General Physics

Lecture 2: Electricity

first stage

by

Assistant lecturer

Ansam Fadil Ali Showard

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Electrical Current(التيار الكهربائي):

It is the **continuous flow** of free electrons . The unit of current is Ampere (A) and is measured by Ammeter. It is **denoted** by the letter "I".

Ampere(الامبير):

it is the unit of electric current measurement, and it is the flow of charge one coulomb through of the conductor per one second.

Voltage(الفولتية):

To create the current flow in a conductor; the electrical pressure which is used to move the electrons is called voltage. It is denoted by the letter 'V'. the unit of voltage is 'volt' and is measured by voltmeter.

Resistance(المقاومة):

It is the property in the conductor prevent the flow of current through of it. It is denoted by the letter 'R'. the unit of resistance is ohm (Ω) and it is measured by Ohm meter.

Ohm (الاوم): It is the unit of resistance.

Electric Power(القدرة الكهربائية):

Power is defined as the product of voltage and current. Unit of power is watts and denoted by the letter "P".

Engineering prefix(البادئات الهندسية):

Multiplier	Prefix	Symbol
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

Example-1: Express the following in engineering prefix:

a) 10×10^{4} volt. b) 0.1×10^{-3} watts. C) 250×10^{-7} ampere

Solution:

a) $10 \times 10^{4}\ Volt = 100 \times 10^{3}\text{V} = 100\ \text{kV}.$

b) $0.1 \times 10^{-3}\ Watts = 0.1\ miliwatt = 0.1mW$

c) $250 \times 10^{-7} ampere = 25 \times 10^{-6} A = 25\mu A$

Example-2 Convert 0.1MV to kV

Solution

$$0.1 \times 10^6 V = (0.1 \times 10^3) \times 10^3 = 100KV$$

Law of resistance(قانون المقاومه):

The resistance of a conductor in a circuit depends upon the following states

1- It depends upon the material.

2- Directly proportional to the length of the conductor.

3- Inversely proportional to the area of the cross-section of the conductor.

4- It also depends upon the temperature of the conductor.

Resistance calculation(حساب المقاومه):

$$R = \rho \frac{L}{A}$$

Where:

R is the resistance (ohms)

ρ is specific resistance (resistivity) in (ohm. Meter).

L is length of the conductor (meter).

A is area of the cross section of a conductor (Sq.m).

The specific resistance(المقاومه النوعيه):

is a characteristic of a material that depends on the type of material and the temperature, It is denoted by the letter (ρ).

The following table shows the specific resistance of material:

Materials		Specific resistance is ohm - meter
Gold	-	2.42×10^{-8}
Silver	-	1.63×10^{-8}
Copper	-	1.724×10^{-8}
Aluminium	-	2.83×10^{-8}
Rubber	-	8×10^{7}
Glass	-	10×10^{11}

Example-3:

$1cm^2$ cross section 50m long copper conductor has specific resistance $1.72*10^{-8}$ Ω.cm find the resistance?

Solution:

$$L=50m=50*100cm=5000cm$$

$$A=1cm^2$$

$$\text{Specific resistance} = 1.72\times 10^{-8}\Omega..cm$$

$$R=\rho\frac{L}{A}$$

$$= 1.72\times 10^{-8} \times \frac{5000}{1} = 0.0086\Omega$$

Ohm's Law:

A relationship was derived by the scientist Ohm; between the current; voltage and resistance of the circuit. It says; "At a constant temperature; the current flowing through the circuit is directly proportional to the voltage and inversely proportional to the resistance". If any two of the three values (I; V; R) are known the third value can be easily calculated.

$$\text{Current} = \frac{\text{voltage}}{\text{Resistance}}$$

$$\text{i.e. } I = \frac{V}{R}$$

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

$$V = I \times R$$

Example-4: The supply voltage of the circuit is 240V and the resistance value is 12 Ω. Calculate the current flowing through this circuit.

Solution:

Voltage (V) = 240V

Resistance (R) = 12Ω

Current (I) = ?

According to Ohm's law:

$$\text{I} = \frac{V}{R} = \frac{240}{12} = 20\text{A}$$

Example-5 The supply voltage of the circuit is 230V. if 10A current is flowing through this circuit. Calculate the resistance value of the circuit.

Solution:

Voltage (V) = 230v

Current (I) = 10A

Resistance (R) = ?

According to Ohm's law

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

$$R=\frac{230\ V}{10\ A}$$

$$R=23\ \Omega$$

Homework:

Find out the voltage of the circuit when 6A current is Homework flowing through the circuit. Resistance of the circuit is 40Ω.