave antenna that is vertically mounted and grounded is designated as the

1. Marconi antenna
2. Hertz antenna
3. inverted L military antennas
4. long wire antenna

23-52. At what point is the effective current maximum in a Marconi antenna?
1. At the base
2. 1/4λ up from the base
3. At the top of the antenna
4. Along the entire length of the antenna

23-53. If the earth beneath a Marconi antenna is a good conductor a mirror image of the antenna will be created due to reflections. When this occurs the Marconi antenna will assume most or all the characteristics of which of the following?
1. A horizontal mounted dipole
2. A vertically mounted dipole
3. A folded dipole
4. None of the above

● All antennas have an input impedance and that part of the input impedance which causes energy to be radiated into space is known as the radiation resistance.

At its resonant frequency, an antenna's input impedance is composed almost entirely of radiation resistance and the efficiency of the antenna is quite high. However, as the applied signal frequency is reduced below antenna resonance, the antenna input impedance increases becoming increasingly capacitive in nature and at the same time there is a decrease in radiation resistance which results in a decrease in antenna efficiency.

The increase in capacitive reactance may be offset by adding inductance in series with the antenna. This inductance, usually in the form of a coil of wire called a load coil, is normally placed as near as possible to the antenna feed point. The effect of this added inductance is to increase the effective length of the antenna causing it to resonate at a lower frequency.

The loading coil, however, has resistance which when added in series with the feed line and the antenna will increase the losses in the system resulting in a decrease in antenna efficiency. As long as the frequency remains within the range specified for a given antenna, such as 1.8 to 30 MHz for a 35 foot whip antenna, the loss of efficiency due to the loading coil resistance will remain quite small and, for practical purposes, may be ignored.

23-54. The vertical 35 foot whip antenna used in naval communications can be used over the frequency range of 1.8 MHz to 30 MHz if
1. identical reactances are inserted in the antenna to balance each other
2. opposing reactances are inserted in the antenna to cancel each other
3. additional 35 foot sections are added when the antenna is operating at the higher frequencies
4. resistance is added by inserting resistors equal to the impedance of the antenna

23-55. If a shipboard whip antenna is tuned to operate below its resonant frequency, most of the power loss occurs in the
1. capacitive reactance
2. radiation pattern
3. loading coil inductance
4. loading coil resistance

● Although the methods for computing the dimensions (either diameter or length) of both the whip and sleeve sections of a sleeve antenna are the same, the constants to be used in each case will be different as illustrated by figure 29-22 of your textbook.

23-56. Critical dimensions for a sleeve antenna are determined by which of the following?
1. Lowest frequency to be used
2. Amount of power to be radiated
3. The desired standing wave ratio
4. None of the above

23-57. The radiator of a sleeve antenna is cut to a length of 10 feet. What should be the diameter of the sleeve pedestal on which the radiator is mounted?
1. 24 in.
2. 36 in.
3. 40 in.
4. 60 in.

23-58. Referring to the previous question, compute the sleeve length for this antenna.
1. 24 in.
2. 36 in.
3. 40 in.
4. 60 in.

23-59. Assume that a sleeve antenna has an impedance of 200 ohms. The quarter-wave section used to match the antenna to 50-ohms feed line should have an impedance of
1. 75 ohms
2. 100 ohms
3. 125 ohms
4. 150 ohms

23-60. When a wider frequency range and greater low angle radiation are required, which of the following would be a likely choice to replace a whip antenna?
1. The long wire antenna
2. The folded dipole
3. The sleeve antenna
4. The inverted L military antenna

23-61. An antenna that has a length of one-half wavelength or a multiple of one-half wavelength is known as a
1. Marconi antenna
2. Hertz antenna
3. Zeppeling antenna
4. rhombic antenna

● Item 23-62 is to be judged True or False.

23-62. A Hertz antenna may be mounted in either a vertical or horizontal position.

23-63. An advantage the Hertz antenna has over other type antennas is that it will operate effectively whether (a) or (b).
1. (a) grounded, (b) ungrounded
2. (a) short, (b) long
3. (a) resonant, (b) nonresonant
4. (a) voltage fed, (b) current fed

● In present day applications a Hertz antenna may be used for broadband operation in the 200 to 400-MHz range.

The half-wave Hertz antenna and the half-wave dipole antenna will, under similar operating conditions, have similar radiation patterns.

NOTE: The number of lobes in the radiation pattern of a Hertz antenna will increase by a factor of two as its effective length is measured in multiples of a half-wavelength as follows:

Antenna length	Number of lobes
$\frac{\lambda}{2}$	2
λ	4
$\frac{3\lambda}{2}$	6
2λ	8

The radiation patterns of all antennas are affected both by their mounting structures and their proximity to other objects both metallic and nonmetallic.

23-64. While normally designed to operate in the 3.5 to 70 MHz range, Hertz antennas may be used in the VHF/UHF ranges for
1. long range operation
2. broad-band operation
3. short range operation
4. emergency operation

23-65 As with other antennas the radiation pattern of a Hertz antenna will be affected by which of the following?
1. The antenna mounting
2. Other antennas in the immediate vicinity
3. In the case of shore based antennas the presence of tall buildings in the immediate vicinity
4. All of the above

23-66. The input impedance of a multi-element array will approach zero as the number of driven elements in the array is increased thus making it increasingly difficult to obtain a proper impedance match between the antenna and the transmission line. One of the methods used to minimize this problem is to make use of driven elements which by themselves will have a relatively higher input impedance. Which of the following is such an element?
1. The dipole antenna
2. The folded dipole antenna
3. The Hertz antenna
4. The sleeve antenna

Assignment 24

Antennas

Textbook Assignment: Pages 518 through 527

Learning Objective (continued): Describe the characteristics of some of the more commonly used antennas and indicate how these characteristics may be affected by changes in environmental conditions. Textbook pages 518 through 527.

● Items 24-1 through 24-5 refer to the section on folded dipoles in your textbook and should be judged True or False.

24-1. A folded dipole is formed when a long wire full wavelength antenna is bent or folded to form two half-wave dipoles which are connected at the ends; one of the dipoles is center fed and becomes the driven element while the other acts as a parasitic element.

24-2. Since the two elements of the folded dipole are parallel and connected at the ends, the voltage at the ends is the same and the current induced in the parasitic element by the driven element will be of the same polarity and magnitude as that in the driven element.

24-3. Since the fields produced by the currents in the two elements of the folded dipole tend to aid each other, the radiated field strength is doubled and the power density per square meter in space is increased by a factor of 4 when compared to that of the simple dipole.

24-4. Since the radiated field strength of the folded dipole is 4 times that of the simple dipole, the input power to the folded dipole must be 4 times greater than the input power to the simple dipole.

24-5. Since the folded dipole actually comprises a two element array, its input impedance should be less than that of a simple dipole.

24-6. Given an input impedance of 75 ohms and an antenna current of 10 amperes, what is the radiated power of a simple dipole?
1. 75 watts
2. 750 watts
3. 7500 watts
4. 75,000 watts

24-7. Given an input impedance of 60 ohms and an antenna current of 5 amperes, what is the radiated power of a folded dipole?
1. 375 w
2. 1,500 w
3. 7,200 w
4. 90,000 w

24-8. When con-~-red to that of the simple dipole the input impedance of a folded dipole will be
1. 1/2 as great
2. 2 times as great
3. 1/4 as great
4. 4 times as great

● As indicated in your textbook, increasing the diameter of one of the sections of a folded dipole antenna will cause an increase in its input impedance. However, since one of the factors determining its input impedance is the ratio between the diameters of the two sections of the folded dipole antenna, the effect will be the same irrespective of whether the diameter of one of the sections is increased or decreased.

24-9. If a folded dipole is made nonsystematical by changing the diameter of one of its elements, what effect will this have on the antenna's input impedance?
1. It will increase.
2. It will decrease.
3. It will become predominantly capacitive.
4. It will become predominantly inductive.

24-10. While the function of a driven element in a parasitic array is fairly obvious the functions of the various parasitic elements are not so obvious. Which of the following statements describe the basic function of all parasitic elements?
1. They alter the antenna's input impedance so that it will more readily match the impedance of the transmission line, thus providing for efficient transfer of energy between the antenna and transmission line.
2. They alter the antenna's radiation pattern so that antenna gain in one direction is increased while gain in the opposite direction is decreased.
3. They make the antenna resonate at a frequency other than its natural frequency.
4. They alter the antenna's radiation pattern so that it will match the input impedance.

24-11. When a parasitic element is to be used as a director, it will be cut so that its physical length is slightly less than that of the driven element and will be placed parallel to and at such a distance from the driven element that when the energy it absorbs from the driven element is reradiated the fields of the two elements will
1. aid each other thus increasing antenna gain on the side of the director and decreasing it on the side opposite the director
2. oppose each other thus decreasing antenna gain on the side of the director and increasing gain on the side opposite the director
3. oppose each other thus decreasing antenna broadside gain while increasing end gain
4. aid each other thus increasing antenna gain in all directions

24-12. When used as a reflector, the parasitic element will be cut so that its physical length is slightly greater than the driven element and it will be placed parallel to, and at such a distance from the driven element, that when the energy it absorbs from the driven element is reradiated the fields of the two elements will
1. aid each other on the side of the reflector, thus increasing gain in that direction while opposing each other on the side of the driven element, reducing gain in that direction
2. oppose each other on the side of the reflector, thus decreasing gain in that direction while aiding each other on the side of the driven element, increasing gain in that direction
3. oppose each other thus decreasing antenna broadside gain while increasing end gain
4. aid each other thus increasing antenna gain in all directions

● Items 24-13 and 24-14 should be judged True or False.

24-13. As can be seen, a great variety of antenna patterns may be obtained using an antenna system comprised of only two elements; a driven element and a parasitic element; all that is necessary is to vary either the spacing between elements or their length relative to each other.

24-14. The inverted L military antenna is comprised of a fairly long horizontal section called a flattop and a vertical down lead which may be connected to either end of the flattop.

24-15. The effective length of the inverted L antenna includes
1. the down lead only
2. the flattop only
3. both down lead and flattop
4. neither down lead or flattop

24-16. Since in the single wire inverted L antenna both down lead and flattop sections are each made $\frac{\lambda}{4}$ long the current loop appears at the
1. free end of the flattop
2. feed point (bottom of down lead)
3. midpoint of the flattop
4. top of the down lead

24-17. Although the single wire inverted L antenna will have increased radiation efficiency as a result of the current appearing at the top of the down lead, it will also radiate considerable energy at high angles and this energy may be lost since it may not be refracted back to earth by the ionosphere. High angle radiation from this antenna occurs as a result of
1. current flow in the down lead
2. current flow in the horizontal section (flattop)
3. the combined current flow in down lead and flattop
4. none of the above

24-18. What is the result of using a multiwire arrangement instead of a single wire for the flattop of an inverted L antenna?
1. Radiation efficiency will increase.
2. Radiation efficiency will decrease.
3. High angle radiation is reduced.
4. High angle radiation is increased.

24-19. The advantages of increased radiation efficiency and a large reduction in high angle radiation may best be achieved with an inverted L antenna through which of the following?
1. Changing the feedpoint for the antenna
2. Changing the diameter of the wire in the flattop thus increasing its d. c. resistance causing a decrease in current flow in the flattop which will result in a decrease in high angle radiation
3. The use of a properly designed multiwire flattop arrangement
4. Changing the physical length of both sections of the antenna from a quarter to a half-wave - length

24-20. Which of the following is a characteristic of the longwire antenna?
1. It will be longer than a half-wavelength.
2. The currents in adjacent half-wave sections will flow in opposite directions.
3. It will have greater gain and directivity than all antennas previously discussed in this assignment except parasitic arrays.
4. All of the above are characteristics.

24-21. Referring to figure 29-25 of your textbook, (a) which of the antenna systems depicted qualify as long-wire antennas and (b) why?

1. (a) b, c, and d (b) each of them is more than a half-wavelength long.
2. (a) a and b (b) they are a half-wavelength or more long and the current flow in both halves of each antenna is in the same direction.
3. (a) c and d (b) they are a half-wavelength or more long and the current flow in both halves of each antenna is in opposition.
4. (a) None (b) to qualify they must be longer than a wavelength.

24-22. In an antenna that is 2 half-wavelengths, the current in the left side of the antenna flows $\frac{(A)}{\text{toward, away}}$ from the generator and the current in the right side flows $\frac{(B)}{\text{toward, away}}$ from the generator.

1. (A) toward (B) toward
2. (A) toward (B) away
3. (A) away (B) toward
4. (A) away (B) away

Item 24-23 is to be judged True or False.

24-23. In a long wire antenna, there is NO radiation off the ends of the antenna.

24-24. Which of the following will occur if either the transmitter frequency or the length of the long-wire antenna is increased in such a fashion that the number of standing waves on the antenna is increased in either odd or even multiples?

1. Antenna gain increase.
2. The number of antenna lobes increases.
3. The major lobes of the antenna will be closer to the axis of the antenna.
4. All of the above will occur.

Items 24-25 through 24-29 refer to the section entitled "Cyclic Variations of Reactance and Resistance at Center of Antenna" in text. When using a half-wave center fed antenna match the applied signal frequency conditions in column A with the resultant resistance/reactance listed in column B. (Note: Items in column B may be used more than once.)

	(A) Applied Signal Frequency Conditions	(B) Reactance
24-25.	Slightly above resonance	1. Low (none)
		2. Inductive
24-26.	Increases to the point at which the frequency is slightly less than a full wavelength	3. Capacitive
24-27.	Increases to the point at which the frequency is between 1 1/4 and 1 1/3 wavelengths	
24-28.	Increases to the point at which the frequency is 1 3/4 wavelengths	
24-29.	Increases to the point where the frequency is equal to 1 wavelength	

24-30. Which of the following statements best defines why end feeding is preferred for long-wire antennas?

1. The directional properties of the antenna are improved
2. When end fed only, a single wire transmision line is required
3. Impedance matching between antenna and transmission line is made easier
4. When fed at a point other than the end the antenna functions properly as a long-wire antenna only when its length is equal to some odd multiple of the wave-length of the applied frequency

24-31. Since either a resonant or a non-resonant open two wire transmission line is normally used to feed a long-wire antenna, what occurs when the antenna is end fed?

1. The feeder will be unbalanced
2. Lobe intensity in the direction of the feed end is reduced
3. Lobe intensity in the direction away from the feed end is increased
4. All of the above occur

24-32. What limitations, if any, are imposed when a matching section or stub is used to match the impedance of a nonresonant line to that of a long-wire antenna?

1. The antenna system will be restricted to single frequency operation, that for which the matching stub becomes effectively a quarter-wave section of transmission line
2. Such an arrangement may be used only if the antenna is end fed
3. Since the feeder is a nonresonant line, the system will function effectively only over a narrow band of frequencies which is determined by the length of stub used
4. No limitations are imposed

24-33. Providing the antenna's tuner has sufficient range to match the input impedance of the long-wire antenna to the output impedance of the trans-mitter, operation on either even or odd harmonic becomes possible by using

1. center feed and a nonresonant feeder
2. center feed and a resonant feeder
3. end feed and a nonresonant feeder
4. end feed and a resonant feeder

24-34. An antenna may be excited by which of the following means?

1. Direct connection to the transmitter
2. Induction fields from nearby antennas
3. Radiation fields from distant antennas
4. All of the above

24-35. Why is antenna tuning a necessity aboard ship?

1. Due to space limitations, the number of antenna systems which may be installed aboard a ship is limited; thus, a given antenna system may be required to operate with more than one transmitter and at more than one frequency
2. For ease of construction and maintainability, antenna systems designed to cover a given fre-quency range will all be of a standard size and shape
3. Since an antenna's input impedance is affected by environmental conditions, that is, the proximity of other objects and other antennas, a means for compensating for variations in input impedance is required if reasonably efficient antenna performance is to be maintained
4. All of the above are true

24-36. Antenna tuning is normally accomplished by which of the following?
1. Tuning the transmitter to operate at the resonant frequency of the antenna
2. Increasing or decreasing its radiation resistance
3. Changing its apparent length by adding either inductance or capacitance at the feed point
4. Changing the physical length of the antenna

24-37. Top loading an antenna is accomplished by
1. adding capacitance to the feed line to make the antenna appear longer
2. adding a resistor in parallel at the top of the antenna
3. adding inductance in parallel with the top of the antenna
4. adding inductance in series at the top of the antenna

24-38. In addition to the proximity of objects including other antennas, antenna radiation patterns and resistance are affected by which of the following?
1. Conductivity of the earth (ground) over which the antenna is mounted
2. Uniformity of ground conductivity
3. Any change in ground conductivity whatever the cause
4. All of the above

24-39. Which of the following may be used to improve ground conductivity for an antenna system?
1. A radial ground system
2. Treating the earth below with a conducting substance such as coal dust
3. The use of a counterpoise
4. All of the above

24-40. When a counterpoise is used, what will result should the counterpoise not be properly insulated from ground?
1. A grounded counterpoise will increase angle radiation with the result that a greater portion of the energy contained in the skywave will be radiated into space and lost.
2. Absorption losses are increased, since the grounded counterpoise will absorb energy from the antenna radiation field in much the same manner as the earth's surface
3. The counterpoise, when grounded, has little appreciable effect on either antenna's efficiency or radiation pattern
4. The counterpoise will act like a leaky capacitor, and as a result of the leakage current there will be I^2R losses which will be added to the losses already present in the antenna system

24-41. The units commonly used to express antenna radiation field intensity are microvolts or milliwatts per meter. These terms evolved as a result of which of the following?

1. Measurements taken at a distance of one meter from the radiating antenna
2. The use of a standard antenna for making field strength measurements, this antenna being a single wire antenna which is cut to be exactly one meter long
3. A ratio determined by dividing the signal amplitude or power at the receiving antenna by the distance (in meters) that the receiving antenna is located from the radiating antenna
4. All of the above

24-42. The purpose of making field strength measurements is to

1. determine if a given antenna system is functioning as desired by using these measurements to plot the radiation pattern of the antenna system
2. determine if the field strength at at given distance from the antenna is of sufficient strength to drive a receiver
3. determine antenna system efficiency
4. determine the power being radiated by the antenna

● Items 24-43 through 24-48 refer to the section on field intensity in your textbook and should be judged True or False.

24-43. Other antennas may be substituted for the standard one meter antenna when making field strength measurements providing these antennas have been calibrated against the standard antenna.

24-44. Rod antennas will generally be used when making ground wave field intensity measurements, and loop antennas will generally be used when making sky wave field intensity measurements.

24-45. A sensitive well-shielded receiver is used to select, amplify and apply the desired signal to the indicating device when making field intensity measurements.

24-46. The indicating device for such a system will generally be a voltmeter, and when the system is properly calibrated the meter will indicate the absolute field strength in microvolts per meter.

24-47. Should such a system be uncalibrated, a true field strength indication may still be obtained by comparing the output of the system to the output of a calibrated signal generator.

24-48. The power of a radiated wave from an antenna will decrease in proportion to the square of the distance between the transmitting and receiving antenna.

24-49. A field strength meter may be used to determine directional antenna beam patterns. It is a relatively simple device and is portable and therefore has a distinct advantage over the system previously discussed; however, it has certain limitations as indicated by which of the following?

1. It is uncalibrated and therefore can give only a relative indication of field strength.
2. It has a very low power handling capability and therefore cannot be used in close proximity to a radiating antenna.
3. Its indicating device tends to load down its tuning circuits which flattens their response curve making it more difficult to tune.
4. All of the above are true.

24-50. Which of the following materials is not normally used in the construction of antenna insulators?
1. Ceramics
2. Hard rubber
3. Wood
4. Isolantite

24-51. Irrespective of whether the insulation resistance of a given antenna should be high or low, it may be determined through measurements taken using which of the following devices?
1. Voltmeter
2. Ammeter
3. Megger
4. Ohmmeter

24-52. If the insulation resistance of the antenna is not the same as that set forth in the technical manual for the antenna, antenna performance will suffer. Which of the following are factors which may affect antenna insulation resistance and thus antenna performance?
1. Transmission line end-seals
2. Waveguide windows
3. Chipped or cracked insulators
4. All of the above

Learning Objective: Describe in general terms the proper procedures to follow when servicing antennas and list such safety precautions as may be applicable. Textbook pages 525 and 526.

24-53. As a general safety precaution all personnel should be warned not to approach within a certain distance of any antenna system unless it has been determined previously by competent authority that an antenna is unenergized. This distance will normally be
1. 1 foot
2. 5 feet
3. 10 feet
4. 20 feet

● Note: If the radiated power and frequency are such as to constitute a radiation hazard, then the size of the danger zone should be increased accordingly.

24-54. Unauthorized personnel should, as a safety precaution, be prohibited from
1. tampering with electrical and electronic equipment
2. attempting an inspection of electrical and electronic equipment
3. operating any electrical and electronic equipment
4. performing any of the above actions

● When it becomes necessary to work aloft as when servicing antennas, a certain procedure should be followed in order to ensure the safety of personnel going aloft. The steps in this procedure are given below, it should be noted however that the steps have not been given in proper sequence.

(A) The CDO or the OOD should direct the communications officer to secure such transmitters as are necessary to render the work area safe.

(B) The CDO or OOD should notify the engineering duty officer that men will be working aloft so that he may take the necessary precautions to ensure that boiler safety valves will not be lifted during the time the men are aloft.

(C) Permission to go aloft should be requested from the CDO or OOD.

(D) After the work is completed the CDO or OOD should be notified and his permission obtained to energized equipment previously deenergized.

(E) Prior to men going aloft, radar antennas and/or other antennas in the work area that may nutate (exhibit nutation, that is, nod) or rotate should have their actuating mechanisms deenergized and their power switches tagged open.

(F) Once the work has been completed and permission obtained to re-energize or reactivate the equipment previously secured to render the work area safe, the person who deactivated the equipment should reactivate it and remove the tags from those switches tagged open.

24-55. Before going aloft to work on equipment the technician must take the specific steps indicated in the preceding list. When should step A be accomplished?
1. First
2. Second
3. Third
4. Fourth

● Items 24-56 through 24-60 should be judged True or False.

24-56. Ungrounded ship's rigging and antennas that supposedly have been deenergized by deactivating their transmitters may have sufficient energy induced from nearby radiating antennas as to cause electrical shock to personnel and sparking with metallic objects that come in contact with them.

24-57. In the case of nutating and/or rotating antennas the antenna pedestal will contain the motors for driving the antenna and synchros, switches and such other control circuitry as is necessary to control its operation from a remote location.

24-58. Because of difficulty of access, maintenance will be performed on antennas that nutate or rotate only when a failure occurs.

24-59. In addition to the driving motors and control circuitry the antenna pedestal for nutating and/or rotating antennas will contain a rotary joint for coupling the stationary wave guide to the moving antenna and a space heater which is used to prevent condensation in cold climates.

24-60. As a safety feature, a disabling switch will be located at the base of the antenna pedestal; its purpose is to remove power from the antenna drive motor thus preventing the antenna from being activated from a remote location while maintenance is being performed and thus preventing injury to personnel.

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11	☐	☐	☐	☐	_____	36	☐	☐	☐	☐	_____	61	☐	☐	☐	☐	_____
12	☐	☐	☐	☐	_____	37	☐	☐	☐	☐	_____	62	☐	☐	☐	☐	_____
13	☐	☐	☐	☐	_____	38	☐	☐	☐	☐	_____	63	☐	☐	☐	☐	_____
14	☐	☐	☐	☐	_____	39	☐	☐	☐	☐	_____	64	☐	☐	☐	☐	_____
15	☐	☐	☐	☐	_____	40	☐	☐	☐	☐	_____	65	☐	☐	☐	☐	_____
16	☐	☐	☐	☐	_____	41	☐	☐	☐	☐	_____	66	☐	☐	☐	☐	_____
17	☐	☐	☐	☐	_____	42	☐	☐	☐	☐	_____	67	☐	☐	☐	☐	_____
18	☐	☐	☐	☐	_____	43	☐	☐	☐	☐	_____	68	☐	☐	☐	☐	_____
19	☐	☐	☐	☐	_____	44	☐	☐	☐	☐	_____	69	☐	☐	☐	☐	_____
20	☐	☐	☐	☐	_____	45	☐	☐	☐	☐	_____	70	☐	☐	☐	☐	_____
21	☐	☐	☐	☐	_____	46	☐	☐	☐	☐	_____	71	☐	☐	☐	☐	_____
22	☐	☐	☐	☐	_____	47	☐	☐	☐	☐	_____	72	☐	☐	☐	☐	_____
23	☐	☐	☐	☐	_____	48	☐	☐	☐	☐	_____	73	☐	☐	☐	☐	_____
24	☐	☐	☐	☐	_____	49	☐	☐	☐	☐	_____	74	☐	☐	☐	☐	_____
25	☐	☐	☐	☐	_____	50	☐	☐	☐	☐	_____	75	☐	☐	☐	☐	_____

PRINT OR TYPE

NAVAL ELECTRONICS, PART 1A
NAVEDTRA 10445-D

NAME ______________________________ ADDRESS ______________________________
Last   First   Middle   Street/Ship/Unit/Division, etc.

____
City or FPO   State   Zip

RANK/RATE ________ SOC. SEC. NO. ________________ DESIGNATOR ________ ASSIGNMENT NO. ________

☐ USN ☐ USNR ☐ ACTIVE ☐ INACTIVE OTHER (Specify) ________________ DATE MAILED ________

SCORE

	1 T	2 F	3	4		1 T	2 F	3	4		1 T	2 F	3	4
1	☐	☐	☐	☐	26	☐	☐	☐	☐	51	☐	☐	☐	☐
2	☐	☐	☐	☐	27	☐	☐	☐	☐	52	☐	☐	☐	☐
3	☐	☐	☐	☐	28	☐	☐	☐	☐	53	☐	☐	☐	☐
4	☐	☐	☐	☐	29	☐	☐	☐	☐	54	☐	☐	☐	☐
5	☐	☐	☐	☐	30	☐	☐	☐	☐	55	☐	☐	☐	☐
6	☐	☐	☐	☐	31	☐	☐	☐	☐	56	☐	☐	☐	☐
7	☐	☐	☐	☐	32	☐	☐	☐	☐	57	☐	☐	☐	☐
8	☐	☐	☐	☐	33	☐	☐	☐	☐	58	☐	☐	☐	☐
9	☐	☐	☐	☐	34	☐	☐	☐	☐	59	☐	☐	☐	☐
10	☐	☐	☐	☐	35	☐	☐	☐	☐	60	☐	☐	☐	☐
11	☐	☐	☐	☐	36	☐	☐	☐	☐	61	☐	☐	☐	☐
12	☐	☐	☐	☐	37	☐	☐	☐	☐	62	☐	☐	☐	☐
13	☐	☐	☐	☐	38	☐	☐	☐	☐	63	☐	☐	☐	☐
14	☐	☐	☐	☐	39	☐	☐	☐	☐	64	☐	☐	☐	☐
15	☐	☐	☐	☐	40	☐	☐	☐	☐	65	☐	☐	☐	☐
16	☐	☐	☐	☐	41	☐	☐	☐	☐	66	☐	☐	☐	☐
17	☐	☐	☐	☐	42	☐	☐	☐	☐	67	☐	☐	☐	☐
18	☐	☐	☐	☐	43	☐	☐	☐	☐	68	☐	☐	☐	☐
19	☐	☐	☐	☐	44	☐	☐	☐	☐	69	☐	☐	☐	☐
20	☐	☐	☐	☐	45	☐	☐	☐	☐	70	☐	☐	☐	☐
21	☐	☐	☐	☐	46	☐	☐	☐	☐	71	☐	☐	☐	☐
22	☐	☐	☐	☐	47	☐	☐	☐	☐	72	☐	☐	☐	☐
23	☐	☐	☐	☐	48	☐	☐	☐	☐	73	☐	☐	☐	☐
24	☐	☐	☐	☐	49	☐	☐	☐	☐	74	☐	☐	☐	☐
25	☐	☐	☐	☐	50	☐	☐	☐	☐	75	☐	☐	☐	☐