DPP – 02

CLASS – 12th

TOPIC – Ohm's Law & Series Parallel Combination

Q.1 A potential difference of 200 volt is maintained across a conductor of resistance 100 ohm. Calculate the number of electrons flowing through it in one second. Charge on electron, $e = 1.6 \times 10^{-19}$ C.

Q.2 A wire of resistance 5 ohm is drawn out so that its length is increased to twice its original length. Calculate its new resistance.

Q.3 Calculate the electrical conductivity of the material of a conductor of length 3 m, area of cross-section 0.2 mm^2 having a resistance of 2 ohm.

Q.4 A carbon resistor has coloured strips as shown in Fig. 1.36. What is its resistance?

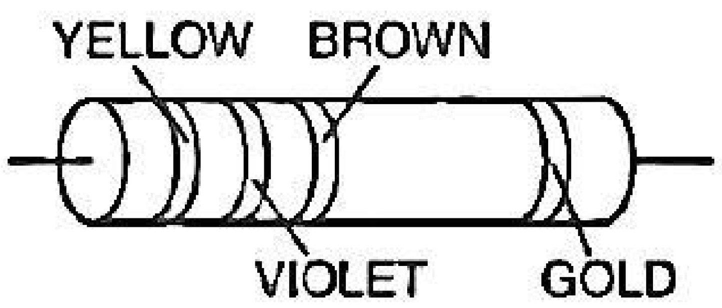

Fig. 1.36

Q.5 How will you represent a resistance of 37,00 $\Omega \pm 10\%$ by colour code?

Q.6 A series combination of three resistors takes a current of 2 A from a 24 V supply. If the resistors are in the ratio 1 : 2 : 3, find the values of the unknown resistors.

Q.7 A parallel combination of three resistors takes a current of 5 A from a 20 V supply. If the two resistors are of 10 ohm and 8 ohm, find the value of third one.

Q.8 A resistor of 5Ω resistance is connected in series with a parallel combination of a number of resis-tors each of 6Ω. If the total resistance of the combination is 7Ω, how many resistors are in parallel ?

Q.9 Five resistors are connected as shown in Fig. 1.37. Find the equivalent resistance between the points A and C

Q.10 Three resistances of 30 Ω each are connected to form a triangle. A cell of e.m.f. 2 V and negligible internal resistance is connected between any two vertices [Fig.1.39]. Find the current through the cell.

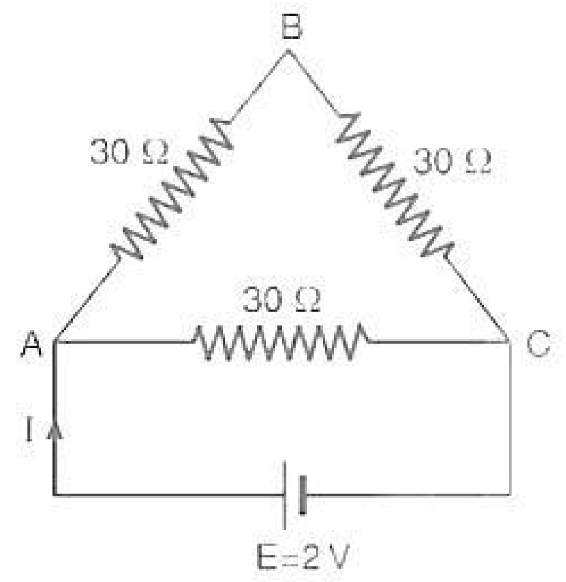

Fig. 1.39

SOLUTION

(PHYSICS) **Current Electricity**

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TOPIC – Ohm's Law & Series Parralel Combination

Sol.1 Here, V = 200 volt; R = 100 ohm; e = 1.6×10^{-19} C

Now, $I = \frac{V}{R} = \frac{200}{100} = 2$ ampere

The charge flowing in 1 s,

$$q = I\,t = 2 \times 1 = 2\text{ C}$$

Therefore, the number of electrons flowing through the conductor in 1s,

$$n = \frac{q}{e} = \frac{2}{1.6 \times 10^{-19}} = \mathbf{1.25 \times 10^{19}}$$

Sol.2 Let l be the length and A, the area of cross-section of the wire. If p is the resistivity of its material, then

$$R = \rho \frac{l}{A} \qquad \text{............... (i)}$$

Suppose that when length of the wire is increased to $l'(= 2l)$, its area of cross-section becomes A'. As the volume of the wire must remain the same, we have

$$A\,l = A'\,l' \quad \text{or} \quad A' = \frac{A\,l}{2\,l} = \frac{A}{2}$$

Let R' be the new resistance of the wire. Then,

$$R' = \rho \frac{l'}{A'} = \rho \frac{2\,l}{A/2} = 4\,\rho \frac{l}{A}$$

From the equations (i) and (ii), we have

$R' = 4 R = 4 \times 5 = 20\ \Omega$ $\qquad \because R = 5\Omega$

Sol.3 Here, l = 3m; A = 0.02 mm² = 0.2×10^{-6} m²;

$R = 2\,\Omega$

Now, $R = \rho \frac{l}{A}$ or $\rho = \frac{R\,A}{l}$

Also, the conductivity of the wire, $\sigma = \frac{1}{p}$

Or $$\sigma = \frac{l}{R\,A} = \frac{3}{2 \times 0{\cdot}2 \times 10^{-6}} = 7{\cdot}5 \times 10^{6}\ \mathrm{S\ m^{-1}}$$

Sol.4 Corresponding to first two colour bands of yellow and violet colours, the figures are 4 and 7. Corresponding to the third band of brown colour, the multiplier is 10^1 i.e. 10. Therefore, the given carbon resistor is of value 47 × 10 i.e. 470 Ω. Since the band showing the tolerance is golden, the value of resistor,

R = 470 $\Omega \pm 5\%$

Sol.5 Here, R = 3700 $\Omega \pm 10\%$ = 37 × $10^2\,\Omega \pm 10\%\,\Omega$

According to colour code of carbon resistance, the colour of bands corresponding to figures 3 and 7 are orange and violet respectively and corresponding to multiplier 10^2, the colour of band is red. Finally, corresponding to tolerance of 10%, the colour of band is silver.

Hence, the resistance of $37{,}000\Omega \pm 10\%$ will be represented by the bands of colour orange, violet, red and silver.

Sol.6 Here, E = 24 V;I = 2 A

$\therefore \quad R_S = \frac{24}{2} = 12\,\Omega$

Let R1, R2 and R3 be the resistances of the three unknown resistors. The resistors are in the ratio 1 : 2 : 3 Let $R_1 = R_2 = 2R$ and $R_3 = 3R$.

Now, $Rs = R_1 + R_2 + R_3$ or $12 = R + 2R + 3R$

Or $6R = 12$ or $R = 2$

Hence, $R_1 = 2\,\Omega$, $R_2 = 4\,\Omega$ and $R_3 = 6\,\Omega$

Sol.7 Here, E = 20 V; I = 5A

$\therefore \quad R_p = \frac{20}{5} = 4\,\Omega$

Let R be the unknown resistance. Then,

or $\frac{1}{R_p} = \frac{1}{R} + \frac{1}{10} + \frac{1}{8}$ or $\frac{1}{4} = \frac{1}{R} + \frac{1}{10} + \frac{1}{8}$

or $\frac{1}{R} = \frac{1}{4} - \frac{1}{10} - \frac{1}{8} = \frac{1}{40}$

or $R = 40\,\Omega$

Sol.8 Let n resistors each of $6\,\Omega$ be connected in parallel and then the combination be connected in parallel and then the combination be connected in series with resistor of $6\,\Omega$. The resistance of the parallel combination of n resistors, each of $6\,\Omega$, is given by

$$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{6} + \frac{1}{6} \ldots\ldots n \text{ times} = \frac{n}{6}$$

or $R_p = \frac{6}{n}\Omega$

As this parallel combination is connected in series with the resistor of $5\,\Omega$, the total resistance of the combination is given by

$$R = R_p + 5 = \frac{6}{n} + 5$$

Since resistance of the combination is $7\,\Omega$, it follows that

$\frac{6}{n} + 5 = 7$ or $\frac{6}{n} = 2$

or $n = 3$

Sol.9 The resistances of segments AB and BC are in series. If R_1 is effective resistance of the part ABC of the circuit, then

$R_1 = 9 + 5 = 14\ \Omega$

Also, the resistances of segment AD and DC are in series. If R_2 is effective resistance of the part ADC of the circuit, then

$R_2 = 3 + 7 = 10\ \Omega$

The resistances R_1. 10 Ω (of segment AC) and R_2 are in parallel. If R is the effective resistance of the circuit, then

$$\frac{1}{R} = \frac{1}{14} + \frac{1}{10} + \frac{1}{10} = \frac{5+7+7}{70} = \frac{19}{70}$$

or $R = \frac{70}{19}\Omega$

Sol.10 The resistances AB and BC are in series. Therefore, their effective resistance,

$$R_1 = 30 + 30 = 60\ \Omega$$

The effective resistance R_1 (= 60 Ω) and the resistance AC (=30 Ω) are in parallel. Therefore, the equivalent resistance of the network is given by

$$R = \frac{60 \times 30}{60 + 30} = 20\Omega$$

If I is current through the cell , then

$$I = \frac{E}{R} = \frac{2}{20} = 0.1A$$