# Electricity

**1. What does an electric circuit mean?**

Solution:

A continuous closed path made of electric components through which an electric current flows is known as an electric circuit. A simple circuit consists of the following components:

(a) Conductors

(b) Cell

(c) Switch

(d) Load

**2. Define the unit of current.**

Solution:

The unit of current is ampere. Ampere is defined by the flow of one coulomb of charge per second.

**3. Calculate the number of electrons constituting one coulomb of charge.**

Solution:

The value of the charge of an electron is $1.6 \times 10^{-19}$ C.

According to charge quantization,

**$Q = nq_e$,** where $n$ is the number of electrons and $q_e$ is the charge of an electron.

Substituting the values in the above equation, the number of electrons in a coulomb of charge can be calculated as follows:

$$1\ \mathrm{C} = n \times 1.6 \times 10^{-19}$$
$$n = \frac{1}{1.6 \times 10^{-19}} = 6.25 \times 10^{18}$$

Therefore, the number of electrons constituting one coulomb of charge is 6. 25 $\times 10^{18}$.

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**4. Name a device that helps to maintain a potential difference between across a conductor.**

**Solution :** Battery

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**5. What is meant by saying that the potential difference between two points is 1 v?**

**Solution :** The potential difference between two points is said to be 1 volt, if 1 joule of work is to be done for moving charge of 1 coulomb from one point to another.

**6. How much energy is given to each coulomb of charge passing through a 6-volt battery?**

**Solution :**

Potential difference (V) = 6 V

Charge (Q) = 1 C

Energy = total work done (W) = Q x V = 1×6 = 6 joule.

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**7. On what factor does the resistance of a conductor depend?**

**Solution :** 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

**8. Will current flow more easily through a thick wire or a thin wire of the same material, when connected to the same source? Why?**

**Solution :** The current flows more easily through a thick wire as compared to thin wire of the same material, when connected to the same source. It is due to the reason that resistance increases with decrease in thickness.

**9. Let the resistance of an electric 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?**

**Solution :** It is given that resistance R of the electrical component remains constant but the potential difference across the ends of the component decreases to half of its value.

Hence, as per Ohm's law, new current also decreases to half of its original value.

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

**Solution :** Coils of electric toasters and electric irons are made of an alloy due to the following reasons:

(i.) Resistivity of an alloy is generally higher than that of pure metal.

(ii.) At high temperature, an alloy does not oxidize readily. Hence, coil of an alloy has longer life.

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**5. Use the Data in Table To Answer the Following:**
**Table: Electrical resistivity of some substances at**

20 ∘ C20 ∘ C

| | **Material** | **Resistivity** ΩmΩm |
|---|---|---|
| | Silver | 1.60×10−81.60×10−8 |
| | Copper | 1.62×10−81.62×10−8 |
| | Aluminium | 2.63×10−82.63×10−8 |

| | | |
|---|---|---|
| **Conductor** | Tungsten | 5.20×10−85.20×10−8 |
| | Nickel | 6.84×10−86.84×10−8 |
| | Iron | 10.0×10−810.0×10−8 |
| | Chromium | 12.9×10−812.9×10−8 |
| | Mercury | 94.0×10−894.0×10−8 |
| | Manganese | 1.84×10−81.84×10−8 |
| **Alloy** | Constantan (alloy of Cu and Ni) | 44×10−644×10−6 |
| | Manganin (alloy of Cu, Mn and Ni) | 49×10−649×10−6 |
| | Nichrome (alloy of Ni, Cr, Mn and Fe) | 100×10−6100×10−6 |
| **Insulator** | Glass | 1010~10141010~1014 |
| | Hard rubber | 1013~10161013~1016 |
| | Ebonite | 1015~10171015~1017 |
| | Diamond | 1012~10131012~1013 |
| | Paper (Dry) | 10121012 |

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**a) Which Among Iron and Mercury is a Better Conductor?**

**Ans:** Resistivity of iron=10.0×10−8Ωm=10.0×10−8Ωm

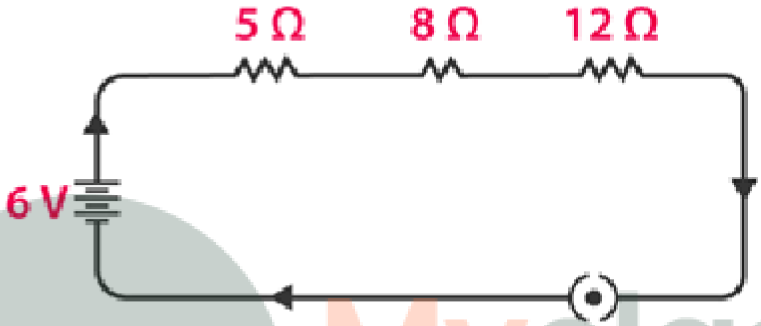
Resistivity of mercury=94.0×10−8Ωm=94.0×10−8Ωm

Resistivity of mercury is more than that of iron. So, iron is a better conductor than mercury because resistivity is inversely proportional to conductivity.

**b) Which Material is the Best Conductor?**
**Ans:** Metal with least resistivity is the best conductor. In the above question, according to the table, Silver is the best conductor.
**1. 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.**

Solution:

A battery of three cells of 2 V each equals to battery of potential 6 V. The circuit diagram below shows three resistors of resistance 12 Ω, 8 Ω and 5 Ω connected in series along with a battery of potential 6 V.

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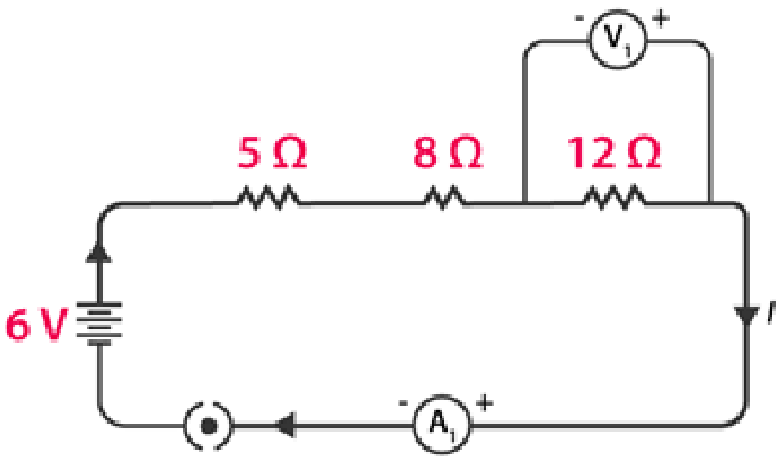
**2. Redraw the circuit of Question 1, putting in an ammeter to measure the current through the resistors and a voltmeter to measure the potential difference across the 12 Ω resistor. What would be the readings in the ammeter and the voltmeter?**

Solution:

An ammeter should always be connected in series with resistors while the voltmeter should be connected in parallel to the resistor to measure the potential difference as shown in the figure below.



Using Ohm's Law, we can obtain the reading of the ammeter and the voltmeter.

The total resistance of the circuit is 5 Ω + 8 Ω +12 Ω = 25 Ω.

We know that the potential difference of the circuit is 6 V, hence the current flowing through the circuit or the resistors can be calculated as follows:

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

Let the potential difference across the 12 Ω resistor be $V_1$.

From the obtained current $V_1$ can be calculated as follows:

$V_1$ = 0.24A × 12 Ω = 2.88 V

Therefore, the ammeter reading will be 0.24 A and the voltmeter reading be 2.88 V.

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

Solution:

(a) When 1 Ω and $10^6$ are connected in parallel, the equivalent resistance is given by

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

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

Therefore, the equivalent resistance is 1 Ω.

(b) When 1 Ω, $10^3$ Ω, and $10^6$ Ω are connected in parallel, the equivalent resistance is given by

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

Solving, we get

$$R = \frac{10^6 + 10^3 + 1}{10^6} = \frac{1000000}{1000001} = 0.999\,\Omega$$

Therefore, the equivalent resistance is 0.999 Ω.

**15. 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**

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**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?**

**Solution :**

Here, voltage (V) = 220 V

$R_1$ = 100 Ω, $R_2$ = 50 Ω and $R_3$ = 500 Ω

$1/R = 1/R_1 + 1/R_2 + 1/R_3$ ——

1/R = 1/100+1/50 +1/500 = 16/500

R = 500/16 = 31.25 Ω

The resistance of electric iron, which draws as much current as all three appliances take together = R = 31.25 Ω.

Current passing through electric iron (I) = V/R = 220/31.25 = 7.04 A.

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

**Solution :** Advantage of connecting electrical devices in parallel with the battery are as follows:

(i) Voltage across each connecting electrical device is same and device take current as per its resistance.

(ii) Separate on/off switches can be applied across each device.

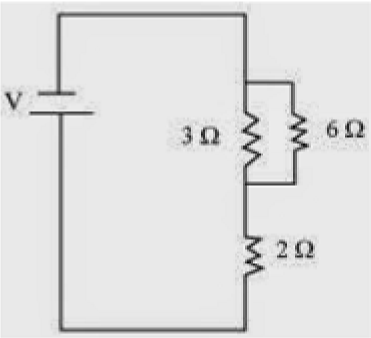
(iii) Total resistance in parallel circuit decreases, hence, a great current may be drawn from cell.

(iv) If one electrical device is damaged; then other devices continue to work properly.

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

**Solution :**

(a) If we connect resistance of 3 Ω and 6 Ω in parallel and then resistance of 2 Ω is connected in series of the combination, then total resistance of combination is 4 Ω.




(b) If all the three resistance are joined in parallel the resultant resistance will be 1 Ω.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**18. What is (a) the highest, (b) the lowest total resistance that can be secured by combination of four resistances of 4 Ω, 8 Ω, 12 Ω and 24 Ω?**

**Solution :**

(a) To obtain highest resistance, all the four resistances must be connected in series arrangement. In that case resultant $R = R_1 + R_2 + R_3$

= 4+8+12 48 Ω

(b) To obtain lowest resistance, all the four resistance must be connected in parallel arrangement. $1/R = 1/R_1 + 1/R_2 + 1/R_3$

= 1/4 +1/8 +1/12 + 1/24 = 12/24 Ω

= 24/12 = 2 Ω

**1. Why Does the Cord of an Electric Heater Not Glow While the Heating Element Does?**
**Ans:** Heat produced in a system is proportional to its resistance.
The resistance of the heating element is more; so more heat is produced and so it glows.

Also, the resistance of wire is less; so, the heat produced is also less. Hence, the wire does not glow but the heating element does.
**2. Compute the Heat Generated While Transferring**

9600096000

**coulomb of Charge in One Hour Through a Potential Difference of**

50 V50 V

.
**Ans:** The amount of heat

(H)(H)

produced is given by the Joule's law of heating as

H = VIt H = VIt

Where,

Voltage,

V= 50 V V= 50 V

Time,

t = 1 h = 1 × 60 × 60 s t = 1 h = 1 × 60 × 60 s

H=V.I.tH=V.I.t
⇒H=V·qt·t⇒H=V·qt·t
⇒H=V·q⇒H=V·q
⇒H=50×96000⇒H=50×96000
⇒H=4.8×106J⇒H=4.8×106J
Thus, heat produced while transferring the charge is H=4.8×106JH=4.8×106J.
**3. An Electric Iron of Resistance**

20 Ω 20 Ω

**Takes a Current of**

5 A5 A

**. Calculate the Heat Developed in**

30 s30 s

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.

**Ans:** The amount of

(H)(H)

heat produced is given by the Joule’s law of heating as

H=VIt=I2RtH=VIt=I2Rt

.

Where,

Current,

I = 5 A  I = 5 A

Time,

t = 30 s  t = 30 s

Resistance

R = 20Ω  R = 20Ω

H=I2RtH=I2Rt
⇒H=52×20×30⇒H=52×20×30
⇒H=1.5×104J⇒H=1.5×104J
Therefore, the amount of heat developed in the electric iron is H=1.5×104JH=1.5×104J.

**Intext Exercise 7**

**1. What Determines the Rate at Which Energy is Delivered by a Current?**
**Ans:** The rate at which energy is delivered by a current or consumed by the appliance is the power of the appliance.

**2. An Electric Motor Takes**

5 A5 A

**from a**

220V220V

**line. Determine the Power of the Motor and the Energy Consumed in** 22 **hrs.**
**Ans:** Power

(P)(P)

is given by the expression

P=VI  P=VI

.

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Where,

Voltage,

$$V= 220\ V \quad V= 220\ V$$

Current,

$$I = 5\ A \quad I = 5\ A$$

$$P = 220 \times 5 = 1100\ W \quad P = 220 \times 5 = 1100\ W$$

Energy consumed by the motor=P×t =P×t
Where,

Time,

$$t=2h=2\times60\times60=7200s\ t=2h=2\times60\times60=7200s$$

$$\Rightarrow P=1100\times7200\ \Rightarrow P=1100\times7200$$

Therefore, the power of the motor

$$=1100\ W \quad =1100\ W$$

Energy consumed by the motor =7.92 × 106J=7.92 × 106J.
**NCERT Exercise**

**1. A Piece of Wire of Resistance** RR **is Cut into Five Equal Parts. These parts are then Connected in Parallel. If the Equivalent Resistance of this Combination is**

$$R' \ R'$$

**, then the Ratio**

$$R/R' \ R/R'$$

**is**
**a.** 125125
**b.** 1515
**c.** 55
**d.** 2525
**Ans:** Relation between resistance and current is R∝IR∝I.
If the wire is cut into five equal parts, the resistance of each part

$$=R5=R5$$

.
All the five parts are connected in parallel. Hence, equivalent resistance

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({R}')({R}')

is given as
1R′=5R+5R+5R+5R+5R=5+5+5+5+5R=25R1R′=5R+5R+5R+5R+5R=5+5+5+5+5R=25R
⇒RR′=25⇒RR′=25
Therefore, the ratio

RR′RR′

is 2525.

**2. Which of the following does not represent electrical power in a circuit?**

**(a) $I^2R$**

**(b) $IR^2$**

**(c) VI**

**(d) $V^2/R$**

Solution:

**Answer**: b) $IR^2$

**Explanation:**

Electrical power is given by the expression $P = VI$. (1)

According to Ohm's law,

$V = IR$

Substituting the value of V in (1), we get

$P = (IR) \times I$

$P = I^2R$

Similarly, from Ohm's law,

$I = V/R$

Substituting the value of $I$ in (1), we get

$P = V \times V/R = V^2/R$

From this, it is clear that the equation $IR^2$ does not represent electrical power in a circuit.

**3. An electric bulb is rated 220 V and 100 W. When it is operated on 110 V, the power consumed will be ______.**

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**(a) 100 W**

**(b) 75 W**

**(c) 50 W**

**(d) 25 W**

Solution:

**Answer:** 25 W

**Explanation:**

The energy consumed by the appliance is given by the expression

$P = VI = V^2/R$

The resistance of the light bulb can be calculated as follows:

$R = V^2/P$

Substituting the values, we get

$R = (220)^2/100 = 484\ \Omega$

Even if the supply voltage is reduced, the resistance remains the same. Hence, the power consumed can be calculated as follows:

$P = V^2/R$

Substituting the value, we get

$P = (110)^2\ V/484\ \Omega = 25\ W$

Therefore, the power consumed when the electric bulb operates at 110 V is 25 W.

**4. 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**

Solution:

Let $R_s$ and $R_p$ be the equivalent resistance of the wires when connected in series and parallel respectively.

For the same potential difference V, the ratio of the heat produced in the circuit is given by

$$\frac{H_S}{H_p} = \frac{\frac{v^2}{R_s}t}{\frac{v^2}{R_p}t} = \frac{R_p}{R_s}$$

The equivalent resistance of resistors connected in series $R_s$ is $R + R = 2R$

The equivalent resistance of resistors connected in parallel $R_p$ is $\frac{1}{\frac{1}{R}+\frac{1}{R}} = \frac{R}{2}$

Hence, the ratio of the heat produced in series and parallel combinations would be

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

Hence, the ratio of the heat produced is 1:4.

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

**Solution :** A voltmeter is always connected in parallel to resistance across the point between which the potential difference is to be measured.

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**29. A copper wire has diameter 0.5 mm and resistivity of 1.6 x $10^{-8}$ m. what will be the length of this wire to make its resistance 10? How much does the resistance change if the diameter is doubled?**

**Solution :**

Diameter of wire (d) = 0.5 mm, resistivity (ρ) 1.6 x $10^{-8}$ Ωm, resistance (R) = 10 Ω.

R = ρL/A

L= $\pi D^2 R/4\rho$

= 22 x (5 x $10^{-4}$)2/ 7 x 4 x 1.6 x $10^{-8}$ = 122.5 m

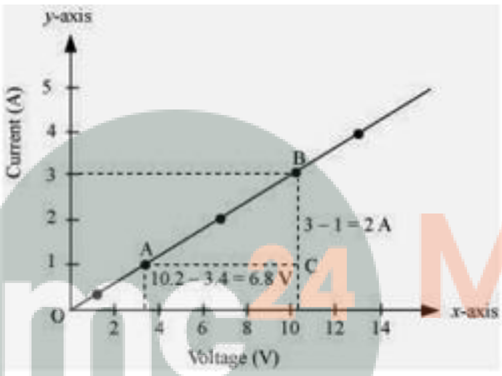
If the diameter is doubled for given length of given material resistance is inversely proportional to the cross-section area of wire.

**30. The value 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 |

Plot a graph between V and I and calculate the resistance of that resistor.

**Solution :** From the given data the I-V graph is a straight line as shown below:

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The slope of the line gives the value of Resistance(R) as,

Slope = 1/R = BC/AC = 2/6.8

R = 6.8/2 = 3.4 Ω

Therefore,the resistance of register is 3.4Ω.

**31. 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.**

**Solution :**

Voltage of battery = V = 12 V, Current (I) = 2.5 mA = 2.5 x $10^{-3}$ A

Resistance (R) = V/I = 12V/ 2.5 x $10^{-3}$ A = 4800 Ω.

**32. A battery of 9 V is connected in series with resistance 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 resistor?**

**Solution :**

Potential difference (V) = 9 V.

Total resistance (R) = $R_1 + R_2 + R_3 + R_4 + R_5$

= 0.2 +0.3 + 0.5 + 0.5 + 12 = 13.4 Ω

Current in the circuit (I) = V/R = 9 V / 13. 4 Ω = 0.67 A.

In series circuit same current flows through all the resistance, hence current of 0.67 A will flow through 12 Ω resistor.

**10. How Many**

176 Ω 176 Ω

**resistors (in parallel) are Required to carry**

5 A5 A

**on a**

220 V220 V

**Line?**
**Ans:** Let's assume the number of resistances to be xx.
The equivalent resistance of resistors connected in parallel is given by

1R= x×11761R= x×1176

⇒R=176x⇒R=176x
Now, Ohm's law is given as

V=IRV=IR

⇒R=VI⇒R=VI
Where,

Supply voltage,

V = 220 V   V = 220 V

Current,

$$I = 5\ A\ I = 5\ A$$

So, the equation can be written as,

$$176x=2205176x=2205$$

$$\Rightarrow x=17644\Rightarrow x=17644$$

$$\Rightarrow x=4\Rightarrow x=4$$

Therefore, four resistors of

$$176\ \Omega\ 176\ \Omega$$

are required to draw the given amount of current.

**11. Show How You Would Connect Three Resistors, Each of Resistance**

$$6\ \Omega\ 6\ \Omega$$

**, so that the combination has a resistance of**

**a).**

$$9\ \Omega\ 9\ \Omega$$

**Two Resistors in Parallel**: Consider the following figure.

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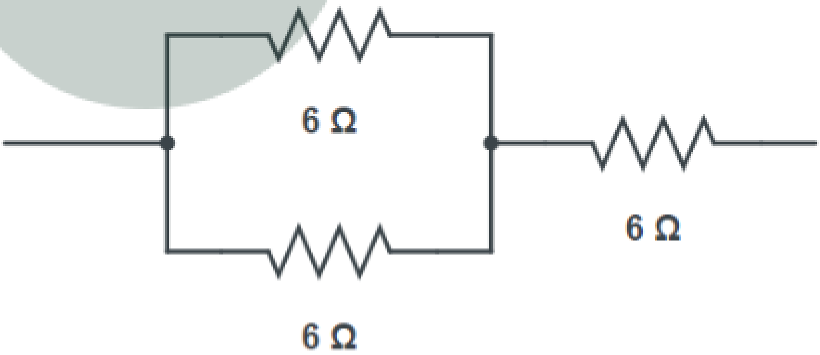



Two

$$6\ \Omega\ 6\ \Omega$$

resistors are connected in parallel. Their equivalent resistance will be

$R=116+16=6\times66+6=3\Omega R=116+16=6\times66+6=3\Omega$

The third

$$6\,\Omega 6\,\Omega$$

resistor is connected in series with

$$3\,\Omega\ 3\,\Omega$$

.

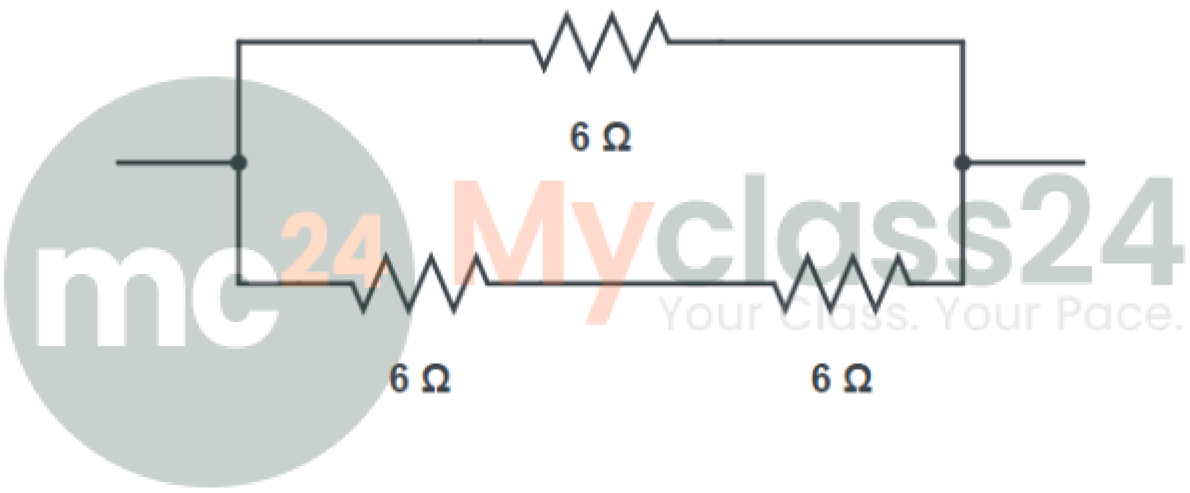
Hence, the equivalent resistance of the circuit is

$$6\,\Omega+\ 3\,\Omega=9\,\Omega.\ \ 6\,\Omega+\ 3\,\Omega=9\,\Omega.$$

**b).**

$$4\,\Omega\ 4\,\Omega$$

**Two Resistors in Series:** Consider the following figure.




Two

$$6\,\Omega\ 6\,\Omega$$

resistors are connected in series.
Their equivalent resistance will be the sum

$$R=6+6=12\Omega\ R=6+6=12\Omega$$

The third

$$6\,\Omega\ 6\,\Omega$$

resistor is in parallel with

$$12\,\Omega\ 12\,\Omega$$

.

Hence, equivalent resistance will be

$\Rightarrow{{R}_{eq}}=\frac{1}{\frac{1}{12}+\frac{1}{6}}=\frac{12\times 6}{12+6}=4\Omega$

Therefore, the total resistance is

$4\,\Omega$ $4\,\Omega$

.

**12. Several Electric Bulbs Designed to be Used on a**

220 V220 V

**Electric Supply Line, are Rated**

10W 10W

**. How Many Lamps can be Connected in Parallel with Each Other Across the Two Wires of**

220 V220 V

**line if the maximum allowable current is**

5 A5 A

**?**

**Ans:** Resistance

$R_1 R_1$

of one bulb is given by the expression,

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

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

Where,

Supply voltage,

$V = 220\ V \quad V = 220\ V$

Maximum allowable current,

$I = 5\ A \quad I = 5\ A$

.

Rating of an electric bulb,

$P_1 = 10\ W \quad P_1 = 10\ W$

.

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Resistance of one bulb is R1=(220)210=4840ΩR1=(220)210=4840Ω.
Apply Ohm's law to circuit with all the bulbs,

V = IRV = IR

RRis the total resistance of the circuit for x number of electric bulbs.
⇒R=VI=2205=44Ω⇒R=VI=2205=44Ω
Resistance of each electric bulb,

R1= 4840 Ω R1= 4840 Ω

.
Clearly, since the resistors are connected in parallel,

1R=1R1×x1R=1R1×x
⇒x=R1R=484044=110⇒x=R1R=484044=110
Therefore, 110110 electric bulbs can be connected in parallel.

**13. A Hot Plate of an Electric Oven Connected to a**

220 V220 V

**Line has Two Resistance Coils** AA **and** BB **, Each of**

24 Ω 24 Ω

**Resistances, Which May be Used Separately, in Series, or in Parallel. What are the Currents in the Three Cases?**

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**Ans:** The given data in the question is as follows:

Supply voltage,

V=220 V V=220 V

.
Resistance of one coil,

R=24 Ω R=24 Ω

.
**a) Coils are Used Separately:**
According to Ohm's law,

V = I1R1 V = I1R1

Where,

I1I1

is the current flowing through the coil.

⇒I1=VR1=22024=9.166A⇒I1=VR1=22024=9.166A
Therefore,

9.16 A9.16 A

current will flow through each coil when used separately.

**b) Coils are Connected in Series:**

Total resistance,

R2= 24 Ω + 24 Ω = 48 Ω   R2= 24 Ω + 24 Ω = 48 Ω

According to Ohm’s law,

V=I2R2   V=I2R2

Where,

I2I2 is the current flowing through the series circuit.
⇒I2=VR2=22048=4.58A⇒I2=VR2=22048=4.58A
Therefore,

4.58 A4.58 A

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

**c) Coils are Connected in Parallel:**

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Total resistance,R3R3 is given as
R3=1124+124=242=12 Ω R3=1124+124=242=12 Ω
According to Ohm’s law,

V=I3R3   V=I3R3

Where,

I3I3is the current flowing through the circuit.
⇒I3=VR3=22012=18.33A⇒I3=VR3=22012=18.33A
Therefore,

18.33 A18.33 A

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

**14. Compare the Power Used in the**

2 Ω 2 Ω

**Resistor in Each of the Following Circuits:**

**a).**

6 V6 V

**battery in series with**

1 Ω 1 Ω

**and**

$2\ \Omega\ 2\ \Omega$

**resistors, and**
**Ans:** In the question it is given that

$V = 6\ V \quad V = 6\ V$

.

$1\ \Omega\ 1\ \Omega$

and

$2\ \Omega\ 2\ \Omega$

resistors are connected in series.
Therefore, equivalent resistance of the circuit,

$R=1+2=3\ \Omega \quad R=1+2=3\ \Omega$

According to Ohm's law,

$V = IRV = IR$

Where,

II is the current through the circuit

$\Rightarrow I =63= 2\ A \quad \Rightarrow I =63= 2\ A$

In series the same current flows in the entire circuit.

Hence, current flowing through the

$2\ \Omega \quad 2\ \Omega$

resistor is

$2\ A2\ A$

.
Power is given by the expression,

$P=I2R = 22\times 2 = 8\ W \quad P=I2R = 22\times 2 = 8\ W$

**b).**

$4\ V4\ V$

**battery in parallel with**

$12\ \Omega\ 12\ \Omega$

**and**

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2 Ω 2 Ω

**resistors.**
**Ans:** Potential difference,

V = 4 V  V = 4 V

.
12 Ω 12 Ω and

2 Ω  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  2 Ω

resistor will be

4 V4 V

.
Power consumed by

2 Ω  2 Ω

resistor is given by

P=V2R=422= 8 W  P=V2R=422= 8 W

Therefore, the power used by

2 Ω  2 Ω

resistor is 8W8W.
**38. 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?**

**Solution :**

Current drawn by 1$^{st}$ lamp rated 100 W at 220 V = P/V = 100/ 220 = 5/11 A.

Current drawn by 2$^{nd}$ lamp rated 60 W at 220 V = 60/220 = 3/11 A.

In parallel arrangement the total current = I1 +I2 = 3/11+ 5/11 = 8/11 = 0.73 A.

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**39. Which uses more energy, a 250 W TV set in 1 hour, or a 1200 W toaster in 10 minutes?**

**Solution :**

Energy used by a TV set of power 250 W in 1 hour = P x t = 250 Wh.

Energy used by toaster of power 1200 W in 10 minute (10/60 h)

= P x t = 1200 W x 10/60 h = 200 Wh.

**40. An electric heater of resistance 8 draws 15 A from the service mains for 2 hours. Calculate the rate at which heat is developed in the heater.**

**Solution :**

Resistance of electric heater (R) = 8 Ω, current (I) = 15 A.

Rate at which heat developed in the heater = I2Rt/t = 15 x 15 x 8 = 1800 W.

**18. 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 copper and aluminium wires are usually employed for electricity transmission?**

Solution:

a. The resistivity and melting point of tungsten is very high. Due to this property, it doesn't burn readily when heated. Electric lamps operate at high temperature. Hence, tungsten is a choice of metal for the filament of electric lamps.

b. The conductors of electric heating devices are alloys because of their high resistivity. Due to its high resistivity it produces large amount of heat.

c. The voltage is divided in series circuit as result each component in the circuit receives a small voltage because of which the amount of current decreases and the device gets hot and does not work properly. This is the reason why series circuits are not used in domestic circuits.

d. Resistance is inversely proportional to the area of cross section. When the area of cross section increases the resistance decreases and vice versa.

e. Copper and aluminium are good conductors of electricity and have low resistivity because of which they are usually employed for electricity transmission.

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