Chapter
1

ELECTRICITY

Introduction

Electricity is a branch of physics which deals with the nature and effects of stationary or moving electric charges.

➢ Electric Charges

There are two kinds of electric charges.

(i) Positive Charge (ii) Negative Charge

- **SI unit of charge:** The SI unit of charge is coulomb. It is denoted by C. 1 coulomb of charge is equivalent to the charge of nearly 6×10^{18} electrons.
- **Conductors:** Those substances through which electricity can flow freely are called conductors.

  For Example: Silver, copper, aluminium, graphite, etc.
- **Insulators:** Those substances through which electricity cannot flow are called insulators.

  For Example: Glass, rubber, paper, plastic, *etc.*

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➢ Electric Current

The amount of charge flowing through a given cross-section of a conductor per unit time is called electric current.

Let Q be the amount of charge flowing through a conductor in time *t* seconds, then electric current is given by

$$I = \frac{Q}{t}$$

Where I = Electric Current

Q= Charge

t = time

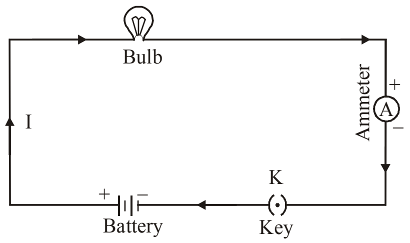
Electric current is a scalar quantity. The SI unit of electric current is ampere (A).

➢ Direction of Electric Current

Conventionally, the direction of electric current in an electric circuit is opposite to the direction of flow of electrons, *i.e.,* the direction of current is from positive terminal of a cell (or battery) to the negative terminal, through external circuit.

➢ Electric Circuit

A continuous and closed path of an electric current is called an electric circuit.



A simple electric circuit is shown in the figure.

- **Open Circuit:** An electric circuit through which no electric current flows is known as open electric circuit.
- **Closed Circuit:** An electric circuit through which electric current flows continuously is known as closed circuit.

➢ **Electric Potential**

The electrostatic potential at any point in the electric field is defined as the work done in bringing a unit positive charge from infinity to that point. Potential is denoted by the symbol V and its SI unit is volt.

➢ **Potential Difference**

The potential difference between two points in an electric field is defined as the amount of work done in moving a unit positive charge from one point to the other. That is,

Potential difference (V) between two points $= \dfrac{\text{Work done (W)}}{\text{Charge (Q)}}$

or $V = \dfrac{W}{Q}$

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➢ **Ohm's Law**

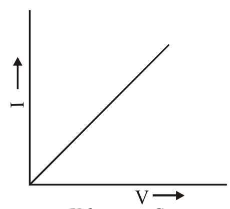
Ohm's law states that at constant temperature, the current flowing through a conductor is directly proportional to the potential difference across its ends. Thus, according to Ohm's law,

$I \propto V$

or $I = V/R$

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

Where R is a constant of proportionality called resistance of the conductor. The SI unit of resistance is ohmΩ.



Voltage vs. Current for an Ohmic material

Graph between V and I is a straight line passing through origin as shown in the figure.

- **Resistance of a Conductor**

The property of a conductor due to which it opposes the flow of current through it is called resistance.

- **Factors on which Resistance of a Conductor Depends**

The resistance of a conductor depends on the following factors:

(i) Length of the conductor

(ii) Area of cross-section of the conductor (or thickness of the conductor)

(iii) Nature of the material of the conductor

(iv) Temperature of the conductor.

- **Effect of Length of the Conductor:** The resistance of a conductor is directly proportional to its length.

$$R \propto l \qquad \text{...(i)}$$

where l is the length of the conductor.

- **Effect of Area of cross-section of the conductor:** The resistance of a conductor is inversely proportional to its area of cross-section. That is,

$$R \propto \frac{1}{A} \qquad \text{...(ii)}$$

From relation (i) and (ii)we have

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

or $$R = \rho\frac{l}{A} \qquad \text{...(iii)}$$

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Where, ρ(rho) is a constant known as resistivity (or specific resistance) of the material of the conductor. The SI unit of resistivity is ohm-metre(Ω m).

Now in relation (iii), if we put A = 1, and l = 1 we get

$$\rho = R$$

Thus, the resistivity of material of conductor is defined as the resistance of the conductor of unit length and unit area of cross-section.

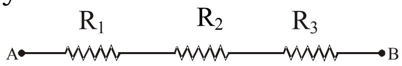
Note: *The resistivity of a substance does not depend on its length or thickness. It depends only on the nature and temperature of the substance.*

- **Combination of Resistances (or Resistors)**

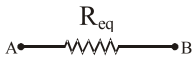
There are two methods of joining the resistors together (i) in series and (ii) in parallel.

- **Resistors in Series**

When two (or more) resistances are connected end to end consecutively, they are said to be connected in series.



or



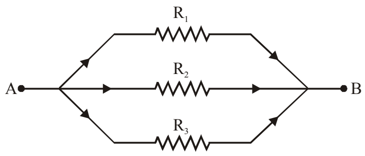
or

Effective resistance is given by

$$R_{eq} = R_1 + R_2 + R_3$$

- **Resistors in Parallel**

  When two (or more) resistances are connected between the same two points, they are said to be connected in parallel.



or

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

➢ **Advantages of Connecting Electrical Appliances in Parallel**

(i) In a series combination, when one component fails, the circuit is broken and none of the components in the circuit works. But in parallel combination if one component fails, the working of other components will not be affected.

(ii) In a series circuit the current is constant throughout the electric circuit. So, it is impracticable to connect electric bulb and an electric heater in series, because they need currents of different values to operate properly. On the other hand, a parallel circuit divides the currents through the electrical gadgets and this is helpful when each gadget has different resistance and requires different current to operate properly.

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- **Electric Power**

  The rate of doing work is called Power.

$$P = \frac{\text{Work done}}{\text{Time taken}}$$

$$\text{or} \qquad P = \frac{W}{t}$$

  The SI unit of electric power is watt (W)

- **Formula for Calculating Electric Power**

$$P = V \times I$$

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

$$P = I^2R$$

- **Incandescent Electric lamp (Bulb) :** The heating effect of electric current is also used to produce light, like in an electric bulb. The filament of bulb is made up of tungsten with high melting point (3380°C). It is thermally isolated using insulated support. Presence of chemically inactive gases like argon and nitrogen prolong the life of filament.

When voltage is applied across the filament of the bulb, the current is passed through it. The filament get heated to a very high temperature (2700°C). It then becomes white hot and starts radiating heat and light.

- **Rating of electrical appliance :** The value of power consumed (i.e., wattage) and operating voltage across its terminal, printed on each appliance, taken together is called the rating of electrical appliances.

  e.g., If the bulb has 40 W – 220 V rating, it means bulb uses 40 J of energy per second, when a voltage of 220 V is applied across its terminals. Then 40 J of electrical energy per second is converted into heat and light energy.

➢ Commercial Unit of Electrical Energy

For commercial purpose we use a bigger unit of electrical energy which is called kilowatt-hour (kWh).

One kilowatt-hour is the amount of electrical energy consumed when an electrical appliance having a power rating of 1 kilowatt is used for 1 hour.

$$1\text{ kWh} = 3.6 \times 10^6\text{ J}$$

➢ Heating Effect of Electric Current

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Whenever the electric current is passed through a metallic conductor, it becomes hot after some time. This indicates that the electrical energy is being converted into heat energy. This effect is known as heating effect of current.

➢ Formula for Calculating Heat Produced in a Conductor

$$H = VIt$$

$$H = I^2Rt$$

$$H = \frac{V^2}{R}t$$

➢ Applications of Heating Effect of Current

(i) The heating effect of current is used in electrical heating appliances like electric iron, room heater.

(ii) The heating effect of electric current is utilized in electric bulbs for producing light.

(iii) An electric fuse is safety device connected in series with the electric circuit.

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SOLVED EXAMPLES

Example 1: How many electrons are in 1 coulomb of charge ?

Solution: We know,

$$Q = ne$$

Where n = number of electrons

or $n = \frac{Q}{e} = \frac{1}{1.6\times10^{-19}} = 6.25\times10^{18}$ electrons.

1 coulomb of charge contains nearly 6×10^{18} electrons.

Example 2: 6×10^{17} electrons cross through an area per minute. What is the electric current?

Solution: Charge on 1 electron = 1.6×10^{-19} C

Total charge carried by 6×10^{17} electrons is $Q = 6 \times 10^{17} \times 1.6 \times 10^{-19}$ C

So, the current $i = \frac{Q}{t} = \frac{6\times10^{17}\times1.6\times10^{-19}\,C}{60\,s} = 1.6\times10^{-3}\,A = 1.6\,mA$

Example 3: Calculate the amount of work done to carry 4C of charge from a point at 100V to a point at 120 V.

Solution: Here, potential difference between two points, V = 120 V – 100 V = 20 V

Charge to be moved, Q = 4C

If W is the amount of work done, then

$$W = Q \times V = 4 \times 20 = 80\ J$$

Example 4: Calculate the resistance of a copper wire of length 1 m and area of cross section 2 mm². Resistivity of copper is $1.7 \times 10^{-8}\Omega$ m.

Solution : $R = \rho\frac{l}{A} = (1.7\times10^{-8}\,\Omega\,m)\times\frac{1\,m}{2\times(10^{-3}\,m)^2} = 8.5\times10^{-3}\,\Omega.$

Example 5: A copper wire has a resistance of 0.5 Ω. Another copper wire of the same mass as the first one is double in length of the first. Find the resistance of the second wire.

Solution: For the first wire, let

l = length and A_1 = cross-sectional area.

For the second wire,

$2l$ = length and A_2 = cross-sectional area.

Now, density = mass / volume.

The two wires have the same mass and they have the same density (being made of the same material). So, their volumes are equal.

$\therefore \quad lA_1 = 2lA_2$

or $\quad A_1 = 2A_2$.

Let the resistivity of copper be ρ.

Resistance of the first wire is 0.6 Ω = $\rho\frac{l}{A_1}$ ...(i)

Resistance of the second wire is R = $\rho\frac{2l}{A_2}$ ...(ii)

Dividing (ii) by (i),

$$\frac{R}{0.6\,\Omega}=\frac{2lA_1}{lA_2}=\frac{2(2A_2)}{A_2}=4$$

R = 0.6 Ω× 4 = 2.4 Ω.

Example 6: How will the resistance of a wire change if its diameter (d) is doubled, its length remaining the same ?

Solution: The cross-sectional area of the wire is $A_1 = \pi r^2 = \pi\left(\frac{d}{2}\right)^2 = \frac{\pi d^2}{4}$.

Its resistance = $R_1 = \rho\frac{l}{A_1} = \rho\frac{l}{\frac{\pi d^2}{4}} = \frac{4\rho l}{\pi d^2}$.

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When the diameter is doubled, cross-sectional area $A_2 = \pi\left(\frac{2d}{2}\right)^2 = \pi d^2$.

Its resistance = $R_2 = \rho\frac{l}{A_2} = \rho\frac{1}{\pi d^2}$.

Thus, $$\frac{R_2}{R_1}=\frac{\frac{\rho l}{\pi d^2}}{\frac{4\rho l}{\pi d^2}}=\frac{1}{4}$$

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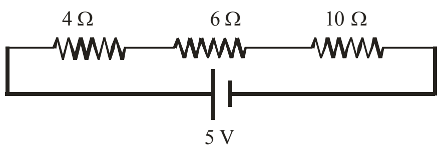
or $$R_2=\frac{1}{4}R_1.$$

So, on doubling the diameter, the area of cross section becomes 4 times and the resistance becomes one-fourth of the initial value.

Example 7: Calculate the potential difference across each resistor in the circuit shown in Figure.



Solution: The three resistors are joined in series. Their equivalent resistance is

R = 4 Ω + 6 Ω + 10 Ω = 20 Ω.

The current through the cell is $i=\frac{5\,V}{20\,\Omega}=0.25\,A$.

The same current passes through each resistor. Using Ohm's law, the potential difference

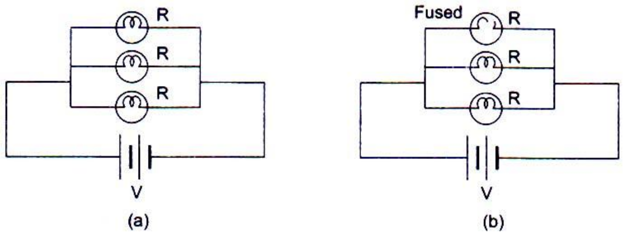
across the 4-Ω resistor = 0.25 A × 4 Ω = 1 V,

across the 6-Ω resistor = 0.25 A × 6 Ω = 1.5 V, and

across the 10-Ω resistor = 0.25 A × 10 Ω = 2.5 V.

Example 8: Three identical bulbs are connected in parallel with a battery. The current drawn from the battery is 6 A. If one of the bulbs gets fused, what will be the total current drawn from the battery ?

Solution: Let the potential difference maintained by the battery be V, and let the resistance of each bulb be R. If the equivalent resistance of the circuit is R_{eq},



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$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R}$$

or $$R_{eq} = \frac{R}{3}.$$

The current is $i = \frac{V}{R_{eq}} = \frac{3V}{R}$. It is given that this current is 6 A.

So, $$6A = \frac{3V}{R} \quad \text{or} \quad \frac{V}{R} = 2A.$$

If one of the bulbs gets fused, only two bulbs remain connected in parallel. The equivalent resistance R_{eq}' in that case is given by

$$\frac{1}{R_{eq}'} = \frac{1}{R} + \frac{1}{R} \quad \text{or} \quad R_{eq}' = \frac{R}{2}.$$

The current in the battery will be

$$i' = \frac{V}{R_{eq}'} = \frac{2V}{R} = 2 \times (2\ A) = 4\ A.$$

Example 9: A uniform wire of resistance R is cut into three equal pieces, and these pieces are joined in parallel. What is the resistance of the combination ?

Solution: Resistance of the wire is R = $\rho \frac{l}{A}$.

Resistance of a piece of length $\frac{l}{3}$ is $R' = \rho \frac{l}{3A}$

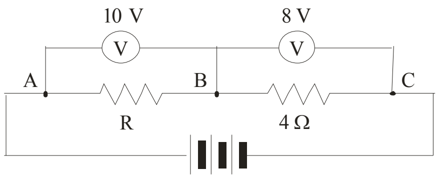
or $R' = \frac{R}{3}$.

Let the equivalent resistance of the three wires in parallel be R_{eq}. Then,

$$\frac{1}{R_{eq}} = \frac{1}{R/3} + \frac{1}{R/3} + \frac{1}{R/3} = \frac{3}{R} + \frac{3}{R} + \frac{3}{R} = \frac{9}{R}.$$

$\therefore$ $R_{eq} = \frac{R}{9}$.

Example 10: Consider the circuit shown in Figure. The voltmeter on the left reads 10 V and that on the right reads 8 V. Find (a) the current through the resistance R, (b) the value of R, and (c) the potential difference across the battery.



Solution: (a) Apply Ohm's law to the 4-Ω resistor. The current through this resistor is

$$i = \frac{8\,V}{4\,\Omega} = 2\,A.$$

As the two resistors are connected in series, the same current passes through the two resistors (the volmeteres draw only a negligible current). Hence, the current through R is 2 A.

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(b) Applying Ohm's law to the resistance R,

$$10\text{ V} = R \times (2\text{ A}) \quad \text{or} \quad R = \frac{10\,V}{2\,\Omega} = 5\,\Omega.$$

(c) The potential difference across the battery is

$$V_A - V_C = (V_A - V_B) + (V_B - V_C) = 10\text{ V} + 8\text{V} = 18\text{ V}.$$

Example 11: How many bulbs of resistance 6 ohms should be joined in parallel to draw a current of 2 amperes from a battery of 3 volts ?

Solution: The equivalent resistance of the circuit = $R = \frac{V}{i} = \frac{3\,V}{2\,V} = 1.5\,\Omega$.

Let n bulbs be joined in parallel to achieve this resistance, Then,

$$\frac{1}{1.5\,\Omega} = \frac{1}{r_1} + \frac{1}{r_2} + \ldots + \frac{1}{r_n} = \frac{n}{6\,\Omega} \qquad \text{(as all resistances = 6 Ω)}$$

$\therefore$ $n = \frac{6\,\Omega}{1.5\,\Omega} = 4.$

So, 4 bulbs should be connected in parallel.

Example 12: A current of 4 A passes through a resistance of 100 Ω for 15 minutes. Calculate the heat produced.

Solution: The heat produced is $H = I^2Rt$

$$= (4\ A)^2 \times (100\ \Omega) \times (15 \times 60\ s) = 1.44 \times 10^6\ J.$$

Example 13: A bulb draws 24 W when connected to a 12-V supply. Find the power if it is connected to a 6-V supply. (Neglect resistance change due to unequal heating in the two cases).

Solution: We have $P = \frac{V^2}{R}$

or $$24\ W = \frac{(12\ V)^2}{R}. \quad \ldots(i)$$

Suppose the bulb draws power P_1 when connected to the 6-V battery. Then,

$$P_1 = \frac{(6\ V)^2}{R}. \quad \ldots(ii)$$

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From (i) and (ii), we have

$$\frac{P_1}{24\ W} = \frac{(6\ V)^2}{(12\ V)^2} = \frac{1}{4}$$

or $$P_1 = \frac{24\ W}{4} = 6\ W.$$

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Example 14: A bulb is rated 60 W, 240 V. Calculate its resistance when it is on. If the voltage drops to 192 V, what will be the power consumed and the current drawn ?

Solution: Power, $P = \frac{V^2}{R}$.

$$\therefore \quad R = \frac{V^2}{P} = \frac{(240\ V)^2}{60\ W} = 960\ \Omega.$$

When the voltage drops to 192 V, the power consumed will be

$$P = \frac{V^2}{R} = \frac{(192\ V)^2}{960\ \Omega} = 38.4\ W.$$

The current drawn will be $i = \frac{V}{R} = \frac{192\ V}{960\ \Omega} = 0.2\ A.$

Example 15: A room has two Bulbs, a fan and a Cooler. Each Bulb draws 40 W, the fan draws 80 W, and the Cooler draws 60 W. On the average, the Bulbs are kept on for five hours, the fan for twelve hours and the Cooler for eight hours every day. The rate for electrical energy is Rs 3.10 per kWh.

Calculate the cost of electricity used in this room in a 30-day month.

Solution: For each bulb, power P = 40 W = $\frac{40}{1000}$ kW. So, the energy consumed by each bulb in a day is

$$U = P \times t = \left(\frac{40}{1000} kW\right) \times (5\ h) = 0.2\ kWh.$$

Energy consumed by the fan in a day is

$$U = P \times t = (80\ W) \times (12\ h) = 0.96\ kWh.$$

Energy consumed by the Cooler in a day is

$$U = P \times t = (60\ W) \times (8\ h) = 0.48\ kWh.$$

Total energy consumed in a day is

$$2 \times 0.2\ kWh + 0.96\ kWh + 0.48\ kWh = 1.84\ kWh.$$

Energy consumed in a month is

$$(1.84\ kWh) \times 30 = 552\ kWh.$$

The cost of electricity = Rs (552.2 × 3.1) = Rs 1711.82.

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EXERCISE

LEVEL-I

1. A wire of resistance 20 Ωis bent to form a closed square. What is the resistance across a diagonal of the square ?

2. What is the shape of the graph between V and i, where V is the potential difference between the ends of a wire and i is the current in it ?

3. Which material is the best conductor of electricity at room temperature ?

4. Why is a series arrangement not used for connecting domestic electrical appliances in a circuit ?

5. There are two electric bulbs (i) marked 60 W, 220 V and (ii) marked 100 W, 220 V. Which one of the two has a higher resistance?

6. A voltmeter is used to measure

(a) potential difference (b) electric current

(c) electric power (d) resistance

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7. An ammeter is always connected in ..... And a voltmeter in ..... . The suitable words, in order, for the blanks are

(a) series ; series (b) parallel ; parallel

(c) parallel ; series (d) series ; parallel

8. In the following circuits Figure, heat produced in the resistor or combination of resistors connected to a 12 V battery will be

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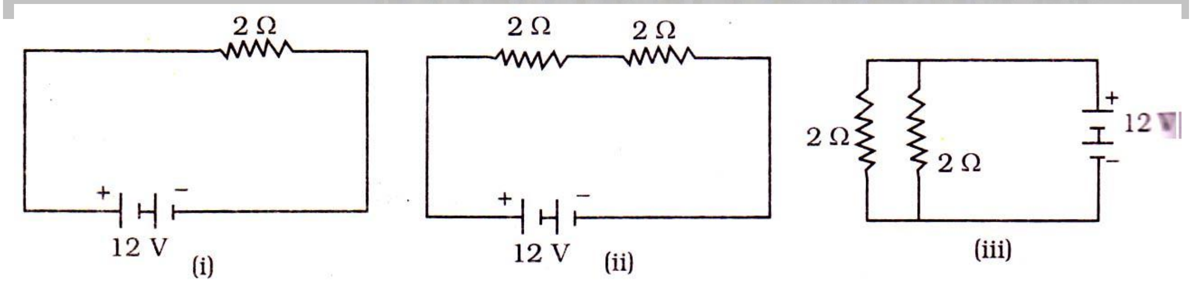


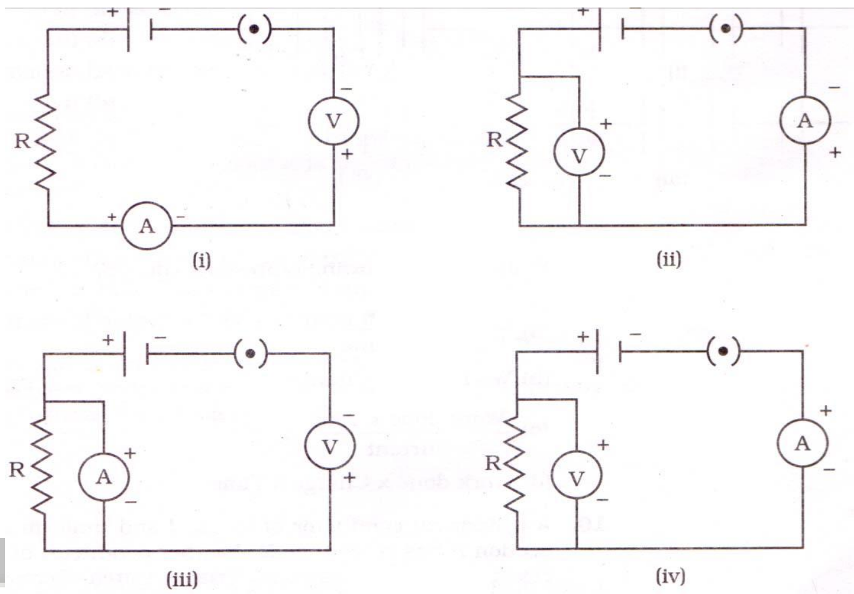
(a) same in all the cases

(b) minimum in case (i)

(c) maximum in case (ii)

(d) maximum in case (iii)

9. Identify the circuit (in Figure) in which the electrical components have been properly connected.



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

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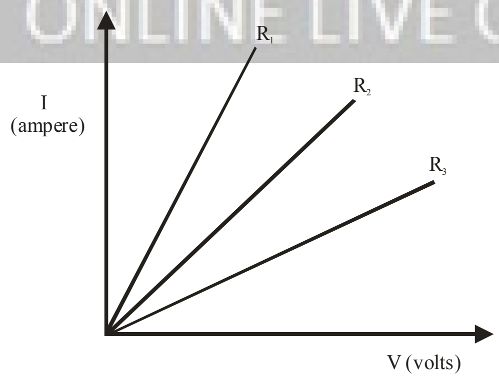
10. A student carries out an experiment and plots the V-I graph of three samples of nichrome wire with resistances R_1, R_2 and R_3 respectively (Figure A). Which of the following is true ?



(Figure A)

(a) $R_1 = R_2 = R_3$ (b) $R_1 > R_2 > R_3$
(c) R3> R2> R1 (d) $R_2 > R_3 > R_1$

LEVEL-II

1. Should the resistance of an ammeter be low or high? Give reason.

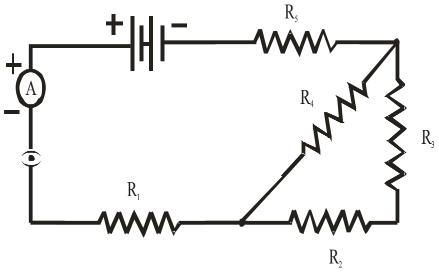
2. An electrical iron has a rating of 750 W, 220 V. Calculate the

(i) current flowing through it, and

(ii) its resistance when in use.

3. The charge possessed by an electron is 1.6×10^{-19} coulombs. Find the number of electrons that will flow per second to constitute a current of 1 ampere.

4. Consider the following circuit diagram. If $R_1 = R_2 = R_3 = R_4 = R_5 = 3\ \Omega$, find the equivalent resistance (R_S) of the circuit.



5. An electric lamp is marked 25 W, 220 V. It is used for 10 hours daily. Calculate

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(i) its resistance while glowing.

(ii) energy consumed in kWh per day.

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

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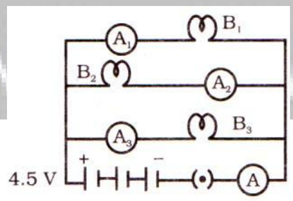


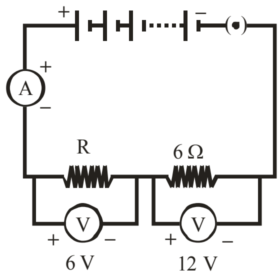
(i) What happens to the glow of the other two bulbs when the bulb B_1 gets fused ?

(ii) What happens to the reading of A_1, A_2, A_3 and A when the bulb B_2 gets fused ?

(iii) How much power is dissipated in the circuit when all the three bulbs glow together ?

7. Two devices of rating 44 W, 220 V and 11 W, 220 V are connected in series. The combination is connected across a 440 V mains. The fuse of which of the two devices is likely to burn when the switch is ON ? Justify your answer.

8. A circuit is shown in the diagram given below.



(a) Find the value of R.

(b) Find the reading of the ammeter.

(c) Find the potential difference across the terminals of the battery.

9. Two resistors with resistances 5 Ω and 10 Ω are to be connected to a battery of emf 6 V so as to obtain :

(i) minimum current

(ii) maximum current

(a) How will you connect the resistances in each case ?

(b) Calculate the strength of the total current in the circuit in the two cases.

10. Name the unit used in selling electrical energy to consumers. Two lamps, one rated 100 W at 220 V and the other 40 W at 220 V are connected in parallel to a 220 V mains supply. Calculate the electric current drawn from the supply line.

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LEVEL-III

1. Three incandescent bulbs of 100 W each are connected in series in an electric circuit. In another circuit another set of three bulbs of the same wattage are connected in parallel to the same source.

(a) Will the bulb in the two circuits glow with the same brightness ? Justify your answer.

(b) Now let one bulb in both the circuits get fused. Will the rest of the bulbs continue to glow in each circuit ? Give reason.

2. (a) Though same current flows through the electric line wires and the filament of bulb, yet only the filament glows. Why ?

(b) The temperature of the filament of bulb is 2700°C when it glows. Why does it not get burnt up at such high temperature ?

(c) The filament of an electric lamp, which draws a current of 0.25 A is used for four hours. Calculate the amount of charge flowing through the circuit.

(d) An electric iron is rated 2 kW at 220 V. Calculate the capacity of the fuse that should be used for the electric iron.

3. Find out the following in the electric circuit given in Figure.

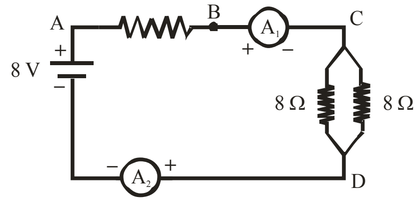
(a) Effective resistance of two 8 Ω resistors in the combination

(b) Current flowing through 4Ω resistor

(c) Potential difference across 4Ω resistance

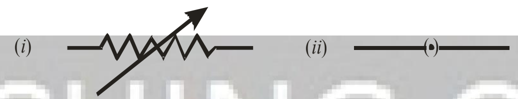
(d) Power dissipated in 4Ω resistor

(e) Difference in ammeter reading, if any.



4. (a) Name an instrument that measures electric current in a circuit. Define the unit of electric current.

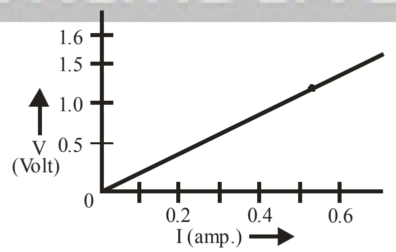
(b) What do the following symbols mean in circuit diagrams ?



(c) An electric circuit consisting of a 0.5 m long nichrome wire XY, an ammeter, a voltmeter, four cells of 1.5 V each and a plug key was set up.

(i) Draw a diagram of the electric circuit to study the relation between the potential difference maintained between the points 'X' and 'Y' and the electric current flowing through XY.

(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 ?

5. (a) What does an electric circuit mean ? Distinguish between an open and a closed circuit.

(b) Define the unit of current. Name the instrument used to measure electric current. How is it connected in a circuit ?

(c) State the direction of conventional current.

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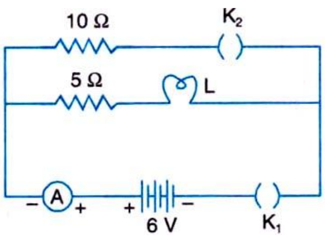
6. Study the circuit shown below :



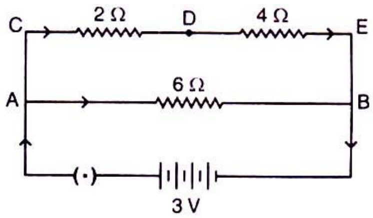
A current of 0.6 A is shown by ammeter in the circuit when the key K_1 is closed. Find the resistance of the lamp L. What change in current flowing through the 5Ω resistor and potential difference across the lamp will take place, if the key K_2 is also closed. Give reason for your answer.

7. In a circuit shown below calculate :

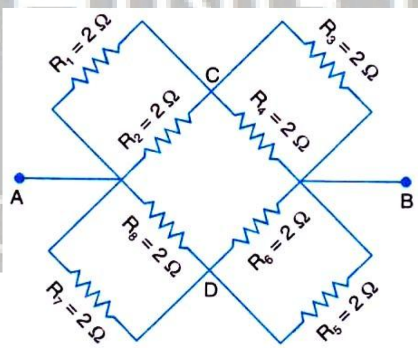
(a) Total resistance in the arm CE,

(b) Total current drawn from the battery, and

(c) Current in each arm, i.e., AB and CE of the circuit.

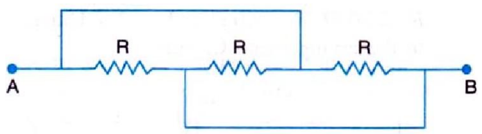


8. Find the equivalent resistance across the two ends A and B of this circuit.

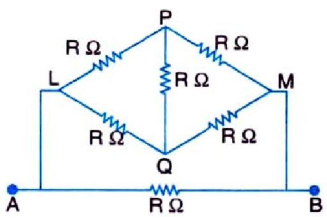


9. Find the equivalent resistance across the two ends A and B of the following circuits.

(i)



(ii) Assume that P and Q are at the same potential.



10. Mr. Kapilgot frustrated by frequent power cuts, purchased a new generator. He kept that 500 m away from his mains and connected that with high resistive conductive material wire. After few hours a power cut happened again. He switched on the generator but required voltage could not be obtained from the mains. In the mean time one of his friends Mr. Naveen, visited his house. On seeing it, he advised him to change the wire to that of low resistive conductive material wire. After changing the wire, as per advice, the required necessary voltage was obtained.

(a) Why the required voltage could not be obtained with high resistive material wire ?

(b) Name some materials which Mr. Naveen would have suggested.

(c) What qualities do you find in Mr. Kapil ?

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WORKSHEET-1

1. Define electric current and write its SI unit.

2. Define potential difference (P.D.) and write its SI unit.

3. A current of 4 A flows around a circuit for 10 s. How much charge flows past a point in the circuit in this time ?

4. Which statement / statements is / are correct ?

1. An ammeter is connected in series in a circuit and a voltmeter is connected in parallel.
2. An ammeter has a high resistance.
3. A voltmeter has a low resistance.

(a) 1, 2, 3 (b) 1, 2 (c) 2, 3 (d) 1

5. If the current through a flood lamp is 5 A, what charge passes in 10 seconds ?

(a) 0.5 C (b) 2 C

(c) 5 C (d) 50 C

6. (a) What is meant by the "resistance of a conductor" ? Write the relation between resistance, potential difference and current.

(b) When a 12 V battery is connected across an unknown resistor, there is a current of 2.5 mA in the circuit. Calculate the value of the resistance of the resistor.

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7. A cylinder of a material is 10 cm long and has a cross-section of 2 cm^2. If its resistance along the length be 20 Ω, what will be its resistivity in numbers and units ?

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8. A piece of wire of resistance 20 Ω is drawn so that its length is increased to twice its original length. Calculate resistance of the wire in the new situation.

9. What is Ohm's law ?

10. The unit of electrical resistance is :

(a) ampere (b) volt (c) coulomb (d) ohm

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WORKSHEET-2

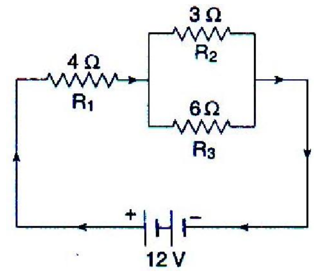
1. Two resistors, with resistances 5 Ω and 10 Ω respectively are to be connected to a battery of emf 6 V so as to obtain :

(i) minimum current flowing (ii) maximum current flowing

(a) How will you connect the resistances in each case ?

(b) Calculate the strength of the total current in the circuit in the two cases.

2. The circuit diagram given below shows the combination of three resistors R_1, R_2 and R_3 :



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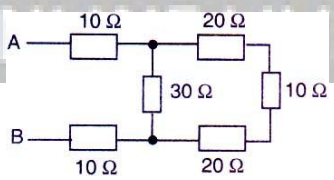
Find : (i) total resistance of the circuit.

(ii) total current flowing in the circuit.

(iii) the potential difference across R_1.

3. What is the resistance between A and B in the figure given below?



4. A resistor of 8 ohms is connected in parallel with another resistor X. The resultant resistance of the combination is 4.8 ohms. What is the value of the resistor X?

5. Define Electric power. Write its SI unit.

6. Discuss briefly three applications of heating effect of current.

7. A heater wire whose power is 4KW is connected to 220 V source. Calculate : -

(a) Electric current in the circuit (b) Resistance of heater

(c) Energy consumed in 2 hours.

8. In which of the following case energy consumption is more ?

(i) A 250 W TV set runs for one hour.

(ii) An electric iron of 1000W is used for 10 min.

9. A 400W refrigerator operates for 16 hrs / day. Calculate the cost to operate it for 30 days at Rs. 3 per KWh.

10. Two conducting wire of same material and of equal length and diameters are first connected in series and then in parallel in a circuit across the same supply. What will be the ratio of heat produced in series and parallel ?

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