Total resistance = 1 + 2 + 3 = 6 Ω

Current flowing through the circuit = I

Emf of the battery, E = 12 V

Total resistance of the circuit, R = 6 Ω

The relation for current using Ohm's law is,

$$I = \frac{E}{R}$$
$$= \frac{12}{6} = 2 \text{ A}$$

Potential drop across 1 Ω resistor = V_1

From Ohm's law, the value of V_1 can be obtained as

$V_1 = 2 \times 1 = 2$ V … (i)

Potential drop across 2 Ω resistor = V_2

Again, from Ohm's law, the value of V_2 can be obtained as

$V_2 = 2 \times 2 = 4$ V … (ii)

Potential drop across 3 Ω resistor = V_3

Again, from Ohm's law, the value of V_3 can be obtained as

$V_3 = 2 \times 3 = 6$ V … (iii)

Therefore, the potential drop across 1 Ω, 2 Ω, and 3 Ω resistors are 2 V, 4 V, and 6 V respectively.

Question 3.4:

Three resistors 2 Ω, 4 Ω and 5 Ω are combined in parallel. What is the total resistance of the combination?

If the combination is connected to a battery of emf 20 V and negligible internal resistance, determine the current through each resistor, and the total current drawn from the battery.

Answer

Temperature, $T_2 = 100°C$

Resistance of the silver wire at T_2, $R_2 = 2.7\ \Omega$

Temperature coefficient of silver = α

It is related with temperature and resistance as

$$\alpha = \frac{R_2 - R_1}{R_1(T_2 - T_1)}$$
$$= \frac{2.7 - 2.1}{2.1(100 - 27.5)} = 0.0039\ °C^{-1}$$

Therefore, the temperature coefficient of silver is $0.0039°C^{-1}$.

Question 3.8:

Aheating element using nichrome connected to a 230 V supply draws an initial current of 3.2 A which settles after a few seconds toa steady value of 2.8 A. What is the steady temperature of the heating element if the room temperature is 27.0 °C? Temperature coefficient of resistance of nichrome averaged over the temperature range involved is $1.70 \times 10^{-4}\ °C^{-1}$.

Answer

Supply voltage, $V = 230$ V

Initial current drawn, $I_1 = 3.2$ A

Initial resistance = R_1, which is given by the relation,

$$R_1 = \frac{V}{I}$$
$$= \frac{230}{3.2} = 71.87\ \Omega$$

Steady state value of the current, $I_2 = 2.8$ A

Resistance at the steady state = R_2, which is given as

$$= -3\left(\frac{-2}{17}\right) = \frac{6}{17}\text{ A}$$

$$I_2 = -2(I_4)$$

$$= -2\left(\frac{-2}{17}\right) = \frac{4}{17}\text{ A}$$

$$I_2 - I_4 = \frac{4}{17} - \left(\frac{-2}{17}\right) = \frac{6}{17}\text{ A}$$

$$I_3 + I_4 = \frac{6}{17} + \left(\frac{-2}{17}\right) = \frac{4}{17}\text{ A}$$

$$I_1 = I_3 + I_2$$

$$= \frac{6}{17} + \frac{4}{17} = \frac{10}{17}\text{ A}$$

Therefore, current in branch $\text{AB} = \frac{4}{17}\text{ A}$

In branch BC = $\frac{6}{17}\text{ A}$

In branch CD = $\frac{-4}{17}\text{ A}$

In branch AD = $\frac{6}{17}\text{ A}$

In branch BD = $\left(\frac{-2}{17}\right)\text{ A}$

Total current = $\frac{4}{17} + \frac{6}{17} + \frac{-4}{17} + \frac{6}{17} + \frac{-2}{17} = \frac{10}{17}\text{ A}$

Question 3.10:

In a metre bridge [Fig. 3.27], the balance point is found to be at 39.5 cm from the end *A*, when the resistor *Y* is of 12.5 Ω. Determine the resistance of *X*. Why are the connections between resistors in a Wheatstone or meter bridge made of thick copper strips?

Determine the balance point of the bridge above if *X* and *Y* are interchanged.

What happens if the galvanometer and cell are interchanged at the balance point of the bridge? Would the galvanometer show any current?

When a steady current flows in a metallic conductor of non-uniform cross-section, the current flowing through the conductor is constant. Current density, electric field, and drift speed are inversely proportional to the area of cross-section. Therefore, they are not constant.

No, Ohm's law is not universally applicable for all conducting elements. Vacuum diode semi-conductor is a non-ohmic conductor. Ohm's law is not valid for it.

According to Ohm's law, the relation for the potential is $V = IR$

Voltage (V) is directly proportional to current (I).

R is the internal resistance of the source.

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

If V is low, then R must be very low, so that high current can be drawn from the source.

In order to prohibit the current from exceeding the safety limit, a high tension supply must have a very large internal resistance. If the internal resistance is not large, then the current drawn can exceed the safety limits in case of a short circuit.

Question 3.19:

Choose the correct alternative:

Alloys of metals usually have (greater/less) resistivity than that of their constituent metals.

Alloys usually have much (lower/higher) temperature coefficients of resistance than pure metals.

The resistivity of the alloy manganin is nearly independent of/increases rapidly with increase of temperature.

The resistivity of a typical insulator (e.g., amber) is greater than that of a metal by a factor of the order of (10^{22}/10^{3}).

Answer

Alloys of metals usually have greater resistivity than that of their constituent metals.

Alloys usually have lower temperature coefficients of resistance than pure metals.

The resistivity of the alloy, manganin, is nearly independent of increase of temperature.

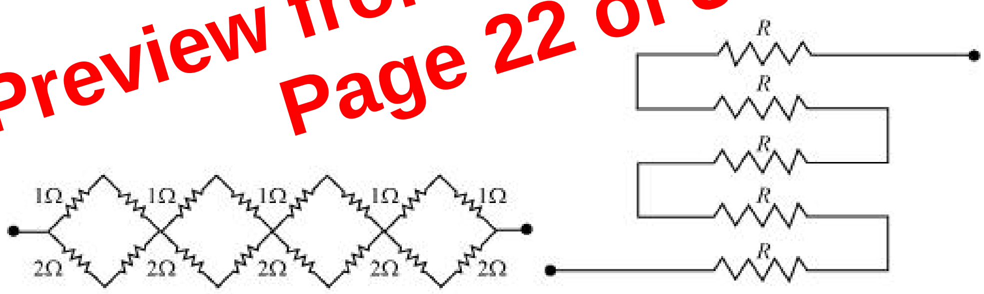
The resistivity of a typical insulator is greater than that of a metal by a factor of the order of 10^{22}.

Question 3.20:

Given n resistors each of resistance R, how will you combine them to get the (i) maximum (ii) minimum effective resistance? What is the ratio of the maximum to minimum resistance?

Given the resistances of 1 Ω, 2 Ω, 3 Ω, how will be combine them to get an equivalent resistance of (i) (11/3) Ω (ii) (11/5) Ω, (iii) 6 Ω, (iv) (6/11) Ω?

Determine the equivalent resistance of networks shown in Fig. 3.31.



(a) (b)

Answer

Total number of resistors = n

Resistance of each resistor = R

When n resistors are connected in series, effective resistance R_1 is the maximum, given by the product nR.