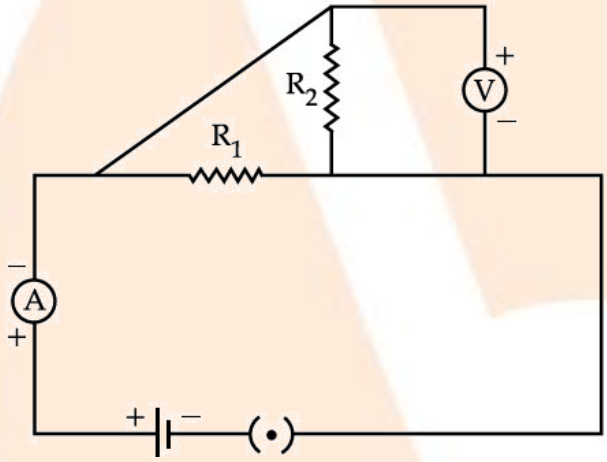
Important Questions for Class 10

Science

Chapter 11 – Electricity

Very Short Answer Questions **1 Mark**

1. Which two circuit components are connected in parallel in the following circuit diagram?
(a) R_1 and R_2 only
(b) R_1,R_2 only
(c) R_2 and V only
(d) R_1 and V only



Ans: (a) The two circuit components that are connected parallel in the circuit diagram is and R_2 only.

2. A metallic conductor has loosely bound electrons called free electrons. The metallic conductor is
(a) negatively charged
(b) positively charged
(c) neutral
(d) Either positively charged or negatively charged
Ans: (c) The metallic conductor is neutral.

3. Which of the following expressions does not represent the electric power in the circuit?
(a) VI .
(b) I^2/R
(c) V^2/R

(d) I^2R

Ans: (b) The expression which does not represent the electric power in the circuit is I^2 / R .

4. Resistivity of a metallic wise depends on

(a) its length

(b) its shape

(c) its thickness

(d) nature of material

Ans: (d) Resistivity of a metallic wire depends on the nature of the material.

5. If the current I through a resistor is increased by 100% the increased in power dissipation will be (assume temperature remain unchanged)

(a) 100%

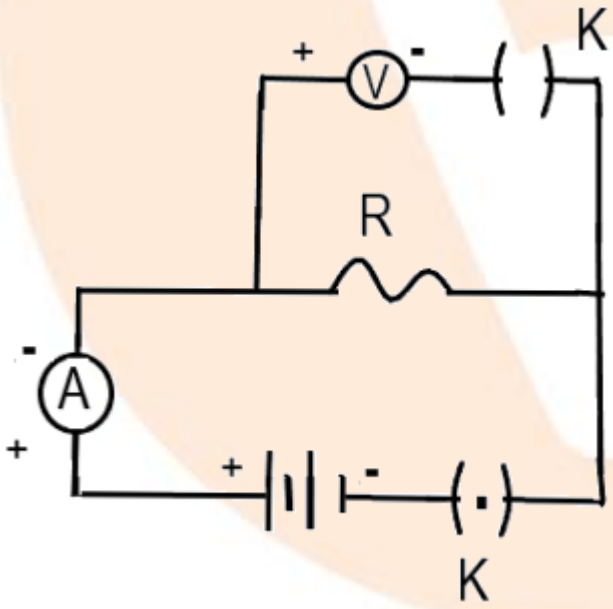
(b) 200%

(c) 300%

(d) 400%

Ans: (c) The increase in power dissipation will be 300% .

6. For the circuit arrangement shown below, a student would observe.



(a) Some reading in both ammeter and voltmeter.

(b) No reading in either the ammeter or the voltmeter.

(c) Some reading in the ammeter but no reading in the voltmeter.

(d) Some reading in the voltmeter but no reading in the ammeter.

Ans: (c) A student will observe some reading in the ammeter but no reading in the voltmeter**.**

7. A wire of resistance R is cut into five equal pieces. These pieces are connected in parallel and the equivalent resistances of the combination are R'. Then the ratio $\frac{R}{R'}$ is

(a) $\frac{1}{5}$

(b) 5

(c) $\frac{1}{25}$

(d) 25

Ans: (d) The ratio $\frac{R}{R'}$ is 25.

8. The resistance of the conductor is R. If its length is doubled, then its new resistance will be

(a) R

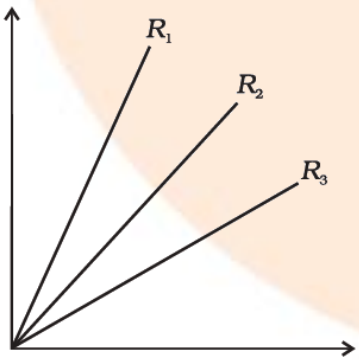
(b) $2R$

(c) $4R$

(d) $8R$

Ans: (c) The new resistance is $4R$.

9. A student carries out an experiment and plots the V-I graph of three samples of nichrome wire with resistances R_1, R_2, R_3 respectively as shown in the figure. Which of the following is live?



(a) $R_3 > R_2 > R_1$

(b) $R_2 > R_3 > R_1$

(c) $R_1 > R_2 > R_3$

(d) $R_1 = R_2 = R_3$

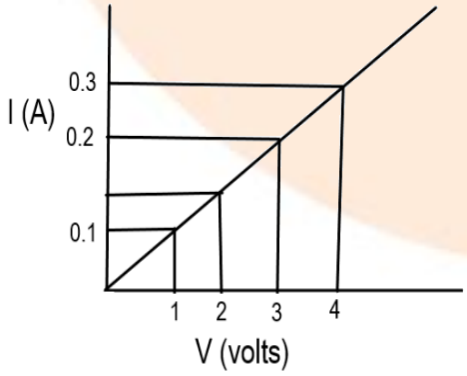
Ans: (a) According to the graph, $R_3 > R_2 > R_1$

10. The nature of the graph between potential difference and the electric current flowing through a conductor is
(a)parabolic
(b) circle
(c) straight line
(d) hyperbolic
Ans: (c) The nature of the graph between potential difference and the electric current flowing through a conductor is a straight line.

11. An electric heater is salted at 1500 w. How much heat is produced per hour?
(i) 5400 J
(ii) 54000 J
(iii) 5.4×10^5
(iv) 5.4×10^6.
Ans: (iv) The electric heater produces 5.4×10^6 J per hour.

12. A student says that the resistance of two wires of the same length and same area of cross section is the same. This statement is correct if
(a) Both wires are of different materials
(b) Both wires are made of the same material and are at different temperatures.
(c) Both wires are made of the same material and are at the same temperature.
(d) Both wires are made of different materials and are at the same temperature.
Ans: This statement is correct if (c) The resistance of two wires of the same length and same area of cross section is the same if both wires are made of the same material and are at the same temperature.

13. In an experiment ohm' s law a student obtained a graph as shown in the diagram. The value of resistance of the resistor is

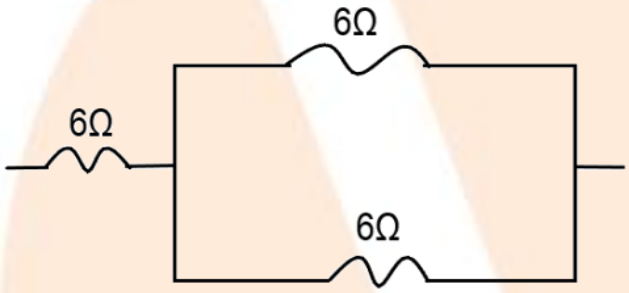


(a) 0.1Ω
(b) 1.0Ω
(c) 10Ω
(d) 100Ω

Ans: (d) The value of resistance of the resistor is 100Ω .

14. Work done to move 1 coulomb charge from one point to another point on a charged conductor having potential 10 volt is
(a) 1 Joule
(b) 10 Joule
(c) zero
(d) 100 Joule
Ans: (c) Work done to move 1 coulomb charge from one point to another point on a charged conductor having potential 10 volt is zero.

15. Three resistors are shown in the figure. The resistance of the combination is



(a) 3Ω
(b) 6Ω
(c) 9Ω
(d) 7Ω
Ans: (c) The resistance of the combination is 9Ω .

16. Name a device that helps to maintain a potential difference between across a conductor.
Ans: A device that helps to maintain a potential difference between conductors is the battery.

17. What determines the rate at which energy is delivered by a current?
Ans: The rate at which energy is delivered by a current is determined by electric power.

18. A wire of resistance R is cut into five equal pieces. These pieces are connected inparallel and the equivalent resistances of the combination are R' . Then the ratio $\frac{R}{R'}$ is

(a) $\frac{1}{5}$

(b) 5
(c) $\frac{1}{25}$
(d) 25
Ans: (d) A wire of resistance R is cut into five equal pieces. These pieces are connected inparallel and the equivalent resistances of the combination are R'. In this cases, the ratio $\frac{R}{R'}$ is 25 .

19. 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
Ans: (b) The term that does not represent electrical power in a circuit is IR^2 .

20. An electric bulb is rated 220 V and 100 W. When it is operated on 110 V, the power consumed will be:
(a) 220 W
(b) 75 W
(c) 50 W
(d) 25 W
Ans: (d) The power consumed will be 25 W.

21. 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 combination would be:
(a) 1:2
(b) 2:1
(c) 1:4
(d) 4:1
Ans: (c) The ratio of heat produced in series and parallel combination will be $1:4$.

22. A wire of resistance R is bent in the form of a closed circle, what is the resistance across a diameter of the circle?
Ans: The resistance across a diameter of the circle $1/R' = 1/(R/2) + 1/(R/2) R'$
$= R/4$

23. A charge of 6 C is moved between two points P and Q having, potential 10 V and 5 V respectively. Find the amount of work done.
Ans: The amount of work done, $W = q(V_2 - V_1)$

$$= 6(10 - 5)$$
$$= 30 \text{ joule}$$

24. Name the physical quantity whose SI unit is JC
Ans: the physical quantity whose SI unit is JC is Potential.

25. Why are copper wires used as connecting wires?
Ans: Copper wires are used as connecting wires because in case of copper the electrical resistivity for it is low.

26. A wire of resistivity p is stretched to double its length. What is its new resistivity?
Ans: When a wire of resistivity p is stretched to double its length, then the new resistivity remains the same because resistivity depends on the nature of material.

27. What is the resistance of the connecting wire?
Ans: The resistance of a connecting wire made of good conductor is extremely low.

28. What is the resistance of an ammeter?
Ans: An ammeter's resistance is very minimal, and in an ideal ammeter, it is zero.

29. What is the resistance of a Voltmeter?
Ans: An ideal voltmeter's internal resistance is infinite.

Short Answer Questions **2 Marks**

1. How does use of fuse wire protect electrical appliances?
Ans: When a large quantity of current passes through the circuit, the temperature of the wire rises and the fuse wire melts. This prevents current from flowing into the house's other circuits, saving electrical appliances.

2. Calculate the resistance of an electric bulb which allows a 10 A current when connected to a 220 V power source?
Ans: I is given from the question that an electric bulb which allows a 10 A current when connected to a 220 V power source.
Therefore,
$I = 10 \text{ A}$,

$V = 220\ V$

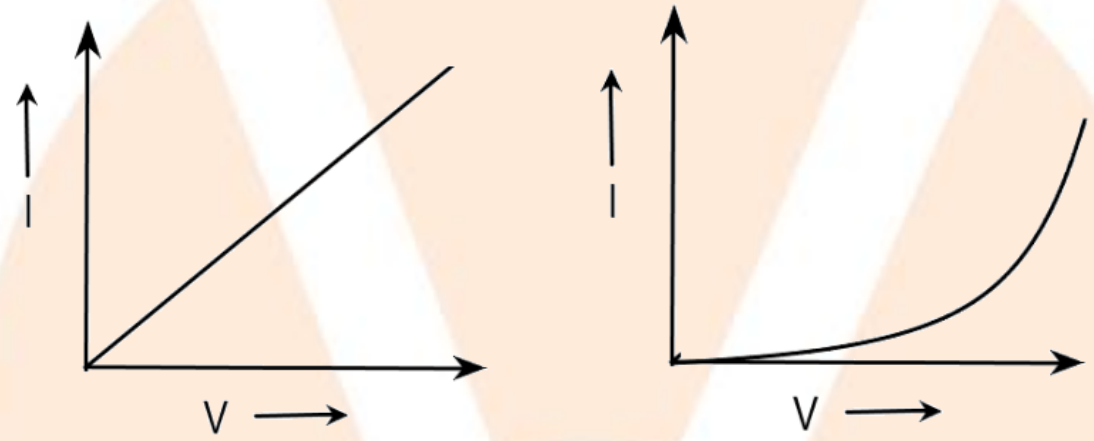
$R = \frac{V}{I}$

$= \frac{220}{10}$

$= 22\ ohm$

3. (i) Identify the $V - I$ graphs for ohmic and non-ohmic materials.

Ans: The $V - I$ graphs for ohmic and non-ohmic materials respectively can be represented as shown below:



(ii) Give one example of each.

Ans: Some examples of ohmic material are Copper, Nichrome and some examples of Non-ohmic material are Diode, Transistor.

4. What do the following symbols represent in a circuit? Write the name and one function of each?

(i)

Ans: It symbolises a battery that maintains a potential difference across the circuit element to allow current to flow.

(ii)

Ans: It's an ammeter that measures how much current is flowing across a circuit.

5. Define the term "volt"?

Ans: If 1joule of energy is transferred between two points A and B, the potential difference between them is one volt. In an electric circuit, work is done to move one coulomb of charge from one point to another field.

6. Why does the connecting rod of an electric heater not glow while the heating element does?

Ans: As its resistance is lower than that of the heating element, the connecting cord of an electric heater does not glow. As a result, the heating element produces more heat than the connecting cord, and it glows

7. A number of n resistors each of resistance R are first connected in series and then in parallel. What is the ratio of the total effective resistance of the circuit is series combination and parallel combination?

Ans: Total effective resistance of the circuit when in series combination $R_s = nR$

And for parallel combination is $R_p = \frac{R}{n}$ and

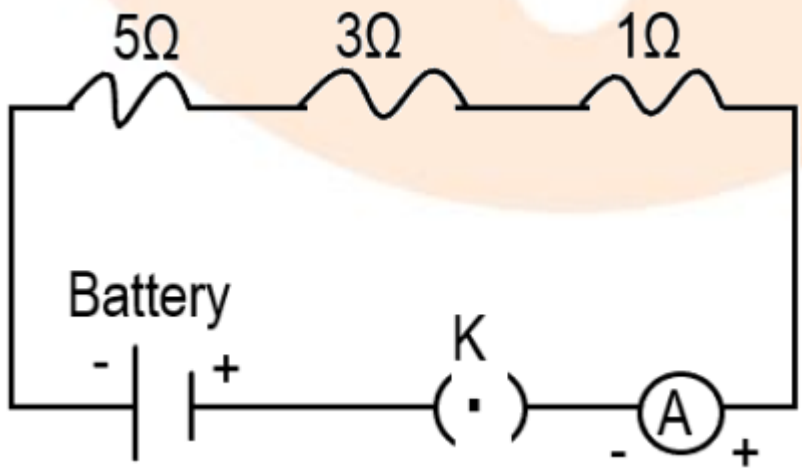
$$\frac{R_s}{R_p} = \frac{nR}{\frac{R}{n}}$$

$$= n^2$$

The ratio will be n^2 .

8. Draw a schematic diagram of a circuit consisting of 3 V battery, 5 ohm, 3Ω and 1Ω resistor, an ammeter and a plug key, all connected in series.

Ans: The circuit diagram of a circuit consisting of 3 V battery, 5 ohm, 3Ω and 1Ω resistor, an ammeter and a plug key, all connected in series can be represented as show below,



9. A copper wire has diameter 0.5 mm and Resistivity of $1.6\times10^{-8}\Omega$m What is the length of this wire to make its resistance ? How much does the resistance change if diameter is doubled?

Ans: Diameter of the copper wire, $D=0.5\times10^{-3}$ m

$P=1.6\times10^{-8}$

$R=10$

Then,

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

$$=\frac{\rho l}{\pi r^2}$$

$$=\frac{4\rho l}{\pi D^2}$$

$$\Rightarrow l=\frac{\pi R D^2}{4\rho}$$

$$l=\frac{3.14\times10\times(5\times10^{-4})^2}{4\times1.62\times10^{-8}}$$

$$=121.14$$

Length of the wire, $l=121.14$ m

$$\text{New } R'=\frac{4\rho l}{\pi(D')^2}$$

$$=\frac{1}{4}\frac{4\rho l}{\pi D^2}$$

$$=\frac{1}{4}R$$

Length of the wire to make its resistance 10Ω is 121.14 m and when the diameter is doubled the new resistance will be one fourth that of the old one.

10. Alloys are used in electrical heating devices rather than pure metals. Give a reason.

Ans: Alloys are utilised in electricity heating devices rather than pure metals because alloys have a higher resistivity and hence produce more heat. Furthermore, alloy is non-combustible (or oxidise easily at higher temperature).

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

Ans: The factors that Resistance depends are,

(a)Length of the conductor

(b)Area of cross - section
(c)Temperature
(d)Nature of material

12. Calculate the number of electrons consisting of one coulomb of charge?
Ans: Let $x =$ no. of electrons
Charge on 1 electron $= 1.6 \times 10^{-19}$ C , that is

$$x = \frac{1}{1.6 \times 10^{-19}}$$

$$x = 6.25 \times 10^{18}$$

The number of electron consisting one coulomb of charge is 6.25×10^{18} .

13. What does an electric circuit mean?
Ans: An electric circuit is a current route that is both continuous and closed. Current can flow through an electric circuit if it is complete.

14. Define the unit of current.
Ans: The ampere is the SI unit for electric current. If 1 coulomb charge flows per second across a conductor cross-section, the current is said to be 1 ampere.

15. Calculate the number of electrons constituting one coulomb of charge.
Ans: The charge on one electron $= 1.6 \times 10^{-19}$ coulomb.

Number of electrons in one coulomb of charge $= \frac{1}{1.6 \times 10^{-19}}$

$$= 6.25 \times 10^{18}$$

The number of electron consisting one coulomb of charge is 6.25×10^{18} .

16. What is meant by saying that the potential difference between two points is 1 v?
Ans: If 1 joule of labour is required to move a charge of 1 coulomb from one location to another, the potential difference between the two points is said to be 1 volt.

17. Ammeter burns out when connected in parallel. Give reasons.
Ans: When a low-resistance wire is connected in series, a huge quantity of current travels through it, causing it to be burned, or short-circuited.

18. Judge the equivalent resistance when the following are connected in parallel:
(a) Equivalent resistance of 1Ω and $10^6\Omega$

Ans: When the resistances are connected in a parallel arrangement, the resultant resistance is given by:

$$\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}+\cdots$$

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

$$=1+10^{-6}$$

$$R=1\Omega$$

The equivalent resistance is 1Ω .

(b) Equivalent resistance of 1Ω , $10^3\Omega$ and $10^6\Omega$

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

$$=1+10^{-3}+10^{-6}$$

$$R=1\Omega$$

The equivalent resistance is 1Ω .

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

Ans: Resistance of electric iron, $R=20\Omega$, current, $I=5$ A and time $=30$ s.

Heat generated $H=I^2Rt$

$$=5^2\times 20\times 30$$

$$=15000 \text{ j}$$

The heat developed in 30 second is 15000 j .

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

Ans: The given information is as shown below,

Charge transferred, $Q=96000$

Potential difference, $V=50$ V.

Heat generated, $H=VQ$

$$=50\times 96000$$

$$=4800000 \text{ j}$$

$$=4.8\times 10^6 \text{ j}$$

The heat generated while transferring 96000 coulomb of charge in one hour through a potential difference of 50 V is 4.8×10^6 j

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

Ans: Given that current drawn by electric motor $I = 5$ A.
The line voltage $V = 220$ V
Time, $t = 2$ h
Power of motor , $P = VI$
$= 220 \times 5$
$= 1100$ W and
the energy consumed $E = Pt$
$= 2 \times 1100$
$= 2.2$ KWh
The power of the motor and energy consumed in 2 h are 1100 W and 2.2 kWh respectively.

22. How is a voltmeter connected in the circuit to measure the potential difference between two points?
Ans: A voltmeter is connected in parallel to the resistance across the place where the potential difference is to be determined.

23. 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: Given that Voltage of battery, $V = 12$ V,
Current, $I = 2.5$ mA
$= 2.5 \times 10^{-3}$ A
Resistance, $R = V / I$
$= \frac{12}{2.5 \times 10^{-3}}$
$= 4800\Omega$
The value of the resistance of the resistor is 4800Ω .

24. 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: The given information is as shown below
Each bulb is rated as 10 W, 220 V,
It draws current, $I = P / V$
$= \frac{10}{220}$ V
$= 1/22$ A.
The maximum allowable current is 5 A and all lamps are connected in parallel. Therefore the maximum number of bulbs joined in parallel with each other $= 5 \times 22$ which is 110 .

25. 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: Current drawn by 1st lamp rated 100 W at 220 , $V = P/V$

$= 100/220$

$= 5/11$ A.

Current drawn by 2nd lamp rated 60 W at 220 , $V = 60/220$

$= 3/11$ A.

In parallel arrangement the total current $= 3/11 + 5/11$

$= 8/11$

$= 0.73$ A.

Current drawn from the line if the supply voltage is 220 V is 0.73 A .

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

Ans: Energy used by a TV set of power 250 W in 1 hour $= Pt$

$= 250$ Wh

Energy used by toaster of power 1200 W in 10 minute $(10/60\text{h}) =$ 200 Wh.

A 250 W TV set in 1 hour uses more energy.

27. 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.

Ans: Resistance of electric heater, $R = 8\Omega$,

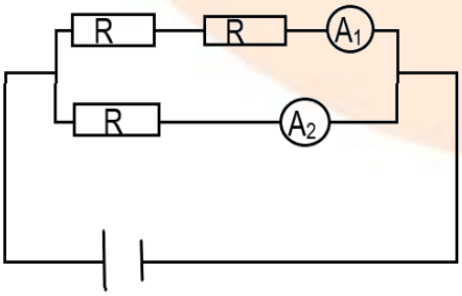
current, $I = 15$ A.

Rate at which heat developed in the heater $= \dfrac{I^2Rt}{t}$

$= 1800$ W.

The rate at which heat is developed in the heater is 1800 W.

28. In the given figure what is the ratio of current in A



Ans: Observe that it I clearly known to us that $V = IR$

$\dfrac{I_1}{I_2} = \dfrac{R}{2R}$

$= \frac{1}{2}$

The ratio of current is $1/2$.

29. Two wires of equal cross sectional area, one of copper and other of managing have the same resistance. Which one will be longer?

Ans: Using the equation $\rho = \frac{RA}{l}$, where ρ is the resistivity, R is the resistance and A the area

We can see that copper wire has a lower resistance than manganin, hence copper will last longer.

30. A Rectangular block of iron has dimensions $L \times L \times b$. What is the resistance of the block measured between the two square ends? Given p resistivity.

Ans: $R = \frac{pb}{L^2}$ is the resistance of the block measured between the two square ends

31. Three equal resistances are connected in series then in parallel. What will be the ratio of their Resistances?

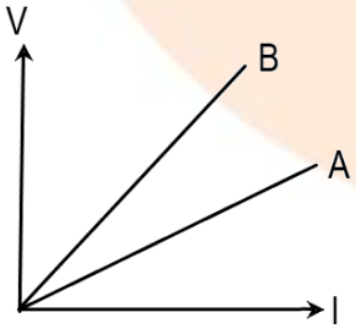
Ans: $R_{series} = 3R$

$R_{parallel} = R/3$

The ratio of Resistances is 9 .

32. Justify for any pair of resistance the equivalent resistance equivalent resistance in parallel.

Ans: As $R = V/I$



From the graph for any pair of resistance the equivalent resistance in series is greater than equivalent resistance in parallel.

$A =$ Series, $B =$ Parallel

33. How many bulbs of 81 should be joined in parallel to draw a current of 2 A from a battery of 4 V?

Ans: $R = V / I$

$= 4 / 2$

$= 2\Omega$

let n be the number of bulbs.

$$1/R = 1/R_1 + 1/R_2 + \cdots + 1/R_n = \frac{n}{8}$$

$$\Rightarrow \frac{1}{2} = \frac{n}{8}$$

$$\Rightarrow n = 4$$

Number of bulbs are 4 .

34. Two cubes A and B are of the same material. The side of B is thrice as that of A . Find the ratio R_A / R_B .

Ans: The value of $R_A = \frac{pL}{A}$ and

$$R_B = \frac{p3L}{9A}$$

$$R_A : R_B = 3:1$$

35. If there are 3×10^{11} electrons are flowing through the filament of the bulb for two minutes. Find the current flowing through the circuit. Charge on one electron 1.6×10^{19}

Ans: Observe as shown below,

Using the equation

$q = ne$

$= 3\times10^{11}\times1.6\times10^{19}$ C

$= 4.8\times10^{8}$ C

$I = q / t$

$$= \frac{4.8\times10^{8}}{2\times60}$$

$= 4\times10^{7}$ A

The current flowing through the circuit is 4×10^{7} A.

36. A nichrome wire of resistivity 100 W m and copper wire of resistivity 1.62 M ohm-m of the same length and same area of cross section are connected in series , current is passed through them, why does the nichrome wire get heated first?

Ans: Looking at the equation

$Q = I^2RT$

$Q = I^2(pL / A)t$

Henceforth, because nichrome wire has a higher resistance than copper wire, it must be heated first.

37. What is represented by joule/coulomb?

Ans: The potential difference is represented by the joule/coulomb.

38. A charge of 2 C moves between two plates, maintained at a p.d of IV . What is the energy acquired by the charge?

Ans: The energy acquired by the charge, $W = QV$

$= 2\ J$

The energy acquired is $2\ J$

39. Which has more resistance: 100 W bulb or 60 W bulb?

Ans: As, it is clearly known that $R \propto \frac{1}{P}$, thus the resistance of 60 W bulb is more.

40. What happens to the current in a circuit if its resistance is doubled?

Ans: As current and resistance are inversely proportional, the current is reduced to half of its previous value.

41. What happens to the resistance of a circuit if the current through it is doubled?

Ans: Resistance is unaffected since the circuit's resistance is independent of the current flowing through it.

42. How does the resistance of a wire depend upon its radius?

Ans: As $R \propto \frac{1}{A}$

$\Rightarrow R \propto V$

Resistance of a wire is directly proportional to its radius.

43. Two wires are of the same length, same radius, but one of them is of copper and the other is of iron. Which will have more resistance.

Ans: Since $R = p1/A$,

but A and I are the same. It is solely determined by resistivity, hence iron has a higher resistance.

44. Two wires of same material and same length have radii R and r Compare their resistances.

Ans: Suppose R and r are resistances, then $R = r$ as p and I are the same.

Short Answer Questions **3 Marks**

1. Two metallic wires A and B are connected wire A has length I and radius r , while wire B has length 2l and radius 2r . Find the ratio of total resistance of series combination and the resistance of wire A , if both the wires are of the same material?

Ans: Observe as shown below,

Resistance of metallic wire A , $R_1 = \frac{\rho l}{A}$

$$= \frac{\rho l}{\pi r^2}$$

Resistance of metallic wire B , $R_2 = \frac{\rho 2l}{4\pi r^2}$

Total resistance in series is $R = R_1 + R_2$

$$= \frac{\rho l}{\pi r^2} + \frac{2\rho l}{4\pi r^2}$$

$$= \frac{3\rho l}{2\pi r^2}$$

The ratio of the total resistance is series to the resistance of A is

$$\frac{R}{R_1} = \frac{\frac{3\rho l}{2\pi r^2}}{\frac{\rho l}{\pi r^2}}$$

$$= 2/3$$

The ratio of the total resistance is series to the resistance of A is $2/3$.

2. Should the heating element of an electric iron be made of iron, silver or nichrome wire? Justify giving three reasons?

Ans: The following reasons can be found, why the heating element of an electric iron is composed of nichrome wire.

(1) Due to the high resistance, the passage of current generates additional heat.

(2)High melting point.

(3) At high temperatures, it does not easily oxidise (or burn).

3. (a) Define electric resistance of a conductor?

Ans: A conductor's electric resistance is defined as the resistance it provides to the flow of current.

That is $R = V / I$ and its S.I. unit is ohm , Ω .

(b)A wire of length L and resistance R is stretched so that its length is doubled and the area of the cross section is halved. How will its
(i) resistance change

Ans: It is clearly known that resistance, $R = \frac{\rho l}{A}$

New length $L' = 2L$ and

$A' = \frac{A}{2}$

Therefore $R^1 = \frac{\rho L'}{A'}$

$= 4R$

Therefore, the resistance of a wire becomes 4 times its original resistance.

(ii) resistivity change?
Ans: The size of a wire has no bearing on its resistance. As a result, resistance does not vary.

4. Two resistor of resistance R and 2R are connected in parallel in an electric circuit. Calculate the ratio of the electric power consumed by R and 2R ?

Ans: Power consumed by R , $\rho_1 = \frac{V^2}{R}$

Power consumed by $2R$, $\rho_2 = \frac{V^2}{2R}$

Ratio $\frac{\rho_1}{\rho_2} = \frac{\frac{V^2}{R}}{\frac{V^2}{2R}}$

$. = 2:1.$

The ratio of the electric power consumed by R and $2R$ is $2:1$.

5. The length of different metallic wires but of same area of cross section and made of the same material are given below

Wire	**Length**
A	1m
B	1.5m
C	2.0m

(i) Out of these two wires which wire has higher resistance.
Ans: As $R \propto l$ (length of the conductor) and since length of wire C is more than A and B, wire C has higher resistance.

(ii) Which wire has higher electrical resistance? Justify your answer.
Ans: The electrical resistivity of a wire is determined by the nature of the material, not by its dimensions. As a result, the resistivity of all wires is the same as the substance of all wires.

6. Two resistors of resistances R and 2R are connected in series with an electrical circuit? Calculate the ratio of the electric power consumed by R and 2R ?
Ans: It is clearly known that Electric power consumed by R, $P_1 = I^2R$
Also, electric power consumed by $2R$, $P_2 = I^2 2R$

$$\frac{P_1}{P_2} = 1/2$$

The ratio of the electric power consumed by R and $2R$ is $1:2$.

7. Two conducting wires of the same material and of equal lengths and equal diameters are first connected in series and then in parallel in an electric circuit. 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) Let resistance of each wire is R
In series, resistance is $= 2R$
Heat produced, $H_1 = \frac{V^2}{2R}t$
In parallel total resistance $= R/2$

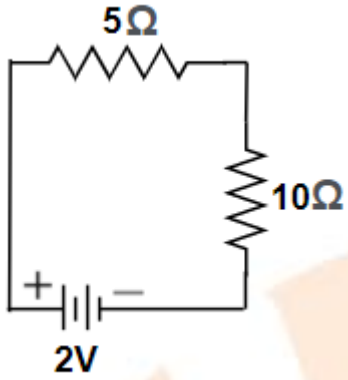
Heat produced, $H_2 = \left(\frac{V^2}{\frac{R}{2}}\right)t = \frac{2V^2}{R}t$

$$H_2 = 4H_1$$

$$\frac{H_1}{H_2} = 1/4$$

The ratio of heat produced in series and parallel combinations is $1:4$.

8. Calculate the following of a circuit shown in the figure.



(i) effective resistance

Ans: Effective resistance, $R = R_1 + R_2$

$= 5 + 10$

$= 15$

The effective resistance is 15Ω .

(ii) current

Ans: Current, $I = V / R$

$= 2 / 15$

$= 0.133$

The current is 0.133 A.

(iii) Potential difference across 10Ω resistor

Ans: Potential difference across 10Ω

$V = IR$

$= \frac{2}{15} \times 10$

$= 1.33$

The potential difference across 10Ω is 1.33 volt.

9. A Piece of wire of resistance 20Ω is drawn out so that its length is increased to twice its original length to calculate the resistance of the wire is the new situation?

Ans: Resistance of wire $= 20\Omega$

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

And as length of a wire is increased, its area of cross- section decreases, and volume of the wire remains constant.

$l' = 2l$

$A' = A/2$

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

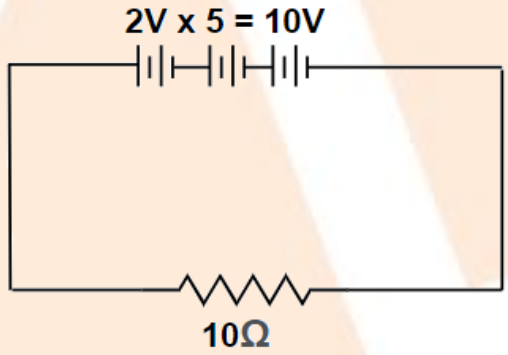
$= \dfrac{4\rho l}{A'}$

$\dfrac{R'}{R} = \dfrac{4}{1}$

$\Rightarrow R' = 80$

The resistance of the wire is the new situation is 80Ω .

10. A battery made of 5 cells each of 2 V and have internal resistance $0.1\Omega, 0.2\Omega, 0.3\Omega, 0.4\Omega$ and 0.5Ω is connected across 10Ω resistance. Draw circuit diagram and calculate the current flowing through 10Ω resistance?



Ans: The internal resistance , $0.1+0.2+0.3+0.4+0.5=1.5\Omega$

Total resistance $=1.5+10$

$=11.5$

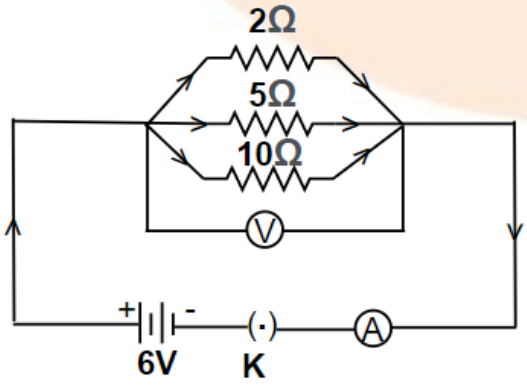
$I = V/R$

$=10/11.5$

$I = 0.869$ A

Current flowing through 10Ω resistance is 0.869 A.

11. In the circuit diagram given here Calculate-



(a) The total effective resistance

Ans: As resistances are in parallel

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

$$=\frac{1}{2}+\frac{1}{5}+\frac{1}{10}$$

$$=\frac{8}{10}$$

$$R=\frac{10}{8}$$

Total effective resistance is $\frac{10}{8}\Omega$

(b) The total current

Ans: Total current, $I=V/R$

$$=\frac{6}{10/8}$$

$$=4.8$$

The total current is 4.8 A.

(c) The current through each resistor.

Ans: From the circuit diagram, I_1, I_2 and I_3 be the current through $2\Omega, 5\Omega$ and 10Ω respectively

Therefore, $I_1=\frac{V}{R_1}$

$$=3$$

$$I_2=\frac{V}{R_2}$$

$$=1.2$$

$$I_3=\frac{V}{R_3}$$

$$=0.6$$

Current through each $2\Omega, 5\Omega$ and 10Ω is 3 A ,1.2 A, and 0.6 A respectively.

12. You have two circuits Compare the power used in 2Ω resistor in each case.

(i) a $6V$ battery is series with 1Ω and 2Ω resistor

Ans: Potential difference, $V=6V$

$R_1 = 1\Omega$

$R_2 = 2\Omega$

Total Resistor $= R_1 + R_2$

$= 1 + 2$

$= 3$

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

$= \frac{6}{3}$

$= 2$

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

$= 8$

The power used in 2Ω resistor is 8 W.

(ii) a 4V battery in parallel with 12Ω and 2Ω resistor

Ans: Potential difference, $V = 4V$

$R_1 = 12\Omega$

$R_2 = 2\Omega$

$P_2 = \frac{V^2}{R}$

$= 8$

The power used in 2Ω resistor is 8 W.

The ratio of both power is 1:1 .

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

Ans: Potential difference, $V = 6V$

Charge, $Q = 1C$

Energy = total work done

= Q x V

= 1x6

= 6 joule.

Energy given to each coulomb of charge passing through a 6 volt battery is 6 joules.

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

Ans: A conductor's resistance is determined by the following factors:

(i) length of conductor

(ii) Area of cross-section

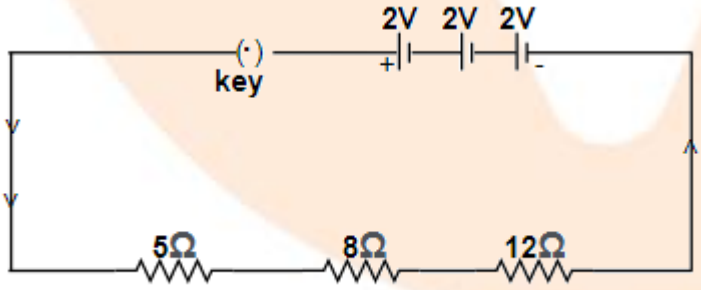
(iii) Temperature
(iv) Conductors are made from a variety of materials.

15. 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: When linked to the same source, current flows more freely through a thick wire than via a small wire of the same material. It's because resistance rises as thickness decreases.

16. Let the resistance of an electric component remain 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: The electrical component's resistance R remains unchanged, but the potential difference across its ends falls to half of its original value. As a result of Ohm's law, new current is reduced to half of its initial value.

17. Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal?
Ans: The following reasons are why the coils of electric toasters and electric irons are built of an alloy rather than a pure metal:
(i) An alloy's resistivity is higher than that of pure metal.
(ii) An alloy does not rust quickly at high temperatures.

18. Draw a schematic diagram of a circuit consisting of a battery of three cells of 2V , each, a 5Ω resistor, 8Ω resistors and a 12Ω and a plug key, all connected in series.
Ans: The diagram of circuit is as follows:



19. An electric lamp of 100Ω , a toaster of resistance 50Ω and a water filter of resistance 500Ω are connected in parallel to a 220V 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: It can be found from the question, voltage, $V = 220V$
$R_1 = 100\Omega$

$R_2 = 50\Omega$

$R_3 = 500\Omega$

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

$R = 500/16$

$= 31.25\Omega$

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

Current passing through electric iron, $I = V/R$

$= 220/31.25$

$= 7.04$ A.

That is the current passing is 7.04 A.

20. What is

(a) the highest total resistance that can be secured by combination of four resistance of $4\Omega, 8\Omega, 12\Omega$ and 24Ω ?

Ans: When all four resistances must be connected in series, the highest resistance is achieved. In that instance, the outcome

$R = R_1 + R_2 + R_3 + R_4$

$= 4 + 8 + 12 + 24$

$= 48\Omega$

The highest resistance is 48Ω .

(b) the lowest total resistance that can be secured by combination of four resistance of $4\Omega, 8\Omega, 12\Omega$ and 24Ω ?

Ans: All four resistances must be connected in parallel to produce the lowest resistance.

$1/R = 1/R_1 + 1/R_2 + 1/R_3 + 1/R_4$

$= 1/4 + 1/8 + 1/12 + 1/24$

$= 12/24$

The lowest resistance is 2Ω .

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

Ans: When connected to the voltage source, the cord of a heater and the cord of an electric heater are connected in series and carry the same current.

Because the resistance of the cord is so low in comparison to the resistance of the heater element.

As a result, the amount of heat created in the cord is extremely low, but significantly higher in the heater element. As a result, the heating element glows, but the cord does not.

22. A copper wire has diameter 0.5 mm and resistivity of 1.6×10^{-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?

Ans: The diameter of wire, d = 0.5 mm,

Resistivity, $\rho = 1.6\times10^{-8}$

resistance $R = 10\ \Omega$

$R = \rho L / A$

$$L = \frac{\pi D^2 R}{4\rho}$$

$$= \frac{22\times(5\times10^{-4})^2}{7\times4\times1.6\times10^{-8}}$$

$= 122.5$ m

As resistance is inversely proportional to the cross-section area of wire, when the diameter is doubled for a given length of material, the resistance reduces.

23. A battery of 9V is connected in series with resistance of $0.2\Omega, 0.3\Omega, 0.4\Omega, 0.5\Omega$ and 12Ω respectively. How much current would flow through the 12 resistor?

Ans: Potential difference $V = 9V$.

Total resistance $= 0.2 + 0.3 + 0.5 + 0.5 + 12$

$= 13.4\ \Omega$

Current in the circuit $I = V / R$

$= 9\ V\ /\ 13.4\ A.$

$= 0.67$

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

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

Ans: Let resistor of 176Ω are joined in parallel.

Their combined resistance,

$1/R = 1/176 + 1/176 \ldots\ldots$ times

$= n/176$ or

$\Rightarrow R = 176/n\Omega$

Given that $V = 220V$ and

$I = 5$ A

$R = V / I$

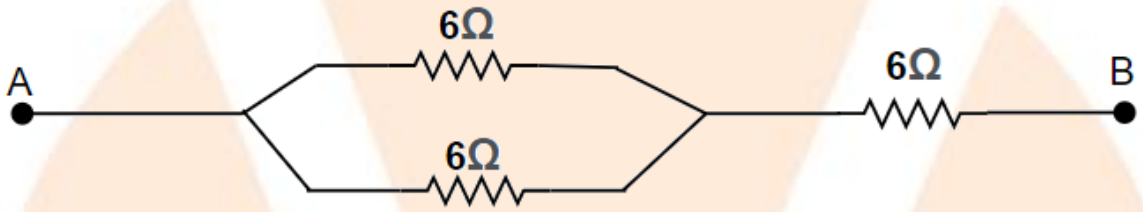
$= 176/n$

$= 220/5$

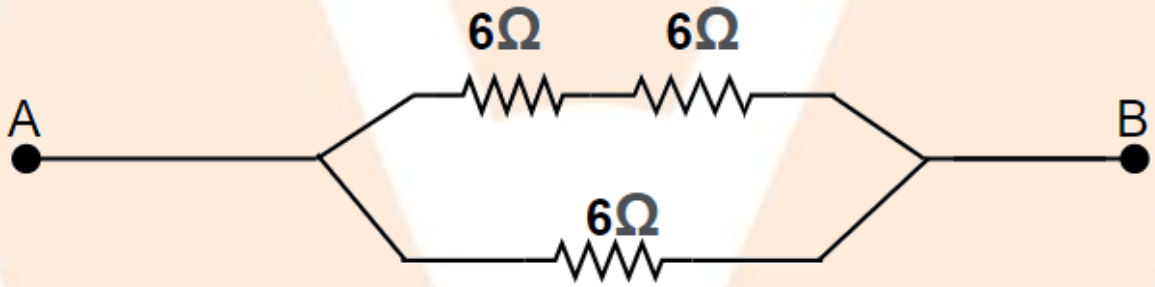
$= 44\Omega$

$n = 176/44$
$= 4$,
A number of 4 resistors should be joined in parallel.

25. Show how you would connect three resistors, each of resistance 6Ω so that the combination has resistance of
(i) 9Ω
Ans: From the question, $R_1 = R_2$
$= 6$
Join three resistors as below to get net resistance of 9Ω :



(ii) 4Ω
Ans: Join three resistors as below to get 4Ω net resistance :



26. A hot plate of an electric oven connected to a 220V line has two resistance coils A and B . Each of 24Ω resistances, which may be used separately, in series or in parallel. What are the currents in the three cases?
Ans: From the question, potential difference $V = 220$ V .
Resistance of coil A = Resistance of coil B
$= 24\ \Omega$
When coil is used separately, the circuit $I = V/R$
$= 220V/24\Omega$
$= 9.2$ A
The current is 9.2 A .
When coils are used in series total resistance $R = R_1 + R_2$
$= 24 + 24$
$= 48\Omega$
The current flowing, $I = V/R$
$= 220V/48\Omega$

$= 4.6\ A$

The current is $4.6\ A$.

Two coils are joined in parallel.

Total resistance $R = 1/24 + 1/24$

$= 2/24$

$R = 12\ \Omega$.

Current $I = V/R$

$= 220V/12\Omega$

$= 18.3\ A$.

The current is $18.3\ A$.

27. Compare the power used in the 2Ω resistor in each of the following circuits:
(i) a 6 volt battery in series with 1Ω and 2Ω resistors and,

Ans: Suppose a 2Ω resistor is joined to a $6\ V$ battery in series with 1Ω and 2Ω resistors.

Total resistance $R = 2 + 1 + 2$

$= 5\Omega$

Current $I = 6V/5\Omega$

$= 1.2\ A$

Power used in $2A$ resistor $= I^2R$

$= 2.88\ W$

Power used is $2.88\ W$.

(ii) a 4V battery in parallel with 12Ω and 2Ω resistors.

Ans: Suppose 2Ω resistor is joined to a $4V$ battery in parallel with 12Ω resistor and 2Ω resistors,

the current flowing in $2\Omega = 4V/2\Omega$

$= 2A$

Power used in 2Ω resistor $= I^2R$

$= 8\ W$

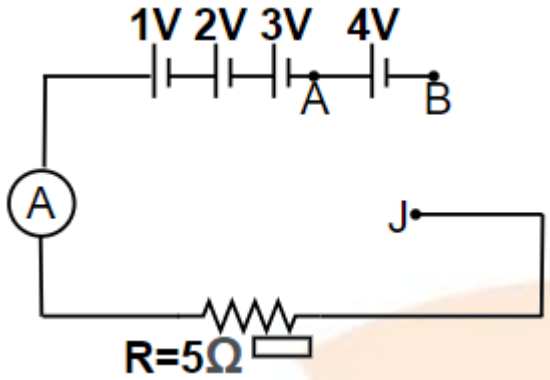
Ratio $= 2.88/8$

$= 0.36:1$

The ratio of power used is $0.36:1$.

28. In the given figure what is ratio of ammeter reading when J is connected to A and then to B

Ans: Connect J to A , then



$I = V / R$
$= 3 / 5$
$= 0.6A$
When J is connected to B $V = 1 + 2 + 3 + 4$
$= 10V$
$I = 10 / 5$
$= 2A$
Ratio of ammeter reading when J is connected to A and then to B is $3:10$.

29. Given a resistor each of resistors R . How will you combine them to get the
(i) maximum effective resistance?
Ans: For maximum resistance $R = nr$, this is the same as combining a series of numbers.

(ii) minimum effective resistance? What is the ratio of the maximum to minimum resistance?
Ans: For minimum resistance $R' = r / n$, this is the same as combining a series of numbers.The ratio of the maximum to minimum resistance is $R / R' = n^2$.

30. A wire of length L and resistance R is stretched so that its length is doubled. How will its
(a) Resistance change
Ans: The resistance of a wire is determined by its length, cross-sectional area, and resistivity as $R = \frac{\rho l}{A}$
Hence, if the length is doubled and area is halved, then we have

$$\frac{R_2}{R_1} = \frac{\frac{\rho l_2}{A_2}}{\frac{\rho l_1}{A_1}}$$

$= \frac{l_2 A_1}{l_1 A_2}$

$= 4$

Therefore, $R_2 = 4R_1$

Hence, resistance of the wire becomes four times the original value.

(b) Resistively change?

Ans: The substance from which wire is formed has a property called wire resistivity. As a result, changing the wire's size has no effect on its resistivity.

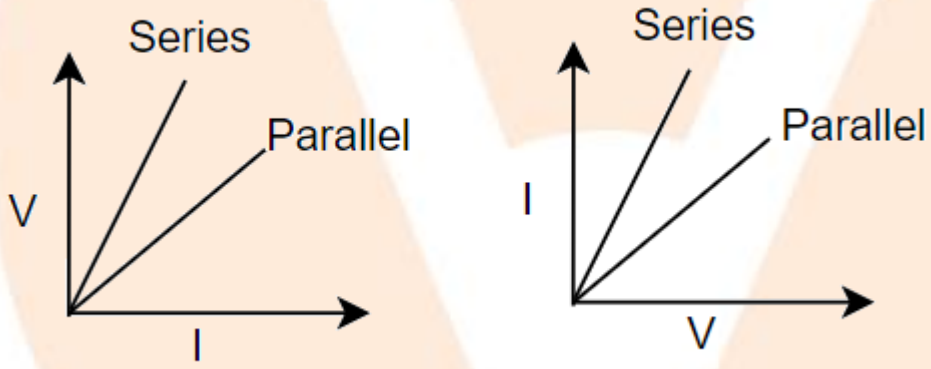
31. Two students perform the experiments on series and parallel combinations of two given resistors R_1 and R_2 and plot the following $V - I$ graphs.

Ans: Both students are correct because

$AV / A1 =$ resistance R and

$A1 / AV = l / R$

The term "series" refers to high resistance, while "parallel" refers to low resistance.



32. A household uses the following electric appliances. Calculate the electricity bill of the household for the month of June if the cost per unit of electric energy is Rs. 3.00

(i) Refrigerator of rating 4 for ten hours each day.

Ans: Month of June has 30 days.

Refrigerator of 400 W is running 2 hours each day.

Total hours it is run in 30 days $= 2 \times 30$

$= 60$ h

Energy consumed in kWh is $= 400 \times 60 / 1000$

$= 24$ kWh

(ii) Two electric fans of rating 80 each for twelve hours each day.

Ans: Two electric fans of 80 W are run 12 hours each day.

Total hours they are run in 30 days $= 12 \times 30$

$= 360$

Energy consumed in kWh is $= 2 \times 80 \times 360 / 1000$

$= 57.6$ kWh

(iii) Six electric tubes of rating 18 W each for 6 hours each day.

Ans: Six electric tubes each of 18 W are run 6 hours daily.

Total hours it is run in 30 days $= 6 \times 30$

$= 180$ h

Energy consumed in kWh is $= 6 \times 18 \times 180 / 1000$

$= 19.44$ kWh

Net energy consumed in the month of June is $= 24 + 57.6 + 19.44$

$= 101.04$ kWh

Thus, the electric bill is $= 3 \times 101.04$

$= \text{Rs}303.12$

Long Answer Questions **5 Marks**

1. Two wires A and B are of equal length, different cross sectional areas and made of the same metal.

(a)(i) Name the property which is same for both the wires,

Ans: Resistivity - As resistivity is a property of a substance, it is constant for both wires.

(ii) Name the property which is different for both the wires.

Ans: Resistances - As the cross sectional areas of each wires are different, they are treated as separate objects.

(b)If the resistance of wire A is four times the resistance of wire B , calculate (i) the ratio of the cross sectional areas of the wires and

Ans: Since $R = \frac{\rho l}{A}$

For wire A , $R_1 = \frac{\rho l}{A_1}$

For wire B , $R_2 = \frac{\rho l}{A_2}$

$\Rightarrow \frac{R_2}{R_1} = \frac{A_1}{A_2}$

Since $R_1 = 4R_2$

$\Rightarrow \frac{A_1}{A_2} = 1:4$

$\frac{A_1}{A_2} = \frac{\pi r_1^2}{\pi r_2^2}$

$= \left(\frac{r_1}{r_2}\right)^2$

Ratio is $\left(\frac{r_1}{r_2}\right)^2$.

(ii) The ratio of the radii of the wire.

Ans: $\left(\frac{r_1}{r_2}\right)^2 = 1/4$

Ratio is $1:2$.

2. (a) State ohm's law?

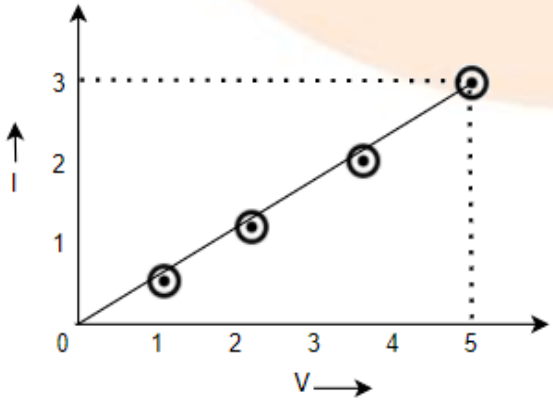
Ans: If the temperature and other physical conditions of the conductor stay constant, the electric current flowing through the conductor is precisely proportional to the potential difference across the conductor's end.

(b) The value of (I) current flowing through a conductor for the corresponding values of (V) potential difference are given below

I (Amperes)	**0.5**	**1.0**	**1.5**	**2.5**	**3**
V (Volts)	**1**	**2**	**3**	**4.5**	**5**

Plot a graph between V and I and also calculate resistance.

Ans: Along x -axis $IV = 1$ cm



$R = 5/3$
$= 1.67$
The resistance is 1.67Ω .

3. (a) Define electrical energy with S.I. unit?
Ans: The effort done by a source of electricity to sustain current in a circuit is known as electrical energy. The joule is its SI unit.

(b) A household uses the following electric appliance; Calculate the electricity bill of the household for the month of June if the cost per unit of electric energy is Rs. 3.00 .
(i) Refrigerator of rating 400 w for ten hour each day.
Ans: Electricity consumed by refrigerator in one day $=$ power $\times$ time
$= 400 \times 10$
$=$ 4000 Wh
$= 4$ kwh
Therefore the electricity consumed is 4 KWh.

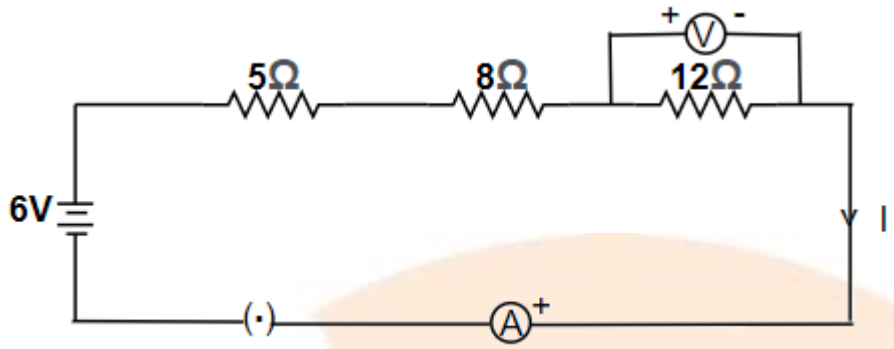
(ii) Two electric fans of rating 80 w each for twelve hours each day.
Ans: Electricity consumed by 2 electric fans in 1 day . . power $\times$ time
$= 2 \times 80 \times 12$
$=$ 1.92 kwh
Therefore the electricity consumed is 1.92 KWh.

(iii) Six electric tubes of rating 18 w each for 6hours each day.
Ans: Electricity consumed by 6 electric tubes in 1 day $= 6 \times 18 \times 6$
$=$ 0.648 kwh
Therefore the electricity consumed is 0.648 KWh.
Total energy consumed in one day $= 4 + 1.92 + 0.648$
$= 6.548$ kwh

Total energy consumed in one month $= 6.568 \times 30$
$= 197.04$ kwh
Cost of 1 unit (kwh) $=$ Rs 3.00
Cost of 197.04 kwh $= 197.04 \times 3$
Electricity bill $=$ Rs591.12
The electricity bill of the household for the month of June is Rs. 591.12 .

4. 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 12Ω resistors. What would be the reading in the ammeter and voltmeter?

Ans:



Ammeter A has been joined in series of circuit and voltmeter V is joined in parallel to 12 ohms resistor.

Total voltage of battery $V = 3x2$

$= 6$ V.

Total resistance $R = R_1 + R_2 + R_3$

$= 5\Omega + 8\Omega + 12\Omega$

$= 25\Omega$

Ammeter reading $= I$

$= V / R$

$= 6 / 25$

$= 0.24$ A.

Voltmeter reading $=$ IR

$= 0.24$ x 12

$= 2.88$ V.

The reading in the ammeter and voltmeter is 0.24 A and 2.88 V respectively.

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

Ans: The following are the benefits of connecting electrical equipment in parallel with the battery rather than in series:

(i)Each connecting electrical device will have the same voltage, and the device will take current according to its resistance.

(ii)It is possible to use separate on/off switches.

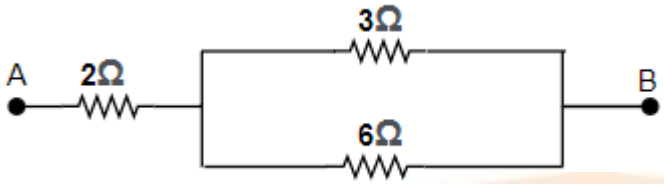
(iii) As the total resistance in the parallel circuit falls, a large current can be pulled from the cell.

(iv) Even if one electrical gadget is broken, other devices continue to function normally.

6. How can three resistors of resistance $2\Omega, 3\Omega$ and 6Ω be connected to give a total resistance of

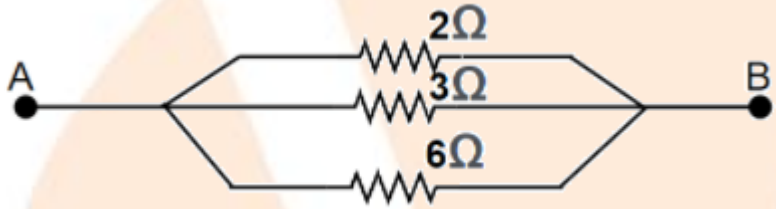
(a) 4Ω

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



(b) 9Ω

Ans: If all the three resistance are joined in parallel the resulting resistance will be 3Ω .

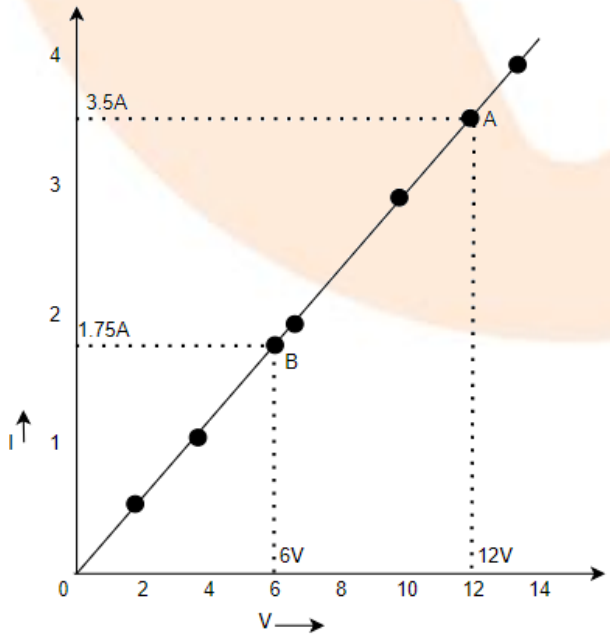


7. The value of current I flowing in a given resistor for the corresponding values of potential difference V across the resistor are given below:

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.

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



Resistance of resistor $R = V_A - V_B / 1_A - 1_B$

$= 12\ V - 6\ V / 3.6\ A - 1.8\ A$

$= 6V / 1.8\ A$

$= 3.3\ \Omega$

8. Explain the following:

(a) Why is tungsten used almost exclusively for filament of electric lamps?

Ans: For the filament of electric lamps, we need a robust metal with a high melting point. Because of its high melting point, tungsten is utilised only for electric lamp filament.

(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?

Ans: Electric heating device conductors are composed of an alloy because it has a higher resistance than pure metal and a higher melting point, which prevents it from oxidising at high temperatures.

(c) Why is the series arrangement not used for domestic circuits?

Ans: As the current to all appliances remains constant despite varying resistance, each appliance cannot be turned on or off independently.

(d) How does the resistance of wire vary with its area of cross-section?

Ans: As resistance of a wire is inversely proportional to its cross-section area, the resistance will decrease when the area of cross section increases.

(e) Why are copper and aluminium wires usually employed for electric transmission?

Ans: As copper and aluminium wires are good conductors with low resistance, they are commonly utilised for electrical transmission. They can also be drawn into thin wires since they are ductile.