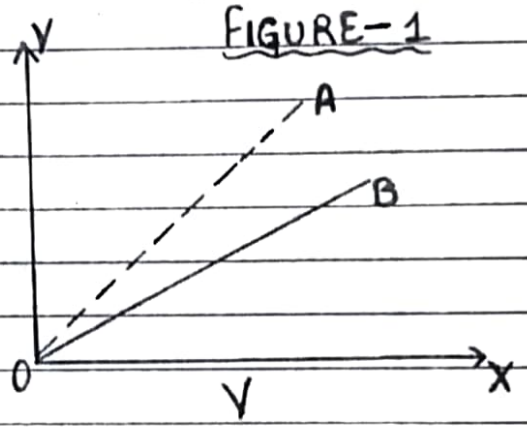
CLASS- X SUBJECT- PHYSICS
CHAPTER-8 TEACHER- charanjeet kaur

Good Morning Students!
This lesson is of class-X, for the subject of 'Physics', Topic- 'V-I and I-V Graph, Factors affecting the resistance of a conductor', which is covered in Chapter-8, titled- 'Current Electricity' starting on Page Number-179 of your Physics Textbook, titled- 'Concise Physics by Selina Publications' and is being submitted to you on 3rd July, 2023.
All of you may now open Page Number-179 of your Physics Textbook.

I-V GRAPH

FIGURE-1



Students observe figure-1, (drawn on Page Number-1), for I-V graph, we will draw I along Y-axis and V along X-axis.

Students, remember how we use to draw slope of a given graph in class-IX.

$$\text{Slope of a graph} = \frac{\text{change along Y-axis}}{\text{change along X-axis}}$$

Here, Slope of I-V graph $= \frac{\Delta I}{\Delta V}$ (Δ represents change)

$$\text{Slope} = \frac{1}{\text{Resistance}(R)} = \text{Conductance}$$

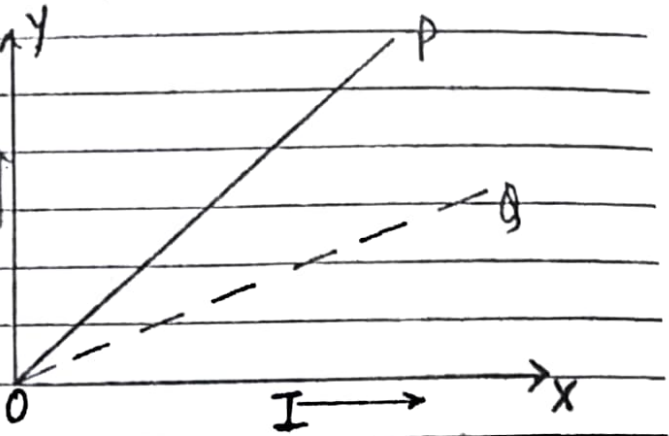
Slope of I-V graph = Conductance (G)

Students, as it can be seen in figure-1 that out of solid and dashed line, slope of dashed line (i.e A) is more than solid line (B).

Hence, Conductance of conductor A is more than conductor B (if A and B represents two conductors following Ohm's Law i.e. $I \propto V$)

V-I GRAPH

FIGURE-2



for- V-I graph, we will be taking V along Y-axis and I along X-axis as it can be seen in figure-2 drawn on page number-2

So, in this case:

$$\text{slope} = \frac{\Delta Y\text{-axis}}{\Delta X\text{-axis}} = \frac{\Delta V}{\Delta I} = R \quad (\because R = V/I)$$

Students now observe figure-2, and write down out of P and Q, which conductor is having: a) less resistance, and b) less conductance.

(Students now pause the audio and write the answer in your Physics notebook)

Now let us check the answer of the question based on figure-2.

Solution: Slope of P > slope of Q, thus as this is a V-I graph, so its slope tells about resistance of the conductor.

Hence, Resistance of P > Resistance of Q

Hence, a) Q will have less resistance

b) P will have more resistance than Q.

and as, Resistance $\propto$ 1/Conductance

∴ Conductance of P is less than that of Q.

CHAPTER-8

Ohmic Resistors – These are the conductors which obey Ohm's Law. For example – all metallic conductors, nichrome, copper sulphate solution with copper electrodes, and dilute sulphuric acid etc. at a constant temperature

Non-Ohmic Resistors – These are the conductors which do not obey Ohm's law. For example – solar cell, filament of a bulb, LED etc.

(Students, in non-ohmic resistors the V-I graph is not like figure-1 and figure-2 rather it is a non-linear graph as shown in figure-3 on Page Number-3 of the notes sent to you on 9th August, 2021)

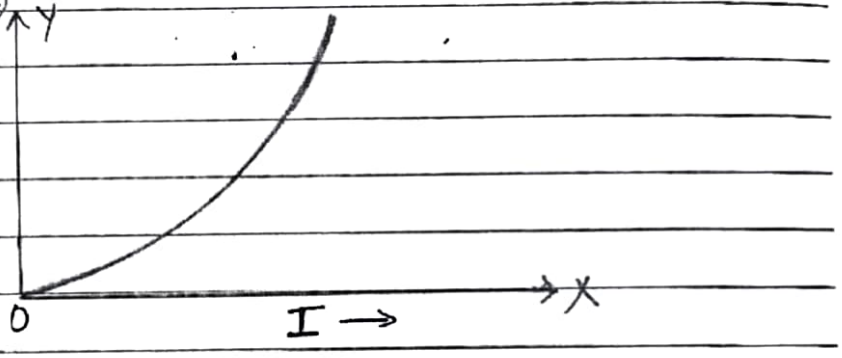


FIGURE-3

In Non-Ohmic Resistors, the resistance does not remain constant (as in ohmic resistors), rather in this case value of resistors changes for each set of potential difference (V) and current (I).

Factors affecting the resistance of a conductor

(Students we have already done this topic in class-IX also)

1.) Resistance is directly proportional to length of the conductor (i.e. more is the length of conductor, more number of collisions of electrons with positive ions occur due to which resistance of the conductor increases). so $R \propto l$

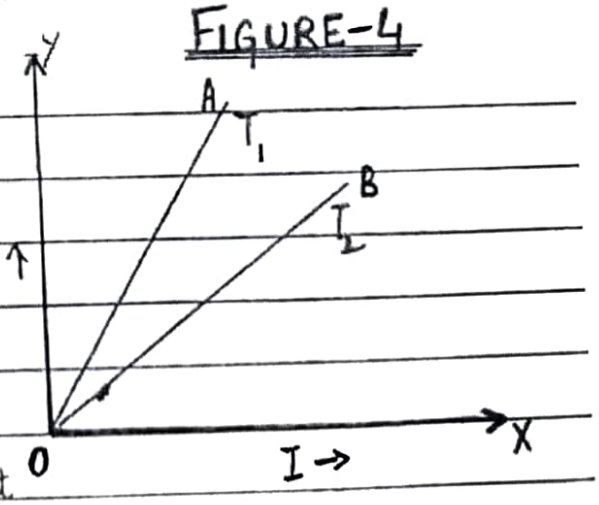
2.) Resistance is inversely proportional to area of the conductor i.e. thicker is the conductor, more is the area and thus less will be the number of collisions between free electrons and positive ions due to which resistance of wire decreases.

3) Resistance is directly proportional to temperature of the conductor (i.e. if we heat a conductor, its temperature increases which results in increase number of collisions between electrons and positive ions which further results in increase of resistance)

4) Resistance depends on material of conductor - substances which have a large concentration of electrons, offer less resistances and such materials are known as conductors.

Students, now I am going to ask you a question based on the topics which we have studied till now. Listen the question carefully and observe figure-4.

FIGURE-4



Q. Students, on the basis of figure-4, you have to answer which conductor A or conductor B is having more temperature and write reason in support of your answer.
(Now pause this audio and resume it to check your answer once you have tried it yourself).

Solution: Slope of V-I graph = Resistance
Since in figure-4:
Slope of A > Slope of B
So, $R_A > R_B$ and since resistance is directly proportional to temperature of the conductor, hence, $T_1 > T_2$.

SPECIFIC RESISTANCE (RESISTIVITY)

As we have already discussed earlier, that
i) $R \propto l$, and ii) $R \propto 1/A$
Combining both results, we get:
$R \propto l/A$ or, $R = \frac{\rho l}{A}$

where, ρ = constant of proportionality and is known as **specific resistance** (or resistivity) of the material of a wire

S.I. units of Resistivity (ρ): $\rho = \frac{R \times A}{l}$

or, $\rho = \frac{\Omega \times m^2}{m} = \Omega \cdot m$

Specific resistance of a material is the resistance of a wire of that material of unit length and unit area of cross section.

NOTE- Students, ① specific resistance or resistivity is independent of length and area while it is having a specific (particular) value for a particular material. For example: ρ of Cu = 1.78×10^{-8} m, now if you double the length of Cu wire or if you make the Cu wire thinner or thicker, the value of ρ remains constant while resistance (R) of the wire will change.

② Resistivity (ρ) of a substance also depends on its temperature.

- If substance is conductor - ρ increases with increase in temperature (for metals)
- If substance is semiconductor - ρ decreases with the increase in temperature (Germanium and Silicon comes in the category of semiconductors)
- For alloys like Constantan, Manganin the value of ρ remains constant with change in temperature.

CONDUCTIVITY : (σ)

Reciprocal of specific resistance is known as conductivity so, $\sigma = 1/\rho$

Units : $\sigma = \frac{1}{\Omega m} = \Omega^{-1} m^{-1} = \text{Siemens/m}$

Now, I want you all to solve the numerical which I am about to give you now. Listen carefully and after listening it, pause the audio and solve the numerical in your Physics notebook. (listen the units carefully)

Q. Calculate the resistance of 1.0 km long wire of radius 1 mm (ρ of Cu = $1.72 \times 10^{-8} \Omega m$).

(I hope you have done the numerical correctly. Now let us find the correct answer).

Solution: Using: $R = \frac{\rho l}{A} = \frac{\rho l}{\pi r^2}$

$$R = \frac{1.72 \times 10^{-8} \times 1 \times 10^3}{3.14 \times (10^{-3})^2} = 5.5 \Omega$$

Students, if we are asked to find conductance, then

$$G = \frac{1}{R} = \frac{1}{5.5} = 0.182\ \Omega^{-1} \text{ or } 0.182 \text{ Siemen}$$