Title : Familiarizing with the basic DC circuit terms & concepts. Introduction to Laboratory Equipment.

Abstract:
In this experiment the basic equipment like resistors, trainer board, multi meter etc. was observed and their operation were studied. Also some basic laws like Ohm's law, the definition of voltage and current were studied and their operation was verified with the basic equipment.

Introduction:

The main objective of this experiment was to verify the ohms law. In doing so, followings were performed:

a) To design an electrical circuit with relevant parameters and sources.

b) To set up the circuit with appropriate connections, sources, and instruments.

c) To compare the measured value with the theoretical estimated value.

d) To find the reason for error in result, and to draw conclusion on how to overcome.

Theory and Methodology:

Ohm's Law: Ohm's Law deals with the relationship between voltage and current in an ideal conductor. This relationship states that:

At fixed temperature in an electrical circuit, the current passing through a conductor between two points is proportional to the potential difference (i.e. voltage drop or voltage) across the two points, and inversely proportional to the resistance between them. In mathematical terms, ths is written as:

$$V = IR$$

Where I is the current in amperes, V is the potential difference in volts and R is a constant measured in ohm's, called the resistor. The potential difference is also known as the voltage drop and is sometime denoted by E or U instead of V.

Current: The amount of electric current through some surface, a section through a copper conductor, is defined as the amount of electric charge flowing through that

surface over time. If Q is the amount of charge that passed through the surface in the time T, then the average current I is :

$$I=Q/T$$

Voltage: Voltage is the difference of electrical potential between two points of an electrical or electronics circuit, express in volts. It measures the potential energy of an electric field to cause an electric current in an electrical conductor. Depending on the difference of electrical potential it is called extra low voltage, low voltage, high voltage, extra high voltage.

Ammeter: Ammeter is a device that is used to measure the current level of the circuit.

Voltmeter: Voltmeter is a device that is used to measure the voltage difference between two points. The potential difference can be measured by simply connecting the leads of the across the two points.

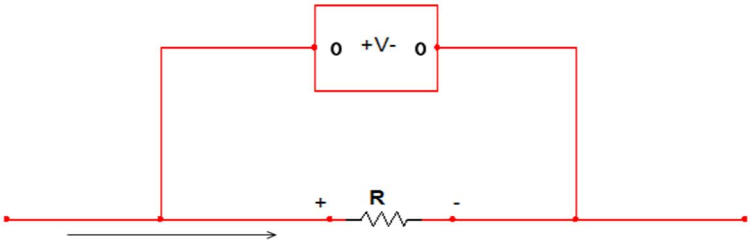


Figure:

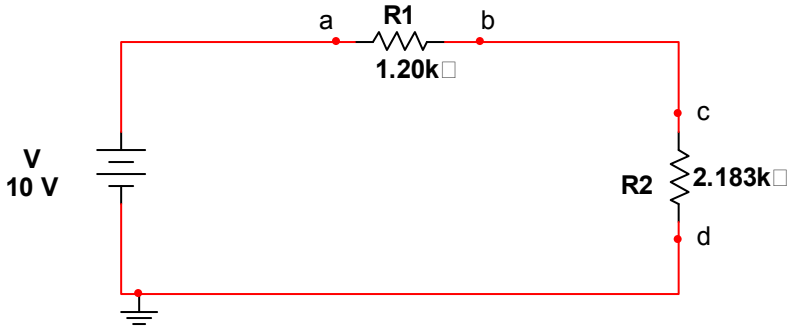


Figure: 1

Pre-Lab Homework:

Some basic idea of Electricity:

CURRENT: denoted by I and measured in amperes. Current flows from negatively charged material to positively charged material and is essentially the number of electrons per second that are carried through a conductor. Current is measured in units of amps. 1 amp = 1 coulomb/sec = 6.2 x 10^{18} electrons per second!

VOLTAGE: Potential difference between a negatively charged object and a positively charged one (like two terminals on a battery). Potential difference is measured in units of Volts (**V**)which represents the work done per unit charge to move electrons between the positive and negative terminals. If a potential difference exists, then energy can be extracted.

The amount of stored energy is given by:

$$E = qV$$

Where, V is the voltage or electric potential of some system. The units of voltage or Volts: 1 Volt = 1 Joule/Coulomb

RESISTANCE: Property of material that helps prevent the flow of electrons in it. Metals are good conductors due to low resistance. Wood is a poor conductor due to high resistance. Resistance, *R* , is measured in ohms and depends upon both the type of material and its size. Long wires have more resistance than short wires; thin wires have more resistance than thick wires. *R* is also temperature dependent

Apparatus:

1. Trainer Board
2. Voltmeter
3. Ammeter
4. AVO meter or Multi meter
5. DC source
6. Resistors

Precautions:

1.When measuring Voltage, the multi meter was connected two points in a circuit in order to obtain a good reading. While measuring Voltage, caution was taken to not touching the bare probe tips together, as that would create short-circuit.

2.Resistance was not tested or read for continuity with a multi meter on a circuit which was energized.

3.While measuring current the multi meter was connected in a circuit so the electrons could flow through the meter.

4.Multi meter had practically no resistance between their leads. That was intended to allow electrons to flow through the meter with the latest possible difficulty. Otherwise the meter would add extra resistance in the circuit, which affected the current.

Experimental Procedure:

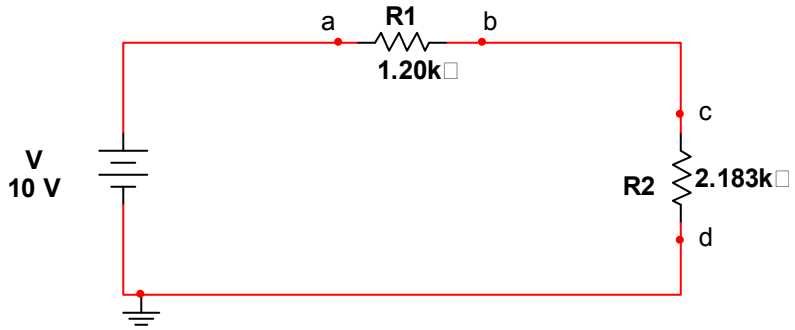
1. The Value of the supplied resistors was calculated using the color code chart theoretically. Then the value was measured using a multi meter and the following table:

Resistor	Value using color code chart	Value using Multi meter
• R1. R-R-R-G	• $22\times10^2\pm5\%\Omega$	• $21.83\times10^2\Omega$
R2. Br-Gre-R-G	$15\times10^2\pm5\%\Omega$	$15.33\times10^2\Omega$
R3. Br-R-R-G	$12\times10^2\pm5\%\Omega$	$12\times10^2\Omega$
R4. Or-Or-R-G	$33\times10^2\pm5\%\Omega$	$33.73\times10^2\Omega$
R5. Br-Bl-Or-G	$10\times10^2\pm5\%\Omega$	$99.9\times10^2\Omega$

2. The following circuit was constructed. Theoretically R_T(Total Resistance), I(Total Current), V_{ab}, V_{cd}, V_a and v_b was calculated.

Simulation and Measurement:

Simulation



Table

E	Theoretical Calculations						Multi meter readings				
	R_T	I	V_{ab}	V_{cd}	V_a	V_b	I	V_{ab}	V_{cd}	V_a	V_b
		A	V	V	V	V	A	V	V	V	V
10V	3.383	2.956	3.3547	6.45	10	4.653	2.806	3.564	6.48	10.05	6.48

Calculation:

$R_T = R_1 + R_2 = 1.20 + 2.183 = 3.383\ K\Omega$

$I = V/R = 10 / 3.383 = 2.956$ Amp

$V_{ab} = I \times R_{ab} = 2.956 \times 1.20 = 3.3547$ V

$V_{cd} = I \times R_{cd} = 2.956 \times 2.183 = 6.45$ V

$V_a = V_{ab} + V_b$.....(i)

$V_c = V_{cd} + V_d$

$=6.45 + 0 \quad [V_d = 0]$

$=6.45$ V

Since, $V_b = V_c$

So, $V_b = 6.45$ V

So from equ (i),

$V_a = V_{ab} + V_b = 3.547 + 6.45 = 10$ V

Result:

$R_T = 3.383\ K\Omega$

$I = 2.956$ Amp

$V_{ab} = 3.3547$ V

$V_{cd} = 6.45$ V

$V_a = 10$ V

$V_b = 6.45$ V

Answer of the Questions:

1.Show the difference between your theoretical value and Multi meter Value

Ans:

Theoretical Calculations:

$R_T = R_1 + R_2 = 1.20 + 2.183 = 3.383\ K\Omega$

$I = V/R = 10 / 3.383 = 2.956$ Amp

$V_{ab} = I \times R_{ab} = 2.956 \times 1.20 = 3.3547$ V

$V_{cd} = I \times R_{cd} = 2.956 \times 2.183 = 6.45$ V

$V_a = V_{ab} + V_b$.....(i)

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So from equ (i),

$V_a = V_{ab} + V_b = 3.547 + 6.45 = 10$ V

Multi meter readings:

I = 2.806 A

Vab = 3.564 V

Vcd = 6.48 V

Va = 10.05 V

Vb = 6.48 V

2.Do you have difference between in these values? If you have, then explain the reason.

Ans: Yes, I have. Because of the tolerance of the resistance and taking smaller value.

3.Why an ammeter can be damaged if it is connected in parallel to the load resistor?

Ans: An ammeter has a tolerance almost zero. When it is connected in parallel, huge current enter into the ammeter and for this it could be damaged.

Discussion:

1. The trainer board and the multimeter was checked before the start of the experiment.
2. The resistor was placed properly according to the figure.
3. The value of the voltage was increased gradually as applying a large voltage can damage the resistors.
4. During the experiment some error was taken place due to the fault of voltage source. It was solved with the help of course instructor.
5. Finally all the data was placed in the data table. For the given equation, a result was obtained.

Conclusions:

In this experiment the basic idea of DC terms and circuits was observed and verified with specific theory. Also we come to know how to measure the voltages and current using multimeter. So the experiment is successful .

Reference :

[1]http://zebu.uoregon.edu/disted/ph162/lec04.html

[2]Robert L. Boylestad, " Introductory Circuit Analysis '' , Pearson , Twelfth Edition ,pp#101-109 ,ISBN 978-81-317-6476-3.