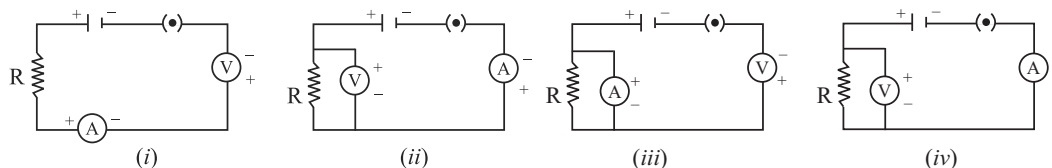# Electricity

I. Multiple Choice Questions (1 Mark)

Choose the correct answer from the given options.

1. Electrical resistivity of a given metallic wire depends upon
   - (a) its length
   - (b) its thickness
   - (c) its shape
   - (d) nature of the material

2. Identify the circuit (Fig) in which the electrical components have been properly connected.

   - (a) (i)
   - (b) (ii)
   - (c) (iii)
   - (d) (iv)

3. Electric current flows from 'A' to 'B' in metallic conductor. The point is at higher potential is
   - (a) A
   - (b) B
   - (c) Both have equal potential
   - (d) Both have lower potential

4. If electrons flow from A to B, current will flow from
   - (a) A to B
   - (b) B to A
   - (c) It will not flow
   - (d) None of these

5. When a 4V battery is connected across an unknown resistor there is a current of 100 mA in the circuit. The value of the resistance of the resister is:
   - (a) $4 \, \Omega$
   - (b) $40 \, \Omega$
   - (c) $400 \, \Omega$
   - (d) $0.4 \, \Omega$

   [*CBSE* Sample Paper 2019-2020]

6. A cell, a resistor, a key and ammeter are arranged as shown in the circuit given below. The current recorded in the ammeter will be
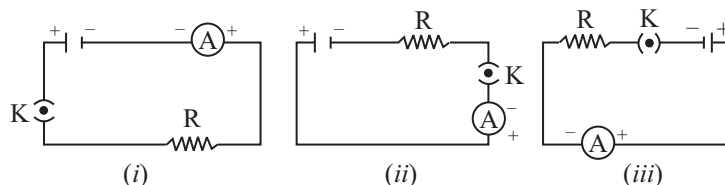
   - (a) maximum in (i)
   - (b) maximum in (ii)
   - (c) maximum in (iii)
   - (d) the same in all the cases

II. Assertion-Reason Type Questions (1 Mark)

For question numbers 1 and 2 two statements are given-one labeled as **Assertion** (a) and the other labeled **Reason** (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:

   - (a) Both 'A' and 'R' are true and 'R' is correct explanation of the Assertion.
   - (b) Both 'A' and 'R' are true but 'R' is not correct explanation of the Assertion.

(c) 'A' is true but 'R' is false.

(d) 'A' is false but 'R' is true.

1. **Assertion:** Resistance depends on length and area of cross-section of material and temperature.

   Reason: Resistivity is a characteristic property of material.

2. **Assertion:** Fuse wire is thin and has high resistance.

   Reason: Alloys do not oxidise readily at high temperature.

III. Very Short Answer Type Questions (1 Mark)

1. Let the resistance of an electrical 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? [*NCERT*] [**HOTS**]

2. Which among iron and mercury is a better conductor?

   (Given: $\rho_{Fe} = 10.0 \times 10^{-8}\ \Omega - m$, $\rho_{Hg} = 95 \times 10^{-8}\ \Omega - m$

3. Write the S.I. unit of resistivity. [*Delhi* 2015, 16]

4. Mention two reasons why tungsten is used for making filaments of electric lamps. [*Delhi* 2016]

5. How does resistivity of alloys compared with those of pure metals from which they have been formed? [*CBSE* 2014]

6. State the difference between a wire used in the element of electric heater and in fuse wire. [*Delhi* 2013] [*CBSE* 2014]

7. Name a device which helps to maintain the potential difference across a conductor. [*CBSE* 2014]

8. Draw a circuit diagram having the following components:

   (a) Bulb   (b) A two cell battery   (c) Ammeter   (d) A closed key

9. Name the factors on which the resistance of a conductor depend? [*NCERT*]

OR

List the factors on which the resistance of a conductor in terms of shape of a wire depends.

10. What happens to the resistance of a conductor when its temperature is increased? [*CBSE* 2010]

11. Nichrome is used to make the element of an electric heater, why? [*CBSE* 2010]

12. Mention two special features of the material to be used as an element of an electric iron. [*CBSE* 2014]

13. What happens to resistance of a conductor when its area of cross section is increased? [*Delhi* 2011]

14. What does electric circuit mean? [*NCERT*]

15. List two factors on which resistance depends. [*CBSE* 2015]

16. In an electric circuit, state the relationship between the direction of conventional current and the direction of flow of electrons. [*CBSE* 2014]

17. A given length of wire is doubled on itself and the process is repeated once again. By what factor does the resistance of wire will change? [*CBSE* 2011]

IV. Short Answer Type Question-I (2 Marks)

1. Out of the two wires 'X' and 'Y' of the same material as shown below, which one has greater resistance? Justify your answer. [*Delhi* 2012]
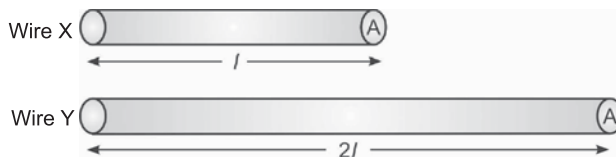
## V. Short Answer Type Questions-II (3 Marks)

1. Resistance of a metal wire of length 1 m is 26 Ω at 20°C. If the diameter of the wire is 0.3 mm, what will be the resistivity of the metal at that temperature? [*NCERT*] [**HOTS**]

2. The figure below shows three cylindrical copper conductors along their face areas and lengths. Discuss in which geometrical shape the resistance will be the highest. [*Delhi* 2013]
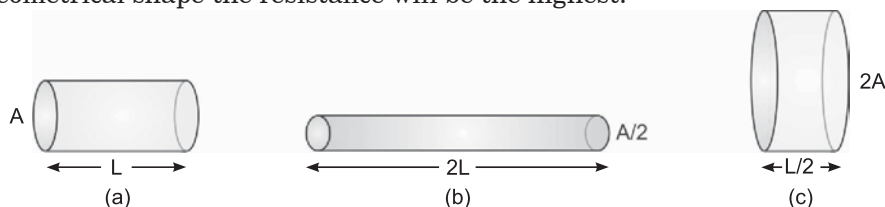
3. Calculate the resistance of 1 km long wire of copper of radius 1 mm. (Resistivity of copper is 1.72×10^{-8} Ω m.) [Delhi 2013]

4. The resistance of a wire of 0.01 cm radius is 10 Ω. If resistivity of the material of wire is 50×10^{-8} ohm metre, find the length of the wire. [Delhi 2016]

5. The resistance of a wire of length 250 m is 1 ohm. If the resistivity of the material of wire is 1.6×10^{-8} ohm metre, find the area of cross-section of the wire. How much does the resistance change if the diameter of the wire is doubled? [Delhi 2016]

6. The electrical resistivity of three materials A, B, C are given below:

   'A' = 2.3×10^3 ohm metre   'B' = 2.63×10^{-8} ohm metre   'C' = 1.0×10^{15} ohm metre

   Which material will you use for making (i) electric wires, (ii) handles for soldering iron and (iii) solar cells? Give reason to support your answer.

7. Suppose the ammeter or voltmeter you are using in Ohm's law experiment do not have +ve and –ve terminal markings, how will you use such an ammeter or voltmeter in the circuit? [Delhi 2015]

8. Study the V–I graph for a resistor as shown in the figure and prepare a table showing the values of I (in amperes) corresponding to four different values of V (in volts). Find the value of current for V = 10 volts. How can we determine the resistance of the resistor from this graph?
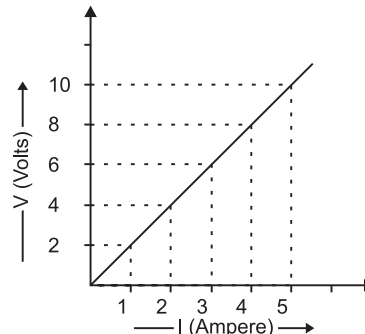

9. Name and define SI unit of resistance. Calculate the resistance of a resistor if current flowing through it is 200 mA, when the applied potential difference is 0.8 V. [CBSE 2014]

10. V–I graph for two wires A and B are shown in the figure. If both the wires are of same length and same thickness, which of the two is made of a material of high resistivity? Give justification for your answer.
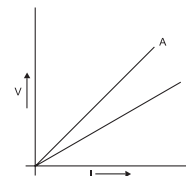
11. The figure below shows three cylindrical copper conductors along with their face areas and lengths. Compare the resistance and the resistivity of the three conductors. Justify your answer.
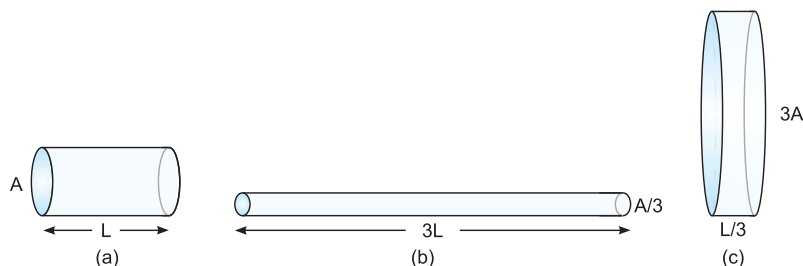
12. The potential difference between the terminals of an electric heater is 60 V when it draws a current of 4 A from the source. What current will the heater draw if the potential difference is increased upto 120 V? [NCERT]

13. (i) How much current will an electric bulb draw from a 220 V source, if resistance of the filament of a bulb is 1200 Ω?

    (ii) How much current will an electric heater coil draw from a 220 V source, if the resistance of the heater coil is 100 Ω? [NCERT] [Delhi 2012]

14. A wire of given material having length l and area of cross-section A has a resistance of 4 Ω. What would be the resistance of another wire of the same material having length l/2 and area of cross-section 2A? [NCERT] [HOTS]

15. 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 of the wire is doubled? [NCERT]

16. 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

Plot a graph between V and I and calculate the resistance of that resistor. [*NCERT*] [**HOTS**]

17. 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. [*NCERT*]

18. A piece of wire of resistance 20 Ω is drawn out of a material so that its length is increased to twice of its original length. Calculate the resistance in the new situation. [**HOTS**]

19. V-I graph for two wires 'A' and 'B' are shown in the figure. If both the wires are of same length and are of same thickness, which of these two is made of the material of higher resistivity? Give justification for your answer.
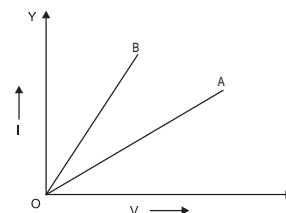
**20.** (*i*) What are the values of mA and μA in amperes?
(*ii*) Draw the symbols of battery and rheostat? [*CBSE* 2014]

VI. Long Answer Type Questions (5 Marks)

1. (*i*) Write an expression for the resistivity of a substance.
(*ii*) State the SI unit of resistivity.
(*iii*) Distinguish between resistance and resistivity.
(*iv*) Name two factors on which the resistivity of a substance depends and two factors on which it does not depend. [*Delhi* 2015]

2. List two distinguishing features between the resistance and resistivity of a conductor. A wire is stretched so that its length becomes 6/5 times of its original length. If its original resistance is 25 Ω, find its new resistance and resistivity. Give justification for your answer in each case. [*Delhi* 2016]

3. State Ohm's law. Draw a labelled circuit diagram to verify this law in the laboratory. If you draw a graph between the potential difference and current flowing through a metallic conductor, what kind of curve will you get? Explain how would you use this graph to determine the resistance of the conductor. [*Delhi* 2016]

4. You have been assigned a duty to create awareness in your school about saving electricity.
(*i*) Write any two ways by which you will create awareness among your schoolmates about saving electricity.
(*ii*) Explain how saving electricity is important at individual level as well as at national level. [*Delhi* 2015]

5. (*i*) Draw a closed circuit diagram consisting of a 0.5 m long nichrome wire XY, and ammeter, a voltmeter, four cells of 1.5 V each and a plug key.
(*ii*) Following graph was plotted between V and I values:
What would be the values of V/I ratios when the potential difference is 0.8 V, 1.2 V and 1.6 V respectively? What conclusion do you draw from these values?
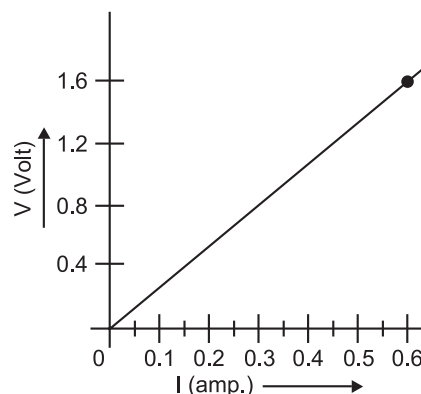
Answers 1.1

I. 1. (*d*) It depends only upon nature of the material. Resistance depends on the length of wire and area of cross section.
2. (*b*) It is correct because Ammeter should be connected in series and voltmeter should be connected in parallel.
3. (*a*) 'A' because current flow from higher to lower potential.
4. (*b*) Current flows in opposite direction to the direction of flow of electrons, B to A.
5. (*b*) V = IR, V = 4V, I = 100 mA = 0.1 A; Hence, R = V/I = 4/0.1 = 40.
6. (*d*) It will be same in all cases
II. 1. (*b*) Both 'A' and 'R' are true but 'R' is not correct explanation of the assertion.
2. (*b*) Both 'A' and 'R' are true but 'R' is not correct explanation of the assertion.

III. **1.** The current flowing through the electrical component will get halved.
  2. Iron
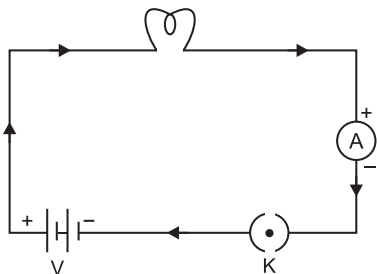 **3.** Ω m (ohm metre)
  4. (i) High resistivity, (ii) High melting point
  5. Alloys have higher resistivity as compared to pure metals.
  6. The wire used in the elements of an electric heater has high melting point whereas a fuse wire has low melting point.
  7. Cell or battery eliminator.
  8.

  9. (i) Nature of material, (ii) Length of conductor [or $R \propto l$]
  (iii) Area of cross section of the conductor [or $R \propto 1/A$], (iv) Temperature
  10. Its resistance increases.
  11. It is an alloy with high resistivity and high melting point.
  12. The material should have (i) high resistivity, (ii) high melting point.
  13. Resistance decreases, $\because$ $R \propto \dfrac{l}{A}$, Resistance is directly proportional to length but inversely proportional to area of cross-section.
  14. It is a continuous and closed path in which current flows with the help of conducting wires. It consists of a cell, an ammeter, voltmeter, plug key, bulb, etc.
  15. (i) Length, (ii) Area of cross section
  It is directly proportional to the length and inversely proportional to the area of cross section of a resistor.
  16. The direction of conventional current is opposite to the direction of flow of electrons.
  17. Length becomes 4 times whereas area becomes $\dfrac{1}{4}$ times of the original value. Since,

  $$R = \rho\frac{L}{A} = \rho\frac{4L}{\dfrac{A}{4}} = \rho\frac{16L}{A} = 16\rho\frac{L}{A}$$ where ρ (rho) is resistivity, L is length and 'A' is area of cross section.

  $\therefore$ Resistance will become 16 times of the original value.

IV. **1.** 'Y' has more resistance because resistance is directly proportional to the length of the wire.

V. **1.** R = 26 Ω, l = 1 m, d = 0.3 mm = 3×10^{-4} m

  $$r = \frac{d}{2} = \frac{3 \times 10^{-4}}{2} = 1.5 \times 10^{-4} \text{ m}$$

  $$A = \pi r^2 \Rightarrow A = \frac{22}{7} \times (1.5 \times 10^{-4})^2$$

  $$\rho = \frac{R \times A}{l} = \frac{26 \times 22 \times 2.25 \times 10^{-8}}{7 \times 1\,\text{m}} = 1.84 \times 10^{-6}\ \Omega\ \text{m}$$

  2. $R_1 = \rho \times \dfrac{L}{A}$ (i)

  $R_2 = \rho \times \dfrac{2L}{A/2} = 4\rho \times \dfrac{L}{A} = 4\ R_1$ (ii)

  $R_3 = \rho \times \dfrac{L/2}{2A} = \dfrac{1}{4} \times \rho \times \dfrac{L}{A} = \dfrac{1}{4} R_1$ (iii)

  Thus in figure (b) the resistance is maximum.
  So, from equations (i), (ii) and (iii), we get $R_2 > R_1 > R_3$.

Hence, the cylinder having length (2L) and area of cross-section (A/2) has the highest resistance followed by the cylinder having length (L) and area of cross section (a), while cylinder with length (L/2) and area of cross-section (2A) has the least resistance. This is because resistance of a substance is directly proportional to the length and is inversely proportional to the area of cross-section.

3. $$R = \rho \times \frac{l}{A}$$

$\rho = 1.72 \times 10^{-8}\,\Omega\,m;\ r = 1\,mm = 1 \times 10^{-3}\,m;\ A = \pi r^2 = \frac{22}{7} \times 1 \times 10^{-6}$

$l = 1\,km = 1000\,m$

$$\Rightarrow R = \frac{1.72 \times 10^{-8} \times 1000 \times 7}{22 \times 1 \times 10^{-6}} = \frac{12.04}{22} \times 10^{-8+3+6} = \frac{120.4}{22} = 5.473\,\Omega$$

4. $R = \rho \times \dfrac{l}{A}$

$R = 10\,\Omega, \qquad r = 0.01 \times 10^{-2}\,m = 1 \times 10^{-4}\,m, A = \pi r^2 = \frac{22}{7} \times 1 \times 10^{-8}$

$\rho = 50 \times 10^{-8}\,\Omega\,m$

$$\therefore\ l = \frac{R \times A}{\rho} = \frac{10 \times 22 \times 10^{-8}}{50 \times 10^{-8} \times 7} = \frac{220}{350} = 0.628\,m = 62.8\,cm$$

5. $R = \rho \dfrac{l}{A} \Rightarrow A = \dfrac{\rho l}{R}$

$$A = \frac{1.6 \times 10^{-8}\,\Omega\,m \times 250\,m}{1\,\Omega} = 4 \times 10^{-6}\,m^2$$

If diameter is doubled then area of cross-section becomes four times and the resistance will become one fourth, i.e., 0.25 Ω.

6. (i) 'B' will be used for electric wires because it has lowest resistivity, therefore current can flow easily.
   (ii) 'C' will be an insulator, so it can be used for handles of soldering iron. Since its resistivity is very high, therefore current cannot pass through it.
   (iii) 'A' will be used in solar cells because it is a semiconductor which can convert solar energy into electric energy.

7. (i) Connect the device in the circuit with battery.
   (ii) Close the circuit and notice the deflection of the pointer.
   (iii) If the deflection is in the opposite direction i.e. below zero, then interchange the terminals.

8.

I (in amp)	2	4	6	8
V (in Volt)	1	2	3	4

When V = 10 Volts, I = 5 amperes, then $R = \dfrac{V}{I} = \dfrac{10\,V}{5\,A} = 2\,\Omega$

9. (i) The SI unit of resistance is Ohm (Ω).
   (ii) If the current of 1 ampere flows through a wire on applying a potential difference of one volt across it, then the resistance of the wire is said to be 1 Ω.
   (iii) I = 200 mA = 200 × 10^{-3} A

   $$R = \frac{V}{I} = \frac{0.8}{0.2} = 4\,ohms$$

10. Greater the slope of V–I graph, greater will be the resistance of the given metallic wire. In the given graph, wire A has greater slope than B. Hence, wire A has greater resistance.

    For the wires of same length and same thickness, resistance depends on the nature of the material of wire, i.e.

    $$R_1 = \rho_1 \frac{l}{A} \text{ and } R_2 = \rho_2 \frac{l}{A} \Rightarrow \frac{R_1}{R_2} = \frac{\rho_1}{\rho_2} \text{ or } R \propto \rho$$

    Since, $R_1 > R_2$. Hence, wire 'A' is made of a material of high resistivity.

11. For the geometrical shapes shown in figure:

$R_a = \rho\dfrac{l}{A}$; $R_b = \rho\left(\dfrac{3L}{A/3}\right) = 9\dfrac{\rho L}{A} = 9R_a$; $R_c = \rho\left(\dfrac{L/3}{3A}\right) = \dfrac{1}{9}\dfrac{\rho L}{A} = \dfrac{1}{9}R_a$

Hence $R_b > R_a > R_c$

$\rho_a = \rho_b = \rho_c$ because all the three conductors are of same material.

12. V = 60 V, I = 4 A

$R = \dfrac{V}{I} = \dfrac{60}{4} = 15\,\Omega$ [∵ By Ohm's Law: V = IR]

Now, V = 120 V, I = ? R = 15 Ω

$I = \dfrac{V}{R} = \dfrac{120}{15} = 8$ A

13. (i) V = 220 V, R = 1200 Ω

$I = \dfrac{V}{R} = \dfrac{220}{1200} = 0.18$ A   [∵ By Ohm's Law: V = IR]

(ii) Now, V = 220 V, R = 100 Ω

$I = \dfrac{220}{100} = 2.2$ A

14. $R_1 = \rho \times \dfrac{l}{A} = 4\ \Omega$ $\left[\because R = \rho \times \dfrac{A}{l}\right]$

Also, $R_2 = \rho \times \dfrac{l/2}{2A} = \rho \times \dfrac{1}{4} \times \dfrac{l}{A}$

$R_2 = \dfrac{1}{4}R_1 = \dfrac{1}{4} \times 4 = 1\ \Omega$

15. $\rho = 1.6 \times 10^{-8}\Omega$ m ; R = 10 Ω, d = 0.5 mm = 5 × 10⁻⁴ m   [∵ 1 mm = 10⁻³ m]

$r = \dfrac{5}{2} \times 10^{-4}$ m = 2.5 × 10⁻⁴ m; $A = \pi r^2 = \dfrac{22}{7} \times (2.5 \times 10^{-4})^2$ m²

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

$1.6 \times 10^{-8} = 10 \times \dfrac{22}{7} \times \dfrac{6.25 \times 10^{-8}}{l}$ $\Rightarrow$ $l = \dfrac{10 \times 22 \times 6.25 \times 10^{-8}}{7 \times 1.6 \times 10^{-8}} = \dfrac{1375}{11.2} = 122.77$ m

16. The slope of the graph is equal to the resistance.

$R = \dfrac{\text{Change in V}}{\text{Change in I}} = \dfrac{\Delta V}{\Delta I} = \dfrac{13.2 - 1.6}{4.0 - 0.5},$
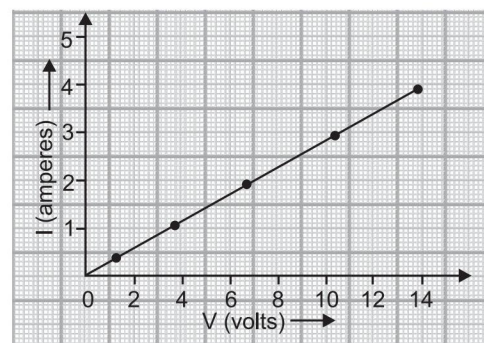
$R = \dfrac{11.6}{3.5} = 3.314\ \Omega$

17. V = 12 V, I = 2.5 mA = 2.5 × 10⁻³ A

(∵ 1 mA = 10⁻³ A)

$R = \dfrac{V}{I} = \dfrac{12}{2.5 \times 10^{-3}} = \dfrac{12000}{2.5} = 4800\ \Omega = 4.8\ k\Omega$

(∵ By Ohm's Law: V = IR)

18. $R_1 = \rho \times \dfrac{l}{A}$; $R_2 = \rho \times \dfrac{2l}{A}$

$\therefore \dfrac{R_2}{R_1} = \dfrac{\rho \times \dfrac{2l}{A}}{\rho \times \dfrac{l}{A}}$ $\Rightarrow$ $R_2 = 2R_1 = 2 \times 20 = 40\ \Omega$

19. 'A' has greater resistivity than 'B'. It depends upon the nature of material. High resistivity means lower value of electric current flowing through the wire.

20. (*i*) 1mA = 10^{-3}A, 1µA = 10^{-6}A.

(*ii*) ⊣⊢⊣⊢ is the symbol of battery, and —⋁⋀⋀— or ⌐⋀⋀⋀ is the symbol of rheostat.

VI. 1. (*i*) Resistivity (ρ) = $\dfrac{RA}{l}$ (*ii*) Its SI unit is Ω m.

(*iii*) Resistivity is a characteristic property of a material that does not depend upon the dimensions of the material whereas resistance depends upon the dimensions of the material.

(*iv*) Resistivity does not depend on the:

(*a*) length of conductor,   (*b*) area of cross section of conductor

Resistivity depends on the:

(*a*) nature of material of conductor   (*b*) temperature of conductor

2.

Resistance	Resistivity
(*i*) It is the ratio of voltage over current at a particular temperature.	(*i*) It is the resistance of a wire of length 1 m and area of cross section 1 m².
(*ii*) Its S.I. unit is ohm.	(*ii*) Its S.I. unit is ohm metre.
(*iii*) It is the property of a conductor.	(*iii*) It is the property of the material of the conductor.

(Any two)

Since resistance is directly proportional to the length and is inversely proportional to the area of cross section.

$\therefore$ New Resistance: R = $\dfrac{6}{5} \times \dfrac{25}{\left(\dfrac{5}{6}\right)^2}$ = $\dfrac{150}{5 \times 25} \times 36 = \dfrac{216}{5}$ = 43.20 ohms

When the wire is stretched, its length becomes 6/5 times of its original length, and area of cross-section will become 5/6. Resistivity will remain the same because it does not depend upon the length and area of cross section. It depends on the nature of material of the substance and the temperature.

3. Ohm's Law: It states that ratio of potential difference and current is constant and is equal to the resistance of the conductor at a particular temperature. In other words, the current flowing through a conductor is directly proportional to the potential difference at a constant temperature.

The graph between V and I will be a straight line.

Slope = tan θ = 'R'

Slope = $\dfrac{BC}{AC}$ = R
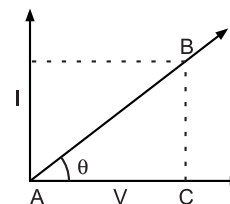
4. (*i*) Speaking over it in the morning assembly in school.
   • Putting posters over it on the school notice board.

(*ii*) If we save electricity, it can be used by those villages which do not have electricity.
   • It can be used in industries, agriculture and for other useful purposes.
   • It improves the national economy because high speed trains, industries, development in villages depends upon electricity.

5. (*i*)
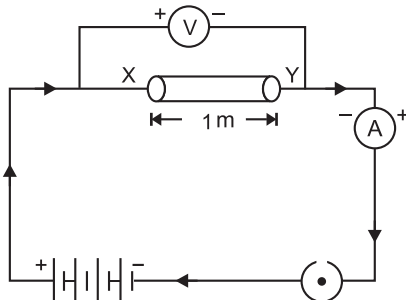
(*ii*) The V/I ratio for

• V = 0.8 V, $\dfrac{V}{I}$ is $\dfrac{0.8}{0.3}$ = 2.67 ; • V = 1.2 V, $\dfrac{V}{I}$ = $\dfrac{1.2}{0.45}$ = 2.67

• V = 1.6 V, $\dfrac{V}{I}$ = $\dfrac{1.6}{0.6}$ = 2.67

It shows that V α I or $\dfrac{V}{I}$ = constant.

EXERSISE 1.2

I. Multiple Choice Questions (**1 Mark**)

Choose the correct answer from the given options.

1. When the current passing through each resistor is same, the circuit is called
   (*a*) series circuit   (*b*) parallel circuit   (*b*) Both (*a*) and (*b*)   (*c*) None of these

2. In parallel circuit, which of the following is same across resistors
   (*a*) Current   (*b*) Potential difference
   (*c*) Resistance   (*d*) Resistivity

3. When resistance is doubled at constant voltage, current will become.
   (*a*) $\dfrac{1}{2}$ (*b*) 2 times   (*c*) $\dfrac{1}{4}$ (*d*) 4 times

4. Resistance in a circuit if current flowing is doubled will become
   (*a*) double   (*b*) half   (*c*) four times   (*d*) remains same

5. 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   [*CBSE* 2020, *NCERT*]

6. Two conducting wires of the same material and of equal lengths and equal diameter are first connected in series and then in 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   [*NCERT*]

II. Assertion-Reason Type Questions (**1 Mark**)

For question numbers 1 and 2 two statements are given-one labeled as **Assertion** (*a*) and the other labeled **Reason** (R). Select the correct answer to these questions from the codes (*a*), (*b*), (*c*) and (*d*) as given ahead:
   (*a*) Both 'A' and 'R' are true and 'R' is correct explanation of the Assertion.
   (*b*) Both 'A' and 'R' are true but 'R' is not correct explanation of the Assertion.

(c) 'A' is true but 'R' is false.

(d) 'A' is false but 'R' is true.

1. **Assertion:** In parallel circuit, the current is divided into electrical gadgets, therefore, used in domestic circuit.

   Reason: The resistance in parallel circuit decreases, therefore, useful.

2. **Assertion:** Fairy lights circuit is connected in series connection.

   Reason: In series combination, if one component fails then complete circuit is broken.
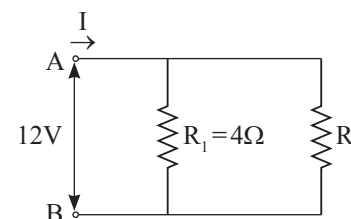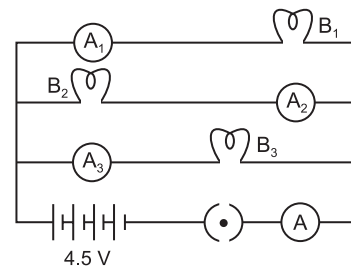
III. Very Short Answer Type Questions   (1 Mark)

1. Draw a schematic diagram of a circuit consisting of a battery of three cells of 6 V each, a 5 Ω resistor, an 8 Ω resistor and a 12 Ω resistor and a plug key, all connected in series.   [*NCERT*]

2. Judge the equivalent resistance when the following are connected in parallel:

   (*i*) 1 Ω and 10^6 Ω

   (*ii*) 1Ω, 10^3 Ω and 10^6 Ω   [*NCERT*]

3. What are the advantages of connecting electrical devices in parallel with the battery instead of connecting them in series?   [*NCERT*]

4. Two unequal resistances are connected in parallel. If you are not provided with any other parameters (eg. numerical values of I and R), what can be said about the voltage drop across the two resistors?

   [*CBSE* Sample Paper 2020-21]

## IV. Short Answer Type Questions-I   (2 Marks)

1. If you connect three resistors having values 2 Ω, 3 Ω and 5 Ω in parallel, calculate the equivalent resistance.

2. B_1, B_2, B_3 are three identical bulbs connected as shown in the figure. When all the three bulbs glow, a current of 3 A is recorded by the ammeter A.

   (*i*) What happens to the glow of the other two bulbs when bulb B_1 gets fused?

   (*ii*) What happens to the reading of A_1, A_2, A_3 and A when bulb B_2 gets fused.   [*CBSE* 2010]

3. Redraw the circuit in the above question, putting an ammeter to measure the current through the resistors and a voltmeter to measure the voltage across the 12 Ω resistor. What would be reading in the ammeter and the voltmeter?   [*NCERT*] [**HOTS**]

4. A student has two resistors- 2 Ω and 3 Ω. She has to put one of them in place of R2 as shown in the circuit. The current that she needs in the entire circuit is exactly 9A. Show by calculation which of the two resistors she should choose.


V. Short Answer Type Questions-II   (3 Marks)

1. What is (*a*) the highest, (*b*) the lowest total resistance that can be secured by combination of four coils of resistances 4 Ω, 8 Ω, 12 Ω, 24 Ω?   [*NCERT*]

2. 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.   [**HOTS**]

3. (*i*) What are the disadvantages of resistances connected in a series circuit?

   (*ii*) Find the resistance between A and B in the following network.   [*Delhi* 2014]
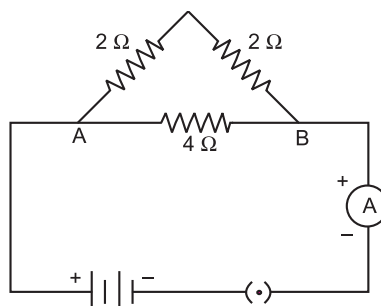
4. What are the advantages of connecting electrical devices in parallel combination with the battery rather than in series combination?

5. Find the current drawn from the battery by the network of four resistors as shown in the figure.
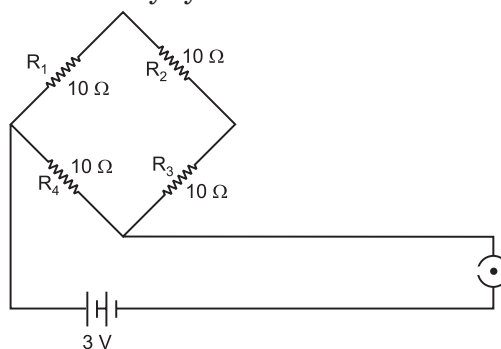

6. Show how would you join three resistors, each of resistance 9 Ω so that the equivalent resistance of the combination is (*i*) 13.5 Ω, (*ii*) 6 Ω? [*CBSE* 2018]

7. If three resistors of 6 Ω, 9 Ω and 21 Ω are connected in series to a 12 V battery, find:
   (*a*) The total resistance of the circuit.
   (*b*) The current flowing through the circuit.
   (*c*) The potential difference across the 21 Ω resistor.

8. 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 the three appliances, and what is the current flowing through it? [*NCERT*]

9. Study the following electric circuit and find the
   (*i*) current flowing through the circuit and
   (*ii*) the potential difference across 10 Ω resistor. [*Delhi* 2016]
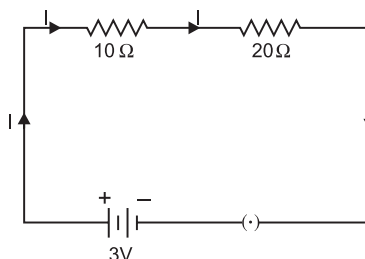
10. Figure shows a 2 Ω resistor and a 6 Ω resistor connected in series with a 4 V battery. Calculate:
    (*a*) the combined resistance of the resistors.
    (*b*) the current in the battery.
    (c) the current in 2 Ω resistor.

11. 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? [*NCERT*]

12. The parallel combination of two 10 Ω resistors are placed across the terminals of a 24 V battery.

    (*a*) What is the effective resistance of the parallel combination of resistances in the circuit?
    (*b*) What is the current through the entire circuit?
    (*c*) What is the current through each branch of the circuit?

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

14. A hot plate of an electric oven connected to a 220 V line has two coils A and B, each of 24 Ω resistance, which may be used separately, in series, or in parallel. What are the values of current in the these cases? [*NCERT*]
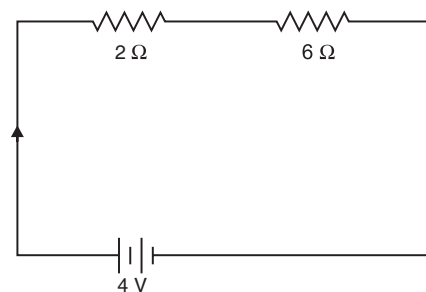
VI. Long Answer Type Questions (5 Marks)

**1.** (i) What is meant by series combination and parallel combination of resistances?

(ii) In the circuit diagram given below five resistances of 5Ω, 20Ω, 15Ω, 20Ω and $10\ \Omega$ are connected as given in the figure to a 6 V battery.

Calculate: (a) Total resistance in the circuit.

(b) Total current flowing in the circuit. [*Delhi* 2016]

2. Study the following electric circuit and find (i) the current flowing in the circuit and (ii) the potential difference across the $10\ \Omega$ resistor.
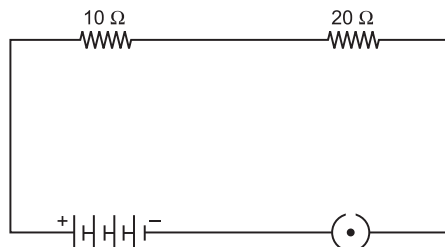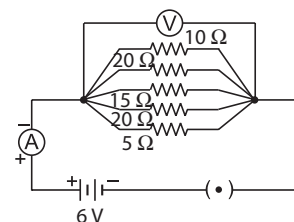
3. Find the net current flowing through the following electric circuit:
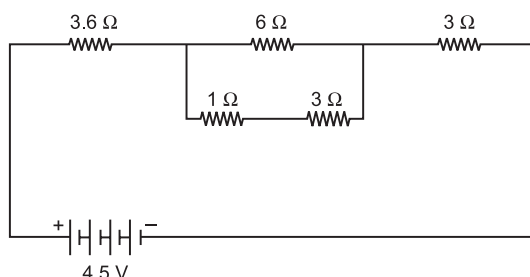
4. (a) With the help of suitable circuit diagram prove that the reciprocal of the equivalent resistance of a group of resistances joined in parallel is equal to the sum of the reciprocal of the individual resistances.

(b) In an electric circuit two resistors of $12\ \Omega$ each are joined in parallel to a 6V battery. Find the current drawn from the battery.

5. Figure shows a $3\ \Omega$ resistor and a $6\ \Omega$ resistor connected in parallel across a 1.5 V cell.

Calculate the current across: (i) $3\ \Omega$ resistor, (ii) $6\ \Omega$ resistor, (iii) the cell, (iv) calculate the resistance of the parallel combination of $3\ \Omega$ and $6\ \Omega$ resistors.
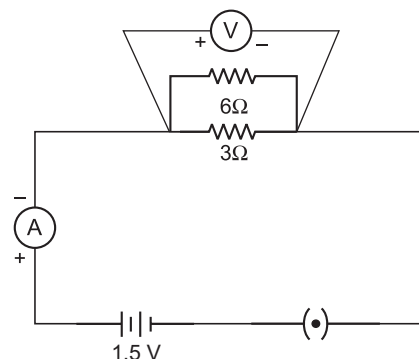
Answers 1.2

I. 1. (a) The circuit is called series circuit.

2. (b) Potential difference is same.

3. (a) It will became $\dfrac{1}{2}$ $\quad \because \boxed{I = \dfrac{V}{R}}$

4. (d) Resistance does not depend upon current.

5. (d) $\dfrac{1}{R'} = \dfrac{1}{\dfrac{R}{5}} + \dfrac{1}{\dfrac{R}{5}} + \dfrac{1}{\dfrac{R}{5}} + \dfrac{1}{\dfrac{R}{5}} + \dfrac{1}{\dfrac{R}{5}} = \dfrac{25}{R}$

$R' = \dfrac{R}{25}\ \Omega \quad \Rightarrow \quad \dfrac{R}{R'} = 25$. So option (d) is correct.

6. (*c*) Resistances of identical conducting wires are equal. Let R be the resistance of each resistor in series combination.

$\therefore R_s = R + R = 2R$

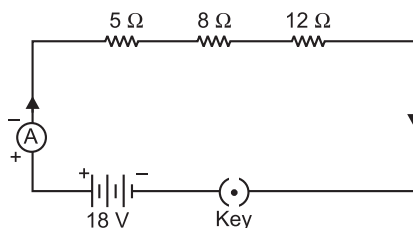H_s = Heat produced in series. Hence $\boxed{H_s = \dfrac{V^2}{2R}}$

When resistances are connected in parallel, $\dfrac{1}{R_P} = \dfrac{1}{R} + \dfrac{1}{R} = \dfrac{2}{R}$ $\boxed{R_P = R/2}$

$\boxed{H_P = \dfrac{V^2}{R/2}}$

$\dfrac{H_S}{H_P} = \dfrac{V^2}{2R} \times \dfrac{R}{2V^2} = \dfrac{1}{4}$. So option (*c*) is correct.

II. 1. (*a*) Both 'A' and 'R' are true and 'R' is correct explanation of the assertion.

2. (*b*) Both 'A' and 'R' are true but 'R' is not correct explanation of the assertion.

III. 1.

2. Equivalent resistance in parallel combination of resistances is always less than the lowest individual resistance i.e. less than 1 Ω in both the cases (*i*) and (*ii*).

3. Parallel circuit advantages:
   (*a*) Voltage is same across all the components when connected in parallel.
   (*b*) Parallel combination of resistances helps us to obtain an overall lower potential than the resistances used.
   (*c*) In household circuit, parallel connection is useful because each appliance has its own ON/OFF switch.
   (*d*) A fault in one appliance will not affect the working of other appliances.   (Any two)

4. Voltage-drop is same across both resistors.

IV. 1. $\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3} = \dfrac{1}{2} + \dfrac{1}{3} + \dfrac{1}{5} = \dfrac{15 + 10 + 6}{30} = \dfrac{31}{30}$

$R = \dfrac{30}{31} = 0.967\ \Omega$

2. (*i*) The glow of bulbs B_2 and B_3 will remain same because they are in parallel connection with bulb B_1.
   (*ii*) A_1 shows 1 ampere reading, A_2 shows zero and A_3 show 1 ampere reading. 'A' will show 2 A reading.

3. $R_S = R_1 + R_2 + R_3 = 5 + 8 + 12 = 25\ \Omega$; $V = 6\ V$

$I = \dfrac{V}{R} = \dfrac{6\ V}{25\ \Omega} = 0.24\ A$

In series combination current in all resistances is same.
Here, I = 0.24 A across 12 Ω resistance
$\therefore$ Voltmeter reading, V = IR = 0.24 × 12 = 2.88 V
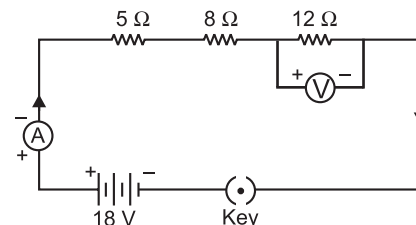$\therefore$ I = 0.24 A,   V = 2.88 V

4. The overall current needed = 9A. The voltage is 12V
Hence by Ohm's law V=IR,

The resistance for the entire circuit = $\dfrac{12}{9} = \dfrac{4}{3}\ \Omega. = R$
R_1 and R_2 are in parallel.

Hence, $R = \dfrac{(R_1 R_2)}{(R_1 + R_2)} = \dfrac{4R_2}{(4 + R_2)} = \dfrac{4}{3}$

$R_2 = 2\Omega$

V. 1. (a) The highest resistance can be obtained by connecting all resistances in series, i.e.

$R_s = R_1 + R_2 + R_3 + R_4 = 4\,\Omega + 8\,\Omega + 12\,\Omega + 24\,\Omega = 48\,\Omega$

(b) The lowest resistance can be obtained by parallel combination:

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} = \frac{1}{4} + \frac{1}{8} + \frac{1}{12} + \frac{1}{24} = \frac{6+3+2+1}{24} = \frac{12}{24}$$

$R_p = 2\,\Omega$

2. (i) When two 6 Ω resistances are connected in parallel and connected to another 6 Ω in series, we get 9 Ω resistance.

$$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3} \Rightarrow R_p = 3\,\Omega \Rightarrow R_{Net} = R_3 + R_P = 6 + 3 = 9\,\Omega$$

(ii) When two resistors are connected in series and third one is in parallel, we get 4 Ω resistance.

$R_s = R_1 + R_2 = 6 + 6 = 12\,\Omega$

$$\frac{1}{R_p} = \frac{1}{R_s} + \frac{1}{R_3} = \frac{1}{12} + \frac{1}{6} = \frac{1+2}{12} = \frac{3}{12} \Rightarrow R_p = 4\,\Omega$$

3. (i) Circuit in series vs Circuit in Parallel (**Disadvantages of series circuit**):

(a) If one electrical appliance stops working due to some factor, then all the other appliances also stop working.

(b) All the electrical appliances have only one switch due to which they can't turned on or off individually.

(c) The appliances do not get the same voltage as of the input power supply.

(d) Overall resistance increases due to which the current from the input power supply becomes low.

(ii) Two resistances of 2 Ω are in series $\therefore$ $R_s = R_1 + R_2 = 2 + 2 = 4\,\Omega$

The third resistance of 4 Ω is parallel to R_s $\therefore$ $\dfrac{1}{R_p} = \dfrac{1}{R_s} + \dfrac{1}{R_3} = \dfrac{1}{4} + \dfrac{1}{4} = \dfrac{2}{4}$

$\Rightarrow \boxed{R_P = 2\,\Omega}$

4. (1) The current required by each device is different which is possible only in parallel combination.

(2) If one device fails others can still work.

(3) Total resistance in the circuit is decreased.

5. R_1, R_2, R_3 are in series combination and R_4 is in parallel combination to these combination of resistors. Equivalent resistance of the given network is given as:

$$\frac{1}{R} = \frac{1}{R_4} + \frac{1}{R_1 + R_2 + R_3} = \frac{1}{10} + \frac{1}{10 + 10 + 10} = \frac{1}{10} + \frac{1}{30} = \frac{3+1}{30} = \frac{4}{30}$$

$\therefore R = \dfrac{30}{4} = 7.5\,\Omega$

Current drawn from the battery $I = \dfrac{V}{R} = \dfrac{3}{7.5} = \dfrac{30}{75} = \dfrac{2}{5}$ $\Rightarrow$ $I = 0.4\,A$
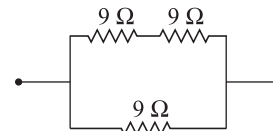
6. (i)
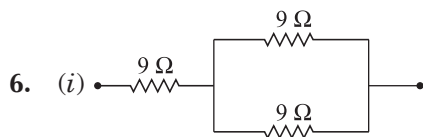
Two 9 ohm resistors in parallel combination are connected to one 9 ohm resistor in series;

$$\frac{1}{R_p} = \frac{1}{9} + \frac{1}{9} = \frac{2}{9} \qquad \therefore \qquad R_p = \frac{9}{2}\,\Omega$$

$R = 9\,\Omega + \dfrac{9}{2}\,\Omega = 13.5\,\Omega$

(ii) Two 9 ohm resistors in series connected are connected to one 9 ohm resistor in parallel;

$R_s = 9\,\Omega + 9\,\Omega = 18\,\Omega$

$\dfrac{1}{R} = \dfrac{1}{18} + \dfrac{1}{9} = \dfrac{3}{18}$ $\therefore$ $R = 6\,\Omega$

7. (a) $36\,\Omega$ (b) $I = \dfrac{V}{R} = \dfrac{12\ V}{36\,\Omega} = 0.33\ A$ (c) $V = R \times I \Rightarrow V = 21 \times 0.33 = 6.93\ V$

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

$\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3} = \dfrac{1}{100} + \dfrac{1}{50} + \dfrac{1}{500} = \dfrac{5 + 10 + 1}{500} = \dfrac{16}{500}$

$R_p = \dfrac{500}{16} = \dfrac{125}{4}\,\Omega = 31.25\,\Omega$

Current through all appliances $= \dfrac{V}{R} = \dfrac{220 \times 4}{125} = \dfrac{880}{125} = 7.04\ A$

Current will remain the same if the electric iron is connected with the same source, i.e.

$I = 7.04\ A$

$R = \dfrac{125}{4} = 31.25\,\Omega$ across the electric iron.

9. (i) $R_s = R_1 + R_2 = 10\,\Omega + 20\,\Omega = 30\,\Omega$

$I = \dfrac{V}{R} = \dfrac{3\ V}{30\,\Omega} = 0.1\ A$

(ii) $V = I \times R = 0.1 \times 10 = 1\ V$

10. (a) $R_s = R_1 + R_2 = 2\,\Omega + 6\,\Omega = 8\,\Omega$

(b) $I = \dfrac{V}{R} = \dfrac{4}{8} = 0.5\ A$

(c) Current across the $2\,\Omega$ resistor $= 0.5\ A$

11. (a) In order to get $4\,\Omega$ resistance, $2\,\Omega$ resistance should be connected in series with a combination of $3\,\Omega$ and $6\,\Omega$ resistances connected in parallel with each other.

$\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} = \dfrac{1}{3} + \dfrac{1}{6} = \dfrac{3}{6} \Rightarrow R_p = 2\,\Omega$

$\Rightarrow R_s = R_3 + R_p = 2\,\Omega + 2\,\Omega = 4\,\Omega$

(b) In order to get $1\,\Omega$ resistance all the three resistors should be connected in parallel.

$\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$

$= \dfrac{1}{2} + \dfrac{1}{3} + \dfrac{1}{6} = \dfrac{3 + 2 + 1}{6} = \dfrac{6}{6} = 1$

$\Rightarrow R_p = 1\,\Omega$

12. (a) $\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} = \dfrac{1}{10} + \dfrac{1}{10} = \dfrac{2}{10} = \dfrac{1}{5}$ $\Rightarrow R_p = 5\,\Omega$

(b) From Ohm's law, $I = \dfrac{V}{R} = \dfrac{24}{5} = 4.8\ A$

(c) $I_1 = \dfrac{V}{R} = \dfrac{24}{10} = 2.4\ A$ $I_2 = \dfrac{V}{R} = \dfrac{24}{10} = 2.4\ A$

13. When 'N' resistors each of resistance 'R' are connected in parallel, then $R_p = \dfrac{R}{N}$
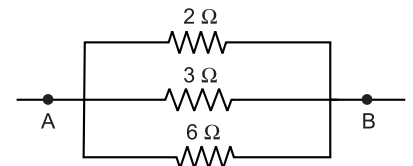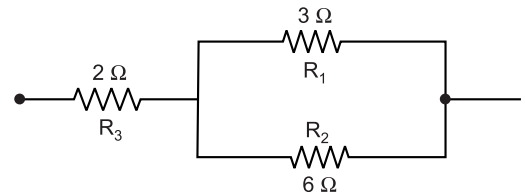
Current drawn from the cell, $I = \dfrac{V}{R_p} = \dfrac{V}{\dfrac{R}{N}} = \dfrac{V \times N}{R}$

$\Rightarrow \qquad\qquad\qquad\qquad 5A = \dfrac{220 \times N}{176\ \Omega}$

$$N = \dfrac{5 \times 176}{220} = \dfrac{880}{220} = 4$$

14. $I = \dfrac{V}{R} = \dfrac{220}{24} = 9.17$ A

When coils are used in series, $R_s = R_1 + R_2 = 24 + 24 = 48\ \Omega \Rightarrow I = \dfrac{V}{R} = \dfrac{220}{48} = 4.58\ \Omega$

When coils are used in parallel,

$\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} = \dfrac{1}{24} + \dfrac{1}{24} = \dfrac{2}{24} \Rightarrow R_p = 12\ \Omega \Rightarrow I = \dfrac{V}{R} = \dfrac{220}{12} = 18.3$ A

VI. 1. (*i*) **Resistors in Series**: When resistors are joined end to end, it is called series combination of resistances.

In series combination of resistors, the current remains the same through each resistor. Therefore the value of current in the ammeter remains the same, independent of its position in the electric circuit.

In the above circuit, V is equal to the sum of V_1, V_2, V_3, that is the total potential difference (V) across a combination of resistors in series is equal to the sum of potential differences across the individual resistors.

$V = V_1 + V_2 + V_3$

The current through each resistor is I.

$V = IR$

$V_1 = IR_1 \quad V_2 = IR_2 \quad V_3 = IR_3$

As $V = V_1 + V_2 + V_3 \quad \Rightarrow \quad \therefore IR = IR_1 + IR_2 + IR_3 \quad \Rightarrow$

$R_S = R_1 + R_2 + R_3$

$\therefore$ We can conclude that when several resistors are joined in series, then equivalent resistance of the combination is equal to the sum of their individual resistances and is thus greater than any of the individual resistance.

- **Resistors in Parallel:**

When the resistances, says, R_1, R_2, R_3 are connected in in parallel combination as shown in the diagram, then the potential difference remains the same across each resistor in parallel combination of resistors. In parallel combination the current is distributed in different resistances in different branches.

As, $I = I_1 + I_2 + I_3$

According to Ohm's Law, $I = \dfrac{V}{R_p} \qquad \Rightarrow I_1 = \dfrac{V}{R_1}, \quad I_2 = \dfrac{V}{R_2}, \quad I_3 = \dfrac{V}{R_3}$

$\therefore I = I_1 + I_2 + I_3$

$\Rightarrow \dfrac{V}{R_p} = \dfrac{V}{R_1} + \dfrac{V}{R_2} + \dfrac{V}{R_3} \qquad$ Or $\qquad \boxed{\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}}$

(*ii*) (*a*) Resistance across parallel combination,

$$\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3} + \dfrac{1}{R_4} + \dfrac{1}{R_5}$$

Resultant resistance of 5 Ω, 20 Ω, 15 Ω, 10 Ω, and 20 Ω resistances is given as:
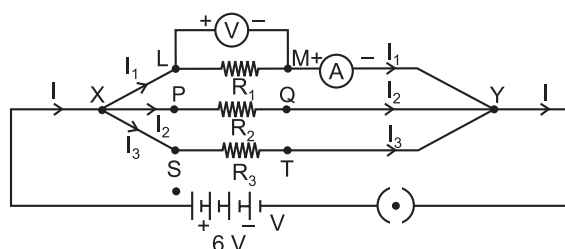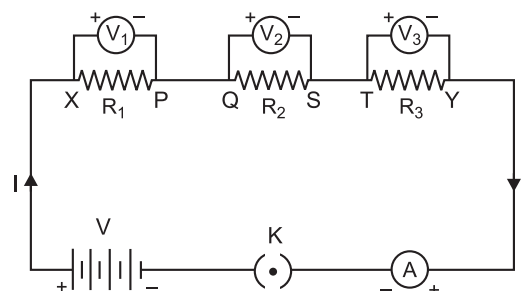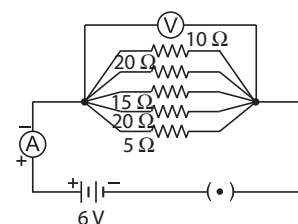
$$\frac{1}{R_p} = \frac{1}{5} + \frac{1}{20} + \frac{1}{15} + \frac{1}{10} + \frac{1}{20} \quad \Rightarrow \quad \frac{1}{R_p} = \frac{12 + 3 + 4 + 6 + 3}{60}$$

$$\frac{1}{R_p} = \frac{28}{60} \quad \Rightarrow \quad \boxed{R_p = \frac{60}{28}\ \Omega} \Rightarrow \boxed{R_p = 2.14\ \Omega}$$

(b) V = 6 V, Resistance = $\frac{60}{28}\ \Omega$

$$\therefore\ I = \frac{V}{R} = \frac{6 \times 28}{60} \quad \Rightarrow \quad \boxed{I = 2.8\ A}$$

2. 10 Ω and 20 Ω resistances are connected in series, therefore their equivalent resistance is given by: R_1 = $R_1 + R_2 = 10 + 20 = 30\ \Omega$

  (i) Current flowing in the circuit, $I = \dfrac{V}{R_S} = \dfrac{3}{30} = \dfrac{1}{10} = 0.1\ A$

  (iii) Potential difference across the 10 Ω resistor, V = IR = $\dfrac{1}{10} \times 10 = 1$ volt

3. Series combination of 1 Ω and 3 Ω resistance is in parallel combination with 6 Ω resistor. Their equivalent resistance is

$$\frac{1}{R_P} = \frac{1}{6} + \frac{1}{3+1} = \frac{1}{6} + \frac{1}{4} = \frac{2+3}{12} \quad \Rightarrow \quad R_P = \frac{12}{5} = 2.4\ \Omega$$

  Now, 3.6 Ω, 2.4 Ω and 3 Ω resistors are connected in series, therefore their equivalent resistance be given by: $R_S = R_1 + R_2 + R_3 = 3.6 + 2.4 + 3 = 9\ \Omega$

  Hence, the current flowing through the circuit is, $I = \dfrac{V}{R} = \dfrac{4.5}{9} = \dfrac{45}{90} = \dfrac{1}{2} = 0.5\ A$

4. (a) Refer to Answer 1(i) — Long Answer Type Questions.

  (b) $\dfrac{1}{R_p} = \dfrac{1}{R_1} - \dfrac{1}{R_2} = \dfrac{1}{12} + \dfrac{1}{12} = \dfrac{1+1}{12} = \dfrac{2}{12} \Rightarrow R_p = 6$ Ohms

  $I = \dfrac{V}{R} = \dfrac{6\,V}{6\ ohm} = 1$ Ampere

5. (i) $I_1 = \dfrac{V}{R} \Rightarrow I_1 = \dfrac{1.5}{3} = 0.5\ A$,   (ii) $I_2 = \dfrac{V}{R} \Rightarrow I_2 = \dfrac{1.5}{6} = 0.25\ A$

  (iii) $I_{Total} = I_1 + I_2 = 0.50 + 0.25 = 0.75\ A$ (iv) $\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} = \dfrac{1}{3} + \dfrac{1}{6} = \dfrac{3}{6} = \dfrac{1}{2} \quad \Rightarrow \quad \boxed{R_p = 2\Omega}$

EXERSISE 1.3

I. Multiple Choice Questions   (1 Mark)

Choose the correct answer from the given options.

1. In an electrical circuit three incandescent bulbs A, B and C of rating 40 W, 60 W and 100 W respectively are connected in parallel to an electric source. Which of the following is likely to happen regarding their brightness?
   (a) Brightness of all the bulbs will be the same
   (b) Brightness of bulb A will be the maximum
   (c) Brightness of bulb B will be more than that of A
   (d) Brightness of bulb C will be less than that of B

2. In an electrical circuit two resistors of 2 Ω and 4 Ω respectively are connected in series to a 6 V battery. The heat dissipated by the 4 Ω resistor in 5 s will be
   (a) 5 J   (b) 10 J   (c) 20 J   (d) 30 J

3. An electric kettle consumes 1 kW of electric power when operated at 220 V. A fuse wire of what rating must be used for it?
   (a) 0.454A   (b) 2 A   (c) 4 A   (d) 5 A

4. The type of current supplied by cell or battery is
   (a) A.C   (b) D.C   (c) Both (a) and (b)   (d) None of these

5. Unit of electric power may also be expressed as:
   (a) volt-ampere   (b) kilowatt-hour   (c) watt-second   (d) joule-second
   [*CBSE* Sample Paper 2019-2020]

II. Assertion-Reason Type Questions   (1 Mark)

For question numbers 1 to 3 two statements are given-one labeled as **Assertion** (a) and the other labeled **Reason** (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given ahead:
   (a) Both 'A' and 'R' are true and 'R' is correct explanation of the Assertion.
   (b) Both 'A' and 'R' are true but 'R' is not correct explanation of the Assertion.
   (c) 'A' is true but 'R' is false.
   (d) 'A' is false but 'R' is true.

1. **Assertion:** Electric toasters are made up of alloys.
   Reason: Alloys have high resistivity and do not get oxidised at high temperature.
2. **Assertion:** The commercial unit of electrical energy is 1 kWs
   Reason: 1 kWh = 3.6×10^6 J.
3. **Assertion:** A fuse wire is always connected in parallel with the mainline.
   Reason: If a current larger than the specified value flows through the circuit, fuse wire melts.
   [*CBSE* Sample Paper 2019-2020]

III. Very Short Answer Type Questions   (1 Mark)

1. What determines the rate at which energy is delivered by a current?   [*NCERT*]
2. Which uses more energy, a 250 W TV set in 1 hr, or a 1200 W toaster in 10 minutes?
3. Name the type of current used in household supply.   [*Delhi* 2016]

4. Write the relationship between heat energy produced in a conductor when potential difference V is applied across its terminals and a current, I flows through it for the time 't'. [*Delhi* 2016]
5. Why does the cord of an electric heater not glow while the heating element does? [*NCERT*]
6. Why heat is produced when current is passed through a conductor?
7. Explain the role of fuse wire connected in series with any electrical appliance in an electric circuit. Why should a fuse with a defined rating for an electric circuit not be replaced by the one with a larger rating?
8. Why are heating elements made of alloys rather than metals?

OR

Why are alloys commonly used in electrical heating devices like toasters and electric iron? Give reason.
[*CBSE* 2019 AI]
9. A bulb gets dimmer when an electric iron or geyser is switched on, why?

IV. Short Answer Type Questions-I (2 Marks)

1. Compute the heat generated while transferring 96000 coulomb of charge in one hour through a potential difference of 50 V. [*NCERT*]
2. An electric iron of resistance 20 Ω takes a current of 5 A. Calculate the heat developed in 30 s. [*NCERT*]
3. An electric motor takes 5 A from a 220 V line. Determine the power of the motor and the energy consumed in 2 hours. [*NCERT*]
4. 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? [*NCERT*]
5. Find the resistance of bulb rated as 100 W at 250 V. [*CBSE* 2014]
6. Name the commercial unit of energy. Convert it into Joules. What is other name of commercial unit of energy?
7. Find the minimum rating of fuse that can be safely used on a line on which two 1.1 kW rating electric geysers are to be run simultaneously. The supply voltage is 220 V. [*Delhi* 2016]

V. Short Answer Type Questions-II (3 Marks)

1. An electric heater of resistance 8 Ω draws 15 A current from the supply mains for 2 hours. Calculate the rate at which heat is developed in the heater.
2. A potential difference of 4 V derive a current of 3 A through a resistor. How much electrical energy will be converted into heat during 10 seconds?
3. An electric fan has a rating of 460 W on the 230 V mains line. What fuse should be fitted in the plug?
4. What is the cost of running an AC with average power of 1000 W for 8 hours for 30 days. The cost of electric energy is ₹4.70 per kW h.
5. Why do we get electric shock in damp conditions?
6. Compare the power used in the 2 Ω resistor in each of the following circuits: (*i*) a 6 V battery in series with the 1 Ω and 2 Ω resistors, and (*ii*) a 4 V battery in parallel with 12 Ω and 2 Ω resistors. [*NCERT*]
7. Two lamps, one rated 100 W at 220 V, and the other 60 W at 220 V, are connected in parallel to electrical mains supply. What current is drawn from the line if the supply voltage is 220 V? [*Delhi* 2018] [*NCERT*]
8. (*i*) Explain what is the difference between direct current and alternating current. Write one important advantage of using alternating current.
   (*ii*) An air conditioner of 2 kW is used in an electric circuit having a fuse rating of 10 A. If the potential difference of the supply is 220 V, will the fuse be able to withstand when the air conditioner is switched on? Justify your answer. [*Delhi* 2016]
9. What is meant by 'electrical resistance' of a conductor? State how resistance of a conductor is effected when
   (*i*) Low current passes through it for a short duration.
   (*ii*) A heavy current passes through it for 30 seconds. [*Delhi* 2015]
10. An electric kettle of 2 kW works for 2 hours daily. Calculate the
   (*a*) Energy consumed in SI unit and commercial unit.
   (*b*) Cost of running it in the month of June at a rate of ₹ 3.00 per unit. [*Delhi* 2014]
11. An electric bulb is rated 220 V and 100 W, when it is operated at 110 V. What will be the power consumed? [*Delhi* 2010]

12. An electric iron has a rating of 750 W, 220 V. Calculate the

(*i*) Current flowing through it and (*ii*) Its resistance when it is in use.

13. Draw a circuit diagram of an electric circuit containing a cell, a key, an ammeter, a resistor of 4 Ω in series with a combination of two resistors (8 Ω each) in parallel and a voltmeter across parallel combination. Each of them dissipate maximum energy and can withstand a maximum power of 16 W without melting. Find the maximum current that can flow through the three resistors.

<div align="right">[<i>CBSE</i> Sample Paper 2017-2018]</div>

14. Two lamps, one rated 100 W at 220 V and the other 200 W at 220V are connected (*i*) in series and (*ii*) in parallel to electric main supply of 220V. Find the current drawn in each case.

15. How many 40 W; 220 V rating lamps can be safely connected to a 220 V, 5 A line? Justify your answer.

<div align="right">[<i>Delhi</i> 2015]</div>

VI. Long Answer Type Questions (5 Marks)

1. An electric circuit two resistors of 20 Ω and a conductor of resistance 4Ω are connected to a 6 V vattery as shown in the figure. Calculate:

(a) The total resistance of the circuit,

(b) the current through the circuit,

(c) the potential difference across the (*i*) electric lamp and (*ii*) conductor, and

(d) power of the lamp.

2. Explain the following:

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

(*ii*) Why are the conductors of electric heating devices, such as bread-toaster and electric iron, made of an alloy rather than a pure metal?

(*iii*) Why is series arrangement not used for domestic circuits?

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

(*v*) Why are copper and aluminium wires usually used for the transmission of electric current?

<div align="right">[<i>NCERT</i>]</div>

3. (*a*) Define electric power. Express it in terms of potential difference, V and resistance, R.

(*b*) An electrical fuse is rated at 2 A. What is meant by this statement?

(*c*) An electric iron of 1 kW is operated at 220 V. Find which of the following fuse that are respectively rated at 1 A, 3 A and 5 A can be used for it.

4. (*a*) Write two points of differences between electric energy and electric power.

(*b*) Out of 60 W and 40 W lamps, which one has higher electrical resistance when in use.

(*c*) What is the commercial unit of electric energy? Convert it into the units of Joule.

5. Two identical wires, one of nichrome and other of copper are connected in series and a current (*i*) is passed through them. State the change observed in the temperature of the two wires. Justify your answer. State the law which explains the above observations.

6. (*a*) State Ohm's law. Derive the relation and give graphical representation for it.

(*b*) An electric oven rated at 500 W is connected to a 220 V line and used for 2 hours daily. Calculate the cost of electric energy per month at the rate of ₹ 5 per kW h.

7. In the given circuit, A, B, C and D are four lamps connected with a battery of 60V.
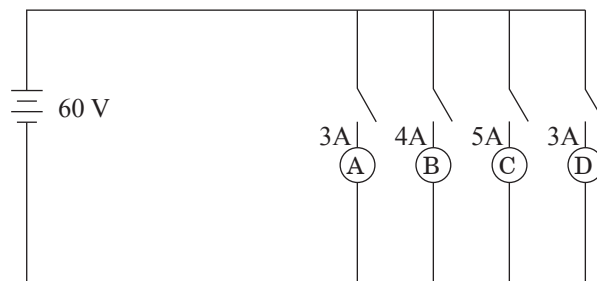
Analyse the circuit to answer the following questions.

(*i*) What kind of combination are the lamps arranged in (series or parallel)?

(*ii*) Explain with reference to your above answer, what are the advantages (any two) of this combination of lamps?

(*iii*) Explain with proper calculations which lamp glows the brightest?

(*iv*) Find out the total resistance of the circuit. [*CBSE* Sample Paper 2020-21]

8. (*a*) What is the function of fuse wire in an electric circuit?

(*b*) What would be the rating of the fuse for an electric kettle which is operated at 220 V and consumes 500 W power?

(*c*) How is the SI unit of electric energy related to its commercial unit?

9. (*i*) Consider a conductor of resistance 'R', length 'L', thickness 'd' and resistivity 'ρ'. Now this conductor is cut into four equal parts. What will be the new resistivity of each of these parts? Why?

(ii) Find the resistance if all of these parts are connected in: (*a*) Parallel (*b*) Series

(*iii*) Out of the combinations of resistors mentioned above in the previous part, for a given voltage which combination will consume more power and why? [*CBSE* Sample Paper 2019-2020]

Answers 1.3

I. 1. (*c*) Higher the wattage (power), more will be brightness

2. (*c*) H = I²× R × t = 1 × 4 × 5 = 20 J. $\boxed{I = \dfrac{V}{R} = \dfrac{6\,V}{6\,\Omega} = 1A}$

3. (*a*) $I = \dfrac{P}{V} = \dfrac{1000\,W}{220\,V} = 0.454\,A$

4. (*b*) D.C (Direct current) which flows only in one direction.

5. (*a*) volt-ampere ∵ Power = Voltage × Current.

II. 1. (*a*) Both 'A' and 'R' are true and 'R' is correct explanation of the assertion.

2. (*d*) 'A' is false and 'R' is true because commercial unit is kW h and not kW s.

3. (*d*) 'A' is false and 'R' is true.

III. 1. Electric power is the rate at which energy is delivered by a current.

2. Energy consumed by 250 W TV in 1 h = 250 × 1 = 250 W h

Energy consumed by 1200 W toaster in 10 minutes = $\dfrac{1200 \times 10}{60}$ = 200 W h

Here total energy consumed by the TV is more than toaster.

3. Alternate current

4. H = VIt

5. The cord of the electric heater is made up of copper or aluminium which has lower resistance and higher conductance, therefore very less heat energy is produced.

Heating element is made up of alloys which have high resistance and lot of heat is produced, and only a little amount of electric energy makes it to glow.

6. The electrons collide with each other while moving and loses some kinetic energy which is converted into heat energy.

7. Fuse wire is a safety device connected in series with the live wire of the circuit, since it has high resistivity and low melting point. It melts when a sudden urge of large current passes through it and disconnects the entire circuit from the electrical supply. But in case if we use a larger rating fuse wire instead of a defined rating fuse wire then it will not protect the circuit as high current will easily pass through it and it will not melt.

8. Alloys have high resistivity/high melting point/alloys do not oxidise (or burn readily at high temperatures).

9. It is because electric iron or geyser draws heavy current from the circuit, takes heavy power and therefore bulb becomes dimmer due to decrease in voltage.

IV. 1. Q = 96000 C, t = 1 hr = 3600 s, V = 50 volt

H = V × I × t = V × Q = 50 × 96000 C = $\dfrac{50 \times 96000}{1000}$ kJ = 4800 kJ

2. $R = 20\ \Omega$, $I = 5\ A$, $t = 30\ s$
   $H = I^2 \times R \times t = 5 \times 5 \times 20 \times 30 = 15000\ J = 15\ kJ$

3. $I = 5\ A$, $V = 220\ V$, $P = ?$, $E = ?$, $t = 2$ hours
   $P = V \times I = 220\ V \times 5\ A = 1100\ W$
   $E = P \times t = 1100\ W \times 2\ h = 2200\ W\ h = 2.2\ kW\ h$

4. Total power = $N \times P$ where 'N' is the number of bulbs, 'P' power of each bulb.

   $$\because I = \frac{N \times P}{V} \quad \Rightarrow \quad 5 = \frac{N \times 10}{220} \quad \Rightarrow \quad N = \frac{5 \times 220}{10} = 110$$

5. $P = \dfrac{V^2}{R} \quad \Rightarrow \quad R = \dfrac{V^2}{P} = \dfrac{250 \times 250}{100} = 625\ \Omega$

6. The commercial unit of electrical energy is kW h. (Kilowatt hour)
   $1\ kW\ h = 1\ kW \times 1\ hour = 1000\ W \times 3600\ s = 3.6 \times 10^6\ J$

7. $I = \dfrac{P}{V} = \dfrac{1.1 \times 1000}{220} = \dfrac{1100}{220} = 5\ A$

   The rating of fuse that can be used is more than 5 A.
   It is also called Board of Trade Unit (BOTU)

V. 1. $R = 8\ \Omega$, $I = 15\ A$, $t = 2$ hours

   $$\text{Rate of heat developed} = \frac{H}{t} = \frac{I^2 \times R \times t}{t} = I^2 \times R$$

   $= 15^2 \times 8 = 1800\ J\ s^{-1} = 1800\ Watt = 1.8\ kW$

   2. $R = \dfrac{V}{I} = \dfrac{4}{3} = 1.33\ \Omega$

   $H = I^2 \times R \times t = 3 \times 3 \times \dfrac{4}{3} \times 10 = 120\ J$

   3. $P = V \times I \quad \Rightarrow \quad 460 = 230 \times I \quad \Rightarrow \quad I = 2$ Ampere
   A 3A fuse should be fitted (It should be slightly more than 2A).

   4. $E = P \times t = 1000\ W \times 8 \times 30 = 240000\ W\ h = 240\ kW\ h$
   Cost of electric energy = $240 \times 4.70 = ₹\ 1128$.

   5. Water provides conducting path for a current to flow through the human body in damp conditions like bathroom. We get electric shock if we are bare footed. Wet body has low resistance, high current can easily pass through, leading to electric shock.

   6. (i) $R_s = R_1 + R_2 = 1\ \Omega + 2\ \Omega = 3\ \Omega$, $V = 6\ V$

   $$I = \frac{V}{R} = \frac{6}{3} = 2\ A$$

   $P = I^2 \times R$ (Since same current flows through each resistor) $= 2 \times 2 \times 2 = 8\ W$ \qquad (P R = 2 Ω)

   (ii) $\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} \quad \Rightarrow \quad \dfrac{1}{R_p} = \dfrac{1}{12} + \dfrac{1}{2} = \dfrac{1 + 6}{12} = \dfrac{7}{12} \quad \Rightarrow \quad R_p = \dfrac{12}{7}\ \Omega$
   Resistance will change, voltage remains the same.

   Power across 2 Ω resistor, $P = \dfrac{V^2}{R} = \dfrac{4 \times 4}{2} = 8\ W$

   Power used are in the ratio 1 : 1.

   7. $R_{100\ \Omega} = \dfrac{V^2}{P} = \dfrac{220 \times 220}{100}$; $R_{60\ \Omega} = \dfrac{V^2}{P} = \dfrac{220 \times 220}{60}$

   $I = \dfrac{V}{R_{100}} = \dfrac{220 \times 100}{220 \times 220} = \dfrac{100}{220} = 0.45\ A$; $I = \dfrac{V}{R_{60}} = \dfrac{220 \times 60}{220 \times 220} = \dfrac{6}{22} = 0.27\ A$

   $\therefore$ Total current = $0.45\ A + 0.27\ A = 0.72\ A$

   8. (i) The current whose direction gets reversed after every half cycle is called alternating current or A.C.
   There is no change in the direction of D.C. D.C. is a uni directional current.

The most important advantage of using A.C. over D.C. is that in the A.C. mode electric power can be transmitted over long distances at a high voltage and low current with very little loss of power.

(ii) Here P = 2 kW = 2000 W, V = 220 Volt

$$P = VI, \text{ so the current, } I = \frac{P}{V} = \frac{2000}{220} = 9.09 \text{ A}$$

As the current is 9.09 A below the rating of fuse, therefore the fuse will withstand, i.e. it will not blow off when A.C. is on.

9. It is in opposite direction offered to the flow of electric current.

(i) No effect on resistance, low current, hence no appreciable rise in temperature so there no change in resistance.

(ii) Heavy current for 30 seconds may increase the temperature so resistance will increase.

10. (a) P = 2 kW, t = 2 h

E = P × t = 2 × 2 h = 4 kW h

(b) Total energy consumed per month = 4 kW h × 30 = 120 kW h

Total cost = 120 × 3 = ₹ 360.

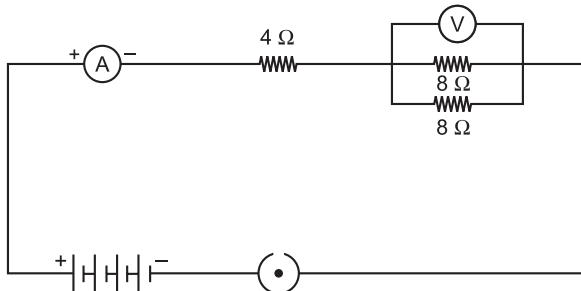11. $R = \dfrac{V^2}{P} = \dfrac{220 \text{ V} \times 220 \text{ V}}{100 \text{ W}} = 484 \; \Omega$

$P = \dfrac{V^2}{R} = \dfrac{110 \times 110}{484} = 25 \text{ W}$

12. (i) P = 750 W, V = 220 V

$P = V \times I \Rightarrow 750 = 220 \times I \Rightarrow I = \dfrac{750}{220} = 3.409 \text{ A}$

(ii) $P = \dfrac{V^2}{R} \Rightarrow R = \dfrac{V^2}{P} = \dfrac{220 \times 220}{750} \Rightarrow R = 64.53 \; \Omega$

13.

Maximum current through 4 Ω resistor = $\sqrt{\dfrac{P}{R}} = \sqrt{\dfrac{16 \text{ W}}{4 \; \Omega}} = 2 \text{ A}$

Maximum current through each 8 Ω resistor = $\sqrt{\dfrac{P}{R}} = \sqrt{\dfrac{16 \text{ W}}{8 \; \Omega}} = \sqrt{2} = 1.414 \text{ A}$

14. $R_1 = \dfrac{V^2}{P_1} = \dfrac{220 \times 220}{100} = 484 \; \Omega; \; R_2 = \dfrac{V^2}{P_2} = \dfrac{220 \times 220}{200} = 242 \; \Omega$

In series: $R_s = R_1 + R_2 = 484 + 242 = 726 \; \Omega$

$\therefore I_s = \dfrac{V}{R_s} = \dfrac{220}{726} = \dfrac{10}{33} A = 0.30A$

In parallel: $\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} = \dfrac{1}{484} + \dfrac{1}{242} \Rightarrow R_p = \dfrac{484}{3} \Omega$

$I_p = \dfrac{V}{R_P} = \dfrac{220 \times 3}{484} = \dfrac{30}{22} A = 1.36A$

15. $I = \dfrac{N \times P}{V} \Rightarrow 5\,A = \dfrac{N \times 40\,W}{220\,V} \Rightarrow N = \dfrac{220\,V \times 5\,A}{40\,W} = \dfrac{110}{4} = 27$ lamps

VI. 1. (*a*) $R_s = R_1 + R_2 = 20\,\Omega + 4\,\Omega = 24\,\Omega$

(*b*) $I = \dfrac{V}{R} = \dfrac{6\,V}{24\,\Omega} = 0.25\,A$

(*c*) (*i*) $V = I \times R = 0.25\,A \times 20\,\Omega = 5\,V$
(*ii*) $V = I \times R = 0.25\,A \times 4 = 1V$

(*d*) (*i*) $P = I^2 \times R = \left(\dfrac{1}{4}\right)^2 \times 20 = \dfrac{1}{16} \times 20 = 1.25\,W$

2. (*i*) It has high resistance and high melting point. So it does not melt when current is passed through it.

(*ii*) Alloys have more resistivity and higher melting point.

(*iii*) It increases the resistance and current decreases. Also if one component fails to work, others will also not work

(*iv*) Resistance is inversely proportional to the area of cross section.

(*v*) It is because Cu and Al have low resistivity and it allows current to flow.

3. (*a*) Electric power is the rate of doing work by an energy source or the rate at which the electrical energy dissipated or consumed per unit time in the electric circuit.

So, Power (P) = $\dfrac{\text{Work done (W)}}{\text{Time } (t)}$

$= \dfrac{\text{Electrical energy dissipated}}{\text{Time } (t)}$

$\Rightarrow$ VI or $P = \dfrac{V^2}{R}$
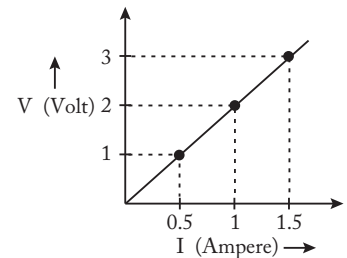
(*b*) It means the maximum current will flow through it is only 2 A. Fuse wire will melt if the current flowing through it exceeds 2 A value.

(*c*) Given: P = 1 kW = 1000 W, V = 220 V

Current drawn, $I = \dfrac{P}{V} = \dfrac{1000}{220} = \dfrac{50}{11} = 4.54\,A$

To run electric iron of 1 kW efficiently, rated fuse of 5 A should be used.

4. (*a*) Difference between electric energy and electric power:

Electric Energy	Electric Power
(*i*) The work done or energy supplied by the source in maintaining the flow of electric current is called electrical energy. It appears in the form of heat and is given by: $$H = VIt = \dfrac{V^2 t}{R} = I^2Rt$$	(*i*) The time rate at which electric energy is consumed or dissipated by an electrical device is called electric power and is given by: $$P = VI = \dfrac{V^2}{R} = I^2R$$
(*ii*) It is also equal to the product of power and time taken: $$E = P \times t$$	(*ii*) It is also equal to the rate of doing work by an energy source and is given by: $$P = \dfrac{W}{t}$$
(*iii*) Its SI unit is Joule (J) $$1\,J = 1\,W \times 1\,s$$	(*iii*) Its SI unit is Watt (W) $$1\,W = 1\,J\,s^{-1} \qquad \text{(Any two)}$$

(b) For the same applied voltage, $P \propto \dfrac{1}{R}$,

i.e. smaller the power of electrical device, higher is its electrical resistance.
So a 40 W lamp has higher electrical resistance than a 60 W lamp.

(c) Kilowatt hour – Commercial unit of electrical energy.
1 kW h = 1000 W h = 1000 J/s × 3600 s = 3600000 J = 3.6×10^6 J

5. The resistivity of nichrome is more than that of copper, so its resistance is also high. Therefore large amount of heat is produced in the nichrome wire for the same current passed as compared to that of the copper wire. Accordingly greater change in temperature is observed in case of nichrome wire. This can be explained by Joule's law of heating.

Joule's law of heating states that the amount of heat produced in a conductor is:

(i) Directly proportional to the square of current flowing through it, i.e.
$$H \propto I^2$$

(ii) Directly proportional to the resistance offered by the conductor to the flow current, i.e.
$$H \propto R$$

(iii) Directly proportional to the time for which current is flowing through the conductor, i.e.
$$H \propto t$$

Combining these, we get, $H \propto I^2Rt$,   or $H = KI^2Rt$
where K is a proportionality constant and in SI units, it is equal to unity.

6. (a) Linear equation, hence a straight line passing through the origin is obtained as follows:

Ohm's law states that potential difference across the given metallic wire in an electric circuit is directly proportional to the electric current flowing through it, if the temperature remains constant.

Mathematically, $V \propto I$.

or $\dfrac{V}{I}$ = Constant

or   V = IR (where R is a constant known as the constant of proportionality).
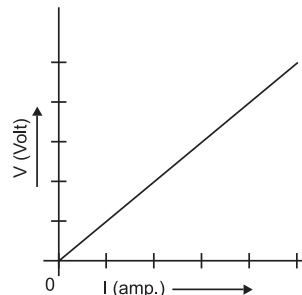
(b) Energy consumed per day = 1 kW h.
∴   P = V × I, E = P × t $\Rightarrow$ E = V × I × t = 220 × 2.27 × 2 = 1 kWh

So, I = $\dfrac{P}{V}$ = $\dfrac{500}{220}$ = 2.27 A $\left(\because P = V \times I \ \ \therefore I = \dfrac{500}{220} \right)$

Cost of electric energy for 30 days = 1 × 5 × 30 = ₹ 150.00

7. (i) The lamps are in parallel.

(ii) Advantages:
If one lamp is faulty, it will not affect the working of the other lamps.
They will also be using the full potential of the battery as they are connected in parallel.

(iii) The lamp with the highest power will glow the brightest.
$$P = VI$$
In this case, all the bulbs have the same voltage. But lamp C has the highest current.
Hence, for lamp C, P = 5 × 60 Watt = 300 W. (the maximum).

(iv) The total current in the circuit = (3 + 4 + 5 + 3) A = 15A
The Voltage = 60V
V = IR and hence R = V/I
R = 60/15 Ω = 4 Ω

8. (a) Fuse wire protects the electrical circuits from over voltage and high current.

(b) 2.2 A flows through the circuit, fuse should be rated 3 A.

(c) 1 kW h = 3.6×10^6 J

9. (i) Resistivity will not change as it depends on the nature of the material of the conductor.

(ii) The length of each part becomes L/4. While ρ, A remain constant. $\because$ R = ρL/A.
Resistance of each part = R_{part} = (ρL/4)/A = R/4.

(a) In parallel connection, $\dfrac{1}{R_{eqv}} = \dfrac{1}{R_{part}} + \dfrac{1}{R_{part}} + \dfrac{1}{R_{part}} + \dfrac{1}{R_{part}} = \dfrac{4}{R_{part}} = \dfrac{16}{R} \Rightarrow R_{eqv} = \dfrac{R}{16}\,\Omega$

(b) In series connection, $R_{eqv} = \dfrac{R}{4} + \dfrac{R}{4} + \dfrac{R}{4} + \dfrac{R}{4} = R\,\Omega$ (ohms)

(iii) $P = V^2/R$.

If R_{eqv} is less, power consumed will be more.

In the given case, R_{eqv} is lesser in the parallel connection and the power consumed will be more.

CASE STUDY QUESTIONS

1. Ohm's law gives the relationship between current flowing through a conductor with potential difference across it provided the physical conditions and temperature remains constant. The electric current flowing in a circuit can be measured by an ammeter.

Potential difference is measured by voltmeter connected in parallel to the battery or cell. Resistances can reduce current in the circuit. A variable resistor or rheostat is used to vary the current in the circuit.
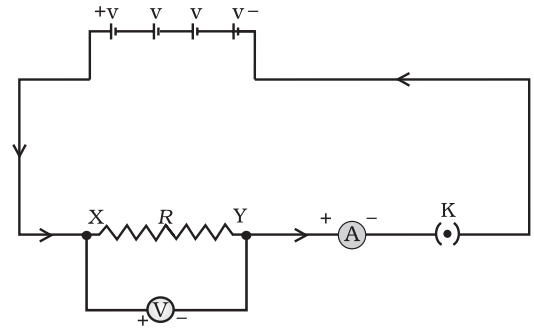
(i) What type of conductor is represented by the following graph?
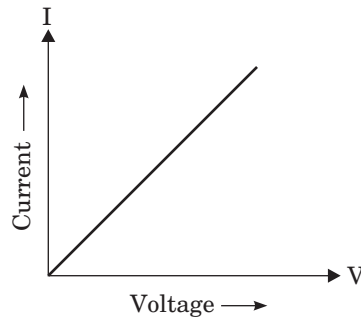
(a) Non-ohmic conductor like thermistor   (b) Non-ohmic conductor like metal filament

(c) Ohmic conductor like copper   (d) None of these

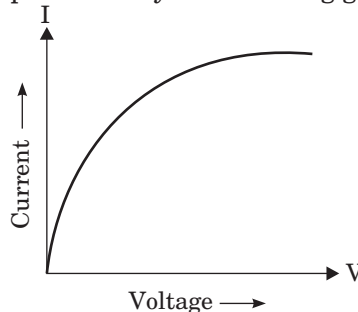(ii) What type of conductors are represented by the following graph?

(a) Non-ohmic conductor like thermistor
(b) Non-ohmic conductor like metal filament
(c) Ohmic conductor like copper
(d) None of these

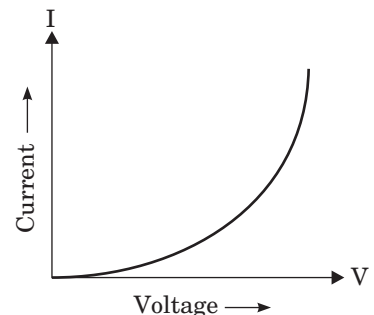(iii) Which type of conductor is represented by the graph given alongside?
(a) Non-ohmic conductor like thermistor
(b) Non-ohmic conductor like metal filament
(c) Ohmic conductor like copper
(d) None of these

(*iv*) What is the slope of graph in (*i*) equal to?

    (*a*) V   (*b*) I   (*c*) R   (*d*) VI

(*v*) Which of the following is the factor on which resistance of a conductor does not depend?

    (*a*) Length   (*b*) Area   (*c*) Temperature   (*d*) Pressure

Ans. (*i*) (*c*)   (*ii*) (*b*)   (*iii*) (*a*)   (*iv*) (*c*)   (*v*) (*d*)

2. Study this table related to material and their resistivity and answer the questions that follow.

	Material	**Resistivity (Ω m)**
Conductors	Silver	1.60×10^{-8}
	Copper	1.62×10^{-8}
	Sluminium	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}
Alloys	Constantan (alloy of Cu and Ni)	49×10^{-6}
	Manganin (alloy of Cu, Mn and Ni)	44×10^{-6}
	Nichrome (alloy of Ni, Cr, Mn and Fe)	100×10^{-6}
Insulators	Glass	$10^{10} - 10^{14}$
	Hard rubber	$10^{13} - 10^{16}$
	Ebonite	$10^{15} - 10^{17}$
	Diamond	$10^{12} - 10^{13}$
	Paper (dry)	10^{12}

(*i*) What is the range of resistivity in metals, good conductors of electricity?

    (*a*) 10^{-8} to $10^{-6}\,\Omega$m   (*b*) 10^{-6} to $10^{-4}\,\Omega$m   (*c*) 10^{10} to $10^{14}\,\Omega$m   (*d*) 10^{12} to $10^{14}\,\Omega$m

(*ii*) Which property of the alloy makes it useful in heating devices like electric iron, toasters, immersion rods, etc.?

    (*a*) Higher resistivity   (*b*) Do not oxidise at low temperature

    (*c*) Do not reduce at high temperature

    (*d*) Oxidise at high temperature

(*iii*) Which of the following is used in transmission wires?

    (*a*) Cr   (*b*) Al   (*c*) Zn   (*d*) Fe

(*iv*) Which is the best conducting metal?

    (*a*) Cu   (*b*) Ag   (*c*) Au   (*d*) Hg

(*v*) Which of the following is used as a filament in electric bulbs?

    (*a*) Nichrome   (*b*) Tungsten   (*c*) Manganese   (*d*) Silver

Ans. (*i*) (*a*)   (*ii*) (*a*)   (*iii*) (*b*)   (*iv*) (*b*)   (*v*) (*b*)

ASSIGNMENT

Total Marks : 20

I. Multiple Choice Questions (**1 Mark**)

Choose the correct answer from the given options.

1. Which of the following does not represent electric power?

   (*a*) I^2R (*b*) IR^2 (*c*) VI   (*d*) V^2/R [*CBSE* 2020]

2. If a person has five resistors each of value $\frac{1}{5}\Omega$, then the maximum resistance he can obtain by connecting them is

   (*a*) $1\,\Omega$ (*b*) $5\,\Omega$ (*c*) $10\,\Omega$ (*d*) $25\,\Omega$ [*CBSE* 2020]

II. Assertion-Reason Type Questions (**1 Mark**)

Note: Use instructions as given in topical exercises of the chapter.

1. Assertion: The graph between V and I is a straight line.

   Reason: V is directly proportional to 'R' and the slope gives value of 'R'.

2. Assertion: At high temperature, metal wires have greater chances of short circuiting.

   Reason: Both resistance and resistivity of metallic wires varies with temperature.

III. Very Short Answer Type Questions (**1 Mark**)

1. What is the function of rheostat?

2. List two factors on which resistance depends.

IV. Short Answer Type Questions-I (**2 Marks**)

1. Which has more resistance, ammeter or voltmeter? Give reason.

2. How are voltmeter and ammeter connected in an electric circuit?

3. If you connect three resistors having values $2\,\Omega$, $6\,\Omega$ and $8\,\Omega$ in parallel, calculate the equivalent resistance.

V. Short Answer Type Question-II (**3 Marks**)

1. (*a*) Write mathematical expression for Joule's Law of heating.

   (*b*) Compare the heat generated while transferring 96500 coloumb of charge in two hours through a potential difference of 40 V.   [*CBSE* 2020]

VI. Long Answer Type Question (**5 Marks**)

1. (*a*) Two lamps rated 100 W, 200 V and 10 W, 220 V are connected in parallel to 220 V supply. Calculate the total current through the circuit.

   (*b*) Two resistors X and Y of resistance $2\,\Omega$ and $3\,\Omega$ respectively are first joined in parallel and then in series. In each case the voltage is 5 V.

    (*i*) Draw circuit diagram to show the combination of resistors in each case.

    (*ii*) Calculate the voltage across the $3\,\Omega$ resistor in the series combination of resistors.

              [*CBSE* 2020]