Electrotechnology Lab Report

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Class: Electrotechnology CS1025

INTRODUCTION

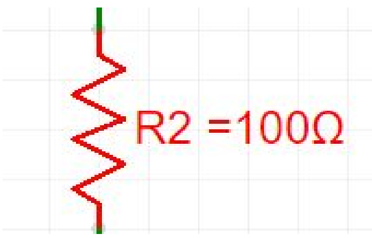
This experiment uses the concept of elementary direct current to help demonstrate and verify Ohm's Law and Kirchoff's Current and Voltage Laws .

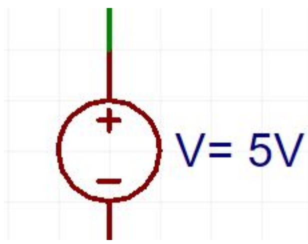
Apparatus

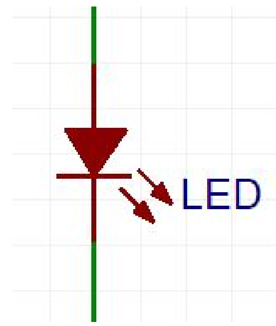
Resistors

D.C Power Supply **(5V)**

LED **(Light emitting diode)**

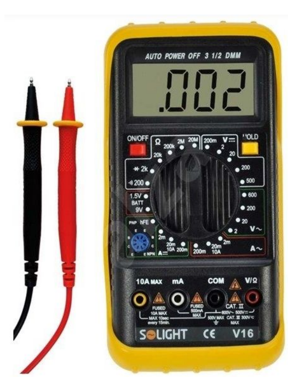


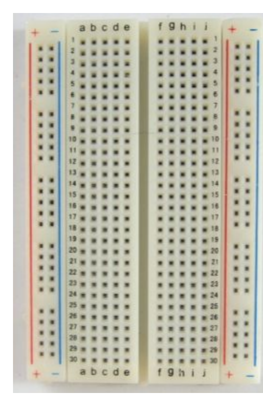




MultiMeter

BreadBoard





Background

OHM'S LAW

One of the key components of this experiment was the resistor. A resistor is a two -terminal element which impedes the flow of electrical current. It converts some of the electrical energy into another form of energy. The degree of impedance is measured in ohm's Ω. Every material has resistance to a certain extent. Resistors are also referred to as Ohmic Materials. A material is deemed ohmic when there is a linear relationship between the applied voltage and the current. **Ohm's Law** states that the current through a conductor between two points is directly proportional to the voltage across the two points.

$$v(t) = Ri(t)$$

- 'R' is known as the Resistance
- 't' is time
- 'v(t)' is voltage across the terminals
- 'i(t)' is the current flowing through the device

To find the Voltage, (V)

[V = I x R]   V (volts) = I (amps) x R (Ω)

To find the Current, (I)

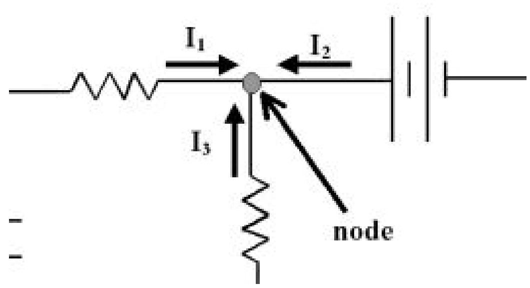
[I = V ÷ R]   I (amps) = V (volts) ÷ R (Ω)

To find the Resistance, (R)

[R = V ÷ I]   R (Ω) = V (volts) ÷ I (amps)

Kirchoffs Current Law

Kirchoff's Current Law states that the: **"total current or charge entering a junction or node is exactly equal to the charge leaving the node as it has no other place to go except to leave, as no charge is lost within the node".** A principal node is a branch point where the currents divide or combine. Current entering the node is given a positive sign and that leaving is given a negative sign, in other words the sum of all the currents entering and leaving a node must be equal to zero.

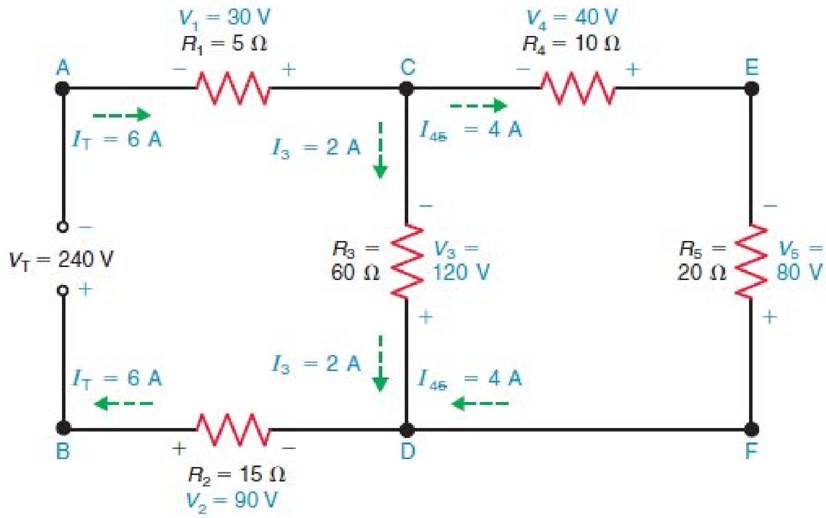


$$I_1 = I_2 + I_3$$

$$I_1 + (-I_2) + (-I_3) = 0$$

$$\sum I_{Node} = 0$$

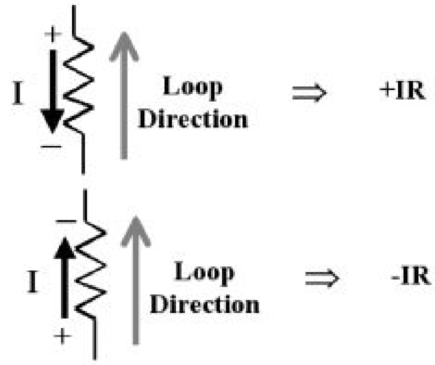
I(exiting) + I(entering) = 0.

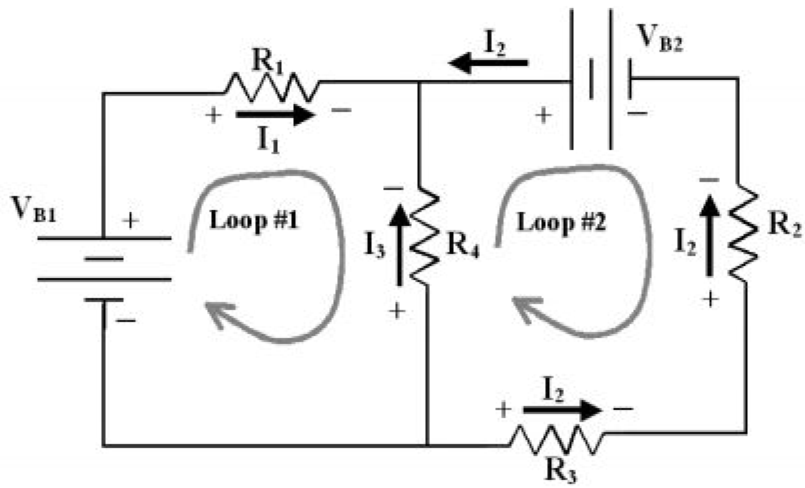


Kirchoff's Voltage Law

Kirchhoff's Voltage Law states that: **"in any closed loop network, the total voltage around the loop is equal to the sum of all the voltage drops within the same loop"** In other words the sum of all voltages within the loop must be equal to zero. The electrons flowing into the receiving end of the resistor causes that end to be negative in respect to the other. For a normal voltage source electrons flow from negative to positive. This idea by Kirchoff is known as the **Conservation of Energy.**

$$\sum v_{rise} = \sum v_{drop}$$



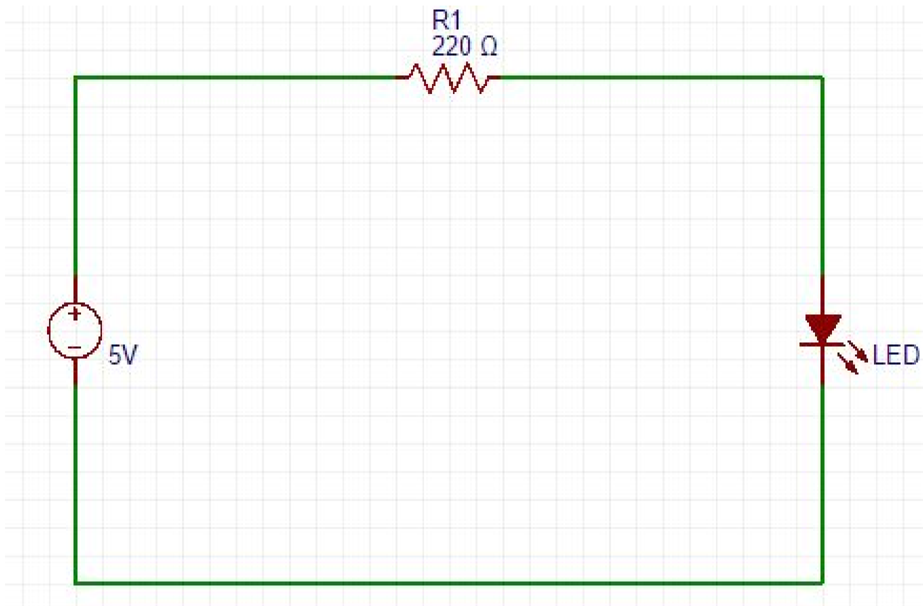


METHOD

Before we started the experiment we measured the resistance of each of the resistors with the multimeter to ensure we were using the right ones. We did this by setting the scale on the multimeter. We then used the multimeter to measure the voltage of the d.c. power source.

Circuit One

This consists of a 220 Ω resistor connected to a 5V D.C power source and an LED (Light Emitting Diode).



Method

1. Set up the circuit shown in the diagram above using D.C. power source, 220 resistor and the LED
2. Measure the current through the resistor using a multimeter. Put the results on the table.
3. Measure the voltage drop of the resistor in the circuit using the multimeter. Put the results on the table
4. Measure the current through the LED using a multimeter. Put the results on the table.

DATA

COMPONENT	RESISTOR	LED
Resistance (Ω)	480	0.004
Voltage (V)	2.25	4.8
Current (mA)	10	10

RESULTS / CALCULATIONS

The LED lights up. This shows that the circuit is closed and working correctly.

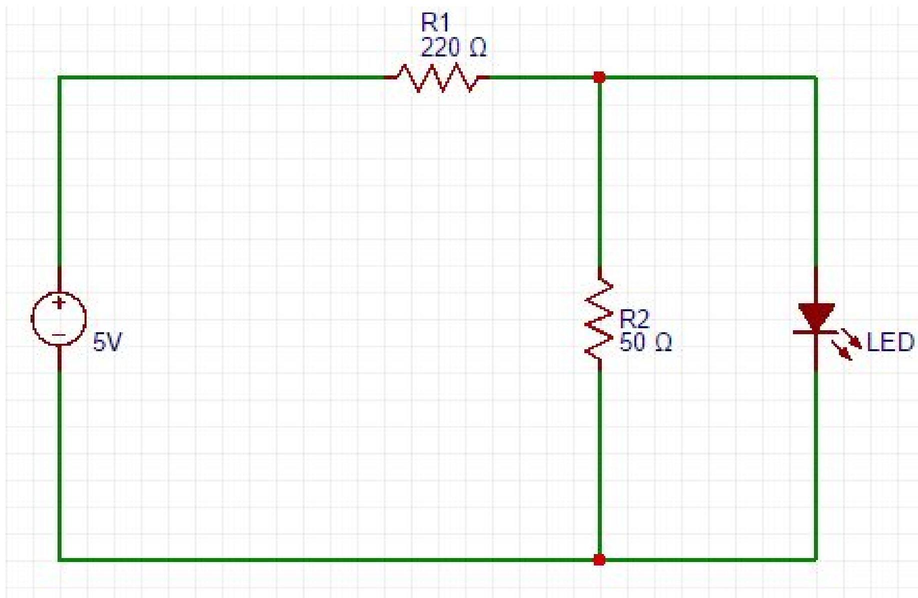
Resistance of LED = V / I

= 10x10^-3 V / 2.25mA

= 0.004 Ω

Circuit Two

This circuit was made by adding a 50 Ω resistor in parallel to the original circuit



Method

Repeat the steps above for this circuit.

DATA

<table>
<tr><th>COMPONENT</th><th>BASE RESISTOR</th><th>SECOND RESISTOR</th><th>LED</th></tr>
<tr><td>Resistance (Ω)</td><td>220</td><td>50</td><td>0</td></tr>
<tr><td>Voltage (V)</td><td>5.6</td><td colspan="2">1.3</td></tr>
<tr><td>Current (mA)</td><td>26</td><td>25</td><td>0</td></tr>
</table>

RESULTS / CALCULATIONS

The LED has a very dim glow.

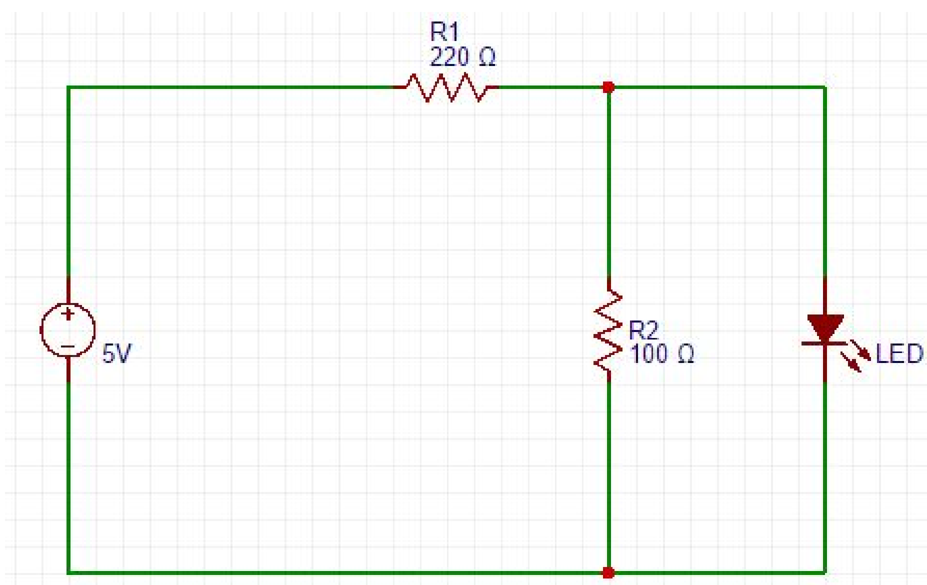
Resistance of the LED = V / I

= 0 V / 1.3mA

= 0 Ω

Circuit Three

This circuit was made by replacing the 50 Ω resistor with a 100 Ω resistor



Method

Repeat the steps above for this circuit.

DATA

COMPONENT	BASE RESISTOR	SECOND RESISTOR	LED
Resistance (Ω)	220	100	0.00048
Voltage (V)	4.8	2.05	
Current (mA)	22	21	1

RESULTS / CALCULATIONS

The LED is slightly brighter than the case with the 50 Ω

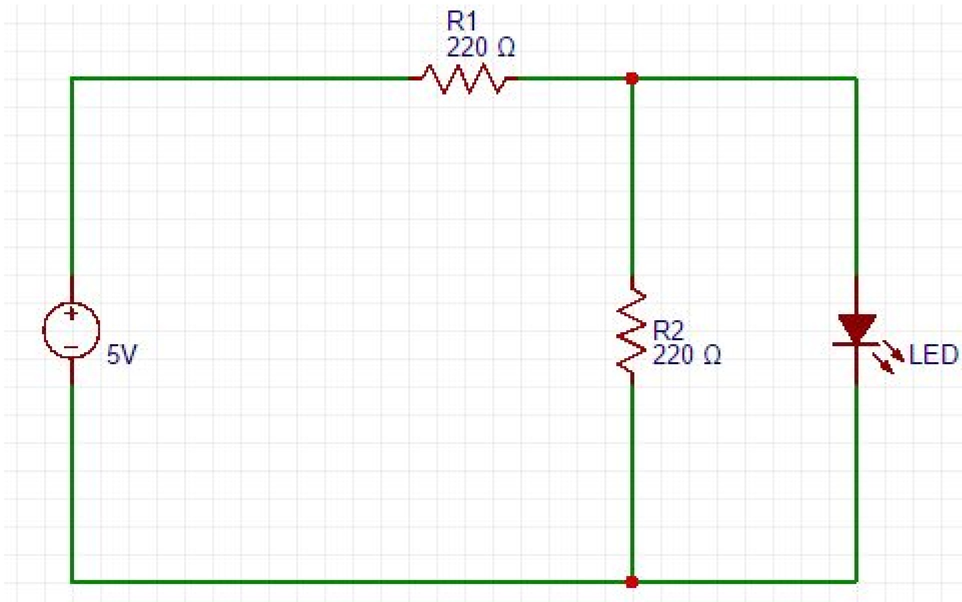
Resistance of the LED = V / I

= 1x10^-3 V / 2.05 mA

= 0.000488 Ω

Circuit Four

This circuit was made by replacing the 100 Ω resistor with a 220 Ω resistor



Method

Repeat the steps above for this circuit.

DATA

COMPONENT	BASE RESISTOR	SECOND RESISTOR	LED
Resistance (Ω)	220	220	1.5 x 10^-3
Voltage (V)	3.9	3	
Current (mA)	18	13.5	4.5

RESULTS / CALCULATIONS

The LED is slightly brighter than the case with the 100 Ω

Resistance of the LED = V / I

= 4.5 x 10^-3 V / 3 mA

= 1.5 x 10^-3 Ω

CONCLUSION/OBSERVATIONS

In all cases the voltage was around 7V, this proves Kirchoff's Voltage Law.

Circuit 1

4.8v + 2.25v = 7.05 v

Circuit 2

1.3v + 5.6v = 6.9v

Circuit 3

2.05v + 4.8v = 6.85v

Circuit 4

3v + 3.9v = 6.9v

Also for each circuit the current leaving was approximately equal to the current entering the circuit, this proves Kirchoff's Current Law.

Circuit 1

10mA = 10mA

Circuit 2

26mA = 25mA + 0mA

Circuit 3

22mA = 21mA + 1mA

22mA = 22mA

Circuit 4

13.5mA + 4.5mA = 18mA

18mA = 18mA

The resistance of the LED varies depending on how much voltage is going through it therefore we cannot use the multimeter to measure the resistance.

Kirchhoff's Law can be proven by assembling together a circuit with more than one resistor and it holds true in all cases.

REFERENCES

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