Ohm's Law

Theory: Ohm's law state that[1], "If temperature and other physical condition of a conductor remain unchanged then current flowing through the conductor is directly proportional to the voltage difference between two terminals of the conductors".

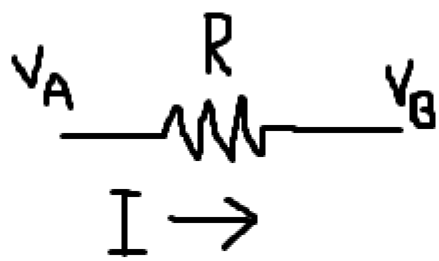


Fig:01

Here, a conductor AB. Voltage of A point is V_A and Voltage of B is V_B.

Where $V_A > V_B$

Now, Voltage difference between A and B is

$V_{AB} = V_A - V_B$

Register R and current flow between AB conductor is I.

Now According Ohm's law[2],

$$I \propto V_{AB} \qquad (1)$$

Taking proportional constant $\frac{1}{G}$ in both sides,

$$I = \frac{V}{G}$$

$$I = \frac{V}{R} \qquad (2)$$

Mathematical Explanation: Now using equation (2) [3]we explain Ohm's law.

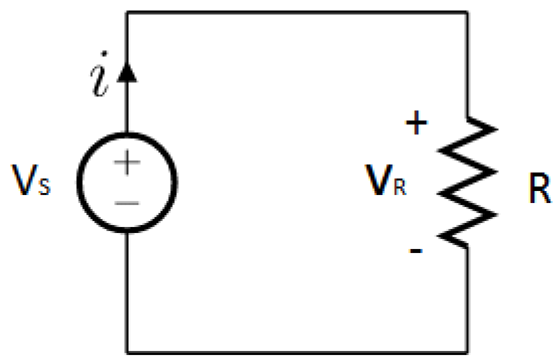


Fig:02

Let, Register R = 10 Ω

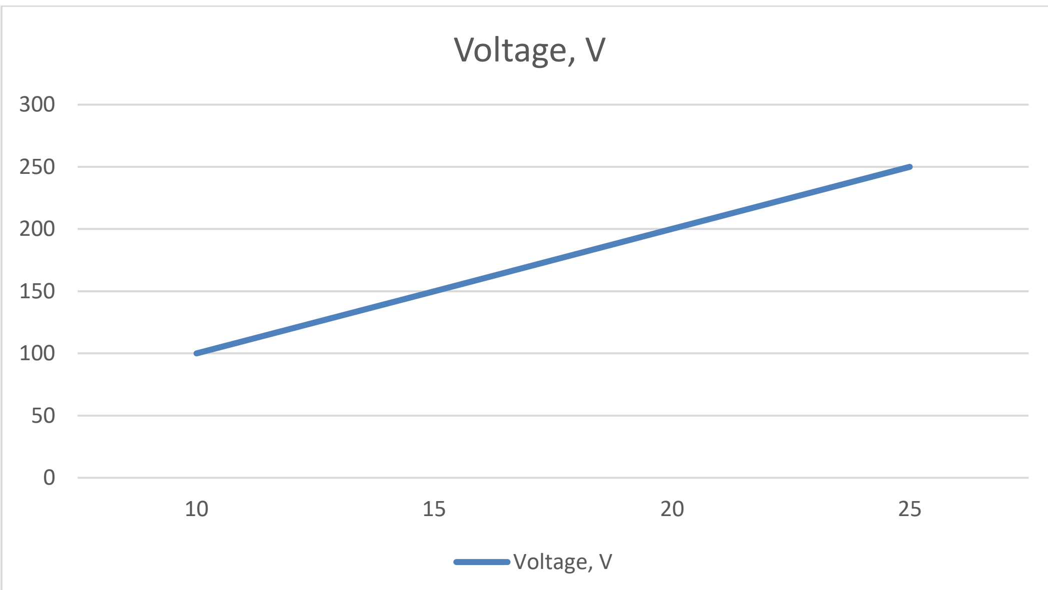
Now, we change current across this register in this circuit and calculate V_s respectively.

Sq.no	Current, I	Voltage, V
1	10 A	100 V
2	15 A	150 V
3	20 A	200 V
4	25 A	250 V
5	30 A	300 V

From the table we see that, voltage is increase according to current. That is indicate proportional relationship between current and voltage.

Graphical representation:

To verify this law we can use graph. To draw graph we use table data.



Graph: 01

From the graph we see that, the graph is straight line. It represents y = mx equation. Where, y = current, x = voltage and slope, m = register.

Resistivity: Consider a conductor with length "l" and cross-sectional area "a." Its resistance should be R. Allow it to have an I current flowing through it and a voltage difference of V volts between its ends.

Now imagine a second conductor with the same dimensions but a doubled length. This may be compared to two first-class conductors connected in series. As a result, their voltages increase. As a result, the voltage will increase to 2V.

R = (V/T) according to Ohm's law.

R = (2V / I) = 2R in this case.

Thus, resistance grew as length did. R l is that

Application of Ohm’s Law: Ohm's law can be used to calculate the voltage[4], current, impedance, or resistance of a linear electric circuit if the other two quantities are known.It also makes power calculations simpler.

Ohm's law is used to maintain the desired voltage drop between the electrical components.

It is necessary to determine the voltage, resistance, or current of an electric circuit.

Ohm's law is also used in DC ammeters and other DC shunts to reroute current.

Limitation of Ohm’s law: Ohm's law has some restrictions[5], one of which is that it cannot be used to networks that are unilateral. Only one direction of current flow is permitted in unilateral networks. Such networks include, for instance, transistors and diodes.

Ohm's law also does not hold true in the case of non-linear objects. The applied voltage has no bearing on how much current flows through these components. This is due to the fact that these components' resistance values vary depending on the voltage and current values. Thyristors are an example of non-linear components.

In the case of non-metallic conductors, Ohm's Law is invalid.

It might be challenging to calculate using Ohm's law when dealing with complex circuits.

Reference:

[1] K. Tenny and M. Keenaghan, “Ohms Law,” 2017, Accessed: Jul. 19, 2023. [Online]. Available: https://europepmc.org/books/nbk441875

[2] N. I. Chernov, G. L. Eyink, J. L. Lebowitz, and Y. G. Sinai, “Derivation of Ohm’s law in a deterministic mechanical model,” *Phys Rev Lett*, vol. 70, no. 15, pp. 2209–2212, 1993, doi: 10.1103/PHYSREVLETT.70.2209.

[3] “ohm’s law circuit diagram - Google Search.” https://www.google.com/search?q=ohm%27s+law+circuit+diagram&oq=ohm%27s+law&aqs=chrome.0.69i59j69i57j69i64j0i512l3j69i60l2.8749j0j7&sourceid=chrome&ie=UTF-8 (accessed Jul. 19, 2023).

[4] “Application of ohms law - Google Search.” https://www.google.com/search?q=Application+of+ohms+law&oq=Application+of+ohms+law&aqs=chrome..69i57j0i10i512j0i20i263i512j0i10i512l5j0i22i30l2.8249j0j7&sourceid=chrome&ie=UTF-8 (accessed Jul. 19, 2023).

[5] “limitations of ohm’s law - Google Search.” https://www.google.com/search?q=limitations+of+ohm%27s+law&oq=limitat&aqs=chrome.1.69i57j0i67i650l5j0i131i433i512j0i67i650j0i512l2.5828j0j7&sourceid=chrome&ie=UTF-8#cobssid=s (accessed Jul. 19, 2023).