UNIVERSITY OF LAHORE

Department of Computer engineering

Linear Circuit Analysis Laboratory Manual 1

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Name		Roll Number	
Section		Semester	

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Experiment # 1 : Introduction

Objective

1. Understand the lab and its basics Equipment’s
2. Hands on and introduction to trainers
3. Understanding Basic Lab Equipment
4. Experiments to demonstrate different concepts , developed during First Lab

Material Required

1. Lab Manual
2. Trainers

Objective 1 : Understand the lab and its basics Equipment’s

1.Preparation for the experiment:

Before conducting the experiment, the student is required to have read the experiment background and procedure from the experiment manual and studied the related theory. The lab instructor may, during the experiment, ask students questions pertaining to the procedure and theory. The lab instructor may give negative points to and even prevent an unprepared student from conducting the experiment.

2.Laboratory teams:

The class will be divided in teams of two or three students. The composition of the teams (which students will team up) is left to the preference of the students, but the lab instructor makes the ultimate decision as to each team's composition.

3.Observations

Each lab experiment requires observations and readings to be carefully noted in the manual. The lab reports are due on the next lab meeting. Each experiment consists of Pre lab quiz, observations , reading, and Post lab quiz, or any other combination of above mentioned items. You are required to read and answer the questions in details .

Objective 2 : Hands on and introduction to trainers

We will be using IT 2000 and its modules for the lab experiment purposes in this lab . IT 2000 For Bread Board based Projects we will be using IT 100.

In next topic we will try to visualize the trainers and their different sections and thier functions

IT 2000

IT-2000 is a comprehensive and self-contained system suitable for electronic circuit experiments. All necessary equipment for electronic circuit experiments such as power supply, function generator, digital meters are installed on the main unit.

Features

- *Standard Function Generator*
- *AC/DC Power Supplies*
- *Basic Measuring Instruments I*
- *Components Required are Mounted on Modules*
- *Protection Circuits Included*

Sections

Display meters

The IT 2000 comes with built-in Voltmeter and Ammeter . The out put display is digital .

A **voltmeter** is an instrument used for measuring electrical potential difference between two points in an electric circuit. Analog voltmeters move a pointer across a scale in proportion to the voltage of the circuit; digital voltmeters give a numerical display of voltage by use of an analog to digital converter.

An **ammeter** is a measuring instrument used to measure the electric current in acircuit. Electric currents are measured in amperes (A), hence the name

Range of Voltmeter

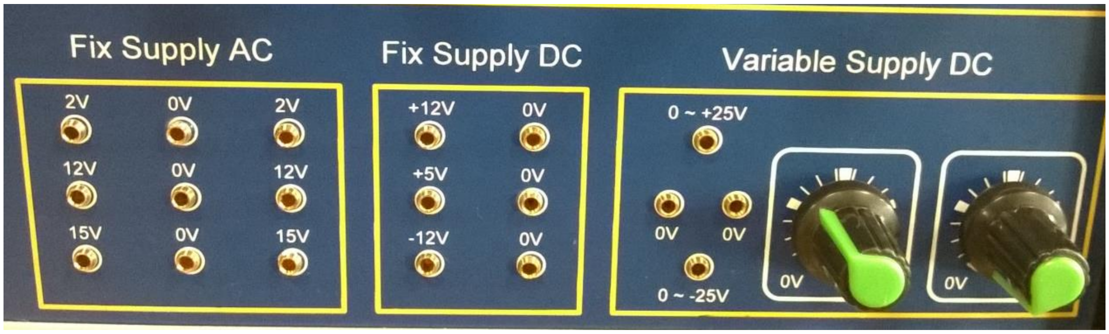
Digital voltmeter comes with different ranges. The selection of different ranges allow voltmeter to represent data in required manner and style.

The Ranges available in LAB TRAINER voltmeter are

- 0→ 200 mV
- 0→ 2 V
- 0→20 V
- 0→200 V

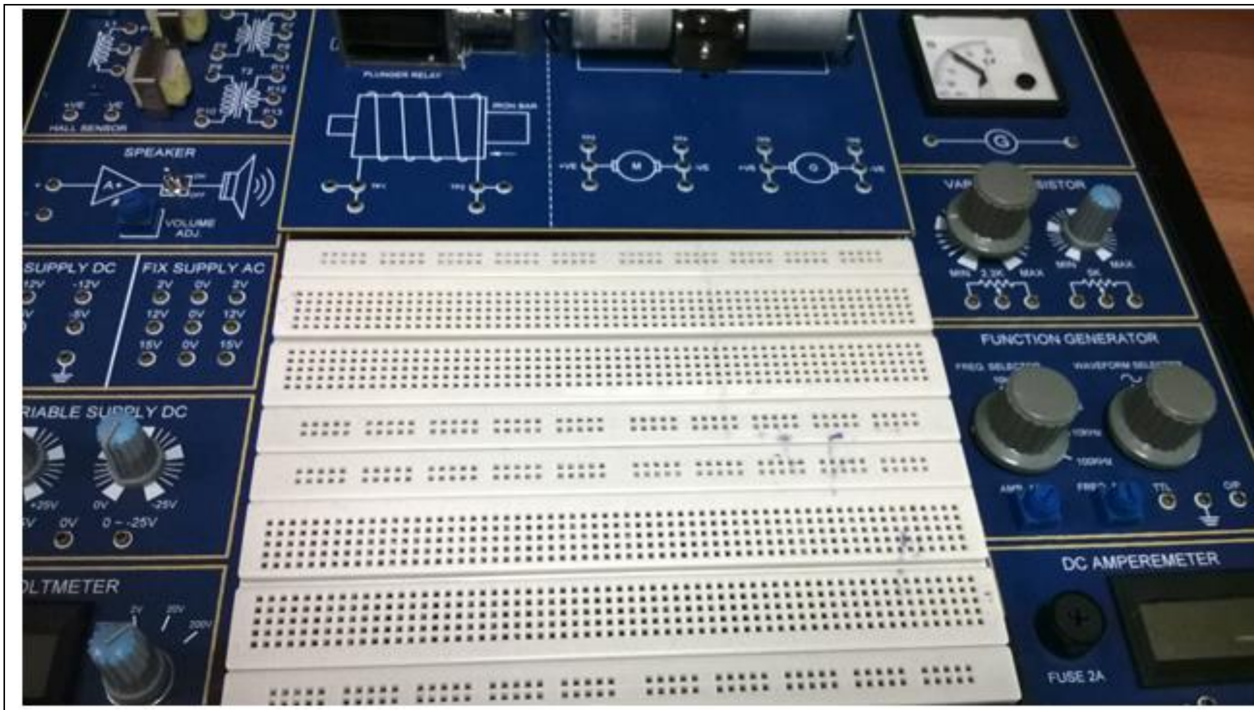
Variable and Fixed Power Supply

Power supplies are used to provide power sources for electronic components. The trainer contains both fixed AC and DC Voltage point as well as variable DC power Supply

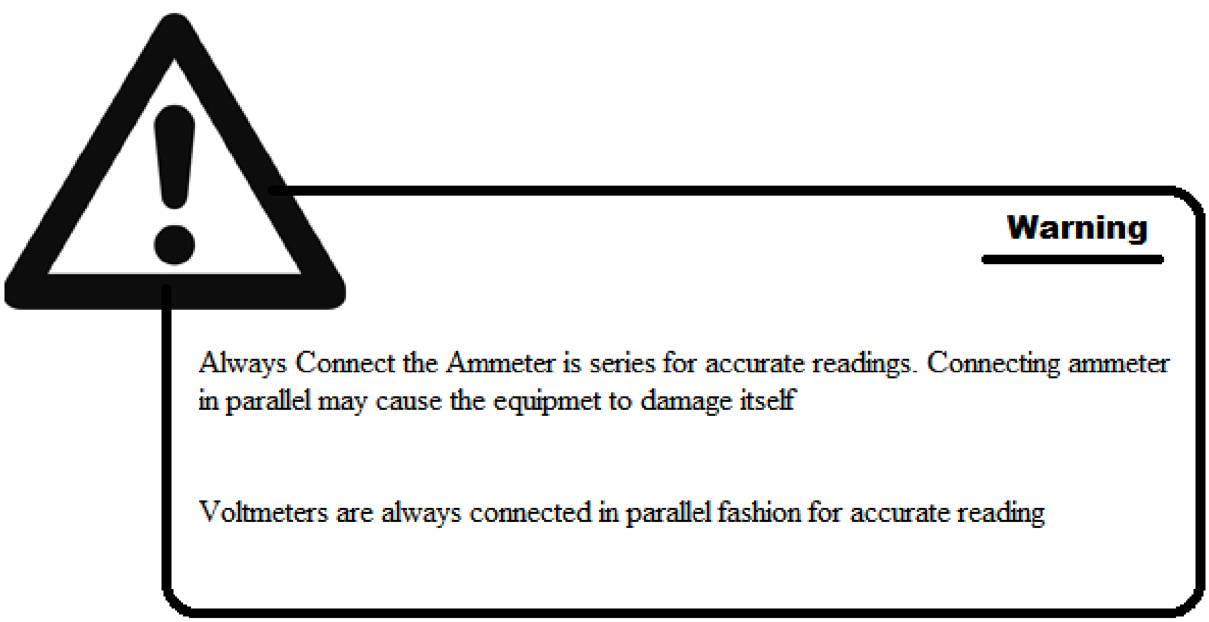


The Variable DC supply has output for both + and – supply

IT 100



IT 100 has same almost same options as IT 2000. However it comes with additional option of bread board. For bread board purposes we will be using this module

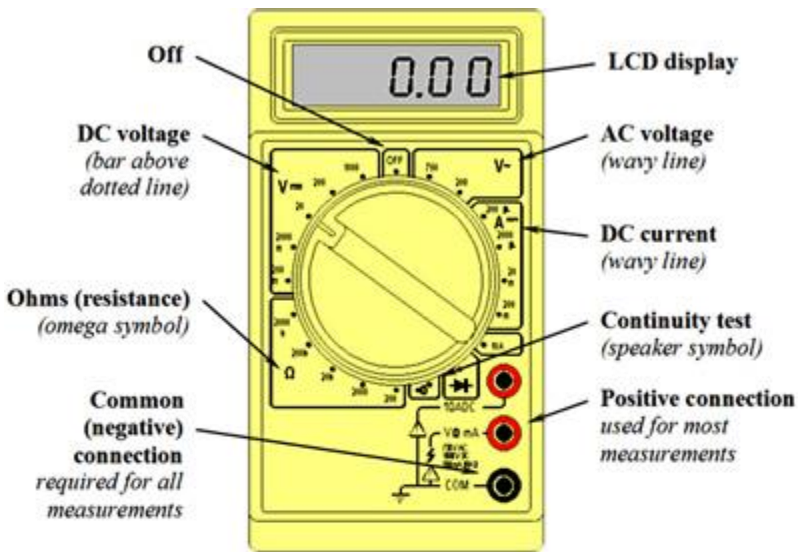


Objective 3 : Understanding Basic Lab Equipment

Multimeter

A multimeter or a multimeter, also known as a VOM (Volt-Ohm meter), is electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter would include basic features such as the ability to measuring voltage, current, and resistance. Analog multimeter use a pointer moves over a scale calibrated for all the different measurements that can be made. Digital multimeter (DMM, DVOM) display the measured value in numerals, and may also display a bar of a length proportional to the quantity being measured. Digital multimeters are now far more common than analog ones, but analog multimeter are still preferable in some cases, for example when monitoring a rapidly varying value.

The below diagram shows different features that are commonly available in a Digital multimeter



Soldering Iron

A soldering iron is a hand tool used in soldering. It supplies heat to melt the solder so that it can flow into the joint between two work pieces.

A soldering iron is composed of a heated metal tip and an insulated handle. Heating is often achieved electrically, by passing an electric current (supplied through an electrical cord or battery cables) through a resistive heating element

Objective 4 Experiments to demonstrate different concepts , developed during First Lab

TASK 1: Calculating Resistance

Most resistors have four colored bands. The first three bands indicate the nominal value of the resistor and the fourth band indicates the tolerance in value. The tolerance band is typically either gold or silver. A gold tolerance band indicates that the measured value will be within 5% of the nominal value. A silver band indicates 10% tolerance. The resistors that do not have any color band for resistance has 20 % default tolerance .

1. Provide the resistor Color Code Chart in space below

2 Your are provided with different resistors. Calculate their values using both color chart method and multimeter

Specimen	**Specimen Band Color**				**Value Calculated by Colour Code**	**Value Calculated by Multimeter**
	Band 1	**Bnad 2**	**Band 3**	**Band 4**		
Specimen 1						
Specimen 2						
Specimen 3						
Specimen 4						

TASK 2: Calculating Voltage and Current

**complete the post lab exercise , before carrying out this experiment*

Calculating the Voltage

1-Turn on the DC Power supply.

2- Connect the voltmeter with Variable DC power Supply .

4- Measure the voltage value , while you rotate the Variable supply

5- Write Down observations

Experiment # 2 : Measuring Current and Voltage and Understanding OHMS LAW

Objective

1. Understanding how ammeter and Voltmeters are used to measure vltahge and current
2. Understanding how bread board works
3. Understanding OHMs law

Material Required

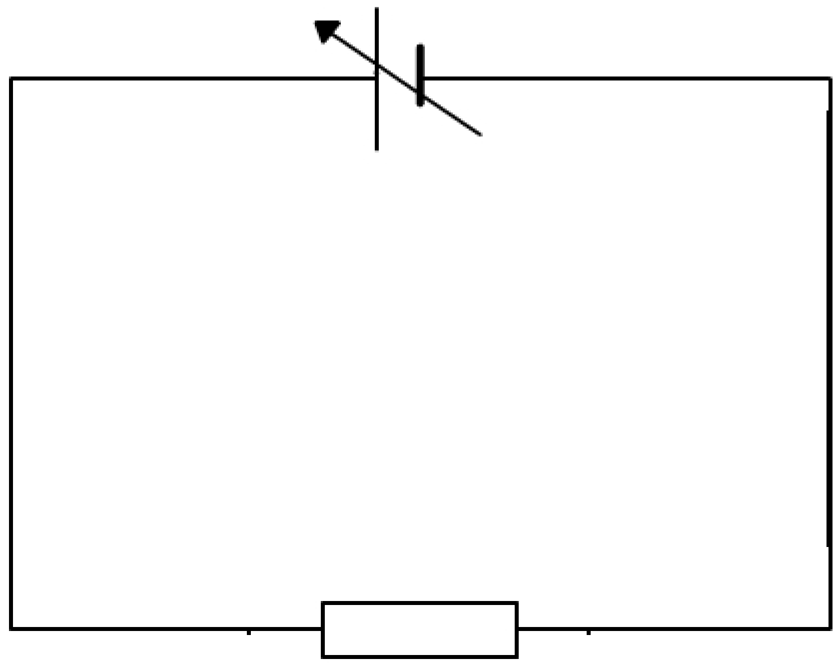
1. Lab Manual
2. Trainer IT 100
3. Resistors
4. Multimeter
5. Resistor 100Ω, 220 Ω, 1k Ω

PRE LAB EXCERCISE – Ammeter and Voltmeter

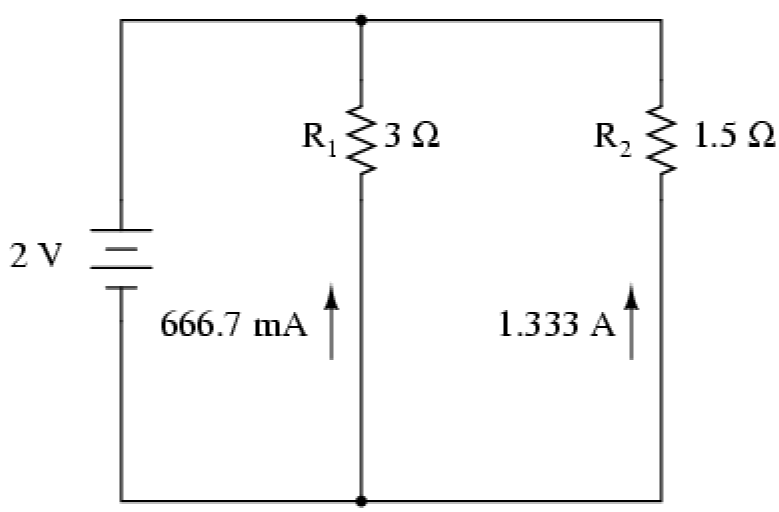
Suppose you were about to measure an unknown voltage with a manual-range voltmeter. This particular voltmeter has several different voltage measurement ranges to choose from: •500 volts • 250 volts •100 volts • 50 volts •25 volts •10 volts•5 volts.

What range would be best to begin with, when first measuring this unknown voltage with the meter? Explain your answer

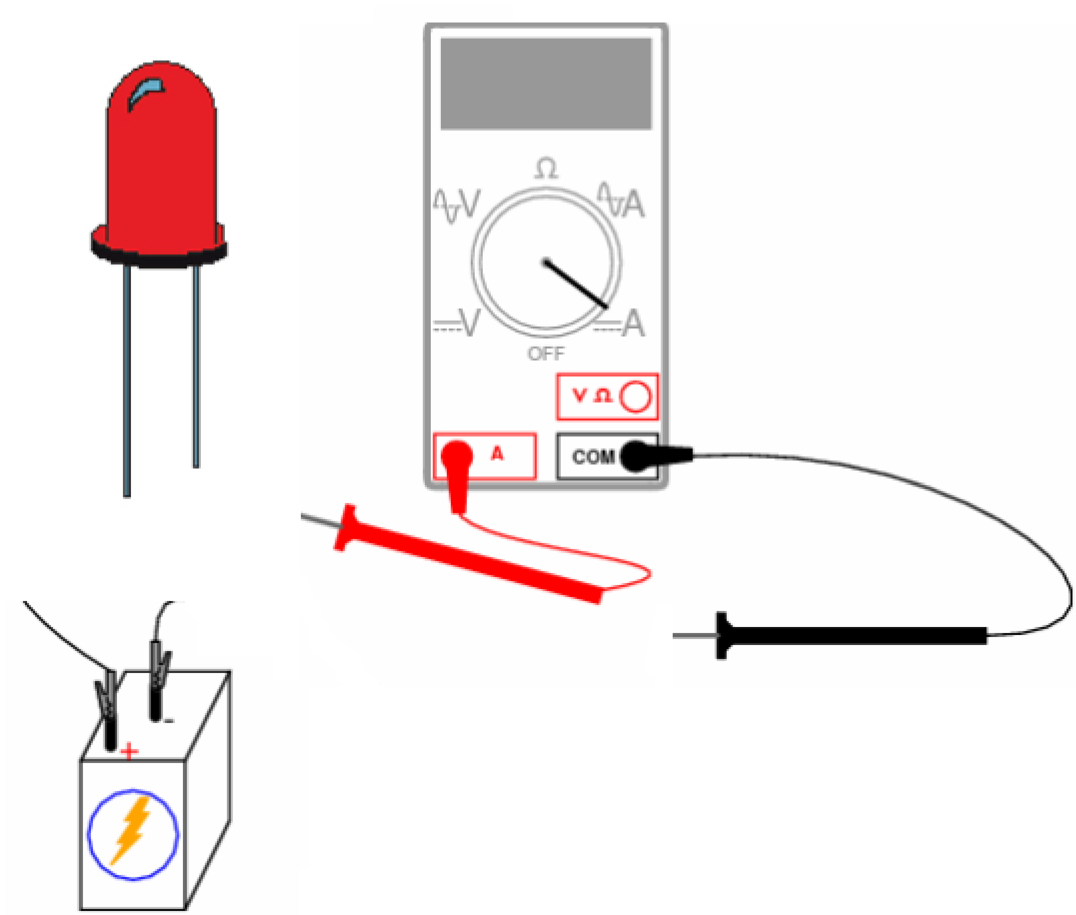
Draw voltmeter and Ammeter if we need to measure current and voltage across R



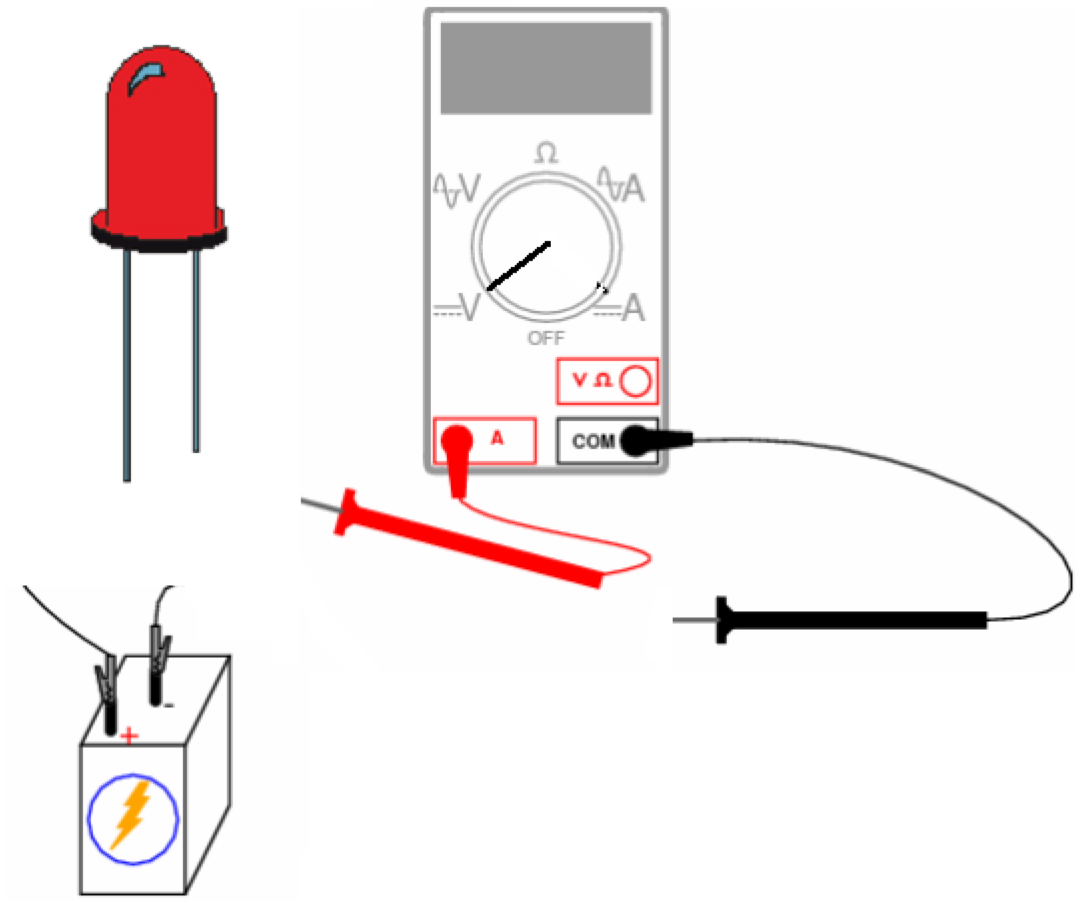
Draw voltmeter and Ammeter if we need to measure current and voltage across R2 and R1



Make connection, if current value is to be find for the following circuit



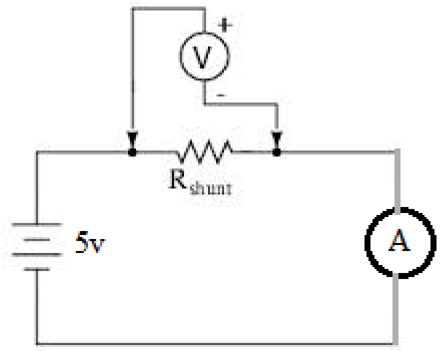
Make connection , if voltage value across led is to be find for the following circuit



TASK 1 : Implementing a circuit on bread board and Measuring Voltage and Current across it

Steps .

1. Find the value of Resistor Provided to you
2. Implement the following circuit on Bread Board



3. \
4. Fill in the table

Resistor Value	
Voltage across resistor	
Current across circuit	

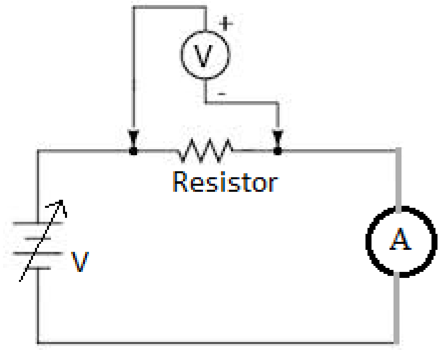
5. Now change the probes position with each other and repeat the experiment

Fill in the table

Resistor Value	
Voltage across resistor	
Current across circuit	

TASK 2 Understanding Ohms Law

1. Connect the circuit as shown in the diagram



2. Adjust the voltage of supply to be 0 Volt
3. Increase the voltage supply from 0 to 1. Note down the Current readings from ammeter
4. Similarly note down the values of Current at different voltage values

Observations

Fill the following Table

Resistance	Voltage	Current	Current (Calculated via formula)

Resistance	Voltage	Current	Current (Calculated via formula)

Resistance	Voltage	Current	Current (Calculated via formula)

GRAPH 1

GRAPH 2

GRAPH 3

Experiment # 3 : Measuring Current and Voltage in Series Circuit .

Objective

1. To understand the characteristics of the resistors in series and parallel DC Current an
2. To be able to determine the current , the total resistance and the voltage drop across in the series DC circuit

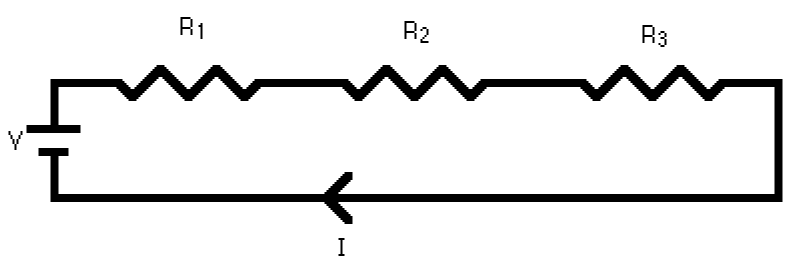
Material Required

1. Multimeter
2. Trainer
3. Resistor 100 Ohm 80 Ohm 1 K Ohm
4. Line Cords

Theory

Series circuit is a circuit in which resistors are arranged in a chain, so the current has only one path to take. The current is the same through each resistor. The total resistance of the circuit is found by simply adding up the resistance values of the individual resistors:

equivalent resistance of resistors in series : $R = R_1 + R_2 + R_3 + ...$



A series circuit is shown in the diagram above. The current flows through each resistor in turn. If the values of the three resistors are:

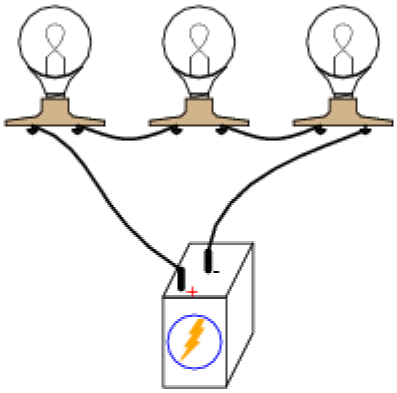
$R_1 = 8\,\Omega$, $R_2 = 8\,\Omega$, and $R_3 = 4\,\Omega$, the total resistance is $8 + 8 + 4 = 20\,\Omega$.

With a 10 V battery, by V = I R the total current in the circuit is:

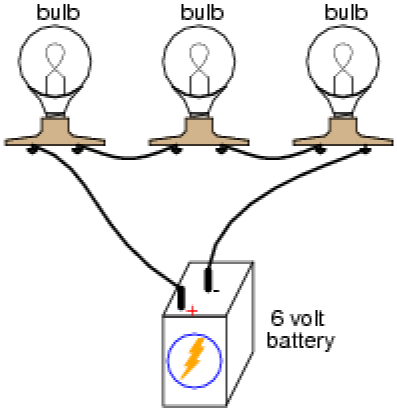
I = V / R = 10 / 20 = 0.5 A. The current through each resistor would be 0.5 A.

TASK . PRE LAB EXCERCISE

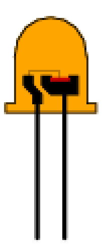
1. Re-draw this circuit in the form of a schematic diagram:



2. Qualitatively compare the voltage and current for each of the three light bulbs in this circuit (assume the three light bulbs are absolutely identical):

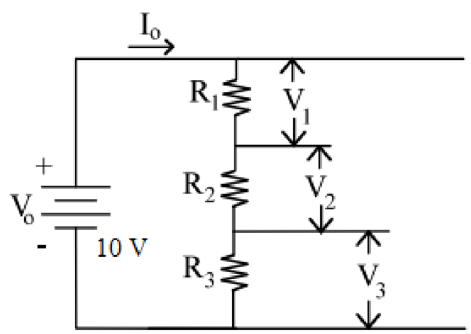


3. Light-emitting diodes, or *LED*s, are rugged and highly efficient sources of light. They are far more rugged and efficient than incandescent lamps, and they also have the ability to switch on and off much faster because there is no filament inside needing to heat or cool:

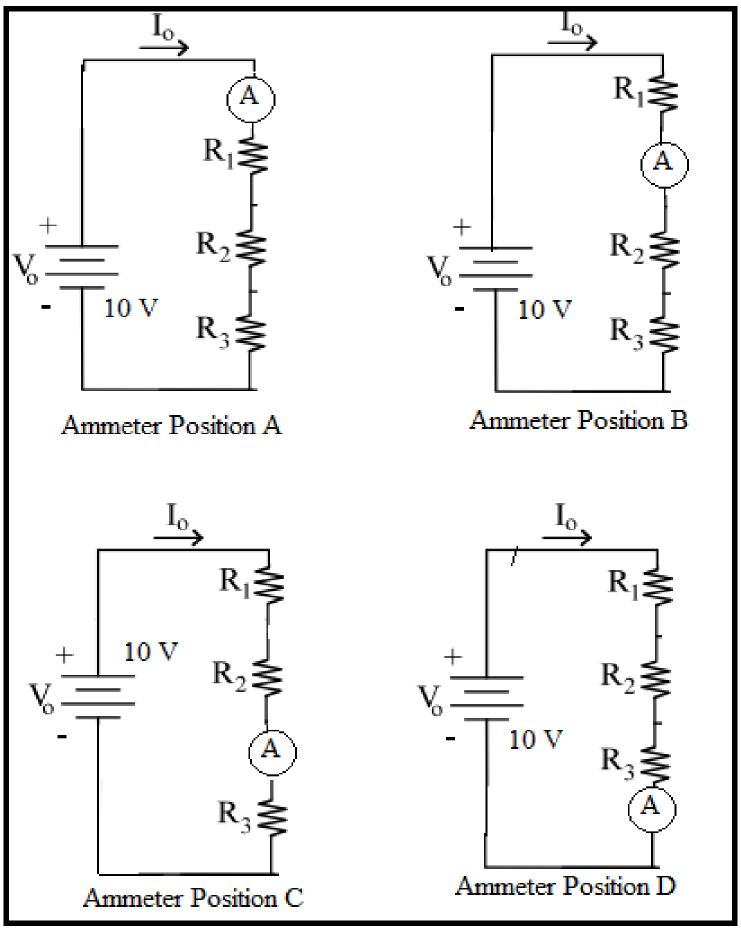
Close-up view of a light-emitting diode 	LEDs are low voltage devices, typically rated in the range of 1.5 to 2 volts DC maximum. Single diodes generally draw low currents as well, about 20 milliamps each. The problem is, how do you operate an LED from a typical electronic power source, which may output 24 volts DC or more?

TASK 1 . Observing Current In series Circuit

1. Take three resistors. Measure the resistance of each resistor individually using the ohmmeter (i.e., the multimeter).
2. Connect the circuit as shown in figure , using trainer



3. Now turn by turn , Connect the ammeter at following places , as shown in below diagrams , and record the current value



<u>**Observation**</u>

<u>**Table 1**</u>

	Calculated	**Measured**
Value of R1		
Value of R2		
Value of R3		
Total Value of R calculate by formula R total= R1+R2+R3		
Total Value of R calculate by Multimeter		

Value of Current When Ammeter is at Position	
Position A	
Position B	
Position C	
Position D	

<u>**Table 2**</u>

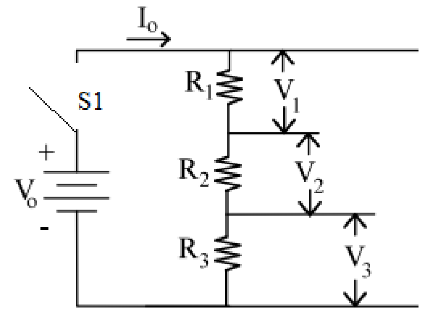
Total Resistance Total	
Total Voltage	
I total (Using Ohms Law)	

Is the value Calculated by formula and Ammeter is same

I (Calculated by Ammeter)	I (Calculated by Ohms Law)	% Error

TASK 2 A . Observing Voltage Drop in Series Circuit

Procedure



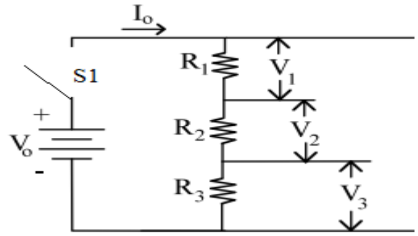
1. Set the Circuit as shown in figure . Calculate the resistance individually and then calculate the total resistance , while switch is in open state . Keep value of voltage 10 V
2. Now Calculate the value of Current , and compare it with Measured current using ammeter
3. Now Calculate the following Values, VR1, VR2,VR3, VTotal and record the values in table. And then compare the values with voltage drop calculated by formula

Resistors Values	**Calculated Value**	**Measured Values**
Value of R1		
Value of R2		
Value of R3		
Value of R total		
Error Percentage (R)		
Current Values	**Calculated Value**	**Measured Values**
Value of Current		
Error Percentage (Current)		
Voltage Values	**Calculated Value**	**Measured Values**
VR1		
VR2		
VR3		
Vtotal		
Percent Error Voltage		

TASK 2 B . Observing Voltage Drop in Series Circuit

Procedure

Repeat the same Experiment , but change the value of voltage to 5 Volts



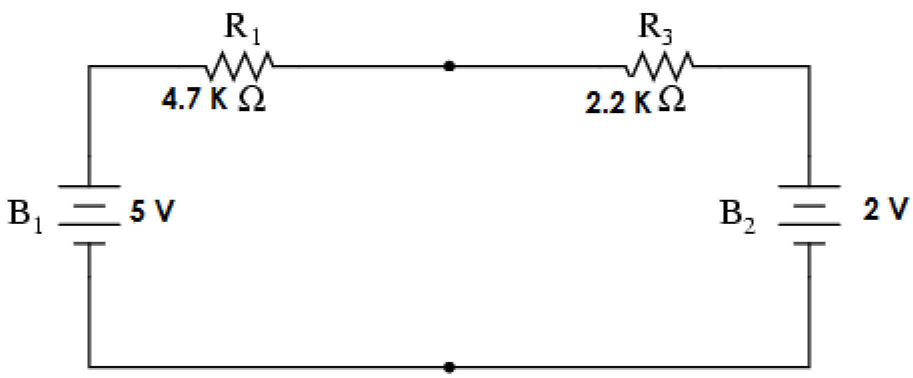
Resistors Values	**Calculated Value**	**Measured Values**
Value of R1		
Value of R2		
Value of R3		
Value of R total		
Error Percentage (R)		
Current Values	**Calculated Value**	**Measured Values**
Value of Current		
Error Percentage (Current)		
Voltage Values	**Calculated Value**	**Measured Values**
VR1		
VR2		
VR3		
Vtotal		
Percent Error Voltage		

Circuit	**Voltage Supplied**	**Voltage Dropped**	**Circuit**	**Voltage Supplied**	**Voltage Dropped**
Circuit 1			Circuit 2		

TASK 3 . Series Circuit with Multiple Sources.

Procedure

1. **Connect the following Circuit**
2. **Solve the Circuit manually and fill the table**
3. **Find The values using Multimeter**



Resistors Values	Calculated Value	Measured Values
Value of R1		
Value of R2		
Error Percentage (R)		
Current Values	**Calculated Value**	**Measured Values**
Value of Current		
Error Percentage (Current)		
Voltage Values	**Calculated Value**	**Measured Values**
VR1		
VR2		

Change the Polarity of B2 source and now calculate the values

Resistors Values	**Calculated Value**	**Measured Values**
Value of R1		
Value of R2		
Error Percentage (R)		
Current Values	**Calculated Value**	**Measured Values**
Value of Current		
Error Percentage (Current)		
Voltage Values	**Calculated Value**	**Measured Values**
VR1		
VR2		

Experiment # 4 : Measuring Current and Voltage in Parallel Circuit .

Objective

3. To understand the characteristics of the resistors in parallel DC Current an
4. To be able to determine the current , the total resistance and the voltage and current across in the Parallel DC circuit

Material Required

1. Multimeter
2. Line Cords
3. 15V DC Power Supply.
4. DMM.
5. 1 K Ohm , 2,2 K Ohm
6. 10 K ohm x3
7. 220 K ohm

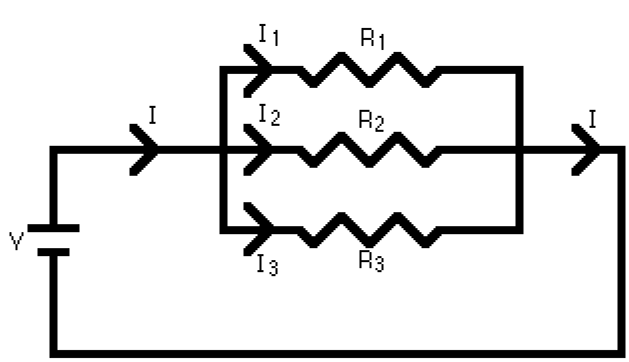
Theory

Parallel circuits

A parallel circuit is a circuit in which the resistors are arranged with their heads connected together, and their tails connected together. The current in a parallel circuit breaks up, with some flowing along each parallel branch and re-combining when the branches meet again. The voltage across each resistor in parallel is the same.

The total resistance of a set of resistors in parallel is found by adding up the reciprocals of the resistance values, and then taking the reciprocal of the total:

equivalent resistance of resistors in parallel: $1 / R = 1 / R_1 + 1 / R_2 + 1 / R_3 + ...$



A parallel circuit is shown in the diagram above. In this case the current supplied by the battery splits up, and the amount going through each resistor depends on the resistance. If the values of the three resistors are:

$R_1 = 8\,\Omega$, $R_2 = 8\,\Omega$, and $R_3 = 4\,\Omega$, the total resistance is found by:

$1 / R = 1 / 8 + 1 / 8 + 1 / 4 = 1 / 2$. This gives $R = 2\,\Omega$.

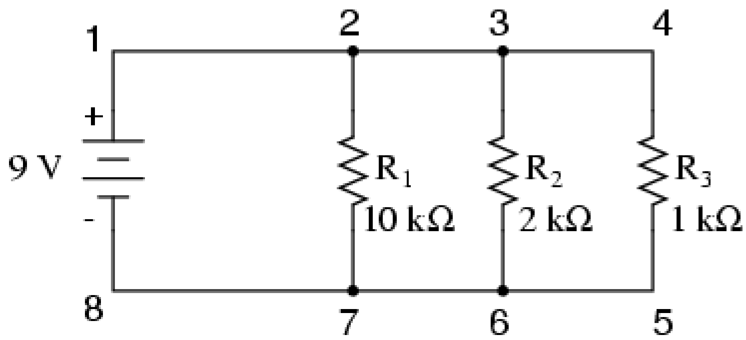
With a 10 V battery, by V = I R the total current in the circuit is: I = V / R = 10 / 2 = 5 A.

The individual currents can also be found using I = V / R. The voltage across each resistor is 10 V, so:

$I_1 = 10 / 8 = 1.25$ A
$I_2 = 10 / 8 = 1.25$ A
$I_3 = 10 / 4 = 2.5$ A

PRE LAB Exercise

Fill the table below using following diagram



	R_1	R_2	R_3	Total	
E	9	9	9	9	Volts
I					Amps
R	10k	2k	1k		Ohms

Task 1. Understanding Parallel Resistors Circuits and Using Ohms Law

1- Construct the circuit shown in Figure

2- Set the DC supply to 15V by using DMM.

3- Pick the resistances values 1KΩ, 2.2 K Ω & 10 K Ω. Also verify their resistance by using DMM.

4- Measure voltage across each resistor with DMM and record it in the Table

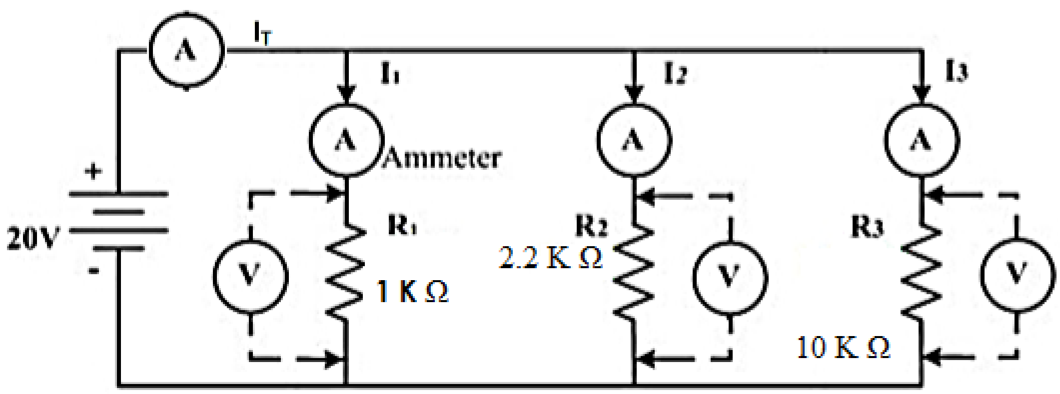
Measure the currents IT, I1, I2, I3 .

5- Shut down & disconnect the power supply. Then measure input resistance „RT‟ across Points A-B using DMM. Record that value.

6- Now calculate respective voltages (using V=IR) and RT (using equivalent resistance Formula).

7- Calculate I1, I2 , I3

8- Create an open circuit by removing R2 and measure all voltages and currents.



OBSERVATION:

a) Resistors:

S No.	Nominal Values (Ω)	Measured Value (kΩ)	R_T (Measured) (kΩ)	R_T (Calculated) kΩ
1.	R1			
2.	R_2			
3.	R_3 =			

b) Voltages:

S No.		Measured Value (V)	Measured Value (V) when R_2 Open Circuited	Calculated Value (V) (Ohm's Law)
1.	V_1			
2.	V_2			
3.	V_3			

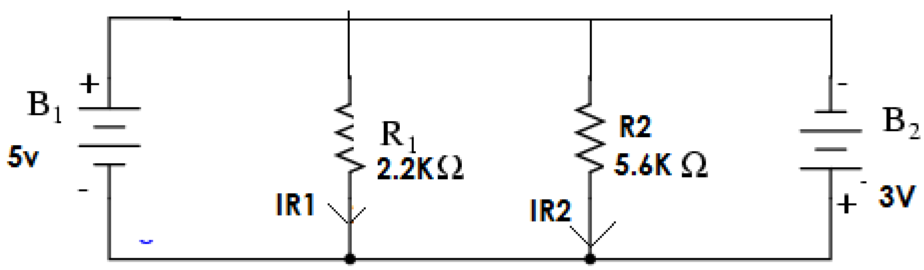
c) Current:

S.No	Measured Value (mA)	Measured Value (mA) When R2 is Open Circuited	Calculated Value (mA) Using CDR
1.	I_1=	I_1=	I_1=
2.	I_2=	I_2=	I_2=
3.	I_3=	I_3=	I_3=
4.	I_T=	I_T=	I_T=

TASK 2- A . Parallel Circuit with Multiple Sources.

Procedure

1. **Connect the following Circuit**
2. **Solve the Circuit manually and fill the table**
3. **Find The values using multimeter**



Resistors Values	**Calculated Value**	**Measured Values**
Value of R1		
Value of R2		
Error Percentage (R)		
Current Values	**Calculated Value**	**Measured Values**
Value of Current IR1		
Value of Current IR2		
Total Current		
Error Percentage (Current)		
Voltage Values	**Calculated Value**	**Measured Values**
VR1		
VR2		

TASK 2- B . Parallel Circuit with Multiple Sources.

Repeat the same above experiment , however change the polarity of B2

Resistors Values	**Calculated Value**	**Measured Values**
Value of R1		
Value of R2		
Error Percentage (R)		
Current Values	**Calculated Value**	**Measured Values**
Value of Current IR1		
Value of Current IR2		
Total Current		
Error Percentage (Current)		
Voltage Values	**Calculated Value**	**Measured Values**
VR1		
VR2		

OBSERVATION SHEET

Series and Parallel Circuits

When two or more devices are connected to a battery in a circuit, there are a couple of methods by which they can be connected. One method is called a series connection and the other method is called a parallel connection. In a series circuit, such as that shown in Figure 1, all the devices are connected such that charge passes through each device in a consecutive fashion. When devices are connected in parallel, such as Bulbs 1, 2 and 3 shown in Figure 2, charge comes to a branching location. At the branching location, the charge divides into multiple pathways, passing through only one of the branches. Any charge that passes through Bulb 1, will not pass through Bulb 2 or Bulb 3.

Figure 1

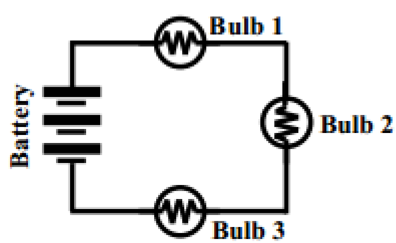
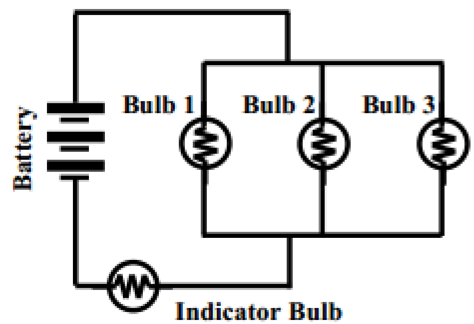


Figure 2



A group of physics students conducted the following experiments in order to compare and contrast the characteristics of series and parallel circuit connections. In their experiments, light bulbs are used to indicate the amount of current (rate of charge flow) at each location. The brightness of the bulbs is proportional to the amount of current.

Experiment 1

Students constructed a series circuit consisting of a battery and three identical light bulbs as shown in Figure 1. All the bulbs are lit. They then unscrew Bulb 1 from its socket; they observe that Bulb 2 and Bulb 3 are no longer lit. They then unscrew Bulb 3; they observe that Bulb 1 and Bulb 2 are no longer lit

Experiment 2

Using the circuit in Figure 1, students observe that the brightness of all three bulbs is identical. The students remove Bulb 3 from the circuit. They then re-wire the circuit so that it includes only two bulbs. They observe the brightness of the remaining bulbs are equal, but brighter than when there were three. They then remove a second bulb so that there is only bulb in the circuit. They observe that the bulb is brighter than when present in the 2-bulb and the 3-bulb circuit.

Experiment 3

The students construct the circuit shown in Figure 2. Three identical bulbs - 1, 2, and 3 – are wired in parallel.A fourth bulb (a different type than bulbs 1, 2 and 3) is added outside the branches to serve as an indicator of the amount of current in the entire circuit. All the branch bulbs are lit and the students observe that their brightness is the same. The Indicator Bulb is lit as well; it is brighter than the branched bulbs. The students then unscrew bulb 1 from its socket. They observe that Bulb 2 and Bulb 3 remain lit; the Indicator Bulb becomes dimmer than it was when all three bulbs were present. Then the students unscrew both Bulb 1 and Bulb 2 from their sockets. They observe that Bulb 3 remains lit. They also observe that the Indicator Bulb is dimmer than it was with two and with three branched bulbs.

Questions

1. In which type of circuit does charge flow through every light bulb in the circuit?

a. Series Circuits
b. Parallel Circuits
c. Both Series and Parallel Circuits
d. Neither Series and Parallel Circuits

2. Which type of circuit is characterized by the presence of branch locations?

a. Series Circuits
b. Parallel Circuits
c. Both Series and Parallel Circuits
d. Neither Series and Parallel Circuits

3. Which one of the following conclusions is NOT consistent with the findings of Experiment 1 and Experiment 2?

a. Increasing the number of bulbs in a series circuit will decrease the current.

b. Identical bulbs in a series circuit will be equally bright regardless of their location.

c. If the last bulb in the series breaks down, the bulbs that come before it can still remain lit.

d. The brightness of bulbs in a series circuit is inversely proportional to the number of bulbs.

4. Which of the following conclusions is NOT supported by the findings of Experiment 2?

a. When there are more bulbs in a series circuit, the current is less.

b. Adding more bulbs to a series circuit causes each bulb to become dimmer.

c. The current in a series circuit is affected by the number of bulbs in the circuit.

d. Bulbs that are closer to the battery are brighter than bulbs that are further from the battery.

5. Which statement most accurately describes the purpose of Experiment 2?

a. To determine how many different bulbs the battery could push charge through.

b. To determine if all branched bulbs must be lit in order for any of them to be lit.

c. To determine how decreasing the number of light bulbs effects the amount of current.

d. To determine if unscrewing any bulb would interrupt the change flow and cause the other bulbs to not light.

6. The rate at which charge flows through a series circuit is inversely proportional to the amount of overall resistance in the circuit. Based on the results in Experiment 2, which one of the following series circuits has the greatest resistance?

a. A 1-bulb series circuit.

b. A 2-bulb series circuit.

c. A 3-bulb series circuit.

d. The resistance would be independent of the number of light bulbs.

7. The rate at which charge flows through a series circuit is inversely proportional to the amount of overall resistance in the circuit. Based on the results in Experiment 2, which one of the following rules accurately describes the effect of the number of bulbs upon overall current and overall resistance?

a. Increasing the number of bulbs will cause both the current and the resistance to increase.

b. Increasing the number of bulbs will cause both the current and the resistance to decrease.

c. Increasing the number of bulbs will cause the current to increase and the resistance to decrease.

d. Increasing the number of bulbs will cause the current to decrease and the resistance to increase.

8. What was the role of the Indicator Bulb in Experiment 3?

a. It indicated whether the circuit was a series or a parallel circuit.

b. It was included so that there would be at least one bulb in seires.

c. It brightness indicated the rate of charge flow within the circuit as a whole.

d. Its presence allowed the students to control the amount of current in the branches.

9. The overall rate at which charge flows through a parallel circuit is inversely proportional to the amount of overall resistance in the circuit. Based on the results in Experiment 3, which one of the following parallel circuits has the greatest resistance?

a. A 1-bulb parallel circuit.

b. A 2-bulb parallel circuit.

c. A 3-bulb parallel circuit.

d. The resistance would be independent of the number of light bulbs.

10. Which one of the following statements does NOT describe a difference between the findings of Experiments 1 and 2 and the findings of Experiment 3?

a. In series, adding more light bulbs decreases the current; it is just the opposite for parallel.

b. In series, when one bulb burns out, the other bulbs do not work; it is just the opposite for parallel.

c. In series, a decrease in the number of bulbs increases the current; it is just the opposite for parallel.

d. In series, the bulb closest to the battery lights the brightest; they have equal brightness when in parallel.

1I. Rooms in homes and businesses are wired such that one device in a circuit can be OFF or even broken, but the other devices will still work. How are such devices wired - in series or in parallel - and how do you know?

Experiment # 6 : Observing Open and Short Circuits, along with power absorbed and Supplied (Series)

Objective

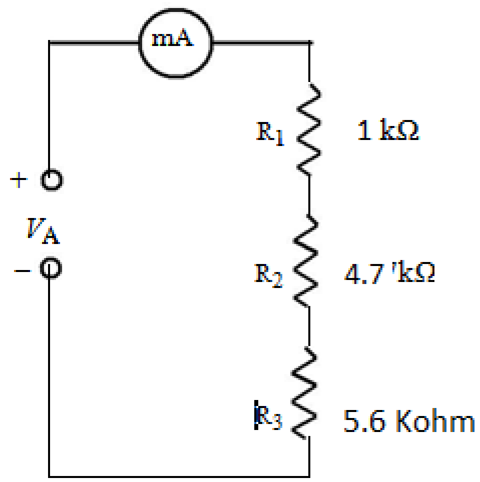
1. To demonstrate that power distribution in a series circuit is directly related to the distribution of resistance
2. To provide experience with the change that occurs when an open develops in a series circuit.
3. To prove that the applied voltage appears across the open portion of a series circuit.
4. To verify that the total power equals the sum of all the individual power dissipations.
5. To provide experience with the changes (current , voltage) that occur when a short develops in a series circuit.
6. To verify that the power dissipation in a parallel branch is inverse to that branch's resistance value.
7. To verify that total power in a parallel circuit is equal to the sum of all the individual branch power dissipations.
8. To provide experience with the change that occurs when an open develops in a parallel circuit.
9. To provide experience with the change that occurs when an short develops in a parallel circuit.

Material Required

1. Electronics Trainer
2. Digital multi-meter
3. Resistors: 1kΩ, 4.7 kΩ & 5.6. kΩ

TASK 1: Power In Resistors

1. Connect the initial circuit as shown in Figure



2. Apply 20 volts (VA) to the circuit. Measure each of the individual voltage drops and the current, and then calculate the power dissipated by each resistor.

QUANTITY	**VALUE**
RV1	
RV2	
RV3	
Total Current	
P1	
P2	
P3	

Since the current is the same through all the resistors, the power dissipated by each resistor is directly related to its __________________________.

a.) power rating b.) physical size c.) composition d.) resistance

The resistor with the largest value R will dissipate the ____________________ power.

a.) most b.) least

The resistor with the smallest value R will dissipate the ____________________ power.

a.) most b.) least

Record the sum of all the individual resistor power dissipations.

P1 + P2 + P3 = ____________________.

Calculate the total power by using the formula: PT = VT x IT

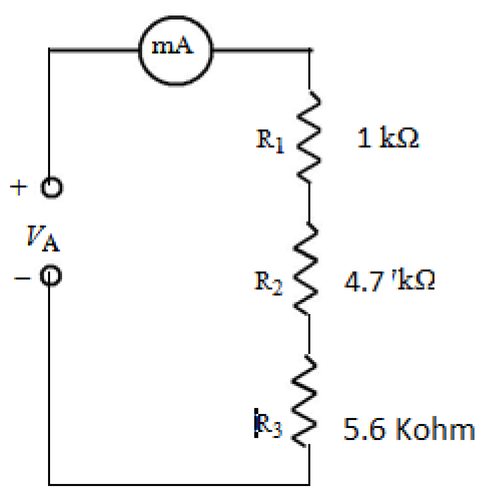
PT = VT x IT = ____________________.

The percentage of power between two resistors in a series circuit is the same as the percentage of ______________________ between the same two resistors.

When the applied voltage was decreased to half its original value, current decreased to ________________ its original value and the total power dissipated in the circuit decreased to ________________ its original value. The power dissipated by each resistor also decreased ____________its original value.

TASK 2: Detecting Open Series Circuits

1. Connect the initial circuit as shown in Figure below



2. Adjust the VA to 20 volts. Measure and record the current and individual voltage drops.

IT = ____________________________

RV1 = ___________________________

RV2 = ___________________________

RV3 = ___________________________

3.Simulate an open circuit by removing R2 and leave the circuit open between R1 and R3. Measure and record the current and individual voltage drops.

IT = ____________________________

V1 = ___________________________

V2 (across open) = __________________

V3 = ___________________________

Since there is only one path for current to flow in a series circuit, creating an open within the series circuit will cause ___________________________.

a.) continuity b.) discontinuity

The total resistance of the circuit then appears to be infinitely ________________________.

a.) high b.) low

The voltage drop across R1 and R3 were __________ volts because, with zero current, the I x R must equal __________.

If any part of a series circuit opens, RT will (increase, decrease) _________________to _______________________ and IT will (increase, decrease) ______________________ to _______________________. The voltage drops across the unopened resistors will (increase, decrease) _______________________ to _______________________ and the voltage across the open resistor will (increase, decrease) _______________________ to_______________________.

4.Predict the results if R3 were to be removed from the circuit instead of R2.

IT = _____________________________

RV1 = ____________________________

RV2 = ____________________________

RV3 = ____________________________

Replace back R2 and remove R3 as suggested in step 4. Make the following measurements and record the results below.

IT = _____________________________

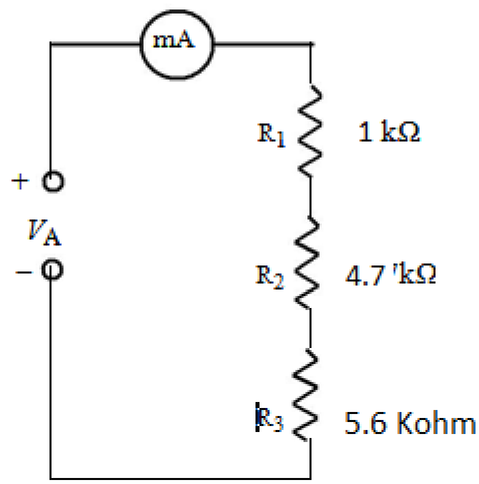
RV1 = ____________________________

RV2 = ____________________________

RV3 (across open) = ___________________

TASK 3: Detecting Short Series Circuit

1. Connect the initial circuit as shown in Figure



2.Adjust the VA to 20 volts. Measure and record the current individual voltage drops.

IT = ____________________________

RV1 = ___________________________

RV2 = ___________________________

RV3 = ___________________________

3.Simulate a resistor "shorting out" by removing R3 and replacing it with a jumper wire. Measure and record the circuit current and individual voltage drops.

IT = ____________________________

RV1 = ____________________________

RV2 = ___________________________

RV3 (across short) = __________________

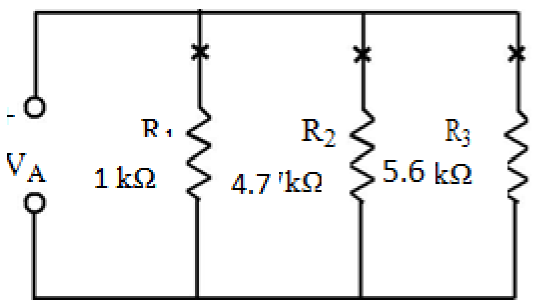
Shorting out R3 caused the circuit RT to (increase, decrease)____________ to ______________ ohms. This caused IT to (increase, decrease) ___________________.The new current value caused the voltage drops across the unshorted resistors in the circuit to (increase, decrease) ________________________. The resistance of the simulated short (jumper wire) is essentially ______________ ohms. Therefore, since V = I x R, the voltage drop across the shorted resistor of a series circuit will essentially equal ______________. We can conclude that if there is a short in any part of a series circuit, the RT will (increase, decrease) ______________________; IT will (increase, decrease) _____________________; the voltage drop across the unsorted R will (increase, decrease) _____________________; and the voltage across the shorted R will (increase, decrease) _______________________; to _____________.

Experiment # 6-B : Observing Open and Short Circuits, along with power absorbed and Supplied (Parallel)

Material Required

4. Electronics Trainer
5. Digital multi-meter
6. Resistors: 1kΩ, 4.7 kΩ & 5.6. kΩ

TASK 1: Observing Power in Parallel Circuits



1. Set the above circuit .

2. Set the voltage to 20 DC

3. Using a Ammeter measure I1 , I2 , I3 and It

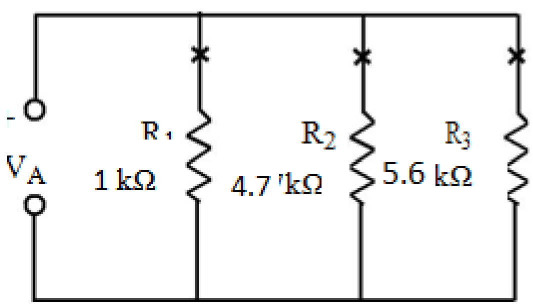
Voltage Across R1	
Current Across Branch 1	
Voltage Across R2	
Current Across Branch 2	
Voltage Across R3	
Current Across Branch 3	
Power Across R1	
Power Across R2	
Power Across R3	
Total Current	
Total Voltage	
Total Power	

Does $P_1 + P_2 + P_3$ equal the answer given for P_T

Which resistor dissipates the most power? ________________________ Is this the largest or the smallest value resistor in the circuit? ________________________

Which resistor dissipates the least power? ________________________ Is this the largest or the smallest value resistor in the circuit? ________________________

TASK 2: Detecting an Open in Parallel Circuit



1. Connect the circuit as shown in Figure

2. Apply 20 volts to the circuit. Measure the total circuit current and the individual branch currents. Calculate RT.

IT = ______________________________.

RT = ______________________________.

I1 = ______________________________.

I2 = ______________________________.

I3 = _____________________________.

The total resistance is less than the _______________________ value resistance branch.

a.) highest b.) lowest c.) both a & b

The total circuit current is equal to the _______________________ of the branch currents.

.Remove resistor R1 to simulate an open in that particular branch. Keep the applied voltage at 20 volts and measure the total circuit current and the individual branch currents. Calculate RT.

IT = ___________________________. I2 = __________________________.

RT = __________________________. I3 = __________________________.

I1 = ___________________________.

If any branch of a parallel circuit becomes open, RT will ___________________. Therefore, since the voltage remained the same, IT will ___________________.

Did the current through R2 and R3 change when R1 became open? ____________________

RT increased because when R1 became open there was one less _________________ path. The current through the open branch decreased to _________________ mA.

When R1 became open, what happened to the current through the unopened branches?

Did the voltage across all the branches change when R1 became open? ________________

Using the normal circuit condition values in calculate each branch power dissipation and the total circuit power dissipation.

PT = ____________________________ P2 = ____________________________

P1 = ____________________________ P3 = ____________________________

Calculate each branch power dissipation and the total circuit power dissipation using the values when R1 was open

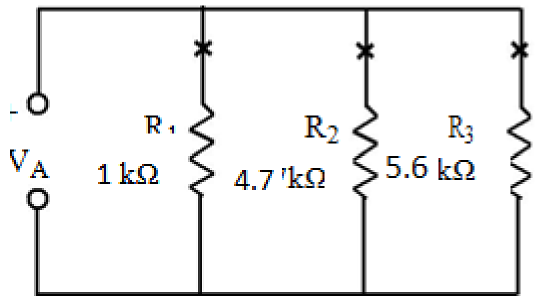
PT = ____________________________ P2 = ____________________________

P1 = ____________________________ P3 = ____________________________

When one branch of a parallel circuit becomes open, is the power dissipated by the other

branches affected? ______________________. Is PT affected? _____________________

TASK 3 : Detecting an Short in Parallel Circuit



1. Connect the circuit as shown in Figure

2. Using an ohmmeter, measure between points A and B to find the total resistance of the circuit. Remember, there is to be no power applied to the circuit when making resistance measurements

RT = __________________________.

3. Simulate R1 becoming shorted by removing it and replacing it with a jumper wire. Measure the new RT and record the result below.

New RT = __________________________.

When a branch of a parallel circuit is shorted, RT (increases, decreases) _________________

.Without connecting the power supply, assume there is 15v applied between points A and B. How much current would be going through R2? ___________________. How much current would be going through R3? ___________________. With the assumed 15v applied, what would the voltage reading be across R2? _____________Across R3? _____________.

Verify Your results by Filling the following table

RT=________________________________

Current in Brach 1 =___________________

Current in branch 2 =___________________

Experiment # 7 : Analysis of Resistance, Current Voltage of Series Parallel Combination Circuits

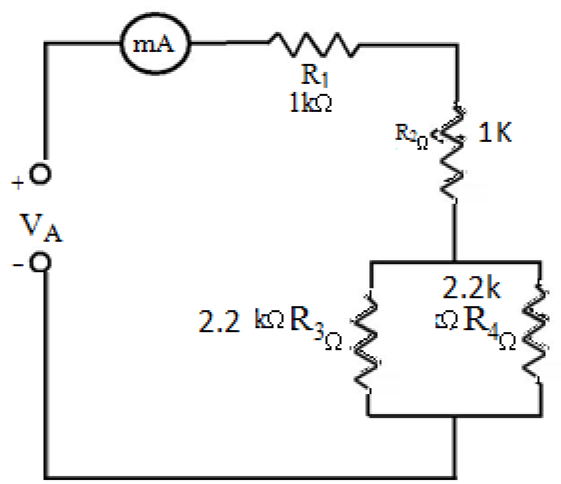
Objective

1. To verify series and parallel resistance rules as they apply to series-parallel combination circuits
2. To better understand the characteristics of current flow in series-parallel combination circuits by combining both the series and parallel circuit analysis methods

Material Required

3. Resistors:
4. Multimeter
5. Resistors: 1kΩ, 2.2kΩ, 4.7K Ω

TASK 1: Resistance in Series Parallel Resistors



1. Connect the circuit as shown in figure 1

2. Calculate the total circuit resistance from the resistor values given.

3. Apply enough voltage to obtain a total circuit current of 1.0mA. Measure and record the following voltages.

Total resistance	
Voltage value , when current becomes 1 m Ampere	
V1	
V2	
V3	
V4	

Since the applied voltage is ___________________ V and the total circuit current is

___________________ mA, then according to Ohm's Law the total resistance must be

___________________ Ω. Is this close to the result in step 1? __________________

Which resistors in this circuit are in parallel?

____________________ ___________________ ______________

Voltage in parallel resistor 1	
Voltage across parallel resistor 2	
Current in parallel resistor 1	
Voltage in parallel resistor 2	
Total Current	

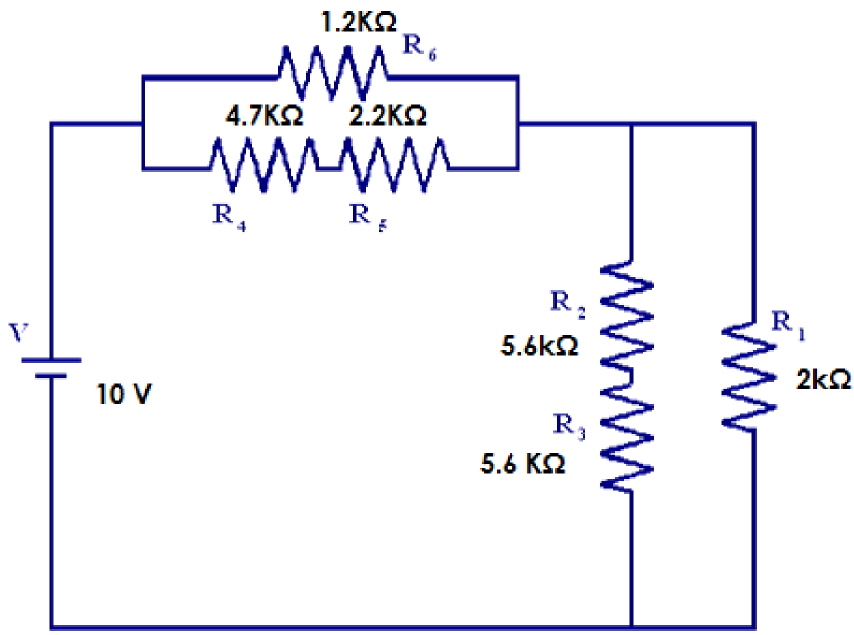
Which resistors in this circuit are in series?

____________________ ___________________ ______________

- Current in branch R1 ___________________________

- Current in Branch R 2 ____________________________

Task 2 : Calculating Total Resistance , Current and Voltage in Series parallel Circuit

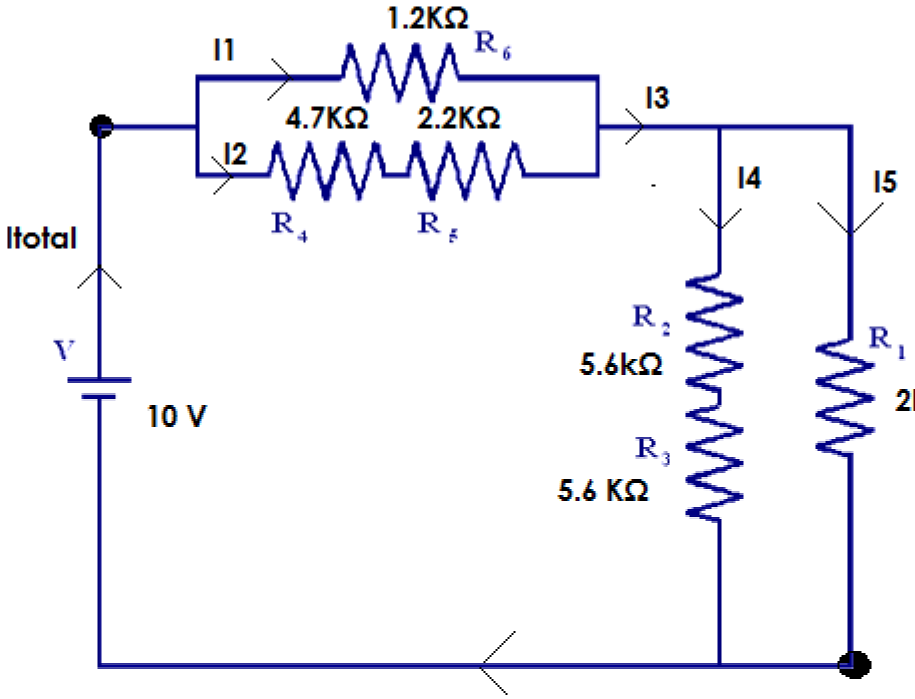


Fill in the table

Resistor	Color Code Value	Value Calculated by Ohm meter
R1		
R2		
R3		
R4		
R5		
R6		

Find The total resistance as Calculated by the formula

Find the total Resistance as Calculated By Multimeter



For the Circuit given above , Fill the following table

Branch	**Value Calculated By Formula**	**Value Calculated by Ammeter**
I1		
I2		
I3		
I4		
I5		
Itotal		

For the Circuit given above , Fill the following table

Voltage Across	**Value Calculated By Formula**	**Value Calculated by Voltmeter**
R1		
R2		
R3		
R4		
R5		
R6		