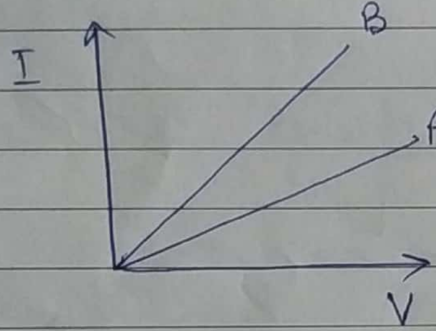
Assignment No 2

Q1: A Conductor of resistance R is stretched to double its length. What will be new Value of resistance?

Q2: Two Copper wires of same length, One is thin and other is thick. Which wire will have more value of resistivity?

Q3:



V-I characteristic for two metallic Conductors are shown in diag.
For which Conductor, resistance will be more?

Q4: A metallic Conductor of Copper is heated. What will happen to Value of resistance of metallic Conductor?

Q5: Name the physical quantity whose unit is ohm-metre.

Q6: specific resistance of Copper, silver and Constantan are $1.18 \times 10^{-6}\ \Omega$ cm, $1.0 \times 10^{-6}\ \Omega$ cm and $48 \times 10^{-6}\ \Omega$ cm, resp. Which is the best Conductor of electricity and why?

Q7: Calculate electric field strength in the Copper wire which Carries a current of 100 Amp. and having area of Cross-section $1.0 \times 10^{-4}\ m^2$. Given Resistivity of Copper is $1.6 \times 10^{-8}\ \Omega$ metre

Q8: The number of free electrons in $1\ cm^3$ of Copper is 8.5×10^{22}. If 1 Amp Current flows through Copper wire of Cross-Section $2\ mm^2$. Calculate the drift velocity of electrons in Copper wire.

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Ans 1: As wire is stretched to double its length, it means that area of Cross-section of wire will change so that volume of wire remains Constant.

$$\therefore A_1 l_1 = A_2 l_2$$

$$\Rightarrow \frac{A_1}{A_2} = \frac{l_2}{l_1} = \frac{2l}{l} = \frac{2}{1}$$

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

$$\Rightarrow \frac{R_2}{R_1} = \frac{l_2}{l_1} \times \frac{A_1}{A_2}$$ { ∵ ρ remains Constant for particular wire }

$$\frac{R_2}{R_1} = \frac{2}{1} \times \frac{2}{1} = \frac{4}{1}$$

As $R_1 = R$ ∴ $R_2 = 4R_1$

$$\boxed{R_2 = 4R}$$

Resistance of wire will become 4R

Ans2: Resistivity will be same for both wires. Because, resistivity depends only on the nature of material of wire.

Ans3: Slope of V-I characteristic $= \frac{1}{R}$

$$\therefore R = \frac{1}{\text{Slope of V-I graph}}$$

Hence, lesser the value of slope of V-I graph; more will be value of resistance.

Conductor A will have more value of resistance As slope of V-I graph is less for A.

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Ans4: On heating metallic Conductor, thermal velocity of free e's will increase. Hence, chances of Collisions suffered by free e's with ions will increase which Causes increase in the value of resistance.

Resistance of metallic Conductor increases with rise of temp i.e. On heating.

Ans 5: Resistivity

Ans6: Silver is best Conductor of electricity because specific resistance of Silver is least.

Ans 7:

$I = 100$ Amp $\quad A = 10^{-4} m^2 \quad \rho = 1.6 \times 10^{-8} \Omega m$ (given)

$E = ?$

We know that $V = IR = I\rho \frac{l}{A}$

$$\therefore \frac{V}{l} = \frac{I\rho}{A} \Rightarrow E = \frac{I\rho}{A} \quad \left\{ \because E = \frac{V}{l} \right\}$$

$$\therefore E = \frac{100 \times 1.6 \times 10^{-8}}{10^{-4}} = 1.6 \times 10^{-2} V/m$$

$$\boxed{E = 1.6 \times 10^{-2} V/m}$$

Ans 8:

$$A = 2 mm^2 = 2 \times 10^{-6} m^2 \left\{ \because 1 \text{ metre} = 10^{+3} mm, \; 1 m^2 = 10^{+6} mm^2 \quad \text{OR } 1 mm^2 = 10^{-6} m^2 \right\}$$

no. of Carriers in $1 cm^3 = 8.5 \times 10^{22}$

no. of Carriers in $1 m^3 = 8.5 \times 10^{22} \times 10^6 \quad \left\{ 1 m = 100 cm, \; 1 m^3 = 10^6 cm^3 \right\}$

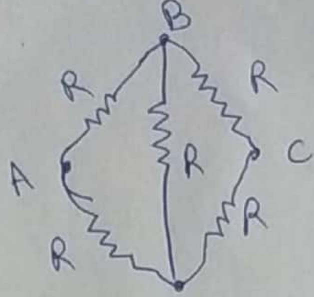
We know that $I = neAv_d$

$e \rightarrow$ charge on electron $= 1.6 \times 10^{-19}$ Coulomb

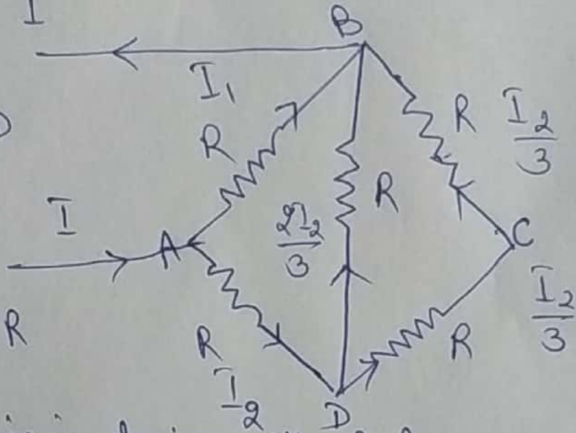
$$\therefore v_d = \frac{I}{neA} = \frac{1}{8.5 \times 10^{28} \times 1.6 \times 10^{-19} \times 2 \times 10^{-6}}$$

$$= \frac{100}{8.5 \times 3.2} \times 10^{-5} = 3.68 \times 10^{-5} m/sec$$

Problem: Five equal resistances each of value R are connected to form a network as shown in figure. What is the equivalent resistance of the network between points A and B?



Solution:



Resistance across points B and D

R and 2R are in parallel

$$\therefore R_p' = R_{BD} = \frac{R \times 2R}{3R} = \frac{2}{3}R$$

Now R (across points A and D) is in series with $\frac{2}{3}R$

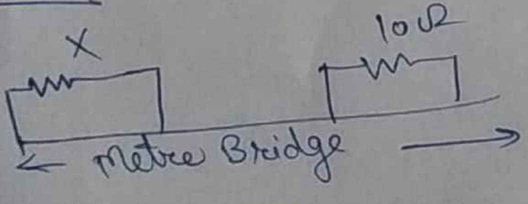
$$\therefore R_s' = R + \frac{2}{3}R = \frac{5}{3}R$$

Now R and $\frac{5}{3}R$ are in parallel

$$\therefore R_{eq} = \frac{(R)\left(\frac{5}{3}R\right)}{8/3\,R} = \frac{5}{8}R$$

Problem: A wire connected in the left gap of a metrebridge balance 10 Ω resistance in the right gap to a point which divides the bridge wire in the ratio 3:2. If the length of wire is 1 metre, then what will be the length of one ohm wire.

Solution:



$$\frac{X}{10} = \frac{3}{2} \text{ (given)}$$

$$\therefore X = \frac{30}{2} = 15\,\Omega$$

Now length of 15 Ω resistance wire is 1 metre (given)

Since Resistance ∝ length (Keeping ρ, A to be constant)

$$\Rightarrow \frac{15}{1} = \frac{1}{l} \qquad \therefore l = \frac{1}{15} \text{ metres}$$

$$= .067 \text{ metres}$$