Chapter :3

- DIRECT CURRENT
  - Ohm'S Law
  - Resistance
  - Kirchhoff'sLaw
  - Wheat stone bridge
  - Heating effect of current and concept of power
  - Application of Electricity

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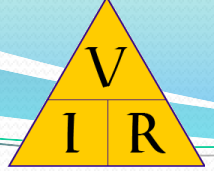
Current

- The rate of flow of electric charge is called electric current.
- It is measured in Ampere I= Q/T.
- Cureent is a scaler quantity. Although it represent the direction of flow of postive charge but even than it is consider scaler because
  - It can be added by ordinary law of algebra.
  - The strength and direction of current remains unchanged even if the wire is bent at different angels at different points and different crosss section is taken.



Ohms law,

defines the relationship between voltage, current and resistance

If the physical condition of conductor remain same then voltage applied is derectly proportional to current flow through the conductor

i.e

$V \alpha I$

$V = IR$

(proportionality is repaced by a factor called resistence)

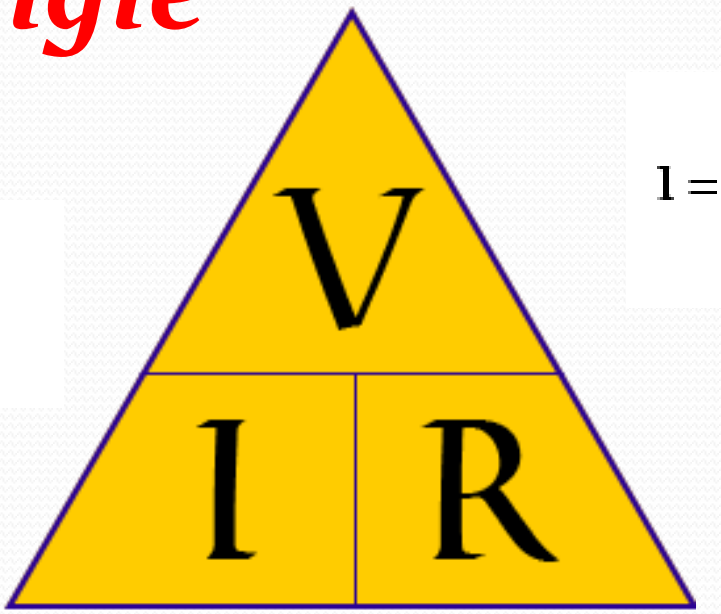
Ohm's Law is the foundation of electronics and electricity.

This formula is used extensively by electricians.

Without a thorough understanding of "Ohm's Law" an electrician ***can not*** design or troubleshoot even the simplest of electronic or electrical circu

Ohm's law magic triangle

$$E = I R$$



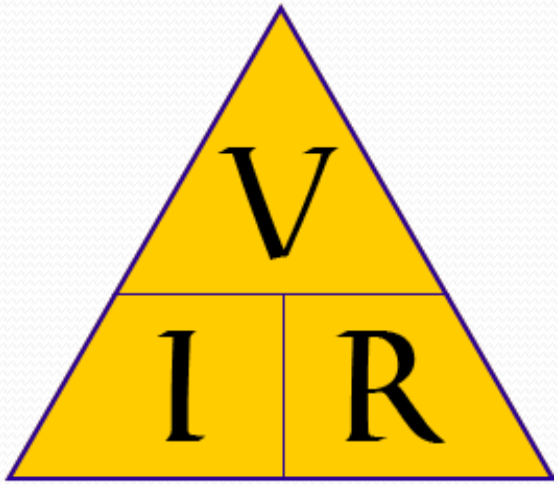
$$I = \frac{E}{R} \qquad R = \frac{E}{I}$$

Voltage measured in *volts*, symbolized by the letters "E" or "V".

Current measured in *amps*, symbolized by the letter "I".

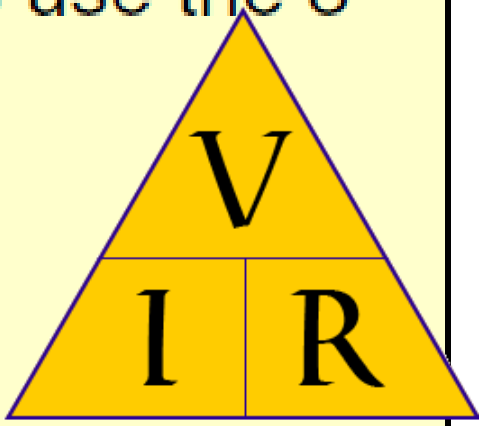
Resistance measured in *ohms*, symbolized by the letter "R".

Quantity	Symbol	Unit of Measurement	Unit Abbreviation
Current	I	Ampere ("Amp")	A
Voltage	E *or* V	Volt	V
Resistance	R	Ohm	Ω

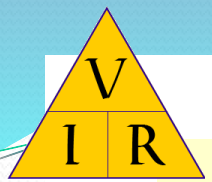


To obey Ohm's law means a conductor has a constant resistance regardless of the voltage.

- If you know two of the three variables you should be able to solve for the third.
- When using Ohm's law always use the 3 step form
  - 1. Write the equation
  - 2. Replace the known values
  - 3. Solve the problem



. Label with the correct unit of measurement.

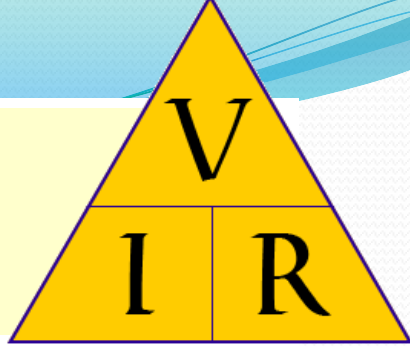


Practice problems

In a circuit, 0.5 A is flowing through the bulb. The voltage across the bulb is 4.0 V. What is the bulbs resistance?

1. Write the equation → $R = \frac{V}{I}$
2. Replace the known values → $R = \frac{4.0}{0.5}$
3. Solve → $R = 8$
4. Label → $R = 8\ \Omega$

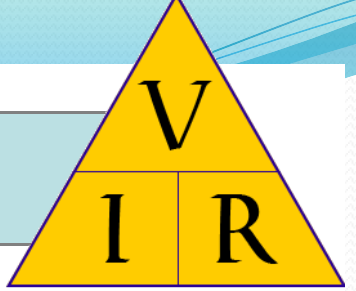
Practice problem



- You light a light bulb with a 1.5 volt battery. If the bulb has a resistance of 10 ohms, how much current is flowing?

1. Write the equation → $I = \frac{V}{R}$
2. Replace the known values → $I = \frac{1.5}{10}$
3. Solve → $I = 0.15$

Ohm's Law



	Resistance	Current	Voltage
Definition	The opposition to the flow of charges	The flow of electrons through a circuit	**The force or pressure behind electricity**
Symbol	R	I	V
Equation	$R = \frac{V}{I}$	$I = \frac{V}{R}$	$V = I R$

Practice problems

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2. Replace the known values →
3. Solve →
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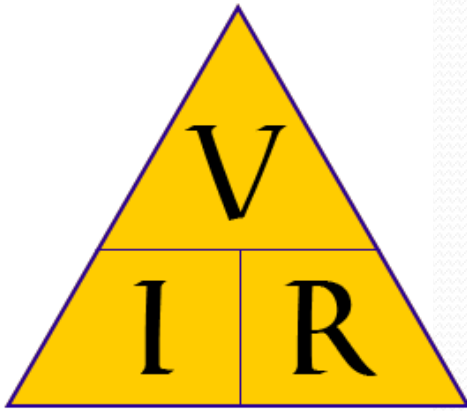

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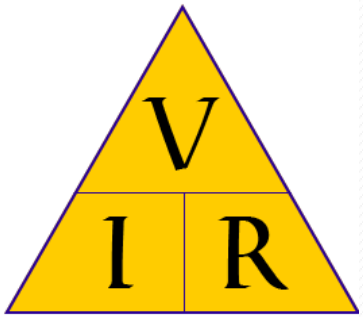

Resistence

- The resistence is the property of material by virtue of which it opposes the flow of electric current through it.
- The s.i unit of resistence is ohm .
- Resistence of a conductor depends on following factor
- -length-resistence is directly proportional to length of a conductor
- -area of crosssection of conductor
- -nature of a material
- -temperature

Specific resistence

- $R=\rho \ell/A$
- Where ρ is spefic resistence.
- The specific resistance of materials is independent of length and cross-sectional area.
- Specific resistance is a constant entity. Its value remains constant for every individual substance.
- Any sort of change in length or cross-sectional area may bring about a change in the resistance of a wire as we have the relation R= pL /A, where p But, the specific resistance of the wire in all above conditions is same. Only a change in temperature can bring about a change in the specific resistance.
- Whenever there is a change in area or length, it brings about a corresponding change in R in such a way that specific resistance ‘p’ always remains constant.

Conductance

- Conductance is an expression of the ease with which electric current flows through a substance. It is reciprocal of resistence.
- $R = 1/G$
- conductance is symbolized by the uppercase letter *G*. The standard unit of conductance is the *siemens* (abbreviated S), formerly known as the *mho*.

EFFECT OF TEMPERATURE ON RESISTENCE

$$R = R_{ref}\,[1 + \alpha(T - T_{ref})]$$

Where,

R = Conductor resistance at temperature "T"

R_{ref} = Conductor resistance at reference temperature T_{ref} , usually 20°C, but sometimes 0°C.

α = Temperature coefficient of resistance for conductor material.

T = Conductor temperature in degrees Celcius.

T_{ref} = Reference temperature that α is specified at for the conductor material

Example: Copper wire has the resistance of 15 ohms at 20° C. Calculate the resistance at 80° C

Solution: $R_2 = R_1 [1 + \alpha_1 (T_2 - T_1)]$

$R_2 = 15\ \Omega [1 + 0.00393 (80 - 20)]$

$R_2 = 15\ \Omega (1.2358)$

$R_2 = 18.5$

Positive temperature coefficient vs Negative temperautre coefficient

The material whose resistence increases with increase in temperature is known as positive temperature coefficient. While material whose resistence decreases with increases in temperature is known as negative temperature coef ficient material
that are classed as CONDUCTORS tend to INCREASE their resistance with an increase in temperature. INSULATORS however are liable to DECREASE their resistance with an increase in temperature. Materials used for practical insulators (glass, plastic etc.) only exhibit a marked drop in their resistance at very high temperatures. While resistence of SEMICONDUCTORS decreases with increase in temperature.

SUPERCONDUCTORS

- A superconductor is an element or metallic alloy which, when cooled below a certain threshold temperature, the material dramatically loses all electrical resistance. In principle, superconductors can allow electrical current to flow without any energy loss (although, in practice, an ideal superconductor is very hard to produce). This type of current is called a supercurrent.
- The threshold temperature below which a material transitions into a superconductor state is called critical temperature.at this temperature resistence and resistiviy of conductor becomes zero and conductance and conductivity becomes infinitly large.Not all materials turn into superconductors.
- Mercury become superconductor at 4.2 K

resistence in series and parallel.pdf