NCERT SOLUTIONS

CLASS - 10th



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Class : 10th
Subject : Science
Chapter : 12
Chapter Name : Electricity

Q1 What does an electric circuit mean?

Answer. An electric circuit consists of electric devices, switching devices, source of electricity, etc. that are connected by conducting wires.

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Q2 Define the unit of current.

Answer. 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.

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Q3 Calculate the number of electrons constituting one coulomb of charge.

Answer. One electron possesses a charge $1.6 \times 10^{-19} \mathrm{C}, \text{ i.e., } 1.6 \times 10^{-19} \mathrm{C}$ Of charge is contained in 1 electron.
contained in 1 electron $\frac{1}{1.6 \times 10^{-19}} = 6.25 \times 10^{18} = 6 \times 10^{18}$ electrons Therefore,

6×10^{18} electrons constitute one coulomb of charge.

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Q1 Name a device that helps to maintain a potential difference across a conductor.

Answer. A source of electricity such as cell, battery, power supply, etc. helps to maintain a potential difference across a conductor.

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Q2 What is meant by saying that the potential difference between two points is 1 V?

Answer. If 1 J of work is required to move a charge of amount 1 C from one point to another, then il that the potential difference between the two points is 1 V.

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Q3 How much energy is given to each coulomb of charge passing through a 6 V battery?

Answer. The energy given to each coulomb of charge is equal to the amount of work required to move it. The amount of work is given by the expression,
Potential difference = $\frac{\text{Work done}}{\text{Charge}}$
Work Done = Potential Difference x Charge
Where,
Charge = I C
Potential difference = 6 V
Work Done = $6 \times 1 = 6\mathrm{J}$
Therefore, 6 J of energy is given to each coulomb of charge passing through a battery of 6 V.

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Q1 On what factors does the resistance of a conductor depend?

Answer. 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

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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?

Answer. Resistance Of a wire, R= $\rho \frac{l}{A}$

Where,
P = 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.

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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?

Answer. The change in the current flowing through the component is given by Ohm's law as,
$V = IR$
$I = \frac{V}{R}$
Where,
Resistance Of the electrical component =R
Potential difference = V
Current = I
The potential difference is reduced to half, keeping resistance constant.
Let the new resistance be R' and the new amount of current be I '
Therefore, from Ohm's law, we obtain the amount of new current.
$I' = \frac{V'}{R'} = \frac{\frac{V}{2}}{R'} = \frac{\frac{V}{2}}{R} = \frac{1}{2}\left(\frac{V}{R}\right) = \frac{I}{2}$
Therefore, the amount of current flowing through the electrical component is reduced by half.

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Q4 Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal?

Answer. 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.

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Q5 Use the data in Table to answer the following –

–	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}
Alloys	Manganin (alloy of Cu, Mn and Ni)	44×10^{-6}
	Nichrome (alloy of Ni, Cr, Mn and Fe)	100×10^{-6}
	Glass	$10^{10} - 10^{14}$
Insulators	Hard rubber	$10^{13} - 10^{16}$
	Ebonite	$10^{15} - 10^{17}$
	Diamond	$10^{12} - 10^{13}$
	Paper (dry)	10^{12}

(a) Which among iron and mercury is a better conductor?
(b) Which material is the best conductor?

Answer. (a) Resistivity of iron = $10.0 \times 10^{-8} \Omega \mathrm{m}$
Resistivity of mercury =$94.0 \times 10^{-8} \Omega \mathrm{m}$
Resistivity of mercury is more than that of iron. This implies that iron is a better conductor than mercury.

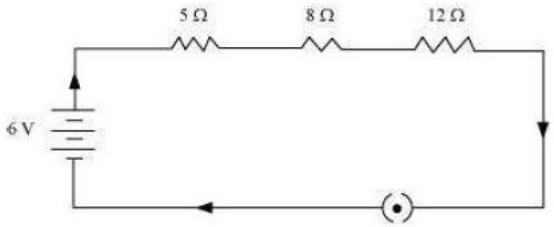
(b) It can be observed from Table 12.2 that the resistivity of silver is the lowest among the listed materials. Hence, it is the best conductor.

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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

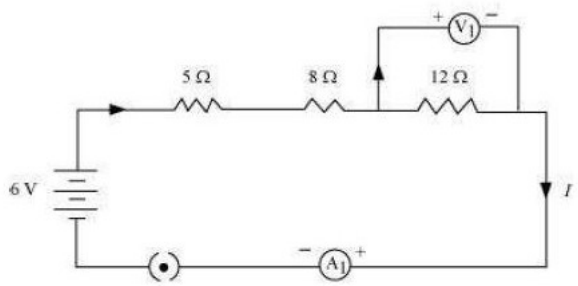
Answer. Three cells of potential 2 V, each connected in series, is equivalent to a battery of potential 2 V + 2 V + 2 V = 6V. The following circuit diagram shows three resistors of resistances 5 G, 8 G and 12 G respectively connected in series and a battery of potential 6 V.



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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?

Answer. To measure the current flowing through the resistors, an ammeter should be connected in the circuit in series with the resistors. To measure the potential difference across the 12 G resistor, a voltmeter should be connected parallel to this resistor, as shown in the following figure.



Ohm's law can be used to obtain the readings of ammeter and voltmeter. According to Ohm's law,
V= IR_r
Potential difference, v 5 v
Current flowing through the circuit/resistors = I
Resistance of the circuit, $R = 5 + 8 + 12 = 25\Omega$
$I = \frac{V}{R} = \frac{6}{25} = 0.24\text{A}$
potential difference across 12 Q resistor =V_1
Current flowing through the 12 Q resistor,$I = 0.24\text{A}$
Therefore, using Ohm's law, we obtain
$V_1 = IR = 0.24 \times 12 = 2.88\text{V}$
Therefore, the reading of the ammeter will be 0.24 A.
The reading Of the voltmeter Will be 2.88 V.

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Q1 Judge the equivalent resistance when the following are connected in parallel $-(a) 1\Omega \text{ and } 10^{\circ}\Omega,\ (\text{b})\ 1\Omega \text{ and } 10^{3}\Omega,\ \text{and } 10^{6}\Omega$

Answer. (a) When Q and Q are connected in parallel:
Let R be the equivalent resistance
$\therefore \frac{1}{R} = \frac{1}{1} + \frac{1}{10^6}$
$R = \frac{10^6}{10^6+1} \approx \frac{10^6}{10^6} = 1\Omega$
Therefore, equivalent resistance $\approx 1\Omega$

(b) When,1 Ω, $10^3\Omega$, and $10^6\Omega$,are connected in parallel,
Let R be the equivalent resistance.

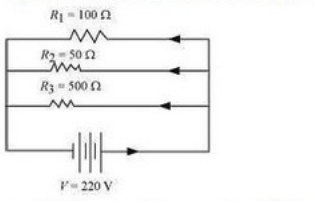
$$\frac{1}{R} = \frac{1}{1} + \frac{1}{10^3} + \frac{1}{10^6} = \frac{10^6 + 10^3 + 1}{10^6}$$
$$R = \frac{1000000}{1001001} = 0.999\Omega$$
Therefore, equivalent resistance ,$= 0.999\Omega$.

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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?

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

Resistance Of toaster, $R_2 = 50\Omega$
Resistance Of water filter, $R_3 = 500\Omega$
Voltage OF the source, $V = 220\text{V}$
These are connected in parallel, as shown in the following figure.



Let R be the equivalent resistance Of the circuit.
$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{100} + \frac{1}{50} + \frac{1}{500}$
$= \frac{5+10+1}{500} = \frac{16}{500}$
$R = \frac{500}{16}\Omega$
According to Ohm's law,
$V = IR$
$I = \frac{V}{R}$
Where,
Current flowing through the circuit = I
I= $\frac{220}{\frac{500}{16}} = \frac{220\times 10}{500} = 7.04\text{A}$
7.04 A Of Current is drawn by all the three given appliances.
Therefore, current drawn b'/ an electric iron connected to the same source of potential
$220\text{V} = 7.04\text{A}$
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 31.25Ω and the current flowing through it is 7.04 A.

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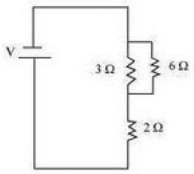
Q3 What are the advantages of connecting electrical devices in parallel with the battery instead of connecting them in series?

Answer. There is no division of voltage among the appliances when connected in parallel. The potential difference across each appliance is equal to the supplied voltage. The total effective resistance Of the circuit Can be reduced by connecting electrical appliances in parallel.

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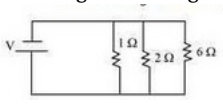
Q4 How can three resistors of resistances 2 Ω, 3 Ω, and 6 Ω be connected to give a total resistance of (a) 4 Ω, (b) 1 Ω?

Answer. There are three resistors of resistances 2 Q, 3 Q, and 6 Q respectively.
(a) The following circuit diagram shows the connection of the three resistors.



Here, 6 Q and 3 Q 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 Q is connected to a 2 Q resistor in series.
Therefore, equivalent resistance of the circuit = $2\Omega + 2\Omega = 4\Omega$
Hence, the total resistance of the circuit is 4Ω

(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 1Ω

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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?

Answer. There are four coils of resistances $4\Omega, 8\Omega, 12\Omega and 24\Omega$ respectively.
(a) If these coils are connected in series, then the equivalent resistance will be the highest, given by the sum $4+8+12+24=48\Omega$
(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 Q is the lowest total resistance.

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

Answer. The heating element of an electric heater is a resistor. The amount of heat produced by it is proportional to its resistance. The resistance of the element of an electric heater is very high. As current flows through the heating element, it becomes too hot and glows red. On the other hand, the resistance of the cord is low. It does not become red when current flows through it.

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

Answer. The amount of heat (H) produced is given by the Joule's law of heating as
H -Vlt
Where,
Voltage, $V=50\mathrm{V}$
Time, t = 1 h = 1 x 60 x 60 s
Amount of current, $I=\frac{\text{Amount of charge}}{\text{Time of flow of charge}}=\frac{96000}{1\times60\times60}=\frac{80}{3}\mathrm{A}$
$H=50\times\frac{80}{3}\times60\times60=4.8\times10^{6}\mathrm{J}$
Therefore, the heat generated is $4.8\times10^{6}\mathrm{J}$

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

Answer. The amount of heat (H) produced is given by the joule's law of heating as
H -Vlt
Where,
Current, I = 5 A
Time, t = 30 s
Voltage, V = Current x Resistance = 5 x 20 = 100 V
$H=100\times5\times30=1.5\times10^{4}\mathrm{J}$
Therefore, the amount of heat developed in the electric iron is $1.5\times10^{4}J$

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

Answer. 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.

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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.

Answer. power (P) is given by the expression,
P=VI
Where,
Voltage, v = 220 v
Current, I = 5 A
Energy consumed by the motor =Pt
Where,
Time, $t=2h=2\times60\times60=7200\mathrm{s}$
$\therefore P=1100\times7200=7.92\times10^{6}\mathrm{J}$
Therefore, power of the motor = 1100 w
Energy consumed by the motor =$7.92\times10^{5}J$

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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

Answer. (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 = $\frac{R}{5}$
All the five parts are connected in parallel. Hence, equivalent resistance 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.

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Q2 Which of the following terms does not represent electrical power in a circuit?
(a) I^2R
(b) IR^2
(c) VI
(d) V^2/R

Answer. (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
$\text{From equation (i), it can be written}$
$P=(IR)\times I$
$\therefore P=I^2R$
$\text{From equation (ii), it can be written}$
$I=\frac{V}{R}$
$\therefore P=V\times\frac{V}{R}$
$\therefore P=\frac{V^2}{R}$
$\therefore P=\frac{V^2}{R}$
Power P cannot be expressed asIR^2.

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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

Answer.
$\text{(d)Energy consumed by an appliance is given by the expression,}$
$P=VI=\frac{V^2}{R}$
$P=VI=\frac{V^2}{R}$
$R=\frac{V^2}{P}$
$R=\frac{V^2}{P}$
Where,
$\text{Power rating, } P=100\text{W}$
$\text{Voltage, } V=220\text{V}$
$\text{Resistance, } R=\frac{(220)^2}{100}=484\Omega$
The resistance of the bulb remains constant if the supply voltage is reduced to 110 V. If the bulb is operated on 110V, then the energy consumed by it is given by the expression for power as
$\therefore P'=\frac{(V')^2}{R}=\frac{(110)^2}{484}=25\text{W}$
$\text{Therefore, the power consumed will be 25w}$

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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

Answer. (c) Heat produced in the circuit is inversely proportional to the resistance R.
Let Rs and R, be the equivalent resistances of the wires if connected in series and parallel respectively. Hence, for same potential difference V, the ratio of heat produced in the circuit is given by

$\frac{H_s}{H_r} = \frac{\frac{V^2}{R_S}t}{\frac{V^2}{R_p}t} = \frac{R_P}{R_s}$

Where,
Heat produced in the series circuit $= H_s$
Heat produced in the parallel circuit $= H_p$
Equivalent resistance, R_s = R + R = 2R

$R_p = \frac{1}{\frac{1}{R}+\frac{1}{R}} = \frac{R}{2}$

$\frac{H_s}{H_p} = \frac{\frac{R}{2}}{2R} = \frac{1}{4}$

Therefore, the ratio Of heat produced in series and parallel combinations is 1:4.

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Q5 How is a voltmeter connected in the circuit to measure the potential difference between two points?

Answer. To measure the potential difference between two points, a voltmeter should be connected in parallel to the points.

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Q6 A copper wire has 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?

Answer.
Resistance (R) of a copper wire of length t and cross-section A is given by the expression,

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

Where,

Resistivity of copper, $\rho = 1.6 \times 10^{-8}\Omega\text{m}$

Area of cross-section of the wire, $A = \sqrt[\pi]{\frac{\text{Diameter}}{2})^2}$

Diameter$=0.5\text{ mm} = 0.0005\text{m}$

Resistance, $R = 10\Omega$

$l = \frac{RA}{\rho} = \frac{10\times3.14\times\left(\frac{0.0005}{2}\right)^2}{1.6\times10^{-8}} = \frac{10\times3.14\times25}{4\times1.6} = 122.72\text{m}$

If the diameter of the wire is doubled, new diameter $= 2 \times 0.5 = 1\text{mm} = 0.001\text{m}$

Therefore, resistance R'

$R' = \rho\frac{I}{A} = \frac{1.6\times10^{-8}\times122.72}{\pi\left(\frac{1}{2}\times10^{-3}\right)^2}$

$= \frac{1.6\times10^{-8}\times122.72\times4}{3.14\times10^{-6}} = 250.2 \times 10^{-2} = 2.5\Omega$

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

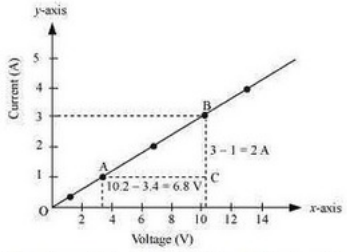
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Q7 The values of current I flowing in a given resistor for the corresponding values of potential difference V across the resistor are given below –
I (amperes) 0.5 1.0 2.0 3.0 4.0
V (volts) 1.6 3.4 6.7 10.2 13.2

Answer. The plot between voltage and current is called IV characteristic. The voltage is plotted 01 x-axis and current is plotted on y-axis. The values of the current for different values c 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,

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

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

Therefore, the resistance of the resistor is 3.4Ω

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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

Answer.

Resistance (R) of a resistor is given by Ohm's law as,

$V = IR$

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

Where,

Potential difference, $V = 12\text{V}$

Current in the circuit, $I = 2.5\text{mA} = 2.5 \times 10^{-3}\text{A}$

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

Therefore, the resistance of the resistor is $4.8\text{k}\Omega$.

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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?

Answer.

There is no current division occurring in a series circuit. Current. Clow through the component is the same, given by Ohm's law as

$V = IR$

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

Where,

R is the equivalent resistance of resistances $0.2\Omega, 0.3\Omega, 0.4\Omega, 0.5\Omega,$ and 12Ω . These are connected in series. Hence, the sum of the resistan

$R = 0.2 + 0.3 + 0.4 + 0.5 + 12 = 13.4\Omega$

Potential difference, $V = 9\text{V}$

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Q10 How many 176 Ω resistors (in parallel) are required to carry 5 A on a 220 V line?

Answer.

For x number of resistors of resistance $176\Omega,$ the equivalent resistance of the resistors connected in parallel is given by Ohm's law as

$V = IR$

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

Where,

Supply voltage, $V = 220\text{V}$

Current, $I = 5\text{A}$

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 176Ω are required to draw the given amount of current.

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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.

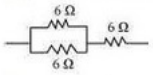
Answer.

If we connect the resistors in series, then the equivalent resistance will be the sum of the resistors, i.e., $6\Omega + 6\Omega + 6\Omega = 18\Omega,$ which is not desired. If we connect the resistors in parallel, then the equivalent resistance will be

$\frac{6}{2} = 3\Omega,$ which is also not desired.

series or parallel.

(i) Two resistors in parallel

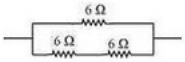


Two 6Ω resistors are connected in parallel. Their equivalent resistance will be

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

The third 6Ω resistor is in series with 3Ω. Hence, the equivalent resistance of the circuit is $6\Omega + 3\Omega = 9\Omega$.

(ii) Two resistors in series



Two 6 Ω resistors are in series. Their equivalent resistance will be the sum $6 + 6 = 12\Omega$

The third 6Ω resistor is in parallel with 12. Hence, equivalent resistance will be

$\frac{1}{12} + \frac{12 \times 6}{12+6} = 4\Omega$

Therefore, the total resistance is $^{4\Omega}$.

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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?

Answer.

Resistance R_1 of the bulb is given by the expression,

$P_1 = \frac{V^2}{R_1}$

$R_1 = \frac{V^2}{P_1}$

Where,

Supply voltage, $V = 220\text{V}$

Maximum allowable current, $I = 5\text{A}$

Rating of an electric bulb $P_1 = 10\text{W}$

$R_1 = \frac{(220)^2}{10} = 4840\Omega$

According to Ohm's law,

$V = IR$

Where,

R is the total resistance of the circuit for x number of electric bulbs

$R = \frac{V}{I} = \frac{220}{5} = 44\Omega$

Resistance of each electric bulb, $R_1 = 4840_\Omega$

$\therefore \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_1} + \ldots$ up to x times

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

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

Therefore, 110 electric bulbs are connected in parallel.

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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 resistance, which may be used separately, in series, or in parallel. What are the currents in the three cases?

Answer.

Supply voltage, $v = 220\text{V}$

Resistance of one coil, $R = 24\Omega$

(i)Coils are used separately

According to Ohm's law,

$V = I_1 R_1$

Where,

I_1 is the current flowing through the coil

$I_1 = \frac{V}{R_1} = \frac{220}{24} = 9.166\text{A}$

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

(ii)Coils are Connected in series

Total resistance, $R_2 = 24\Omega + 24\Omega = 48\Omega$

According to Ohm's law,

$V = I_2 R_2$

Where,

I_2 is the current flowing through the series circuit

$I_2 = \frac{V}{R_2} = \frac{220}{48} = 4.58\text{A}$

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

(iii) Coils are connected in parallel

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

Total resistance, R is given as $\frac{1}{24} + \frac{1}{24} = 12\Omega$

According to Ohm's law,

$V = I_3 R_3$

where,

I_3 is the current flowing through the circuit

$I_3 = \frac{V}{R_3} = \frac{220}{12} = 18.33\text{A}$

Therefore, 18.33 A current will flow through the circuit when connected in parallel.

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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.

Answer.

(i) Potential difference, $V = 6\text{V}$

1Ω and 2Ω resistors are connected in series. Therefore, equivalent resistance of the circuit, $R = 1 + 2 = 3\Omega$

According to Ohm's law,

$V = IR$

Where,

I is the current through the circuit

$I = \frac{6}{3} = 2\text{A}$

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 2Ω resistor is ${}^{2}A$

Power is given by the expression, .

P

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

(ii) Potential difference, $V = 4\text{V}$

12Ω and 2Ω resistors are connected in parallel. The voltage across each component of a parallel circuit remains the same. Hence, the voltage across 2Ω resistor will be 4V .

Power consumed by 2Ω resistor is given by

$P = \frac{V^2}{R} = \frac{4^2}{2} = 8\text{W}$

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

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Q15 Two lamps, one rated 100W at 220V, 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?

Answer. 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 b'/ the bulb of rating 100 W is given by,

$\text{Power } = \text{ Voltage Current}$

$\text{Current } = \frac{\text{Power}}{\text{Voltage}} = \frac{100}{220}\text{A}$

Similarly, current drawn by the bulb of rating 100W is given by,

$\text{Power } = \text{ Voltage } \times \text{ Current}$

$\text{Current } = \frac{\text{Power}}{\text{Voltage}} = \frac{60}{220}\text{A}$

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

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Q16 Which uses more energy, a 250 W TV set in 1 hr, or a 1200 W toaster in 10 minutes?

Answer.

Energy consumed by an electrical appliance is given by the expression,

$H = Pt$

where,

$\text{Power of the appliance } = P$

$\text{Time } = t$

$\text{Energy consumed by a TV set of power 250W in 1h} = 250 \times 3600 = 9 \times 10^5\text{J}$

$\text{Energy consumed by a toaster of power 1200W in 10 minutes } = 1200 \times 600$

$= 7.2 \times 10^5\text{J}$

Therefore, the energy consumed by a 250W TV set in 1h is more than the energy consumed by a toaster of power 1200w in 10 minutes.

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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.

Answer.

Rate of heat produced by a device is given by the expression for power as

$P = I^2R$

Where,

$\text{Resistance of the electric heater, } R = 8\Omega$

$\text{Current drawn, } I = 15\text{A}$

$P = (15)^2 \times 8 = 1800\text{J/s}$

Therefore, heat is produced by the heater at the rate of 1800J/s .

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Q18 Explain the following.
(a) Why is the 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?

Answer. (a) The melting point and resistivity of tungsten are very high. It does not burn readily at a high temperature. The electric lamps glow at very high temperatures. Hence, tungsten is mainly used as heating element of electric bulbs.
(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. It produces large amount of heat.
(c) There is voltage division in series circuits. Each component of a series circuit receives a small voltage for a large supply voltage. As a result, the amount of current decreases and the device becomes hot. 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 wires have low resistivity. They are good conductors of electricity. Hence, they are usually employed for electricity transmission.

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