National Radio Institute

ESTABLISHED 1914

Washington, D. C.

RADIOTRICIAN AND TELETRICIAN BINDER

REGISTERED U. S. PATENT OFFICE

Your School

NATIONAL RADIO INSTITUTE

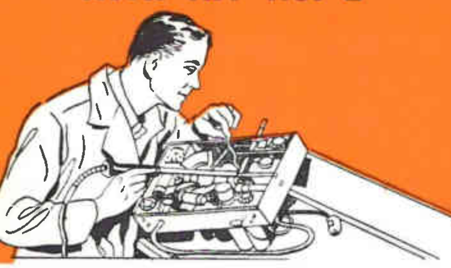
16TH AND U STS. N. W., WASHINGTON, D. C.

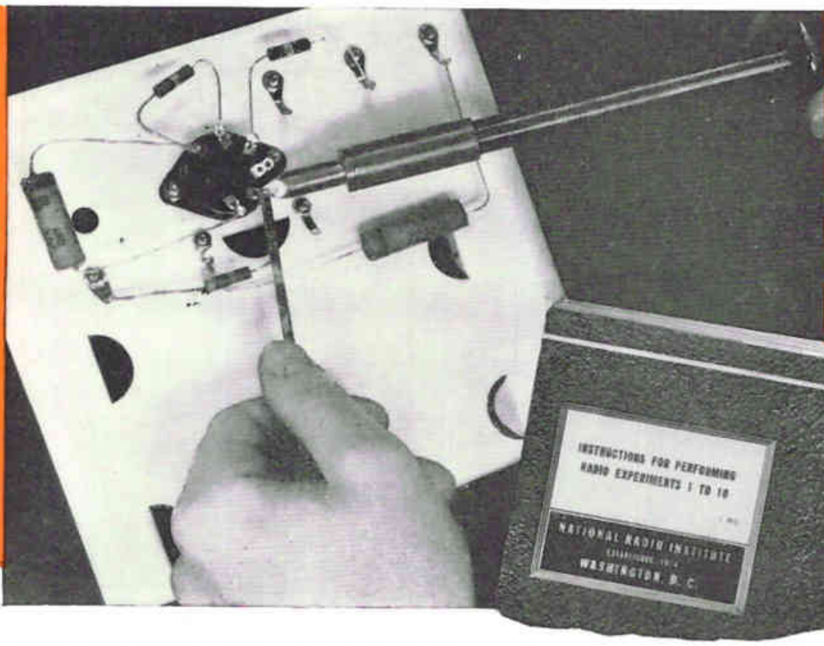
You—"*Learn by Doing*"— Practice Fixing Radios as an NRI Student

J. E. SMITH, *Pres.*, National Radio Institute, Washington, D. C.

THE NRI course is a well balanced combination of textbook study and *practice.* Seven kits of parts, each accompanied by a manual of directions and instructions, are included. We call ours a "50-50" course because about half the time required to finish it is given to studying lesson texts—learning the *why,* the theory—the other half conducting experiments that teach you the *how.* This page tells what you practice with Kit No. 1. Succeeding pages tell what you practice with the remaining six kits. Read this and the other pages. See how carefully, how thoroughly, how completely you "learn by doing"—how you practice fixing Radios as an NRI student—learn professional techniques, acquire skill, gain confidence. No matter what branch of Radio you enter this "learn by doing" training benefits you. Basic Radio principles are essentially the same for all branches of the Radio industry—Broadcasting, Aviation, Police Radio, Servicing Home and Auto Radios, etc. Getting a job, holding it, and winning promotions is easier when you've had practical training and experience. Studying our texts and doing the experiments is planned so you'll get the most out of both. That's why kits are sent on a schedule that ties in with NRI lesson texts. We want you to study the theory first, then practice; learn basic principles, then demonstrate them. SEE THE BOTTOM OF PAGES 1, 2, 3, 4, 5, 6 and 8 TO FIND OUT WHEN EACH KIT IS SENT. BE SURE TO SEND US THE ENCLOSED CARD AT ONCE. WE MUST HAVE THE INFORMATION IT REQUESTS BEFORE WE CAN SEND KIT NO. 1.

You PRACTICE soldering WITH KIT NO. 1





LOOK under a Radio chassis and you see many, many soldered connections. Obviously, a Radio Technician must know HOW TO SOLDER AND UNSOLDER. When fixing Radios—he does just that dozens of times a day. Therefore Kit No. 1 gives you soldering practice. You get an electric soldering iron—or if you do not have electricity, a flame type iron—a chassis, many different Radio parts and supplies. You learn how to heat a flame iron; what soldering is; the color of solder when it has set; how to heat a joint to make solder stick to the wire; how to tin a soldering iron; how to care for a soldering iron so it will give you long, trouble-free service; professional hurry-up ways of getting insulation off wires; cleaning wires for easy soldering; how to tin leads and wires; how solder lugs make connections to chassis possible; how to solder two or more leads together so they'll hold; how to make temporary or permanent connections; how to make professional joints and splices—lap joints, a temporary hook joint, permanent hook joint, "T" joint, Western Union and Bell splices; how to mount Radio parts and solder them in place—exactly as you would do in fixing Radios; how to unsolder and remove actual Radio parts. You learn the seven rules for making a good soldering job. "Learning by doing" teaches you the how. You will recognize and soon learn the difference between neat and poor work. The manual that comes with this kit gives you easy-to-follow directions. This first kit teaches you the first things you need to know to be a successful Radio Technician. With NRI first things come first. Just as a builder can judge whether a carpenter knows his stuff by the way he handles his tools, so employers of Radio Technicians gain good or bad first impressions of a new employee by the way he tackles soldering. The practice you get with this and later kits, soldering and unsoldering, will give you confidence and skill because you do the very things you will be called upon to do when you tackle a job as a professional.

WE SEND KIT NO. 1 when we grade your answers to lesson 6, provided your tuition payments are up to date.

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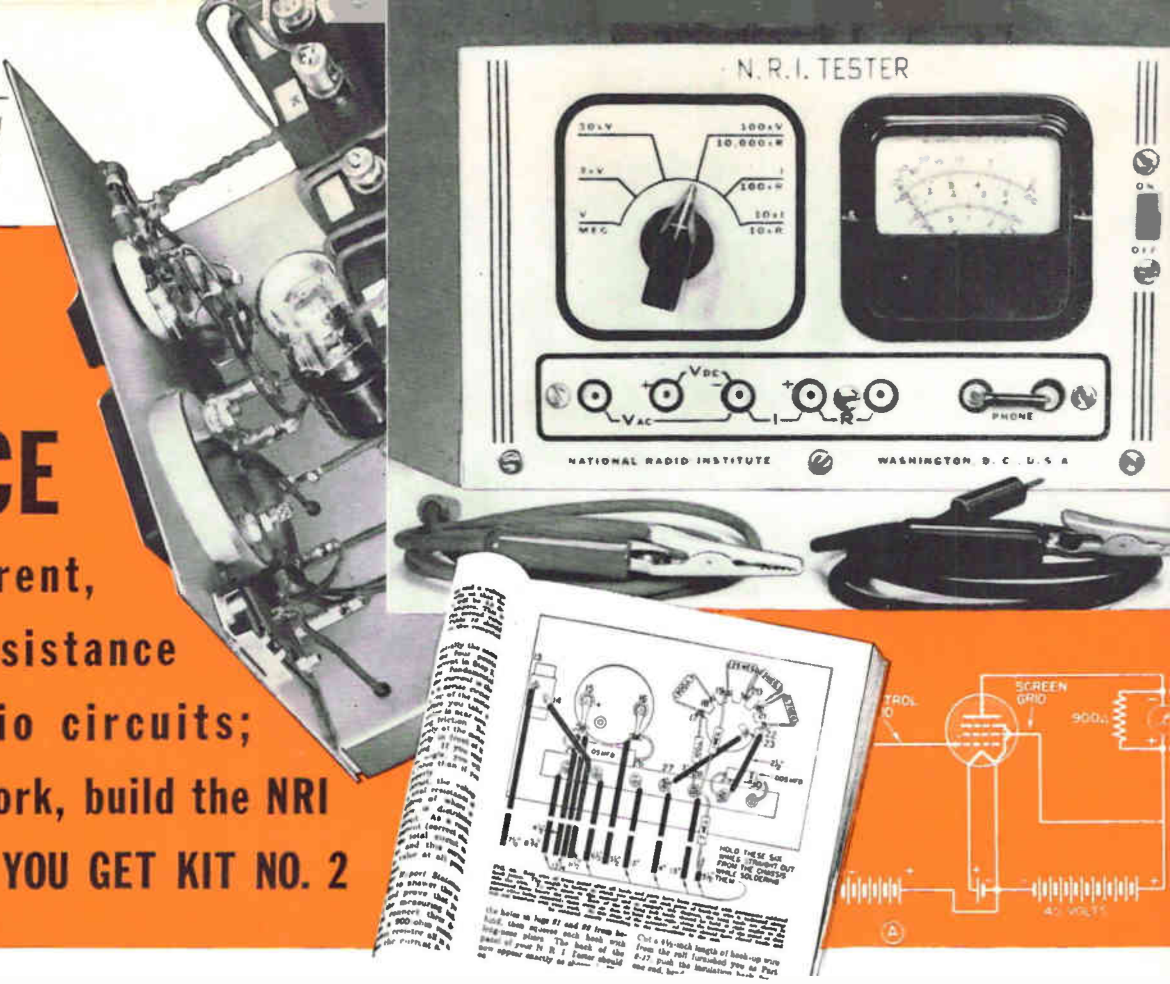

You PRACTICE

measuring current, voltage and resistance values in Radio circuits; see how tubes work, build the NRI Tester . . . WHEN YOU GET KIT NO. 2

EVEN if you've never seen a Radio Technician fix a Radio, common sense tells you that with Kit No. 2 you start working with real Radio circuits, actually demonstrate their characteristics to yourself. You prove that electrons flow in a definite direction between the source and the load in a d.c. circuit; increase the source voltage and see that current increases; increase resistance in a circuit and prove current decreases exactly as Ohm's Law says it will.

See a Tube Control Current

You may know that vacuum tubes can control current flow. Well, you'll actually prove current can flow through a vacuum inside a tube, and how a tube can control the flow of electrons. You practice measuring Radio tube operating voltages and currents—something you will do many times when you become a professional Radio Technician; see how a tube can amplify; you practice making voltage and current measurements in Radio circuits; learn that the amount of current in a circuit depends on the amount of voltage. You must know how to measure voltage in a circuit, otherwise parts may be damaged.

Build and Use the NRI Tester

You build the NRI Tester with which you measure a.c.-d.c. and r.f. voltages, d.c. current and resistance values. You use this tester in your experiments in each of the remaining five kits. You learn the RMA color code for resistors. This is extremely valuable. Different colors on resistors are used to designate different values. To know them speeds servicing—a glance, and you know the right value of the resistor you need for replacement purposes.

A 72-page manual tells you step by step what to do and how to do it. You learn progressively from the easy to the harder, and in the correct order, the principles which are demonstrated. We teach the "why" so you understand what you are doing; the "how" so you can use professionally what you learn.

Here is Marcel Ravera's instrument panel showing the NRI Tester mounted, ready for use in Radio servicing. The NRI Tester, being a combination vacuum tube voltmeter and multimeter, often substitutes for a professional instrument with beginners. Mr. Ravera sent us this photograph.

Here's a photograph of a student's well-organized study room, typical of a great many in the homes of ambitious young men. Notice his NRI Tester is handy. Spare hours devoted regularly to study and practice are short, quick steps to a career as a recognized Radio Technician.

WE SEND KIT NO. 2 when we grade answers to lesson 12, provided you have submitted a report statement on Kit No. 1 and your tuition payments are up to date.

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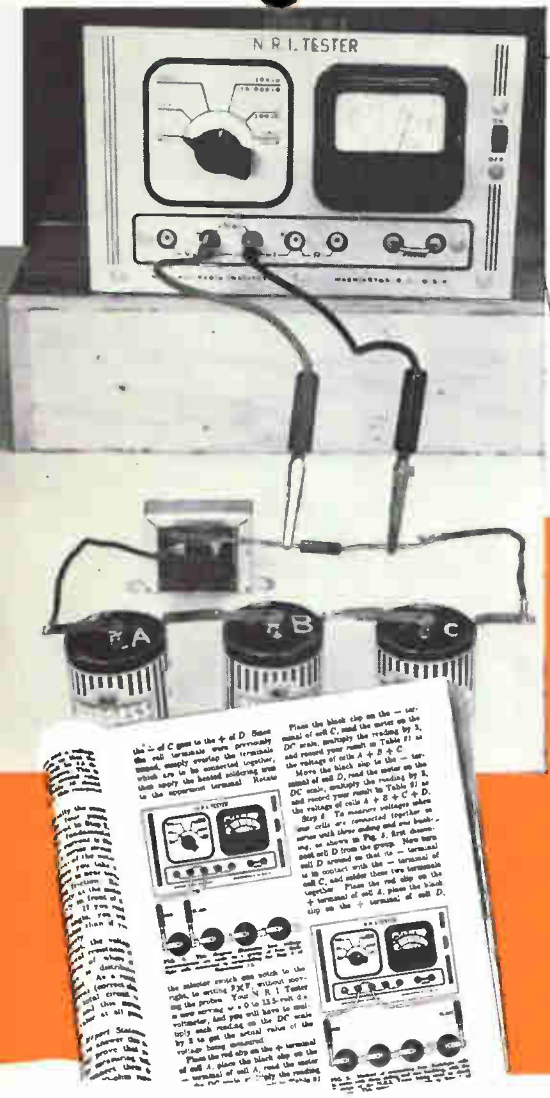

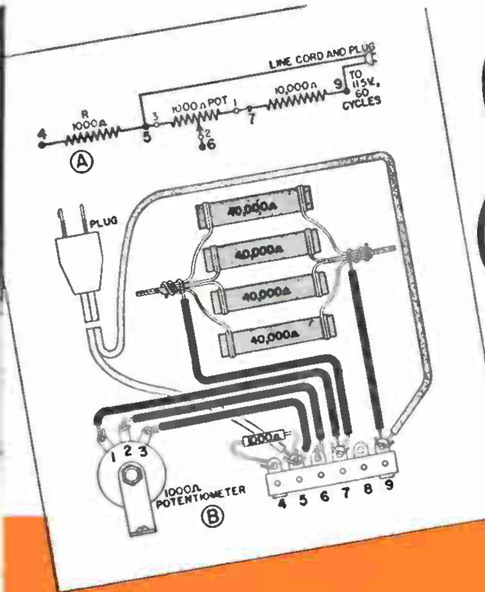

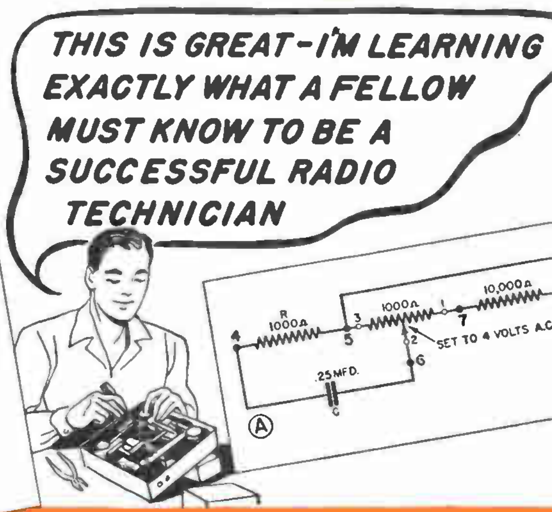

You PRACTICE

tuning Radio circuits, see how voltages and currents are distributed in circuits using the NRI Tester . . . WHEN YOU GET KIT NO. 3

NRI Kits Build Confidence, Develop Skill

"The NRI kits give a person an idea of what actual Radio repair work is like. Their best value, I think, though, is in building confidence for a man doubtful of his own skill, because he actually demonstrates to himself that the things he reads are true. While in the Army I graduated from the Radio Mechanics School at the top of a class of 477 other men."

MILTON RHODES,
515 E. Gibbs St., Union City, Tenn.

THREE basic laws of electricity apply to all Radio circuits. They're taught in the early lesson texts. You convince yourself of their reliability, fix them in your mind, when you experiment with Kit No. 3. They are: 1. Ohm's Law; 2. Kirchhoff's Current Law; 3. Kirchhoff's Voltage Law.

You use your NRI Tester to prove these laws. You measure voltage, current and resistance values; learn the uses of Ohm's and Kirchhoff's Laws; practice measurements which fix in your mind voltage and current distribution in simple and complex circuits so you know what's wrong when you discover incorrect voltage and current values in defective receivers. A working knowledge of these laws makes fixing Radios easier. You practice a.c. voltage measurements in circuits containing coils, condensers and resistors—standard parts used in every receiver; learn the properties of resonant circuits (resonance makes possible tuning-in desired programs and rejecting others); learn how to prevent being shocked when working with Radio equipment; that it takes a definite time to charge a condenser through a resistor, that the charging time may be varied by changing the resistor or the condenser value—knowledge you need for servicing special circuits such as automatic volume control systems and Television circuits.

You may not realize the full significance of the technical terms and phrases here but any good Radio man can tell you that we're giving you information, practice, experience you must have, in a manner that makes mastering it easy.

WE SEND KIT NO. 3 when we grade answers to lesson 18, provided you have submitted a report statement on Kit No. 2 and your tuition payments are up to date.

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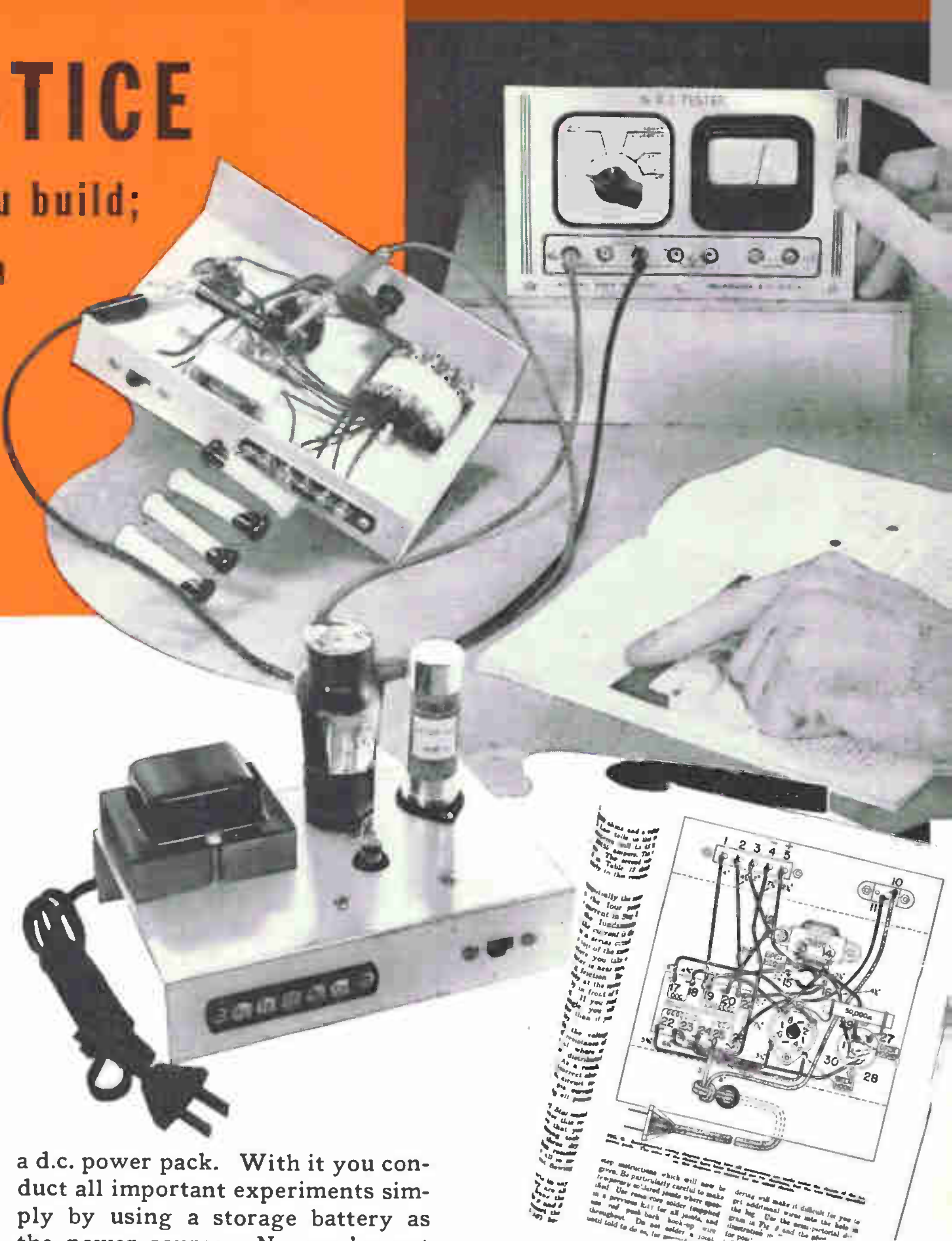
You PRACTICE

with a power pack you build; introduce defects which cause hum, squealing, howling, motorboating . . . WHEN YOU GET KIT NO. 4



ELECTRICITY, usually alternating current (a.c.), is the source of power for most receivers, transmitters, etc. Since d.c. is needed to operate vacuum tubes, a power pack is used to change the a.c. line power to the d.c. power needed. You build a power pack when you get Kit No. 4; introduce circuit changes which cause hum, motorboating (a rapid put-put sound), squealing and howling in a receiver—the best kind of practice for a beginner. It tells what parts and circuits to test for those kinds of customer complaints.

Shop Training in Your Home

Notice that you get real shop training right in your home. No method can excel learning by doing. As an NRI student you learn to fix Radios by practicing.

You make continuity tests, point-to-point resistance and voltage measurements — exactly what you do when fixing Radios. You experiment with different power pack filters identical with those used in actual receivers; learn what to expect from each. The power pack you build is the type used in receivers. You learn correct techniques so you develop safe, professional habits. You make clear to yourself important facts and procedures through demonstrations.

Lack of Electric Power No Handicap

If you do not have correct a.c. power we send a kit for building a d.c. power pack. With it you conduct all important experiments simply by using a storage battery as the power source. No, you're not left out if your home is not wired for electricity. Notice how we give you the "know how" and show you techniques and methods for successful servicing.

• • •

Kits Taught Servicing

"I service all makes of Radios. I started fixing Radios for friends after my 16th lesson. With the NRI kits I learned how to do the real service job instead of having to learn to do it the hard way. NRI has changed my future."

HOBERT HEAD,
Poseyville, Indiana

Not a Dull Moment

"I have not found a dull moment in any lesson or experiment. I thank NRI for teaching me effect-to-cause reasoning."

S. H. STRICKLAND,
191 Dale Homes, Portsmouth, Va.

Kits Taught Him Circuits

"I started to earn profits after about my 20th lesson, averaged around $15 a week while training. The NRI kits taught me to understand the functions of a Radio circuit, helped a lot in servicing work."

JOSEPH GULYA,
260 Varick St., Jersey City, N. J.

WE SEND KIT NO. 4 when we grade answers to lesson 24, provided you have submitted a report statement on Kit No. 3 and your tuition payments are up to date.

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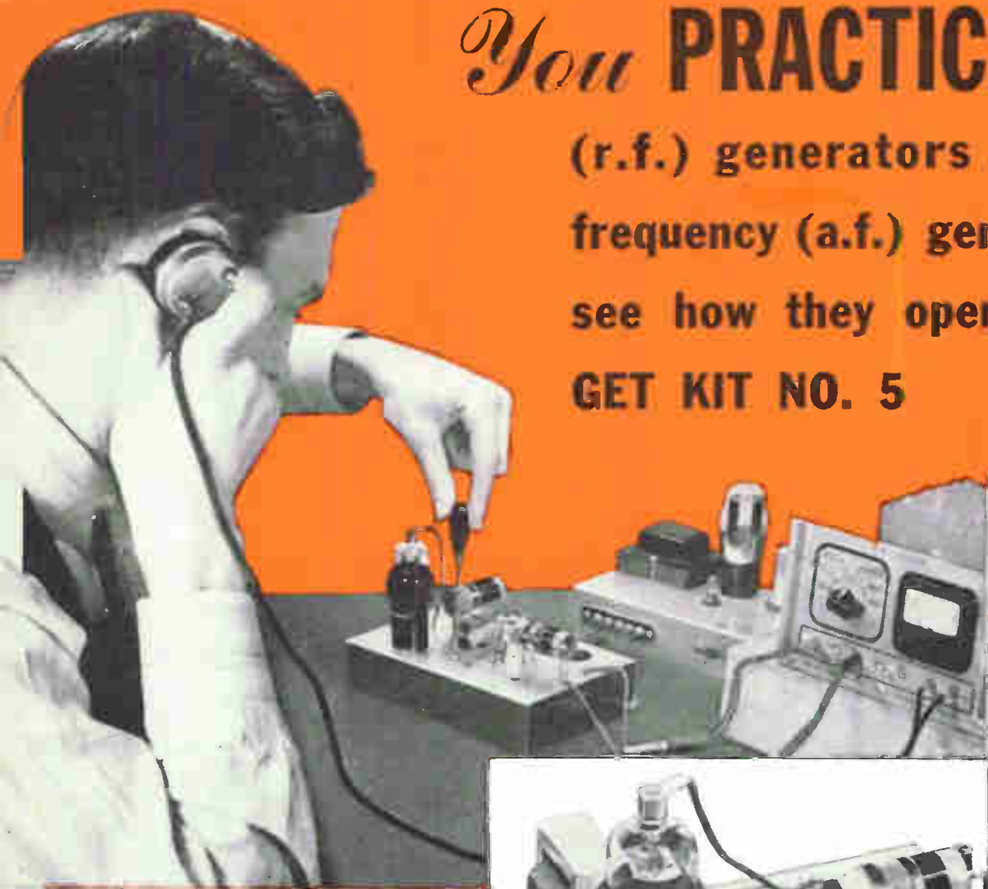
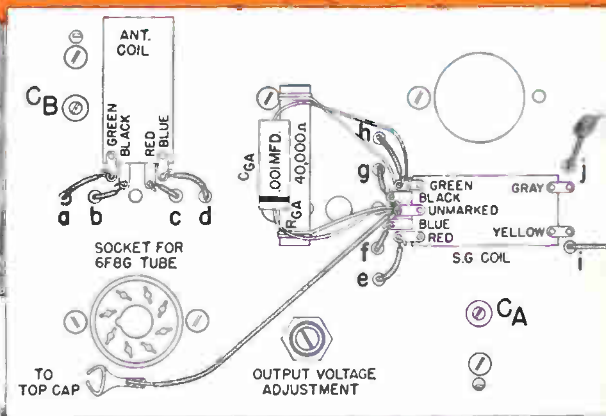
You PRACTICE with radio frequency (r.f.) generators and amplifiers, audio frequency (a.f.) generators and amplifiers; see how they operate . . . WHEN YOU GET KIT NO. 5





NOTICE the illustrations, particularly the interesting, clear, easy-to-understand schematic diagrams. While only two are shown here, every one of the seven manuals give detailed, clear instruction like this. More than 5,500 man-hours were needed to plan, design, and develop these kits and the experiments you do with them. They're engineered to do a job for you.

Hundreds of young men trust their futures to NRI. We don't take that trust lightly. Half-way measures don't suit our temperament or our objectives. Satisfaction in doing a good job isn't the compelling reason either. We glory in what our students accomplish and profit in proportion to their success.

When you get Kit No. 5 you build and experiment with radio frequency signal generators of the modulated and unmodulated type. You measure audio frequency voltages with your NRI Tester. You build radio frequency (r.f.) amplifiers, practice making dynamic measurements on them; build and practice with audio frequency (a.f.) amplifiers; build a beat frequency oscillator; practice with audio frequency signal generators and also modulating an r.f. oscillator with an audio frequency. Plate, grid and cathode modulation are used.

You Use a Dual Triode Tube

You build Radio circuits using a dual triode—a dual tube—really two separate tubes in the same glass envelope. You make radio frequency measurements in radio frequency stages. These measurements fit you to fix Radios with r.f. troubles. "How to do it" knowledge is what the NRI course gives you—that kind of training shows up in your pay envelope, in your achievements.

WE SEND KIT NO. 5 when we grade answers to lesson 30, provided you have submitted a report statement on Kit No. 4 and your tuition payments are up to date.

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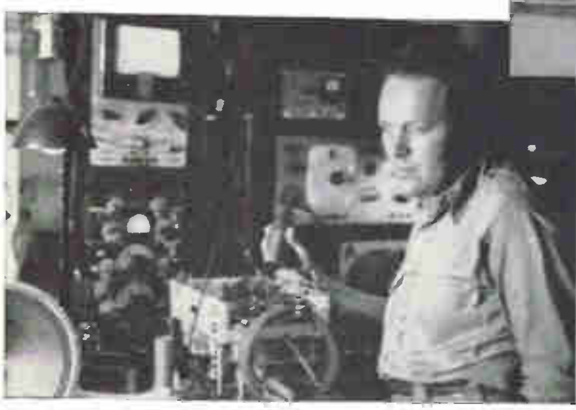
SINCE the vacuum tube is the basis of all Radio, mastering advance tube circuits is essential. The practice you get, the experiments you make with this kit give you a command of advance Radio circuits. You build an AM superheterodyne circuit that will tune in Radio stations, practice testing and aligning it; demonstrate to yourself three types of interference, code, image, and beat note. With this experience, it will be easy to recognize and know how to fix these troubles.

Basic Servicing Techniques

You practice signal tracing, learn how to trace trouble to a section, then to a stage of the circuit—a basic servicing technique. You practice with the individual stages that make up a superheterodyne, align amplifiers using tuned circuits—just as professionals do it. Amplifier circuits using a.v.c. (automatic volume control) won't be a mystery when you finish this kit. You will understand C-bias detectors, diode detectors and grid-leak condenser detectors in combination with r.f. amplifiers using tuned circuits.

You learn how to know if the oscillator is working—a trouble shooting test. You practice with a mixer-first detector and oscillator circuit and produce an i.f. frequency which is fed through an i.f. transformer. Your ambition to acquire the "know-how" of Radios and Radio circuits is now close to complete. You can rejoice in what you have accomplished, take pride in what you know and can do. Now you can discuss design features of Radio equipment with Radio engineers and surprise many with how much you know.

You PRACTICE with FM circuits . . . align and test a superheterodyne circuit, build and test detectors, i.f. amplifiers, manual and automatic volume controls . . . WHEN YOU GET KIT NO. 6



Excellent Basic Training

"The NRI Tester is in our main test panel. NRI provides excellent basic training for either the service field or transmitter operation and maintenance. I can speak for both fields, having been operator for WKBH and now own a service shop. You teach the 'why' without which Radio men remain screwdriver mechanics."

JOHN F. GRUBER,
73 Birch St., Manchester, Conn.

WE SEND KIT NO. 6 when we grade answers to lesson 36, provided you have submitted a report statement on Kit No. 5 and your tuition payments are up to date.

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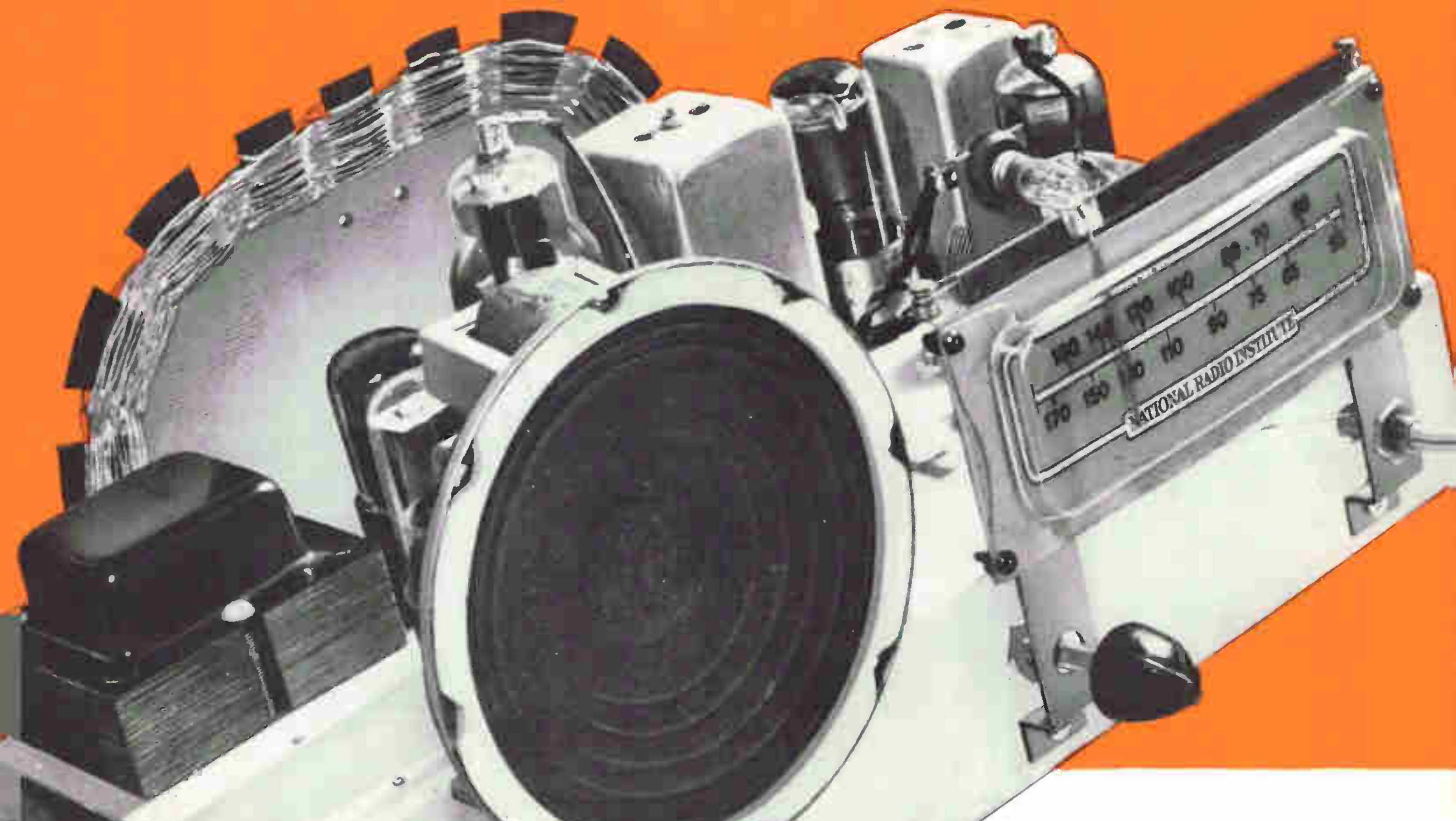
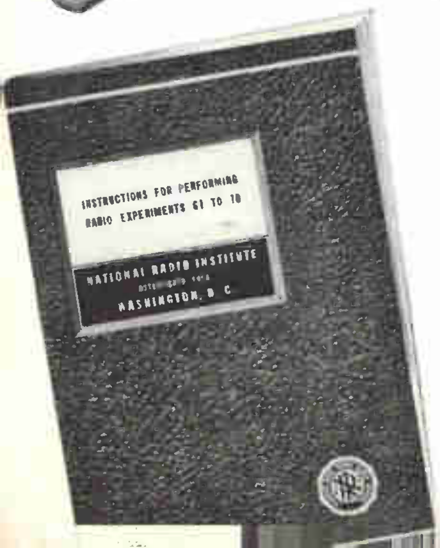
You PRACTICE servicing this 5-tube broadcast band superheterodyne receiver complete with calibrated dial, ganged tuning condensers, loop antenna, electrodynamic speaker—which you build . . . WHEN YOU GET KIT NO. 7



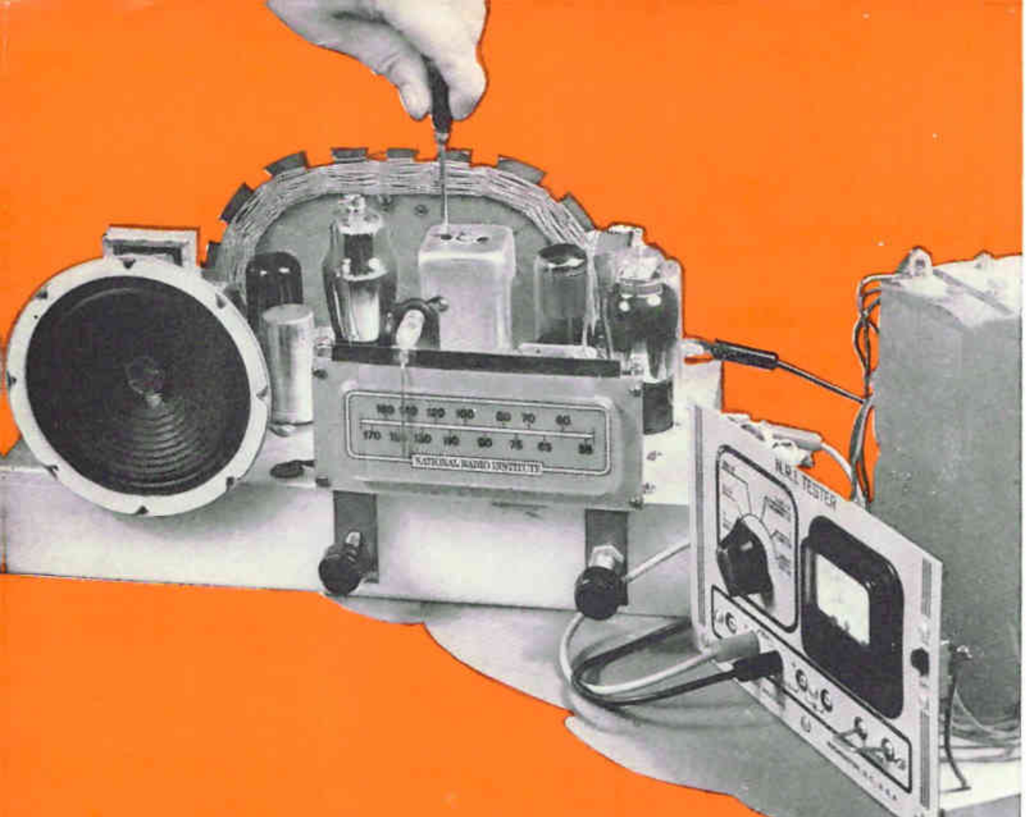


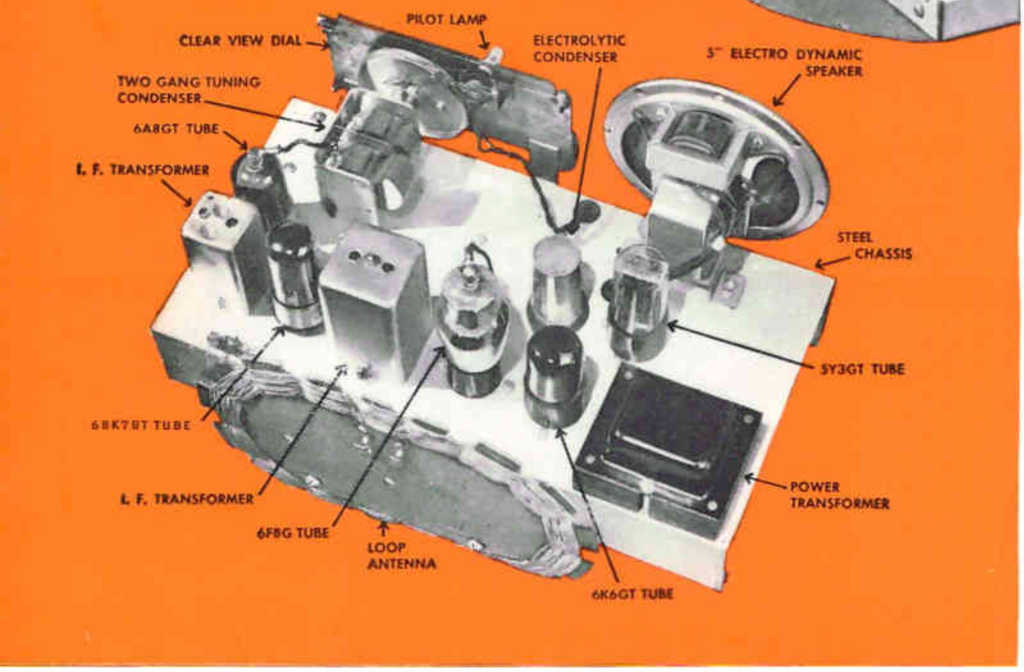
THIS Radio, complete as shown above when you build it, is yours to keep. If you have wanted another Radio for your den or spare room, here it is. Some students build or buy a cabinet for it, they like it so well; others use it just as it's shown in the photo above. You will be proud of what you've accomplished when you plug it in and hear its rich, mellow tone.

You Build a Battery Set if You Do Not Have Electricity

Students who do not have the correct electricity build a receiver using auto Radio type of power supply. They get a vibrator, special manual and power transformer, a rectifier tube, etc., so they too have a Radio on which to perform "experience getting" tests and measurements. Nearly everybody interested in Radio has a hankering to build his own receiver. This should satisfy those who feel that way, but this kit has a much more important purpose.

THERE'S MORE ABOUT KIT NO. 7 ON THE BACK





You Practice Servicing

You learn how to test resistors, coils, condensers, transformers, like a professional; practice making complete point-to-point voltage and resistance measurements; align your receiver using your NRI Tester as an output meter, also align the circuits with and without a signal generator. You introduce hum, distortion, motorboating, weak reception, hum modulation, so you will know how to identify these defects when called upon to fix them.

You learn troubles caused by cathode-to-heater leakage in tubes; see how an open coupling condenser in an audio amplifier can affect reception and learn a quick test for finding this trouble; learn how a leaky coupling condenser in an audio amplifier affects reception and a quick test to locate it; how loss in volume occurs on distant stations when coil Q is lowered—valuable knowledge. Coils sometimes absorb moisture. Professional Radio Technicians are often called upon to correct this trouble.

Manual Tells What To Do

A manual detailing experiments and tests to make accompanies every kit. Everything is down in black and white. Schematic diagrams, photos, sketches, guide you. For example, in the seventh manual you read exactly what to do to learn what happens when electrolytic condensers dry out and as a result develop a high power factor; to learn the difference in symptoms produced by a high power factor in the input and in the output filter condensers; to see how hum modulation occurs if a.c. gets into the automatic volume control circuit, and find hum present only when you tune to a station. You learn the directional effect of a loop antenna, how weak signals can be increased and interfering signals can be reduced in strength.

The practice you have, the experiments you conduct do not harm the receiver's operating efficiency. You finish with a Radio you will proudly show your friends, your family, or sell at a good price.

NRI Kits of Great Benefit

"The NRI kits have been of great practical benefit to me. It is my opinion that without working experience with circuits, theory will seldom carry a man to his goal. One must have both theory and experience real to understand Electronic apparatus. I am an Administrative Assistant with an Aircraft Corporation. My assignment is of course electrical and radio. I find I can enjoy the companionship of my wife and children to the fullest and still maintain a very comfortable income."

C. THURSTON HIGGS,
139 East Ave., Hagerstown, Md.

WE SEND KIT NO. 7 when we grade answers to lesson 42*, provided you have submitted a report statement on Kit No. 6 and your tuition payments are up to date.

* There are 65 lessons altogether in the complete NRI RADIO and TELEVISION SERVICING Course.

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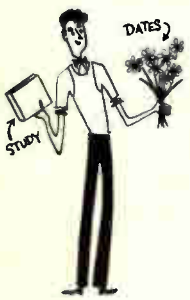
HOW TO GET THE MOST VALUE OUT OF YOUR NRI COURSE

JAMES A. DOWIE, Chief Instructor

Here are some suggestions and instructions that will help you get the greatest value out of each lesson you study, and out of the whole NRI course. Also, they tell you how to get fast, efficient service from NRI. Into these suggestions and instructions I have put facts and ideas that have come to me during a period of more than thirty-five years as Chief Instructor at NRI. I believe you will profit by reading this folder carefully—every word of it. Then keep it handy and re-read it from time to time. Follow my suggestions carefully and you will help *me* give *you* the exact kind of instruction and service you want. Remember—every one of these suggestions is made for *your* benefit.

PLAN YOUR TIME



No matter what you start out to do, your job will be easier—and you will get better results—if you lay out a definite *plan*, and stick to that plan. So right at the beginning of your NRI course *plan* the way you are going to study. Think about this very carefully.

Now you probably work about 8 hours a day and sleep 8 hours. So that leaves 8 hours for other activities. Why not *plan* to use two or three of these hours for your Radio studies and experiments? If you can *average* only *one* hour a day, you can make fair progress. But try your best to arrange a *plan* that calls for two hours or more of study, at least 5 days per week.

Then decide on definite hours for study. Write your *plan* down on paper—*and stick to it.* Remember that REGULARITY—day after day and week after week—will most quickly bring you the money-making knowledge you are after.

FOLLOW "STUDY SCHEDULES"

In the front of each book you will find a "Study Schedule." These "Study Schedules" make your lessons easier by dividing the books into sections. Complete as many sections as you have time for, whenever you study a lesson. But always make it a point to complete *at least* one section before you stop.

HOW TO ANSWER LESSON QUESTIONS

On the last page of each lesson text, you will find ten examination questions. These questions cover subjects you have just studied. As you study a lesson according to the Study Schedule, answer the questions as you go along. Just write out the answers in your own words. (No need to copy the questions—just give the numbers opposite or above your answers.)

Then mail in these answers for grading. To get best service, send me the answers to *one lesson at a time.* Also, keep a record of the lesson answers you send me. A simple way is to put a check mark—and the date—along side the words "Lesson Questions" in each text book, as soon as you send in your answers.

Now here's an important tip about the examination questions: Many of them should be easy for you to answer. Some will require much thought. A few may seem quite difficult. On each question, you should think out the full and complete answer in your own mind—then write it out in as few words as possible.

Just do your best and put enough time on each lesson so you can say that you have given it careful study. If you need help, write us and mention the specific points that are bothering you. When you have answered and written down *all ten* of the lesson questions to the best of your ability—mail your lesson sheet to us at once—then *get going on your next lesson without any delay!*

HINTS ON THE WAY TO START YOUR FIRST LESSON

Take the lesson numbered 1FR (Introducing You to Radio) and a sheet of your "Answer Paper." Now first of all, ready the Study Schedule. Then read lesson 1, section by section, as directed in the Study Schedule, and answer the questions as you go along.

How should you answer the questions? Let's take Question 1—"What is an audio signal?"

You'll probably know the answer to this question as soon as you finish Step 3 as directed by the Study Schedule. So your answer to Question 1 will be "An audio signal is sound in electrical form"—or you might answer "an audio signal is one which will produce sound if put into headphones or a loud speaker." Just answer the question ***in your own words,*** as briefly as you can.

Now let's take Question 5—"Will the current in a complete circuit ***increase, decrease*** or ***remain the same*** when you increase the voltage of the battery?" Well—when you have read the part of lesson 1 directed by Step 5 of your Study Schedule, you will know that the current will ***increase.*** So your answer to Question 5 is "increase."

This won't be so tough—will it? Just follow the Study Schedules, and answer the questions as well as you can. Study each lesson *carefully*—but don't hold up sending in an examination because a few questions puzzle you. Go ahead and make a few mistakes! I'll catch them—and help you correct them. That's what I'm here for.

HOW TO SEND EXAMINATION ANSWERS FOR GRADING

Write out your answers as neatly and legibly as possible, using pen and ink. Or if you have a typewriter, so much the better. Then when you finish, don't take a chance on having some of your good work lost. ALWAYS *print* your name, address, student number and lesson number on each answer sheet you send me. This is very important.

Then be sure your envelope is properly addressed and stamped. And *mail* it. Don't stick it in your coat pocket and forget it!

HOW FAST TO STUDY

You probably will get the most out of our course by averaging one lesson a week. I strongly advise you against hurrying. Thoroughness is more important than speed. You also will find it well worth while to review your lessons regularly. Every time you complete a group of five lessons, review for a few hours. When you finish lesson 5, go back and read through lessons 1, 2, 3, 4, and 5 again. Review in this manner every time you complete a group of five lessons. This practice will help you clear up points that were "hazy" the first time—and will help fix important facts in your mind.

DO NOT TRY TO MEMORIZE

One thing I want to impress upon you is that ***memorizing*** is not ***learning.*** To really LEARN, you will need to memorize only a ***very few*** terms and rules. Your important objective in studying your course will be to: 1. ***Understand*** the facts presented—and 2. Either remember these facts so you can recall them ***in your own words,*** OR remember where to look them up when you need them.

EXPLANATION OF WAY IN WHICH LESSONS ARE NUMBERED

You will probably wonder what some of the numbers and letters on your lessons mean. I'll explain by taking this typical lesson number as an example: ***12FR2.*** The number "12" shows the book's location in your course—it is the *twelfth* lesson. The letters "FR" are for our information here, and tell us the ***series*** in which the book belongs. The number "2" is the ***edition*** number of that particular book and is also for our information.

When you write us about a lesson, please use the exact numbers and letters printed on that lesson. Then there can be no question about ***which*** book you are referring to.

WHEN YOU DRAW DIAGRAMS

From time to time you will be asked to draw diagrams. Use a pencil for these drawings and draw the diagrams from memory if you can. Some of the advanced, complete circuit diagrams ***need not*** be drawn from memory. The benefit you get from drawing them will be in understanding what you draw and in reviewing the principles involved.

Do not let the drawing of diagrams worry you. I don't expect you to be an artist or expert draftsman!

HOW WE SEND NEW LESSONS

At the present time, we send you six lessons when you enroll. Then we send ***one NEW lesson*** each time you send in a lesson for grading. For example, when you send answers to lesson 1 for grading, we grade and return your examination and send ***new lesson*** 7. When you send answers to lesson 2 for grading, we send you new lesson 8—and so on. This means we always keep about ***six lessons ahead of you.*** You will always have plenty of new lessons on hand. Your graded answers are returned by First Class Mail. The new lessons are sent by Third Class Mail and probably will arrive a few days later.

To insure absolute accuracy in addressing new lessons, we ask YOU to prepare the label for each new lesson. As you will see, we supply the labels. And as you send lessons for grading, you make out labels showing the address to which the new lessons are to be sent.

In order to give you efficient and economical service, the above method of sending new lessons may be changed from time to time. But any change will be for the purpose of ***serving you better.*** And we will always make it a point to keep you well supplied with lessons so you will never have to wait or slow down your studies.

USE YOUR STUDENT NUMBER

We can give you ***much faster service*** if you will ***always*** remember to use your Student Number when you send mail of any kind to NRI. Use your student number, and your records can be located just as soon as your letter reaches us. Otherwise, your letter or lesson answers will have to go to the Filing Department—your student number will have to be looked up—and this sometimes delays mail as much as a day or possibly more.

Remember—we might have ***several*** students with names and initials the ***same*** as yours—but we have only ONE man with your student number!

ALWAYS PRINT YOUR NAME AND ADDRESS

Whenever you write your name and address on a lesson, a letter, an envelope or a label—please ***print.*** For one thing, this will help prevent mix-ups. And also, this will be good practice for you. When drawing diagrams of Radio circuits, you'll find it very handy to be able to print rapidly and clearly.

No matter how perfect your regular handwriting may be, ***printed*** names and addresses are easier to read and are more foolproof. Postal Clerks, Mail Clerks, and File Clerks handle a lot of mail in a hurry—and they can do a better, faster job with ***printed*** names and addresses.

WHEN WILL YOUR GRADED ANSWERS BE RETURNED?

Your answers usually will be graded the day they reach NRI—and by the end of the following day will be on the way back to you. Remember though—every set of answers you send in will receive individual, personal service. This kind of service and attention must not be hurried. So do not be concerned if slight delays happen from time to time. And also keep in mind the fact that week-ends and holidays can delay both Postal service and NRI service!

WHEN YOU ASK QUESTIONS

Please use the regular Consultation Service Blanks when you ask questions about a subject in your lessons or any Radio problem. When you write about matters which are ***not technical,*** just use any kind of paper you wish. But please DO NOT ask a question or write a letter on your ***Answer Sheets.*** To do so will cause unnecessary delay. We cannot grade your lesson and answer your letter at the same time—so either your lesson or your letter must be put aside. ***Please*** use the Consultation Service Blanks!

IF YOU MOVE

Tell us *promptly*, if you move to a new address. If possible, notify us ahead of time. Use one of the CHANGE OF ADDRESS NOTICES which we provide. This will help you be absolutely sure that the proper changes are made on your records here, and none of your lessons or experimental kits will be delayed or lost.

Also, when you move—give your local post office a definite ***order to change address.*** The post office or your mailman will give you a card on which you can order your address changed. This is a simple thing to do and will save you plenty of trouble and lost or delayed mail.

WHEN YOU SEND MONEY

Usually the cheapest, safest and most convenient way to send money is to buy a postal money order. You get a receipt each time, and if the money order is lost a duplicate can be obtained by making proper application to the post office. At some post offices ***Postal Notes*** also may be bought in amounts up to $10. This is a safe way to send a remittance, but before mailing BE SURE:

1. To write "NATIONAL RADIO INSTITUTE, WASHINGTON 9, D. C." on the ***front*** of the Note.
2. To write YOUR OWN NAME AND ADDRESS on the ***back*** of the Note.

You can also safely send payments by means of a personal check, bank draft, or express money order. It is ***very risky*** to send currency by ordinary mail, because you have no come-back if it goes astray. If you have to send currency always use REGISTERED MAIL.

IS YOUR MAIL BOX WELL MARKED?

If you live in an apartment house, a rooming house, or on a RFD route, be sure your mail box is well marked with your name. Perhaps the mailman on your route knows you well. But some day he may be on vacation—sick—or transferred to another route. If your mail box is clearly marked, the new carrier won't make a mistake.

IF MAIL IS DELAYED

Nine chances out of ten (or better) you will get through the course and receive all your material without delays or complications. Nevertheless, a mistake occurs once in a while. A new lesson text, a set of graded answers, even a letter, ***can*** be delayed for a short or even a long time, be mislaid or improperly delivered, or lost. If this should ever be your experience, you will want to know what to do.

First, ***make sure*** the item in question was not actually delivered to your home. Once in a while a student notifies us that a lesson text, for example, never reached him. Then he finds out that it was delivered, but mislaid or lost by someone in his own home. Accidents do occur in even the best regulated families. Be sure that you have a good, foolproof way of getting every piece of mail delivered to you, and keeping it from loss or destruction after it is delivered.

Second, ***allow enough time*** for mail matter to reach you. (Mail is delayed a few days, more often than it is lost.) For example, allow at least a week before writing us about non-delivery of a new lesson text after you have received your graded answers. And keep in mind the fact that holidays and week-ends are bound to slow down the mail.

IF A TEXT BOOK IS LOST

If a lesson text, reference book, etc. is lost in the mails—or is lost after you receive it—***please tell us promptly.*** I'll be glad to see that the missing book is replaced free of charge.

★ ★ ★ ★ ★

Have you read all these directions and suggestions carefully? Remember—they are to help you get ***more*** out of your course, and to help you get ***better*** service, ***faster*** service!

Now save this sheet. Read it again in a few days. Then keep it along with your NRI lessons so you can refer to it from time to time.

James A. Dowie, Chief Instructor

This is Your

FIRST ASSIGNMENT

In this package are the materials you need to get a flying start into your NRI Course.

Please inspect this Assignment—check each article by the list below—and if anything is missing, tell us.

"How to Get the Most Value Out of Your NRI Course"—This folder suggests ways for getting the most benefit out of your lessons. Be sure to read it carefully and keep for future reference.

"Change of Address Notices" Sheet. Keep until needed.

Answer Paper—A supply of paper punched for easy filing, and printed for your convenience, is enclosed. You'll also find some envelopes in this assignment, which you may use to send in your answers to the lesson questions.

"Radio Servicing Methods" Booklets—You will find the first six of these booklets on "How to Make Extra Money FIXING RADIOS" in this package, and will receive many more as you go ahead with your Course.

"Radio and Electronic Dictionary"—This is a special book to help you when you run across Radio expressions not clear to you—and it will become increasingly valuable as you go further into your Course.

Lesson Texts*—

1FR—Introducing You to Radio.
2FR—How Radio Programs are Sent from the Studio to Your Home.
3FR—Simple Radio Circuits and Meters.
4FR—Getting Acquainted with Receiver Servicing.
5FR—Radio Resistors and How They Are Used.
6FR—Radio Coils and How They Work.

You'll get more lessons as you study these. New lessons are sent to you as you send in your answers. Our system of sending you new lessons is fully explained in the letter you will receive with your graded answers to Lesson 1FR.

"How Much Is a Good Name Worth?"—We'd like to know your friends. You no doubt know one or more who could benefit by taking the NRI Course. Use this form for sending their names to us.

Folder—Describes the handy NRI Radiotrician Binder, NRI Pin, NRI Pennant, Lesson Paper and Envelopes, Stamp and Pad and tells you how you may order them.

"Learn by Doing"—Describes the NRI kits of experimental material for practical training. Please fill in the **card** which asks for information about your power supply and return it **promptly.**

*** Titles of lesson texts may change—latest book will be sent in every case.**

PLEASE READ OTHER SIDE OF THIS SHEET FOR IMPORTANT INSTRUCTIONS.

S36-15-348

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PLEASE FOLLOW THESE INSTRUCTIONS CAREFULLY

1. Always give your FULL NAME, COMPLETE ADDRESS and STUDENT NUMBER whenever you write to us.
2. Write your name and return address **on the envelope.** Be sure that the envelope is securely **sealed.**
3. Notify us promptly when you change your address. Use the "Change of Address" form.
4. Send all remittances by Post Office, Express or Bank Money Order, or by check. **Do not send cash unless by registered letter.** If you live in Canada or a foreign country, use International Money Order.
5. Mail directed to "National Radio Institute, Washington 9, D. C.," will reach us. Our street address is 16th and U Streets, N. W.
6. Consult us on your Radio problems, take us into your confidence about any condition or circumstance that may influence your progress with the course, or your future success in Radio—and make your letters clear and to the point so we can give you exactly the information you want.
7. To earn your NRI Diploma and Graduate Card you must submit and pass examinations on each lesson.

When Answering and Sending in Lesson Answers for Grading—

1. **Print** your **Full Name, Complete Address, Student Number** and **Lesson Number** at the top of each Answer Sheet. Include your street address, Rural Route number, Post Office box number or Postal Delivery Zone number if you have one. Be sure to do this neatly and clearly because your answers are returned in a window-face envelope.
2. Please read each lesson question **carefully** before you answer it. Be neat. Be accurate. Be clear but brief.
3. Write the **number** of the question in the left-hand margin. Start your answer to each question on a separate line.
4. **Do not copy the questions.** Write the answers only.
5. Use only one side of the paper. If you need more than one sheet to answer the questions of a lesson, number the sheets. Do not write the answers for more than one lesson on the same sheet of paper.
6. Write plainly. Use pen and blue or black ink, or typewriter with a good ribbon. Remember, our instructors must be able to read what you have written.
7. Send in the answers to only **one** lesson at a time. As soon as you finish a lesson, send your answers in for grading and correction. Answer **all** the questions—**never send in part of a lesson.**
8. Follow the numerical order of the lessons in sending in your answers. Do not skip any lessons.
9. Do not return the lesson text with your answers. The book is yours to keep.
10. If your lesson answers are returned marked "Low," it is below passing. You are required to submit another set of answers on any such lesson.
11. Do not ask questions or write letters on the same Answer Sheet on which you write answers to the questions of a lesson. For prompt service, submit your technical questions on a CONSULTATION SERVICE BLANK.

NATIONAL RADIO INSTITUTE
Washington 9, D. C.

BE SURE TO READ THE OTHER SIDE ALSO

FINAL EXAMINATION
PRACTICAL RADIO AND TELEVISION SERVICING COURSE
NATIONAL RADIO INSTITUTE
16TH AND U STREETS NORTHWEST
WASHINGTON 9, D.C.

No. FXRH-4

NAME Joseph A. Ricci E1-AC5
972 West 3rd St.
ADDRESS Plainfield, N. J.
CITY & STATE

DATE Sept. 17, 1952
STUDENT NUMBER E1-A05
GRADE C

Read Instructions Carefully Before Answering Questions

FILL OUT AND SEND IN THIS EXAMINATION AFTER YOU COMPLETE LESSON 65RH.

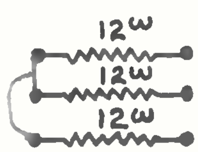
The questions in this examination are based on the lessons you have studied in your Course. Some of the questions are not directly answered in the lessons from which they are taken, but if you have mastered the lessons you will be able to give the correct answers.

Unless otherwise instructed in the question, you are to pick one and only one of the answers shown. The numeral preceding the answer you choose as correct is to be inserted in the space provided at the right of the question. Two examples are given below:

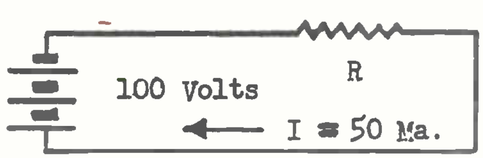
San Francisco is located in: 1, Nebraska; 2, New York; 3, Oregon; 4, California; 5, Texas. 4

San Francisco is not located in: 1, The Western Hemisphere; 2, The United States; 3, North America; 4, California; 5, Canada. 5

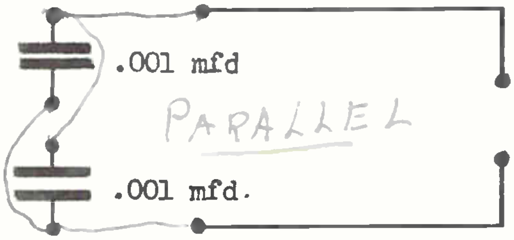
1. The purpose of the limiter in an FM receiver is to: 1, change FM into audio; 2, limit the frequency change in the FM signal; 3, cut off all signals above a certain amplitude. 3

2. 

With a pencil connect these resistors so their total value is 18 ohms.

3. 

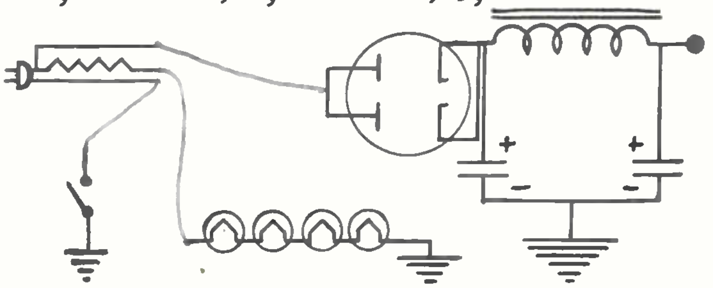
In order for 50 milliamperes to be drawn from this 100-volt source, resistor R must have a value of: 1, 150ω; 2, 1500ω; 3, 200ω; 4, 2000ω; 5, 5000ω. 3

4. 

Total Capacity = .002 mfd.

Draw in the connections so the total capacity is .002 mfd.

5. If the power factor of the input filter condenser in a receiver power supply using a half-wave rectifier increases, the dc voltage at the output of the filter will:
1, increase; 2, decrease; 3, remain the same; 4, drop to zero. 2

6. 

Complete the connections between the line cord and the rest of this power supply.

7. A superheterodyne receiver which has specially cut oscillator tuning condenser plates tracks at the high frequency end of the dial but not at the low frequency end. This trouble may be corrected by:
1, replacing the oscillator tube; 2, realigning the oscillator low frequency padder; 3, realigning the i-f amplifier. 3

8. An ac-dc receiver has the following tubes: 25Z5, 25L6, 6A8, 6K7, 6Q7. These tubes all have a filament current of .3 ampere, and the line voltage is 117 volts. The line cord resistor should have a value of approximately:
1, 165Ω; 2, 50Ω; 3, 1600Ω; 4, 360Ω. 1

9. If a dc voltage is measured across the power output tube grid resistor, and the grid end is positive, this shows that:
1, the circuit is working normally; 2, the tube is gassy or the coupling condenser is leaky; 3, the grid resistor is open; 4, convection current is flowing in the circuit. 1

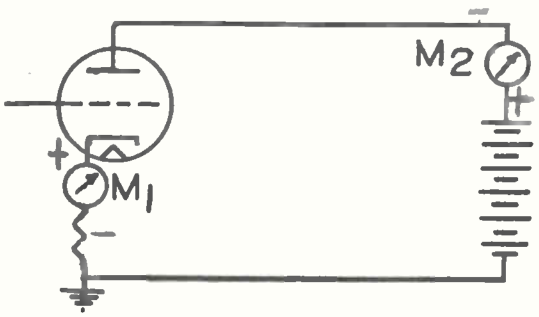
10. If in a TV receiver the video i-f and audio i-f carriers are allowed to beat together, a frequency of:
1, 21.25 mc; 2, 4.5 mc; 3, 9 mc; 4, 25.75 mc will be produced. 2

11. If the raster in a receiver using a 16" picture tube is tilted the trouble may be corrected by:
1, turning the picture tube; 2, turning the focus coil; 3, turning the deflection yoke. 3

12. If the vertical sweep in a TV receiver is not linear, the picture will be distorted extending from:
1, top to bottom (vertically); 2, left to right (horizontally). 2

13. The starting length of an open line stub to prevent FM station interference with TV programs should be:
1, 60 inches; 2, 30 inches; 3, 15 inches; 4, 42 inches. 2

14.



Put the proper polarity markings beside meters M_1 and M_2, so that they will read up-scale.

15. If the signal from a distant station fades in and out when reception from local stations is normal, fading is due to:
1, a defective tube; 2, intermittent local oscillator;
3, atmospheric conditions; 4, poor antenna; 5, defective speaker. 3

16. If with a superheterodyne receiver you are able to pick up only one station operating on the low frequency end of the band, and that station is spread out over most of the broadcast band, the:
1, set needs alignment; 2, oscillator is not operating;
3, loop antenna is open; 4, set needs a better antenna;
5, volume control is defective. 1

17. A single horizontal bar across the face of the picture on a TV receiver is due to:
1, 60 cycle hum getting into the picture circuits; 2, 120 cycle hum getting into the picture circuits; 3, sound getting into picture; 4, defective filter condensers in a set using a power transformer; 5, open coupling condenser in video amplifier. 1

18. In a TV receiver using a "Kick-Back" high voltage supply, a raster which has collapsed into a thin bright vertical line on the face of the picture tube indicates:
1, a defective horizontal oscillator; 2, a defective horizontal output tube; 3, a defective yoke; 4, a defective high voltage rectifier; 5, a defective damping tube. 3

19. In a broadcast band superheterodyne, the oscillator frequency is usually:
1, the same as; 2, higher than; 3, lower than; the frequency of the signal to which the receiver dial is set. 2

20. We can lower the frequency of an oscillator tank circuit using a powdered-iron, adjustable-core coil by:
1, turning the core farther into the coil; 2, turning the core to draw it out of the coil. 1

ANSWERS TO QUESTIONS

HERE are the correct answers to the questions in this Lesson. Compare your own with the standard by which they were graded. Where we felt it would be helpful, the correct answer and reason for it, or how it was derived, is given. Your own answers should always be brief, to the point.

LESSON 65RH-4 - TV RECEIVER ALIGNMENT

1. Poor high-frequency response.

2. Poor low-frequency response.

3. Used to cause the double trace on the oscilloscope to overlap and form one image.

4. To restrict the width of the pip.

5. The gains of the stages will change, and the over-all response will therefore be altered.

6. Because the tube will act as a decoupler and prevent the generator from detuning the circuit being aligned.

7. There is a poor ground connection between the instruments and the set.

8. Overloading will cause a false flattening of the response curve.

9. The video i-f response of an intercarrier set is more symmetrical so that a part of the sound i-f signal will pass through the video i-f.

10. At the point of sound take-off and in any following video stage.

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Prepare at Home for a Better Future in Radio and Television

ANSWER SHEET

NATIONAL RADIO INSTITUTE
16TH AND U STREETS NORTHWEST
WASHINGTON 9 D. C.

INSTRUCTION DEPARTMENT

DATE Aug. 20, 1952

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.
~~Plainfield, N. J.~~

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 65 RH-4
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- The response of the set is less than 4 mc., it is out of aligment, or it is intended to be less than 4 mc. The high-frequency response can be determining by observing where the line in the (Vertical) wedge appear to blend.

2- Low-frequency response.

3- To permit the sweep image to be overlapped.

4- To have a limited series of beats.

5- The over-all response of the I.F. amplifier will be greatly affected.

6- The tube will act as a decoupler & prevent the generator from detunning the circuit.

7- Poor ground connection between set & equipment.

8- Some stages will be overloaded, to the extend that they will act as a limiter, & produce a false flatting in the trace of the over-all response, on the face of the oscilloscope

9- The over-all video response of an intercarrier set is ~~more~~ symmetrical on the two side than that of a conventional set.

10 To remove the 4.5 mc. beat from the picture signal before it is applied to the picture tube.

10

These sheets available 100 for 75¢; 60 addressed envelopes 50¢. OR 100 sheets AND 60 envelopes BOTH for $1, remittance with order.
PLEASE DO NOT WRITE ON THE BACK OF THIS SHEET.

NATIONAL RADIO INSTITUTE, 16th and U Sts., N. W., Washington 9, D. C.

ANSWERS TO QUESTIONS

HERE are the correct answers to the questions in this Lesson. Compare your own with the standard by which they were graded. Where we felt it would be helpful, the correct answer and reason for it, or how it was derived, is given. Your own answers should always be brief, to the point.

LESSON 64RH-3 - SERVICING TV RECEIVERS FOR PICTURE DISTORTIONS

1. Poor focus.

2. Poor low-frequency response.

3. A decrease in the output of the high-voltage supply.

4. (A) cathode-to-heater leakage, and (B) defective power-supply filter.

5. 600 cycles.

6. 5 x 2.8 = 14 volts peak-to-peak.

7. Good low-frequency response; extended high frequency response; high sensitivity; low input capacity.

8. The i-f signal is too high in frequency to be viewed, so it must be rectified to permit viewing the modulation.

9. The sweep will distort one wave, so more than one is needed if the exact wave shape is to be viewed.

10. Poor high frequency response.

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Prepare at Home for a Better Future in Radio and Television

ANSWER SHEET

INSTRUCTION DEPARTMENT

NATIONAL RADIO INSTITUTE
16TH AND U STREETS NORTHWEST
WASHINGTON 9 D. C.

DATE Aug 2, 1952

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.
Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 64RH-3
{NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.}

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

1- #1 Poor focus

2- #4 Poor low-frequency response

3- Decrease in the output of the high-voltage supply.

4- A - One bar - Cathode-to-heater leakage.
B - Two bar - Filter defect.

5- 600 cycle = 60 x 10 = 600

6- 14 Volts = 5 x 2.8 = 14 Volts.

7- (1) High sensitivity; (2) good low-frequency response (down to 60 cycles or better); (3) good high-frequency response (up to 1 megacycle or more); (4) low-input capacity tracing.

8- To rectified the encoming signal, so that modulation is available for the oscilloscope.

9- To get a better idea of the actual wave shape.

10- The high frequency response is lost, & there is a lost of picture detail.

NATIONAL RADIO INSTITUTE, 16th and U Sts., N. W., Washington 9, D. C.

ANSWERS TO QUESTIONS

HERE are the correct answers to the questions in this Lesson. Compare your own with the standard by which they were graded. Where we felt it would be helpful, the correct answer and reason for it, or how it was derived, is given. Your own answers should always be brief, to the point.

LESSON 63RH-2 - TV RECEIVER SERVICING TECHNIQUES

1. It has high capacity for its size, and its small size reduces lead inductance and stray capacity.
2. Low-voltage supply or filament supply.
3. Shorted vertical and horizontal yoke windings.
4. Vertical sweep or vertical yoke.
5. One that uses an intercarrier system.
6. Vertical sync pulse.
7. A moire pattern is produced on the lines in the horizontal wedges.
8. Horizontal sync chain.
9. Hanging a magnet near the horizontal sweep amplifier output tube.
10. Leakage in the coupling condensers between the sweep output tubes and the picture tube.

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Prepare at Home for a Better Future in Radio and Television

ANSWER SHEET

INSTRUCTION DEPARTMENT

NATIONAL RADIO INSTITUTE
16TH AND U STREETS NORTHWEST
WASHINGTON 9 D. C.

DATE July 14, 1952

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 63 RH-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

1- They are very small + still have a high capacity.

2- Low-voltage supply or in filament circuit.

3- Horizontal yoke shorted, please vertical sweep or yoke trouble.

4- Vertical sweep or yoke

5- Inter-carrier system.

6- Low-frequency response

7- A coarser picture + produce a moire pattern pattern on the lines in the horizontal wedges of a test pattern.

8- The sync. chain.

9- A magnetic field - mount a bar magnet near the tube on the shield of the high-voltage container, use ion trap magnet around the tube or near the tube.

10- Leakage in the coupling condenser, between the sweep output tube + the picture tube.

These sheets available 100 for 75¢; 60 addressed envelopes 50¢. OR 100 sheets AND 60 envelopes BOTH for $1, remittance with order.
PLEASE DO NOT WRITE ON THE BACK OF THIS SHEET.

NATIONAL RADIO INSTITUTE, 16th and U Sts., N. W., Washington 9, D. C.

ANSWERS TO QUESTIONS

HERE are the correct answers to the questions in this Lesson. Compare your own with the standard by which they were graded. Where we felt it would be helpful, the correct answer and reason for it, or how it was derived, is given. Your own answers should always be brief, to the point.

LESSON 62RH-2 - TV INTERFERENCE AND SPECIAL TV INSTALLATIONS

1. Reduce the direct pickup in the set by shielding, and increase the desired signal pickup from the antenna.

2. Regeneration and improper alignment of the video i-f amplifier.

3. Higher.

4. Series resonant.

5. Use a booster.

6. The adjacent-channel sound trap.

7. A stacked array.

8. The horizontal sweep circuits.

9. Install parallel resonant wave traps in each side of the transmission line, turning them to the frequency of the overstrong station.

10. Use a high-gain antenna array, and use a booster with each receiver.

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Prepare at Home for a Better Future in Radio and Television

ANSWER SHEET

NATIONAL RADIO INSTITUTE
16TH AND U STREETS NORTHWEST
WASHINGTON 9 D. C.

INSTRUCTION DEPARTMENT

DATE June 21, 1952

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 62 RH-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR

LESSON GRADE B

PRINT your name and address *very plainly* on the lines provided above

1- (1) Reduce the direct signal pickup in the receiver by shielding the R.F. + detector circuit, or by shielding the entire chassis.

(2) Increase the signal from the antenna.

2- (1) Incorrect alignment of the I.F. Amplifier

(2) By Regeneration

3- Higher

4- Parallel resonant circuit

5- Can try a booster

6- The sound trap.

7- A stacked array

8- The horizontal sweep circuit

9- Installing a parallel resonant wave trap in the transmission line.

10- (1) Use a high-gain antenna array

(2) An array plus a booster to make up for the loss of signal strength.

These sheets available 100 for 75¢; 60 addressed envelopes 50¢. OR 100 sheets AND 60 envelopes BOTH for $1, remittance with order.
PLEASE DO NOT WRITE ON THE BACK OF THIS SHEET.

NATIONAL RADIO INSTITUTE, 16th and U Sts., N. W., Washington 9, D. C.

ANSWERS TO QUESTIONS

HERE are the correct answers to the questions in this Lesson. Compare your own with the standard by which they were graded. Where we felt it would be helpful, the correct answer and reason for it, or how it was derived, is given. Your own answers should always be brief, to the point.

LESSON 61RH-2 - INSTALLATION ADJUSTMENT OF TV RECEIVERS

1. If the glass portion of the tube is accidentally touched, leakage paths may be set up that can interfere with reception and may also become a shock hazard.
2. To aid in locating the ion trap properly.
3. These loops form the ground contact for the coating.
4. The brightness should be decreased.
5. The vertical lines may be bent, the picture may be badly distorted, or sync may be lost.
6. To prevent burning of the second anode.
7. (a) By rotating the deflection yoke; (b) by rotating the tube.
8. The ion trap, the focus coil, or both.
9. Doing so will interfere with proper ventilation of the set.
10. The viewing distance should be 6 to 8 times the height of the picture.

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ANSWER SHEET

INSTRUCTION DEPARTMENT

NATIONAL RADIO INSTITUTE
16TH AND U STREETS NORTHWEST
WASHINGTON 9 D. C.

DATE May 31, 1952

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 61 RH-2

{NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.}

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A+

PRINT your name and address *very plainly* on the lines provided above

1- The finger marks on the glass section of the tube funnel may create leakage paths that will interfere with reception, & may create a shock hazard also.

2- To use as a guide in initially positioning the ion trap.

3- They ground the outer coating of the tube & should make good contact.

4- The brightness control should be lower until the retrace lines disappear.

5- Contrasty — too light in places, too dark in other. The vertical lines will usually be bent.

6- The second anode of the picture tube may be seriously damadge or ruined.

7- (A) by rotating the deflection yoke.
(B) by rotating the picture tube.

8- The Ion trap & possible the focus coil.

9- To allow the heat to escape though the back of the set, & other ventelation holes in the receiver cabinet.

10- Equal to 6 to 8 times the height of the picture.

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PIONEER HOME STUDY RADIO SCHOOL **CONSULTATION SERVICE**

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WASHINGTON 9, D. C.

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Chief of Training

TAC:60

T70-748

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ANSWERS TO QUESTIONS

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LESSON 60RH-3 - HOW TO SELECT AND ERECT TV ANTENNAS

1. Eliminating ghosts and picking up all stations.
2. When all stations are in the same general direction or by using a rotator with the antenna.
3. Because the electrical code permits it to be carried about through exposed cable.
4. The band width over which reception is secured is increased.
5. Because the set will show the kind of picture that can be secured, whereas the meter will measure noise as well as signal pickup.
6. To the wall of the building.
7. To prevent them from affecting the radiation pattern of the antenna.
8. To keep water out.
9. To minimize pickup of local interference.
10. To minimize pickup of ignition interference from passing cars.

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DATE May 19, 1952

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.
Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 60 RH-3

NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- Reflection, & Ghosts

2- (1) A fixed antenna, or a combination of fixed antenna.
(2) A highly directive broad-band antenna that can be rotated mechanically to pick up the desired station.

3- The electrical code permits it to be carried about through an exposed cabel.

4- It gives a broad-band reception.

5- It will let you see how good a picture is being received. a meter may show a high signal level when it actually is picking up more noise than signal.

6- To the side of the house.

7- To prevent it from affecting the radiation pattern of the antenna.

8- To keep water out of the jacket.

9- To reduce pickups of local interference.

10- It is less likely to pickup ignition interference

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ANSWERS TO QUESTIONS

HERE are the correct answers to the questions in this Lesson. Compare your own with the standard by which they were graded. Where we felt it would be helpful, the correct answer and reason for it, or how it was derived, is given. Your own answers should always be brief, to the point.

LESSON 59RH-3 - HOW TV ANTENNAS WORK

1. There is a certain amount of refraction (bending of the TV waves) in the atmosphere.

2. 50 miles.

3. A ghost will be produced.

4. (a) 73 ohms; (b) 2000 ohms; (c) 90 ohms.

5. 42 degrees.

6. It is more important to match the line to the receiver, because doing so will prevent ghosts.

7. A length that is $\lambda/4$ long at the resonant frequency of the low-band antenna.

8. The active element is made of a single rod rather than of a pair of rods, and the transmission line is connected to the active element at points equidistant from the center of the element.

9. 300 ohms.

10. To the line.

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ANSWER SHEET

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NATIONAL RADIO INSTITUTE
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WASHINGTON 9 D. C.

DATE May 9, 1952

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 59 RH-3

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

1- There is a certain amount of refraction (bending)

2- 50 miles

3- You will have a ghost.

4- $\lambda/2$ = 73 ohms, λ = 2000 Ohms, $3\lambda/2$ = 90 Ohms.

5- 42° Angle

6- To that of the receiver, because you will get line reflection (ghosting), blurring of picture, unless you do.

7- $\lambda/4$ long.

8- It is made of one rod, instead of a pair of rods.

9- 300 ohms.

10- To the line.

ANSWERS TO QUESTIONS

HERE are the correct answers to the questions in this Lesson. Compare your own with the standard by which they were graded. Where we felt it would be helpful, the correct answer and reason for it, or how it was derived, is given. Your own answers should always be brief, to the point.

LESSON 58RH-3 - SPECIAL TV RECEIVER SYSTEMS

1. The coupler is needed to match the impedance of the detector load to the impedance of the coaxial line to prevent excessive loss of signal.

2. Only the end one on the line.

3. Either a considerable portion of the picture sides must be sacrificed, or else the aspect ratio must be changed, which produces a distorted picture.

4. The size of the image is increased, and the viewing angle is decreased.

5. To bring all the light rays from one point to a focus at one point.

6. To prevent light from the picture tube from being reflected right back to the tube face where is would reduce the picture contrast.

7. So light will not be lost in travelling into and out of the glass by diffraction or absorption.

8. Some fluids attack plastics; follow the manufacturer's recommendations.

9. The ambient light passes through the filter twice, once going into the tube face, and again coming out. Hence, the ambient light is reduced by the square of the filter factor. If the factor is .5, the reduction will be .5 x .5 which gives .25 (one quarter).

10. Line resolution.

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DATE April 16, 1952

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.
Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 58 RH-3

NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

1- The Coupler Stage acts as an impedance matcher between the high impedance of the detector load.

2- The last one.

3- We would have to sacrifice a considerable portion of the picture, or to accept a distorted picture.

4- (1) Magnified image of the tube face to viewer,
(2) The further apart the lens + tubes are, the larger this image will be.

5- To bend various rays of light so that they all come to the same focal point.

6- So as not to reflect light at all. (so the light from the picture tube will not be reflected back to the picture tube.

7- So the light will not have to go through the glass + strike the reflecting coating, + then come back through the glass,

8- The chemical in some cleaning fluid may eat away the plastic.

9- because it must go through filter second time to come out.

10- The image detail must be degraded by reducing the line resolution

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ANSWERS TO QUESTIONS

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LESSON 57RH-3 - TV RECEIVER POWER SUPPLIES, SOUND CHANNELS, AND A.G.C.

1. To prevent the supply from causing interference in the set.

2. Because the supply operates only during the horizontal retrace, when the picture tube is kept blank.

3. Voltage multiplier circuits do not require the use of a transformer and rectifier capable of handling extremely high voltages, both of which are expensive.

4. To protect the tubes when the set is first turned on.

5. (1) In the video i.f. amplifier; (2) in the video amplifier.

6. The picture will have a grain pattern, and there will be bars across it.

7. Maximum sound is fed to the sound i.f. stages and minimum sound is passed on to the succeeding video i.f. stages.

8. So that the signal will be amplified without having to use additional 4.5-mc. stages.

9. To prevent overloading and distortion on strong signals.

10. (1) The set may lose vertical sync; (2) the picture will have holes in it when noise is present.

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R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.
Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 57 RH-3
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- (a) To help keep interference at a minimum.
(b) It help to serve as a safty device.

2- The picture tube face is kept blank during interval by the pedistal, + the sync pulse. (any interference that might be produce by the oscillator will not be visible.

3- It is less expensive.

4- To protect the tubes when the set is first turned on.

5- (1) In the video I.F. Amplifier, (immediately following the converter or after the 1st, or 2nd I.F. amplifier
(2) In the Video Amplifier.

6- (1) A very fine grained dot pattern.
(2) The Audio signal will produce bar across the picture.

7- (1) A maximum sound signal is fed to the sound I.F. Stage.
(2) A minimum sound signal is passed on to the succeeding video I.F. Stage.

8- There is a necessary increase in strength of the signal, when taken at the output of the video Amplifier.

9- The R.F. gain is needed to overcome Converter Noise.

10- (1) Too Short will make set lose vertical sync.
(2) Too Long will give noise interference.

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ANSWERS TO QUESTIONS

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LESSON 56RH-3 - TELEVISION SYNCHRONIZING CIRCUITS

1. Clipping is the separating of sync signals from the video signal; segregation is the separating of the horizontal from the vertical sync signals.
2. Sharply peaked.
3. It is necessary to line up the pedestals so the sync pulses can all be separated from the video signal.
4. Output stage.
5. It provides amplitude limiting in addition to clipping.
6. Positive.
7. To ignore the horizontal pulses, the charge stored by them must be small; only the long-time vertical pulse must be able to produce a control pulse.
8. The leading edge.
9. Noise that moves the leading edge of the horizontal pulses will upset synchronization.
10. Because this permits abnormalities in individual pulses to be ignored.

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DATE March 14, 1952

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R. F. D. NO. OR STREET ADDRESS 972 West 3rd St. Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 56 RH-3

{NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.}

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- When more than one separation involved, the first operation is called clipping.

The operation of separating the two kinds of pulses is called segregation.

2- Sharply peaked.

3- To get the pedestals lined up before a television signal can be clipped.

4- The First Video Amplifier

5- It has a limiting Amplitude, This circuit can take sync pulses of different Amplitude + produce pulses of constant amplitude from them.

6- Positive Phase

7- To have the Vertical + Horizontal circuit fired at different time

8- Leading Edge.

9- #3 - Noise moving the leading edge of a sync pulses.

10- So that the Average of pulses, for several lines is used, instead of individual pulses, so that abnormal pulses are ignored.

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ANSWERS TO QUESTIONS

HERE are the correct answers to the questions in this Lesson. Compare your own with the standard by which they were graded. Where we felt it would be helpful, the correct answer and reason for it, or how it was derived, is given. Your own answers should always be brief, to the point.

LESSON 55RH-3 - TV SWEEP CIRCUITS

1. If the beam is allowed to stand still, it will burn a spot on the screen.
2. An electrostatic deflection system is voltage-operated; an electromagnetic deflection system is current-operated.
3. Non-linear sweep.
4. Lower than the desired frequency.
5. Increase.
6. A trapezoidal voltage waveform.
7. When the pentode connection is used, the circuit is basically resistive, and the inductance of the coils is too small to affect the wave shape.
8. Because the picture is wider than it is high, and more sweep voltage is needed to produce this greater width.
9. No.
10. Because it permits the operating point of the tube to be moved to a more linear portion of the e_g-i_p characteristic.

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R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

~~Plainfield, N. J.~~

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 55 RH-3

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- To keep the beam distributed over the face of the tube, so there is no danger of burning the flourescent screen material.

2- The electrastatic deflection system.

3- Non-linear sweep.

4- Lower

5- Increase

6- Trapezoidal wave.

7- You can have a very high plate resistance of the Pentode tube in series with a relativity small load reflected into the primary circuit of transformer, (The plate circuit is so small that the circuit is basically resistive.)

8- The picture with is greater than the picture hight by a ratio of 4 to 3, so more voltage is needed for the horizontal sweep than for the Vertical sweep.

9- No —

10- To find the most linear part of the characteristic of the tube.

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ANSWERS TO QUESTIONS

HERE are the correct answers to the questions in this Lesson. Compare your own with the standard by which they were graded. Where we felt it would be helpful, the correct answer and reason for it, or how it was derived, is given. Your own answers should always be brief, to the point.

LESSON 54RH-3 - VIDEO AMPLIFIERS AND DC RESTORERS

1. A voltage amplifier.

2. It is possible to secure a positive picture by feeding a signal of negative picture phase to the cathode of the picture tube.

3. So that the system will reproduce slow changes in brilliancy or gradual changes in shading from light to dark.

4. The load is shunted by the input and output capacities of the tubes.

5. By the high-frequency response.

6. A grain trap is used.

7. It is necessary to bring the pedestal levels back into line with the brilliancy cut-off point on the E_g-B characteristic curve so retrace lines will not be visible in the picture.

8. Because the diode capacity would shunt the amplifier plate load, thus reducing the high-frequency response of the video amplifier.

9. Several lines (usually about 10 to 20 lines).

10. No.

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STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 54 RH-3

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- Voltage Amplifier

2- To cathode of the picture tube.

3- To have slow change in brilliancy or gradual change in shading from light to dark.

4- When the scanning spot moves from a light to a dark object in a scene.

5- High-Frequency response.

6- A grain trap is to elimanate whatever beat there is between the sound + video carriers signal.

7- To bring the pedestal level back into line with the brilliancy cut-off.

8- The diode capacity would then be shunting the amplifier plate load, + would reduce the high-frequency response of the system

9- Several lines.

10- No. each stage is independent of the other.

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ANSWERS TO QUESTIONS

HERE are the correct answers to the questions in this Lesson. Compare your own with the standard by which they were graded. Where we felt it would be helpful, the correct answer and reason for it, or how it was derived, is given. Your own answers should always be brief, to the point.

LESSON 53RH-3 - VIDEO I-F AMPLIFIERS AND VIDEO DEMODULATORS

1. Separate carriers.
2. If the sound carrier is allowed to reach the video detector, it will beat with the picture carrier to produce a 4.5-mc. beat that causes a "grain" pattern on the picture.
3. Higher.
4. Stagger-tuned parallel-resonant loads, and overcoupled band-pass transformers.
5. To remove the peaks produced by the overcoupling so that a flatter response can be obtained.
6. Trap circuits are used to sharpen slopes.
7. A sound trap may be used as a source of the signal for the sound i-f section.
8. The screen voltage is fed through a series resistor so that the screen-grid voltage changes counteract somewhat the bias changes.
9. Positive.
10. To allow the high-frequency components of the video signal to pass.

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DATE Feb. 4, 1952

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.
Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 53 RH-3

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR

LESSON GRADE C

PRINT your name and address *very plainly* on the lines provided above

1- Separate Carriers

2- So the two carriers will beat against each other to produce a 4.5 mc. signal.

3- The same

4- (1) Stagger tuned circuit, (2) Band-Pass Coupling.

5- It will reduce the peak, + produce a over-all response that is almost flat.

6- Connecting either of the two broad-band I.F. response used in Cascade

7- Adjacent-channel traps

8- Using a series resistor in its screen-grid circuit

9- Positive picture phase.

10- So as not to interfer to much with the reproducing of all the high-frequency components.

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MODEL ANSWERS

TV Input Tuners. No. 52 RH-2

1. The i.f. amplifier.
2. The preselector circuits have low Q to get the pass band; this causes poor selectivity and hence poor image rejection.
3. Low.
4. To prevent inductive effects in the cathode lead from causing an apparent decrease in the input resistance.
5. Neutralization or use in grounded-grid circuit.
6. 75 ohms.
7. At the input of the r.f. stage.
8. To cut out interference at the i.f. frequency, and to prevent the converter oscillating.
9. The internal tube capacities affect the tuning ranges, so it is necessary to get one close to the original in capacity to maintain the same tuning ranges.
10. A fine-tuning control, or an a.f.c.

In order to get the greatest good from your work on this lesson, go over your graded answers carefully. Give special attention to any written comments. Reductions in grade are shown as follows: -2. Mistakes in answers and drawings are marked. Refer to the textbook when improvement is desired and review subject thoroughly.

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DATE Jan. 17, 1952

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 52 RH-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- The I.F. Amplifier

2- The T.V. input tuner has a low Q of the preselector circuit, to give the required pass band for image rejection, as they have poor selectivity

3- Low

4- To reduce the effects of an inductive cathode lead.

5- Neutralization, or by use of the ground-grid circuit

6- Same

7- #1 - at the input of the R.F. Stage.

8- 1- They keep the two tube grid at a very low impedance with respect to ground at I.F. frequency.

2- to prevent oscillation in the mixer.

9- To find a tube that has internal capacity not too far different from the original tube.

10- 1- by using the fine-tuning control

2- by use of A.F.C.

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MODEL ANSWERS

How the TV Picture Tube Works. No. 51 RH-3

1. To attract the secondary emission electrons that come from the screen, and thus to prevent the formation of an electron cloud in front of the screen.
2. This serves to focus the electron beam to a sharp point on the fluorescent screen.
3. By carrying the voltage between a pair of deflection plates it is possible to center the beam and hence the picture on the screen.
4. To distribute the power dissipation and voltage among several resistors.
5. Vertical deflection.
6. It is adjusted for the brightest raster.
7. The aluminum backing prevents the ions from striking the fluorescent screen so they cannot produce an ion burn.
8. This cuts down on internal halation as well as external glare.
9. Best focus over the entire picture area will be obtained with a tube having a curved face.
10. The metal shell is the second anode connection to B++ and if you touch the shell while the set is on you can receive a shock.

In order to get the greatest good from your work on this lesson, go over your graded answers carefully. Give special attention to any written comments. Reductions in grade are shown as follows: -2. Mistakes in answers and drawings are marked. Refer to the textbook when improvement is desired and review subject thoroughly.

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Prepare at Home for a Better Future in Radio and Television

ANSWER SHEET

INSTRUCTION DEPARTMENT

NATIONAL RADIO INSTITUTE
16TH AND U STREETS NORTHWEST
WASHINGTON 9 D. C.

DATE Jan. 5, 1952

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 51 RH-3

NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

1- To prevent electron clouds from forming inside the glass envelope

2- To provide a simple way of focusing the electron beam to a spot.

3- So as to have a Horizontal centering + Vertical centering control.

4- (1) The heat dissipation is high, so even a comparatively high wattage rating is not satisfactory in a single resistor

(2) Less of a chance, of the focusing of the electron beam going off, if wattage rating of individual resistor is not exceeded.

5- # 2 Vertical deflection

6- There will be no shadow in any corner or side, + have a bright raster.

7- The large ions cannot penetrate the aluminum to strike the screen, + cause a formation of an ion spot burn on the screen.

8- It reduces both halation + the external glare

9- One with a reasonable amount of curvature.

10- The Metal Shell serves as the Anode, + is at a high potential, being electrically connected to the anode gun through a conductive coating deposited on the inside of the glass neck section.

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ANSWERS TO QUESTIONS

HERE are the correct answers to the questions in this Lesson. Compare your own with the standard by which they were graded. Where we felt it would be helpful, the correct answer and reason for it, or how it was derived, is given. Your own answers should always be brief, to the point.

LESSON 5ORH-2 - BASIC TV RECEIVER CIRCUITS

1. Negative picture phase.
2. Because the condenser removes the d.c. component from the signal.
3. Because the sync pulses are not constant in amplitude and duration and will not therefore produce a saw-tooth voltage of the desired shape and frequency.
4. So that the sync pulses can control the unblocking of the oscillator and thus control its frequency.
5. By reversing the connections of the diode tube.
6. To keep all the sync signals invisible and all the picture signals visible.
7. To give wide-band response.
8. To increase the low-frequency response.
9. To damp out any tendency toward self oscillation in the circuit.
10. It separates the sync pulses from the video signal.

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DATE Dec. 14, 1951

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 50 RH-2
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- Negative Picture Phase

2- It removes the d.c. component from the T.V. signal.

3- The shape of saw-tooth output wave depend upon both the amplitude + duration of the pulses fed into it. There must be a constant amplitude + correct duration

4- The sync pulses will then arrive just before the oscillator can unblock by itself, + will therefore control the unblocking action.

5- By reversing the connection to the diode detector tube.

6- To make all the sync signal invisible + all the picture signal visible.

7- To give wide-band response.

8- To increase the low-frequency response

9- To damp out any tendency toward self oscillation

10- To separate the sync pulses from video signal, + separate horizontal sync pulses from vertical sync pulses.

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ANSWERS TO QUESTIONS

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LESSON 49RH-4 - THE TELEVISION SIGNAL

1. One of the side bands is partially suppressed, thus reducing the required channel width.
2. Scanning.
3. Persistence of vision, which is the ability of the eye to retain an impression of an object for a short time after the object has disappeared from view.
4. The sync pulses keep the image reconstructing device in step with the scanning mechanism at the transmitter.
5. At the end.
6. When negative modulation is used the sync pulses represent the highest currents and they are less likely to be affected by noise pulses. Hence, better synchronization is obtained.
7. First anode.
8. The contrast changes.
9. (A) 60 cycles per second. (B) 15,750 cycles per second.
10. 4.5 megacycles.

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STUDENT NO. E1 - A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 49 RH-4
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE H

PRINT your name and address *very plainly* on the lines provided above

1- Because by partially suppressing one side band, this range is reduced to less than 6 megacycle, + each station is allocated a channel, 6 megacycle wide.

2- The eye in the camera. D

3- Persistence of vision

4- For controlling + stabilizing the sweep circuit.

5- At the end of each line.

6- So it will be less affected by noise pulses.

7- A1 (Anode A1) is variable + is controled by means of a potentiometer.

8- A change in the amount of contrast between bright + dark areas of the reproduced image.

9- (A) Vertical scanning frequency is 60 cycle per second
(B) Horizontal scanning frequency is 15750 " " "

10 4.5 megacycles.

ANSWERS TO QUESTIONS

HERE are the correct answers to the questions in this Lesson. Compare your own with the standard by which they were graded. Where we felt it would be helpful, the correct answer and reason for it, or how it was derived, is given. Your own answers should always be brief, to the point.

LESSON 48RH-2 - SERVICING RECORD CHANGERS

1. The eccentric groove at the center.
2. Eccentric, positional, and velocity.
3. To synchronize the changer actions with each other.
4. Move the bearing plate by screwing it downward on the push rod.
5. To make the records move toward the support post as they move down the spindle.
6. To separate the bottom record from those above it.
7. The mechanism can jam or be thrown out of adjustment.
8. Don't overheat in soldering its leads.
9. Oil rots the insulation and permits a short.
10. Worn friction pads or lack of oiling of pads.

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STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 48 RH-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A+

PRINT your name and address *very plainly* on the lines provided above

1- The eccentric groove.

2- (1) Eccentric Trips, (2) Positional Trips, (3) Velocity Trips.

3. To synchronized the changer action with each other.

4- Lowering the bearing plate, by screwing it downward on the push rod.

5- To make the records move in the direction of the support head as they feed down the spindle.

6- It goes between the bottom record & the remainder of the stack, then the support shelf are withdrawn to allow the bottom record to drop.

7- (1) throw the changer out of adjustment, (2) can cause it to jam.

8- Not to overheat the terminals when soldering a cable to the cartridge.

9- Oil will destroy the rubber insulation, permitting a cable to short-circuit, and it will reduce or kill the output.

10- Friction pad wear down, or become hard because of lack of oil.

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MODEL ANSWERS

How to Choose, Order, and Install Replacement Parts. No. 47 RH-2

1. Due to an overload.
2. It should light brightly.
3. Yes.
4. For a class B stage.
5. .01 mfd.
6. Yes.
7. At 600 kc.
8. Yes.
9. No.
10. Measure the voice coil d.c. resistance with an ohmmeter, then multiply by 1.5. (This applies only to voice coils.)

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DATE Nov. 12, 1951

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

~~972 West 3rd St.~~

R. F. D. NO. OR STREET ADDRESS Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 47 RH-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- It has been overloaded

2- #2 - brightly

3- Yes - as long it has a rating of any amount of equal to or above the current drawn.

4- Class B Stage.

5- .01 as the replacement capacity.

6- Yes - you could use a 16-mfd, 250 volt condenser as a replacement.

7- 600 K.C.

8- Yes - The resistance value is not, very often important.

9- No - not if any condenser lead are common to two or more condenser.

10- By measuring the voice coil resistance with an ohmmeter, then multiplying this resistance by 1.5

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MODEL ANSWERS

How to Eliminate Man-Made Interference. No. 46 RH-1

1. It dulls the static noises.
2. (1) Place the antenna as high as is reasonably possible. (2) Keep the antenna at a distance from known sources of interference. (3) Place the antenna at right angles to trolley lines or power lines.
3. A combination condenser-and-choke filter.
4. Somewhere between 600 and 1,000 volts.
5. Sparking at the commutator because of poor contact with brushes, or because of dirty or uneven commutator segments.
6. A simple condenser, or a condenser in series with a resistor.
7. As close as possible to the exact points where the lines pass through the screen.
8. Increased noise will be heard in the phones, and the output meter will give a higher reading.
9. The motor.
10. 5 amperes.

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DATE Oct 12, 1951

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 46 RH-1

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR

LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- The static noises gets louder, + more noticeable.

2- (1) Place the antenna as high as is possible keeping all unshielded vertical wires short. (2) keep the horizontal or straightaway portion of the antenna at a maximum distance from known sources of interference, (3) place the horizontal portion at right angle to nearby trolly-lines, main power lines or transmission.

3- A. Combination Condenser -+- choke filter like the one shown at fig-c, or D.

4- Between 600 + 1000 volts.

5- Sparking at the commutators due to poor contact with the brushes, dirty or uneven commutator segments.

6- A filter of a single condenser, or a condenser in series with a resistor.

7- At points where they enter the cage.

8- You will hear the noise in the interference locating receiver get louder.

9- The motor is at fault.

10- 5 amperes per horsepower is required for 220 volts

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MODEL ANSWERS

Receiver Revitalization - Tube Testers. No. 45 RH-1

1. Tube test and an alignment check.
2. The standard output for a receiver rated at 1 watt or less is .05 watt, and .5 watt is the standard output for more powerful receivers.
3. The signal tracer can be used to make stage-by-stage gain checks, thus localizing the defective stage.
4. Probably not, as the receiver gain usually varies over its tuning range.
5. The stage gain will vary with the bias, so a predetermined fixed bias must be used to keep the gain constant during the measurement.
6. Less than the primary voltage. At best, only half as much.
7. The fan drives off the moisture-laden air.
8. Mutual conductance, power output, and emission.
9. A test for shorts and leakages.
10. To see if there are loose elements which can be jarred into touching.

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DATE Oct 4, 1951

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NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 45 RH-1
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- (1) Test tubes, & recommend the replacement of weak one. (2) Check the Alignment & realign if necessary.

2 .05 watt for a set that has an undistorted output power of 1 watt or less. .5 watt for a reciever with an undistorted output power of 1 watt or more.

3- The Signal Tracer you can localized the defective stage, by making stage-by-stage measurement & this is more valuable in service work, than a check of over all gain, which indicate that a defect exist.

4- Yes - you use the same value for 1400 K.C. as you do for 600 K.C.

5- A strong signal will increase the bias & so reduce the gain., for a gain measurement to mean anything we must block the A.V.C. action, & use a fix bias.

6- Less than the primary voltage.

7- To remove the moisture from the chassis & parts. (by blowing a steady stream of hot air, the moisture will be carried away.

8- (1) Mutual Conductance Tester.
(2) Power Output Tester.
(3) Emission Tube Tester.

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R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 45 RH-1
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR

LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

9. Short & leakage test.

10. Check to see if vibration can cause tubes element to touch & cause short or leakage.

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DATE Sept. 11, 1951

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS ~~972 West 3rd St.~~
Plainfield, N. J.

CITY AND STATE
(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 44 RH-1
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A+

PRINT your name and address *very plainly* on the lines provided above

1- (1) Installing a Condenser at the Ammeter
(2) " " " " " generator
(3) " " Suppressor in the distributor Circuit

2- The Cylinder head, with a length of copper bonding or shielding braid, the braid used is the wide & heavy type, like one used to ground the car battery.

3- A condenser between the stop-lite lead & the car chassis will eliminate this.

4- Connect D.C. Voltmeter between B+ & the chassis, so that the meter + goes to B+ & the meter - goes to the chassis. Then Turn set on, if meter reads up scale the right battery polarity connection has been made.

5- 115 cycle if caused by a faulty rectifier, or by grid pick-up, or it will be 230 cycle if caused by defective filter condenser.

6- No - unless there is some unusual stray field Connection.

7- 10- or 15- amp, anything larger will not protect the set effectively.

8- The size = the Ohmmatic value + working Voltage, + can specified what it is used for.

9- No - because mostly all speakers field in auto set are 6 volts field, so they operate in parallel with the tube filament from storage battery, this kind of field cannot be used as a Choke coil.

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DATE Sept. 11, 1951

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St. Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 44 RA-1
{NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.}

LEAVE THIS SPACE BLANK FOR YOUR

LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

10. To unplug the vibrator, if possible, or disconnect it from the power transformer, when making Ohmmeter measurement on B supply circuit. ✓

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MODEL ANSWERS

Servicing Noisy and Intermittent Receivers. No. 43 RH-1

1. Within the receiver.
2. Between the antenna and the volume control, so the noise source is in the r.f. section.
3. Plate circuit.
4. Bent plates, dirt or metal peelings between plates, poor wiping contacts to rotors.
5. The power supply, as it is being introduced in all the stages.
6. Intermittent open in output filter condenser.
7. Wiggle parts, put on leads, thump tubes and shields to try to find the part or connection which, when mechanically disturbed, will cause the set to cut off or cut on each time it is disturbed.
8. The volume control (R_9) and C_{20}.
9. The trouble is between point 9 and the loudspeaker, so it is in the output stage or in the loudspeaker.
10. To the a.v.c. circuit, either at point 12 or at point 13.

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WASHINGTON 9 D. C.

DATE Sept. 2, 1951

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 43 RH-1

NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.

LEAVE THIS SPACE BLANK FOR YOUR

LESSON GRADE B

PRINT your name and address *very plainly* on the lines provided above

1- It is in the receiver.

2- R.F. - I.F section of the receiver.

3- The Supply Circuit.

4- Plates bent a ways out of shape, worn wiper contacts, Dust & metal partical between plates.

5- In the next section of the receiver going toward the Antenna. (In this case it is the detector oscillator section.)

6- ~~#1 - Open Coupling Condenser~~

#3 - Open Output filter Condenser. — 5

7- To disturb defective joints, by pulling on leads, wiggle parts, thump tubes, & resistors, or apply mechanical pressure to joints.

8- C.20 is defective, or the slider is not making a good contact on the Volume Control - R.4.

9- It is the output stage, or speaker defect.

10- Connect it across R.5, to see if the oscillator is working. — 10

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DATE July 27, 1951

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St. Plainfield, N. J.

CITY AND STATE
(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 42 RH-1
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- No - There should be a steady plate current, whether a signal is applied or not.

2- Bias too high, Plate voltage low.

3- When we feed the output signal through the coupling transformer to the following resonant circuit, It restores the lower half of the signal + again we get the original input signal voltage across C. for application to the next tube.

4- By making grid of the tube less negative than normal, or even positive.

5- In a.c. set by pulling tube, if voltage disappear the tube is gassy; if voltage remains It is a leaky coupling C. - In a.c. - D.c. set were serious damage might be caused by pulling tubes, you unsolder one lead of C., if voltage disappears with C. disconnected, C. is leaky, if voltage is still there, it is a gassy tube.

6- Dead Set.

7- Gassy tube or heat warping the speaker frame.

8- Low - frequency sound are reproduced.

9- Remove the cone + push electrical, or lie tape down into the air gap with a piece of stiff wire, the meticallic slivers will stick to the tap + can be withdrawn with it, or a hand pump is used sometime to blow out dirt.

10- A Dead Set.

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DATE 6/11/51

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 41 RH-2

NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.

LEAVE THIS SPACE BLANK FOR YOUR

LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- No - It will cause a dead receiver instead of hum.

2- A good condenser has a low power factor - a high power factor condenser acts like a resistor, an open condenser act as if it were not there. + hum will be loud.

3- Audio Amplifier stage, R.F. + I.F. Stage, or modulation outside the receiver. — 5 valued

4- No - because it is hard to tell how much heat should be developed in a choke coil or speaker field.

5- The Output filter Condenser is open, or has lost capacity.

6- #2 - Cathode-to-heater in leakage in tube, #4 - Open in one of the rectifier tube plates circuit.

7- #1 - a high-impendance grid circuit.

8- 1 - A feedback path - 2, feedback of proper phase to aid oscillation (regeneration) - 3, The strength of the feedback is sufficient.

9- One of the R.F - I.F. Stages is oscillation.

10- 1. Introducing Suppression, 2 - making the plate circuit by-pass condenser more effective, 3 - Shorting the effective lengths of the grid leads.

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16TH & U STS. N. W. WASHINGTON 9, D. C.

MODEL ANSWERS

How to Eliminate Hum, Squeals and Motorboating. No. 41 RH-2

1. No. This removes operating voltages and kills the set.
2. Temporarily connect a test condenser across it. This test condenser should be about the same in capacity and must have the same or a higher working voltage than the suspected one.
3. The first a.f. stage.
4. No. The field will normally run fairly hot and you have no reliable way of telling when it is hotter than normal.
5. The output filter condenser. It is open or has a high power factor.
6. Cathode-to-heater leakage and an open in one of the rectifier tube circuits.
7. High impedance.
8. (1) There must be a feedback path; (2) the feedback must be of the proper phase; (3) there must be sufficient feedback energy to maintain oscillations.
9. An a.v.c.-controlled stage. This can be any r.f. or i.f. stage.
10. Install grid suppressors; bring plate by-pass condensers back to cathode; install grid by-pass condensers and return to cathode.

In order to get the greatest good from your work on this lesson, go over your graded answers carefully. Give special attention to any written comments. Reductions in grade are shown as follows: -2. Mistakes in answers and drawings are marked. Refer to the textbook when improvement is desired and review subject thoroughly.

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Prepare at Home for a Better Future in Radio and Television

ANSWER SHEET

NATIONAL RADIO INSTITUTE
16TH AND U STREETS NORTHWEST
WASHINGTON 9 D. C.

INSTRUCTION DEPARTMENT

DATE April 27, 1951

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 40 RH-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR

LESSON GRADE A+

PRINT your name and address *very plainly* on the lines provided above

1- So that an exact focusing of the beam at the screen can be obtained.

2- Vertical deflecting Plates.

3- Too high a setting can distort the image by causing a non-linear sweep.

4- Defection filter Condenser.

5- Even harmonic distortion.

6- 90° + 270°

7- Twice the rate.

8- When not exactly in resonance, the tracing will separate.

9- The Intensity Control - After the circuits have warm up for about a minute, the Intensity Control is advance until a spot of light is barely visible.

10- One I.F. Trimmer is turned one way + one the other way, because we must increase the capacity of one trimmer, + decrease that of the other on each transformer, so the primaries + secondaries are tuned above + below the proper frequency.

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INSTRUCTION DEPARTMENT

DATE 4/6/51

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 39 RH-1

{NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.}

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A+

PRINT your name and address *very plainly* on the lines provided above

1- Increase - the value to about 50,000 to 75,000 Ohms in a 6.3 volt tube. Too large a resistor will cause blocking of the oscillator.

2- Any local commercial or government station having frequency of the same I.F. value, may force its way through the preselector + then be amplified by the I.F. stage to give interference

3- 1. The tuning condenser may be shorted at the low-frequency end by a bent plate, (2) Dust + metal particles between the plates. (3) The Oscillator may be stopping. (4) case of misalignment.

4- No - the tuning condenser, the oscillator + preselector coils of proper design are use for tracking over the entire frequency.

5- No - a D.C. vacuum tube voltmeter or a high sensitivity d.c. voltmeter is used because it is in the a.v.c. circuit.

6- Yes - because what you want is maximum response rather than any particular amount of response.

7- Rocking - If the dial calibration is off in the low-frequency end it may be necessary to move your dial about 5 K.C. either way to get maximum response by readjusting the padder + find the actual resonant point of the preselector.

8- Find the setting with the least trimmer capacity (Plates open widest) when aligning, then check

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Plainfield, N. J.

CITY AND STATE
(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 39 RH-1
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR

LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

8 Cont. response at low-frequency end of band.

9- The preselector has a low-frequency adjustment, as well as the oscillator.

10- (1) The limiter grid varies directly with the signal strength, so it is an accurate output indicator.
(2) The limiter draws a grid current of 50 microamps or more when station are tuned in. it loads the preceding resonant circuit.

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MODEL ANSWERS

How to Isolate the Defective Circuit and Part. No. 38 RH-2

1. Condenser C3 is open. This condenser should normally keep the screen grid at r.f. ground potential by by-passing signal voltages.
2. Condenser C5 is open, upsetting the a.v.c. time constant.
3. No. The resistance of the halves of the high-voltage transformer winding is not equal.
4. The set side of the ON-OFF switch, the negative terminals of condensers C20 or C21, the cathode of the 6K7G tube, cathode of the diode tube, and plates of rectifier tube A.
5. Condenser C3 (between B+ end of L_o and cathode) is shorted. The 35-ohm reading is approximately correct for the primary of the i.f. transformer.
6. Plate by-pass condenser C3 is leaky or shorted, drawing excess current through R7.
7. The positive probe, as the a.v.c. voltage across R5 is coming through the leaky condenser C16, making the grid end of R6 negative.
8. Resistor 15 is open.
9. Remove the vibrator if possible, otherwise put paper between the vibrator contacts if they can be reached, or disconnect the circuit from transformer terminal c to prevent false readings through the vibrator to the chassis.
10. Measure the plate-to-chassis voltage. If absent or very low, condenser 12 is leaky or shorted. If the same as the d-to-chassis voltage, then 27 is leaky. Also, a voltage across resistor 47 would show leakage in 12, while no voltage across this resistor would mean that 27 is the defective part.

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INSTRUCTION DEPARTMENT

DATE March 16, 1951

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 37-A-2 ~~FL 38~~-2S

NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- The Screen by-pass C.3, it is open, it allows both
U.F + I.F voltage to exist between screen + ground.

2- C.5, it is open. The time constant of the a.v.c.
will respond to very quick changes in signal volume
such as burst of static or noise. this sudden noise may
make the receiver go dead for an instant or two.

3- No - due to the steadily increasing in diameter
of the coil it has more resistance at one end than it
does at the other.

4- Negative leads of C.20, + C.21, set side of on + off
switch or turn switch on + use either side.

5- C.3 is shorted, it provides a path between
Plate + cathode.

6- Plate by-pass C.3 is shorted, + caused the original
burn-out.

7- Positive voltmeter terminal goes to B−.

8- Part 15 is open, because it is the only connection
between part 15 + chassis.

9- The Vibrator is pulled out of the socket, because
vibrator arms may be touching contact B−

10- A continuity check, from the plate to chassis would
tell us if the leakage is in C.12 if this were the lowest
reading or lowest resistance. in this case were reference point
d + chassis is lower than e + chassis indicate C.27 is
leaky. − 10

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ANSWER SHEET

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NATIONAL RADIO INSTITUTE
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WASHINGTON 9 D. C.

DATE Feb. 26, 1951

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05
R. F. D. NO. OR STREET ADDRESS ~~972 West 3rd St.~~
Plainfield, N. J.
CITY AND STATE
(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 38 RH-2
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

1- The Screen Grid by-pass condenser C.3. It is open, it permits both the I.F. + A.F. Voltage to exist between the screen + ground.

2- C.5 is open. The time constant of the A.V.C. system will be greatly shortened. The A.V.C. voltage will respond to very quick changes in signal volume such as bursts of static or noise. This sudden noise may make the receiver go dead for an instant or two.

4 ~~3~~- ~~B-~~, The on + off switch S.W., + the negative leads of C.20 or C21 — 3

5- Coil Lc is shorted, + would be required to unsolder one lead of Cc to prove that the trimmer condenser is not defective. — 10

6- Plate by-pass C3 is propably shorted, which caused the original burnout of R.7.

7- Negative voltmeter terminal go to B- — 10

8- Part 15 is open, because part 15 is the only connection between part 15 + chassis.

9- The Vibrator is pulled out of the socket, because Vibrator arms may be touching contacts B-

10- Ohmmeter reading would tell C27 is leaky. — 10

3 — 10

National Radio Institute
PIONEER HOME STUDY RADIO SCHOOL
CONSULTATION SERVICE

16TH & U STREETS N.W.
WASHINGTON 9, D. C.

Dear Student: File No. TL:38-2S

This is not an easy lesson, but since you must make at least a grade of "C" on each lesson before you graduate, I want you to submit a new set of answers as soon as you have reviewed the lesson along with your enclosed answers, and studied the following discussions. Although they are not the direct answers to the questions, they will help you to understand the facts. When you are sure that it is all perfectly clear to you, write out the correct answers to all ten questions in your own words.

Question 1. If i.f. voltage exists between the screen (terminal 3) of the tube shown in Fig. 1 and the chassis, it means that i. f. signal currents are flowing through resistor R3 to produce the voltage drop across it. Normally point 3 is at the same potential as ground as far as i.f. signals are concerned. This is due to the presence of screen by-pass C3, which offers a low reactance path for signal frequencies. You should now be able to decide which part is defective and what is wrong with it.

Question 2. The length of time it takes for an a.v.c. system to react is dependent upon the time constant of the circuit. The a.v.c. time constant in Fig. 5 is controlled by R3 and C5. If their values are altered, the time constant can become too fast and the sensitivity can change almost instantly with changes in signal strength. Sharp static bursts can, if the a.v.c. acts fast enough, make the set go dead momentarily. If R3 is too small in value or if C5 is too small, the time constant will be too fast and this action may occur.

Question 3. The high-voltage winding on a power transformer has many turns of wire. Since the center tap is made at the exact electrical (AC) center of the winding, there is more wire on the portion outside the center tap than inside; this is due to the steadily increasing diameter of the coil. The greater wire length we have, the more resistance. Bearing this in mind, you should be able to answer this question. No

Question 4. By an easily identifiable point we mean a point that can readily be found. The negative reference point for ohmmeter measurements in Fig. 7 is B-. The ohmmeter probe can be touched to any point connected to B-. However, in a receiver, one wire looks much like another, and it would be difficult to determine which was connected to B-. But by looking at the diagram you can see that B- does connect to parts you can easily find. For example B- connects to the negative leads of electrolytic condensers C20 and C21. Also it connects to the set side of on-off switch SW. In addition B- connects to the cathode of the diode tube shown in dotted lines and through resistor R4 to the cathode of the 6K7. Any of these points can be found easily and can be used as the common negative reference point.

Question 5. Imagine an ohmmeter connected between the plate and cathode of the 6K7 tube in Fig. 7. The ohmmeter battery would normally cause current to flow through the i.f. primary marked LC, resistor R7, the leakage resistance

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MODEL ANSWERS

How to Isolate the Defective Stage or Section. No. 37 RH-2

1. Check the power cord, inspect the power cord plug, and be sure that power exists at the wall outlet.
2. No, the noise is external.
3. To minimize chances for mechanical feedback, which can cause howling.
4. The coupling condenser to this resistor.
5. Hum and possibly distortion or squealing.
6. The fact that signals can normally travel through vacuum tubes in only one direction.
7. The second r.f. stage or the grid circuit of the third r.f. stage. A grid circuit defect would not affect the ability of the third r.f. tube to cause a click when its plate current is interrupted.
8. No. This is a step-down transformer, so you would expect the voltage to decrease.
9. Connect the signal generator through a .05 mfd. condenser between the plate of the last i.f. tube and the chassis. Sweep the signal generator frequency from 500 kc. to 100 kc. The signal generator setting that sends the maximum signal through to the loudspeaker is the i.f. frequency.
10. The signal tracer is tuned and will select the signal you want to measure, excluding all others. The r.f. voltmeter, on the other hand, will measure not only the desired signal, but also all others present, such as hum, noise or r.f. signals from any source.

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ANSWER SHEET

NATIONAL RADIO INSTITUTE
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INSTRUCTION DEPARTMENT

DATE Feb. 10, 1951

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St. Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 37 RH - 2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE B

PRINT your name and address *very plainly* on the lines provided above

1- Check power cord plug, see if it is in the wall outlet, inspect the plug, + see also along the power cord if there is any break. Plug a floor lamp or check voltage with a meter for a defective outlet. ✓

2- No - there is an external noise source, or Antenna-ground system is at fault. ✓

3 They are used to minimize chances for mechanical feedback which can cause howling. ✓

4- The Condenser - it is leaky. ✓

5- Poor sensitivity - can cause degeneration — 5

6- All stage isolation techniques are based on the fact that signals normally travel through vacuum tubes only in one direction. ✓

7- The Second R.F. tube, or the grid of the Third R.F. tube. — 10

8- No - It would decreased, because this is a Voltage step-down device. ✓

9- Connect the S.G. to the grid of the last I.F. tube + sweep its frequency slowly down from 500 KC. to 100 KC. until you get maximum response. ✓

10- The Signal Tracing instrument can be accurately tuned to any frequency, + tell exactly what frequency are present in each stage + there strength, + can be used without serious detuning of a tuned circuit. ✓

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WASHINGTON 9 D. C.

INSTRUCTION DEPARTMENT

DATE Jan. 18, 1951

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 36 RH-1
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR

LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- (b) Explain to the customer that fading is due to natural causes over which you have no control.

2- Audio System. — It may be a low-emission tube, low electrode voltage on a.f. tube, or weak field excitation for the loud-speaker.

3- By shunting the suspected condenser with a good one of the same size, with the set in operation.

4- The part is condenser .0001 mfd to ground —10

5- The Loud Speaker - the voice coil is rubbing against the pole piece.

6- Distortion, a leaky coupling condenser produces a positive bias on an audio amplifier stage having R.C. coupling.

7- (1) Determine the Complaint, (2) Confirm the Complaint, (3) Effect-to-cause Reasoning, (4) Inspect for surface defects, (5) Isolate the Defective Section, (6) Isolate the Defective stage, (7) Isolate the Defective Circuit, (8) Isolate the Defective Part, (9) Repair or Replace Defective Part, (10) Check Performance.

8- Yes - It will give a value of 400 Ohms - 2 watt. (The 2 watt is alright because the resistor will not get as hot as 1 watt.)

9- Yes - It comes in the 20% tolerance of a 90,000 ohms resistor.

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R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 36 RH-1

NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

10. No - It would be nothing but a headache afterward, best to recommend customer to purchase a new + modern receiver.

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MODEL ANSWERS

Professional Radio Servicing Techniques. No. 36 RH-1

1. Explain to the customer that fading is due to natural causes over which you have no control.

2. Look in the a.f. amplifier. (In rare cases, where the set has a separate a.v.c. diode, also suspect the second detector stage.)

3. Shunt a good condenser of the correct size across the suspected condenser. If this clears up the trouble, the original condenser needs replacement.

4. The volume control is open. (The first measurement indicates that we should look for an open between B and ground. The second measurement says it is not between B and A. The third measurement is verification that the open is between A and ground, and hence is in the volume control. Note that the 7.5-ohm resistance of the i.f. transformer secondary has negligible effect on the reading between B and A.)

5. The loudspeaker.

6. Distortion.

7. 1. Determine the complaint; 2. Confirm the complaint; 3. Effect-to-cause reasoning; 4. Inspect for surface defects; 5. Isolate the defective section;

   6. Isolate the defective stage; 7. Isolate the defective circuit; 8. Isolate the defective part; 9. Repair or replace the defective part; 10. Check performance.

8. Yes. (The combination is equivalent to a 400-ohm, 2-watt resistor, which is within 3% of the original value.)

9. Yes. (The original resistor with 20% tolerance could have been any value between 72,000 and 108,000 ohms, so any resistor in this range would work.)

10. No.

In order to get the greatest good from your work on this lesson, go over your graded answers carefully. Give special attention to any written comments. Reductions in grade are shown as follows: -2. Mistakes in answers and drawings are marked. Refer to the textbook when improvement is desired and review subject thoroughly.

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DATE Jan 10, 1951

STUDENT NO. E1-A05

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R. F. D. NO. OR STREET ADDRESS 972 West 3rd St. Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 35 FR-1
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A+

PRINT your name and address *very plainly* on the lines provided above

1- (1) Mechanical Automatic Tuning Systems.
(2) Electrical Automatic Tuning Systems.
(3) Electro-Mechanical Automatic Tuning Systems.

2- A rise in temperature will increase the dielectric constants of insulating materials which are present in the oscillator circuit.

3- (1) Rotary or telephone dial types.
(2) Direct push types.

4- Oscillator tuned circuit will have a far more de-tuning effect than the preselector tuned circuit.

5- (1) The non-homing system.
(2) The self-homing system.

6- To allow the desired station to take hold of the A.F.C. systems.

7- Applying a large negative c bias to the tubes in the frequency converter + I.F. stages. (Reducing the input voltage to the A.F.C. systems in this manner prevents the system from holding a station which is even a small amount of resonance) This method also provide Audio silencing.

8- (1) Series Motors.
(2) Induction Motors.

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WASHINGTON 9 D. C.

DATE Jan 10, 1951

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R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

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LESSON NO. 35 FR-1

NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

9- By inserting a double-pole, double-throw switch in the circuit, If a center-tap field coil arrangement is used - a single-pole, double throw switch will serve for reversing purpose.

10- The rotor of an induction motor will alway rotate toward a shading coil.

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ANSWER SHEET

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DATE Dec. 11, 1950

STUDENT NO. E1 - A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.
Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 34FR-2
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE H

PRINT your name and address *very plainly* on the lines provided above

1- High - The greater the maximum frequency deviation employed for desired signals, the less noticeable to the listener will be a given frequency deviation due to an interfering signal.

2- By changing both the frequency + the amplitude of the desired F.M. signal.

3- The purpose of the discriminator circuit is simple to adjust + give linear operation. (It uses a push-pull circuit to convert frequency variation to amplitude variation at the I. F. frequency + then detect this signal.)

4- The Limiter provides a.v.c. voltage for use during f.m. reception.

5- The Limiter Section in f.m. receivers remove amplitude variation from the f.m. signal.

6- Fast-acting limiter. (must have a short time constant.) if it is to block out sudden noise surges.

7- If the R.F. + I.F. sections have sufficient gain, the limiter will then flatten the over-all response of the preceding section over the entire range of deviation frequencies.

8- Amplitude distortion will occur during loud sounds. (at medium + low program loudness levels it will still be satisfactory)

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ANSWER SHEET

INSTRUCTION DEPARTMENT

NATIONAL RADIO INSTITUTE
16TH AND U STREETS NORTHWEST
WASHINGTON 9 D. C.

DATE Dec. 11, 1950

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 34 FR-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR

LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

9- So the limiter will provide normal loading on the preceding resonant circuit.

10- To cut high frequencies back down to normal. (high-fidelity f.m. receivers have a high-frequency attenuator in the audio amplifier.

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WASHINGTON 9 D. C.

DATE Mar. 20, 1950

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 33 FR - 2
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

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PRINT your name and address *very plainly* on the lines provided above

1- A high signal-to-noise ratio.

2- (1) The electric field component; (2) The Magnetic field component.

3- One-half wavelength long.

4- The Kennelly-Heaviside Layer makes possible long-distance reception of signals.

5- The phase relationships between the sky + ground waves changes continually due to refraction of sky-wave by the rapid-shifting Kennelly-Heaviside layer, giving partial or complete cancellation of the ground wave.

6- At the center - of a half wave receiving antenna + gradually drops to zero as it approaches the extreme ends.

7- This pattern indicates that a vertical antenna receives ground wave equally well from all direction along the surface of the earth, when a grounded vertical antenna is shorter than λ/4, The center of a horizontal wire can be connected to the top of the vertical antenna to form a T antenna or an inverted L antenna.

8- It is used at the antenna to match the antenna impedance to the surge impedance of the transmission line regardless of what this respective value may be,

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NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

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LESSON NO. 33FR-2

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PRINT your name and address *very plainly* on the lines provided above

8 Cont. thereby securing maximum transfer of energy.

9- To change the position of the horizontal pick-up portion of the antenna. (by increasing its height, changing its direction, or moving it to a location farther away from the source of noise.)

10- To prevent electric components of both station + noise signals from effecting the receiver.

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LESSON NO. 32 FR-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE H

PRINT your name and address *very plainly* on the lines provided above

1- No - The circuit diagram is used more for a reference text, than a study text.

2- (1) The dead receiver - it does not play at all,
(2) The receiver plays improperly - like howl, squeal, distort, lack selectivity, lack sensitivity, be noisy, have a faulty automatic tuning, or A.F.C. system, or other defects.

3- The circuit disturbance test.

4- Power Transformer symbol in the power pack circuit tell us it is an a.c. receiver, power transformers are never used in universal or D.C. sets.

5- Trimmer Condenser #13A, 13B, 19A, 19B,

6- Almost always right next to the power transformer

7- It goes through Oscillator plate coil 5 + then through resistors 10 + 12 to the rectifier filament.

8- There should be a conductive path from the rectifier tube filament or cathode, (the highest positive d.c. terminal) to all tube electrodes which are supplied with a positive d.c. potential, such as plate + screen grids.

9- Yes - there should be a conductive path between the plate + the cathode.

10- No - there will be no high frequency trimmers mounted on the gang tuning condenser of an all wave receiver, these will be located near the coil which they adjust, instead.

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DATE Oct, 23, 1950

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS ~~972 West 3rd St.~~ Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 31 FR-1

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

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PRINT your name and address *very plainly* on the lines provided above

1- Into the plate supply leads going to one or more A.V.C. - controlled stages.

2- To correct for slight inaccuracies in the mechanical action of the tuning mechanism + compensate automatically for oscillator frequency drift.

3- The D.C. Voltage - developed across the load resistor of a diode second detector - A.V.C. tube in a receiver is used.

4- It lowers the reactance.

5- (1) The discriminator, (2) the oscillator control circuit

6- The D.C. Control Voltage.

7- By the fact that it will have a double diode vacuum tube, with the two diode plates connected into a tuned circuit having a split a center - tapped coil which is fed with the I.F. amplifier output voltage both inductively + by a direct connection to the center tap.

8- No - It will not allow the A.F.C. to hang onto a powerful local station.

9- The oscillator control tube has no effect whatsoever upon the oscillator tuned circuit.

10- Zero meter reading (this adjustment is quite critical, minimum reading should be secured when adjusting tools is removed.)

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DATE Oct 6, 1950

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS ~~972 West 3rd St.~~ Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 30 FR-1

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE 18

PRINT your name and address *very plainly* on the lines provided above

1- Q factor - $Q = X_L \div R$

2- The B battery causes d.c. current to flow through the coil.

3- The Three Voltage Method

4- Electrolytic - because all electrolytic need a d.c. Voltage to keep the film formed on the anode of the Condenser

5- It indicate a tight coupling - a weak coupling should be used.

6- Inductance, Coil A.C. Resistance, Coil reactance, Capacity.

7- Resonant Voltage step-up. (at resonance - the voltage across the condenser, or the coil equals Q times the source voltage,

8- Set SW-1 - to position 1; set SW-2 - to position 7; set S.W.3 - to position 4, to equal 471 Ohms between terminal - A + B.

9- Minimum Current, - Balance is shown by a zero reading or minimum current by the indicator.

10- It will absorb energy from the Source, (The Plate current rises when this power is being furnished, so the point of maximum rise in plate current is the point of resonance.)

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A ONE-MINUTE DISCUSSION OF EACH QUESTION IN THIS LESSON

You will benefit from reading these discussions. While your own answers should always be brief, these explanations "point-up" important information in the lesson, help many students to remember what they've studied and give extra help on difficulties they may have had.

LESSON 30FR-1 MEASUREMENTS AT AUDIO AND RADIO FREQUENCIES

Question 1. At resonance, the inductive reactance is exactly equal and opposite to the capacitive reactance, so all that is left is the resistance of the tuned circuit; this resistance is practically all in the coil. In a series resonant circuit, for example, this resistance controls the circuit current, and the voltage across the coil is controlled further by the coil reactance. The higher the current and the coil reactance, the higher the voltage across the coil; but the lower the coil resistance, the more the circuit current will be for a given source voltage. If a coil has large inductive reactance and low resistance, this resonant circuit can make a real step-up in voltage. The value $X_L \div R$ is the Q factor of the coil in a resonant circuit, and is a measure of the coil quality or merit.

Question 2. Both alternating and direct currents flow through a choke coil that is used in a power pack. We must take both currents into account because the higher the d.c. current, the lower the inductance, as the result of core saturation. To make our measurement indicate the inductance under working conditions, we must send a normal flow of d.c. through the coil in order to simulate working conditions. Therefore, when choosing the d.c. value for the test, we should use the value which will flow in actual operation since any other value will change the coil's inductance.

Question 3. When measuring inductance values we must use a method that will give the greatest accuracy, so we must take the coil's a.c. resistance into account, especially when the coil has high resistance. The three-voltage method illustrated in Fig. 4 automatically takes the a.c. resistance into account. Then the Q factor may be determined by the use of the formula, $X_L \div R$. Therefore, when we want greatest accuracy, we use the three-voltage method.

Question 4. When air, paper, ceramic, or mica is used as the dielectric, the polarity of the applied voltage does not matter. However, electrolytic condenser dielectrics are chemical films, formed on one plate by a d.c. voltage. After the condenser is manufactured, the same polarity as the forming voltage must be observed, because a reverse of the polarity will remove the film. Hence, to prevent destruction of an electrolytic condenser, a polarizing voltage of the proper polarity and amount must be used.

Question 5. A circuit like that shown in Fig. 10B can be used to measure inductance accurately. The unknown inductance is inductively coupled to the output of the oscillator. This coupling should be loose so that a sharp indication of resonance will be obtained. The meter reading will show a rise at resonance, and the reading will decrease after resonance has been passed. If the coupling is too tight, the meter will have a second peak. This is known as a "double-hump" reading, and that is exactly the way it would appear if you should plot the meter readings on a sheet of paper and connect the points. Since neither is the true resonance peak of the circuit, the results are meaningless for measurements.

Question 6. We know that we can measure inductance, as shown by the circuits in Figure 10. We can determine the distributed capacity of the coil, using this method. First, tune the circuit to resonance at the fundamental frequency and then at the second harmonic of this frequency. Then substitute these values in the formula given on page 15. You can use the circuit shown in Figure 10A to determine the coil's a.c. resistance. To do this, set R to zero, and tune the circuit to resonance. You know that at resonance the coil reactance and condenser reactance cancel each other, leaving only the a.c. resistance. The current indicated by the meter then is equal to the source voltage divided by the circuit resistance ($I = E \div R$). Now, if we adjust R until the current is one-half the current at resonance for the same source voltage, we know that the circuit resistance must be twice as much as the coil resistance. Therefore, the resistance of R must be the same as the a.c. resistance of the circuit. We have then used this circuit to measure resistance.

Since we have found both the inductance and the resistance of the circuit, we can use these two values to find the Q of the coil at the frequency used to make the measurement. First, we must find the inductive reactance of the coil. To do this, multiply the inductance by the frequency used, and then multiply this result by 6.28. Now, if we divide the inductive reactance by the a.c. resistance, we have found the Q of the coil for that particular frequency. Thus we have used the circuits shown in Fig. 10 to measure inductance, capacity, resistance, and Q factor.

Question 7. In the lesson on resonant circuits you learned that there was a resonant voltage step-up and that the more efficient the coil, the greater the voltage step-up. Since the Q factor is the resonance voltage step-up, to measure Q we measure the voltage step-up. In Fig. 11, an r.f. signal is applied across R, which is in the resonant circuit. The voltage drop across the resistor is measured and called the source voltage. The voltage across the tuned circuit is now measured. If we divide the voltage across the coil by the source voltage, the result will be the measure of the coil merit, or Q factor. Thus we have used resonant voltage step-up to determine the Q factor.

Question 8. An examination of Fig. 13 shows that there are three switches connected in series. Each switch has ten contacts. SW_1 has a resistance of 1 ohm connected between each contact, SW_2 has a resistance of 10 ohms between each contact, and SW_3 has 100 ohms connected between each contact. Since the values of resistors connected in series add, we can get 400 ohms by setting SW_3 on contact 4. Then by setting SW_2 on 7, we can increase the total resistance to 470 ohms. Moving SW_1 to contact number 1 makes the total resistance between A and B 471 ohms.

Question 9. The basic bridge circuit is shown in Fig. 12. It is composed of resistors arranged so that the voltage is applied to two terminals, and an indicator is connected between the other two terminals. If the voltage drop across R_1 equals the voltage drop across R_2, then the voltage drop across R_x will equal the voltage drop across R_2. Since the same voltage is applied across R_1 and R_3, there will be no difference in potential between B and C; hence no current will flow between these points. Therefore, the meter will show minimum current when the bridge is balanced.

Question 10. Most oscillators and transmitter r.f. stages have plate current meters. Now, when power is absorbed from the tank circuit, the increased loading will cause a rise in the plate current reading. When a wavemeter does not have a built-in indicator, we can make the circuit that is being checked do the indicating. Bring the wavemeter near the tank, and tune for resonance. At resonance, maximum power is absorbed by the wavemeter tuned circuit, and resonance is indicated by the rise in plate current to its <u>MAXIMUM</u> value. This <u>MAXIMUM</u> value of plate current is obtained when the wavemeter is tuned to the <u>SAME</u> frequency as the transmitter.

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DATE Sept. 25, 1950

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NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

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LESSON NO. 29 FR-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- 1 to 5 megohms - per - Volt.

2- So we could measure d.c. voltage in a circuit containing a.c. + d.c., without the a.c. effecting the reading - (R.3 + C acts as an a.c. filter)

3- To have a self-bias resistor in the Cathode lead, so if the plate current drops because of tube aging or battery supply reduction this bias voltage will also drop, this helps to keep the plate current more constant.

4- To get greater stability + higher sensitivity.

5- Since the V.T.V.M. is primarily a capacitive load, it will detune the resonant circuit. If we retune the circuit with the V.T.V.M. in place, we can automatically cancel this effect + make our measurements. of course the circuit must be retuned to the original frequency when the V.T.V.M. is removed.

6- Because the distorted wave will not, probably, have the same average - to R.M.S. relationship as a sine wave.

7- The D.C. meter V.M. only.

8- In a tuned circuit you can overcome all other interference + make measurements a just the frequency we want. (by tuning to a resonant circuit you can separate frequencies)

9- So the spot will move in such a way that we can see how the wave looks.

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LESSON NO. 29FR-2

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10. Below - So the sweep won't ever discharge by itself + thus get out of step with the synchronizing grid voltage.

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CITY AND STATE Plainfield, N. J.

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LESSON NO. 28FR-3

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PRINT your name and address *very plainly* on the lines provided above

1- Less - $\frac{.100 \times .001}{.100 - .001} = \frac{.1}{.099} = 99\overline{)100.00}$ = 1.01 Ohms or 1 ohm for 10 ma. range it is 11 ohms.

2- Yes - if connected in position B or C where only plate current flows in Fig 8.

-1

3- (1) Always connect the meter in series with the circuit, (2) Correct Point, - In multiple circuit, connect the meter where only the desired current flows. (3) Current Range, - always use a meter range with a higher than the expected current, (4) Meter Resistance must be much smaller than the circuit resistance, (5) Polarity - connect the meter so electron enter the negative terminal.

4- The D'Arsonval meter alone will not read on A.C., - it can only indicate the A.C. average - Zero. regardless of the amount of a.c. current passing through it.

5- (1) Thermocouple with heater unit, (2) Hot-Wire meter, (3) Electrodynamometer used with a current Transformer, (The current transformer can be used with any other A.C. meter having the proper range + proper impedance.

6- You are getting a half-wave rectification, so a half reading, because one of the elements of the bridge is burned out.

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R. F. D. NO. OR STREET ADDRESS 972 West 3rd St. Plainfield, N. J.

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LESSON NO. 28FR-3

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7- 20,000 Ohms-per-Volt-will be more nearly correct for the actual circuit operating condition, because the lower the current needed to give deflection the more nearly correct the ~~result~~ will be.

8- The Shunt-type meter.

10

9- When test leads are held together.

10. The Output jack, to exclude the D.C.

A ONE-MINUTE DISCUSSION OF EACH QUESTION IN THIS LESSON

You will benefit from reading these discussions. While your own answers should always be brief, these explanations "point-up" important information in the lesson, help many students to remember what they've studied and give extra help on difficulties they may have had.

LESSON 28FR-3 CURRENT, VOLTAGE, AND RESISTANCE MEASUREMENTS

Question 1. When we wish to extend the current range of a milliammeter, we can do so by putting a resistor across the terminals of the meter. For example, suppose we want to measure current up to 25 ma., but all we have is a 1-ma. meter. We will have to find a shunt that will pass 24 ma. To do this, we use Ohm's Law: $R = E \div I$. Thus it can be seen that the greater the extension of the range, the smaller the shunt resistor will be.

Question 2. In a simple circuit such as is shown in Fig. 8, the meter may be placed anywhere in the circuit, because the same current flows through the entire circuit. However, when checking screen grid or pentode tubes another problem arises. The cathode current consists not only of the plate current but also of the screen current. Therefore the plate current of a screen grid tube cannot be accurately measured by a meter in the cathode circuit. In this case, the meter must be placed in the plate circuit, at B or C in Fig. 8.

Question 3. Here are the five rules for connecting current meters: 1, always connect the meter in series with the circuit; 2, in multiple circuits, connect the meter so that only the desired current flows through it; 3, always choose a range higher than the expected value of the current you wish to measure; 4, the meter resistance must be many times smaller than the total circuit resistance; 5, connect the meter with proper polarity, so that it reads up-scale.

Now, let's consider these rules one at a time. In rule No. 1 remember that you want the current to pass through the meter itself; this calls for a series meter connection. If the meter is ever connected across a part (across R_1 or from the plate-to-cathode of VT_1 in Fig. 9) it is almost certain to burn out.

In rule No. 2 remember that when more than one tube is used, as in Fig. 9, the meter must be placed to measure only the current in which you are interested. If the meter is placed at the points marked "wrong meter position" it will measure the plate currents of both VT_1 and VT_2.

In rule No. 3 it is necessary to use a range higher than that of the current to be measured; otherwise, the meter may be overloaded and damaged. If you expect the current to be 50 ma. and your meter has ranges of 10 ma., 50 ma., and 100 ma., you would start with the 100-ma. range, dropping to the 50-ma. range if you find that the current is less than this value.

The fourth rule is not so important in radio service; the circuit resistance is nearly always higher than the meter resistance. Suppose, however, that in Fig. 8 the meter at B had more resistance than the combined values of R_1 and the tube. Then, when the meter was put in the circuit, the current would drop below its normal value.

In observing the fifth rule, connect the meter so that the electrons enter its negative terminal. Then the pointer will read up-scale, as it should.

Question 4. The D'Arsonval meter is a d.c. instrument. In a discussion of this type of meter, we learned that it will measure average current. It cannot be used to measure alternating currents because the meter pointer cannot move fast enough to follow the current pattern. As the pointer starts to swing up-scale because of a positive peak, the next peak, which is negative, cancels the action. Hence, a D'Arsonval meter will not indicate on a.c. Furthermore, should the a.c. exceed the range of the d.c. meter, it is possible that the meter might be damaged by the excessive current.

Question 5. Meters used to measure high audio frequencies make use of the fact that any kind of current (a.c., r.f., a.f., or d.c.) with any wave form will heat and expand a resistance wire through which it passes. The amount of expansion will be a measure of the heat produced and, therefore, of current flowing. This principle is used in meters of both the thermocouple and the hot-wire types. Other types cannot be used.

Question 6. Copper-oxide rectifiers for use in meters are usually of the full-wave type. A full-wave rectifier gives a higher average current, about twice that of a half-wave rectifier. This practically doubles the meter sensitivity by giving a higher meter deflection for the same amount of alternating current. If one element of the copper-oxide rectifier burns out, half-wave rectification will be obtained instead of full-wave. Then, since the average current is only about half that for full-wave, the meter will read only about half as much as it should. Readings considerably lower than normal in an instrument of the copper-oxide type mean a defective rectifier, in practically every case.

Question 7. The term "ohms-per-volt" is used to express voltmeter sensitivity. The smaller the current needed for a given deflection, the greater the ohms-per-volt rating of the meter. When a measurement is made in a high resistance circuit, the meter current will increase the voltage drop across the circuit resistance, thus reducing the voltage at the point of measurement. Since the 20,000-ohms-per-volt meter draws the least current, it will have less effect on the voltage distribution and consequently will give a more accurate measurement.

Question 8. For measurement of low resistance values a shunt type ohmmeter is used. In this type of meter, the shunt resistor is adjusted until the meter reads full-scale with the test leads separated. When the test leads are connected to the resistance being measured, a lower meter reading results. This type of meter, when turned on, draws current from its battery, even though the test leads are not touching each other, as proved by the fact that under these circumstances a full-scale meter reading is obtained.

Question 9. In the shunt-type meter the resistor is adjusted until the meter reads full-scale with the test leads separated. When the probes are held together, the meter will not read since the meter is short-circuited. Therefore, the "zero" adjustment on a shunt-type meter is actually the full-scale adjustment.

Question 10. The important fact that you must understand to answer this question is that when a.c. and d.c. exist together, and we wish to measure the a.c. only, a condenser will block the d.c. and still allow the a.c. to be applied to the meter. In either Fig. 29 or Fig. 31, the output terminal may be used for this purpose and will in these two figures be the "common" terminal for the measurement. When the circuit contains only a.c., the terminal marked A.C. ± is the common terminal.

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STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.
Plainfield, N. J.

CITY AND STATE

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LESSON NO. 27FR-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

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1- They will buckle or bend readily even when driven from its center.

2- (1) Centering the voice coil, (2) returning the voice coil + cone to a normal position, when the driving force drops to zero.

3- Low frequencies - resonance occurs below 100 cycles.

4- To secure a flatter frequency response.

5- Yes, this provides a number of widely different path lengths.

6- Yes, - If the box is made sufficiently large or if an infinite flat baffle is used, the natural frequency of the region behind the cone can be made so low that the effects of cavity resonance will not be heard at all.

7- Adjusting the cavity resonant frequency to the natural frequency of the cone system.

8- (1) To prevent cavity resonance, (2) To prevent standing high-frequency sound waves, (3) To give a low cut-off frequency, (4) To give reinforcement of bass response.

9- In a box baffle or on a flat baffle, rarely has an efficiency of greater than 3 per cent, a driving unit used with an exponential horn can have an efficiency as high as 50 per cent.

10- (1) Use of a shading ring, (2) use of a hum-bucking coil.

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16TH AND U STREETS NORTHWEST
WASHINGTON 9 D. C.

INSTRUCTION DEPARTMENT

DATE Aug 17, 1950

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 26 FR-1

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- (1)- An electromechanical driving unit, sometimes call a motor. (2)- The diaphragm or cone. (3)- The air coupling system.

2- (1) Magnetic loudspeakers, (2) Dynamic or moving coil loudspeakers. (3) Condenser loudspeakers, (4) Crystal loudspeakers.

3- The use of a strong permanent magnetic field, & the permanent field provides a continuous attraction for the diaphragm.

4- To the inductance of a coil.

5- The mechanical inductance (mass) + the mechanical capacitance (compliance) of the diaphragm or other object.

6- (1) The strength of the fixed magnetic field existing in the air gap. (2) The length of the wire used for the voice coil, (3) The voice coil current.

7- The application of a voltage of a given polarity to the faces of specially-cut crystal slabs causes a change in shape which is used to drive a diaphragm or cone.

8- The amount of spreading outward in a given horn length.

9- A small flare horn should be used.

10- No - they are rated according to frequency range + not according to power-handling ability.

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DATE Aug 5, 1950

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 25 FR-3

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE B

PRINT your name and address *very plainly* on the lines provided above

1- (1) The Light Source, (2) Light Beam Apparatus, (3) The Photoelectric Cell, (4) The Photoelectric Amplifier, (5) Sensitive Relays, (6) Heavy-Duty Relays.

2- (1) Ultra-violet light, (2) Infra-red light.

3- (1) Photoemissive Cells, (2) Photoconductive Cells, (3) Photovoltaic Cells, (4) Electron-Multiplier Cells.

4- When the Photocell is darkened.

5- ~~Between~~ 25 + 100 Volts. — under no condition should this voltage be exceeded.

6- Small batteries, or Source of direct current. (10

7- Quartz window = Filters, panes of colored glass.

8- Minus to Minus + Plus to Plus.

9- Secondary emission is used.

10- By a tapped voltage divider, (is placed across either a full wave or a half-wave rectified source of current.

—10

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A ONE-MINUTE DISCUSSION OF EACH QUESTION IN THIS LESSON

You will benefit from reading these discussions. While your own answers should always be brief, these explanations "point-up" important information in the lesson, help many students to remember what they've studied and give extra help on difficulties they may have had.

LESSON 25FR-3 LIGHT-SENSITIVE CELLS FOR CONTROL CIRCUITS

Question 1. A complete photoelectric control installation must provide a beam of light which, when changed or interrupted, causes a light-sensitive cell to actuate electrical apparatus in such a way that the load being controlled is either started or stopped, as desired. The six basic parts of a complete photoelectric control installation are: 1, the source of light; 2, the light beam apparatus; 3, the light-sensitive cell; 4, the photoelectric amplifier; 5, the super-sensitive and sensitive relay; 6, the heavy-duty or load-controlling relay.

Question 2. Light waves having frequencies higher and lower than those which can be perceived by the human eye may still be "seen" by some photocells. These are the ultra-violet light, which has a frequency higher than that which can be seen by the eye, and the infra-red light, which has a frequency lower than that which can be perceived by the human eye. These lights are particularly valuable in alarm systems since there is no visible light beam to warn intruders that a photoelectric control circuit is installed.

Question 3. Light-sensitive cells are divided into four classes according to the way in which their electrical characteristics vary with changes in light. Light-sensitive cells in which electrons are emitted by the action of light on a cathode are known as photoemissive cells; cells in which the resistance changes with light are known as photoconductive cells; cells that develop a voltage which is dependent upon the amount of light falling on the cell are known as photovoltaic cells. Then too, we have the electron-multiplier types in which electrons emitted from the cathode strike and liberate other electrons from the following series of dynodes. The four classes of light-sensitive cells are, therefore: 1, photoemissive cells; 2, photoconductive cells; 3, photovoltaic cells; and 4, electron-multiplier cells.

Question 4. In Fig. 5 the grid bias is controlled by the photocell, the resistor R, and the C battery. The B supply voltage causes current to flow through the photocell and resistor R, thus producing voltage drops across them. When light strikes the photocell, its resistance will decrease and the voltage across R will increase. This reduces the net bias on the tube and allows the plate current to increase, thus closing the relay. If we reverse the position of the photocell and resistor R, then the voltage dropped across the photocell is the controlling factor. When light strikes the photocell its resistance will decrease and less voltage will be dropped across it. Then the voltage of the C battery will make the control grid more negative, the plate current will decrease and since insufficient current will be flowing through the relay it will open up. When light does not strike the photocell, (when it is dark) the plate current increases and closes the relay.

Question 5. In gas photoemissive cells, the current for a given amount of light increases very rapidly with increases of voltage beyond a certain limiting value. If this current is allowed to increase too much, a glow discharge will take place in the cell and destroy it. Manufacturers of gas tubes have found that the maximum safe-operating voltage of the average gas photoemissive cell is about 100 volts.

Question 6. Only one type of light-sensitive cell, that which generates its own voltage, can operate a super-sensitive relay without auxiliary apparatus. A super-sensitive relay requires a definite amount of voltage and current for its operation and this cannot be supplied by the other types of light-sensitive cells unless they are connected to a battery or to amplifier circuits. The only type of cell which will generate its own voltage and operate a super-sensitive relay is, therefore, the photovoltaic cell.

Question 7. By studying the color-response curve for the Photronic cell, you can see that this cell responds better to certain wavelengths of light than does the human eye. To give the cell the same response to various colors of light as the human eye has, it is necessary to reduce the effects of the non-visible radiant energy in the ultra-violet and infra-red regions and also to remove the excess blue and red response of the cell. A filter consisting of colored glass is the device which accomplishes this purpose.

Question 8. If you had a number of batteries and wanted to connect them to get a maximum current, you would connect them in parallel, wouldn't you? Photronic cells really are small batteries and can be connected together just like batteries. To get more current capacity than is provided by one Photronic cell, then, the Photronic cells should be connected in parallel.

Question 9. In the electron-multiplier cell, an electron leaving the cathode will strike the first dynode where it may knock off two electrons. These in turn go to the second dynode where each again knocks off two electrons, thus increasing the total number to four. By using a large number of dynodes, the effect of the first electron is multiplied greatly. The principle which makes this possible is that of secondary emission.

Question 10. The number of electrons knocked out of a dynode by a single electron striking it depends upon the velocity of that electron. This velocity, in turn, depends upon the voltage between the electron source and the dynode. If we vary the voltage on one of the dynodes so as to make it unequal to the others, the amplification of the electron-multiplier cell will be varied, since this will vary the number of secondary emission electrons that can be obtained from that dynode.

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INSTRUCTION DEPARTMENT

DATE July 28, 1950

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 24 FR-1
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A+

PRINT your name and address *very plainly* on the lines provided above

1- (1) Tone Control Circuit. (cuts out high-frequency sound components, thereby eliminating predominating noise signals at a sacrifice of fidelity. (2) Noise impulse-silencing circuit. (temporarily cut out all signals for the duration of sharp noise pulses which are stronger than the program signals.). (3) Inter-Carrier noise suppression circuit. (cut out all signal including noise, whenever the station signal is so weak that it is drowned out by noise signals.

2- Yes — & it has difficulty in hearing sounds below & above this frequency range.

3- The signal which it feeds to the next stage has a higher proportion of bass notes, (with respect to medium & treble notes) than the signal fed into the tone control.

4- The Audio Amplifier is designed to have a sharp rise in response at the higher frequencies, & one of the conventional tone control circuit is used to cut down this high frequency or treble response as desired.

5- Automatic bass compensation circuit.

6- To provide a control over tone.

7- The gain of a variable mu or super-control pentode tube varies with the negative C bias voltage which is applied.

8- To give the desired high signal-to-noise ratio.

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PRINT your name and address *very plainly* on the lines provided above

9- The automatic volume control raises the gain of the R.F. system to the point where normal external + internal noise becomes objectionable.

10- (1) Biased demodulator circuit, (2) A.F. Amplifier blocking circuit, (3) I.F. + R.F. Amplifier blocking circuit.

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NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.
Plainfield, N. J.

CITY AND STATE
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LESSON NO. 23 FR-3
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A+

PRINT your name and address *very plainly* on the lines provided above

1- (To have High Q tank circuit having resonant frequency equal to the i.f. value) so this frequency can be accepted + the other plate circuit components rejected.

2- (1) The incoming modulated R.F. Carrier with a (2) Local R.F. Oscillator signal.

3- To eliminate repeat-point reception.

4- Image Interference -

5- By installing a wave trap which is tuned to the interfering Code station, by shortening the antenna, or by changing the I.f. value of the receiver.

6- To build up the strength of the incoming signal so that it will override any converter noise which is present in the mixer-first detector tube.

7- (1) Because it has negligible frequency drift, (2) Negligible degeneration, (even at very high frequencies.)

8- (1) Low-frequency padder, (2) High-frequency trimmer, (are adjusted to make the preselector + the oscillator track each other.)

9 The all-wave receiver has one or more extra preselector + oscillator tuning circuit, which may be switched in as desired.

10- ~~H~~ The I.f. Amplifier - (If the I.f. Amplifier is designed to pass all frequencies 5 Kc. above + below the i.f. value.)

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NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 22FR-2
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- It indicate High Gain + High Selectivity.

2- Yes - severe frequency distortion, because high modulation frequency correspond to side frequencies, the greatest amount of amplitude distortion occurs because of improper tuning.

3- No - Amplitude distortion will not occur

4- By keeping the losses in the coil at a minimum.

5- Yes - a coil which has a very high Q factor at a low frequency will lose its Q factor rapidly at high frequencies. A coil with a reasonably high Q factor at low + medium frequencies will tend to retain this Q factor value as frequencies is increased.

6- The A.C. plate resistance of a pentode tube in an R.F. Amplifier stage of a receiver is extremely high with relation to its plate load resistance.

7- The Gain + Selectivity is lowered when the tuned circuit is loaded by reducing the Ohmic value of the grid resistor (fidelity is considerably improved.

8- (1) provide high selectivity while keeping the number of tubes at a minimum, (2) can be adjusted to give an almost flat top response curve for high fidelity.

9- No - It will be impossible to adjust for a single-peak response.

10- They can be reduced by shunting the primary + secondary circuit tuning condenser with 20,000 to 100,000 ohms resistor

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DATE June 24, 1950

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

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LESSON NO. 21 FR-3

{NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.}

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A+

PRINT your name and address *very plainly* on the lines provided above

1- (1) An Amplifier tube (one with a control grid), (2) a feedback path, (3) a frequency-determining network (4) a self-bias system to set the condition of operation, (5) a coupling circuit or device to transfer energy from the oscillator to the circuit with which it works.

2- The phase will be 180° from what it should be, + oscillation cannot occur.

3- Intermittent - it will release pulse of energy from the B supply at properly timed intervals.

4- The Hartley Oscillator use a tapped coil to supply feed-back, + Colpitts Oscillator use a Capacitive divider instead.

5- The Low-Capacity condenser is used to make up for the variation in this circuit. (Its capacity is added to the corresponding internal tube capacity + it is chosen to adjust the feedback.

6- No - no padder is needed - because the oscillator condenser automatically has less capacity at all position of the tuning condenser control.

7- The tube capacities effects the tuning, by changing the capacitors set for the feedback.

8- (1) They both form an R.C. filter to keep hum out of the oscillator, (2) The condenser acts with L2 to keep the oscillator signal from the B supply, (3) the resistor serves to stabilize the plate voltage on the oscillator tube.

9- By having a higher than normal grid leak + grid condenser values, (The circuit is deliberately made to block at regular intervals, rather than produce a continuous —

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LESSON NO. 21 FR-3

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PRINT your name and address *very plainly* on the lines provided above

9-Cont. sine wave signal. ✓

10- The high voltage is automatically cut off if the sweep fails. This prevents sweep failure from letting the beam stand still & burn the flouorescent screen of the tube. ✓

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NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.
Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 20FR-3
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A+

PRINT your name and address *very plainly* on the lines provided above

1- (1) Through a Conductive Path, such as a wire or a metal chassis; (2) By Electrostatic Induction, where the electric field set up by one circuit repels + attracts electrons in another circuit; (3) By Electromagnetic Induction where the magnetic field set up by one circuit induce interfering current in another circuit.

2- To prevent degeneration, in the cathode circuit.

3- By using a by-pass condenser connected directly across the plate supply, it will offer a low-reactance path for signal current to follow.

4- The by-pass condenser has practically no reactance at signal current frequencies.

5- Yes, a signal current filter will act both way.

6- To prevent undesirable direct coupling between the different circuit in the stage.

7- To prevent capacitive + inductive feedback of signals from the plate circuit to the grid circuit.

8- Yes - the chassis also acts as a shield in preventing interference between parts above the chassis + those below the chassis.

9- Aluminum + Copper, give better shielding effect than poor-conductivity iron + steel.

10- To lesson the chance for feed-back, + simplifies the shielding problem.

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DATE June 2, 1950

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 19FR-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- Yes – All radio receivers require manual volume control, even when equipped with a.v.c..

2- (1) It prevents blasting: (2) It prevents overloading: (3) it minimizes fading.

3- (1) A.F. Voltage Control; (2) R.F. Voltage Control; (3) R.F. Gain Control.

4- By varying the Control grid Voltage.

5- The R.F. input voltage level at which A.V.C. action begins, is call the Threshold point, or Threshold Voltage.

6- The A.F. Signal voltage is kept out of the A.V.C. Control stages by the a.v.c. filter.

7- The value of the resistors + condenser in the A.V.C. filter system.

8- (1) The R.F. Amplifier, which Amplifies the incoming modulated R.F. carrier signal. (2) The Mixer First Detector, which mixes the incoming R.F. signal with the local oscillator signal to a modulated I.F. signal; (3) I.F. Amplifier.

9- A left hand tapered, The taper or Gradual change in resistance is here at the left-hand side of the Control.

10- When the current through the volume Control resistance change in value when the moveable Contact is adjusted, a right-hand tapered volume Control is used.

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DATE May 25, 1950

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 18FR-2

{NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.}

LEAVE THIS SPACE BLANK FOR YOUR

LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1- (a) Selectivity, (b) Sensitivity, (c) Fidelity, (d) power output, (e) signal-to-noise ratio, (f) interference reduction, (g) ease of operation.

2- James Clerk Maxwell, a British scientist predicted it in the year about 1864.

3- To increase the circuit inductance & thus give reception on the longer wavelength (Lower Frequencies)

4- It tuned so broadly it could not be used in crowded wavebands. (It had extremely poor selectivity)

5- Use as a cure for feedback troubles in some of the earlier T.R.F. receivers.

6- The objectionable effect was & still is cross modulation interference.

7- It was used in the B & C battery eliminators.

8- (a) A radio receiver in its table model cabinet, (b) a loudspeaker, (c) a set of tubes, (d) an A B C power pack, (e) a suitable table on which to place the receiver & loudspeaker with a shelf underneath for the a b c pack.

9- The year 1928 marked the general introduction of a.c. operated receivers.

10- (a) Trace the power pack & supply circuit leads through the signal circuit & tubes. (b) Trace the signal from the antenna to the loudspeaker (or image reconstructor in case of a television receiver) (c) Trace any signal control circuit, such as a.v.c., tone control, a.f.c.

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DATE May 19, 1950

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.
Plainfield, N. J.

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LESSON NO. 17FR-3

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

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PRINT your name and address *very plainly* on the lines provided above

1- Rectifaction & signal separation, - First the incoming signal is rectified, so that half of each cycle is removed, second is to separate the desired intilligence from the undesired r.f. current.

2- Sensitivity, fidelity, & voltage-handling ability.

3- Strong signal - on 100% modulation you need a strong signal to produce the least amount of distortion.

4- The time constant (RxC) of our load circuit will be rather high, this tends to cut off the higher audio frequencies.

5- It is used for Control purpose.

6- C5, because C5 & R4 acts as a filter & removes the a.f. & R.F. Components.

7- The filtering capacity is the shield leads going to the grid of the first picture amplifier tube.

8- In the grid circuit: Rectifaction & signal separation occur in the grid circuit.

9- We must first convert the f.m. signal to one with a varying amplitude before we can demodulate the signal.

10- The bias in fig 40B is due to stray electrons, which are capture by the grid & cause an extremely small grid current flow through a very high resistance.

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DATE 5/10/50

STUDENT NO. E1-A05

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Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 16FR-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A+

PRINT your name and address *very plainly* on the lines provided above

1- To select the desired signal from among all those pick ups by the antenna.

2- Fidelity will be sacrificed if the r.f. amplifier reduces or cuts off some of the side-band frequencies.

3- Very narrow — higher the Q, the narrow the pass-band

4- 225, 15×15 = 225 the resulting gain at resonance

5- Narrow.

6- Better than, the fidelity is more superior, because of wide band of frequencies is amplified equally, + no selectivity is sacrificed.

7- The most important draw-back of the triode tube is the appreciable inter-electrode capacity that exist between the grid + plate within the tube.

8- The plate voltage of the Pentode can be made to swing over a very wide range without distortion from secondary emission.

9- Reduce the Capacity + Transit time. - Reduce the Capacity by reducing the internal tube capacity. - Transit time is the time needed from for the electrons to travel from the cathode to the plate.

10- The triode tube is better because as the closer spacing between the Cathode + the plate, permits a reduction in transit time

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DATE 5/4/50

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.
Plainfield, N. J.

CITY AND STATE
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LESSON NO. 15FR-2
NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.

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STUDY
EXTRA HELP

1- The demodulator

2- Decreased

3- 12 X 10 = 120 total voltage amplification of the two.

4- Yes - the higher the load resistance, the flatter the curve.

5- Twice the plate resistance value will give the maximum undistorted power output.

6- C3 is used to prevent oscillation, by being used as a by-pass at high frequencies + reduces the feedback enough to prevent oscillation.

7- Even harmonic distortion is eliminated by the push-pull stage.

8- The current type, when there is no condenser the plate load consists of both, the output transformer + the cathode resistor R2.

9- Phase Inverter stage are used to eliminate input transformer. (a phase inverter is use to feed the grid of one of the push-pull tubes from a voltage Amplifier.) It is cheaper to use a tube stage than expensive input push-pull transformer.

10- So that the proper voltage division will be obtained to counteract the gain of VT_4.

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A ONE-MINUTE DISCUSSION OF EACH QUESTION IN THIS LESSON

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LESSON 15FR-2 LOW-FREQUENCY AMPLIFIERS FOR SOUND AND TELEVISION RECEIVERS

Question 1. The low-frequency amplifier is the audio amplifier in a home receiver, or the video amplifier in a television set. The audio and video signals are stripped off the carrier by the demodulator and are fed directly into the low-frequency amplifier. No signals are delivered to a stage by a power supply in good working condition, and the i.f. amplifier delivers the modulated signal to the input of the demodulator.

Question 2. In the figure referred to in the question, condenser C_3 and resistor R_4 act as a voltage divider for the signals amplified by VT_1. But only that part of the signal which is across R_4 is applied to the input of tube VT_2. At mid frequencies and at high frequencies the reactance of C_3 is so low that practically all of the signal appears across R_4. However, at low frequencies, the reactance of C_3 becomes quite high, and less of the signal voltage exists across R_4. To increase the low-frequency response, C_3 should be made larger in capacity -- then its reactance will be small enough at low frequencies so that most of the low-frequency signals appear across R_4 for amplification by VT_2.

Question 3. When we say that stages are cascaded, we mean that the output of the first stage feeds into the input of the following stage. If the first stage amplifies twelve times, and 1 volt is fed into it, it will deliver 12 volts to the input of the second stage. If the second stage amplifies the 12-volt signal 10 times, it will deliver a 120-volt signal. Since our 1-volt signal is raised to 120 volts, the total voltage amplification of two cascaded stages is not the sum of their gains, but the product -- in this case 10 x 12, or 120.

Question 4. When two different radio parts are placed in series, and a.c. is applied to them, the circuit will act like the part having the greater resistance or reactance. Since the load resistance is in series with the tube, increasing the ohmic value of the load will make the combination of tube and load act more like a pure resistor. A pure resistance is linear -- that is, it has a straight characteristic, so increasing the ohmic value of the load will tend to straighten the Eg-Ip curve.

Question 5. Maximum power output is obtained when the plate load is equal to the plate resistance. However, under this condition, considerable distortion is present because the Eg-Ip characteristic curve of the tube is not straight. If the load is reduced to half of the plate resistance, the curvature will increase, and even more distortion will result. Increasing the load resistance will straighten the curve and reduce the distortion. It has been found that maximum power without noticeable distortion is obtained, for a triode tube, when the load resistance is twice the plate resistance.

Question 6. The power output tube plate-to-cathode condenser is used to make the plate circuit capacitive at high frequencies. This reduces the tendency toward oscillation.

Question 7. If a circuit which balanced out the odd harmonics were used, the fundamental would also be eliminated. The fundamental must come through, so the push-pull stage must eliminate the even harmonics. (The odd-harmonic distortion is reduced by proper plate loading and by the use of plate by-pass condensers.)

Question 8. Inverse feedback due to omission of the cathode bias by-pass condenser is of the current type. This is so, because the degenerative voltage which reduces the applied grid-cathode signal voltage is produced by the plate signal current flowing through the bias resistor.

Question 9. A phase inverter stage is used to shift the phase of the signal 180° so that the control grids of the output push-pull tubes can be fed with signals 180° out of phase. The phase inverter stage contributes no gain, and eliminates the use of a push-pull input transformer.

Question 10. The values of resistors R_4 and R_5 are chosen so that VT_4 is fed the same amount of signal as VT_1. This is necessary so that tubes VT_2 and VT_3 will receive signals of same strength. If incorrect replacement values are chosen, VT_3 will receive either more or less signal than VT_2, and distortion will result.

D15FR-2

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R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

CITY AND STATE Plainfield, N. J.

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LESSON NO. 14FR-2

(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

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LESSON GRADE A+

PRINT your name and address *very plainly* on the lines provided above

1- (a) Sound, like that used in radio broadcasting, in radiotelephone communication + in telphone systems.
(b) picture, either still or moving, such as those transmitted by radio or land wire, television + facsimil systems.
(c) Coade, such as the dots + dashas used in radio + wire telegraph.

2- There is no vibration in a perfect vacumm. (no sound is produced by a vibration which accurs in a vaccumm)

3- 1,089 feet per seconds.

4- (a) Reflected from the surface of the material, (b) absorbed, by the material, (c) transmitted through the material.

5- By placing sound-absorbing material on the wall + ceiling

6- Amplitude + Frequency. the Amplitude of a sound wave determins the loudnes of the sound, while its frequency determins its pitch.

7- No - if the sound is complex, the smallest change in level an average ear can notice is about 3 db.

8- (a) frequency distortion, (b) Amplitude distortion.

9- Persistence of vision.

10- The number of elements in each line has been increased by the aspect ratio. (the with of the picture divided by its hights is call Aspect Ratio.)

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R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

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LESSON NO. 13 FR-2
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PRINT your name and address *very plainly* on the lines provided above

1- About 165 Volts.

2- To get a higher out-put voltage.

3- The purpose of placing a resistor at point (a) is to control the right amount of drained current to the circuit to protect the rectifier tube.

4- Yes - you should always replace the new pilot lamp with the same voltage as the old one.

5- No - because the polarity of a d.c. power line does not reverse.

6- No - the polarity make no difference in a receiver having a non-synchronous vibrator + tube rectifier.

7- (a) Convection Current Bias, (b) Automatic Bias, (c) Filament Bias, (d) Bias Cell, (E) Mallary Grid Bias. 2

8- To prevent leakage path from draining the B. battery, because the by-pass condenser C1 is an electrolytic condenser, since all electrolytic condenser have a certain amount of leakage, it would be a drain on the B. battry, until the B circuit through C1 is open by SW1.

9- Vaccuum tube Voltmeter.

10- Vaccuum tube rectifier have a large power loss by having a high voltage drops.

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A ONE-MINUTE DISCUSSION OF EACH QUESTION IN THIS LESSON

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LESSON 13FR-2 SPECIAL POWER SUPPLIES FOR RADIO EQUIPMENT

Question 1. If no load exists, there will be no voltage drop between the output of the universal supply and the line. The filter condensers will be charged through the rectifier to the peak line voltage, and this will be the voltage output of the power supply. The line voltage value given in this question is the r.m.s. value, and the peak value is found by multiplying 115 volts r.m.s. by 1.41. This gives about 162 volts, the highest voltage that can be obtained from the universal power supply, when the line voltage is 115 volts.

Question 2. The condenser-input type filter must be used in a universal power supply in order to get enough voltage for proper operation. If a choke-input filter were used, the output voltage would be too low to operate the tubes in a receiver. The next time you work on a universal receiver make this test: Measure the power supply voltage; then disconnect the input filter condenser and recheck the voltage. You will find that it has decreased to a very low value, just as it would if a choke-input filter were used.

Question 3. Such a resistor serves to limit the current through the tube on positive voltage peaks. If the resistor is omitted, the sudden surge of current in charging the input filter condenser may be sufficient to burn out the cathode lead inside the tube. The greatest danger of this occurs when the switch is turned off long enough for the input condenser to discharge, and then turned on again while the rectifier cathode is still hot enough to emit electrons. If the switch is turned on at the point in the line voltage cycle which will apply a maximum positive voltage to the plate, the rush of current through the tube into the condenser will damage the tube unless there is a limiting resistor.

Question 4. In a universal receiver, the pilot lamp is always part of a series circuit. It must be capable of lighting with the current carried by this circuit and of carrying its share of this current. For this reason, the current rating of the lamp is very important. If a lamp with the wrong rating is used, it will either burn out or fail to light. In an a.c. set using a power transformer, the current rating is not so important, but in this case the lamp must be designed to operate at the voltage available from the power transformer.

Question 5. A transformerless voltage-doubler type receiver cannot be operated from a d.c. power line. For voltage doubling to take place, condensers must be alternately charged and connected so that their voltages add. This requires an a.c. power line.

Question 6. When a rectifier tube is used in conjunction with a vibrator, the source polarity does not matter since the tube will determine the polarity of the output voltage. However, if the wrong source polarity is applied to a synchronous vibrator supply, which does not use a rectifier tube, the d.c. output voltage will have reversed polarity and this can damage any electrolytic condensers used in the filter. In this case, to find a correction for improper source polarity, simply reverse the two outside connections to either the power transformer secondary or primary --- not to both.

Question 7. The five methods of getting C bias in a battery receiver are: by convection current through a grid resistor; by means of a bias cell; by means of a C battery; by bringing the grid return to a point on the filament string negative with respect to its filament (used when filaments are in series); and by placing a resistor between B- and the filaments and using the drop across it for bias purposes.

Question 8. If the B supply circuit as well as the A circuit in Fig. 27 were not opened, the B batteries would gradually discharge through C_1 and R, which would always be connected across the B supply. Remember, electrolytic condensers, such as C_1, have a definite leakage resistance, and some current always flows through these condensers when voltage is applied to them.

Question 9. A grid bias cell is not capable of supplying appreciable current, so a vacuum tube voltmeter which draws negligible current should be used to test the cell voltage. The cell may also be checked very simply by trying another cell and noting the effect on reception. If an ordinary meter is used to measure bias cell voltage, the meter will draw enough current to ruin the cell.

Question 10. When a high current is required for any purpose, such as to light tube filaments, a receiver type rectifier tube cannot be used because it will be unable to pass sufficient current. However, copper-oxide (or selenium) rectifiers will pass the necessary current; you will find them where the current requirements are high and the required voltages are low. It is costly to build copper-oxide rectifiers which will not be damaged by high voltages; for this reason, they are not used to replace rectifier tubes in B supply circuits.

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LESSON NO. 12FR-2

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PRINT your name and address *very plainly* on the lines provided above

1- (a) The Signal Circuit - (b) The Power Supply Circuit.

2- (a) Provide correct amount of Voltage to each tube electrode, each voltage must have the correct polarity. (b) it must furnish as near a pure d.c. voltage as possible to those electrode where variation would produce distortion, interference, or unwanted signals. (c) it must not transmit signal from one stage to another.

3- If a 2.5 volt filament tube were place in a 6.3 volt tube socket it would burn out, because it would draw to much current and it would burn out almost at once.

4- Pulsating dc - is produce than a rectifier tube.

5- Coil L + Condenser C

6- The dc voltage would be greatly reduced, because the circuit than acts effectively as a choke input filter

7- No - it does not matter if the filter choke is place in the negative side - or postive + side, the same amount of filter is obtained in each case.

8- To reduce variation, or eliminate it entirely.

9- Increase - because only screen grid current would flow through R1, so its voltage drop would be less + more voltage would be applied to the screen grid.

10- A Choke input.

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LESSON NO. 11FR-2
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LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

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1- Reluctance - is the opposition effect of a Magnetic Circuit.

2- Ampere-turn - is the practical unit of Magnetomotive force for Coil.

3- Saturation - is the condition to exist in a iron Core when increased in magnetomotive force, produce little or no increase in magnetic flux.

4- By constructing the core from thin sheets called Lamination.

5- No - because primary leakage flux does not link with the secondary, so it cannot induce a voltage into the secondary.

6- Smaller than the Secondary Current.

7- Low step up turns ratio - usually it will be less than 3 to 1

8- Equal to the source impedance.

9- Secondary winding will have the highest Resistance

10- No - the half that is closer to the iron core use turns of smaller diameter, this calls for less wire, so this half will have a lower resistance

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LESSON 11FR-2 HOW IRON-CORE COILS AND TRANSFORMERS OPERATE IN RADIO CIRCUITS

Question 1. In a simple electrical circuit, the voltage source sends current through the opposition offered by the total circuit resistance. Similarly, in a magnetic circuit, the magnetomotive force sends magnetic flux through the opposition offered by the total magnetic circuit. This opposition effect in a magnetic circuit is called "reluctance".

Question 2. When a magnetic field is produced by passing a current through a coil (an electromagnet), we find that the strength of the magnetic field can be increased either by increasing the amount of current flowing through the coil or by increasing the number of turns on the coil. This makes it convenient and practical to express the magnetomotive force of a coil in "ampere-turns". This unit is simply the number of amperes flowing through the coil multiplied by the number of turns in the coil.

Question 3. When increases in magnetomotive force produce little or no increase in the magnetic flux through an iron core, the condition is the same as when a sponge has absorbed all the water it is capable of holding. This condition for both the core and the sponge is called "saturation". When a magnetomotive force is applied to an iron core, some of the tiny magnetic particles of iron line up. In so doing, they add their magnetomotive force to that of the source, thus greatly increasing the flux. Some of these particles line up easily; others require more magnetomotive force. As the magnetomotive force is increased, more and more of the particles are lined up. However, when all the particles are lined up, increases in the magnetomotive force can add only a small amount of flux; it is not aided by further increases in core magnetism. When this point is reached, we say that saturation exists.

Question 4. When a varying magnetic flux links with a conductor, a current flow will be set up in a direction at right angles to the flux direction. Hence, when magnetic flux is passing through an iron core (a semi-conductor for current), a current will be forced to flow at right angles (across the core) to the flux path. This eddy current flows through the core resistance and results in a power loss. If the core is solid, the eddy current rings or paths are large; this means that the rings not only have high resistance, but also enclose or link with many lines of flux so that a high voltage is induced in them, resulting in appreciable current. This will result in considerable eddy current power loss. However, when the core is laminated (made of thin strips of iron), the eddy current paths (rings) can be no wider than each lamination. Hence, each ring links with a smaller number of flux lines. This reduces the flux linkage, and, therefore, reduces the induced voltage and loss. Thus, laminating the core reduces the power lost in eddy currents.

Question 5. In a transformer, there are two or more windings, arranged in such a way that paths for magnetic lines of force pass through both windings. A magnetic field is produced by current flow through the primary winding, and the part of this magnetic field that passes through the other winding induces a voltage in it. That part of the primary flux which escapes from the core and, consequently, does not pass through the secondary is known as leakage flux. This flux is wasted because it does not induce any voltage in the secondary winding of the transformer.

Question 6. First of all, we have shown that the name of the transformer (step-up or step-down) is determined by what happens to the <u>voltage</u>. Hence, in a <u>step-down</u> transformer, the secondary <u>voltage</u> V_s is less than the primary <u>voltage</u> V_p. Now, let's see what the current relationship is. Of course, the amount of secondary current depends on the load demand and, since a transformer is a power transferring device, the secondary current I_s will determine the primary current I_p. The secondary power is $V_s \times I_s$, and the primary must draw the same amount of power from the source (assuming no losses exist). Therefore, since the secondary voltage is less than the primary voltage, the primary current must be smaller than the secondary current, so the primary $V_p \times I_p$ will equal the secondary, $V_s \times I_s$. Using figures in an example, let's suppose:

$$V_p = 50 \text{ v.}; V_s = 25 \text{ v.}; I_s = 4 \text{ amps.}$$

The formula is: $V_p \times I_p = V_s \times I_s$. Substituting values, we have:

$$50 \times I_p = 25 \times 4; \text{ so } 50 \times I_p = 100, \text{ and } I_p \text{ must be } 2.$$

Hence, the primary I_p is smaller than the secondary I_s when a step-down transformer is used.

Question 7. If a transformer has a high step-up turns ratio, there will be a great number of secondary turns. As a result, considerable distributed capacity will be present in the secondary. If such a transformer is used, the higher audio frequencies will be by-passed, and high-fidelity transmission is impossible. For this reason, you would expect a high-fidelity interstage transformer to have a low step-up turns ratio.

Question 8. When various values of load impedance are connected across a power source, the power delivered to the different loads will vary. By experiment and by calculation, we find that maximum power will be transferred when the load impedance is equal to the source impedance.

Question 9. The windings on a power transformer are of ordinary copper wire, so the resistance will depend on the size and length of the wire used. The smaller the size of the wire and the greater its length, the larger the resistance will be. Windings supplying high currents must use large wire so that there will be less power loss. Also, windings on step-down secondaries will have but few turns (as they furnish low voltages), so the wire on these windings will be short in length. Therefore, the high voltage secondary will have the most turns (the greatest wire length) because it is a step-up winding, and, since it supplies the smallest current, it will have the smallest diameter wire.

Question 10. The resistance of a coil winding depends on the size and length of the wire with which it is wound. In a center-tapped high-voltage winding, the size of the wire is the same for both halves. Since each half has the same number of turns, it might seem that the length of wire on each half is equal, giving equal resistance. This is wrong; the windings are put on in layers, one over the other. The turns on the outside of the winding have a larger diameter than those on the inside, and hence require longer lengths of wire. Because of this, the outside half of the high-voltage winding has more resistance than the inner half. A test with an ohmmeter will show that this is true.

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R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

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PRINT your name and address *very plainly* on the lines provided above

1- The fundamental principle of the Superheterodyne Circuit is — Incoming signal is combined with a local R.F. signal so that a lower frequency R.F signal is produced.

2- Class A.

3- Mutual Conductance - tells directly how much the Grid Voltage controls the Plate current.

4- When resistance of the load is equal to the A.C. plate resistance of the tube.

5- (1) Prevent an undesirable loss of signal.
(2) Prevent undesirable Coupling between Stages.
(3) Prevent undesirable signals from the power supply from getting into the Amplifying Stage.

6- Drops to zero.

7- Condensor + Resistor

8- (a) power Transformer (b) the rectifier tube (c) filter section (d) Voltage divider.

9- Diode rectifier tube

10- Convert the frequency variation back into an Amplitude change before we can reclaim the Original Intelligence signal.

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LESSON NO. 9FR-3

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1- Increase - The selectivity of the Circuit.

2- Higher Value -.

3- Lower Frequency - is made by increase the Capacity of C. in Series Resonance Circuit, (Lower the Capacity of C. in Series Resonance Circuit you get a higher Frequency.)

4- Higher Resistance - as a resistor of high Ohmic Value.

5. The part having the lower reactance.

6- High Q - a coil with a high Q give the highest possible selectivity.

7- Increase the inductance - it reduce the reluctance of the magnetic field,

8- Series Resonant Circuit.

9. 1- Direct Coupling, 2- Capacitive Coupling, 3- Direct Inductive Coupling, 4 - Inductive Coupling.

10. When all of the magnetic flux produced by the primary winding links with (pass through) the entire Secondary winding, is knowed as Unity Coupling

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LESSON NO. 8FR-4

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PRINT your name and address *very plainly* on the lines provided above

1- Cathood + Anode

2- No - There is no electrical connection between Plate + filament. The negative Plate repel negative electron emitted from filament. (like charge repel unlike charge attracts.)

3- No - The A. battery only heats the filament + does not emitt elections. Election comes from atoms of the filament wire itself.

4- Pulsating D.C.

5- Heater Type tubes

6- When speeding election knocks other election loose from its surface. This is call secondary emission.

7- Controls the flow of current from B. supply through tube. (it acts like a electrical valve.)

8- Decrease - As the c bias voltage is made more negative - The Plate current will decrease so,

9- Five - elements - 1 - Plate - 2 - Suppresor Grid, 3 - Screen grid, 4 - Control grid 5-Cathood.

10- Filament Voltage - in steps of 1 volt.

HOW TO READ GRAPHS

IT IS frequently necessary to use graphs in describing the actions of radio circuits, particularly when the actions are complicated. Often, descriptions that would be unclear even if thousands of words were used in them can be made perfectly understandable by the use of one or two graphs. In fact, graphs are used all through your N.R.I. Course for precisely this reason.

The purpose of this data sheet is to give you practice in graph-reading and to explain how graphs are used. Follow the steps carefully, restudying and reviewing as you would one of your lessons. You will find this extra effort well worth your while—for, once you thoroughly understand how to read and use graphs, you'll get far more out of the lessons to come.

Uses for Graphs. *A graph is a record of certain information.* It always shows us the relationship between two sets of values, and points out how changes in one set affect the other. For example, a graph frequently used in radio shows the relationship between grid voltage and plate current in a vacuum tube; from such a graph, it is easy to see what change in plate current is caused by a change in grid voltage.

A graph may be constructed from information found in a table, from a word description, or from experimental measurements. So far as the particular information on which it is based is concerned, the graph is no better than its source. However, *it possesses the great advantage of permitting you to determine in-between values—values which were not in the original description, table, or measurements. Furthermore, the shape of the graph shows you what happens to one set of values if changes occur in the other set.* This last also is information not readily conveyed by a word description or by a table.

Plotting a Graph. Perhaps the easiest way to learn what a graph can do is to go through the steps of drawing (or plotting) one.

Suppose we are interested in something that is easily shown by pictures—for example, how fast a weed grows. After the first week of growth, we might measure the height of the weed stalk every two weeks, recording our results in a table, as follows:

First week	¼ foot
Third week	1 foot
Fifth week	3 feet
Seventh week	5¼ feet
Ninth week	5¾ feet
Eleventh week	6 feet

We can show the same facts with the pictorial presentation in Fig. *1*. Comparing the height of the weed with the adjacent ruler shows you just how tall the weed was at the end of each period. Notice how much easier it is to *visualize* the growth of the weed from these pictures than it is from the figures in the table.

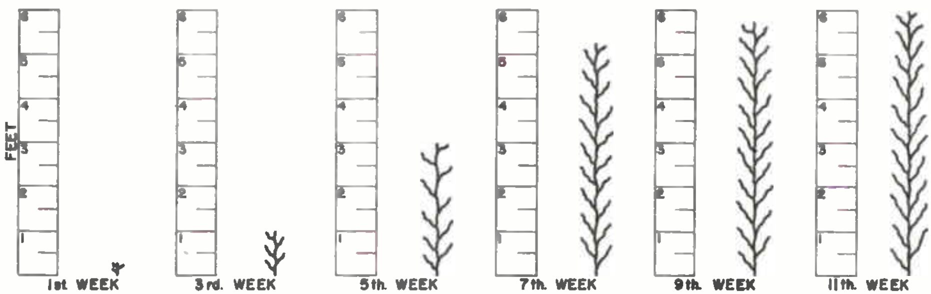

FIG. 1. A Pictorial Graph.

Now, suppose we take away all but one of the rulers and show the growth of the weed as in Fig. *2*. Again, you just compare the height of the weed with ruler markings to determine its height at the different two-week intervals.

Figs. *1* and *2* are "picture" graphs; the weed is represented by an actual picture or drawing of it. To save the trouble of drawing these pictures, we can just put a dot where the top of the stalk should come, as shown in Fig. *3*, and the height at each period will still be clearly indicated. (Compare Figs. *2* and *3*.)

None of the graphs drawn so far have given us any more information than was contained in the original table, although they have made it easier for us to visualize what that information means. But now we can take one more step and connect the dots of Fig. *3* with a line. This gives us the usual form of graph, shown in Fig. *4*—and at once presents us with information that neither the table nor any of the previous graphs contained in a convenient form.

The use of the ruled or lined graph paper

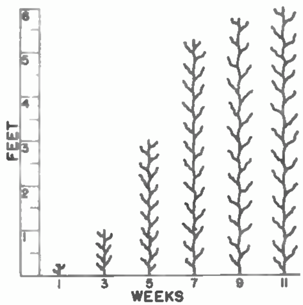

FIG. 2.

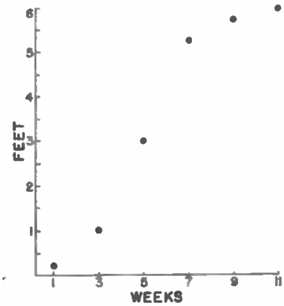

FIG. 3.

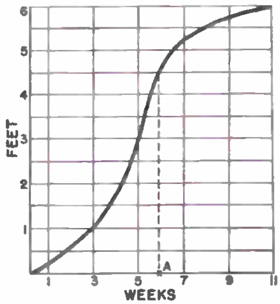

FIG. 4.

in Fig. *4* is purely a convenience, making it easier for us to read values from the graph. The scale of numbers at the left of the graph replaces the ruler that was used as a scale in Figs. *1* and *2*. This left-hand scale, which has numbers one above the other in a vertical column, is called the *vertical scale*. The numbers in it show the vertical distance each horizontal line is from the bottom scale. The scale along the bottom of the graph is called the *horizontal scale*. The numbers in it show the horizontal distance each vertical line is from the scale at the left of the graph. The graph itself (the line connecting the dots) is called a *curve*, even though parts of it (or sometimes the entire line) may be straight.

Interpolation. The *curve* in Fig. *4* lets us find where the top of the stalk is at *any* time. For example, let's find the height of the stalk at eight weeks. We cannot get this information easily from the table since it is not listed there, but the graph gives it to us right away. You see seven weeks and nine weeks marked at the bottom of the graph; eight weeks must be half-way between them. Therefore, to find the eight-week height, we first go straight up along an imaginary line half-way between seven and nine until we strike the curve; then, we go straight over from this intersection point to the left-hand side of the figure, where the height in feet is given. We find that the stalk was a little more than 5½ feet high at the end of eight weeks.

Let's use our graph again to find *when* the stalk was 4½ feet high. We locate 4½ feet at the left, then go straight over to the curve. From the intersection, we go straight down to the bottom of the graph (along the dotted line). We will hit the bottom or horizontal scale at the point marked "*a*." Since this is not a marked value, we must estimate the time. We know that the distance half-way between five and seven represents six weeks, and point "*a*" lies about one-half of the way between five and seven, so we will call this point 6 weeks—the time at which the stalk was 4½ feet high.

Thus, *our line graph lets us find values that were not present in our original tabulation of facts.* This demonstrates one of the important uses for graphs. Not only does our graph present all the information contained in the original table, but also it permits us to find in-between values in which we may be interested. Finding these in-between values is called "interpolation."

Determining Rates. As we mentioned, *the shape* of the curve itself tells us many things about how changes occur. In fact, often we are more interested in the general shape of the curve than we are in reading values from it. For this reason, you frequently will find that the curve is not shown on graph paper at all. Sometimes, even numbered scales are not shown (although, of course, they must be used in plotting the original graph; they are dropped only after the curve is drawn).

The *angle* at which the curve rises shows the *rate* at which changes occur. Fig. *4* shows that the weed grew slowly at first, then speeded up between the third and seventh weeks (indicated by the curve being more nearly vertical), and finally slowed down again. Furthermore, the fact that the portion between the third and seventh weeks is a straight line indicates that the weed grew uniformly between these points.

The ability of graphs to show *how* changes occur is perhaps their most useful feature as far as radio is concerned. Let us now take up a typical radio graph and see why its shape is so informative.

THE E_g–I_p CURVE

Very often in radio we want to know how the characteristics of a signal may be altered by a radio tube, part, or stage. Such information not only helps us understand how the particular device or stage operates, but also points out when and how distortion can occur and how much distortion we can expect under various conditions. The easiest way to get this information is to use a graph of the characteristics of the tube or stage in which we are interested, such as the E_g-I_p curve of a vacuum tube. This curve tells us how the plate current of a tube will be varied by different voltages applied to the grid of the tube.

Let's suppose we have a sine-wave signal and want to know if we can get a sine-wave plate current change when the signal is applied to the grid. There are quite complex mathematical solutions to this question, but the best and quickest answer can be obtained from graphs.

If the vacuum tube characteristic were a straight line, like the curve shown in Fig. *5*, we would know the answer at once. This straight line characteristic is absolutely linear—that is, the plate current is always directly proportional to the grid voltage, so

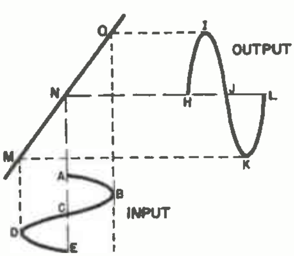

FIG. 5. A Linear Graph.

whatever is applied to the input will be exactly copied at the output.

Thus, if we apply the input signal *A-B-C-D-E*, we will get the output signal *H-I-J-K-L*. This output signal is an exact copy of the input in form. (It may, of course, be larger or smaller than the input, depending on whether the tube amplifies or has losses, but the general form of the input and output will be the same.)

To see how the output wave is developed, let's start when the input signal is at *A*. Reading upward from this point till we strike the curve at *N*, and then reading directly over to the right, we come to *H*.

When the input signal changes to value *B*, we again read upward to the curve, this time striking it at *O*. Reading over to the right, we come to the value *I*.

When the input signal moves to *C*, point

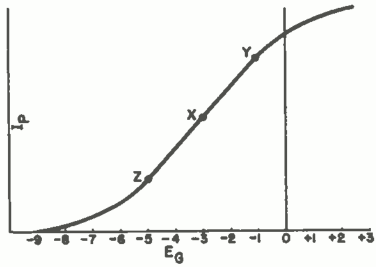

FIG. 6. Typical E_g-I_p Curve.

N gives us the value *J*, while when it moves to *D*, point *M* gives us the value *K*.

Notice—when we use the characteristic curve this way, we pay no attention to what the actual output values are—all we want to know is whether each point of the output corresponds to the similar point of the input. In fact, we don't need to have a vertical scale on the graph at all.

Of course, as you already know, the E_g-I_p curve of a tube is not a straight line, but is instead shaped more like the curve shown in Fig. *6*. Only the portion of the curve between *Z* and *Y* is straight—the rest is definitely curved. Therefore, not all the E_g-I_p tube characteristic is linear. What does this mean?

First, it means that if we want the output to be exactly like the input, we must restrict the input signal to the portion of the curve which is straight. In other words, we must find an operating point which will be within the straight portion of the curve, and then must limit the input signal so that the straight-line section will be the only portion of the curve over which the grid voltage swings.

Before we take up a practical example, notice the scale at the bottom of Fig. *6*. Since grid voltage values may be either positive or negative, zero (0) on this scale is not at the lower left-hand corner, but is instead moved over near the right end of the bottom scale. Positive numbers go from zero towards the right, while negative numbers go from zero to the left.

We do not use any scale for plate current here, because we don't care how much plate current flows. All we want to determine is the *shape* of the output signal.

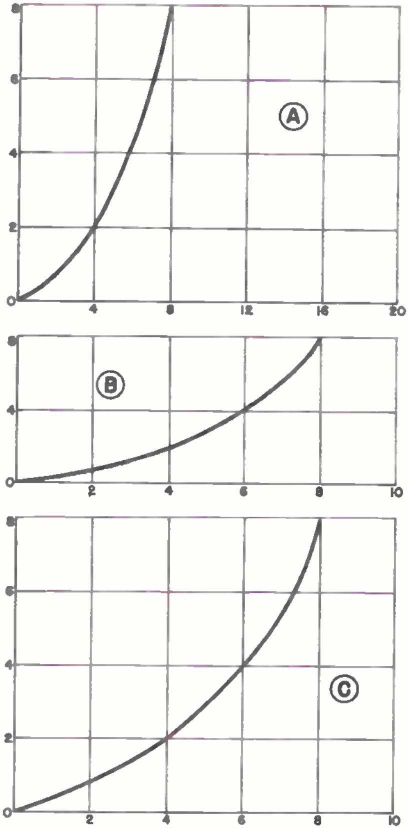

FIG. 12. Effects of Scales.

way between *2* and *4* must represent *3*.

In addition, each of these major divisions is further divided by the light-weight lines into five units. Each light line therefore represents two-tenths (or .2, as we usually write it) of the distance between major divisions. Going from *1* to *2*, we would mentally count off 1.2, 1.4, 1.6, 1.8 as we passed each light line. (We have labeled these lines here to show how they are to be read.)

Now, suppose you want to find the point representing 1.75 on the scale shown in Fig. *11*. From the previous explanation you know that the third line above *1* indicates 1.6 and the fourth line indicates 1.8. Therefore, 1.7 would be half-way between these two lines. The point we want, 1.75, would be half-way between this mid-point and 1.8. (The approximate location of this point has been marked on Fig. *11*.)

In other words, when you must estimate some intermediate value, mentally divide the distance between known values into smaller convenient units. Almost never will it be necessary to divide it into more than two or three sections.

There is one other important thing about graph scales. The scales chosen may cause graphs to appear different, although they represent the same thing. For example, in Fig. *12*, graphs *A*, *B*, and *C* are identical except for the scales chosen. (Check this by comparing points on the three curves.)

Usually it is best to choose scales which will produce the biggest curve, because large curves are easier to plot and easier to read. By this standard, the scales chosen for graph *C* are best. Remember—all three of these curves show the same thing, and all can be used in the same manner. Graph *C* is preferable only because it is the easiest to read.

This, of course, indicates that when you are comparing graphs, you must be sure that they are drawn to the same scales; otherwise, you may be fooled.

To summarize: graphs are a pictorial means of showing how some action occurs—how one thing varies with respect to another. As such, they are very helpful in explaining the operation of radio circuits, particularly those in which tubes are used.

It is common practice to select the midpoint of the straight part of the characteristic (between Z and Y) as the operating point. This is point X in Fig. 6. Tracing down from X to the bottom scale, we find we will need to use a bias value of -3 volts to operate at this point.

Now, let us apply an a.c. voltage which has a peak value of 2 volts to the grid. This a.c. voltage swings from zero to a maximum of 2 volts positive, reverses to zero, and then goes to 2 volts negative, after which it returns to zero and repeats the cycle.

As Fig. 7 shows, this a.c. voltage alternately adds to and subtracts from the bias

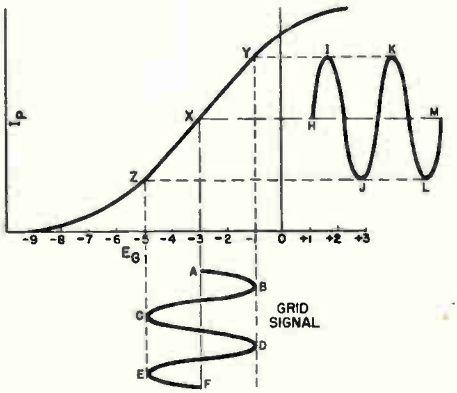

FIG. 7. Undistorted Output.

voltage. When the a.c. voltage is zero, we will have our initial or operating bias of -3 volts. This is represented by point A on the grid signal curve. When the grid signal swings in the positive direction, it subtracts from the negative bias voltage, so that it moves to point B and produces a total grid voltage of -1 volt. On the other hand, when the signal swings negative to point C, the grid voltage becomes -5 volts. Thus, the grid voltage swings alternately from -3 to -1 to -5, etc.

Extending lines upward from the various points on the input signal *A-B-C-D-E-F* shows us that the plate current rises when the grid voltage becomes less negative (more positive) and falls when the grid voltage becomes more negative. The resulting plate current variations are represented by the curve *H-I-J-K-L-M*—which, you will notice, has the same shape as the grid voltage curve. Hence, there is no distortion of the output if we operate only over the linear region *Z-Y* on the curve.

But suppose we allow the grid voltage to swing past the linear part of the curve—what will happen? Fig. 8 shows one possible effect. Here we apply the same 2-volt signal, but we use a bias of -5 volts instead of -3 volts. This puts our operating point at Z. The grid voltage swing is now from -5 to -3, then to -7, back to -5, etc., between U and V; that is, we are operating over the lower bend of the characteristic. Under these conditions, the applied a.c. signal *A-B-C-D-E-F* produces the plate current change *N-O-P-Q-R-S*.

Obviously, the input signal and the output signal do not have the same shape in Fig. 8. As you can see, the distance from the line *Z-Z* to O is much greater than the distance from the line *Z-Z* to P. Therefore, the plate current pulses do not have the same shape on the two halves of the cycle; in other words, the plate current is not a pure sine wave like the applied grid voltage. This means that the output of the tube is distorted.

Now, let's see what would happen if we kept the operating bias value of -3 volts used in Fig. 7, but applied an a.c. signal having a peak value of 6 volts. Under this condition, the input signal would swing from -3 to $+3$, then back through -3 to

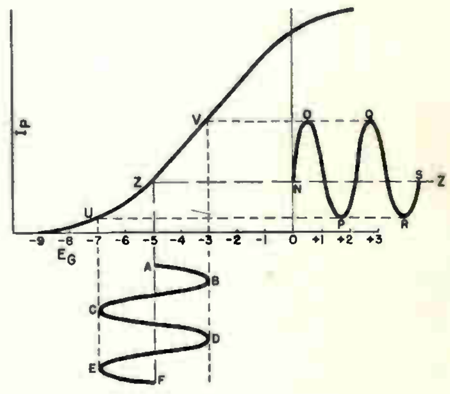

FIG. 8. Distortion.

-9, back to -3, etc. For practice, trace out the resulting output signal on a sheet of paper. You should get a wave which has a relatively square shape rather than a smooth sine wave. Again, this means distortion in the tube output.

To sum up, you can see that the tube E_g-I_p graph has served the useful function of showing us just how the tube will perform under various operating conditions. Specifically, it has shown us that we will get no distortion if we operate on the straight part of the graph, but will get distortion if we: (a) use the wrong bias, which makes us operate over a bent part of the characteristic, or (b) apply so large a signal that we go off the linear part of the characteristic.

We might tell you these facts time after time without its being clear to you just why distortion occurs under such circumstances. But the graph lets you *see* what happens when the wrong bias or too large a signal is applied, and so makes the explanation quite simple. Furthermore, the graph makes it easy for you to figure out what happens under *any* operating conditions, not just under the conditions given in our examples.

You won't usually have to draw any graphs, or figure out operating conditions from them, in your regular service work. (*You won't have to draw a graph when servicing a set for distortion, but you certainly would check the bias supply or the input signal because graphs have shown you that improper bias or excessive signals will cause distortion.*) Your primary use of graphs will be as assistants in *helping you to understand circuit operations*—both now, as a student, and in

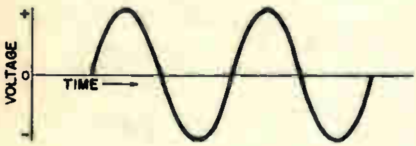

FIG. 9. Sine Wave Graph.

the future, as an N.R.I. graduate—when you will be keeping up with the latest advances in radio by reading the literature of the radio profession.

TIME RELATIONSHIPS

An important group of graphs are those showing how certain things change with respect to changes in *time*. The growth of the weed in our first example was such a graph. A graph showing an a.c. cycle is another typical example.

Consider Fig. *9*, where a typical sine wave is shown. (This may well be a graph of a power line voltage variation.) You see that the a.c. voltage first rises to a peak in the positive direction, then goes through zero to a corresponding peak in the negative direction, repeating the cycle over and over as time passes. (Notice that this is another case where the zero on one of the graph scales does not occur at the lower left-hand corner.)

Another good example of a time graph is shown in Fig. *10*. This is a typical curve showing the voltage developed across a condenser when it is first connected to a source of voltage through a resistor. At the instant the circuit is closed, (zero time) the voltage developed across the condenser is zero. However, it begins to build up at once—rapidly at first, and then much more gradually. The early rapid build-up is indicated by the steep first portion of the curve. As time passes, the curve becomes more nearly horizontal, indicating a much slower change in voltage with a change in time.

If we mark off equal units of time along the horizontal time scale, such as the distances *O-A*, *A-B*, *B-C*, and *C-D*, we will find from the vertical scale how much the voltage increases in each unit of time—that is, the *rate of increase* of voltage. As you see, the distance from *O* to *K* is much greater than the distance from *K* to *L*, which in turn is greater than the distance from *L* to *M*. The distance *M* to *N* is the smallest of all. Therefore, while the voltage increases all the time, the rate at which it increases becomes less and less as time goes on.

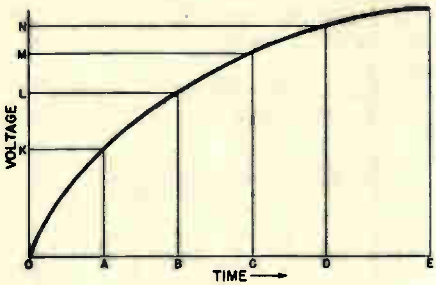

FIG. 10. Condenser Charge Curve.

GRAPH SCALES

Sometimes there is some difficulty in reading graph scales. Of course, you don't have to worry about this except on the rare occasions when you are trying to find exact values from a graph. Nonetheless, it is well for you to know how scales should be read.

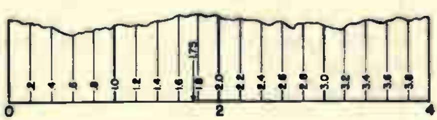

FIG. 11. Typical Graph Scale.

Often you must estimate values which may fall between two marked values. This may be hard or easy, depending on how many values are marked on the graph, and on the number of lines provided. For example, consider the horizontal scale in Fig. *11*. The only *marked* values on the scale are *0*, *2*, and *4*. However, the heavy intermediate line half-way between *0* and 2 must represent *1*, and the similar line half-

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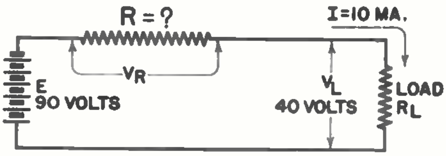
RESISTOR EXAMPLES

THIS data sheet gives practical examples of the important radio laws which you have studied in connection with resistors. Of course, in ordinary radio work you will rarely have to figure out more than one thing at a time; here we show several examples for each circuit only in order to emphasize the maximum possible number of basic radio principles.

EXAMPLE 1

A resistance load requires 40 volts and draws 10 milliamperes. It is to be connected into a circuit having a 90-volt source, with a series resistor being used to get rid of the undesired voltage. What ohmic value and wattage rating should the series voltage-dropping resistor have?

SOLUTION: First we draw the schematic diagram of the circuit, and place on it all known information, as follows:



Since we are to find the ohmic value of series resistor R by means of Ohm's Law, we must first know the values of E and I for this resistor ($R = E \div I$). We already know that I is 10 ma. because this is a series circuit, and the load current must flow through series resistor R. To change this 10-ma. current value to amperes, we move the decimal point three places to the left, and thereby get .01 ampere as the value of I.

To find the voltage drop V_R across R, we make use of Kirchhoff's Voltage Law. It says that the voltages dropped across the load and the series resistor must add up to the source voltage. The only voltage value for R which will meet this fundamental requirement is a value equal to the difference between the source voltage of 90 volts and the load voltage of 40 volts. Therefore, voltage drop V_R is equal to 90 — 40, which is 50 volts.

Knowing that V_R is 50 and I is .01, we can now use the Ohm's Law formula. $R = E \div I$ to give us the ohmic value of R:

$R = V_R \div I$

$R = 50 \div .01$

$R = 5000$ ohms

```
         5000.
.01. |50.00.
      5
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NOTE: Division with decimals is explained near the end of this data sheet.

Series voltage-dropping resistor R must therefore have an ohmic value of 5000 ohms. But can we use any 5000-ohm resistor? No. We must be sure that the resistor we use will be able to handle the amount of power which is lost in it as heat. That is why we figure out this power loss before choosing a resistor.

The power formula, you will recall, says that the power in watts is equal to the voltage drop across the resistor multiplied by the current flowing through the resistor ($P = E \times I$). Thus:

$P = V_R \times I$

$P = 50 \times .01$

$P = .5$ watt

If series resistor R is located in open air, a 5000-ohm resistor having a wattage rating of ½ watt will serve the purpose. If the resistor is mounted underneath a chassis

RESISTOR FORMULAS

OHM'S LAW FORMULAS	POWER FORMULAS
$E = I \times R$	$P = E \times I$
$R = E \div I$	$P = I \times I \times R$
$I = E \div R$	$P = E \times E \div R$

PARALLEL RESISTANCE FORMULA

$$R = \frac{R_1 \times R_2}{R_1 + R_2}$$

E = VOLTAGE in VOLTS
I = CURRENT in AMPERES
R = RESISTANCE in OHMS
P = POWER in WATTS

where air circulation is limited, we should provide an ample margin of safety by using a resistor having a considerably higher wattage rating than the computed power value. In other words, we should use a 5000-ohm resistor having a 1-watt or even larger rating.

EXAMPLE 2

The load resistance in our first example was 4000 ohms ($R = E \div I = 40 \div .01 = 4000$ ohms). Instead of a resistor, this load could be a vacuum tube which varies considerably in resistance during certain operating conditions. The load voltage, however, should remain constant at 40 volts. Will the tube still get 40 volts if the tube resistance drops to 1000 ohms?

SOLUTION: According to Ohm's Law, the load voltage will be equal to the load current multiplied by the load resistance ($E = I \times R$). When the load resistance drops to 1000 ohms, the total circuit current changes, the resistance changes, and hence the load current changes. Here is how we can figure the new load current value.

In our circuit now, we have a 5000-ohm series resistor and a load resistance of 1000 ohms. These two resistances are in series, so their values add. This means that the total resistance which the source "sees" in this circuit is 5000 + 1000, or 6000 ohms.

With a source voltage of 90 volts acting on a total resistance of 6000 ohms, the circuit current will be:

$$I = E \div R$$
$$I = 90 \div 6000$$
$$I = .015 \text{ ampere.}$$

Now we can figure out the load voltage:

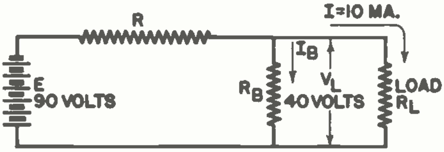
$$V_L = I \times R_L \text{ (same as } E = I \times R)$$
$$V_L = .015 \times 1000$$
$$V_L = 15 \text{ volts}$$

This load voltage value of 15 volts is certainly considerably lower than the required value of 40 volts. This demonstrates that in a simple series circuit, a change in load resistance will have considerable effect upon the load voltage.

EXAMPLE 3

By connecting a shunt or bleeder resistor across the vacuum tube load in the previous example, we can make the load voltage more nearly constant when the load resistance changes in value (improve the voltage regulation). What should be the ohmic values and wattage ratings of the series and shunt resistors, and how much will the load voltage change now when the load resistance drops from 4000 ohms to 1000 ohms?

SOLUTION: For the purpose of this explanation, we will first draw our circuit diagram and place on it all known values, as follows:



To begin with, we want the resistance of bleeder resistor R_B to be many times *smaller* than the ohmic value of load R_L, because this is one requirement for good voltage regulation. Stated in another way, we want R_B to carry several times as much current as the load. Let us say that we will make R_B carry 10 times the normal load current; this is 10 times .01 ampere, or .1 ampere.

We know that R_B will get the same voltage as the load, because it is in parallel with the load. Thus, knowing both the current and voltage of R_B, we can determine its resistance value by Ohm's Law:

$$R_B = V_L \div I_B \text{ (same as } R = E \div I)$$
$$R_B = 40 \div .1$$
$$R_B = 400 \text{ ohms}$$

The ohmic value of R_B should thus be 400 ohms. Its power loss will be $P = E \times I = 40 \times .1$, which is 4 watts. The nearest standard-size resistor readily available is 5 watts, and this would be considered the *minimum* safe size. Ordinarily a radio man would use a 10-watt resistor in this location to give ample margin of safety.

Now let us figure the ohmic value of series resistor R. We know that this resistor must drop 50 volts, because we still need 40 volts across the load. We must figure out, however, what the new current value through the series resistor is.

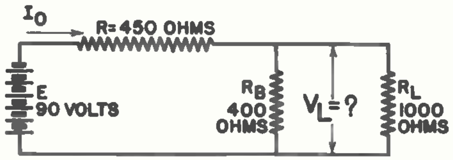
Kirchhoff's Current Law says that the current flowing through this resistor will be the sum of the currents flowing through R_B and R_L. This means that the series resistor current will be .1 + .01, or .11 amp.

Now we can use Ohm's Law to compute the ohmic value of series resistor R:

$$R = 50 \div .11$$
$$R = 454 \text{ ohms}$$

It would be quite difficult to secure a resistor having an ohmic value of exactly 454 ohms. Furthermore, such an exact value is not necessary in radio work. Instead, we use the nearest standard-size resistor. In this case, it would be a 450-ohm resistor. The power loss is $50 \times .11$, or 5.5 watts, hence a 10-watt resistor is the logical choice.

Now let us see what happens to the load voltage in this circuit when the load resistance drops to 1000 ohms. We first draw the circuit diagram in schematic form and put in all of our known values for this new condition, as follows:



If we know the combined resistance of R_B and R_L in parallel, and also know the current which would flow through this combined resistance value (this is the same as the current through series resistor R), we can figure out the load voltage by means of Ohm's Law.

First we figure the combined resistance (let us call it R_O) of R_B and R_L in parallel, as follows:

$$R_O = \frac{R_B \times R_L}{R_B + R_L}$$

$$R_O = \frac{400 \times 1000}{400 + 1000} = \frac{400{,}000}{1{,}400}$$

$R_O = 286$ ohms, combined resistance

This combined resistance of 286 ohms is in series with the 450-ohm value of R, insofar as the source is concerned. The total circuit resistance is then 450 + 286, which is 736 ohms. A source voltage of 90 volts acting on 736 ohms makes circuit current I_O equal to 90 ÷ 736, which is .12 ampere.

To find the load voltage now, all we have to do is multiply circuit current I_O by combined resistance R_O. This gives us .12 × 286, or 35 volts as the load voltage under the condition whereby the tube resistance has dropped to 1000 ohms. This is not at all far off from the desired voltage value of 40 volts, clearly proving the value of the bleeder resistor in keeping the load voltage reasonably constant.

We found in EXAMPLE 2 that the load voltage dropped to 15 volts under similar conditions but without the bleeder resistor. Thus we see that a shunt or bleeder resistor improves the voltage regulation of a circuit. The smaller the change in load voltage when the load resistance varies, the better is the voltage regulation.

REVIEW OF DECIMAL NUMBERS

DECIMALS are merely a convenient short-hand method of specifying fractional values. Since we encounter decimals occasionally when we read a meter or do a bit of figuring for radio circuits, the simple fundamental rules for handling decimal numbers are presented here in condensed form to refresh your memory. Read them once now, and refer to them whenever in doubt about a decimal problem.

We will start off this review with examples of a few decimal numbers and their fractional equivalents.

$.1 = \frac{1}{10}$ = one tenth

$.03 = \frac{3}{100}$ = three hundredths

$.001 = \frac{1}{1000}$ = one thousandth

$.0007 = \frac{7}{10{,}000}$ = seven ten thousandths

$.00007 = \frac{7}{100{,}000}$ = seven hundred thousandths

$.000001 = \frac{1}{1{,}000{,}000}$ = one millionth

$.0025 = \frac{25}{10{,}000}$ = twenty-five ten thousandths

Any number of zeros can be added after a decimal number without changing its value. Thus, .03 is the same as .030 or .03000; 1.405 is the same as 1.40500; 7 is the same as 7.0 or 7.000.

Reading decimal numbers is easy when done the radio man's way. He does not ordinarily bother to use the fractional pronunciations; instead, he calls off the decimal point, zeros and numbers from left to right in their respective order. If a radio man walked into a store to buy a .25-mfd. condenser, he would simply ask for a *"point two five microfarad condenser."* To him, .025 would be *"point oh two five"*; .0025 would be *"point double oh two five"*; .00025 would be *"point triple oh two five."* With a number like 25.079, he would say *"twenty-five point oh seven nine."* Correspondingly, if speaking of a current of .75 ma. which is being measured by a milliammeter in a circuit, he would say and think *there is point seven five milliampere flowing in the circuit,"* instead of saying and thinking *"seventy-five hundredths of a milliampere."*

In radio work, it is often necessary to multiply or divide both whole numbers and decimal numbers by such values as 10, 100, 1000, or 1,000,000. This is necessary when changing values in milliamperes to amperes and vice versa, or when changing values in ohms to megohms and vice versa. On the next page are simple rules for doing this.

MULTIPLICATION RULES

To multiply by 10, move the decimal point ONE place to the RIGHT.

10 × 7 = 70
10 × .7 = 7.0 = 7
10 × .01 = 0.1 = .1
10 × .0035 = 0.035 = .035
10 × 15.79 = 157.9

To multiply by 100, move the decimal point TWO places to the RIGHT.

100 × .01 = 01. = 1
100 × 15.798 = 1579.8

To multiply by 1000, move the decimal point THREE places to the RIGHT.

1000 × .01 = 010. = 10
1000 × 1.75 = 1750

To multiply by 1,000,000, move the decimal point SIX places to the RIGHT.

1,000,000 × .00025 = 250
1,000,000 × 2.5 = 2,500,000

DIVISION RULES

To divide by 10, move the decimal point ONE place to the LEFT.

.0035 ÷ 10 = .00035
125.7 ÷ 10 = 12.57

To divide by 100, move the decimal point TWO places to the LEFT.

.5 ÷ 100 = .005

To divide by 1000, move the decimal point THREE places to the LEFT.

5.7 ÷ 1000 = .0057

To divide by 1,000,000, move the decimal point SIX places to the LEFT.

750,000 ÷ 1,000,000 = .75
3,500,000 ÷ 1,000,000 = 3.5

MULTIPLYING DECIMAL NUMBERS

Decimal numbers are multiplied in the same way that ordinary numbers are multiplied in simple arithmetic. The number of decimal places in the answer is the SUM of the decimal places in the two numbers being multiplied together.

EXAMPLE: Multiply .0025 by 43

```
 .0025    ←4 decimal places
    43    ←0 decimal places
 -----
    75
  100
 -----
  1075        Total is 4 decimal places,
              so the answer is .1075
```

EXAMPLE: Multiply .025 by .0043

```
  .025    ←3 decimal places
 .0043    ←4 decimal places
 -----
    75
  100
 -----
  1075        Total is 7 decimal places,
              so the answer is .0001075
```

DIVIDING DECIMAL NUMBERS

A decimal can be divided directly by a whole number. The decimal point in the answer is placed directly below (or above) the decimal point in the decimal number, and empty places after the decimal point in the answer are filled in with zeros.

EXAMPLE: Divide .012 by 6

```
Set up the problem            6 | .012
in the usual way:

Place the decimal point       6 | .012
for the answer:                  .

6 won't go into 0 or 1,       6 | .012
so put down 00                   .00

6 goes into 12 two
times, so put down a 2:       6 | .012
The answer is .002               .002
```

To divide a whole or decimal number by a decimal number, first set up the number for division. Start with the number you are dividing by, and move its decimal point enough places to the right to change the decimal into a whole number. Next, move the decimal point for the other number the *same number of places to the right*, and put zeros in the empty places. Now you can divide in the usual manner as if working with whole numbers:

EXAMPLE: Divide 140 by .0025

```
.0025 | 140.

0025. | 140 0000.

          5 6000.
   25 | 140 0000.
        125
         15 0
         15 0
            000
```

Note that in the first step, a decimal point has been placed after the whole number. Although a decimal point belongs after every whole number, it is shown only when needed for division purposes.

EXAMPLE: Divide .25 by .0014

```
.0014 | .25

0014. | 2500.

         178.5
   14 | 2500.0
        14
        110
         98
         120
         112
           8 0
           7 0
           1 0
```

You could increase the accuracy of the answer by adding more zeros after 2500. and carrying out the division further, but a practical radio man would rarely add more than one zero in a problem like this. In fact, he would be more likely to stop with 178, or even call the answer about 180.

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16TH AND U STREETS NORTHWEST
WASHINGTON 9, D. C.

INSTRUCTION DEPARTMENT

DATE 3/4/50

STUDENT NO. E1-A05

NAME Joseph A. Ricci E1-A05

R. F. D. NO. OR STREET ADDRESS 972 West 3rd St.

Plainfield, N. J.

CITY AND STATE

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO. 7FR-3

{NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.}

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PRINT your name and address *very plainly* on the lines provided above

1- (a) Area of the Plate
(b) Number of Plate
(c) Spacing of Plates - (Distance)
(d) Dielectric used.

2- Maximum voltage that can safely be applied to the Condenser. You can always use a larger volt Condenser than what the circuit call for.

3- Yes - The Anode must always be connected to the positive +. The Cathode to the Negative -.

4- Connect them in Parallel.

5- Increased - the capacitive reactance when frequency is decreased.

6- Decreased - Its reactance when Capacity of Condenser is increase

7- Increase - The resistor is to increase the time to Charge of the Condenser when connected in Series.

8. Condenser - Soon as the Condenser is charged there is no further D.C. flow through Circuit.

9. More - Larger the capacity, higher the Source frequency, lower the Condenser reactance, greater is the voltage applied to the load.

10. Leaky or Short-circuited - will cause flow through Condenser & through resistor R2 where it is not wanted.

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STUDENT NO. E1-A05

LESSON NO. 6FR-3

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(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

PRINT your name and address *very plainly* on the lines provided above

1- When you increase number of ampere-turn you increase amount of magnetic flux produced by coil.

2- (a) Copper — Non-Magnetic
(b) Sheet Steel — — Magnetic
(c) Plywood — Non-Magnetic
(d) Aluminum — Non-Magnetic
(e) Cast iron — Non-Magnetic
— — Magnetic

3- Maximum Flux - Lowering reluctance make Flux increase.

4- 75,000 Flux Linkage — 25,000 x 3 = 75,000

5- Yes - any change in flux linkage you get a induced voltage - the faster the rate of change the greater will be the induced voltage.

6- No - because we have no change amount of flux passing through the coil.

7- because we are changing the flux linkage of the coil. C any change in flux linkage a voltage will be induced.

8- 2,000 Millihenry = 2 henry

9- No - it varies with frequency.

10- 90° or one quarter cycle.

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LESSON NO. 5FR-4
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R. F. D. NO. OR STREET ADDRESS 972 WEST 3rd ST.

CITY AND STATE PLAINFIELD, N.J.

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PRINT your name and address *very plainly* on the lines provided above

1- (A) E = Voltage
(B) I = Current
(C) R = Resistance
(d) Ω = Ohm
(e) MEG: Megohms

2- Divide voltage value (E) by Resistance Value (R)

3- 4 Ohms - divide voltage value (E) by Current Value I

4- 20 Volts - Multiply the current I by Resistor Value R

5- 2 is the voltage drop (E) across the series Resistor (R)

6- The same - Current I flowing toward terminal must equal current I flowing away from it.

7- Less than 5 Ohms.

8- If you know resistance value (R) + current Value I or Voltage value (E) you can find power Value (P) by—
Power = Current × Current × Resistor or $P = I \times I \times R$ or $P = I^2R$

9- Use a Wattage Rating twice the amount than you need.

10- Increase — The tube filament has a higher resistance when hot.

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DATE Feb 14, 1950

STUDENT NO. E1-A05

NAME Joseph A. Ricci

LESSON NO. 4FR-3

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CITY AND STATE Plainfield New Jersey

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

PRINT your name and address *very plainly* on the lines provided above

1- Pulling firmly - if knobs are to small to get a good grip, slip a hankerchif between the knob + the cabinet + pull on the hankerchif ends

2- The tubes (6K7) the shield goes on receives weak signal + boost them up to a tremendous amount. - Undiserabl signal would get the same boost, to keeps these undeserable signal out we place this metal cover over the tube. - to protect the tube electrode from stray field of other parts. - without the shield the set would probable squeal at each station, as you tuned the dial.

3. A - Burned out Filament. - the filament wire melts + breaks open at a thin spot.

B - Low Emision - fewer + fewer electron flow from the cathoods to the plate - caused by aging of chemical on the Cathood.

C - Shorted Electroods - caused by change of temperature to make the electroods sag out of position + make the filament touch the cathoods + cause a short.

4. The Voice Coil is off center - loosened the screws around the outside of the voice coil, or some speaker have, inside the voice coil - recenter the voice coil - by inserting strips of celluloid or cardboard inside the voice coil + central iron core of the loudspeaker to get automatic centering. Cont. —

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CONT.

4. the screws are tighten, + center strips removed. Some voice coil cannot be center, this case send loudspeaker back to loudspeaker factory to replace the voice coil or put a new loudspeaker in place.

5. The Rotor Plates may became bent, + touch the stator plate + cause a short to the tuning circuits + stop the set from playing. All you need is a putty knife or a thin blade screwdriver to straightening the bent plate.

6. The purpose of the two small Trimmer condenser is to take care of any small difference there might be between the two section of the gang tuning condenser.

7. Ohmmeter - is the meter to find shorted or leaky paper condenser.

8. When a power transformer is overloaded it causes it to get to hot. + causes it to damage the insulation between the winding.

9. There are only two connection to be unsolder to disconnect the power cord.

10. Start at the Audio Output stage (next to the loudspeaker) + work ~~toward~~ backward through the stages.

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STUDENT NO. E1-A05

LESSON NO. 3FR-2

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PRINT your name and address *very plainly* on the lines provided above

1- A.C. Voltage.

2- Milliampere

3- Resistor - is used to reduce the amount of current which is flowing in a radio circuit.

4- The current increases when you increase the source voltage, it decrease when you decrease the voltage current.

5. (The current will increase) When you increase the resistance the current will decrease

6. In Series - when the filament requires same current. And the available voltage is equal to the sum of all the filament voltage rating

7. You can connect filament of a radio tube parallel, when all tubes must have the same filament voltage rating

8. (Equal to) or add up to a value exactly equal to the source voltage. in this case 45 volt source voltage.

9. 1.4 or 1 point 4 is the reading on the voltmeter scale.

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LESSON NO. 3FR-2

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PRINT your name and address *very plainly* on the lines provided above

10. To get 6 volts from four 1½ or 1.5 volt dry cell you would connect them in Series - Connect the positive terminal +, to the negative - terminal in series of the four 1.5 or 1½ volt dry cell batteries!

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STUDENT NO. E1-A05

LESSON NO. 2FR-5
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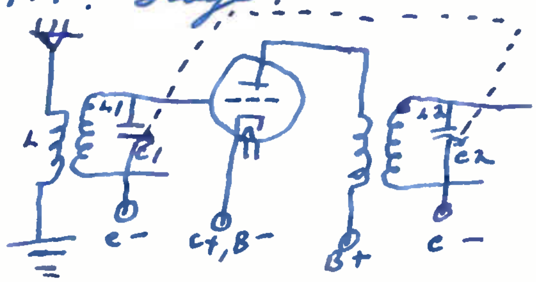
PRINT your name and address *very plainly* on the lines provided above

1. The lowest is 20 cycles + the highest is 20,000 cycles to be heard by human ear.
2. To change sound waves into Audio Signals.
3. Magnetic lines of force.
4. No. "Electrons do not move from one circuit to another"
5. Audio Signal + R.F. Carrier Signal.
6. Electric, + Magnetic fields.
7. Weaker, because of the distance it travel.
8. To build up strength, + keep out undesired signals.
9. 1st R.F. Stage.



10. When the R.F. Carrier Signal has built sufficient strenght, the R.F. Carrier is no longer needed. 10

STUDY EXTRA HELP

A ONE-MINUTE DISCUSSION OF EACH QUESTION IN THIS LESSON

You will benefit from reading these discussions. While your own answers should always be brief, these explanations "point-up" important information in the lesson, help many students to remember what they've studied and give extra help on difficulties they may have had.

LESSON 2FR-5 HOW RADIO PROGRAMS ARE SENT FROM THE STUDIO TO YOUR HOME

Question 1. So that the frequency range to which the average human ear is responsive could be determined, thousands and thousands of persons were tested. Some could hear sounds as low in frequency as 15 cycles per second, and a few reported the ability to hear sounds as high in frequency as 25,000 cycles per second. These are the extreme upper and lower limits, however, because the approximate range of frequencies audible to the human ear is between 20 and 20,000 cycles per second.

Question 2. The microphone is a very essential part of a complete broadcasting system, because it is the device that converts sound into audio signals. This must be done because sound itself usually doesn't get very far away from the object which produced it. The effects of electricity, on the other hand, are far different. By closing the proper switches, the operator in an electric power generating station can turn on the lights in cities hundreds of miles away. By simple reasoning we see that if we convert sound into a form of electricity, we can send it anywhere we desire. As an additional thought, the microphone in converting sound to audio signals makes it possible for us to amplify (strengthen) a sound any desired amount.

Question 3. An important principle is brought out by this statement. A voltage will be induced in a coil when there is a change in the number of lines of force passing through the coil. There are several things which will induce voltage in a coil. The coil may be moved; the magnetic field may be moved; the strength of the field may be varied; or the number of coil turns may be changed. Any of these actions will change the number of lines of force passing through the coil and for this reason induce voltage in the coil.

Question 4. The basic requirement for a flow of electrons is a complete path (circuit) from the negative terminal of the voltage source to the positive terminal. The electrons never leave the complete circuits in which they move, however, because they do not jump out into space away from wires. But once electrons are in motion, their magnetic fields can affect electrons in entirely separate circuits. Individual circuits of a transmitter or receiver are often connected together by a transformer, so the magnetic fields of the electrons in one circuit control the actions of different electrons in the other circuit of the transformer. An examination of the figure in the text will show you that the electrons in this microphone circuit stay there and don't reach the transmitting antenna.

Question 5. To "broadcast" speech or music by radio, two important electric signals are combined in the transmitter of a radio station. One of these signals comes from the studio where the program is produced; it is called the audio signal because it is sound in electrical form. The other signal is produced right in the transmitter itself by the crystal oscillator; radio men refer to it as the radio frequency carrier signal. This is the signal which has the ability to produce radio waves. When these two signals are fed to the same stage of a transmitter, the audio signal affects (modulates) the r.f. carrier signal. The result is a new signal having some of the characteristics of each. The transmitter stage which combines the two signals is called the modulated stage.

Question 6. When electrons begin to move along a wire, they produce a magnetic field around the wire. We must not forget, however, that electrons are particles of negative electricity, and that an electric field surrounds each one of them. Any sudden change in the direction in which an electron is moving causes both the electric and the magnetic fields to move out into space in all directions. As the change in direction of the electron flow becomes more rapid, the two fields of force travel more readily out into space. At radio frequencies, in which the direction is changed millions of times each second, these two fields actually flow far out in space. No matter how far the wave travels, it is still made up of the magnetic and electric fields that originally surrounded the electrons in the transmitting antenna.

Question 7. The energy radiated by the average transmitting antenna moves out into space in all directions. This fact in itself means that the signal picked up by the receiving antenna will be only a part of the original signal and will be much weaker than the original signal. By means of a special transmitting antenna system the radio waves may be focused or, as radio men say, beamed toward a certain receiving antenna. In this way more of the original signal will reach the receiving antenna. However, losses in signal strength occur whenever radio waves travel through space, as they are absorbed by hills, trees, and the layers of gas particles and electrons up in the sky. Because of this, the modulated r.f. current in the receiving antenna is always much weaker than the modulated r.f. current in the transmitting antenna. The signals rapidly become weaker as the distance between the receiving and transmitting antennas is increased.

Question 8. By actual measurement, the r.f. signal in a receiving antenna is extremely weak. It is so weak, in fact, that in many cases it must be amplified (strengthened) millions of times to make it powerful enough to operate the receiver circuit that separates the program (audio) signal from the r.f. carrier signal. To build up the r.f. signal to the required strength is one purpose of the r.f. amplifier section of a t.r.f. receiver.

Radio engineers "kill two birds with one stone" by making the r.f. amplifier perform another, and possibly even more important, task. This task is the selection of the desired station signals from the signals of hundreds of stations broadcasting at the same time. To do this, special circuits which are combinations of tubes, coils, condensers, and resistors are used, as you will learn in coming lessons. Right now, get clearly in mind the fact that the r.f. section of a receiver performs two tasks -- amplifies and selects the desired r.f. signal.

Question 9. One of the quickest ways in which to become familiar with any radio circuit is to make a number of free-hand drawings of it. If you will practice drawing circuits every chance you get, you will quickly learn to recognize the various symbols that are used to represent the different radio parts, and know how to interconnect the parts for any desired purpose. You'll find, too, that drawing a circuit will help you to remember how and why it operates as it does. When you have practiced a little, try Fig. 18 again, and see how easy it is now. Don't try to memorize this or any other diagram -- copy it right from the book.

Question 10. In the very early days of radio, a receiver was just a few coils of wire, a "detector", and a headphone. It was the detector which actually converted the radio signals in the coils to audio signals in the headphone. To this very day radio men speak of the detector when they talk about the stage in a receiver which separates the audio signals from the r.f. carrier signals.

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STUDENT NO. E1-A05

LESSON NO. 1FR-3

(NOTE–Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

NAME JOSEPH A. RICCI

R. F. D. NO. OR STREET ADDRESS 972 WEST 3rd ST.

CITY AND STATE PLAINFIELD, N. J.

(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE A

PRINT your name and address *very plainly* on the lines provided above

1. Sound Waves in Electrical Signal.

2. Microphone, Control Room, Transmitter, Receiving Antenna, Receiving in the home.

3. No. because they will go away frome each other.

4. Negative Terminal - has more Electron than normal.

5. Increase when you increase the voltage of the battery.

6. Yes, the strength of the Electromagnet will be reduced when you reduce the current through the Coil.

7. Plate, is the name of the electrode which attract the electrons emitted by the Cathrode in a radio tube.

8. 1- The Filament Voltage - needed to send Current through filament for heating purpose.

SD5-7-548

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Prepare at Home for a Better Future in Radio and Television

ANSWER SHEET

INSTRUCTION DEPARTMENT

NATIONAL RADIO INSTITUTE
16TH AND U STREETS NORTHWEST
WASHINGTON 9, D. C.

DATE Jan 29, 1950

STUDENT NO. E1-A05

LESSON NO. 1FR-3
(NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 28 FR-3, etc.)

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PRINT your name and address *very plainly* on the lines provided above

8 cont. 2 - The Plate Voltage - needed to make the Plate highley Positive to the Cathrode. This way the Plate will attract the Elections emmitted by the Cathrode.

3 - The grid Bias Voltage - needed to make the grid negative, with respect to the Cathrode to make nearly perfect Amplification of signals

9 Magnetic lines of force, flows through the Iron Core of a Transformer, and make possible the transfer of electrical signals from the primary Coil to the Secondary Coil.

10 A. The Felament — ^

The Cathrode — Γ

The grid — - - - -

The Plate — ⊥

-3

B. The Symbol of battry having 6 cell are |ı|ı|ı|ı|ı|ı +

C. P for primay winding

S. for secondary

P3 | Es
3 | Es

A ONE-MINUTE DISCUSSION OF EACH QUESTION IN THIS LESSON

You will benefit from reading these discussions. While your own answers should always be brief, these explanations "point-up" important information in the lesson, help many students to remember what they've studied and give extra help on difficulties they may have had.

LESSON 1FR-3 INTRODUCING YOU TO RADIO

Question 1. Sound waves are produced by the vibration of a material or object. These sound waves have a definite rate of vibration (back and forth movement). These back and forth movements or vibrations, acting upon the diaphragm of the microphone, set up an alternating current in the wires of the microphone. This current is moving back and forth (varying) at the same rate as the sound waves, so an "audio" signal is an electrical impulse (an alternating current) which varies at the same rate as the sound waves. In other words, an audio signal is SOUND in an electrical form.

Question 2. If you were to visit a broadcasting station, you would be shown the studios in which programs are picked up by microphones (the electric ears of radio); control rooms in which the electric signals from many microphones are combined to form a balanced program; the tubes, coils, and condensers used in the transmitter; and finally, outside the station building, the big transmitting antenna that sends the radio waves out into space. However, this isn't the complete broadcasting system, for there must be both a receiving antenna and a radio receiving set through which the radio signals can be reconverted into the sounds originally produced in the studio.

Question 3. In order to be able to say whether or not an electron will be attracted by a negatively charged object, it is necessary to have a thorough understanding of the Law of Electric Charges. Briefly, this Law says that like charges will repel each other; unlike charges will attract each other. Like charges are those that are both positive or both negative; unlike charges are those that have opposite signs, the one being + (positive) and the other, - (negative). In this question, there are two like charges, the electron always being negative; hence, the electron will be repelled instead of attracted. Since this action is very important in radio, as you will see when you study about radio tubes, fix it firmly in your mind.

Question 4. At the terminals of every battery, there is a difference of electrical potential; this is called voltage. This difference means that one terminal is positively charged; the other terminal is negatively charged. The basic theory of electrons is that any negatively charged object has more than the normal number of free electrons; therefore, the battery terminal having the greatest number of electrons is the negative terminal.

Question 5. A battery is a source of voltage; voltage is an electrical pressure that causes electrons to flow through a complete circuit. This movement of electrons is called a current flow. If the electrical pressure (voltage) is increased when a battery producing more voltage is used, more electrons flow through the circuit. Thus, an increase of the battery voltage in any complete circuit causes an increase in current.

Question 6. Every electron that moves through a wire produces magnetic effects around a wire similar to those of a bar magnet. The more electrons that are in motion (by an increase in current flow), the greater is the magnetic effect.

When current flow is reduced, there are fewer electrons in motion, and there must be fewer magnetic lines of force. Since there are fewer magnetic lines of force, the strength of the electromagnet is reduced.

Question 7. In the very early radio tubes, a small rectangular plate of metal was used to attract the electrons thrown off by the heated filament. Radio men still call this element of the modern radio tube the "plate", although it no longer looks like one. Today it is often made in cylindrical form, completely surrounding the cathode, and can collect more of the electrons thrown off from any part of the cathode.

Question 8. Three requirements must be met before the modern three-electrode tube will operate as it should. First, the proper filament voltage must be applied to the tube, so that its cathode surface will be heated to the proper temperature for the emission of electrons. Next, since the electrons must be attracted to the plate of the tube, a positive potential or plate voltage must be applied to the plate element. Finally, so that the number of electrons which actually reach the plate of the tube can be controlled, a voltage must be applied to the grid element of the tube. This voltage is often referred to by radio men as the grid bias voltage. Sometimes these voltages are represented by the letters A (filament), B (plate), and C (grid), or simply as ABC voltages for easy identification purposes on radio circuit diagrams.

Question 9. When a signal current is sent through the primary coil of an iron-core transformer, the iron becomes magnetized. This means that magnetic lines of force are formed in the core; also, these lines of force change or vary in accordance with the signal voltage variations. You know that a varying number of lines of force will induce a voltage into any coil through which they pass. Therefore, since the core is inside the secondary winding, these varying lines of force "link" with the secondary coil and induce a voltage in it. Hence, the magnetic lines of force pass through the core and make possible the transfer of signals from the primary coil to the secondary coil.

Question 10A. A radio tube symbol showing a filament, cathode, grid, and plate is illustrated in your textbook. Study it carefully because you'll see it many times in radio circuit diagrams. Practice drawing it free-hand, so that you'll become thoroughly familiar with it.

Question 10B. Batteries are usually represented in circuit diagrams by pairs of one long and one short lines. Although it is common practice to assume a value of 1.5 volts for each pair of long and short lines, don't try to determine battery voltage in this manner; on most drawings it is impractical to show sixty pairs of such lines for a 90-volt B battery. A battery having six cells would, however, be represented usually by six pairs of lines (six short ones and six long ones).

Question 10C. The technician can indicate the relative number of turns on each winding with the transformer symbol. If the transformer has a larger secondary winding, the draftsman puts more curls on the secondary coil. If the transformer has the same number of turns on each coil, the symbol is drawn with both sides of the transformer indicated by the same number of curls.

National Radio Institute
PIONEER HOME STUDY RADIO SCHOOL
CONSULTATION SERVICE
16TH & U STREETS N.W.
WASHINGTON 9, D. C.

Dear Student: File No. TA:1F

Here are your graded answers to lesson #1. Since six lesson texts were included in the First Assignment you received, lesson text #7 is being sent to you under separate cover by third class mail. Please don't be impatient about its arrival. Remember third class mail travels slower than first class mail. It may be a day or even quite a few days later reaching you than this graded answer. Rest assured it's on the way.

Your work on this first lesson makes me feel you are going to do well in this Course. You now have a good idea of just what electricity is. You know the important part played by free electrons - those tiny electric charges that can go through seemingly solid metals. You also know quite a bit about magnetism--that like poles repel each other and that unlike poles attract and try to come together.

Our Method of Grading

Perhaps you recognize our method of grading -- it is the same used by most schools and colleges.

A+ = 100%
A = 90% to 99%
B = 80% to 89%
C = 70% to 79%
Low = Below Passing

A check mark (✓) made with colored pencil alongside an answer means that it is correct; a cross (X) indicates your answer is not correct. A minus sign (-) means a certain number of points off. For example, "-4" alongside your answer means four points were taken off, leaving net credit of six points for your answer to that question.

Naturally, you will try for a perfect A grade on each lesson but I find that no one always makes a perfect grade. A student may have been tired while writing out his answers; he may have been interrupted and because of this missed some very important point, or he may not have grasped the idea the lesson is trying to put across.

When an answer to a lesson question is wrong, or when I feel that the student may not have the idea behind the question clearly in mind, I send "extra help" on that question. This discussion is an explanation of the question and of the idea we wish to get across. Sometimes an explanation entirely different from the one given in the lesson will enable you to grasp easily the important point we wish to drive home.

But when I see you have the right idea, I know from experience that further explanation may be confusing. Therefore, when all your answers are right and I can tell that you have thoroughly mastered the lesson, you won't need extra help. Only when you need a different or an additional explanation of some subject will this extra help be enclosed with your lesson answers, and only then will you be expected to give this subject further study.

If your Lesson Answers are returned marked "Low", it means that they are below passing and you are required to submit another set of answers on that lesson. However, please do not send in another set of answers on a lesson when you have already made a passing grade ---A+, A, B, or C --- unless you are specifically requested to do so.

Please send in the answers to the questions of each lesson right after you finish it. Do not save up your answers or send in more than one set of lesson answers at a time. We consider about one lesson a week good progress for the average student.

We want to give you the best possible service in handling your answer sheets and lessons. I know we can depend upon your whole-hearted cooperation to help us do that. For example, always print or type your full name, complete address and student number on every sheet. If you move, notify us promptly of your change of address.

Extra Data

From time to time you will also get a number of Reference Texts in addition to the regular texts. There are no questions in these -- but they contain much valuable information. Study each one carefully at the time suggested in the study schedule in the front of each regular lesson text.

I hope that by the time you receive this letter you are well into your study of the next lesson. I am looking forward with real interest to receiving your answers to the questions on this lesson in the next few days.

Your friend,

J H Dowie

TA:1F

Chief Instructor

"The hardest thing is to get started."

SD6—11-1049

PRINTED IN U. S. A.

Prepare at Home for a Better Future in Radio and Television

ANSWER SHEET

INSTRUCTION DEPARTMENT

NATIONAL RADIO INSTITUTE
16TH AND U STREETS NORTHWEST
WASHINGTON 9, D. C.

DATE

STUDENT NO.

NAME

R. F. D. NO. OR STREET ADDRESS

CITY AND STATE
(BE SURE TO GIVE POSTAL DELIVERY ZONE NUMBER IF YOU HAVE ONE)

LESSON NO.
{NOTE—Exact number of lesson should be shown, as: 1 FR-3, 3 FR-2, 12 FR-2, etc.}

LEAVE THIS SPACE BLANK FOR YOUR LESSON GRADE

PRINT your name and address *very plainly* on the lines provided above

Printed Answer Paper—Addressed Envelopes

This announcement is printed on a sample sheet of the Institute's standard answer paper. Space is provided for your name, address, date, student number and lesson number—also for your lesson grade. The margin lines encourage neatness and accuracy. The punched holes enable you to file your graded lesson answers conveniently. The light weight saves postage.

One hundred sheets of this answer paper may be obtained for seventy-five cents. Sixty envelopes made of strong, light weight paper and already addressed may be obtained for fifty cents. Your order for 100 sheets of answer paper and 60 envelopes, $1.25 value, will be accepted at the combination price of $1. Postage fully prepaid on all orders.

If You Prefer Plain Paper

You are at liberty to use plain, light weight paper of any kind. It should be white and of standard letter size—same size as this sheet.

If you use plain paper, we particularly request that you type, or print your name, complete address, and student number, without fail, on every set of lesson answers you send in.

Start your name and address 1½ inches from the top of the page and 1 inch from the left-hand side; also keep it all in a space 1¼ inches high by 4 inches long—the same as the space marked out for your name and address above. Otherwise your name and address must be typed specially, which means delay, of course, and chances for errors.

(Cut along this line)

Use This Blank to Order Paper and Envelopes

NATIONAL RADIO INSTITUTE,
WASHINGTON 9, D. C. Date

☐ Send me POSTAGE FULLY PREPAID, 100 sheets of answer paper and 60 self-addressed envelopes, for which I enclose $1. (If you live in Washington, D. C., please add 2 cents for D. C. Sales Tax.)

Name Student No.

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LESSON GRADE __________

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WASHINGTON 9, D. C. Date __________

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Name __________ Student No. __________

Address __________

City __________ State __________

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CONSULTATION SERVICE

NATIONAL RADIO INSTITUTE
WASHINGTON, D. C.

SPECIAL DATA SHEET

DATA SHEET NO. Ma-22-349

If you write us again about this subject, BE SURE to mention Data Sheet No. Ma-22-349

RADIO SUPPLY HOUSES

Radio parts, tubes, and receivers should be purchased through your local parts distributor, or if there is no source of supply near you, from one of the large mail-order houses.

The firms listed here are, to the best of our knowledge, reliable and trustworthy. If any of them are within visiting distance get in touch with them. Try to cultivate good relations with your local parts distributors. Such contacts are very valuable to every spare time or full time serviceman. If there are no parts distributors near you, write to one or more of the large mail-order firms for copies of their catalogs so that you can see what they have to offer.

Only men who are actually engaged in or training for radio work are entitled to wholesale discounts. Therefore, allow these names to become known only to yourself or your fellow NRI men. Many of these firms are quite strict, giving discounts only to men who can give proof that they are actively engaged in radio work.

--- An NRI Service For You ---

The only radio parts and tubes which you can purchase from NRI are replacements for those in your Radio Kits. We carry these because the Radio Kits are a part of your Course. The firms listed later can supply you with the replacement parts you need for receiver repair work, but if you need test equipment you should contact the NRI Supply Division.

To make sure NRI students and graduates can buy test equipment which fits the needs of professionally trained men, NRI engineers have designed basic service instruments. We are having these built by nationally known manufacturers for sale to NRI students and graduates only. They are good, and each is a reasonably priced high-quality instrument.

We now have in stock the following items:

- NRI Professional Radio Tube Tester
- NRI Professional Volt-Ohm-Milliammeter (Multimeter)
- NRI Professional Signal Generator
- NRI Professional Signal Tracer
- NRI Professional RC Tester (Condenser-Resistor Analyzer)
- NRI Service Manual, #1, (A volume of most frequently used radio diagrams)

<u>Descriptive Literature</u> showing uses, technical specifications, pictures, and prices of NRI Professional Testers and the NRI Service Manual can be obtained by using the enclosed postcard. Check the item or items in which you are interested, attach a one-cent stamp and drop the card into the mail box.

We try to keep an ample supply of instruments in stock but not all of those listed on the preceding page may be available at some time or another. If we should be temporarily out of stock you will be well repaid by a short wait for any NRI Professional equipment you need.

Names and Addresses of Supply Houses

Firms marked * are large mail-order houses carrying all types of radio apparatus, and publishing a yearly catalog.

For additional names of radio supply firms, consult the Classified Advertising Section in the Telephone Directory of your nearest large city.

ALABAMA:	Birmingham	Auto Service Co., 1916 4th Ave., S.
ARKANSAS:	Little Rock	Southern Radio Supply, 1419 Main Street
CALIFORNIA:	Fresno	Ports Manufacturing Company, 3265 Belmont Ave.
	Hollywood (28)	Pacific Radio Exchange, Inc., 1401 Cahuenga Blvd.
	Los Angeles (25)	Henry Radio Company, 11240 W. Olympic Blvd.
	Pasadena	Dow Radio, Inc., 1759 East Colorado St.
CONNECTICUT:	Bridgeport	Hatry & Young, Inc., 544 E. Main St.
	Bridgeport (3)	R. G. Sceli & Co., Inc., 84 Elm Street
	Hartford	Hatry & Young, Inc., 203 Ann Street
	Hartford (3)	R. G. Sceli & Co., 317 Asylum Street
	New Britain	United Radio Supply, 53 E. Main St.
	New Haven	Hatry & Young, Inc., 77 Broadway
	New London	Hatry & Young of New London, Inc., 428 Bank St.
	Stamford	Hatry & Young, Inc., 525 Main St.
	Waterbury	Hatry & Young, Inc., 89 Cherry St.
DELAWARE:	Wilmington	Radio Electric Service Co., 4th and Tatnall Sts.
DISTRICT OF COLUMBIA:		
	Washington (9)	Capitol Radio Wholesalers, 2120 14th St., N.W.
	Washington (9)	Electronic Wholesalers, 2010 14th St., N.W.
	Washington (9)	Kenyon Radio Supply Co., 2020 14th St., N.W.
	Washington (5)	Rucker Radio Wholesalers, 1312 14th St., N.W.
	Washington	Sun Radio Co., 738 F Street, N.W.
FLORIDA:	Jacksonville (2)	Radio Parts Company, 712 Main Street
	St. Petersburg (7)	Welch Radio Supply, 408 9th Street, So.
GEORGIA:	Atlanta (3)	*Lafayette Concord, 265 Peachtree
ILLINOIS:	Chicago (7)	*Allied Radio Corp, 833 W. Jackson Blvd.
	Chicago	Chicago Radio Apparatus Co., 415 S. Dearborn St.
	Chicago (7)	*Lafayette Concord, 901 W. Jackson Blvd.
	Chicago (6)	*Radolek Company, 601 W. Randolph St.
	Peoria (2)	Klaus Radio & Elec. Co., 707 Main St.
INDIANA:	Indianapolis (6)	Van Sickle Radio Supply Co., 34 W. Ohio
	Muncie	Radio Supply of Muncie, Inc., 108 N. Walnut St.
	Terre Haute	Archer & Evinger, 1348 Wabash Avenue
KENTUCKY:	Louisville	P.I. Burks & Co., 911 West Broadway
	Louisville (3)	Peerless Electronic Equipment.Co., 912 S. 2nd St.

LOUISIANA:	New Orleans (16)	Wm. B. Allen Supply Co., 916-18 No. Claiborne Ave.
	New Orleans (15)	Columbia Radio & Supply, 3940 3rd St.
MAINE:	Bangor	Radio Service Laboratory, 45 Haymarket Square
	Portland (3)	Radio Service Laboratory, 45A Free St.
MARYLAND:	Baltimore	*Henry O. Berman Co., 12 E. Lombard St.
	Baltimore	Radio Elec. Service Co., 3 North Howard St.
	Baltimore	Wholesale Radio Parts Co., 311 W. Baltimore St.
MASSACHUSETTS:	Boston	*Hatry & Young of Massachusetts, Inc., 42-44 Cornhill
	Lawrence	*Hatry & Young of Massachusetts, 639 Essex St.
	New Bedford	C. E. Beckman Co., 11-35 Commercial St.
MICHIGAN:	Detroit (1)	Ferguson Radio Supply Co., 4214 Woodward Avenue
	Detroit (1)	Radio Electronic Supply Co., 1112 W. Warren
	Detroit (26)	Radio Specialities Co., Inc., 325 East Jefferson Ave.
	Detroit (1)	Radio Supply & Engineering Co., Inc., 129 Selden
	Grand Rapids	Radio Electronic Supply Co., 443 So. Division Ave.
	Lansing (29)	Electric Products Sales Co., 427 E. Michigan Ave.
	Muskegon	Fitzpatrick Electric Supply Co., 444 Irwin Ave.
MINNESOTA:	Duluth (2)	Lew Bonn Company, 228 E. Superior St.
	Duluth	Northwest Radio, 109 East First St.
	Minneapolis (4)	Lew Bonn Company, 1211 La Salle Ave.
	St. Paul (2)	Lew Bonn Company, 141-147 West 7th St.
MISSOURI:	Butler	Henry Radio Shop, 211 North Main
	Kansas City (6)	*Burstein Applebee Co., 1012-14 McGee St.
	St. Louis (1)	*Walter Ashe Radio Co., 1125 Pine St.
NEW HAMPSHIRE:	Manchester	Radio Service Laboratory, 1191 Elm St.
NEW JERSEY:	Atlantic City	Trenton Electronics, 1516 Atlantic Ave.
	Camden	Radio Electric Service Co., 513-15 Cooper St.
	Newark	*Radio Wire Television Inc., 24 Central Ave.
NEW YORK:	Albany	Uncle Dave's Radio Shack and Fort Orange Radio Distributing Company, 642-644 Broadway
	Auburn	Dare's Radio Service, 22 E. Genesee St.
	Bronx (58)	*Radio Wire Television Inc., 542 E. Fordham Rd.
	Buffalo (14)	Dymac, Inc., 2329 Main St., (near Leroy Ave.)
	Elmira	Fred C. Harrison, 108 West Church St.
	Ithaca	Stallman of Ithaca, 210-212 N. Tioga St.
	New York (13)	*Lafayette Concord, 100 Sixth Ave.
	New York	Sylvan-Wellington, 269 Canal St.
	Rochester	Masline Radio & Electronic Equipment, 192-196 Clinton Ave. N.
	Syracuse	Roy C. Stage, 265 Erie Boulevard, West
	Utica	Vaeth Electric Co., 35 Genesee St.
	Utica (2)	Beacon Electronic Distributors, 218-220 Pearl St.
NORTH CAROLINA:	Charlotte	Shaw Distributing Co., 205 West First St.
OHIO:	Akron (8)	*Olson Radio Warehouse, Inc., 73 E. Mill St.
	Cincinnati (2)	Steinberg's Inc., 633 Walnut St.
	Cincinnati (10)	United Radio, Inc., 1314 Vine St.

OHIO: (Cont.)	Cleveland	Ferguson Radio, Inc., 14553 Madison Ave., Lakewood
	Cleveland (2)	Northern Ohio Laboratories, 2073 West 85th St.
	Cleveland (15)	Radio & Electronic Parts Corp., 519 Huron Road
	Cleveland (13)	Winteradio, Inc., 1468 West 25th St.
	Youngstown (3)	Ross Radio Co., 325 West Federal St.
OKLAHOMA:	Tulsa	Radio, Inc., 1000 South Main St.
OREGON:	Eugene	United Radio Supply, Inc., 179 W. 8th St.
	Portland (5)	United Ham Shack, 209 S.W. 9th Ave.
	Portland	United Radio Supply, Inc., 203-205 S.W. 9th Ave.
PENNSYLVANIA:	Allentown	Radio Electric Service Co., 1042 Hamilton St.
	Altoona	Hollenback's Radio Supply, 2221-3 8th Ave.
	Harrisburg	Radio Distributing Co., 140 S. Second St.
	Johnstown	Cambria Equipment Co., 12 Iron St.
	Philadelphia (6)	Herbach & Rademan Inc., 522 Market St.
	Philadelphia (6)	M & H Sporting Goods Co., 512 Market St.
	Philadelphia (7)	Eugene G. Wile, 10 South 10th St.
	Philadelphia	Radio Electric Service Co., 3145 N. Broad St.
	Philadelphia	Radio Electric Service Co., 5133 Market St.
	Philadelphia	Radio Electric Service Co., N.W. Corner 7th & Arch St.
	Philadelphia (6)	Almo Radio Co., 509 Arch St.
	Pittsburgh	Cameradio Co., 963 Liberty Ave.
RHODE ISLAND:	Providence (3)	W. H. Edwards Co., 94 Broadway
SOUTH DAKOTA:	Yankton	Dakota Supply Co., 310-312 Walnut St.
TENNESSEE:	Knoxville	Chemcity Radio & Electric Company, 12 Emory Park
	Memphis	Bluff City Distributing Co., 905 Union Avenue
TEXAS:	Amarillo	Amarillo Electric Co., 418 West 10th Ave.
	Beaumont	R.C. & L.F. Hall of Beaumont, 961 Pearl
	Dallas (2)	Dallas Electric Supply Co., 1800 Magnolia
	Dallas	R.C. & L.F. Hall of Dallas, 2123 Cedar Springs
	Galveston	R.C. & L.F. Hall of Galveston, 1803 Tremont
	Houston	R.C. & L.F. Hall, Inc., 1306 Clay
	Houston	Straus-Frank Co., 1618 Fannin Street
	San Antonio (6)	Straus-Frank Co., 301-307 South Flores St.
UTAH:	Salt Lake City (1)	Radio Supply Co., 45 East 4th So.
VIRGINIA:	Norfolk	Radio Supply Co., 711 Granby St.
	Richmond	Johnson-Gasser Co., 1402 East Main St.
	Richmond	Radio Supply Co., 3302 West Broad St.
WASHINGTON:	Tacoma (3)	Wible Radio Supply, 907 S. Tacoma Avenue
WEST VIRGINIA:	Charleston (27)	Chemcity Radio & Elec. Co., 1225 E. Washington St.
	Clarksburg	Trenton Radio Co., 791 W. Pike St.
	Morgantown	Trenton Radio Co., 300 Grant Avenue
WISCONSIN:	Milwaukee (3)	Acme Radio Supply Corp., 510 W. State St.

Use This Blank Only If You Need Help With Your EXPERIMENTAL RADIO KITS

Another blank like this will be sent you with our reply.

FILL IN THESE SPACES

My last graded Lesson No. is 5RK-2

◆

I am having trouble with Radio Kit: 6RK
(Fill in entire number, like 2RK-1, 4RK-DC etc.)

Exp. No. 58

Step No. 3

Page No. 59

◆

Have tubes used in this Experiment been tested?

Yes ☑ No ☐

◆

Was previous Experiment all right?

Yes ☑ No ☐

◆

IMPORTANT

In your letter at the right, give all readings you made on this Experiment.

RK KIT CONSULTATION BLANK

Date May 22 Student No. E1-A05

Name Joseph A. Ricci

Address 972 West 3rd St.

City & State Plainfield, N.J.

J. A. Dowie, Chief Instructor
National Radio Institute
Washington 9, D. C.

MAY 24 1951 2 PM

Dear Mr. Dowie: Please help me with the following Experiment:

In Experiment #58, Step #3, I can't seem to get a frequency-modulated R.F. Signal into my N.R.I. tester. I don't get no reading + no tone in my ear phone. I have check the wiring + parts, they seem to be alright.

If I disconnect one probe of my tester I will get a loud tone + also a reading of 3.5 volts. but I cannot control it by trimmer C-A or potentiometer R3

Please let me know what I could have done wrong.

Joseph A. Ricci E1-A05
972 West 3rd St.
Plainfield, N. J.

Note: If you have written to us before about this same problem, be sure to enclose that letter, and our reply.

T 43-4-150 LITHO. IN U.S.A.

National Radio Institute
PIONEER HOME STUDY RADIO SCHOOL
CONSULTATION SERVICE

16TH & U STREETS N. W.
WASHINGTON 9, D. C.

Mr. Joseph A. Ricci
972 West 3rd St.
Plainfield, N. J.

May 28, 1951
E1-A05
K-277

Dear Mr. Ricci:

The trouble you have encountered in working out Experiment 58 gives you an excellent opportunity to use professional trouble-shooting techniques. Check your experiment as follows:

First, make a careful visual inspection of the entire experimental setup. Check the placement of your parts against the arrangement shown in Fig. 25. This isn't the only way in which the circuit of Fig. 24 could be wired up, but if you place your parts as shown here it will be easier to position them so that resistor and condenser leads cannot touch one another or the chassis when the experiment is set upright on your work bench. Test each soldered connection by wiggling and pulling on the leads with a pair of long-nose pliers. Make sure that excessive solder does not ground any terminal, or short-circuit two adjacent terminals.

Next, make sure that all of your tubes are good by having them carefully checked by a reliable radio dealer. Don't assume that a tube is good simply because it is comparatively new. A tube may fail at any time. Also, make sure that your NRI Tester for Experiments is in good operating order. You cannot expect to get satisfactory results when making measurements with an inaccurate, or improperly calibrated test instrument.

Make sure that the power supply is furnishing normal voltage to the experiment by checking the plate supply voltage at terminals 4 and 5, and the filament supply voltage at terminals 1 and 2 of the output strip of the power pack while the pack is connected to the experiment. If either the plate or filament supply is exceptionally low, disconnect the experiment and measure the output of the pack again. If the voltages are normal now, the trouble is in the experiment.

Measure the operating voltages applied to each tube in the experiment. Normal plate voltage for the audio oscillator is 125 volts, for the r.f. oscillator it is 225 volts, and for the oscillator control tube it is 225 volts. Normal screen voltage for the oscillator control tube is about 60 volts. If your operating voltages are normal, the trouble must be in the signal circuits. However, if the plate voltage for the r.f. oscillator and oscillator control stages is very low, and if resistor R5 becomes exceptionally hot, look for a ground at terminal 11. This could be caused by excess solder, a defective by-pass condenser (C-4) or a defective trimmer (Ca). Check the circuit and components accordingly.

This answers your letter which I am returning. Should you need more help, please send me your original letter, this reply, and your new questions.

Failure to get satisfactory r.f. measurements across L-4 on the frequency-discriminating chassis may be due to setting Ca on the f.m. s.g. chassis to too high a frequency, to improper tuning of trimmer Cd, to improper adjustment of potentiometer R-12, or to a poor ground connection between the two chassis. R.F. without any audio modulation could be due to a failure of the audio oscillator or the oscillator control stage.

While the tests listed above are of a general nature, they should give you valuable clues as to what is wrong. If you should need more help on this experiment, write your results for these tests in the margin of this letter and return it to me, together with your original request for help and any new information you may have. Then I'll have some facts and figures on which to base an opinion that will be of real help to you.

Cordially yours,

Frank Cook

Chief of Training

FC:EC

Use This Blank Only If You Need Help With Your EXPERIMENTS

Do not use this blank for non-technical questions because it will delay our answer.

Another blank like this will be included with our reply.

•

I am studying
Lesson No. . . . .

•

FILL IN THESE SPACES FOR HELP ON KITS

I am having trouble with

Exp. No. . . . .

Step No. . . . .

On Page No. . . . .

Of Manual . . . .
(Fill in entire number)

•

Have tubes used in this Experiment been tested?

Yes. . . .   No. . . . . .

•

Was previous Experiment all right?

Yes. . . .   No. . . .

•

IMPORTANT

In your letter at the right, give complete details including any voltage, current or resistance values you may have measured.

T93-850   LITHO. IN U.S.A.

EXPERIMENT CONSULTATION BLANK

Date . . . . Student No . . . .

Name . . . .

Address . . . .

City & State . . . .

Frank Cook, Chief of Training
National Radio Institute
Washington 9, D. C.

Dear Mr. Cook: Please help me. I am having trouble with an experiment in Manual . . . .
This is the problem:

Note: If you have written to us before about this same problem, be sure to enclose that letter, and our reply.

National Radio Institute
PIONEER HOME STUDY RADIO SCHOOL CONSULTATION SERVICE
16TH & U STREETS N.W.
WASHINGTON 9, D. C.

June 6, 1950 m
E1-A05
File No. TP6

Mr. Joseph A. Ricci
972 West 3rd St.
Plainfield, N. J.

Dear Mr. Ricci:

Your request for a diagram for training purposes is indeed welcome. The NRI Practical Training Plan will develop your ability to service receivers rapidly, if you will follow it faithfully.

In fact, we cannot stress too strongly the value of this plan. It will give you a thorough training in the fundamental servicing techniques. Not only do you gain valuable experience in using test equipment, but you also learn to recognize the sound of various defects in a receiver.

As you learn the meanings of these sounds you will be able to determine, simply by listening to a defective receiver, the comparatively few sources of the trouble. You can check these points immediately and save needless hours of work. Without this first-hand knowledge, you may have to test one part after another until you find which one is causing the trouble.

When you have carried out our Practical Training Plan thoroughly on one receiver, it is best to repeat the process with a second set, preferably of some other make. When you have finished with one receiver, you may be able to trade it for another set. You will find that experimentation on two receivers usually is sufficient to give you the experience you want - experience which otherwise could be gained only by months of actual servicing. If you decide later that you wish a third set to work on, you would do well to get a defective receiver to put in good operating condition.

The enclosed tube chart will enable you to locate tube socket terminals in this and in all other receivers. Knowing where to find the tube socket base connections enables you to tie up schematic diagrams with the actual receiver circuits. To do this, just notice how any part in the diagram connects to some tube socket terminal. Then find this tube on the chassis and with the aid of the tube chart, locate the particular socket terminal in question. Trace the wiring from this terminal to the part. Practice will make this easy.

Be sure to let us know if you have any serious difficulties in this work. We will be glad to give you the benefit of our experience.

Cordially yours,

J A Dowie

Chief Instructor

Encl. 2
JAD-TP6

This answers your letter which I am returning. Should you need more help, please send me your original letter, this reply, and your new questions.

Use This Blank For Requesting TECHNICAL CONSULTATION SERVICE

Do not use this blank for non-technical questions because that would delay the answer.

Another blank like this will be included with our reply.

FILL IN THESE SPACES

I am a Student ☐ Graduate ☐

◆

My last corrected Lesson No. is..............................

◆

The apparatus I ask about is manufactured by:

....

Name of Set is..............................

Model No. is..............................

◆

Serial No. is..............................

◆

The apparatus uses............tubes, having these numbers:

....

....

◆

Have tubes been tested?..............

Do you have a diagram?..............

◆

If you want material sent AIR Mail, enclose necessary postage and check here. ☐

T4-9-148 LITHO. IN U.S.A.

CONSULTATION SERVICE BLANK

Date..................................Student No..

Name..

Address...

City & State..

J. A. Dowie, Chief Instructor
National Radio Institute
Washington 9, D. C.

Dear Mr. Dowie: Please help me with the following technical questions.

Use This Blank For Requesting TECHNICAL CONSULTATION SERVICE

Do not use this blank for non-technical questions because that would delay the answer.

Another blank like this will be included with our reply.

FILL IN THESE SPACES

I am a Student ☐ Graduate ☐

◆

My last corrected Lesson No. is..............................

◆

The apparatus I ask about is manufactured by:

....

Name of Set is..............................

Model No. is..............................

◆

Serial No. is..............................

◆

The apparatus uses..............tubes, having these numbers:

....

....

◆

Have tubes been tested?..............

Do you have a diagram?..............

◆

If you want material sent AIR Mail, enclose necessary postage and check here. ☐

T4-9-148 LITHO. IN U.S.A.

CONSULTATION SERVICE BLANK

Date.............................. Student No..............................

Name..............................

Address..............................

City & State..............................

J. A. Dowie, Chief Instructor
National Radio Institute
Washington 9, D. C.

Dear Mr. Dowie: Please help me with the following technical questions.