Class 10 Solutions Science Chapter 11 Electricity

Q1: What does an electric circuit mean?
Ans: A continuous and closed path of an electric current is called an electric circuit. An electric circuit consists of electric devices, source of electricity and wires that are connected with the help of a switch.

Q2: Define the unit of current.
Ans: The unit of electric current is ampere(A). 1 A is defined as the flow of 1 C of charge through a wire in 1 s.

Q3: Calculate the number of electrons constituting one coulomb of charge.
Ans: One electron possesses a charge of 1.6×10^{-19}C, i.e., 1.6×10^{-19}C of charge is contained in 1 electron.

∴ 1 C of charge is contained in $\dfrac{1}{1.6 \times 10^{-19}} = 6.25 \times 10^{18} = 6 \times 10^{18}$ electrons

Therefore, 6 x 10^{18} electrons constitute one coulomb of charge.

Q1: Name a device that helps to maintain a potential difference across a conductor.
Ans: Any source of electricity like a battery, cell, power supply, etc. helps to maintain a

potential difference across a conductor. **Simple Battery Circuit**

Q2: What is meant by saying that the potential difference between two points is 1 V?
Ans: If 1 J of work is required to move a charge of amount 1 C from one point to another, then it is said that the potential difference between the two points is 1 V.

Q3: How much energy is given to each coulomb of charge passing through a 6V battery?
Ans: The energy given to each coulomb of charge is equal to the amount of work which is done in moving it.
Now we know that,

Potential difference = $\dfrac{\text{Work done}}{\text{Charge}}$

∴ Work done = Potential difference × charge
Where, Charge = 1 C and Potential difference = 6 V
∴ Work done = 6×1
= 6 Joule.

Page No. 181

Q1: On what factors does the resistance of a conductor depend?
Ans: The resistance of a conductor depends upon the following factors:
(a) Length of the conductor
(b) Cross-sectional area of the conductor
(c) Material of the conductor
(d) Temperature of the conductor

A = area

L = length

ρ = resistivity

$= $ —W— R

$R = \rho \dfrac{L}{A}$
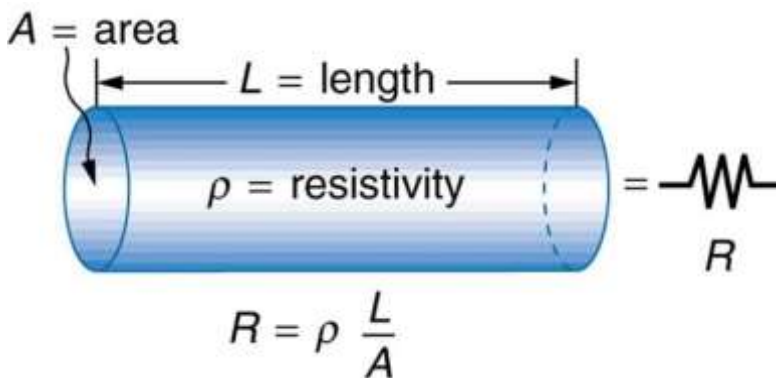
Q2: Will current flow more easily through a thick wire or a thin wire of the same material, when connected to the same source? Why?
Ans:

Resistance of a wire, $R = \rho \dfrac{l}{A}$

Where,
ρ = Resistivity of the material of the wire
l = Length of the wire
A = Area of cross-section of the wire
Resistance is inversely proportional to the area of cross-section of the wire.
Thicker the wire, lower is the resistance of the wire and vice-versa. Therefore, current can flow more easily through a thick wire than a thin wire.

Q3: Let the resistance of an electrical component remains constant while the potential difference across the two ends of the component decreases to half of its former value. What change will occur in the current through it?
Ans:
According to Ohm's law
$V = IR$
$I = V/R$ ... (1)
Now Potential difference is decreased to half
∴ New potential difference $V' = V/2$

Resistance remains constant

So the new current $I' = \dfrac{V'}{R'} = \dfrac{\frac{V}{2}}{R} = \dfrac{1}{2}\left(\dfrac{V}{R}\right) = \dfrac{I}{2}$

Therefore, the amount of current flowing through the electrical component is reduced by half.

Q4: Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal?
Ans: The resistivity of an alloy is higher than the pure metal. Moreover, at high temperatures, the alloys do not melt readily. Hence, the coils of heating appliances such as electric toasters and electric irons are made of an alloy rather than a pure metal.

Q5: Use the data in Table 12.2 to answer the following
Table 12.2 Electrical resistivity of some substances at 20°C

Topics	Material	Resistivity (Ω m)
Conductors	Silver	1.60×10^{-8}
	Copper	1.62×10^{-8}
	Aluminium	2.63×10^{-8}
	Tungsten	5.20×10^{-8}
	Nickel	6.84×10^{-8}
	Iron	10.0×10^{-8}
	Chromium	12.9×10^{-8}
	Mercury	94.0×10^{-8}
	Manganese	1.84×10^{-6}
	Constantan (alloy of Cu and Ni)	49×10^{-6}
	Manganin (alloy of Cu, Mn and Ni}	44×10^{-6}
Alloys	Nichronie (alloy of Ni, Cr, Mn and Fe)	100×10^{-6}
	Glass	$10^{10} - 10^{14}$

	Hard rubber	10^{13} - 10^{16}
Insulators	Ebonite Diamond	10^{15} - 10^{17} 10^{12} - 10^{13}
	Paper (dry)	10^{12}

Ans:
(a) Resistivity of iron = 10.0 x 10^{-8} Ω
Resistivity of mercury = 94.0 x 10^{-8} Ω
Resistivity of mercury is more than that of iron. This implies that iron is a better conductor than mercury.
(b) It can be observed from Table 12.2 that the resistivity of silver is the lowest among the listed materials. Hence, it is the best conductor.

Page No. 185

Q1: Draw a schematic diagram of a circuit consisting of a battery of three cells of 2 V each, a 5 Ω resistor, an 8 Ω resistor, and a 12 Ω resistor, and a plug key, all connected in series.
Ans: Three cells of potential 2 V, each connected in series, therefore, the potential difference of the battery will be 2 V + 2 V + 2 V = 6V. The following circuit diagram shows three resistors of resistances 5 Ω, 8 Ω and 12 Ω respectively connected in series and a battery of potential 6 V and a plug key which is closed means the current is flowing in the circuit.
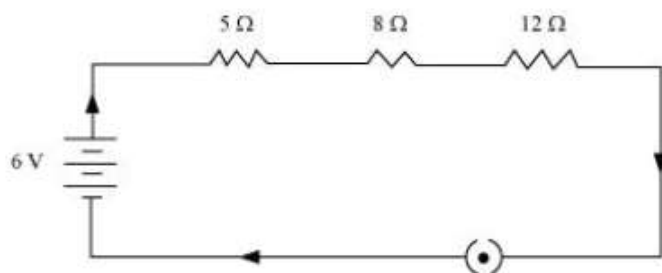
Q2: Redraw the circuit of question 1, putting in an ammeter to measure the current through the resistors and a voltmeter to measure the potential difference across the 12 Ω resistor. What would be the readings in the ammeter and the voltmeter?
Ans: An ammeter should be connected in the circuit in series with the resistors. To measure the potential difference across the resistor it should be connected in parallel, as shown in the following figure.
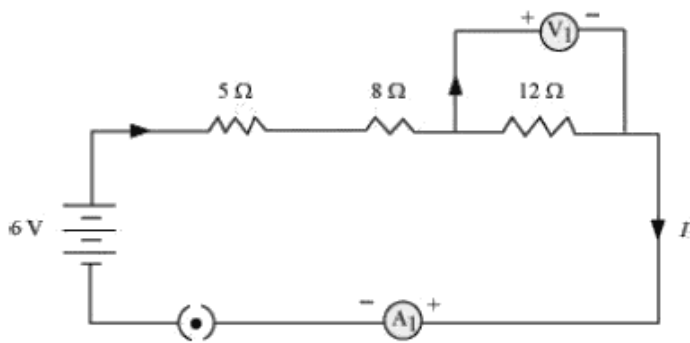
The resistances are connected in series.

Ohm's law can be used to obtain the readings of ammeter and voltmeter. According to Ohm's law,

V = IR,

Where, Potential difference, V = 6 V

Current flowing through the circuit/resistors = I

Resistance of the circuit, R = 5 + 8 + 12 = 25Ω

I = V/R = 6/25 = 0.24 A

Potential difference across 12 Ω resistor = V_1

Current flowing through the 12 Ω resistor, I = 0.24 A

Therefore, using Ohm's law, we obtain

V_1 = IR = 0.24 x 12 = 2.88 V

Therefore, the reading of the ammeter will be 0.24 A.

The reading of the voltmeter will be 2.88 V.

Page No. 188

Q1: Judge the equivalent resistance when the following are connected in parallel – (a) 1 Ω and 10^6Ω,
(b) 1 Ω and 10^3Ω and 10^6Ω.

Ans: (a) When 1 Ω and 10^6 Ω are connected in parallel: Let R be the equivalent resistance.

$$\therefore \frac{1}{R} = \frac{1}{1} + \frac{1}{10^6}$$

$$R = \frac{10^6}{1 + 10^6} \approx \frac{10^6}{10^6} = 1\Omega$$

Therefore, equivalent resistance ≈ 1 Ω

(b) When 1Ω, 10^3 Ω and 10^6 Ω are connected in parallel:

Let R be the equivalent resistance.

$$\frac{1}{R} = \frac{1}{1} + \frac{1}{10^3} + \frac{1}{10^6} \quad \frac{10^6 + 10^3 + 1}{10^6}$$

$$R = \frac{1000000}{1001001} = 0.999 \ \Omega$$

Therefore, equivalent resistance = 0.999 Ω

Q2: An electric lamp of 100 Ω, a toaster of resistance 50 Ω, and a water filter of resistance

500 Ω are connected in parallel to a 220 V source. What is the resistance of an electric iron connected to the same source that takes as much current as all three appliances, and what is the current through it?
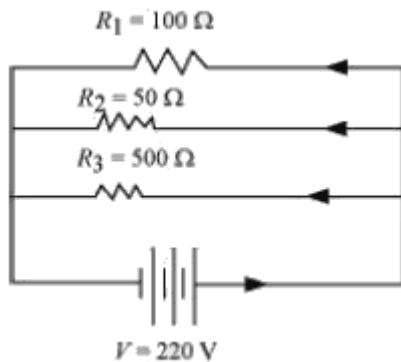
Ans:

Resistance of electric lamp, $R_1 = 100\ \Omega$

Resistance of toaster, $R_2 = 50\ \Omega$

Resistance of water filter, $R_3 = 500\ \Omega$

Potential difference of the source, $V = 220\ V$

These are connected in parallel, as shown in the following figure.

$$R_1 = 100\ \Omega$$
$$R_2 = 50\ \Omega$$
$$R_3 = 500\ \Omega$$
$$V = 220\ V$$

Let R be the equivalent resistance of the circuit.

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{100} + \frac{1}{50} + \frac{1}{500}$$

According to Ohm's law,

$$V = IR$$

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

Where,

Current flowing through the circuit $= I$

$$I = \frac{220}{\frac{500}{16}} = \frac{220/16}{50} = 7.04\ A$$

7.04 A of current is drawn by all the three given appliances.

Therefore, current drawn by an electric iron connected to the same source of potential 220 V= 7,04 A

Let R' be the resistance of the electric iron. According to Ohm's law,

V= IR'

$$R' = \frac{V}{I} = \frac{220}{7.04} = 31.25\ \Omega$$

Therefore, the resistance of the electric iron is 31.25 Ω and the current flowing through it is 7.04 A,

Q3: What are the advantages of connecting electrical devices in parallel with the battery instead of connecting them in series?

Ans: Advantages of connecting electrical devices in parallel:

(i) When the appliances are connected in parallel with the battery, each appliance gets the same potential difference as that of battery which is not possible in series connection.

(ii) Each appliance has different resistances and requires different currents to operate properly. This is possible only in parallel connection, as in series connection, the same current flows through all devices, irrespective of their resistances.
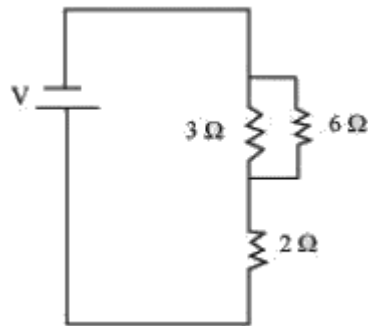(iii) If one appliance fails to work, others will continue to work properly. If they are connected in parallel.

Q4: How can three resistors of resistances 2Ω, 3Ω and 6Ω be connected to give a total resistance of (a) 4Ω, (b) 1Ω?
Ans:
There are three resistors of resistances 2Ω, 3Ω, and 6Ω respectively.

(a) The following circuit diagram shows the connection of the three resistors.

Here, 6 Ω and 3 Ω resistors are connected in parallel.
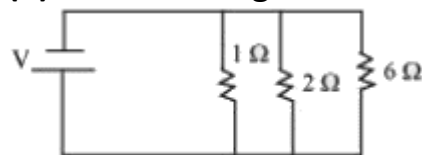Therefore, their equivalent resistance will be given by

$$\frac{1}{\frac{1}{6}+\frac{1}{3}} = \frac{6 \times 3}{6+3} = 2\ \Omega$$

This equivalent resistor of resistance 2 Ω is connected to a 2 Ω resistor in series.
Therefore, the equivalent resistance of the circuit = 2 Ω + 2 Ω = 4 Ω
Hence the total resistance of the circuit is 4 Ω.

(b) The following circuit diagram shows the connection of the three resistors.

All the resistors are connected in series.
Therefore, their equivalent resistance will be given as

$$\frac{1}{\frac{1}{2}+\frac{1}{3}+\frac{1}{6}} = \frac{1}{\frac{3+2+1}{6}} = \frac{6}{6} = 1\ \Omega$$

Therefore, the total resistance of the circuit is 1 Ω.

Q5: What is (a) the highest, (b) the lowest total resistance that can be secured by combinations of four coils of resistance 4 Ω, 8 Ω, 12 Ω, 24 Ω?
Ans:
There are four coils of resistances 4 Ω, 8 Ω, 12 Ω and 24 Ω respectively.

(a) If these coils are connected in series, then the equivalent resistance will be the highest, given by the sum 4 + 8 + 12 + 24 = 48 Ω

(b) If these coils are connected in parallel, then the equivalent resistance will be the lowest, given by

$$\frac{1}{\frac{1}{4}+\frac{1}{8}+\frac{1}{12}+\frac{1}{24}} = \frac{1}{\frac{6+3+2+1}{24}} = \frac{24}{12} = 2\ \Omega$$

Therefore, 2 Ω is the lowest total resistance.

Page No. 190

Q1: Why does the cord of an electric heater not glow while the heating element does?

Ans: The cord of an electric heater is made up of metallic wire such as copper or aluminium which has low resistance while the heating element is made up of an alloy which has more resistance than its constituent metals. Also, heat produced 'H' is

H = I^2Rt

Thus, for the same current H ∝ R, more heat is produced by heating element as it has more resistance, and it glows.

Q2: Compute the heat generated while transferring 96000 coulombs of charge in one hour through a potential difference of 50 V.

Ans:

Given Charge, Q = 96000C

Time, t= 1hr = 60 x 60= 3600s

Potential difference, V= 50volts

Now we know that H= VIt

So we have to calculate I first

As I= Q/t

∴ I = 96000/3600 = 80/3 A

$$H = 50 \times \frac{80}{3} \times 60 \times 60 = 4.8 \times 10^6\ J$$

Therefore, the heat generated is 4.8 x 10^6 J.

Q3: An electric iron of resistance 20Ω takes a current of 5 A. Calculate the heat developed in 30s.

Ans:

The amount of heat (H) produced is given by the joule's law of heating as H= VIt

Where,

Current, I = 5 A

Time, t = 30 s

Voltage, V = Current x Resistance = 5 x 20 = 100 V

H= 100 x 5 x 30 = 1.5 x 10^4 J.

Therefore, the amount of heat developed in the electric iron is 1.5 x 10^4 J.

Page No. 192

Q1: What determines the rate at which energy is delivered by a current?

Ans: The rate of consumption of electric energy in an electric appliance is called electric power. Hence, the rate at which energy is delivered by a current is the power of the appliance.

Q2: An electric motor takes 5 A from a 220 V line. Determine the power of the motor and the energy consumed in 2 h.

Ans:

Power (P) is given by the expression, P = VI

Where,

Voltage, V = 220 V

Current, I = 5 A

P = 220 x 5 = 1100 W

Energy consumed by the motor = Pt

Where,

Time, t = 2 h = 2 x 60 x 60 = 7200 s

∴ P = 1100 x 7200 = 7.92 x 106 J

Therefore, power of the motor = 1100 W

Energy consumed by the motor = 7.92×10^6 J

Exercises: Page No. 193

Q1: A piece of wire of resistance R is cut into five equal parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R', then the ratio R/R' is -

(a) 1/25

(b) 1/5

(c) 5

(d) 25

Ans: (d) Resistance of a piece of wire is proportional to its length. A piece of wire has a resistance *R*. The wire is cut into five equal parts.

Therefore, resistance of each part = (R/5)

All the five parts are connected in parallel. Hence, equivalent resistance (R') is given as

$$\frac{1}{R'} = \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R} = \frac{5+5+5+5+5}{R}$$

$$\frac{1}{R'} = \frac{25}{R}$$

$$\frac{R}{R'} = 25$$

Therefore, the ratio $\frac{R}{R'}$ is 25.

Q2: Which of the following terms does not represent electrical power in a circuit?

(a) I²R

(b) IR²
(c) VI
(d) V²/R
Ans: (b)
(b) Electrical power is given by the expression, *P = VI* … (i)
According to Ohm's law, *V = IR* … (ii)
Where,
V = Potential difference
I = Current
R = Resistance

$$\therefore P = VI$$

From equation (i), it can be written
P = (IR) × I

$$\therefore P = I^2 R$$

From equation (ii), it can be written

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

$$\therefore P = V \times \frac{V}{R}$$

$$P = \frac{V^2}{R}$$

$$\therefore P = VI = I^2 R = \frac{V^2}{R}$$

Power *P* cannot be expressed as *IR²*.

Q3: An electric bulb is rated 220 V and 100 W. When it is operated on 110 V, the power consumed will be -
(a) 100 W
(b) 75 W
(c) 50 W
(d) 25 W
Ans : (d) Energy consumed by an appliance is given by the expression,

$$P = VI = \frac{V^2}{R}$$

$$R = \frac{V^2}{P}$$

Where,
Power rating, P = 100 W
Voltage, V = 220V

Resistance, $R = \frac{(220)^2}{100} = 484 \ \Omega$

The resistance of the bulb remains constant if the supply voltage is reduced to 110 V. If the bulb is operated on 110 V, then the energy consumed by it is given by the expression for power as

$$\therefore P' = \frac{(V')^2}{R} = \frac{(110)^2}{484} = 25 \ \text{W}$$

Therefore, the power consumed will be 25 W.

Q4: Two conducting wires of the same material and of equal lengths and equal diameters are first connected in series and then parallel in a circuit across the same potential difference. The ratio of heat produced in series and parallel combinations would be -
 (a) 1:2
 (b) 2:1
 (c) 1:4
 (d) 4:1
Ans:
(c) The Joule heating is given by, $H = i^2Rt$
Let, R be the resistance of the two wires.
The equivalent resistance of the series connection is $R_S = R + R = 2R$
If V is the applied potential difference, then it is the voltage across the equivalent resistance.

$$V = i_s \times 2R$$
$$\Rightarrow i_s = \frac{V}{2R}$$

The heat dissipated in time f is,

$$H_s = i_s^2 \times 2R \times t = \left(\frac{V}{2R}\right)^2 \times 2R \times t$$

$$\Rightarrow H_s = \frac{V^2 t}{2R}$$

The equivalent resistance of the parallel connection is $R_P = \dfrac{1}{\dfrac{1}{R} + \dfrac{1}{R}} = \dfrac{R}{2}$
y is the applied potential difference across this Rp.

$$V = i_p \times \frac{R}{2}$$
$$\Rightarrow i_p = \frac{2V}{R}$$

The heat dissipated in time f is,

$$H_p = i_p^2 \times \frac{R}{2} \times t = \left(\frac{2V}{R}\right)^2 \times \frac{R}{2} \times t$$

$$\Rightarrow H_p = \frac{2V^2 t}{R}$$

So; the ratio of heat produced is,

$$\frac{H_s}{H_p} = \frac{\dfrac{V^2 t}{2R}}{\dfrac{2V^2 t}{R}} = \frac{1}{4}$$

Note: H ∝ R also H ∝ i^2 and H ∝ t. In this question, f is same for both the circuit. But the

current through the equivalent resistance of both the circuit is different. We could have solved the question directly using H α R if in case the current was also same. As we know the voltage and resistance of the circuits, we have calculated I in terms of voltage and resistance and used in the equation H = I²Rt to find the ratio.

Q5: How is a voltmeter connected in the circuit to measure the potential difference between two points?
Ans: To measure the potential difference between two points, a voltmeter should be connected in parallel to the points.

Q6: A copper wire has a diameter 0.5 mm and resistivity of 1.6 × 10⁻⁸ Ω m. What will be the length of this wire to make its resistance 10 Ω? How much does the resistance change if the diameter is doubled?
Ans:
Area of cross-section of the wire, A =π (d/2)²
Diameter= 0.5 mm = 0.0005 m
Resistance, R = 10 Ω
We know that

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

$$l = \frac{RA}{\rho}$$

$$= \frac{10 \times 3.14 \times (\frac{0.0005}{2})^2}{1.6 \times 10^{-8}}$$

$$= \frac{10 \times 3.14 \times 25}{4 \times 1.6} = 122.72 \text{ m}$$

∴ length of the wire = 122.72m

if the diameter of the wire is doubled , new diameter = 2 x 0.5=1 mm = 0.001 m
let new Resistance be R´

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

$$= \frac{1.6 \times 10^{-8} \times 122.72}{\pi(\frac{1}{2} \times 10^{-3})^2}$$

$$= \frac{1.6 \times 10^{-8} \times 122.72 \times 4}{3.14 \times 10^{-6}}$$

$$= 250.2 \times 10^{-2} = 2.5 \text{ Ω}$$

Therefore, the length of the wire is 122.7 m and the new resistance is 2.5 Ω.

**Q7: The values 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

Ans: Plot a graph between V and I and calculate the resistance of that resistor. The plot between voltage and current is called IV characteristic. The voltage is plotted on x-axis and current is plotted on y-axis. The values of the current for different values of the voltage are shown in the given table.

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

The IV characteristic of the given resistor is plotted in the following figure.
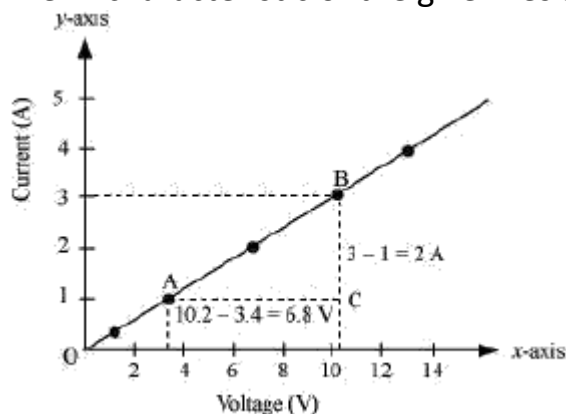
The slope of the line gives the value of resistance (R) as,

$$\text{Slope} = \frac{1}{R} = \frac{BC}{AC} = \frac{2}{6.8}$$

$$R = \frac{6.8}{2} = 3.4 \ \Omega$$

Therefore, the resistance of the resistor is 3.4 Ω.

Q8: 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:
Resistance (R) of a resistor is given by Ohm's law as, V= IR R= V/I
Where,
Potential difference, V= 12 V
Current in the circuit, I= 2.5 mA = 2.5 x 10^{-3} A

$$R = \frac{12}{2.5 \ x \ 10^{-3}} = 4.8 \ x \ 10^{3} \ \Omega = 4.8 \ k\Omega$$

Therefore,
the resistance of the resistor is 4.8 kΩ

Q9: A battery of 9 V is connected in series with resistors of 0.2 Ω, 0.3 Ω, 0.4 Ω, 0.5 Ω and 12 Ω, respectively. How much current would flow through the 12 Ω resistor?
Ans:
There is no current division occurring in a series circuit. Current flow through the component is the same, given by Ohm's law as
V= IR
(I = (V/ R))

Where,
R is the equivalent resistance of resistances 0.2 Ω, 0.3 Ω, 0.4 Ω, 0.5 Ω and 12 Ω. These are connected in series. Hence, the sum of the resistances will give the value of R.
R= 0.2 + 0.3 + 0.4 + 0.5 + 12 = 13.4 Ω
Potential difference, V= 9 V
(I = { 9/13.4 })= 0.671 A
Therefore, the current that would flow through the 12 Ω resistor is 0.671 A.

Q10: How many 176 Ω resistors (in parallel) are required to carry 5 A on a 220 V line?
Ans:
For x number of resistors of resistance 176 Ω, the equivalent resistance of the resistors connected in parallel is given by Ohm's law asV= IR
(R = V/I))
Where,
Supply voltage, V= 220 V
Current, I = 5 A Equivalent resistance of the combination = R,given as

$$\frac{1}{R} = x \times \left(\frac{1}{176}\right)$$

$$R = \frac{176}{x}$$

From Ohm's law,

$$\frac{V}{I} = \frac{176}{x}$$

$$x = \frac{176 \times I}{V} = \frac{176 \times 5}{220} = 4$$

Therefore, four resistors of 176 Ω are required to draw the given amount of current.

Q11: Show how you would connect three resistors, each of resistance 6 Ω so that the combination has a resistance of (i) 9 Ω, (ii) 4 Ω.
Ans: (i) When two 6 Ω resistances are in parallel and the third is in combination with this, the equivalent resistance will be 9Ω.
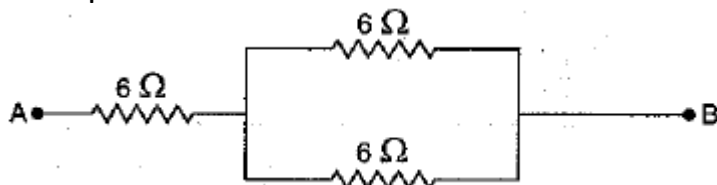
(if) When two 6 Ω resistances are in series and the third is in parallel to them, then it will be 4 Ω.
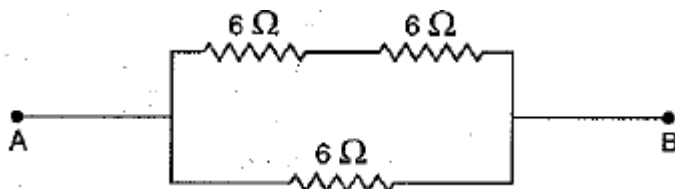
Q12: Several electric bulbs designed to be used on a 220 V electric supply line, are rated 10 W. How many lamps can be connected in parallel with each other across the two wires of 220 V line if the maximum allowable current is 5 A?

Ans: Resistance R_1 of the bulb is given by the expression,

Supply voltage, V = 220 V

Maximum allowable current, I = 5 A

Rating of an electric bulb P=10watts

Because of $R=V^2/P$

$$R1 = \frac{(220)^2}{10} = 4840\,\Omega$$

According to ohm's law

V=IR

Let R is the Total Resistance of the circuit for x number of electric bulbs

$$R=V/I$$

$$= \frac{220}{5} = 44\,\Omega$$

Resistance of each electric bulb, R_1 = 4840 Ω

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots\ldots \text{ upto } x \text{ times.}$$

$$\frac{1}{R} = \frac{1}{R_1} \times x$$

$$x = \frac{R_1}{R} = \frac{4840}{44} = 110$$

∴ Number of electric bulbs connected in parallel is 110.

Q13: A hot plate of an electric oven connected to a 220 V line has two resistance coils A and B, each of 24 Ω resistances, which may be used separately, in series, or in parallel. What are the currents in the three cases?

Ans:

Supply voltage, V= 220 V

Resistance of one coil, R= 24 Ω

(i) Coils are used separately

According to Ohm's law,

V= I_1R_1 Where,

I_1 is the current flowing through the coil

I_1 = V/R_1 = 220/24 = 9.166 A

Therefore, 9.16 A current will flow through the coil when used separately.

(ii) Coils are connected in series

Total resistance, R_2 = 24 Ω + 24 Ω = 48 Ω

According to Ohm's law,V = I_2R_2 Where,

I_2 is the current flowing through the series circuit

I_2 = V/R_2 = 220/48 = 4.58 A

Therefore, 4.58 A current will flow through the circuit when the coils are connected in series.

(iii) Coils are connected in parallel

Total resistance, R_3 is given as =

$$\frac{1}{\frac{1}{24} + \frac{1}{24}} = \frac{24}{2} = 12 \ \Omega$$

According to Ohm's law,

$V = I_3 R_3$

Where,

I_3 is the current flowing through the circuit $I_3 = V/R_3 = 220/12 = 18.33$ A

Therefore, 18.33

A current will flow through the circuit when coils are connected in parallel.

Q14: Compare the power used in the 2 Ω resistor in each of the following circuits:
(i) a 6 V battery in series with 1 Ω and 2 Ω resistors, and
(ii) a 4 V battery in parallel with 12 Ω and 2 Ω resistors.
Ans:
(i) Potential difference, V = 6 V

1 Ω and 2 Ω resistors are connected in series. Therefore, equivalent resistance of the circuit,

R = 1 + 2 = 3 Ω According to Ohm's law,

V = IR Where,

I is the current through the circuit

I= 6/3 = 2 A

This current will flow through each component of the circuit because there is no division of current in series circuits. Hence, current flowing through the 2 Ω resistor is 2 A.

Power is given by the expression,

$P = (I)^2 R = (2)^2 \times 2 = 8$ W

(ii) Potential difference, V = 4 V 12 Ω and 2 Ω resistors are connected in parallel. The voltage across each component of a parallel circuit remains the same.

Hence, the voltage across 2 Ω resistor will be 4 V.

Power consumed by 2 Ω resistor is given by $P = V^2/R = 4^2/2 = 8$ W

Therefore, the power used by 2 Ω resistor is 8 W.

Page No. 194
Exercises

Q15: Two lamps, one rated 100 W at 220 V, and the other 60 W at 220 V, are connected in parallel to electric mains supply. What current is drawn from the line if the supply voltage is 220 V?
Ans:
Both the bulbs are connected in parallel. Therefore, potential difference across each of them will be 220 V, because no division of voltage occurs in a parallel circuit.

Current drawn by the bulb of rating 100 W is given by,

Power = Voltage × Current

(Current = (Power/ Voltage)=(100/ 220}A)

Similarly, current drawn by the bulb of rating 60 W is given by,

Power = Voltage × Current
(Current = (Power/Voltage)={60/220}A)

Hence, current drawn from the line $= \dfrac{100}{220} + \dfrac{60}{220} = 0.727\ A$

Q16: Which uses more energy, a 250 W TV set in 1 hr, or a 1200 W toaster in 10 minutes?
Ans:
Energy consumed by an electrical appliance is given by the expression, H= Pt
Where,
Power of the appliance = P
Time = t
Energy consumed by a TV set of power 250 W in 1 h = 250 ×3600 = 9 ×10^5 J
Energy consumed by a toaster of power 1200 W in 10 minutes = 1200 ×600
Energy consumed by a toaster of power 1200 W in 10 minutes = 1200 ×600 = 7.2×10^5 J
Therefore, the energy consumed by a 250 W TV set in 1 h is more than the energy consumed by a toaster of power 1200 W in 10 minutes.

Q17: An electric heater of resistance 8 Ω draws 15 A from the service mains 2 hours.
Calculate the rate at which heat is developed in the heater.
Ans:
Rate of heat produced by a device is given by the expression for power as, P= I^2R Where,
Resistance of the electric heater, R= 8 Ω Current drawn, I = 15 A
P= $(15)^2$ x 8 = 1800 J/s
Therefore, heat is produced by the heater at the rate of 1800 J/s.

Q18: Explain the following.
(a) Why is tungsten used almost exclusively for filament of electric lamps?
(b) Why are the conductors of electric heating devices, such as bread-toasters and electric irons, made of an alloy rather than a pure metal?
(c) Why is the series arrangement not used for domestic circuits?
(d) How does the resistance of a wire vary with its area of cross-section?
(e) Why are copper and aluminium wires usually employed for electricity transmission?
Ans:
(a) Tungsten is a metal that has a high melting point and is resistant to heat, making it ideal for use in electric lamps where the filament needs to be heated to produce light. The filament is the part of the lamp that gets hot and produces light when an electric current is passed through it.
(b) The conductors of electric heating devices such as bread toasters and electric irons are made of alloy because resistivity of an alloy is more than that of metals which produces large amount of heat.
(c) In series circuits voltage is divided. Each component of a series circuit receives a small voltage so the amount of current decreases and the device becomes hot and does not work

properly. Hence, series arrangement is not used in domestic circuits.
(d) Resistance (R) of a wire is inversely proportional to its area of cross-section (A), i.e.

$$R \propto \frac{1}{A}$$

(e) Copper and aluminium are good conductors of electricity also they have low resistivity. So they are usually used for electricity transmission.