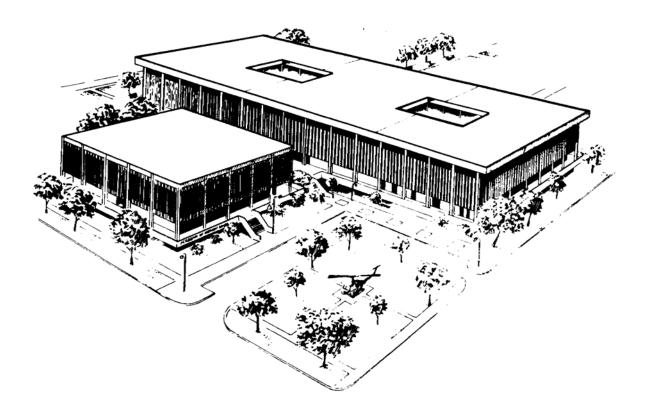
U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL FORT SAM HOUSTON, TEXAS 78234-6100



BASIC ELECTRICAL CIRCUITS

SUBCOURSE MD0903

EDITION 200

DEVELOPMENT

This subcourse is approved for resident and correspondence course instruction. It reflects the current thought of the Academy of Health Sciences and conforms to printed Department of the Army doctrine as closely as currently possible. Development and progress render such doctrine continuously subject to change.

ADMINISTRATION

For comments or questions regarding enrollment, student records, or shipments, contact the Nonresident Instruction Section at DSN 471-5877, commercial (210) 221-5877, toll-free 1-800-344-2380; fax: 210-221-4012 or DSN 471-4012, e-mail accp@amedd.army.mil, or write to:

COMMANDER AMEDDC&S ATTN MCCS HSN 2105 11TH STREET SUITE 4192 FORT SAM HOUSTON TX 78234-5064

Approved students whose enrollments remain in good standing may apply to the Nonresident Instruction Section for subsequent courses by telephone, letter, or e-mail.

Be sure your social security number is on all correspondence sent to the Academy of Health Sciences.

CLARIFICATION OF TRAINING LITERATURE TERMINOLOGY

When used in this publication, words such as "he," "him," "his," and "men" are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.

TABLE OF CONTENTS

Lesson	PAGE
INTRODUCTION	
1 BASIC ELECTRICAL CIRCUITS	1

CORRESPONDENCE COURSE OF THE US ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL

SUBCOURSE MDO903

BASIC ELECTRICAL CIRCUITS

INTRODUCTION

This subcourse is designed to give you a basic knowledge of simple circuits that carry electricity from a power source to some kind of electrical equipment. With a knowledge of these fundamentals, you will be able to make better use of electrical equipment and to better understand future textual materials that mention electrical factors in the function of equipment.

Subcourse Components:

This subcourse consists of programmed text.

Lesson 1. Basic Electrical Circuits

Study Suggestions:

Here are some suggestions that may be helpful to you in completing this subcourse:

--Read and study each lesson carefully.

--Complete the subcourse lesson.

Credit Awarded:

To receive credit hours, you must be officially enrolled and complete an examination furnished by the Nonresident Instruction Section at Fort Sam Houston, Texas. Upon successful completion of the examination for this subcourse, you will be awarded 3 credit hours.

You can enroll by going to the web site <u>http://atrrs.army.mil</u> and enrolling under "Self Development" (School Code 555).

A listing of correspondence courses and subcourses available through the Nonresident Instruction Section is found in Chapter 4 of DA Pamphlet 350-59, Army Correspondence Course Program Catalog. The DA PAM is available at the following website: http://www.usapa.army.mil/pdffiles/p350-59.pdf.

SUBCOURSE MD0903

LESSON 1	Basic Electrical Circuits.
ASSIGNMENT	Frames 1 through 100.
OBJECTIVE	After completing the programmed text, you should be able to choose correct answers to questions about basic electrical circuits, current, resistance, amperes, volts, and equivalent.
INSTRUCTIONS	This text is set up differently from most subcourses It is a workbook that utilizes programmed instruction. The numbered "frames" present information and/or a question about presented information. You should work through the frames in the order presented. Answer each question that is presented. To check your answers, go to the shaded box of the NEXT frame. For example, the solution to the question presented in Frame 2 is found in the shaded box of Frame 3.
SUGGESTIONS	Read Subcourse MD0902, Basic Electricity, before taking this subourse.
	After going through the programmed text at a relatively slow pace, go back through it several times as rapidly as you can. This will not take long and will help you feel more knowledgeable as you study. The purpose of the programmed text is memorization as well as understanding.

FRAME 1	
The diagram below will help you to recall that current is a flow of through a conductor.	
FRAME 2	Solution to Frame 1
Below are several series circuits. Study the carefully.	electrons
$= \underbrace{\begin{array}{c} \\ \\ \\ \end{array}} \\ = \underbrace{\begin{array}{c} \\ \end{array}} \\ = \underbrace{\begin{array}{c} \\ \\ \end{array}} \\ = \underbrace{\begin{array}{c} \\ \end{array}} \\ = \underbrace{\begin{array}{c} \\ \\ \end{array}} \\ = \underbrace{\begin{array}{c} \\ \end{array}} \\ \\ \\ \end{array} \\ \\ = \underbrace{\begin{array}{c} \end{array}} \\ \\ \\ \end{array} \\ \\ = \underbrace{\begin{array}{c} \\ \end{array}} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \\ \end{array} \\ \\ \\ \end{array} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \\ \end{array} \\ \\ \\ \end{array} \\ \\ \end{array} \\ \\ \\ \end{array} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \\ \end{array} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \\ \end{array} \\ \\ \end{array} \\ \\ \\ \end{array} \\ \\ \end{array} \\ \\ \end{array} \\ \\ \\ \\ \end{array} \\ \\ \\ \end{array} \\ \\ \\ \\ \end{array} \\ \\ \\ \end{array} \\ \\ \\ \\ \end{array} \\ \\ \\ \end{array} \\ \\ \\ \\ \end{array} \\ \\ \\ \end{array} \\ \\ \\ \\ \end{array} $	
FRAME 3	Solution to Frame 2
	is only one
The above is a series circuit because	
- <u> </u>	
FRAME 4	Solution to Frame 3
Label each circuit as either "Series" or "Not Series." a. b. c. d. 	it has only one path for current to flow

FRAME 5	Solution to Frame 4
What would be the reading on the ammeter in the series circuit below?	a. Series
I = <u>E</u> = R	b. Not Series
(A	c. Not Series
E = 12v - R = 2A	d. Series
FRAME 6	Solution to Frame 5
No matter where you measure the current in the series circuit below, the current readings would all be the	$\frac{12v}{2 \Omega} = 6 \text{ amp}$
E = 12v - 2	
FRAME 7	Solution to Frame 6
In any part of a series circuit, the current is theas long as the circuit is not changed.	same (6 amp)
FRAME 8	Solution to Frame 7
Write in the current reading of each ammeter connected in the series circuit below.	same
a. b.	

FRAME 9	Solution to Frame 8
In any series circuit, the total resistance (R_t) is the sum (or total) of all the single resistances. In the series circuit below, R_t is the of R_1 and R_2 .	a. 1 amp b. 1.amp
$\begin{bmatrix} & & & \\ & & & & \\ & & & \\ & & & & $	
FRAME 10	Solution to Frame 9
a. The total resistance (R_t) in the series circuit below is 10 Ω + 40 Ω + Ω .	sum (or total)
b. Total resistance (R_t) is ohms.	
FRAME 11	Solution to Frame 10
In the series circuit below	a. 5
$= 5 - R_3$	b. 55
$R_4 = $	
$R_2 = \ R_3 = \ R_4 = \$	
The total resistance (R _t) is	

FRAME 12	Solution to Frame 11
So far, you have learned that in series circuits:	R ₁ = 3 Ω
a. There is (<u>only one/more than one</u>) path for the current to flow.	$R_2 = 2 \Omega$ $R_3 = 5 \Omega$ $R_4 = 10 \Omega$
 b. Current has (<u>the same value</u>/<u>different values</u>) everywhere in the circuit. 	(R _t) = 20 Ω
c. To get R _t (total resistance), we (add/subtract/multiply) all the individual resistances.	
FRAME 13	Solution to Frame 12
To find I _t (current in any series circuit), you must use R _t in the formula I _t = $\frac{E_t}{R_t}$	a. only one
R _t	b. the same value
$\frac{1}{\bar{z}} \qquad $	c. add
To find I _t in the circuit above, you must use in the formula	
FRAME 14	Solution to Frame 13
To find I in the series circuit below, you must use $(\underline{10}/\underline{20}/\underline{30}/\underline{200}) \Omega$ in the formula It = $\underline{E_t}$	R _t
R _t	$I_t = \frac{E_t}{R_t}$
$\frac{1}{20} \xrightarrow{10} R_2$	

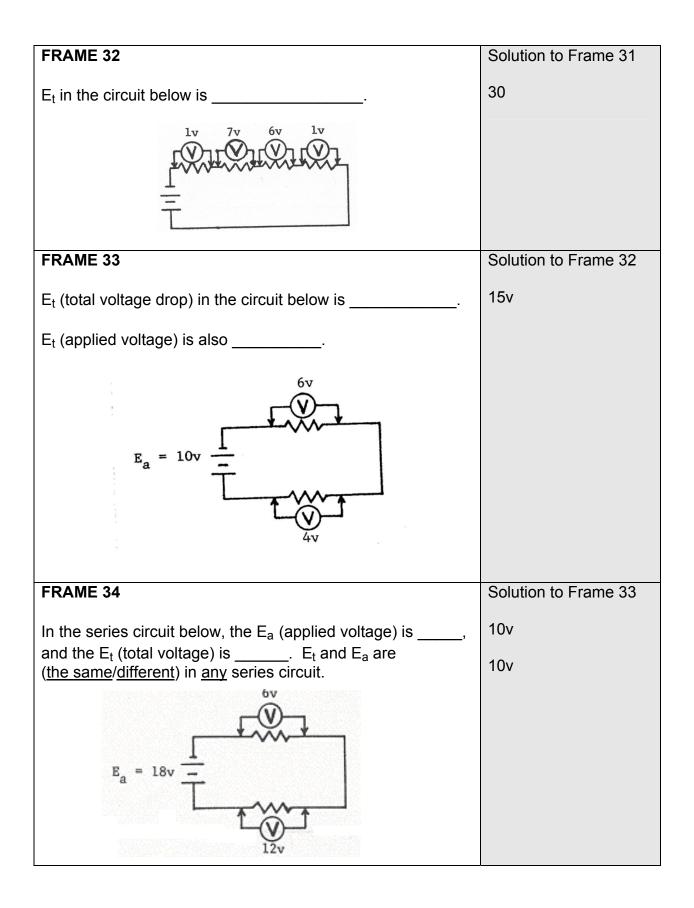
FRAME 15	Solution to Frame 14
In a series circuit with only one resistor, R_1 and R_t must be the same. In the series circuit below, there is only one resistor. This means the R_1 and R_t (are/are not) the same. They are both equal to	30
FRAME 16	Solution to Frame 15
To find the current in the circuit below, you would substitute the number ($\frac{4}{6}/10/24$) for R _t in the formula I _t = $\frac{E_t}{R_t}$.	are 2 Ω
R ₂ FRAME 17	Solution to Frame 16
	Solution to Frame To
In the circuit below, $E_t = $ $R_t = $	10
Find the current $I_t = $ R_1 $E = 90v = \frac{R_1}{10 - 10 R_1}$	

FRAME 18	Solution to Frame 17
If you calculated current (I) in the circuit below and used this formula:	90v
a. $I_t = \frac{E_t}{R_1}$, your answer would be (<u>right/wrong</u>).	30Ω 3 amp
b. $I_t = \underbrace{E_t}_{R_2}$, your answer would be (<u>right/wrong</u>).	$I_t = \frac{E_t}{R_t} = \frac{90v}{30\Omega} = 3 \text{ amp}$
c. $I_t = \frac{E_t}{R_t}$, your answer would be (<u>right/wrong</u>).	
$E = 60v = \frac{1}{1} \qquad B.A. \begin{cases} R_2 \\ R_2 \end{cases}$	
FRAME 19	Solution to Frame 18
In the circuit below, find I.	a. wrong
Example: :	b. wrong
$I_{t} = \underbrace{E_{t}}_{R_{t}} = \underbrace{10 \text{ v}}_{(2+3) \Omega} = \underbrace{10v}_{5\Omega} = 2 \text{ amps}$	c. right
You do this one:	

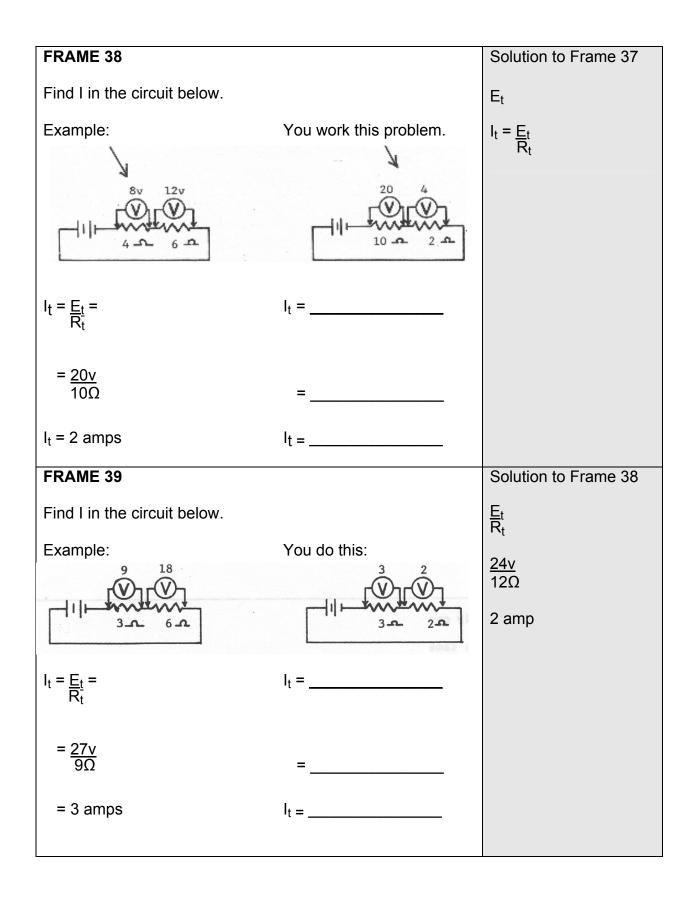
FRAME 20	Solution to Frame 19
In the circuit below, $I_t = $ $E = 90v = \frac{1}{244}$	$I_t = \frac{E_t}{R_t} = \frac{12 \text{ v}}{6 \Omega} = 2 \text{ amps}$
FRAME 21	Solution to Frame 20
So far, you have learned that in series circuits:	3 amp I _t = <u>E</u> t R _t
a. There is/are (<u>only one/more than one</u>) path for the current to flow.	$=\frac{90 \text{ v}}{30 \Omega}$
 b. Current has the (<u>same/different</u>) value everywhere in the circuit. 	= 3 amp
c. To get R _t , we (<u>sum/subtract</u>) all individual resistances.	
d. To find I _t , you must use $(\underline{R_1}/\underline{R_t})$ in the formula $I_t = \underline{E_t}$. $R_{t.}$	
FRAME 22	Solution to Frame 21
The voltage applied by a battery is called the applied voltage	a. only one
(E_a) .	b. same
This battery will apply a voltage called the	c. sum
	d. R _t
FRAME 23	Solution to Frame 22
In the circuit below, the E _a (applied voltage) is volts.	applied voltage (E _a)

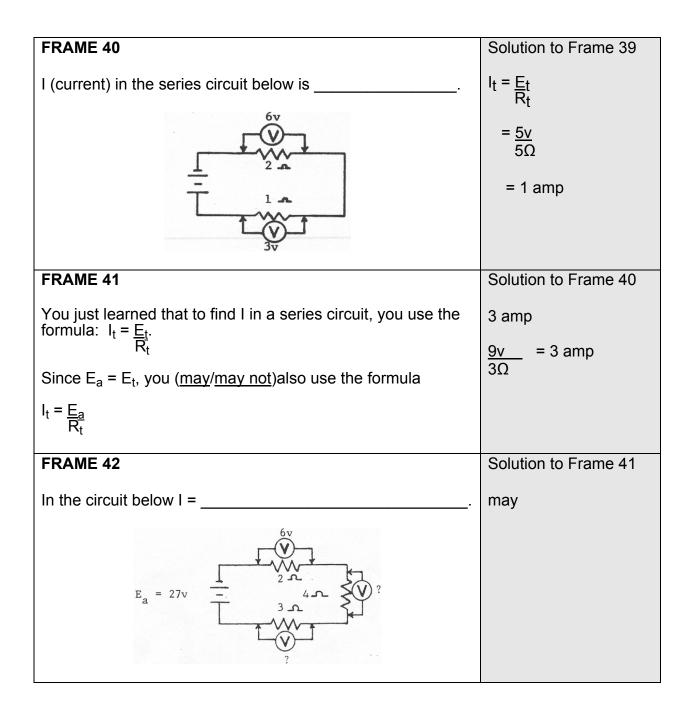
FRAME 24	Solution to Frame 23
To move a wagon uphill, you must apply a force. To move electrons through a resistor, a battery must also apply	24
FRAME 25	Solution to Frame 24
When you move a wagon uphill, force is used up. When electrons are pushed through a resistance, electromotive force (EMF) is also	a force (or a voltage)
FRAME 26	Solution to Frame 25
When EMF is used up, the voltage drops. Across any resistance, EMF is used up and the voltage	used up
FRAME 27	Solution to Frame 26
The drop in voltage is called voltage drop.	drops
10v	
Across the resistor above, we have a 10v	
FRAME 28	Solution to Frame 27
In the diagram below, the voltage drop across R_1 is and across R_2 , it is	voltage drop
$ \begin{array}{c} $	

FRAME 29	Solution to Frame 28
You have learned that the symbol for voltage is E.	(R ₁) 5v
For voltage drop across R_1 , you will use the symbol E_1 .	(R ₂) 20v
For voltage drop across R_2 , you will use the symbol E_2 .	
For voltage drop across R ₃ , you will use the symbol	
FRAME 30	Solution to Frame 29
Total voltage drop (E _t) is the sum of all individual voltage drops. In the circuit below, E _t is theof E ₁ and E ₂ . E _t =	E ₃
FRAME 31	Solution to Frame 30
E _t (total voltage drop) in this circuit is volts.	total (or sum)
$ \begin{array}{c} $	15v



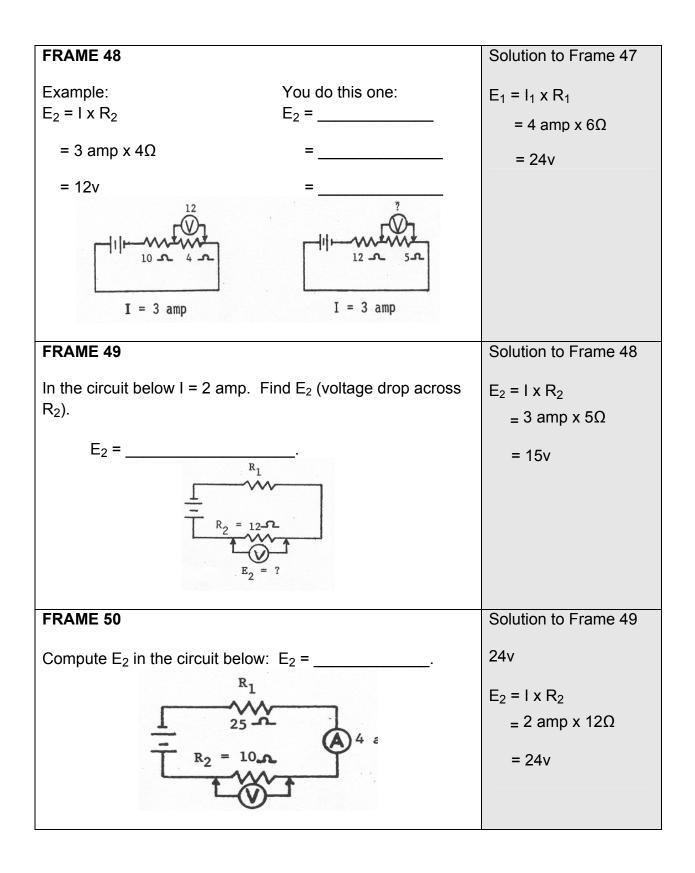
FRAME 35	Solution to Frame 34
E _t in the circuit below is; E _a is $E_{a} = ? = = = = = = = = = = = = = = = = = $	18v 18v the same
FRAME 36	Solution to Frame 356v
If $E_t = 24v$, then $E_a = $	6v
If E _a = 6v then E _t =	6v
If any series circuit, E _t and E _a are	
FRAME 37	Solution to Frame 36
One way to find I (current) in a series circuit is to use E_t in the formula $I_t = \frac{E_t}{R_t}$	24v
	6v
	the same (equal)
To find I _t in the circuit above, use in the formula	
·	



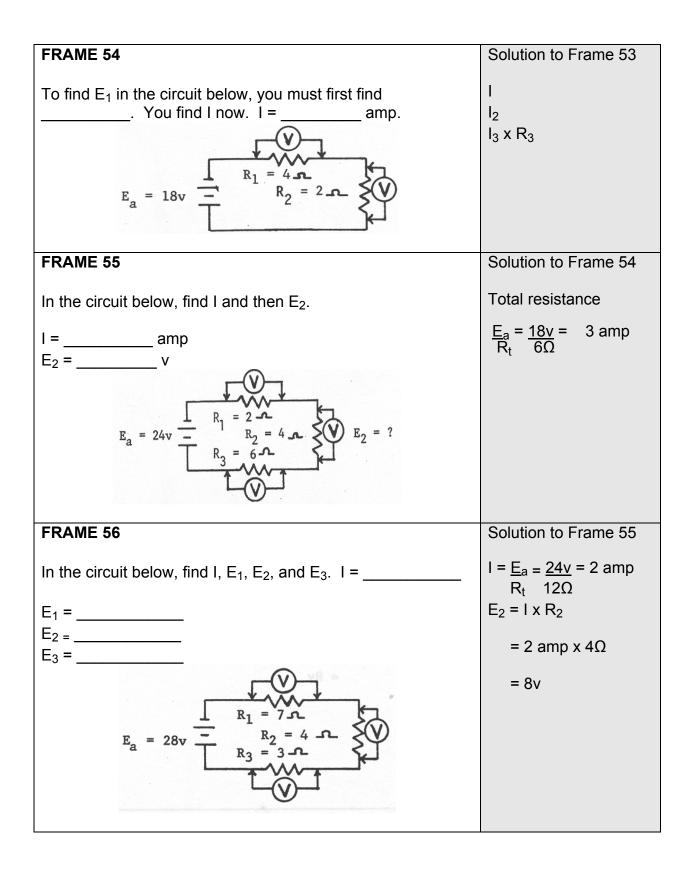


FRAME 43	Solution to Frame 42
Find I in the circuit below:	3 amp
=	$\frac{E_a}{R_t} = \frac{27v}{9\Omega} = 3 \text{ amp}$
	drop at side resistor = 12 v.
	drop at bottom resistor = 9 v
FRAME 44	Solution to Frame 43
So far you have learned that in a series circuit:	8 amp
a. There is/are (<u>only one/more than one</u>) path for the current to flow.	$I_t = \frac{E_t}{R_t} = \frac{80v}{10\Omega} = 8 \text{ amp}$
 b. I (current) has (<u>the same/a different</u>) value(s) everywhere in the circuit c. To get R_t, you (<u>sum/subtract</u>) the individual voltage resistances. d. To get E_t, you (<u>sum/subtract</u>) the individual voltage drops. e. E_t and E_a (<u>are/are not</u>) the same. f. To find I, you (<u>must/must not</u>) use R_t. g. To find I, you (<u>must/must not</u>) use either E_t or E_a. 	
FRAME 45 The statement "The greater the resistance, the greater the voltage drop" does not tell you how to calculate the exact voltage drop. However, Ohm's law does allow you to	Solution to Frame 44 a. only one b. the same c. sum d. sum e. are f. must g. must

FRAME 46	Solution to Frame 45
To calculate E (voltage drop across R_1) exactly, you use the formula $E_1 = I_1 \times R_1$:	calculate the exact voltage drop
$E_1 = ?$ \downarrow \downarrow R_1 \downarrow R_2	
To calculate E ₁ in the circuit above, you use the formula	
FRAME 47	Solution to Frame 46
Find E_1 in the circuits below:	$E_1 = I_1 \times R_1$
Example: You do this one	
$ \begin{array}{c} 6v \\ \hline \\ 2 \\ 2 \\ \hline \\ 2 \\ \hline \\ 2 \\ \hline \\ \\ 2 \\ \hline \\ \\ \\ \\$	
E ₁ = I x R ₁ E ₁ =	
= 3 amp x 2Ω =	
= 6 v =	



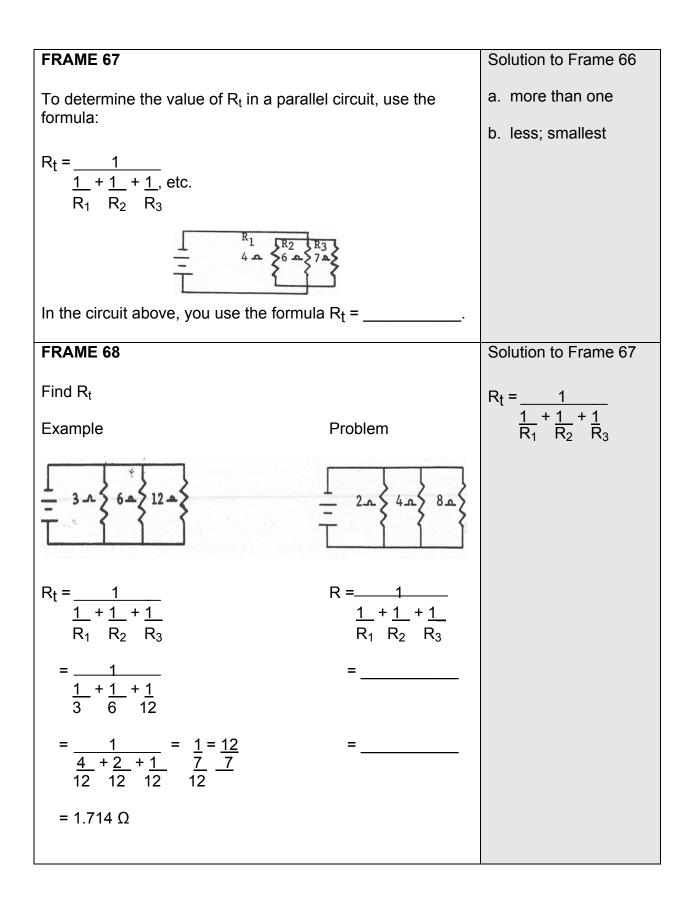
FRAME 51	Solution to Frame 50
FRAME 51	
To check the total voltage drops, you can sum the individual voltage drops to get E_t . This should equal E_a . $E_a = 55v$ $E_a = 55v$ The voltage drops calculated above (do/do not) check.	$E_2 = I \times R_2$ = 4 amp x 10Ω = 40v
FRAME 52	Solution to Frame 51
In the circuit below, find E_1, E_2, E_3 . $E_1 = \underline{\qquad} \qquad E_2 = \underline{\qquad}$ $E_3 = \underline{\qquad} \qquad E_t = \underline{\qquad}$ $I_1 = 10a$, $R_2 = 12$ $R_1 = 10a$, $R_2 = 12$ $R_3 = 7$ $R_3 = 7$ R_3	do
FRAME 53 Sometimes you will not be told the value of I (current). Therefore, before you can compute E_1 , or E_2 , or E_3 , you must find the value of to use in the formulas: $E_1 = I_1 \times R_2$ $E_2 = \ \times R_2$ $E_3 = \$	Solution to Frame 52 $E_1 = 20v$ $E_2 = 24v$ $E_3 = 14v$ $E_t = 58v$



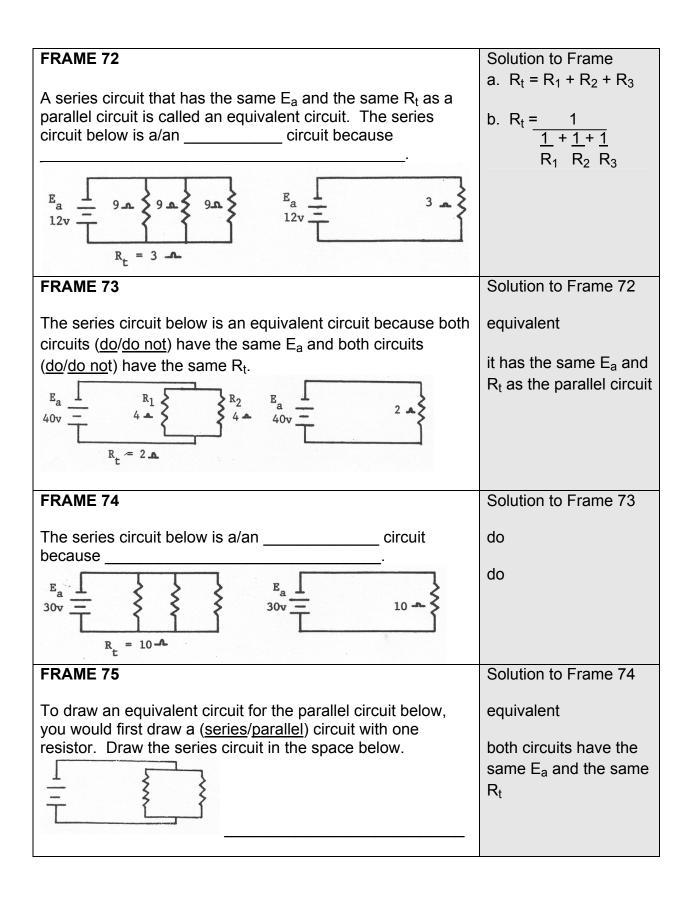
FRAME 57	Solution to Frame 56
In the circuit below, find: $E_1 = _$; $E_2 = _$; $E_3 = _$. Check:	2 amps ($R_t = 7 + 4 + 3$ = 14 Ω I = $E_a = \frac{28}{R_t} = 2$ amps $E_1 = I \times R_1 = 2$ amp x $7\Omega = 14v$ $E_2 = I \times R_2 = 2$ amp x $4\Omega = 8v$ $E_3 = I \times R_3 = 2$ amp x $3\Omega = 6v$
FRAME 58	Yes, 28v = 28v Solution to Frame 57
 To summarize what you have learned about series circuits, complete the statements below: a. There is/are (only one/more than one) path for current to flow. b. I (current) has (the same/a different) value(s) everywhere in the circuit. c. To get Rt, you (sum/subtract) the individual resistances. d. To get Et, you (sum/subtract) the individual voltage drops. e. Et and Ea (are/are not) the same. f. To find I, you (must/must not) use Rt. g. To find I, you (must/must not) use Et or Ea. h. To find E1, use the formula 	E ₁ = 20v E ₂ = 12v E ₃ = 8v Check: E _a = E _t 40v = 40v

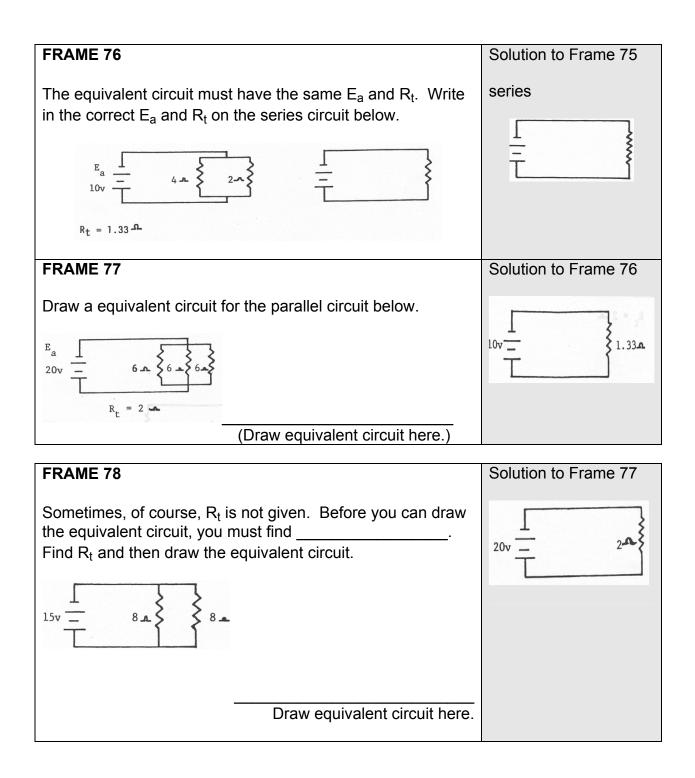
FRAME 59	Solution to Frame 58
This is one way of placing resistors in parallel.This is another way of placing resistors inparallel.	a. only oneb. the samec. sumd. sum
= $ = $ $: : : : : : : : : : : : : : ::::::::$	e. are f. must g. must h. E_{1} x R_{1} i. E_{3} = x R_{3}
Both of the above circuits are circuits.	Solution to Frame 59
These are all parallel circuits. The arrows show the paths of current flow. A parallel circuit has (<u>only one/more than one</u>) path for current flow.	parallel
FRAME 61	Solution to Frame 60
The circuit below is broken at point A. Current still flows because parallel circuit have (<u>only one/more than one</u>) path for current flow.	more than one
FRAME 62	Solution to Frame 61
Label each circuit as either "parallel" or "series." a. b. c. d. $\overbrace{(Label)}$ $\overbrace{(Label)}$ $\overbrace{(Label)}$ $\overbrace{(Label)}$ $\overbrace{(Label)}$	more than one

FRAME 63	Solution to Frame 62
Now let us look at resistance. In the parallel circuit below,	a. Series
resistance 1 (R ₁) is 15 Ω ; R ₂ isΩ; and R ₃ isΩ.	b. Parallel
$\begin{array}{c c} R_1 \\ 15 \\ 15 \\ 10 \\ 10 \\ 10 \\ 10 \\ 10 \\ 1$	c. Series
	d. Parallel
FRAME 64	Solution to Frame 63
In any parallel circuit, R_t (total resistance) is less than the	10
smallest resistance. In the circuit below, R_t is less than Ω .	20
FRAME 65	Solution to Frame 64
R_t will be less than 10Ω in the circuit below. R_t is always (<u>more/less</u>) than the smallest resistance.	5
$\frac{1}{2}$ $\frac{R_1}{10}$ $\frac{R_2}{30}$	
FRAME 66	Solution to Frame 65
So far you have learned that:	less
a. A parallel circuit has (<u>only one/more than one</u>) path for current flow.	
 B. R_t is (<u>more/less</u>) than the (<u>largest/smallest</u>) resistance in a parallel circuit. 	



FRAME 69	Solution to Frame 68
a. In the parallel circuit below, R_t equals b. R_t (<u>is/is not</u>) less than the smallest resistor.	$R_{t} = \frac{1}{\frac{1}{2} + \frac{1}{4} + \frac{1}{8}}$
- 10 m 20m 40 m	$\frac{1}{\frac{4}{8} + \frac{2}{8} + \frac{1}{8}} = \frac{1}{\frac{7}{8}} = \frac{8}{7}$
FRAME 70	= 1.14Ω Solution to Frame 69
 So far you have learned that: a. A parallel circuit has (<u>only one/more than one</u>) path for current to flow. b. To find R_t, you use the formula 	a. $R_t = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$ $R_t = \frac{1}{\frac{1}{10} + \frac{1}{20} + \frac{1}{40}}$
c. You can check on any R _t you compute because the R _t in a parallel circuit must be (<u>more/less</u>) than the (<u>largest/smallest</u>) resistance.	$\frac{1}{\frac{4}{40} + \frac{2}{40} + \frac{1}{40}} = \frac{1}{\frac{7}{40}} = \frac{40}{7}$ R _t = 5.71Ω
FRAME 71	b. is Solution to Frame 70
To help prevent confusion between finding R_t in series circuits and finding R_t in parallel circuits, answer the questions below: $ \begin{array}{c} R_1 & R_2 & R_3 \\ \hline & 4 & 5 & 6 & 6 \\ \hline & 4 & 5 & 6 & 6 \\ \hline & 4 & 5 & 6 & 6 & 6 \\ \hline & 4 & 5 & 6 & 6 & 6 \\ \hline & 4 & 4 & 5 & 6 & 6 & 6 \\ \hline & 4 & 4 & 5 & 6 & 6 & 6 \\ \hline & 4 & 4 & 5 & 6 & 6 & 6 \\ \hline & 4 & 4 & 5 & 6 & 6 & 6 \\ \hline & 4 & 4 & 5 & 6 & 6 & 6 & 6 \\ \hline & 4 & 4 & 5 & 6 & 6 & 6 & 6 \\ \hline & 4 & 4 & 5 & 6 & 6 & 6 & 6 \\ \hline & 4 & 4 & 5 & 6 & 6 & 6 & 6 & 6 \\ \hline & 4 & 4 & 5 & 6 & 6 & 6 & 6 & 6 \\ \hline & 4 & 4 & 5 & 6 & 6 & 6 & 6 & 6 & 6 \\ \hline & 4 & 4 & 5 & 6 & 6 & 6 & 6 & 6 & 6 & 6 & 6 & 6$	a. more than one b. $R_t = 1$ 1 + 1 + 1 $R_1 R_2 R_3$ c. less, smallest

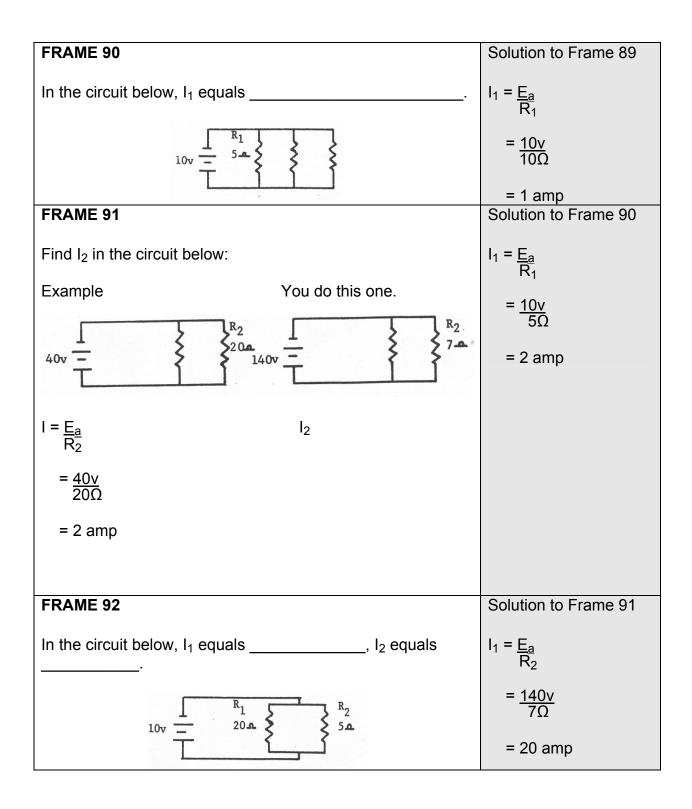




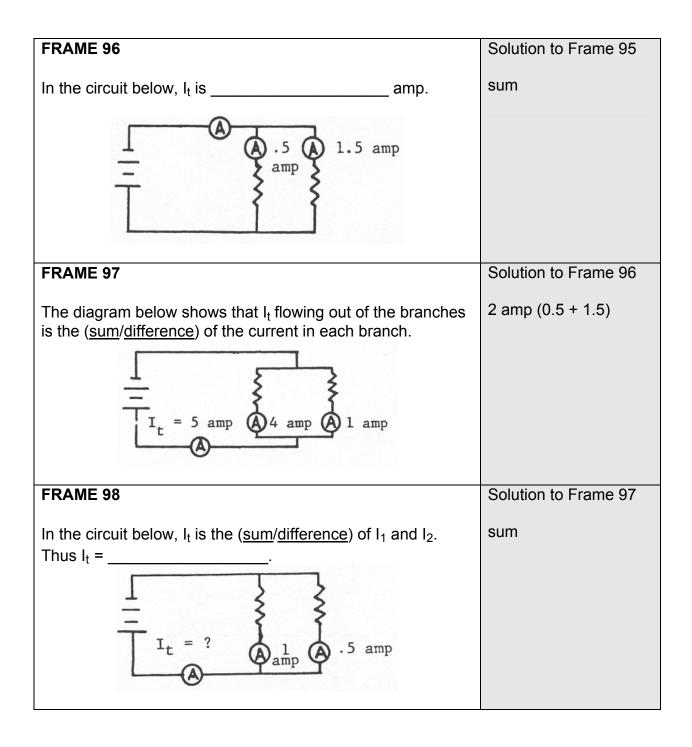
FRAME 79	Solution to Frame 78
For this parallel circuit, draw an equivalent circuit.	R _t
100v 40 40 20 Draw equivalent circuit here.	$R_{t} = \underbrace{1}_{1+1} = 4\Omega$ $15v = \underbrace{1}_{15v} 4 \Delta$
FRAME 80	Solution to Frame 79
So far you have learned that: a. A parallel circuit has for current to flow.	100v = 10.
 b. R_t for a parallel circuit = c. You can check on any R_t you compute because the R_t in a parallel circuit must be (<u>more/less</u>) than the (<u>largest/\/smallest</u>) resistor. 	$\frac{1}{\frac{1}{40} + \frac{1}{40} + \frac{2}{40}} =$ $1 = 40 = 10$
d. An equivalent circuit is a (<u>series/parallel</u>) circuit with the same and as a parallel circuit.	$\frac{1}{\frac{4}{40}} = \frac{40}{4} = 10$
FRAME 81	Solution to Frame 80
In the parallel circuit below, E_a (applied voltage), E_1 (voltage drop across R_1), E_2 (voltage crop across R_2), and E_3 (voltage drop across R_3) are (<u>the same/different</u>).	a. more than one path b. 1 $\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
$E_{a} = 100v = 100v = 100v = 100v$	c. less; smallest d. series; E _a ; R _t

FRAME 82	Solution to Frame 81
In parallel circuit, the voltage drop across each branch is always (the same/different).	the same
FRAME 83	Solution to Frame 82
In a parallel circuit, the voltage drop across each resistor (regardless of size) is the same. In a series circuit, the voltage drops are (the same/different) according to the size of the resistor.	the same
FRAME 84	Solution to Frame 83
Now that you know what happens to resistance and voltage in a parallel circuit, let us look at current. The diagram below shows that in a parallel circuit, the current splits and flows through (<u>only one/each</u>) resistor.	different
FRAME 85	Solution to Frame 84
Because the current splits up and flows through each resistor, it is important that you know how to compute the current flowing through	each
FRAME 86	Solution to Frame 86
You have learned that the symbol for current is I. The symbol for the current flowing through R_1 is I_1 . The symbol for the current flowing through R_2 is I_2 The symbol for the current flowing through R_3 is	each resistor

FRAME 87	Solution to Frame 86
The diagram below shows that when the current splits, more current will flow through the (<u>larger/smaller</u>) resistor.	l ₃
- 6- \$ 12. - 1.66 amp	
FRAME 88	Solution to Frame 87
To accurately measure I ₁ (current flow through R ₁), you use the formula I ₁ = $\underline{E}_{\underline{a}}$, since E ₁ = E _a . R ₁	smaller
$ \frac{1}{1} \xrightarrow{R_1} R_1$	
To measure I ₁ in the circuit above, you use the formula	
FRAME 89	Solution to Frame 88
Find I_1 in the circuits below.	I ₁ = <u>E</u> a R ₁
Example You do this one.	
$12v = \begin{array}{c} R_1 \\ 4 \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ -$	
$I_1 = \underbrace{E_a}_{R_1} \qquad I_1 =$	
$=\frac{12v}{4\Omega}$	
= 3 amp	



FRAME 93	Solution to Frame 92
In the circuit below, find I ₁ , I ₂ , and I ₃ . I ₁ =, I ₂ =, I ₃ = I _{100v} = $50 - 25 - 200 - 200 -$	$I_{1} = \underbrace{E_{a}}{R_{1}} = I_{2} = \underbrace{E_{a}}{R_{2}}$ $\underbrace{\frac{10v}{20\Omega} = \frac{10v}{5\Omega} = \frac{10v}{5\Omega} = \frac{10v}{5\Omega}$ $\underbrace{0.5 \text{ amp} 2 \text{ amp}}{\text{Solution to Frame 93}}$ $I_{1} = \underbrace{E_{a}}{R_{1}} = \underbrace{\frac{100v}{50\Omega} = 2 \text{ amp}}{R_{2}}$ $I_{2} = \underbrace{E_{a}}{R_{2}} = \underbrace{\frac{100v}{25\Omega} = 4 \text{ amp}}{R_{3}}$ $I_{3} = \underbrace{E_{a}}{R_{3}} = \underbrace{\frac{100v}{100\Omega} = 1 \text{ amp}}{R_{3}}$
FRAME 95 The diagram below shows that l_t (total current) flowing into the branches is the (sum/difference) of the current in each branch. $I = \frac{1}{3 \text{ amp}} e^{1 \text{ amp}} 1 \text{ amp}}$	Solution to Frame 94



FRAME 99	Solution to Frame 98
Fill in the value of I_t measured at the two ammeters below:	sum
	1.5 amp (1 + 0.5)
FRAME 100	Solution to Frame 99
In a series circuit, current has only one path to follow; therefore, it has the same value everywhere in the circuit.	3 amp (1 + 0.5 + 1.5) 3 amp (1 + 0.5 + 1.5)
In a parallel circuit, the current (splits/does not split).	
The current in a parallel circuit (<u>does/does not</u>) have the same value everywhere.	
FRAME 101	Solution to Frame 100
Congratulations. You have now completed this programmed instruction booklet.	splits
It is recommended that you review the lesson material before taking the examination.	does not

End of Lesson 1