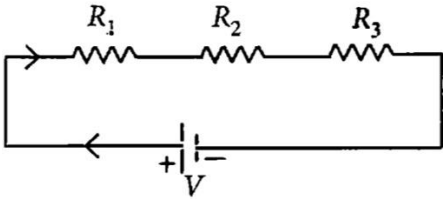
CLASS X CASE STUDY BASED QUESTIONS

Case Study Questions

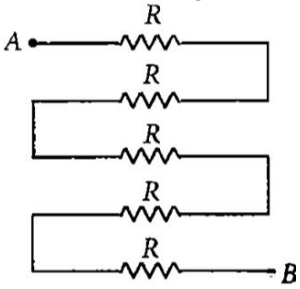
Electricity - 01

Two or more resistances are connected in series or in parallel or both, depending upon whether we want to increase or decrease the circuit resistance.

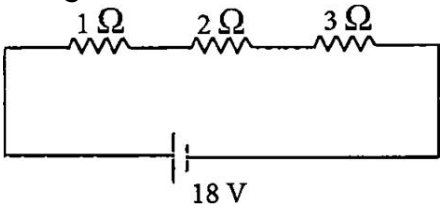


The two or more resistances are said to be connected in series if the current flowing through each resistor is the same.

i. When the three resistors each of resistance R ohm are connected in series then what will be the equivalent resistance?
ii. There is a wire of length 20 cm and having resistance 20 Ω cut into 4 equal pieces and then joined in series. What is equivalent resistance?
iii. In the following circuit, find the equivalent resistance between A and B (R = 2Ω)



iv. In the given circuit, what is the current in each resistor?



Answer Key:

i. In series combination, Rs = R_1 + R_2 + R_3 = R + R + R = 3R.
ii. The equivalent resistance is where the total resistance is connected either in parallel or in series.
Resistance of each wire = 20/4 = 5 Ω
Equivalent resistance in series
R_s = 5 + 5 + 5 + 5 = 20Ω
iii. All are in series, R_s = 5R = 5 × 2 = 10Ω
iv. R_s = 1 + 2 + 3 = 6 Ω

$$I = \frac{18}{6} = 3 \text{ A}$$

Case Study Questions

Electricity - 02

The electrical energy consumed by an electrical appliance is given by the product of its power rating and the time for which it is used. The SI unit of electrical energy is Joule. Actually, Joule represents a very small quantity of energy and therefore it is inconvenient to use where a large quantity of energy is involved. So for commercial purposes, we use a bigger unit of electrical energy which is called kilowatt-hour. 1 kilowatt-hour is equal to 3.6×10^6 joules of electrical energy.

i. The energy dissipated by the heater is E. When the time of operating the heater is doubled, what would be the energy dissipated?
ii. The power of a lamp is 60 W. What will be the energy consumed in 1 minute?
iii. The electrical refrigerator rated 400 W operates 8 hours a day. The cost of electrical energy is ₹5 per kWh. Find the cost of running the refrigerator for one day.
iv. Calculate the energy transformed by a 5 A current flowing through a resistor of 2Ω for 30 minutes.

Answer Key:

i. $E \propto t$
When the time of operating the heater is doubled, the energy dissipated is doubled.
ii. Given: P = 60 W, t = 1 min
E = 60 × 1 × 60 = 3600 J
iii. Given: P = 400 Ω, t = 8 hour
E = 400 × 8 = 3200 Wh = 3.2 kWh
Cost = 3.2 × 5 = ₹16
iv. Given: I = 5A, R = 2Ω, t = 30 min
$E = I^2Rt = 5 \times 5 \times 2 \times 30 \times 60$
E = 90000 J = 90 kJ

Case Study Questions

Electricity - 03

In 1827, a German physicist Georg Simon Ohm (1787-1854) found out the relationship between the current I, flowing in metallic wire and the potential difference across its terminals. He stated that the electric current flowing through a metallic wire is directly proportional to the potential difference V, across its ends provided its temperature remains the same.
The resistance of a circuit is defined as the ratio between the voltage applied to the current flowing through it. Rearranging the above relation,
$R = \frac{V}{I}$
Electric charge flows easily through some materials than others. The electrical resistance measures how much the flow of this electric charge is restricted within the circuit.

i. What is the unit of electrical resistance?
ii. Define Ohm's law.
iii. From graph which resistance have high resistance?
iv. What does the slope of V-I graph at any point represent?

Answer Key:

i. Ohm is the unit of electrical resistance.
ii. According to Ohm's law, there is a relation between the current flowing through a conductor and the potential difference across it. It is given by,
$V \propto I$ $V = IR$
iii. R_3 resistance has high resistance.
iv. The slope of V-I graph at any point represents resistance.

Case Study Questions

Electricity - 04

In our homes, either the overhead electric poles or underground cables support the power supply flowing through the mains supply. One of the wires in this supply is covered with insulation in the colour red, and another wire colored black. At the meter board, these wires pass into an electric meter through the main fuse. The main switch, live wire, and the neutral wire are in connection to the line wires in our homes; these wires then supply electricity to separate electric circuits within the house.

i. What is the colour of the live wire?
ii. Where is the fuse placed in the electric supply in the above-given figure?
iii. What is the commercial unit of the power supply?
iv. What is the role of the fuse in series with any electrical appliance in an electric circuit?

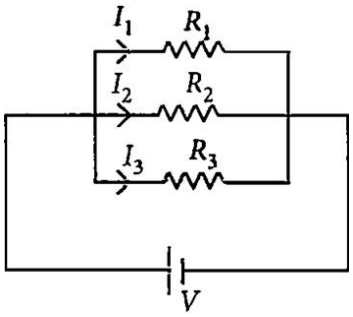
Answer Key:

i. Live wire is of Red colour.
ii. The fuse is connected in between live wire.
iii. KWh is the commercial unit of power supply.
iv. A fuse wire is a safety device connected in series with the live wire of circuit. It has high resistivity and a low melting point.

Case Study Questions

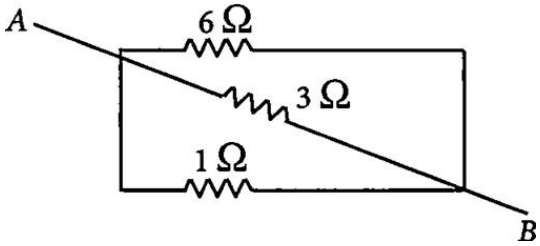
Electricity - 05

If two or more resistances are connected in such a way that the same potential difference gets applied to each of them, then they are said to be connected in parallel.

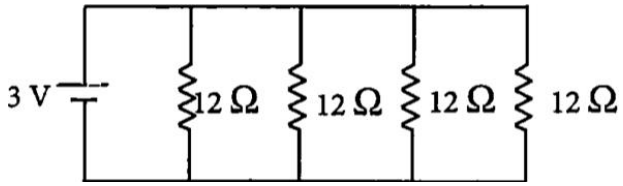


The current flowing through the two resistances in parallel is, however, not the same. When we have two or more resistances joined in parallel to one another, then the same current gets additional paths to flow and the overall resistance decreases.

i. Three resistances, 2 Ω, 6 Ω and 8 Ω are connected in parallel, then what will be the equivalent resistance?
ii. A wire of resistance 12Ω is cut into three equal pieces and then twisted their ends together, then what will be the equivalent resistance?
iii. Three resistances are connected as shown. Calculate the equivalent resistance between A and B?



iv. Find the current in each resistance.



Answer Key:

i. The equivalent resistance in the parallel combination is lesser than the least value of the individual resistance.
The equivalent resistance of parallel combinations
$\frac{1}{Rp} = \frac{1}{2} + \frac{1}{4} + \frac{1}{8}$
$\Rightarrow$ Rp = $\frac{8}{7}\Omega$
Thus equivalent resistance is less than 2Ω.

ii. Resistance of each piece $= \frac{12}{3} = 4\Omega$
$\frac{1}{R_p} = \frac{1}{4} + \frac{1}{4} + \frac{1}{4} = \frac{3}{4} \Rightarrow R_p = \frac{4}{3}\Omega$

iii. All the three resistors are in paralle.
$\therefore \frac{1}{R_p} = \frac{1}{6} + \frac{1}{3} + \frac{1}{1} = \frac{1+2+6}{6} = \frac{9}{6} R_P = \frac{6}{9} = \frac{2}{3}\Omega$

iv. All are in parallel.
$\frac{1}{R_p} = \frac{1}{12} \times 4 = \frac{1}{3} \Rightarrow R_p = 3\Omega$
$I = \frac{3}{3} = 1\ \text{A}$
So, current in each resistor $I' = \frac{3}{12} = \frac{1}{4}\ \text{A}$