Breadboard Circuits

Practical Experiments

BREADBOARD CIRCUITS FOR PRACTICAL EXPERIMENTS

Several of your practical assignments involve breadboarding circuits similar to those described in your lesson texts. After breadboarding each circuit, perform the experiments described. Then, answer the questions following each experiment.

For each experiment, you'll need the breadboard experimenter, your DC power supply, and your multimeter. You will receive the components you need with the appropriate assignment.

PREPARING THE BREADBOARD EXPERIMENTER

The breadboard experimenter allows you to plug in components, Fig. 1. You may then complete electrical circuits without doing any soldering. And you can reuse the same components for the different projects.

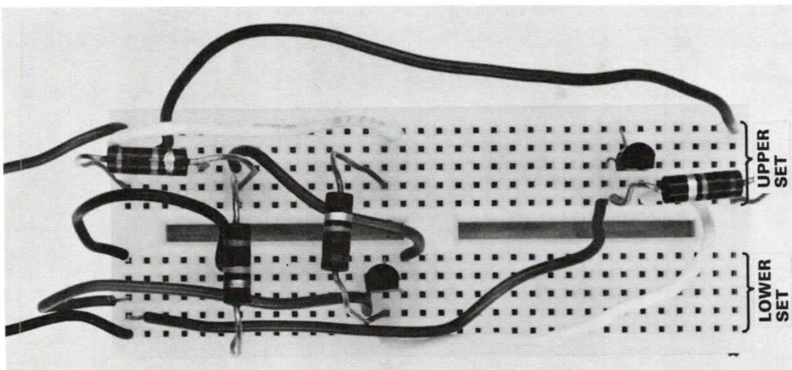

Figure 1 **One of the experimental circuits you'll be building on your breadboard experimenter.**

For your experiments, use the first vertical row of sockets in the upper set for the positive side of the power supply. Any components plugged into this row of sockets is then connected to the positive side of the circuit. Use the first vertical row of sockets in the lower set as negative battery, or common.

You've received two colors of hook-up wire -- red and black. Cut a 3″ length of red hook-up wire and a 3″ length of black hook-up wire. Now, strip ¼″ of insulation from both ends of each wire.

Insert one end of the red hook-up wire into the top socket of the first row, Fig. 2. Insert one end of the black hook-up wire into the bottom socket of the first row in the lower set, also shown in Fig. 2. Each of the sockets in row #1 of the upper set now connects electrically to the red wire. Each of the sockets in row #1 of the lower set connects electrically to the black wire.

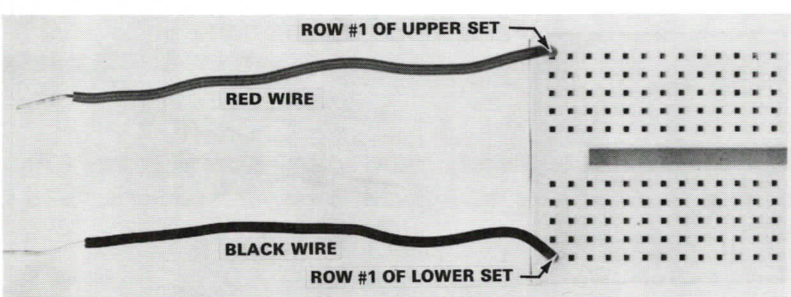

Figure 2

BREADBOARD ASSIGNMENT #1
AN INSIGHT INTO OHM'S LAW

In this experiment, we'll be going through a simple Ohm's law problem in order to demonstrate that the current flowing in a circuit is inversely proportional to the resistance of the circuit. In any circuit, as the resistance of the circuit increases, the current flowing in the circuit decreases.

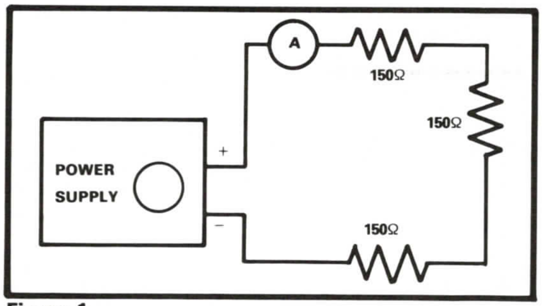

Figure 1

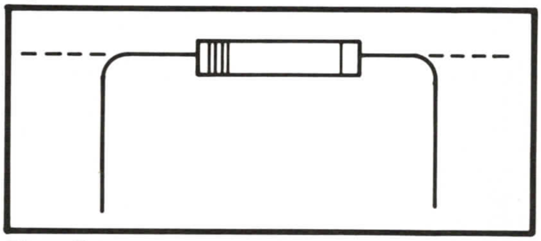
Figure 2

In Fig. 1, you can see the circuit you will be breadboarding in schematic form. The circuit is a simple series-type made with a power supply and 150Ω resistors.

BREADBOARDING THE EXPERIMENTAL CIRCUIT

Select three 150Ω resistors and bend their leads as shown in Fig. 2. This will allow the resistors to be plugged into the breadboard experimenter.

Plug the resistors into the experimenter as shown in Fig. 3. Set your power supply to its lowest output voltage, set the voltage control fully counterclockwise, and connect the supply to the circuit through the power connections in the first row of sockets. Connect your voltmeter between the power connections and set the supply so that it is delivering 10 volts to the circuit.

EXPERIMENTS

1. Break the connection between the positive lead of your power supply and the power lead to the breadboard experimenter. Set your VOM to the DC MA 50ma range and connect your meter in series with the circuit. Be sure that you connect the positive lead from your meter to the positive lead from the power supply. You're now making a measurement of the current flowing through the experimental circuit. Record your current reading for the circuit in space to the left.

CURRENT IN CIRCUIT 1____________

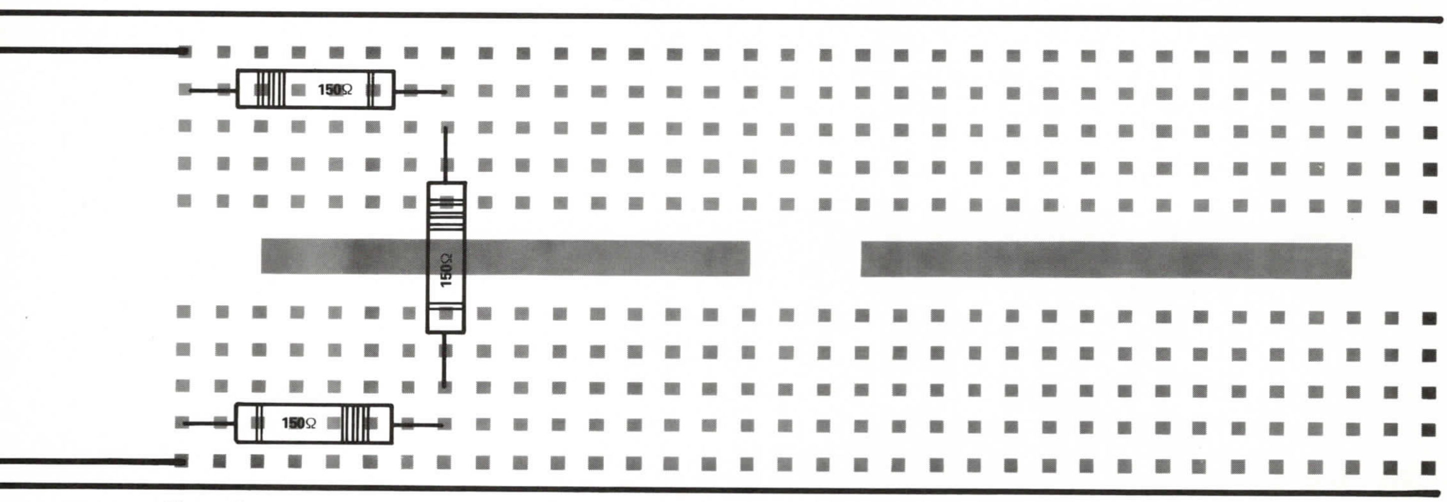

Figure 3

2. Disconnect your meter and then rewire the circuit as shown in Fig. 4. Once again, set the voltage being applied to the circuit to 10 volts. Then, repeat the steps from above, breaking the circuit and using the 50ma range of your meter to measure the current flowing in the circuit. Record the current for this second circuit to the right.

CURRENT IN CIRCUIT 2____________

3. Again disconnect your meter from the circuit and remove a resistor. Rewire the circuit as shown in Fig. 5. Apply 10 volts to the circuit; then break the circuit and make a current reading. This time for the current reading, use the DC MA 500ma range on your VOM. Record your current measurement to the right.

CURRENT IN CIRCUIT 3____________

The circuit you have just constructed can give you an insight into what happens to electrical energy in a resistor. After the circuit has been in operation for about a minute, the resistor will have become quite warm. This is because the resistor has been converting electrical energy to heat.

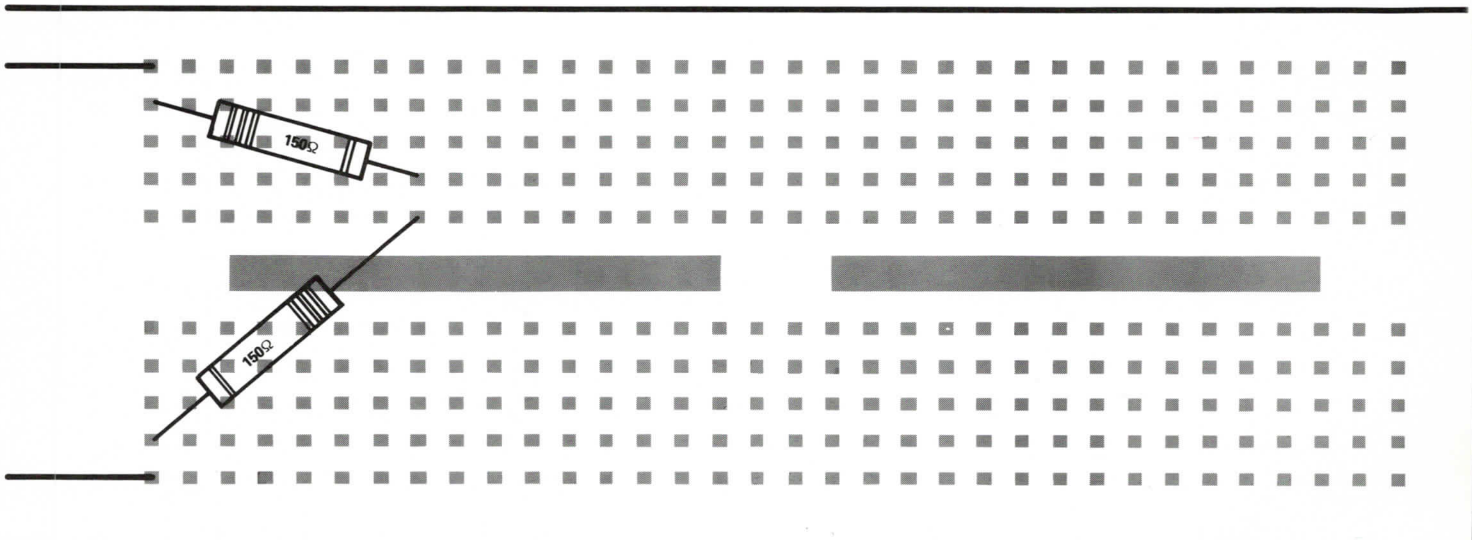

Figure 4

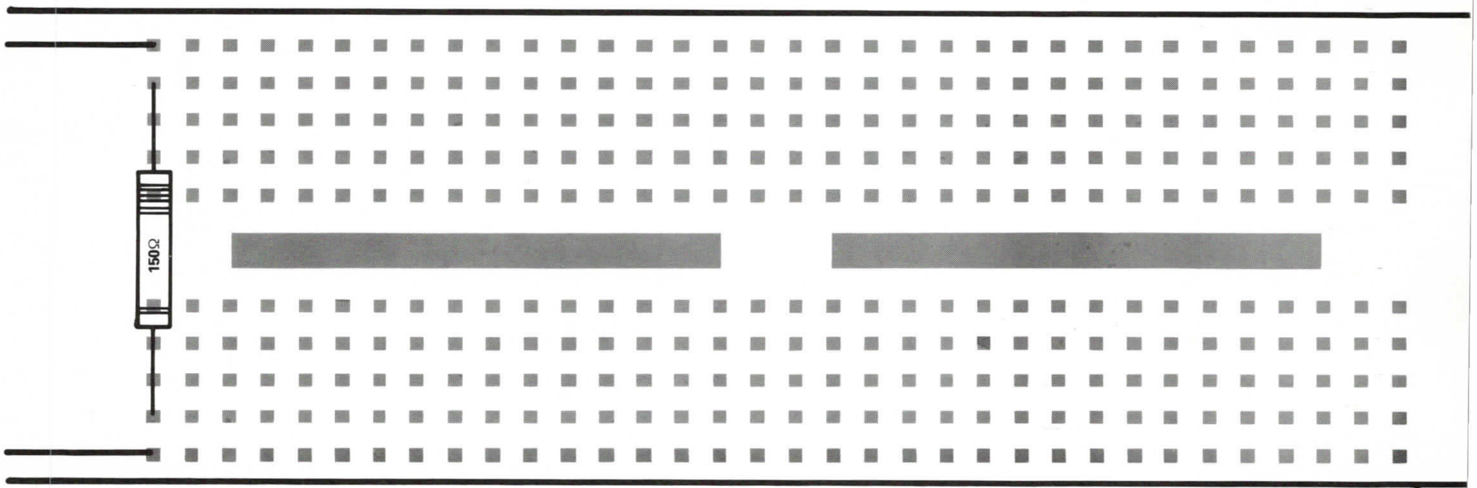

Figure 5

4. Now, let's look at the results from the experimental circuits. It's easy to see that as the resistance of the circuit decreased, the current passing through the circuit increased. In fact, the current increased proportionally with the decrease in resistance. Between the first and the second circuit, the resistance decreased by about 33%, so the current increased by 33%.

Comparing the second and third circuit, notice that the current in the third circuit is double that in the second circuit, while the resistance of the third circuit is half that of the second circuit.

Of course, your results may not follow Ohm's law's predictions exactly, but your results should be close.

TEST QUESTIONS FROM OHM'S LAW EXPERIMENT

Name EUGENE M. PATE

No. 13391 Grade ________

For each of the following questions, write your answer in the space provided to the right of the question.

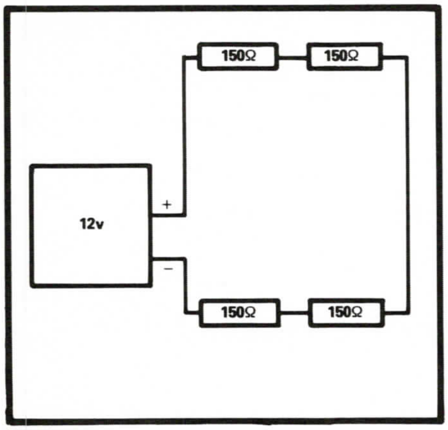

Figure 6

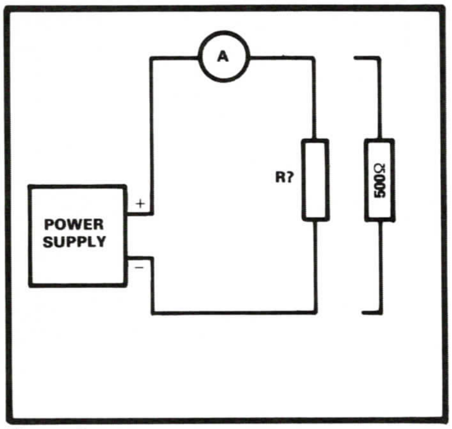

Figure 7

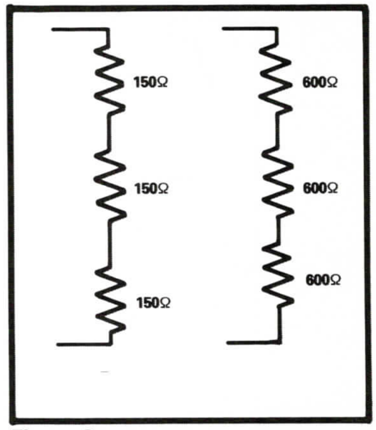

Figure 8

1. Consider that you have constructed the circuit shown in Fig. 6. There are four 150Ω resistors in series with a 12-volt power supply. What current is flowing through the circuit? ________ 20 Amp ~~milliamps~~

2. If the circuit from Fig. 6 were changed to eight 150Ω resistors in series, what would the current in the first circuit be -- twice or half the current in the first circuit? ________ (twice or half)

3. Consider that you constructed the circuit shown in Fig. 7 where 50ma of current is flowing. You then connected a 500Ω resistor into the circuit in place of the first, unknown resistance, and found that the current flowing was 25ma. What would you conclude was the resistance of the first resistor? ________ ohms

4. In Fig. 8, there are two circuits. One is made up of three 150Ω resistors in series; the other is made up of three 600Ω resistors in series. For any voltage which is applied equally to both circuits, you can expect the current in the circuit made up of 150Ω resistors to be how much less or how much greater than the current in the circuit made up of 600Ω resistors? ________ x ________ (greater or less)

5. You have two resistors marked as having the same resistance. First you connect one in series with a power supply and a milliammeter and measure a current flow of 37ma. Then you connect both resistors in series with the meter and supply and find that the current in the circuit is now 27ma. Are the resistors actually equal in value? ________ (yes, no)

BREADBOARD ASSIGNMENT #2
KIRCHOFF'S LAW IN SERIES CIRCUITS

For this experiment, we'll be using two series circuits to demonstrate Kirchoff's voltage law for series circuits. As you remember, Kirchoff's law for series circuits says that the sum of the voltage drops in a series circuit will add up to the voltage being applied to the circuit.

Fig. 1 shows the first circuit to be constructed. The circuit is made up of three 150Ω resistors connected in series with your power supply.

BREADBOARDING THE EXPERIMENTAL CIRCUIT

Select three 150Ω resistors and bend their leads to fit the breadboard experimenter. Plug the resistors into the experimenter as shown in Fig. 2. Connect your power supply to the circuit and set the supply to deliver 12 volts to the circuit.

EXPERIMENTS

1. With 12 volts applied to the experimental circuit, measure the voltage drop across each resistor in the circuit. This voltage across the resistors, or voltage drop, should be very close to 4 volts for each resistor. Notice that the sum of the drops, then, is 12 volts.

You can also see from this circuit that the voltage drop across each resistor of the same resistance is equal to the supply voltage divided by the number of resistors in the circuit.

2. Now remove one of the resistors from the circuit, forming a series circuit with two 150Ω resistors connected to the power supply, Fig. 3. Again, apply 12 volts to the circuit and measure

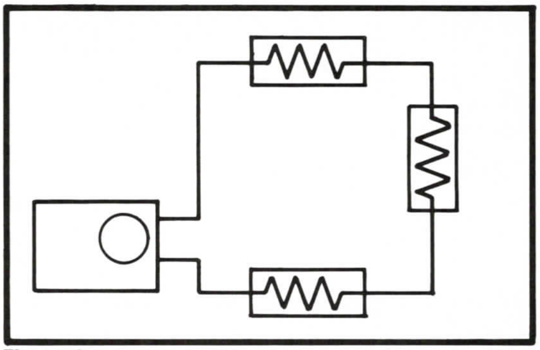

Figure 1

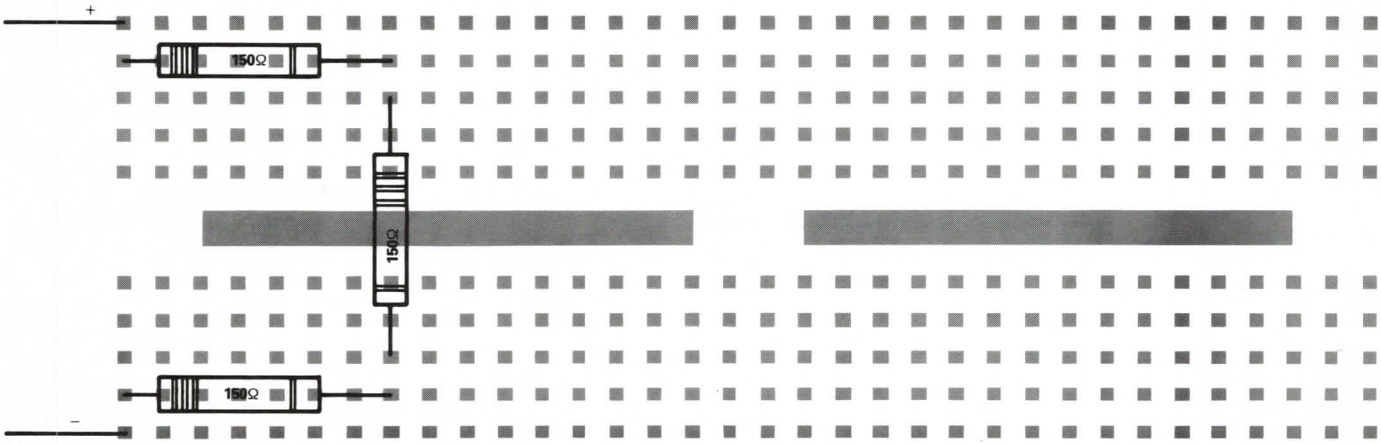

Figure 2

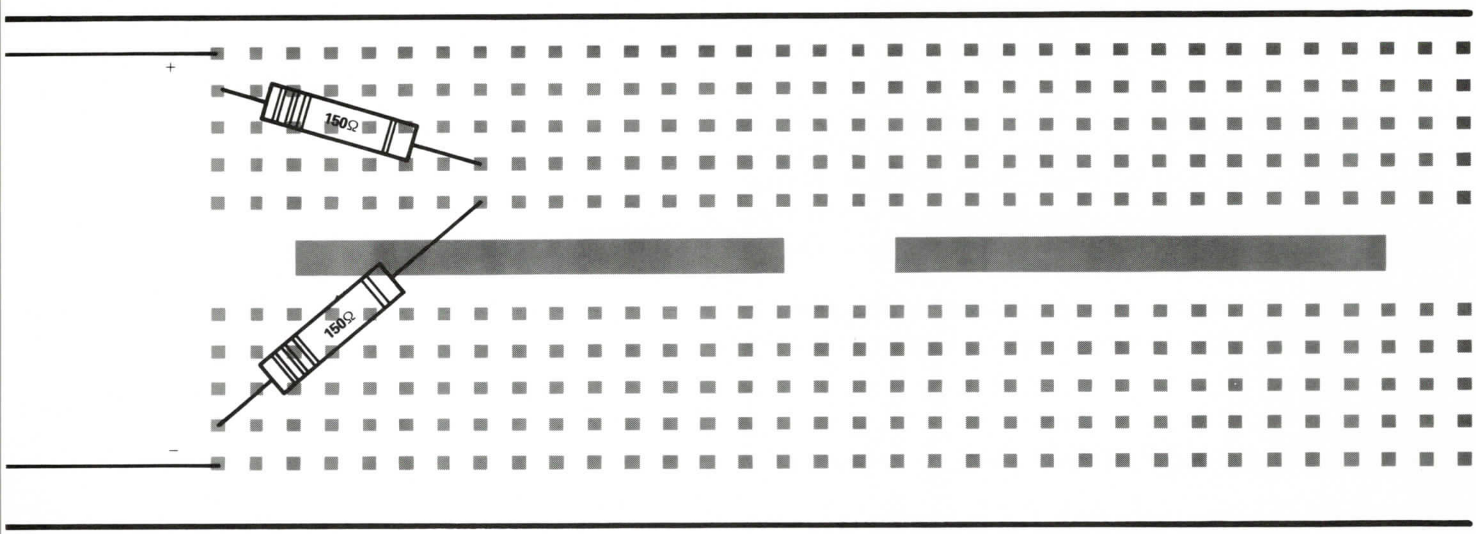

Figure 3

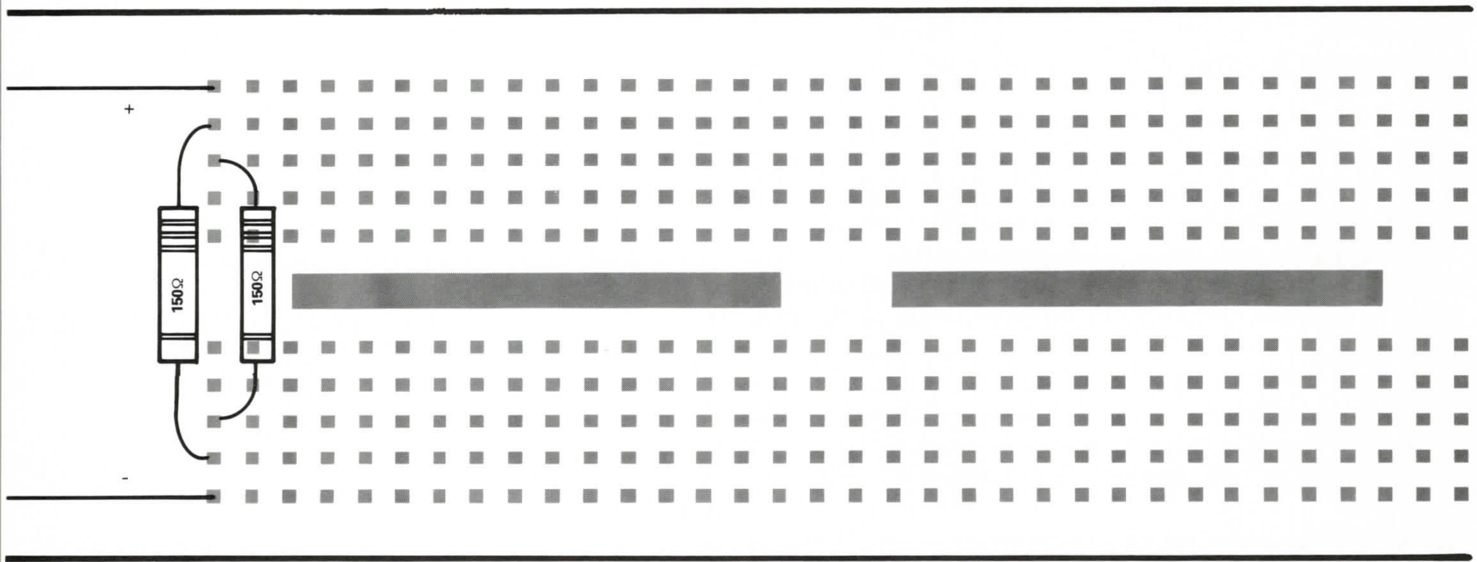

Figure 4

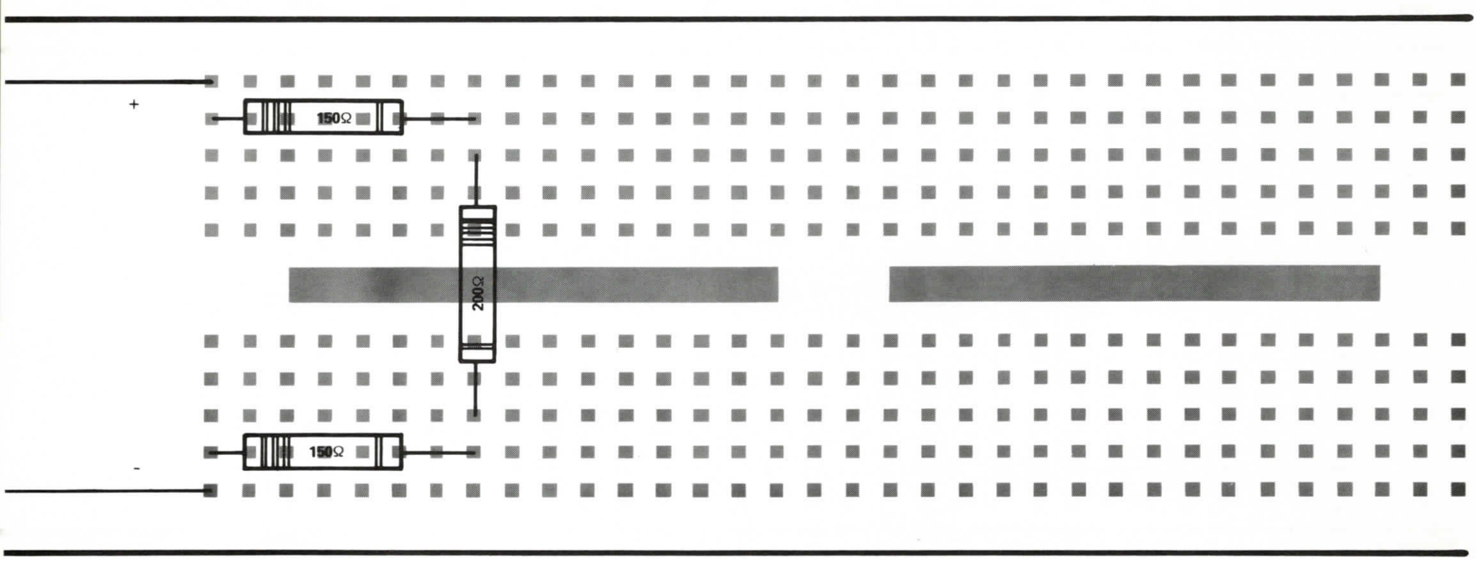

Figure 5

the voltage drop across each resistor. This time you should measure 6 volts across each resistor, and again the sum of the voltage drops is the same as the voltage supplied to the circuit.

3. Use two 150Ω resistors to construct the circuit shown in Fig. 4. Then apply 6 volts to this parallel circuit. Measure the voltage across each of the resistors and notice that the voltage drop for each resistor is the same as your supply voltage. From this example, you can see the Kirchoff's law, as it applies to the sum of voltage drops being equal to the supply voltage, does not apply to parallel circuits.

4. Use a 200Ω and two 150Ω resistors to construct the circuit shown in Fig. 5. Connect your power supply to the circuit and apply 10 volts. Now, use your voltmeter to measure the voltage drop across each resistor. Record the voltages you measure in the spaces provided to the right.

Drop across 150 resistor ______**volts**

Drop across 150 resistor ______**volts**

Drop across 200 resistor ______**volts**

Once you have all of the voltages entered, add the voltage drops you measured and compare the total to the voltage being applied to the circuit. Both should be the same--or very close.

Did you notice that the voltage drop across the 200Ω resistor has higher than the drop across the 150Ω resistors? In fact, the voltage dropped across a resistor in a series circuit is proportional to the resistance of the resistor. And the drop can be calculated without having to determine the current through the entire series string of resistors by using the following formula:

$$\text{Drop} = \text{Supply voltage} \times \frac{\text{Resistance of resistor for which you need drop}}{\text{Total resistance of the series circuit}}$$

So, for example, if a series circuit, powered by 10 volts, contained a 125Ω and two 250Ω resistors, you could find the drop across the 125Ω resistor in this manner:

$$\text{Drop} = 10 \text{ volts} \times \frac{125\Omega}{625\Omega} = 2 \text{ volts}$$

TEST QUESTIONS FROM KIRCHOFF'S LAW IN SERIES CIRCUITS

Name EUGENE M. PATE

No. 13391 Grade ______

For each of the following test questions, write your answer in the space provided to the right of the question.

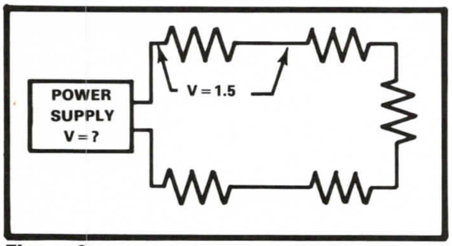

Figure 6

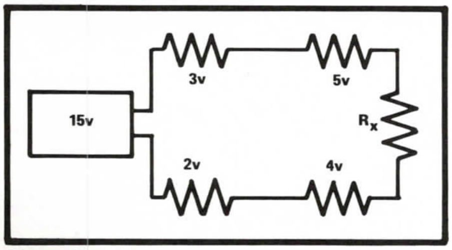

Figure 7

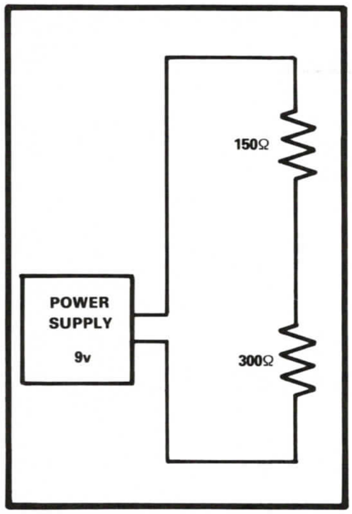

Figure 8

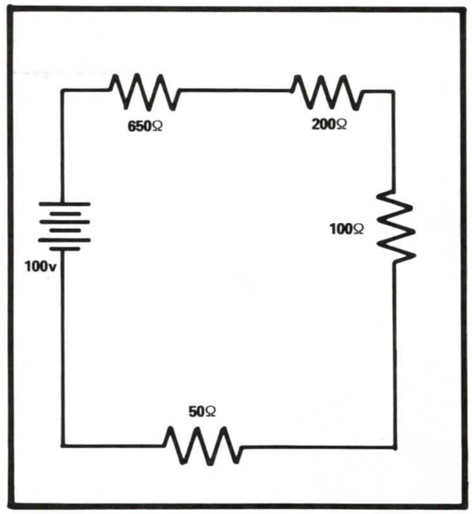

Figure 9

1. Consider that you have constructed the circuit shown in Fig. 6. There are five 2,500Ω resistors in series with a power supply. You use your voltmeter to measure the drop across one of the resistors and find that 1½ volts are dropped. In this case, what must the supply voltage to the circuit be? ______ volts

2. In the circuit shown in Fig. 7, we have not given you the value of the resistors. We have only given you the voltage drops for all but one of the resistors. The voltage supplied to the circuit is 15 volts. What must the drop across R_X be? ______ volts

3. If you were to build a circuit with three 750Ω resistors in parallel and wanted to have a five-volt potential difference across each resistor, calculate the supply voltage you would need to meet this condition. ______ volts

4. You're using resistors marked as being 150Ω and 300Ω to construct the circuit shown in Fig. 8. Then, when you measure the voltage drop across the 150Ω resistor, you find that 5 volts are present. You conclude that one of the resistors is not what its marked value indicates--its resistance is either too high or too low. If the 150Ω resistor were the cause of the problem, would it be too high a resistance or too low a resistance? Too high **(too high, too low)**

If the 300Ω resistor were causing the problem, would it be too high a resistance, or too low a resistance? Too low **(too high, too low)**

5. In the circuit shown in Fig. 9 you need to know the voltage dropped across the 650Ω resistor. Calculate the drop for this resistor assuming that the supply voltage is 100 volts. ______ volts