CLASS NOTES	
Class :x	Topic- Numerical based on resistance, resistivity, ohms law. Combination of system of resistors
Subject: PHYSICS	

NUMERICALS BASED ON RESISTANCE AND RESISTIVITY

1. When a 12 v battery is connected across an unknown resistor, there is a current of 2.5 mA in the circuit. Find the value of the resistance of the resistor.

Ans. Voltage of battery = V = 12 V, Current (I) = 2.5 mA = 2.5 x 10^{-3} A

Resistance (R) = V/I = 12V/ 2.5 x 10^{-3} A = 4800 Ω.

2. A copper wire has diameter 0.5 mm and resistivity of 1.6 x 10-8 m. what will be the length of this wire to make its resistance 10? How much does the resistance change if the diameter is doubled?

Ans. Diameter of wire (d) = 0.5 mm, resistivity (ρ) 1.6 x 10^{-8} Ωm, resistance (R) = 10 Ω.

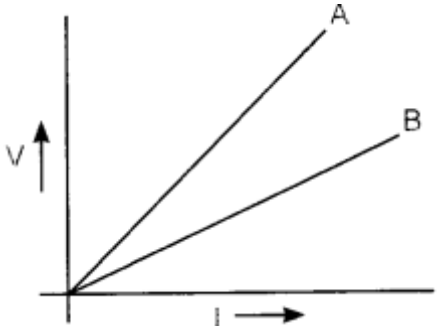
R = ρL/A

L= $\pi D^2 R/4\rho$

= 22 x (5 x 10^{-4})^2/ 7 x 4 x 1.6 x 10^{-8} = 122.5 m

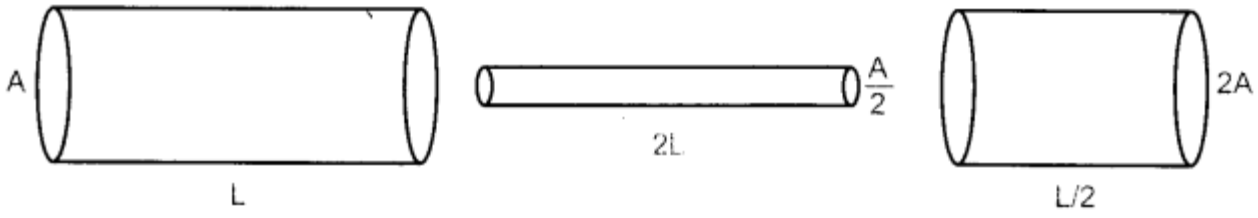
If the diameter is doubled for given length of given material resistance is inversely proportional to the cross-section area of wire.

3. V-I graph for two wires A and B are shown in the figure. If both wires are of same length and same thickness, which of the two is made of a material of high resistivity? Give justification for your answer.



Answer. Greater than slope of V-I graph, greater will be the resistance of given metallic wire. In the given graph, wire A has greater slope then B. Hence, wire A has greater resistance.
For the wires of same length and same thickness, resistance depends on the nature of material of the wire.

4.The figure below shows three cylindrical copper conductors along with their face areas and lengths. Discuss in which geometrical shape the resistance will be highest.



(*i*) (*ii*) (*iii*)

Answer.

For geometrical shape shown in

Figure (*i*) $R_1 = \rho\frac{L}{A}$

Figure (*ii*) $R_2 = \rho\frac{2L}{A/2} = 4\left(\rho\frac{L}{A}\right) = 4R_1$

Figure (*iii*) $R_3 = \rho\frac{L/2}{2A} = \frac{1}{4}\left(\rho\frac{L}{A}\right) = \frac{R_1}{4}$

5.How much current will an electric bulb draw from 220 V source if the resistance of the bulb is 1200Ω? If in place of bulb, a heater of resistance 100 Ω is connected to the sources, calculate the current drawn by it.

Answer.

Given: $V = 220$ V, $R_1 = 1200\ \Omega$, $I_1 = ?$, $R_2 = 100\ \Omega$, $I_2 = ?$

Using Ohm's law,

$$V = I_1R_1$$

$$\Rightarrow \quad I_1 = \frac{V}{R_1} = \frac{220}{1200} = 0.18 \text{ A}$$

and, $$I_2 = \frac{V}{R_2} = \frac{220}{100} = 2.2 \text{ A}$$

6.**Calculate the charge passing through an electric bulb in 20 minutes if the value of current is 200 mA.**

Answer.

$$I = \frac{q}{t}$$

$$t = 20 \times 60 = 1200 \text{ seconds},$$

$$I = 200 \text{ mA} = 200 \times 10^{-3}\text{A}$$

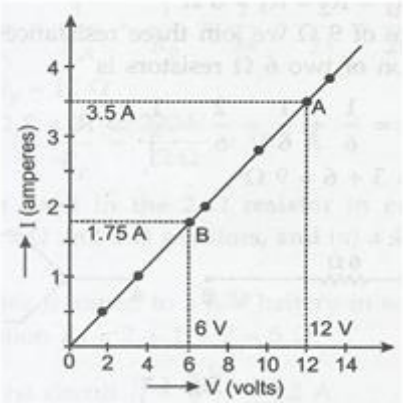
Charge passing $= q = It = 200 \times 10^{-3} \times 1200 = 240$ C

6.The value of current I flowing in a given resistor for the corresponding values of potential difference V across the resistor are given below:

I (amperes)	0.5	1.0	2.0	3.0	4.0
V (volts)	1.6	3.4	6.7	10.2	13.2

Plot a graph between V and I and calculate the resistance of that resistor.

Ans. From the given data the I-V graph is a straight line as shown below:



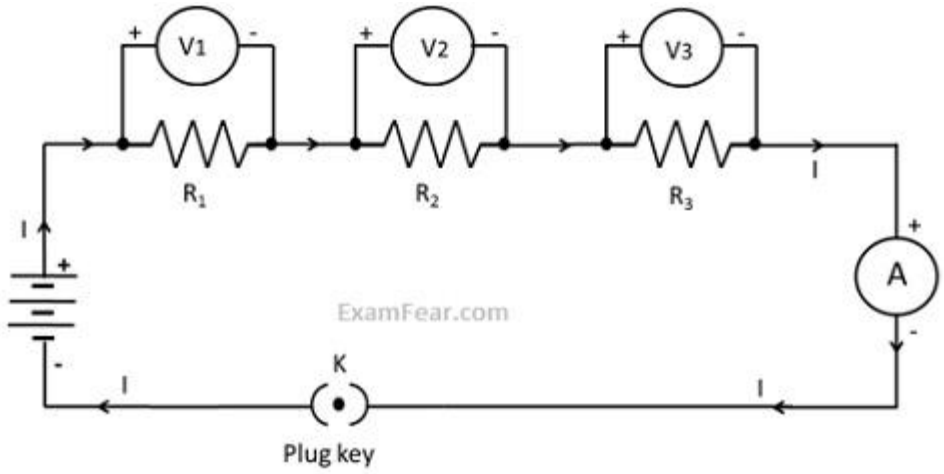
Resistance of resistor (R) = V_A-V_B/1_A-1_B = 12 V – 6 V/ 3.6 A – 1.8 A

= 6V/ 1.8 A = 3.3 Ω

<u>Resistors in series</u>

When two or more resistors are connected in series:

- **The current through the circuit remains the same.**
- **The potential difference becomes sum of the individual potential difference across each resistor.**
- **Equivalent resistance of the circuit is the sum of individual resistances.**



From Ohm's Law,	When resistors are connected in series, potential diff. gets added.	If only one Resistor R is connected in the above such that potential diff. is V, so from Ohm's law,	From (i), (ii) and (iii),
$V_1 = IR_1$ $V_2 = IR_2$ $V_3 = IR_3$	$V = V_1 + V_2 + V_3$	$V = IR$	$V_1 + V_2 + V_3 = IR$ Or, $IR = IR_1 + IR_2 + IR_3$ Or, $R = R_1 + R_2 + R_3$
(i)	(ii)	(iii)	

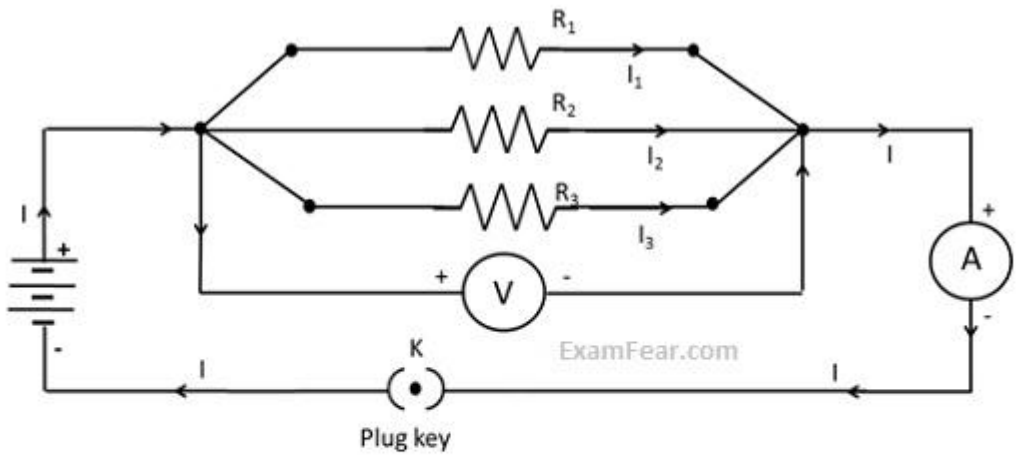
Disadvantages of series arrangement of resistors

- **Two different electrical appliances, having different current requirements, cannot be connected in series as the current is constant in a series circuit.**
- **If one of the components fails in a series circuit, the circuit gets broken and none of the other components get the current.**

Resistors in parallel

When two or more resistors are connected in parallel:

- **The current through the circuit is the sum of currents through each branch of the circuit.**
- **The potential difference across the two points of the circuit remains the same.**
- **The reciprocal of equivalent resistance of the circuit is the sum of reciprocal of the individual resistances.**



From Ohm's Law,	When resistors are connected in parallel, current gets added.	If only one Resistor R is connected in the above such that current is I, so from Ohm's law,	From (i), (ii) and (iii),
$I_1 = V/R_1$ $I_2 = V/R_2$ $I_3 = V/R_3$	$I = I_1 + I_2 + I_3$	$I = V/R$	$I_1 + I_2 + I_3 = V/R$ Or, $V/R = V/R_1 + V/R_2 + V/R_3$ Or, $1/R = 1/R_1 + 1/R_2 + 1/R_3$
(i)	(ii)	(iii)	

Advantages of parallel arrangement of resistors

- **Parallel arrangement divides current in different branches and hence each component receives the required amount of current.**
- **If one of the components fails in the parallel circuit, the rest work as usual.**