Dedicated to Ambitious Men

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Radio-Television Home Training
Since 1922

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I would like to tell you at this time that model answers are sent to you on certain lessons because it is felt that this additional aid will be of help to you. It is not, however, our practice to supply model answers to all of the lessons.

Your exam papers are graded on the percentage basis. For example: A grade of 100 is EXCELLENT, a grade between 95 and 100, Very Good; 85 and 95, Good; 75 and 85 Fair; and a grade of 70, Poor; while below 70 is Very Poor and Unsatisfactory. You will get the most out of your lessons when you receive an EXCELLENT GRADE.

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Yours truly,

Paul H. Thomsen

Paul H. Thomsen
Chief Instructor

PHT/MA

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MODEL ANSWERS

RADIO LESSON 1 RA

INTRODUCING YOU TO A-M RADIO

1. True. It is possible to receive weather reports, campaign speeches, election reports and general news items on a radio receiving set. Page 2, Para. 3.

2. True. The strength of sound waves is known as the volume level. Page 3, Para. 3.

3. True. Sound waves can be heard coming from a cabinet of a radio set because there are holes in the grill which allow the sound waves to pass through them. Page 4, Para. 2.

4. True. The frequency range through which a radio set may receive stations is usually indicated by the numbers on the dial of the set. Page 4, Para. 5.

5. True. A standard broadcast station is licensed by the Federal Communications Commission of the U.S.A. for the transmission of radio-telephone programs intended to be received by the general public. Page 5, Para. 4.

6. False. All of the standard broadcast stations operate in the broadcast band which extends from 550 to 1,600 kilocycles. Page 6, Para. 4.

7. False. Power is supplied to a radio set through a single cord having two flexible wires within it. Page 7, Para. 2.

8. False. An antenna is a metal object such as a wire held in space above the earth. Page 8, Para. 4.

9. False. The electrical pressure found at wall outlets in the U.S.A. is between 110 and 120 volts. Page 9, Para. 4.

10. False. A tube type number is usually preceeded by a number which indicates the electrical pressure applied to the heater within the tube. Page 11, Para. 1.

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MODEL ANSWERS

RADIO LESSON 2 R

ELECTRICITY IN RADIO TUBES AND WIRING

1. We say that each electron has a negative charge and that each proton has a positive charge. Page 4, Para. 4.

2. The words positive and negative are used simply to indicate that the two kinds of charges have opposite characteristics and effects. Page 5, Para. 4.

3. In any insulator there are but few free electrons and these few cannot readily be made to flow from one place to another in or on the insulator. Page 10, Para. 2.

4. Any space or region in which an electric force is acting is called an electric field. Page 13, Para. 4

5. The force called electric potential is measured in a unit called the volt. Page 15, Para. 1

6. A dry cell often called a battery although the word battery really means two or more cells working together. Page 18, Para. 1.

7. The cell terminal at which there is maintained a positive charge is called the positive terminal, and the one at which there is maintained a negative charge is called the negative terminal. Page 20, Para. 4.

8. In a radio tube the electrons are attracted by the positive charge being maintained in the plate. Page 25, Para. 2.

9. In practice we specify rates of electron flow in the unit called an ampere. Page 25, Para. 4.

10. In a circuit external to the source, electron flow is from negative to positive. Page 20, Para. 5.

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MODEL ANSWERS

RADIO LESSON 3 R

HOW RADIO TUBES OPERATE

1. The third element in an ordinary radio tube is called a grid and it is used to control the electron flow that takes place inside the tube. Page 2, Para. 2.

2. The heater in a radio tube is used for the purpose of raising the temperature of the cathode. Page 5, Para. 2.

3. The rate at which electrons are emitted from the cathode of a radio tube is limited by the space charge. Page 6, Para. 4.

4. A positive grid of a radio tube causes an increase in the electron flow in the plate circuit as compared to the flow with a negative grid. Page 14, Para. 3.

5. The purpose of the screen grid element in a radio tube is to separate the fields of the plate and the grid. Page 15, Para. 1.

6. The use of arrows or arrowheads anywhere on a symbol of a part in a diagram nearly always means that the value of the part may be adjusted, or that it is variable. Page 19, Para. 4.

7. The two types or kinds of cathodes used in radio tubes are the heater and filament cathodes. Page 21, Para. 3 and 4.

8. The three different potentials (sources) are the grid, filament and plate potentials. Page 22, Fig. 19.

9. If separate cathodes are shown by either straight or curved lines, we may find grids shown by zig-zag lines or straight dotted or broken dash lines. Page 23, Para. 3 and Fig. 20.

10. The glass and metal styles or types of envelopes are used on radio tubes and diagrams do not indicate the style of envelope used. Page 24, Para. 1.

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MODEL ANSWERS

RADIO LESSON 4 R

RADIO CIRCUITS

1. (a) The correct unit of measurement for the resistance is the ohm. Page 3, Para. 2.

   (b) The correct unit of measurement for electron flow rate is the ampere. Page 3, Para. 3.

   (c) The correct unit of measurement for potential difference is the volt. Page 2, Para. 3.

2. The result of dividing a number of volts of potential by a number of amperes of current is equal to ohms of resistance. Page 7, Para. 6.

3. The potential difference furnished by dry cells similarly constructed is not affected by changes in their size or volume. Page 4, Para. 1.

4. The resistance in ohms of a resistor wherein is flowing a current of ½ (0.5) ampere with a potential difference of 10 volts across the ends of the resistor is 20 ohms. Page 7, Para. 6.

5. If we check the resistance of a bar of copper, a bar of steel and a bar of carbon when all have the same length, cross-sectional area and temperature, we will find that the bar of carbon will have the greatest resistance. Page 8, Table.

6. Doubling the length of a conductor will increase the resistance of a conductor. Page 9, Para. 2.

7. The resistance of a winding of a transformer is greater when the temperature of the winding is raised by the current it is carrying. Page 14, Para. 2. Also, Fig. 9, Page 12.

8. The total resistance in a series circuit made up of three resistors: one of 13 ohms, one of 20 ohms, and one of 10 ohms is 43 ohms. Page 26, Para. 2.

9. Assume a copper conductor and an iron conductor are alike in dimensions and temperature, for a given change of temperature the resistance of iron would be 1½ times as much as that of copper. Page 13, Para. 5.

10. In a certain series circuit the flow rate is exactly 50 ma. when measured at one terminal of the source. After the electron flow has gone through a total resistance of 100 ohms, the flow rate will be exactly 50 ma. Page 28, Para. 4.

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MODEL ANSWERS

RADIO LESSON 5 RA

RESISTANCE POTENTIAL AND CURRENT

1. The ohm is the unit of measurement for electrical resistance in a circuit. Page 1, Para. 2.

2. All of the parts on a metal chassis are at the same potential under all usual conditions. Page 4, Para.5.

3. The 4 items used in measuring the resistance of the filter choke are shown in Fig. 3 and they consist of: 1. The batteries; 2. The milliampere meter at the left; 3. The filter choke and 4. The voltmeter at the right. Page 6, Para. 3.

4. .005 amperes. According to the rule you should remember to move the decimal point 3 places to the left when converting milliamperes to amperes. Page 8, Fig. 5.

5. We can determine the resistance using Ohm's Law, by dividing the voltage by the current. The formula is written as follows: $R=\frac{E}{I}$. Page 8, Para. 3.

6. Yes. In a series circuit all the electron flow in any one part of the circuit passes also through every other part of the circuit. Page 9, Para. 2.

7. Yes. All units connected in parallel are subjected to the same potential difference. Page 10, Para. 2.

8. True, because all parallel units are subjected to the same potential difference they all carry separate and different amounts of current when they contain different amounts of resistance. Page 10, Para. 3.

9. 500 Ohms. The combined resistance of 3 resistors of equal value will be the resistance value of one of the resistors divided by 3. 1,500 divided by 3 equals 500, or 500 ohms. Page 13, Para. 2.

10. 200 Ohms. Ohm's Law says that the voltage is equal to the current multiplied by the resistance. The current in this problem is 2 amperes and the resistance is 100 ohms. 2 multiplied by 100 equals 200, or 200 ohms. The rule is written: $E=I \times R$. Page 14, Para. 5.

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MODEL ANSWERS

RADIO LESSON 6 R

RADIO CAPACITORS

1. True because the insulation between the plates of a capacitor is called the dielectric. Page 3, Para. 2.

2. False because the closer together are the plates of any given capacitor, or the thinner is the dielectric between the plates, the greater will be the charge taken by that capacitor with any given applied potential difference. Page 9, Para. 2.

3. True because capacitors usually are specified or named in accordance with the kind of dielectric material and the purpose for which the capacitor is designed. Page 3, Para. 4.

4. False because when electrons flow into one plate of a capacitor, an equal quantity must leave the other plate and go to the source. Page 5, Para. 2.

5. True because we find that alternating currents can flow back and forth in a circuit containing a capacitor, although no electrons flow all the way through the capacitor. Page 6, Para. 3.

6. True because the number of times that the charge is increased by substituting for air, or vacuum, some other substance is called the dielectric constant of that other substance. Page 10, Para. 2.

7. False because if a capacitor will take a charge of one coulomb when the potential difference is one volt, the capacitance is one farad. Page 11, Para. 3.

8. True because we find that the capacitance itself is affected by 3 factors: by the areas of the plates which are on opposite sides of the dielectric, by the separation between the plates or the thickness of the dielectric, which amounts to the same thing, and by the kind of dielectric between the plates. Page 13, Para. 1.

9. True because the capacitance of any number of equal capacitances connected in series is equal to one capacitance divided by the number of capacitances. Page 18, Para. 4.

10. True because when unequal copacitances are connected in series, the smallest capacitance is subjected to the greatest potential difference, and the largest capacitance is subjected to the least potential difference. Page 21, Para. 2.

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MODEL ANSWERS

RADIO LESSON 7 R

RADIO COILS OR INDUCTORS

1. **False.** There will be emf's induced in the coil winding, no matter what direction you move the magnet with reference to the coil, just so long as the magnetic lines of force cut across the conductors or turns of the coil. Page 10, Para. 3.

2. **True.** The two windings or two coils have mutual induction, meaning that a change in rate of electron flow in either one will induce an emf in the other. Page 13, Para. 2.

3. **False.** The strength of the magnetic field, and the distance which the field and lines of force extend outward from a coil, depend on the rate of electron flow in the coil. Page 14, Para. 3.

4. **True.** When current is increasing the counter-emf is trying to prevent the increase. Page 19, Para. 2.

5. **True.** If the induced emf has a value of one volt when current is changing at the rate of one ampere per second, the coil or circuit has inductance of one henry. Page 20, Para. 3.

6. **True.** At power-line frequencies, such as 60 cycles, and even at most audio frequencies, the inductances of wiring have little effect on performance. Page 23, Para. 2.

7. **False.** Self-inductance is directly proportional also to the square of the winding diameter. Page 24, Para. 3.

8. **True.** With an iron or steel core, the rate of change of flux density will be many times what it is with an air core when the rate of change of electron flow is the same in both cases. Page 26, Para. 2.

9. **True.** When self-inductances are connected together in parallel, we have the familiar rule of dividing the product by the sum to find the total or effective parallel self-inductance. Page 27, Para. 2.

10. **True.** The "closest" coupling, which means greatest mutual inductance and energy transfer, would be obtained when both coils were of the same dimensions and occupied the same space. Page 27, Para. 2.

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MODEL ANSWERS

RADIO LESSON 8 R

ALTERNATING CURRENTS IN RADIO

1. True because actual potential differences in a conductor having only resistance are in the same directions as the resulting electron flows; both are positive or both are negative at any one instant. Page 4, Para. 2.

2. True because the amplitude of an alternating potential or current is its greatest departure from zero value, in either direction. Page 5, Para. 4.

3. True because fundamental rules and formulas relating to alternating potentials and currents are based on the assumption that the potential or current follows a sine wave. Page 8, Para. 1.

4. False because we learned that this counter-emf tries to keep electrons flowing when the rate of flow is decreasing, and that it tries to prevent the flow when the rate is increasing and decreasing, it becomes evident that the counter-emf of induction must oppose the entire flow of alternating current. Page 11, Para. 2.

5. True because inductive reactance, like all other kinds of opposition to electron flow or current, is measured in ohms. Page 13, Para. 2.

6. True because all capacitors limit the rate of electron flow or the current when the flow is alternating. Page 14, Para. 3.

7. False because the rules for the total or combined reactance of either inductive or capacitive reactances in series and in parallel are exactly the same as the rules for resistances in series and in parallel, so long as all of the reactances are of the same kind, all inductive or all capacitive. Page 21, Para. 2.

8. True because in a circuit containing only inductance, the alternating current Lags the applied alternating potential by 90 degress. Page 26, Para. 2.

9. False because in a circuit containing only capacitance, the alternating current leads the applied alternating potential by 90 degrees. Page 29, Para. 2.

10. True because in a circuit containing inductance, capacitance, or both, the opposition to current cannot be due only to inductive reactance, capacitive reactance, or to both, but must be due to combination of reactance and resistance. Page 30, Para. 2.

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MODEL ANSWERS

RADIO LESSON 9 R

TUNED CIRCUITS IN RADIO

1. When the inductive reactance and the capacitive reactance cancel each other for a given frequency, we have a condition called resonance. Page 5, Para. 3.

2. A circuit which may be adjusted to produce resonance at various frequencies is called a tuned circuit. Page 5, Para. 3.

3. The inductance and capacitance are connected in series in a series resonant circuit. Page 6, Para. 2.

4. In a parallel circuit, the potential difference across both branches at every instant of time is the same. Page 8, Para. 2; or Page 9, Para. 1.

5. We will find that the parallel resonant circuit has infinitely high impedance at the resonant frequency when we assume that there is no resistance anywhere in the parallel resonant circuit. Page 10, Para. 5.

6. We will find that the capacitive reactance is greater than the inductive reactance at frequencies below resonance in a series resonant circuit. Page 12, Para. 2.

7. The lag and lead of currents in resonant circuits is always less than 90 degrees because of the resistance. Page 17, Para. 1.

8. The greater the resistance in a parallel resonant circuit, the less is the impedance of this circuit and the greater the line current. Page 19, Para. 4.

9. The resonant frequency is made lower by using either more inductance, more capacitance or more of both. Page 28, Para. 2.

10. The energy which oscillates back and forth in a parallel resonant circuit may be called an oscillatory circuit or an oscillating circuit. Page 24, Para. 1.

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MODEL ANSWERS

RADIO LESSON 10 R

MODERN RADIO COMMUNICATION

1. The velocity of a wave is the distance that a wave travels in one second. Page 3, Para. 4.

2. The frequency of a wave is measured in cycles per second. Page 3, Para. 5.

3. The medium in which sound waves travel is the air. Page 4, Para. 2.

4. Sound waves travel through space at the rate of 1100 feet in one second. Page 4, Para. 3.

5. Audio frequencies. Page 5, Para. 2.

6. 186,000 miles per second. Page 7, Para. 2.

7. Yes, radio or ether waves are reflected by the sides of high mountains. Page 9, Para. 2.

8. The aerial. Page 10, Para. 1.

9. The Commission was created for the purpose of establishing rules and regulations. Page 11, Para. 2.

10. The secretary of the Commission. Page 12, Para. 3.

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MODEL ANSWERS

RADIO LESSON 11 R

ANTENNA SYSTEMS

1. Yes, the waves emitted from an antenna are divided equally into electromagnetic and electrostatic waves in radio wave propagation. Page 2, Para. 3.

2. The ground wave is most important for broadcast reception. Page 2, Para 3.

3. No, the fan and umbrella types of aerials are not used extensively. Page5, Para. 1.

4. Yes, the "L" type aerial has more effective inductance than the "T" type aerial. Page 4, Para. 3.

5. Pure enameled copper wire, in either the solid or stranded form is the best practical type of conductor (wire) metal for the best receiving antenna system. Page 5, last paragraph.

6. Porcelain or glass may be used as a good insulator and may be connected to the ends of an antenna wire. Page 6, Para. 2.

7. Yes, an antenna system will function at maximum efficiency when its fundamental frequency is equal to the frequency of the signals that are to be transmitted or received. Page 12, Para. 3.

8. A counterpoise is a group of wires mounted a few feet above the ground or roof directly below the antenna. Page 7, Para. 2.

9. The counterpoise is used where the ground is very dry or where it is difficult to establish a good ground contact. Page 7, Para. 2.

10. Yes, the lead-in of an antenna is as important as the antenna itself. Page 7, last line.

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MODEL ANSWERS

RADIO LESSON 12 RA

RESISTORS AND THEIR APPLICATIONS IN RADIO CIRCUITS

1. Resistors may be applied in the following radio circuits:

Biasing	Bleeder
Volume Control	Filter
Voltage Dropping	Current Limiting
Ballast	

Page 1, Para. 1

2. Moulded carbon resistors are used more often than any other type resistor in modern radio receivers because of their low cost. Page 1, Para. 2.

3. Resistors used to confine certain signal currents to their respective circuits and to prevent them from passing on into other circuit branches when they might cause disturbances are classified as filter resistors. Page 3, Para. 4.

4. Insulated carbon resistors have three distinct advantages over the noninsulated types, because they prevent shorts, have a protective coating, and are able to withstand a greater amount of heat before losing their qualities. Page 5, Para. 2.

5. A metalized resistor is made by depositing a special metal on a fine glass rod which is mounted within a glass or porcelain tube having a metal cap with wires at each end and they make contact with the resistance element. Page 5, Para. 4.

6. Yes, vitreous enamelled wire wound resistors are used in high voltage circuits or a large amount of power must be dissipated. Page 8, Para. 2.

7. It is possible to suppress regeneration and oscillation in radio frequency amplifiers by using a resistor for grid suppression. Page 18, Para. 1.

8. When an ohmmeter is connected across a resistor and the meter pointer appears not to move or give any noticeable reading, it indicates a continuity-break and that the resistor needs replacement. Page 21, Para. 2.

9. Decade resistance boxes. Page 23, Para. 2.

10. No, a set of head phones in series with a small battery will not distinguish the difference between a short circuit and a circuit having some resistance. Page 22, Para. 4.

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MODEL ANSWERS

RADIO LESSON 13 R

"RESISTANCE IN RADIO CIRCUIT SYSTEMS"

1. **Resistance.** Page 1, Para. 3.

2. 1 megohm. Page 2, Para. 3.

3. Ohms = $\frac{\text{Volts}}{\text{Amperes}}$. Page 3, Para. 2, Formula (2).

4. (1) The length of the conductor
   (2) The cross section area
   (3) The material of which the conductor is made. Page 7, Para. 1.

5. Temperature Coefficient. Page 8, Para. 4.

6. The total resistance of a series circuit is equal to the sum of the separate resistances. Page 10, Para. 4, No. 2.

7. Less. Page 12, Para. 3.

8. Yes. Page 15, Para. 1, Line 2

9. P = I x I x R. Page 20, Para. 4, last line.

10. Color code. Page 22, Para. 5.

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Lesson 14
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Lesson 15
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MODEL ANSWERS

RADIO LESSON 16 RA

TUBE CLASSIFICATION AND MAJOR OPERATING CHARACTERISTICS

1. Yes. The octal.(8-pin) bases have center guide pins. Page 1, Para. 3.
2. The metal shell of metal tubes is always connected to a base pin to permit connection to a ground potential and thus eliminate any danger of electric shock. Page 2, Para. 3.
3. The letter "S" following the first number in the tube symbol indicates the single-end construction. Page 4, Para. 3.
4. To remove a loctal tube from its socket, it is necessary first to exert a slight off side pressure to it. Page 10, Para. 3.
5. The mutual conductance, the amplification factor and the plate impedance. Page 11, Para. 5.
6. Mutual conductance and micromho. Page 12, Para. 2 and Para. 3.
7. The amplification factor. Page 15, Para. 3.
8. The plate resistance or plate impedance and it is measured in ohms. Page 17, Para. 2.
9. Plate impedance. Page 20, Para. 5.
10. Yes, it is true that for voltage amplification, a high plate resistance is essential. Page 20, Para. 2.

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MODEL ANSWERS

RADIO LESSON 18 R

POWER OUTPUT PENTODES

1. The screen grid element is held at a positive charge to counteract the space charge. Page 1, Para. 3.

2. No. The suppressor grid of the type 47 tube is internally connected to the filament of the tube. Page 3, Para. 2.

3. The plate current of the type 47 tube is 32 milliamperes. Page 4, center of page.

4. No. It is not recommended as there is very little to be gained by the change. Page 5, Para. 2.

5. Yes. The use of the type 33 tube affects a battery saving as its use eliminates the need for an audio stage. Page 6, Para. 3.

6. Yes. The cathode of the type 38 pentode tube can be operated from either dc or ac. Page 7A, Para. 2.

7. 1,500 milliwatts, which is 1.5 watts, is the power output of the type 41 tube. Page 8. Para. 1.

8. The type 48 tube is a tetrode. Page 10, Para. 2.

9. 125 volts is the maximum plate operating voltage for the type 48 tube.

10. No. A large by-pass condenser across the self-biasing resistor is not required when operating two tubes in push-pull amplification. Page 11, Para. 3.

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MODEL ANSWERS

RADIO LESSON 19 RA

THE DEVELOPMENT OF TUBES WITH SPECIAL CHARACTERISTICS

1. The radio engineer selects a tube of a given type for a given circuit application in order to obtain reliable, stable and efficient operation. Page 1, Para. 1.

2. The .1 mfd. capacitor connected between the screen grid electrode and the cathode of a screen grid tube is used for the purpose of preventing undesirable coupling between the control grid and plate electrodes. Page 1, Para. 3.

3. The grid suppressors used in r-f and i-f amplifiers have values extending from several hundred ohms to 100,000 ohms. Page 2, Para. 2.

4. The term space charge around the emitter of a vacuum tube is a cloud of electrons which do not succeed in passing through the openings in the grid electrode. Page 3, Para. 2.

5. The suppressor grid is placed between the screen grid and plate electrodes of a pentode tube for the purpose of suppressing secondary emission. Page 4, Para. 4.

6. The screen grid supply voltage supplied to this electrode of a power output pentode tube used for the audio power output stage is nearly equal to the plate supply. Page 5, Para. 1.

7. Cross modulation in the radio sets first using screen grid and pentode tubes was caused by the fact that these tubes operated as detectors and demodulators. Page 5, Para. 4.

8. It is the non-uniform structure of the control grid that gives the variable mu tube its ability to operate either as a low or high mu tube. Page 6, Para. 5.

9. The Eg-Ip characteristic curve of a tube is known as the relative change in plate current for a change in grid voltage. Page 8, Para. 2.

10. A class A amplifier in which the plate current flows over the entire cycle of its input (control grid) voltage and that the plate current is directly proportional to the applied signal voltage. Page 11, Para. 1.

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MODEL ANSWERS

RADIO LESSON 20R

VOLTAGE AND POWER AMPLIFIER TUBES

1. Voltage amplifiers and power amplifiers. Page 1, Para. 2.

2. Class A and Class B. Page 1, Para. 3.

3. The normal operating point of a Class B amplifier falls near the cut-off region on the curve. Page 2, Para. 3.

4. Plate current follows during only half or 180 degrees of each input cycle. Page 3, Para. 1.

5. Yes. Page 3, Para. 2.

6. The amplification factor is high for each triode. Page 7, Para. 3.

7. Yes. Page 7, Para. 4.

8. Yes. Voltage amplifier and phase inverter tubes are available in one envelope. Page 8, Para. 3.

9. The amplification factor is approximately 6. Page 6, Para. 4.

10. Yes, Class A-B amplifier is often called a Class A prime amplifier. Page 3, Para. 3.

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Lesson 21
No Model Answers

Lesson 22
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MODEL ANSWERS

RADIO LESSON 23 RA

POWER SUPPLY CIRCUITS FOR RADIO AND TELEVISION SETS

1. The filament type tube is used for battery operation where power energy drain must be kept low. Page 1, Para. 4.

2. A step-down transformer can be used to reduce the a-c line voltage to the low heater voltage. Page 2, Para. 3.

3. The paralell connection of filament and heater type tubes makes it easier to locate burned out tubes. Page 4, Para. 1.

4. The wires to a power transformer can easily be identified when they are color coded on the replacement transformer. Page 6, Para. 2.

5. There are two elements, the plate and the cathode in a tube used for the purpose of rectification in producing the plate and screen grid d-c voltages from an a-c source. Page 9, Para. 2.

6. The copper-oxide rectifier and the selenium rectifier are used in sets receiving their power from an a-c source. Page 10, Para. 3.

7. Fig. 13. Page 12

8. Fig. 15A. Page 14

9. The most important purpose of the bleeder resistor is to place a continuous load on the power supply voltage which will not reach an unusually high value where it may damage the receiving tubes and the plate and screen grid by-pass capacitors. Page 15, Para. 2.

10. The purpose of the voltage divider in power supply circuits is to make possible the division of voltages according to the voltage values required for the tube electrodes in the receiver. Page 16, Para. 2.

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MODEL ANSWERS

RADIO LESSON 25 RA

OPERATION OF A-M DETECTORS

1. The stage in a standard broadcasting A.M. (amplitude modulated) radio receiver which reproduces the original audio frequency signal is called a demodulator or a detector. Page 1, para. 3.

2. The crystal detector may be intermittent. Page 4, para. 3.

3. The diode method of detection has linear characteristics. That is, its output is directly proportional to its input voltage. Page 5, para. 2.

4. Hum and heater circuit noise voltages are kept out of the diode detector circuit by connecting the cathode lead directly to ground or chassis. Page 6, para. 2.

5. Yes. It is possible to connect the two diodes in parallel. Page 6, para. 3.

6. A duplex-diode pentode tube will give greater overall A.F. signal voltage amplification than a duplex-diode triode tube. Page 7, para. 3.

7. Detection occurs in the plate circuit when using a grid-biased detector circuit. Page 8, para. 2.

8. The grid is made negative with respect to the cathode in the grid-leak and condenser detector circuit. Page 10, para. 1.

9. The A.F. voltages appear in the grid circuit. Page 10, para. 1.

10. The diode or duplex-diode triode detector circuit can handle high signal voltages and also modulated to a high level or percentage. Page 10, para. 4.

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MODEL ANSWERS

RADIO LESSON 26 R

TUNED RADIO FREQUENCY RECEIVERS

1. During the aligning process of a T.R.F. receiver, the volume control on the receiver is always tuned to maximum. Page 5, Para. 1.

2. A dummy tube, as used when neutralizing a T.R.F. receiver, is merely a tube of the same type as used in the R.F. amplifier but with an open filament circuit. Page 5, Para. 1.

3. During the aligning process, all shielding elements in a receiver must be in place and properly secured. Page 5, Para. 3.

4. If a two or three-stage T.R.F. receiver is weak, lacks sensitivity, and tunes broad, a very likely source of trouble may be that the receiver is badly out of of alignment. Page 7, Para. 1.

5. A broadcast station signal is not satisfactory for aligning purposes because the desired frequency is not always available, and the signal is constantly varying in strength. Page 8, Para. 2.

6. A service oscillator is desirable for alignment work because it can furnish a steady signal of any frequency needed and the strength of the signal can be controlled as desired. Page 8, Para. 3.

7. In aligning a tuned R.F. receiver, the trimmer on the last condenser section nearest the detector is adjusted first and, next in order, the successive trimmers toward the antenna tuning section. Page 9, Para. 3 and Para. 4.

8. Body capacity effects are present in aligning a receiver if, upon removing the adjusting wrench or screwdriver, the output meter pointer moves to a different position. Page 10, Line 5.

9. Only a tool made of bakelite or other insulating material should be used for aligning work so as to reduce to a minimum all stray capacity effects. Page 11, Para. 3.

10. Some form of output indicating meter is necessary for accurate alignment work, because the human ear is not sufficiently sensitive to detect small differences in volume. Page 11, Para. 5.

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MODEL ANSWERS

RADIO LESSON 27 R

LOOP AERIALS AND RECEIVERS

1. The loop aerial can be carried from place to place without involving extensive erection or construction work. Page 1, Para. 2.

2. No, the loop aerial is not a perfect aerial, it can absorb only a small amount of energy. Page 1, Para. 3; and Page 6, Para. 2.

3. The loop aerial may be wound into the form of a square, rectangle or octagon. Page 2, Para. 1.

4. The loop aerial is based upon the principles of electromagnetic induction. Page 3, Para. 3.

5. No, the actual size of wire used in winding a loop aerial is not important. Page 5, Para. 4.

6. Yes, it is only necessary to disconnect the leads of the secondary of the coil connected to the grid of the first tube of the receiver and connect the leads of the loop in the circuit. Page 8, Para. 2.

7. Place the receiver in operation and rotate the loop until the signals are heard with maximum intensity. The direction is then shown by means of a line drawn on the map. The receiver is then moved to another spot which is at least several hundred feet away, and another bearing is taken. The direction of the loop is again drawn on the map. Page 13, Para. 2.

8. Receiver coils are acting as minature loops and pick up the energy directly. Page 14, Para. 5.

9. The 3-tap loop aerial has good selectivity and gives excellent loudspeaker volume. Page 10, Para. 4.

10. Fig. 6, Page 11.

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MODEL ANSWERS

RADIO LESSON 28 RA

OPERATION OF A-F AND R-F OSCILLATORS

1. False. Inductive reactance is indicated by the letters XL. XC are the letters used to identify capacitive reactance. Page 4, Para. 4.

2. True. A resonant frequency of 1.5 megacycles will be obtained when the circuit capacitance is 500 micro-microfarads and the inductive reactance is equal to 200 ohms. Page 5, Fig. 5.

3. True. The frequency controlling circuit may be referred to as the tank circuit or the LC circuit in an oscillator circuit. Page 9, Para. 2.

4. False. It is not necessary to supply energy for a complete cycle to the tank circuit of an oscillator to sustain oscillations, however, it is necessary to supply energy to the tank circuit. Page 9, Para. 4.

5. False. It is the grid leak, usually R1 in the oscillator circuits shown in this lesson, that makes it possible for an oscillator to be self-starting. Page 10, Para. 2.

6. False. The frequency stability becomes poor when the losses in the tank circuit of an oscillator are made greater. Page 11, Para. 3.

7. False. The Hartley oscillator circuit has a tank circuit consisting of a single capacitor and a tapped coil. Page 12, Para. 6.

8. True. The neon lamp sweep oscillator is often called a saw-tooth generator because of the shape of the output wave received from this generator. Page 15, Para. 3.

9. False. The Meissner oscillator circuit has a separate tank circuit with two tickler coils. Page 14, Para. 2.

10. True. The tuned-grid tuned plate oscillator circuit offers very good frequency stability as a result of its high plate-load impedance. Page 14, Para. 3.

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MODEL ANSWERS
RADIO LESSON 31 R

AUDIO AMPLIFIER PROBLEMS

1. Yes. When the d-c plate current flows through the loud-speaker winding in the wrong direction, it causes the magnets to demagnetize and loose their effectiveness. Page 1, Para. 2.

2. The effects of demagnetization of the magnets in a loud-speaker can be eliminated by keeping the d-c plate current out of the loud-speaker winding by using either a transformer or a loud-speaker filter circuit. Page 2, Para. 1.

3. The main function of the blocking condenser in the loud-speaker output filter is to prevent the direct current (plate current) from passing through the loud-speaker windings. Page 3, Para. 1.

4. The common cause for unstable operation in an audio amplifier is undesirable coupling of the respective plate circuits of the audio amplifier tubes through the common power supply. Page 5, Para. 3.

5. Yes. Batteries that are partially exhausted can cause such effects as oscillations; that is, howling, or a throbbing noise in an audio amplifier because excessive resistance in B-batteries will cause them to act as resistance coupling units and thus couple the various plate circuits together. Page 5, Para. 4.

6. Unstable operation and oscillations in an audio amplifier due to the resistance coupling effects of B-batteries or power supply can easily be eliminated by the use of suitable filters and by-pass condensers. Page 6, Para. 2.

7. Audio transformers burn out because the magnetic field collapses in the iron core of the audio transformer, which causes self-induction and a large current to flow, thereby burning off the fine wire. Page 8, Para. 3.

8. You would test a transformer winding with a battery and a pair of telephone receivers by disconnecting the transformer from the circuit in which it is used and connecting one of its windings in series with the battery and the telephone receivers. A click will indicate that the winding is complete. Page 9, Para. 3.

9. No. An open winding of an audio transformer cannot be repaired because defective windings of an audio transformer cannot easily be repaired. Page 9, Para. 4.

10. The flow of battery (d-c) current through the winding of a telephone receiver causes a click to be heard because the flow of the d-c current causes the diaphragm to be attracted to the magnets and, as a result, a click is heard. Page 9, Para. 2.

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MODEL ANSWERS

RADIO LESSON 32R

POWER AMPLIFICATION

1. The maximum permissible grid swings or changes for a Class "A" power amplifier are limited by proportionate changes in plate current flow. Page 6, Para. 2.

2. A load resistance of a tube is a resistance or impedance. Page 7, Para. 1.

3. Maximum undistorted power output can be obtained when the load impedance is approximately twice the plate resistance. Page 8, Para. 3.

4. Harmonic distortion in an audio amplifier means that the signal waves have lost their original form and have become distorted. Page 8, Para. 1.

5. The purpose of the phase inverter tube, used in connection with a resistance coupled push-pull power amplifier stage, is to introduce a 180 degree out-of-phase voltage so that one grid is swung positive while the other is swung negative. Page 18, Para. 3.

6. The type 6L6 or 6L6G tubes have 4 elements (tetrode) and are beam power output tubes. Page 29, Para. 3.

7. The push-pull power amplifier is freer from hum than a single tube power amplifier because any ripples that may be present in the plate current are automatically cancelled out in the primary of the push-pull output transformer. Page 14, Para. 3.

8. A push-pull power amplifier will not eliminate harmonic distortion which is present in the input signal. Page 14, Para. 1.

9. Basically the action of the push-pull amplifier is such that the incoming signal swings the grid of one tube positive and that of the other tube negative. Page 10, Para. 2.

10. The type 6B5 and 6N6 tubes consist of two direct coupled triodes built into one composite structure. They have a small triode that serves as a driver for a larger output triode. Page 22, Para. 3.

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MODEL ANSWERS

RADIO LESSON 33 R

PENTODE CIRCUIT FEATURES TO BE OBSERVED

1. True. When using a single pentode tube as an amplifier with the customary bias resistor connected between a center tap on the filament and ground, that is, without a shunting condenser of large capacity, the overall amplification of the amplifier is reduced. Page 1, Para. 2.

2. False. It is not advantageous nor good practice to replace triode output power tubes with pentode power tubes. Page 3, Para. 2.

3. True. When using but one tube and resistance coupling to the grid circuit of the power amplifier pentode tubes like the types 42, 2A5, 6F6G, the grid resistor should not exceed 500,000 ohms when using the self-bias system of biasing. Page 4, Para. 2.

4. True. When using the self-bias system with power pentodes in a push-pull amplifier, by-pass condensers across the self-bias resistor are not needed. Page 5, Para. 3.

5. False. The entire plate and screen grid currents do flow through the self-bias resistor, therefore, the grid will be at a lower potential than the cathode. Page 6, Para. 3.

6. True. Whenever too high a screen grid voltage is applied to a power pentode, it is possible for the screen grid to get red hot and overheat. Page 7, Para. 3.

7. False. Degenerative feedback in audio amplifiers, that is, negative feedback is helpful in obtaining improved amplifier performance. Page 8, Para. 3.

8. True. It is true that noise and hum are reduced in the output of an amplifier employing degeneration. Page 9, Para. 2.

9. True. Degenerative feedback can be introduced either into the grid or cathode circuit of an amplifier tube. Page 10, Para. 2.

10. True. A selective feedback system can be used with a selective tone control system so that any desired type of audio frequency response may be obtained. Page 10, Para. 3.

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MODEL ANSWERS

RADIO LESSON 34 R

REGENERATION, ITS APPLICATION AND METHOD OF CONTROL

1. True. When employing regenerative feedback in a simple receiving circuit, greater operating efficiency is secured and louder sounds are produced in the headphones or loud-speaker. Page 2, Para. 1.

2. False. As explained in the last paragraph on page 3, the tuning unit is composed of three individual coils and is commonly referred to as a 3-circuit tuner. Page 3, Para. 3., also Fig. 4.

3. True. Minimum regeneration is obtained when the receiver circuit employs a tickler set at right angles with the winding of the secondary coil. Page 4, Para, 3.

4. False. The small condenser formed by the grid and plate elements of the vacuum tube permits the transfer of energy from the plate to the grid elements at all times and regardless of the electrical condition existing about the tube. Page 6, Para. 1.

5. False. Regeneration may be controlled by means of a variable condenser as this means of controlling regeneration is stable and not difficult to tune. Page 8, Para. 1.

6. False. In the two variometer set, known as the oldest regenerative circuit, one variometer serves to tune the grid circuit, while the other is used to tune the plate circuit. Page 11, Para. 2.

7. True. Resistance control methods of changing the amount of regeneration are usually very smooth and cause no appreciable detuning of the secondary circuit. Page 16, Para. 2.

8. False. When using a potentiometer as a means of varying the potential applied to the screen grid of a 4-element tube in a regenerative circuit, a positive potential is applied and a smooth and gradual variation in regeneration is obtained. Page 20, Para. 1.

9. False. Radio frequency chokes are coils used to offer high impedance to the passage of high frequency current and permits the passage of audio frequency currents. Page 20, Para. 2.

10. True. The choking effect of a coil increases with an increase in frequency. Page 20, Para. 3.

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Lesson 35
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Lesson 36
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MODEL ANSWERS

RADIO LESSON 37 R

SERVICING SUPERHETERODYNE RECEIVERS

1. One or two stages of tuned radio frequency amplification may be found ahead of the first detector in some superheterodynes. Page 1, para. 2.

2. Intermediate frequency transformers may have iron cores and air cores. Page 2, para. 1.

3. The accuracy to which a given group of transformers may be peaked is the most important feature of any transformer arrangement. Page 2, para. 1.

4. Yes, the same types of tubes are used in the R.F. and I.F. stages of a superheterodyne. Page 3, para. 2.

5. The intermediate frequency for the Emerson Model BL-210, 5-tube, 2-band superheterodyne receiver is 455 kc. Page 4, para. 4.

6. The two leads of the secondary winding of an I.F. transformer are marked by a green wire for the grid lead and a black wire for the grid return lead. Page 7, para. 2.

7. Black leads indicate the primary winding of a power transformer. Page 7, para. 3.

8. The voltmeter and ohmmeter are the two instruments employed in the two methods to check for troubles in a radio receiver. Page 7, para. 6.

9. The first step in checking a radio is to check the tubes. Page 8, para. 1.

10. The following four items may cause a radio receiver to operate improperly. Page 16, para. 1.

    (1) Tubes
    (2) Condensers
    (3) Coils
    (4) Resistors

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MODEL ANSWERS

RADIO LESSON 38 R

AUTOMATIC VOLUME CONTROL SYSTEMS

1. An automatic volume control system can not completely eliminate fading. Page 1, Para. 2.

2. A manual volume control is also used in connection with A.V.C. systems. Page 4B, Para. 1.

3. There must always be a continuous d-c conductive path between the cathode and anode of a diode detector. Page 4B, Para. 2.

4. It is possible to make a diode out of a triode for A.V.C. purposes by connecting the grid and plate together. Page 4B, Para. 2.

5. Electron flow to a diode used for A.V.C. purposes will occur only when the anode is at a positive potential with respect to the cathode. Page 4B, Para. 2.

6. A manual volume is used to set the degree of loudness wanted. Page 6, Para. 2.

7. The A.V.C. system of a radio receiver does not add any over-all amplification to the receivers. Page 7A, Para. 1.

8. Full amplification of a receiver employing A.V.C. is made available when the R.F. signal strength drops to a low value. Page 6, Para. 2.

9. A diode detector will not overload as readily. Page 8, Para. 1.

10. Yes, the A.V.C. voltage developed by the A.V.C. tube is added to the normal grid biases of the tubes controlled. Page 6, Para. 1.

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MODEL ANSWERS

RADIO LESSON 39 R

DELAYED AUTOMATIC VOLUME CONTROL

1. Delayed A.V.C. allows the signal to build up to a predetermined strength before the A.V.C. tube begins to function. Page 1, Para. 2.

2. Delayed A.V.C. increased the volume from weaker stations. Page 1, Para. 4.

3. Delayed A.V.C. action is usually brought about by applying a negative bias to the plate of the diode rectifier that develops the A.V.C. potential so that the signal must build up and exceed this biasing potential before A.V.C. action can take place. Page 2, Para. 2.

4. Amplified A.V.C. is a means of amplifying the signal actuating the A.V.C. so that a strong signal may be produced to excite the grids of the tubes to be controlled. Page 5, Para. 4.

5. Amplified A.V.C. is the process of amplifying part of the I.F. signal before it is rectified for A.V.C. purposes. Page 6, Para. 1.

6. Yes, it is possible to use an I.F. transformer with two independent windings to advantage when employing delayed A.V.C. Page 4, Para. 3.

7. Yes, two diodes are used for regular detection and delayed A.V.C. Page 2, Para. 3.

8. Yes, the diode load resistor used for the diode producing the delayed A.V.C., is generally connected to chassis. Page 3, Fig. 2.

9. Yes, a type 6Q7 tube will function satisfactorily as a delayed A.V.C. and A.V.C. tube. Page 2, Para. 3; Fig. 2, Page 3.

10. Yes, the expression "delay" as used in a delayed A.V.C. system refers to a signal build up. Page 1, Para. 3.

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MODEL ANSWERS

RADIO LESSON 41 R

UNIVERSAL A-C - D-C RADIO RECEIVERS

1. The a-c d-c operating feature is made possible through the use of a half wave rectifier connected into one side of the power line. Page 1, Para. 1.

2. The filaments or heaters of tubes in an a-c d-c set are connected in series. Page 1, Para. 2.

3. A ground connection should not be made to the metal parts in a universal a-c d-c set as this would cause a short circuit. Page 8, Para. 1.

4. The average or total plate current consumed by a universal a-c d-c set is 30 to 40 milliamperes. Page 2, Para. 1.

5. The type 78 tube is used as the first detector-oscillator in Detrola and Franklin receivers. Page 9, Para. 2.

6. Yes, the majority of the tubes used in a-c d-c are designed to operate on the same heater current. Page 1, Para. 2.

7. The action of a voltage doubling arrangement depends upon the alternate charging and discharging of two condensers connected in series across the load. Page 17, Para. 3.

8. Figure 10. During the first half cycle when line A is positive, current flows through diode 1, enters the load at point M, leaves at point N, flows through condenser C1 to point T, and out through line B. During this interval condenser, C2 is charged to practically full line voltage. During the next half cycle, line B is positive and current flows in at point T, through condenser C2 into lead at point M, out at N, through diode 2 to point E, and on through line A. At the same time, condenser C1 is across the line at points N and T and, therefore, is charged to practically line voltage. Page 16, Para. 3.

9. The voltage doubling feature can be employed in universal a-c d-c sets by using a special switching arrangement to change the circuit somewhat for direct current operations. Page 18, Para. 1.

10. The voltage required for the filaments (heaters) of the tubes connected in series will be 6.3 plus 6.3 plus 25 plus 25; which equals 62.6 volts. The voltage drop in the series filament resistor will be 115 minus 62.6 or 52.4 volts. Since the current in the series circuit is 0.3 amperes, the resistance required may be found by using Ohm's Law. R=E divided by I. Therefore, 52.4 divided by 0.3 is 174.6 or 174.6 ohms. Page 21, Para. 3.

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MODEL ANSWERS

RADIO LESSON 43 RA

AUTOMATIC ELECTRIC TUNING METHODS

1. Permeability tuning is the changing of the inductance of a coil by varying its magnetic permeability. Page 1, Para. 1.

2. A high grade iron in a very fine granular condition is used as the cores for permeability tuned coils. Page 1, Para. 4.

3. No. It is not possible to vary the inductance of a coil through a wide enough limit to cover the complete broadcast band with a movable plunger. Page 3, Para. 2.

4. No. The tuned radio frequency stage is not used. Page 7, Para. 3.

5. Capacity tuning is used for the antenna coupler. Page 8, Para. 4 & Page 9, Para. 1.

6. The coil serves as a padder coil to insure proper low-frequency tracking. Page 11, Para. 3.

7. Yes. The circuit can be broken, thereby stopping the motor at the desired position or station. Page 12, Para. 4.

8. The armature is pushed out to release the engaging arm from the driving gear clutch so that the tuning mechanism can be turned freely through the manual control knob and also to operate a switch to silence the receiver. Page 16, Para. 3 & Page 25, Para. 3.

9. A muting circuit is used to bias the triode section of the audio amplifier to the cut-off point. Page 19, Para. 2.

10. The remote control unit consists of the station selecting push-buttons and a volume control. Page 27, Para. 3.

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MODEL ANSWERS

RADIO LESSON 45 R

ALL WAVE SUPERHETERODYNE RECEIVERS

1. Several individual tuners are used in all-wave receivers because a single tuner cannot be designed to cover such a wide frequency range. Page 1, Para. 2.

2. Most foreign broadcast stations operate between 5,800 and 16,200 kc. (about 54 to 18 meters.) Page 1, Last Para.

3. A skip-band receiver is one that is arranged to tune over the American broadcast range of 540 to 1,600 kilocycles and the foreign range of 5,800 to 16,200 kilocycles. Page 1, Para. 4 and Page 2, Para. 1.

4. When three or more tuning ranges are used, individual coils are used for each tuning range. Page 3, Para. 2.

5. The wave trap in the antenna circuit of the Emerson Model D-85 serves to absorb incoming signal frequencies that are close to the frequency of the intermediate amplifier and thus prevents interference. Page 5, Para. 2.

6. In the R.C.A.-Victor Model 128, some of the coils are short-circuited to prevent dead spots in the tuning range due to absorption effects. Page 9, Para. 2.

7. No. The signal can be fed directly into the first detector (mixer) from the antenna. Page 12A, Para. 1.

8. The wave band switch is as the name implies to switch from one band of frequencies to another. Page 11, Fig. 6.

9. The symbol number assigned to the resistor, in series with the minus AVC lead to the R.F. signal input grid of the type 6A7 tube in the Emerson Radio shown on page 11 in Fig. 6 is R2. Page 11, Fig. 6.

10. The symbol number assigned to and used as the oscillator grid condenser is C17, while the symbol number assigned to and used as the oscillator grid resistor is R4. Page 11, Fig. 6.

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MODEL ANSWERS

RADIO LESSON 46 RA

FURTHER DEVELOPMENT OF FREQUENCY CONVERSION

1. True. Frequency conversion in superheterodyne receivers is the process of reducing the incoming R.F. signal to that of an intermediate frequency, and without any other modification of the signal. Page 1, Para. 1.

2. False. The two capacitors, which are in shunt with the R.F. and oscillator tuning capacitors of a frequency converter, are known as the high frequency trimmer capacitors and enable exact alignment of these circuits at the high frequency end of the frequency range covered. Page 3, Para. 2.

3. True. When using a superheterodyne receiver for the reception of signals in the broadcast band, from 550 to 1,600 kc., the R.F. input tuned circuit will cover this frequency range. Page 4, Para. 3.

4. True. When receiving a R.F. signal from a station operating on 550 kc., and when the local oscillator is operating on 1,005 kc., two strong beats will be produced along with the oscillator signal of 1,005 kc. in the plate circuit of the mixer or detector. Page 4, Para. 3 and Page 5, Para. 1.

5. True. The I.F. amplifier frequency is often called the difference frequency. Page 5, Para. 1.

6. False. In order to obtain maximum selectivity and sensitivity from the R.F. input circuit, it is important that this circuit is always tuned to the desired station. Page 5, Para. 2.

7. True. Each R.F. tuning capacitor has its small trimmer (screw driver adjustable) capacitors for exact tuning of these circuits at the high frequency end of the band. Page 6, Para. 1.

8. True. The d-c voltage drop across the self-bias resistor (R4 of Fig. 9) is obtained by adding the screen grid current and plate current, of the mixer section and the plate current of the oscillator section together. This value should be changed to amperes and then multiplied by the resistance in ohms to get the voltage across this resistor. Page 12, Para. 2.

9. True. The pentagrid converter is used extensively because it provides a high conversion gain without the necessity of special adjustments. Page 13, Para. 5.

10. False. Pentagrid-converter tubes are good frequency converting devices at medium R.F. frequencies but their performance is better at lower frequencies than at the higher ranges. Page 13, Para. 6.

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MODEL ANSWERS

RADIO LESSON 47 R

AUTOMOBILE RECEIVERS

1. No. A storage battery is not capable in itself of supplying the necessary voltages to operate an automobile receiver. Page 1, Para. 2.

2. No. A transformer cannot operate from a d-c source of supply. Page 1, Para. 2.

3. The vibrator is used to chop up the d-c into an a-c component. Page 2, Para. 1.

4. Two. The synchronous and non-synchronous vibrators. Page 2, Para. 2.

5. Buffer condensers are necessary in the primary and secondary winding of a transformer to prevent sparking, noise and hum. Page 3, Para. 2.

6. Wheel and static noises can be recognized in a receiver by an intermittent rasping and clicking noise in the receiver. Page 6, Para. 1.

7. Full-wave rectification is the kind of rectification used in the power supply of the Philco auto receiver Model 828. Page 4, Fig. 1.

8. The different types of antennas used in automobile receivers are antennas that are mounted under the car between the axles, under the running board, outside the car, on the roof of the car, and on the back of the car. Page 4, Para. 1.

9. RF chokes are used in the vibrator system to prevent the RF from returning to the battery and burning the contacts of the vibrator. Page 3, Para. 2.

10. Yes. RF and IF tubes are interchangeable. Page 5, Para. 1.

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MODEL ANSWERS

RADIO LESSON 48 RA

TEST EQUIPMENT AND RECEIVER ANALYSIS

1. The two essential instruments to be used for radio service work are: the volt-ohm-milliammeter and a tube tester. Page 1, Para. 4.

2. A broken line cord, a burnt out ballast tube or a series filament resistor burnt out, or the rectifier tube burnt out would prevent the tubes in a receiver from lighting up. Page 5A, Para. 2 & 3.

3. No. If a ballast tube in an AC-DC set were burnt out, the tubes would not light up, because the filaments of the tubes are in series, and if one part of a series circuit is open, current ceases to flow. Page 5A, Para. 3.

4. No. If a plate bypass condenser were short circuited there would be no plate voltage. Page 11A, Para. 4.

5. A simple but yet effective filter consists of two .01 mfd 400 volt condensers connected in series circuit across the primary of the power transformer terminals with the middle or common connections connected to ground. Page 8, Para. 2.

6. If the antenna pick-up were lacking the receiver would lack sensitivity, and also have weak reproduction. Page 11A, Para. 3.

7. Weak reproduction in a battery operated receiver can be caused by batteries which are exhausted. Page 12, Para. 4.

8. Yes. A loose antenna or ground connection can cause noisy reception. Page 9, Para. 2.

9. Distortion can be caused by improper alignment of the RF and IF amplifier. Page 13A, Para. 3.

10. If the series resistor in the plate circuit were defective it may cause low plate voltage. Page 13A, Para. 2.

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MODEL ANSWERS

RADIO LESSON 50 RA-1

FADING AND INTERMITTENT RECEPTION, AND RMA COLOR CODE

1. Fading may be due either to a defective part within the receiver itself or to a faulty condition in the power supply lines or antenna-ground equipment, or it may be that the antenna or lead-in touches another wire or some grounded part of the building. Page 2, Para. 2.

2. The RMA color code was adopted so that one can tell by inspection what the actual value of the unit is without resorting to the use of a measuring device. Page 6, Para. 1.

3. The ten colors and their values in the RMA color code for resistors are: 1, Brown; 2, Red; 3, Orange; 4, Yellow; 5, Green; 6, Blue; 7, Violet; 8, Gray; 9, White; and 0, Black. Page 7.

4. Lack of out-put power (volume) in a receiver employing a single output tube can generally be corrected by connecting a larger bypass condenser (about 25 MFD) across the cathode bias resistor. Page 12, No. 18.

5. Intermittent reception and distortion are frequently caused by a defective coupling condenser between the 2nd detector plate and grid of the audio amplifier. Page 11, No. 7.

6. Generally when replacing an R.F. (or I.F.) shorted plate or screen bypass condenser, it is also advisable to replace the series resistor, for the condenser breakdown often damages the resistor. Page 11, No. 9.

7. No reception over portions of the tuning range especially the low frequency end is frequently caused by a defective resistor or bypass condenser in the cathode circuit of the mixer tube. Page 11, No. 12.

8. Noise in a carbon type volume control can in many cases be eliminated by cleaning the carbon element with a soft rubber eraser. Page 13, No. 24.

9. Whistling and squealing in an A.C.-D.C. midget receiver is usually caused by the electrolytic filter condenser having lost their capacity due to drying out from excessive heat. Page 13, No. 30.

10. Noisy tuning in a motor-driven automatic tuning system can usually be quieted by connecting a .1-mfd condenser from the hot side of the motor to the ground or chassis. Page 12, No. 19.

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MODEL ANSWERS

RADIO LESSON 52 RA

RECTIFIER TYPE A. C. METERS AND METHODS OF METERING RADIO AND TV CIRCUITS

1. The scale range is an important factor in the selection of a meter because a meter is most accurate only over the middle half of the scale. Page 1, para. 2.

2. The rectifier type A.C. meter receives its name from the fact that the alternating current or voltage is first rectified and then sent through a D.C. meter for measuring. Page 1, para. 4.

3. The advantage of the rectifier type A.C. meter is that it has a higher sensitivity, higher ohms per volt than straight A.C. meters have. Page 2, para. 2.

4. The main care to exercise in the use of rectifier type A.C. meters is not to overload the rectifier as this will cause sure injury. Page 3, para. 1.

5. The copper-oxide rectifier consists of a series of copper discs oxidized on one side and assembled on an insulating shaft with thin discs of lead between them for circuit connections. Page 3, para. 3.

6. The three points to consider in selecting a rectifier are: Is a full-wave or half-wave rectifier required? What is the full-scale deflection current of the meter? Does the current capacity of the rectifier equal the meter current sensitivity? Page 7, para. 2.

7. Multiplying resistors are always connected on the A.C. input side of the rectifier. Page 9, para. 2.

8. The condensers used across the multiplying resistors with rectifier type meters serve to compensate for the losses that occur in the rectifier. Page 10, para. 1.

9. To increase the range of a 0-1 milliammeter to 250 milliamperes divide the meter resistance 100 ohms by 249 to obtain the shunt resistance of .4 ohm. Page 13, para. 2.

10. A separate A.C. scale is generally used with combination A.C.-D.C. rectifier meters because the characteristics of the rectifier affect the meter indications somewhat and the A.C. and D.C. indications are not alike. Page 16, para. 3.

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MODEL ANSWERS

RADIO LESSON 53 R

INTRODUCTION TO THE CATHODE-RAY OSCILLOSCOPE

1. Yes. Page 3, Para. 2.
2. The grid is cylindrical and has an opening at the end through which a beam of electrons can escape. Page 3, Para. 2.
3. The intensity control. Page 3, Para. 2.
4. Yes. Page 3, Para. 3.
5. A gas discharge triode is used. Page 4, Para. 3.
6. The synchronizing control. Page 4, Para. 3.
7. The intensity control. Page 5, Para. 3.
8. The value of the condenser and resistor in the saw-tooth oscillator circuit. Page 11, Para. 2.
9. One-half of the signal voltage frequency. Page 13, Para. 3.
10. To lock the saw-tooth sweep oscillator in step with the vertical deflecting frequency. Page 15A, Para. 2.

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MODEL ANSWERS

RADIO LESSON 54 RA

COMPLETE CIRCUIT SYSTEM OF A COMMERCIAL OSCILLOSCOPE

1. Just prior to turning on an oscilloscope, the controls should be set in the following positions. Page 12, Para. 4.

Sweep Frequency	-	Off Position
Ext.-Int. Sweep	-	External Position
Vert. & Hor. Gain	-	Clockwise enough to trip switches
Synchronizing	-	Zero Position
Vert. & Hor. Shift	-	Half Way On
Intensity	-	Clockwise enough to trip switch
Focusing	-	Clockwise ninety degrees.

2. An important precaution to observe is not to allow the spot to remain in a fixed position for any length of time. Page 13, Para. 1.

3. When an oscilloscope ('scope) is to be idle for awhile, the Intensity Control should be set in the minimum position. Page 13, Para. 2.

4. The height and width of the image are regulated by means of the Vertical and Horizontal Gain Controls. Page 14, Para. 3.

5. The symbol number for the Synchronizing Control in the schematic diagram for the oscilloscope, as shown on Page 3, is R-20. Page 5, Para. 2.

6. The oscilloscope can be used as a D.C. voltmeter by connecting the Vertical Plates directly to the external tip jacks. Page 15, Para. 2 & 3.

7. In the Supreme Oscilloscope the grid of the 885 tube is connected to the slider on the Synchronizing Control potentiometer. Page 5, Para. 2.

8. The Ext-Int. Sweep switch in the Supreme Oscilloscope arranges for either an external sweep frequency voltage or that developed by the internal sawtooth generator. Page 5, Para. 3.

9. The Triumph Vertical and Horizontal Amplifiers employ type 6SJ7 tubes. Page 7, Para. 2 & 3.

10. The Triplett Oscilloscope employs a type 25Z6 rectifier tube. Page 9, Para. 5.

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MODEL ANSWERS

RADIO LESSON 55 R

THE OSCILLOGRAPH AND VISUAL ALIGNMENT

1. The signal must be of constant amplitude and variable in frequency. Page 2, Para. 1.

2. The turning of the rotor plates of the trimmer capacitor and the variation of the inductance of the oscillator coil. Page 3, Para. 3.

3. The five screw-type terminals mounted on the plate and on the back of an oscillograph provide a convenient means of making DC or high frequency applications. Page 6, Para. 5 and Page 7, Para. 1.

4. The steel cabinet serves as an effective shield against stray electrostatic fields which may be present in the vicinity of the cathode ray oscillograph. Page 7, Para. 3.

5. It is sometimes necessary to equip the power transformer of a cathode ray oscillograph with a magnetic shield in order that the magnetic fields may not affect the deflection of the beam on the screen of the cathode ray oscillograph. Page 7, Para. 6.

6. The safety switch is connected in series with one side of the primary to the power line; and, therefore, removes the power applied to the transformer when the unit is removed from its cabinet. Page 9, Para. 5.

7. The high voltage for the cathode ray tube is usually obtained from an extension of one side of the secondary winding of the power transformer within the cathode ray oscillograph. Page 10, Para. 3.

8. The current requirements are small and in the order of two or three milliamperes. Page 10, Para. 3.

9. Yes, the spurious deflections resulting from line-voltage changes and from residual hum may occur in cathode ray oscillographs which do not employ balanced deflection circuits. Page 11, Para. 3.

10. The high voltage supply for the cathode ray oscillograph is 1,100 volts. Page 11, Para. 4.

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MODEL ANSWERS

RADIO LESSON 56 R

PUBLIC ADDRESS AND SOUND SYSTEMS

1. Public address systems consist of a sound source, a power amplifier and reproducer system together with the necessary control devices. Page 1, Para. 3.

2. The commonly used sound sources for P.A. systems are microphones, phonograph pick-ups and radio receiver tuners. Page 2, Para. 2.

3. The fundamental frequency of an object is its frequency when it is vibrating as a whole unit. Page 4, Para. 3.

4. The quality of a sound is determined by the number and kind of harmonics present. Page 5, Para. 1.

5. Frequency distortion is a deformation of the signal waves due to some frequencies being amplified more than others. Page 6, Para. 2.

6. A monitor speaker is used to enable the operator to listen in and check the quality of the reproduction. Page 7, Para. 2.

7. The tuned radio frequency tuner for a P.A. system yields better quality and higher fidelity, while a superheterodyne tuner is more selective in tuning. Page 8, Para. 2.

8. See page 6 for skeleton diagram of a P.A. system, Fig. 4.

9. Public address or sound systems are employed when a large group of people are to be served or entertained with a single program that in itself could not be heard intelligibly over the same large area. Page 1, Para. 1.

10. When an object vibrates in two sections, the frequency is twice that of the fundamental and is called the second harmonic. When the frequency is three times that of the fundamental, it is known as the third harmonic, etc. The 2nd, 4th, 6th, etc. harmonics are often referred to as the even harmonics and the 3rd, 5th, and 7th, etc. as the odd harmonics. Page 4, Para. 3.

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Lesson 58
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Lesson 59
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MODEL ANSWERS

RADIO LESSON 60 RA

PHONOGRAPH PICKUPS AND RECORD REPRODUCTION

1. No. The adjacent grooves in a phonograph recording never cross. Page 2, Para. 4.

2. The tip of the playback stylus must be of the proper shape and size to give good quality without damage to the recordings. Page 4, Para. 2.

3. The sapphire type of stylus is especially recommended for automatic record changers. Page 5, Para. 3.

4. No. There is no such thing as a permanent stylus in phonograph record reproduction. Page 5, Para. 4.

5. The phonograph pickup converts the mechanical energy into the electrical signal voltage. Page 9, Para. 2.

6. The three basic parts forming the electromagnetic phonograph pickup are a permanent magnet, a field winding and an armature with its stylus. Page 9, Para. 4.

7. The effects of high temperature, high relative humidity and the growth of fungus may shorten the useful life of crystal phonograph pickups. Page 12, Para. 4.

8. The purpose of the double stylus phonograph pickup cartridge is to permit playing both fine cut and standard recordings using a single tone arm. Page 14, Para. 2.

9. The ceramic type phonograph pickup does not deteriorate in time or lose its efficiency during humid periods. It is moisture and fungus proof and retains its operating efficiency in temperatures ranging from minus 65 to plus 160 degrees Fahrenheit. Page 16, Para. 2.

10. No. The serviceman never attempts to repair a damaged phonograph pickup. He replaces it. Page 20, Para. 2.

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MODEL ANSWERS

RADIO LESSON 61 RA

THE OPERATION AND APPLICATION OF MICROPHONES

1. Sound waves are converted into electrical signals by a microphone. Page 1, Para. 1.

2. When sound waves strike the diaphragm of a carbon microphone, the movement of this diaphragm causes the carbon granules to be moved apart or compressed, thus changing their combined electrical resistance. It is this change in resistance which causes the current flowing through the carbon button and primary of the transformer to change, hence an a.c. signal is produced in the secondary winding of the transformer. Page 1, Para. 3.

3. Care must be taken so that a crystal microphone will not be exposed to temperatures higher than 112 degrees Fahrenheit. Placing the microphone in direct sunlight may cause the crystal to be subjected to excess heat where the crystals would become permanently damaged. Page 4, Para. 4.

4. A microphone which generates a signal voltage by virtue of an induced voltage in a conductor in the form of a coil moving in a magnetic field is called a dynamic or an electrodynamic microphone. Page 5, Para. 4.

5. A ribbon microphone is usually referred to as a velocity microphone. Page 7, Para. 2.

6. In a condenser microphone, the microphone essentially constitutes a condenser with the diaphragm as one plate. As the diaphragm moves back and forth, the charge on this condenser varies, which in turn produces a voltage drop across a high resistance resistor connected in series with this condenser. Page 8, Para. 2.

7. A microphone which has a non-directional characteristic will have pickup response which is equally good from all directions. Page 10, Para. 3.

8. The output impedance of a microphone should be equal to the input impedance of the amplifier to which it is connected. Page 12, Para. 2.

9. The rough treatment that a microphone receives while it is in operation or being carried from one point of operation to another is the usual cause for it becoming defective. Page 14, Para. 3.

10. When a microphone is found to be internally defective, it should be returned to the manufacturer for repair. Page 15, Para. 4.

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Lesson 63
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Lesson 64
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Lesson 65
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MODEL ANSWERS

RADIO LESSON 66 R

GENERAL REVIEW

1. Electrons flow from negative to positive. Page 1, Para. 1.
2. Yes. Electromagnets are constructed with iron of great permeability. Page 2, Para. 2.
3. An ammeter has a very low amount of resistance to the flow of current. Page 3, Para. 4.
4. Farad is the name of the unit designating capacitance. Page 4, Para. 2.
5. Radio waves travel at a speed of 186,000 miles per second. Page 5, Line 8.
6. Between the point where the ground wave stops and the sky wave comes in again, there is a zone which is known as the skip distance. Page 6, Para. 1.
7. Yes. Resistors can be used to confine certain signal currents to their respective circuits. Page 7, Para. 6.
8. To calculate the voltage drop across any resistor, we must know the current in amperes and the resistance in ohms. Page 8, Para. 5.
9. Applying heat to an object is generally termed as thermionic emission. It is the way in which electrons are emitted from the cathode of a tube. Page 9, Para. 4.
10. The diode gives excellent rectification of alternating currents because electrons will flow through it in only one direction. Page 10, Para. 3.
11. The S series of tubes are those known as the single ended type where all electrodes, including the control grid, terminate in pins at the base. Page 11, Para. 2.
12. Yes. The structure of the control grid has a considerable effect upon the amplification factor of a tube. Page 12, Para. 3.
13. The variable "mu" characteristic of a tube is obtained by employing a grid of non-uniform design. Page 13, Para. 3.
14. A radio receiver must have selectivity in order to respond to the waves of only one radio transmitted signal, or one frequency at a time. Page 14, Para. 3.
15. In a circuit containing impedance, we may find resistance, inductance, and capacitance. Page 15, Para. 3.
16. Yes. There will be more turns in the secondary winding than in the primary winding. Page 16, Para. 1.
17. Oscillations in a radio frequency amplifier are caused by a regenerative or feedback action which is introduced by coupling between the grid and plate circuits of one or more of the tubes. Page 17, Para. 1.
18. No. The diode detector does not give any amplification to the signal. Page 18, Para. 1.
19. The inverse duplex system was introduced in order to equalize the load on all tubes in a set. Page 20, Para. 3.
20. When using push-pull amplification, we will find that the two plate currents are equal and flow in opposite directions through the primary windings. Therefore, they produce opposite effects in the transformer coil and these opposite effects prevent magnetization from setting up in the coil. Since no magnetic flux is set up, the iron core of the output transformer can be made much smaller. Page 24, Para. 2.

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Lesson 68
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MODEL ANSWERS

RADIO LESSON 69 RA

ANTENNA SYSTEMS

1. True. If the straight-wire antenna was placed in a vertical position above the earth, the waves emitted from the antenna will be vertically polarized and can, therefore, be received with maximum efficiency on a receiving antenna that is held in a vertical position. Page 1, Para. 3.

2. True. The electrical length of an antenna is expressed in wave length or the distance from the crest of a wave to the crest of the succeeding wave in free space. Page 3, Para. 2.

3. False. Radio waves do not propagate as fast through the conductors as they do through space. Page 4, Para. 1.

4. False. If we were to cut the half-wave antenna in two parts and, at the center we were to find that its impedance to the flow of radio frequency current would be equal to approximately 70 ohms, it would be resistive rather than inductive or capacitive in nature. Page 5, Para. 2.

5. False. Maximum voltage will appear at the ends of the horizontal section of the T-type antenna and a greater current will flow in the vertical section with somewhat greater over-all efficiency than that obtained from the L-type antenna of the same height. Page 6, Para. 4; Page 7, Para. 1.

6. True. Insulators used for the purpose of supporting antenna elements and antenna wire are especially designed to withstand great strength and provide long leakage paths with low end-to-end capacity. Page 8, Para. 2.

7. True. If the height of the ionized layer should change and if the receiving antenna should be near the skip distance zone, we may experience fading. Page 9, Para. 4.

8. True. A transmission line may consist of two parallel wires or one wire supported by insulators within a hollow conductor. Page 12, Para. 1.

9. True. The transposition of the parallel leads of a transmission line causes equal and opposing noise voltages to be picked up, thereby preventing the line from introducing a strong line noise, which may be generated near the line on its way to the input of the receiver. Page 14, Para. 2.

10. True. The important characteristic of half-wave and full-wave antennas is a condition of maximum voltage at the ends of antennas of this length. Page 17, Para. 3.

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MODEL ANSWERS

RADIO LESSON 71 RA

FREQUENCY MODULATION

1. True. The chief advantage in using frequency modulation rather than amplitude modulation is that reception may be relatively free from noises which result from atmospheric static and many other kinds of electrical interference. Page 3, Para. 3.

2. True. Sound-pitch is represented by how often the carrier frequency changes and sound volume is represented by how much the c arrier frequency changes when using frequency modulation. Page 7, Para. 3.

3. True. Two stages in the f-m receiver are not in the a-m receiver; one is the limiter and the other is the discriminator. Page 9, Para. 5.

4. False. Changes of loudness, volume, or amplitude of the sound signal causes the f-m carrier frequency to vary from its average value. Page 9, Line 7, Para. 5.

5. False. The total range of frequencies used, or the total width of the f-m channel, becomes 200 kc. Page 10, Para. 3.

6. True. The term "deviation ratio" is the ratio of the maximum deviation to the maximum audio frequency transmitted in the signal. Page 11, Para. 1.

7. False. The amplification per stage is less than in standard broadcast and short-wave receivers because for f-m reception, we employ an intermediate frequency on the order of 10 megacycles or higher instead of the 455 or 456 kilocycles generally used for standard broadcast i-f amplification. Page 17, Para. 3.

8. True. The purpose of the limiter stage is to remove any amplitude modulation which gets into the frequency-modulated signal at any point between the transmitter and the input of the limiter stage in the receiver. Page 19, Para. 3.

9. True. From the limiter, the frequency-modulated signal of constant amplitude goes to the discriminator, which changes this frequency-modulated signal (which is at an intermediate frequency) into an amplitude-modulated audio frequency signal. Page 22, Para. 1.

10. True. The discriminator output potential (amplitude) varies directly with frequency deviation of the incoming signal, the greater the deviation, the stronger the output. Page 24, Para. 2.

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Lesson 72
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Lesson 73
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MODEL ANSWERS

RADIO LESSON 74 RA

FM RECEPTION AND RECEIVERS

1. True. High-frequency radio waves behave like light not only in that they travel in straight lines, but also because they are reflected from conductive and semi-conductive surfaces much as light is reflected from a mirror. Page 3, Para. 4.

2. False. Because of capacitance effects at the antenna conductors the actual length should be a little less than one-half wave length. Page 5, Para. 3.

3. True. The transmission line which connects the dipole antenna and the receiver is as important as the antenna itself in obtaining satisfactory reception. Page 7, Para. 4 and Page 8, Para. 1.

4. True. One of the really satisfactory types of transmission line consists of two copper conductors separated by a fraction of an inch and held securely in parallel relation throughout the whole length by embedding the conductors in a ribbon of some kind of insulation having low energy absorption at high frequencies. Page 8, Para. 2.

5. False. When reception is desired from only one general direction, rather than from the two opposite directions which are possible with the regular dipole, a reflector may be mounted back of the dipole or on the side of the dipole which is away from the stations to be received. Page 10, Para. 3.

6. False. Tubes used in f-m receivers have "input capacitances" in the order of 8.5 mmfd. Page 17, Para. 3.

7. True. The intermediate frequency used for f-m reception usually is chosen so that there can be no reception of signals which are the image frequency. Page 22, Para. 3.

8. False. The image frequency for any given signal frequency is a frequency which differs from the signal frequency by twice the intermediate frequency. Page 22, Para. 3.

9. True. In order that all image frequencies may fall outside of the band of frequencies which may be tuned on an f-m receiver, the intermediate frequency must be something more than one-half of the band width. Page 23, Para. 3.

10. True. The i-f amplifying system for f-m reception must provide fairly uniform amplification for a range of frequencies much greater than need be handled for amplitude modulation. Page 24, Para. 3.

RADIO-TELEVISION TRAINING SCHOOL, INC.

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MODEL ANSWERS

RADIO LESSON 75 RA

ALIGNMENT OF F-M RECEIVERS

1. True. When aligning a frequency-modulation receiver, we cannot use an amplitude modulated signal, because the amplitude modulation would be removed in the limiter stage and there would be no indication on an output meter connected to the loud speaker circuit. Page 2, Para. 2.

2. True. A 10-volt full-scale d-c voltmeter used across the limiter grid resistor and acting an as "output meter" should have the highest possible resistance, preferably 20,000 ohms per volt or even more. Page 3, Para. 3.

3. False. For any given degree of deviation above and below the center of a discriminator, the resulting positive and negative peaks of audio voltage will be of equal amplitudes. Page 9, Para. 3.

4. True. When adjusting or aligning the discriminator transformer, we will adjust the primary circuit so that there is maximum transfer of energy into the secondary at and near the center frequency. Page 10, Para. 2.

5. True. For alignment of the i-f transformers in an f-m receiver, the high side of the generator may be connected to the control grid of the tube preceding the transformer being aligned. Page 12, Para. 4.

6. False. When only slight re-alignment of the i-f amplifying system in an f-m receiver is required, it is common practice to connect the generator between the converter signal grid 4 and ground, while adjusting all the i-f transformers. Page 17, Para. 4.

7. True. If the limiter tube is not biased by grid rectification, output level indications may be had with either the high-resistance moving coil voltmeter or the electronic voltmeter connected across either one of the discriminator load resistors. Page 18, Para. 4.

8. True. With the visual alignment method, we employ a frequency-modulated signal generator whose operating frequency is continually varying in a regular manner above and below a center frequency, just as do actual f-m signals, and an oscilloscope will trace luminous patterns which show at a glance the response curve of the entire set. Page 23, Para. 4.

9. True. When using the visual alignment method we adjust the primaries and secondaries of the several i-f transformers in an f-m receiver to obtain curves of maximum possible height with a flat or broad waveform. Page 29, Para. 2.

10. True. It is important that the f-m signal generator be set at the exact intermediate frequency with which the f-m receiver is to operate, and that the deviation in frequency be equal on both sides of this center frequency. Page 33, Para. 4.