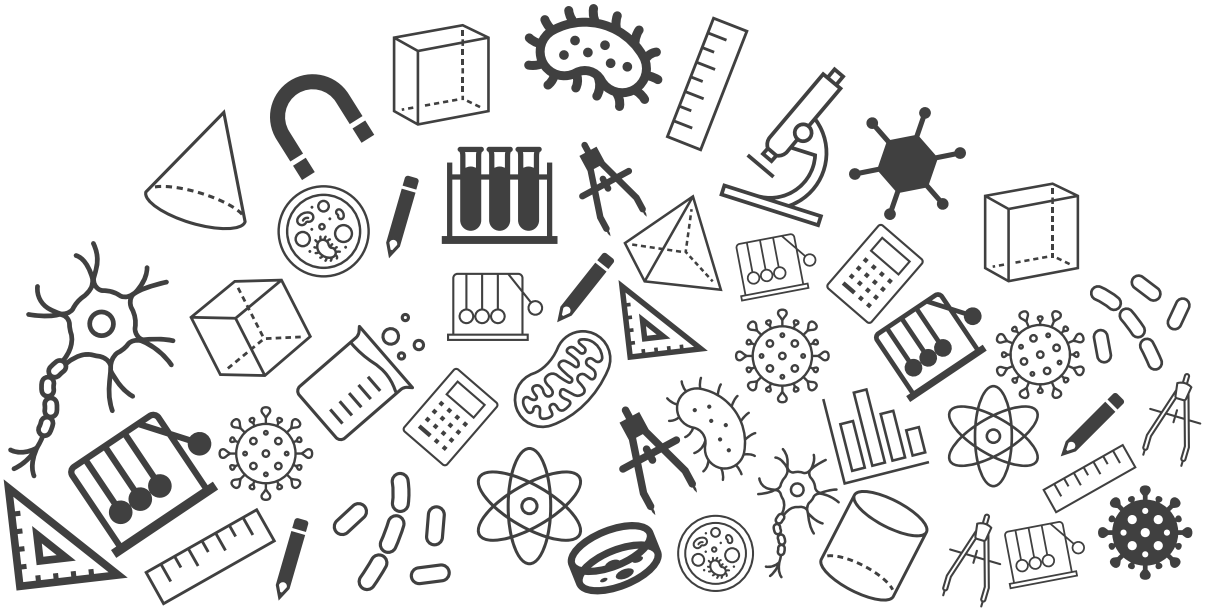
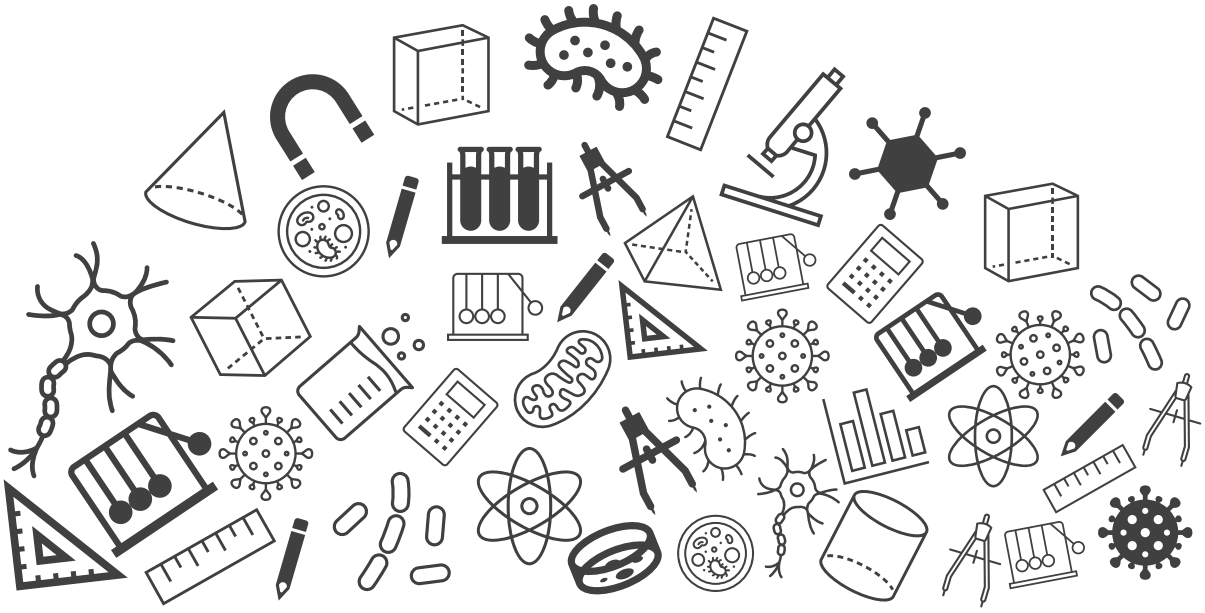
Grade 10: Science
Exam Important Questions



Electricity

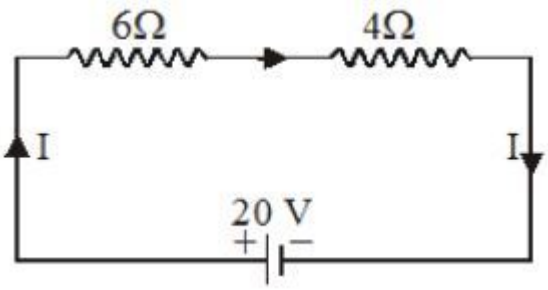


1. Define one ohm. A resistance of 6 ohms is connected in series with another resistance of 4 ohms.
   A potential difference of 20 volts is applied across the combination.
   Calculate the current through the circuit and potential difference across the 6 ohm resistance.

   [4 Marks]

   Solution:

   1. 1 ohm is the resistance of a conductor, for which a current of 1 A flows through it on application of 1 V of potential difference across it. [1 Mark]

   2. 

   We use proper symbols for electrical components.

   Potential difference, $V = 20\ V$
   Total circuit resistance:
   $R = R_1 + R_2$
   $R = 10\ \Omega$ [1 Mark]

   From Ohm's law,
   $I = \frac{V}{R}$
   $I = \frac{20\ V}{10\ \Omega} = 2\ A$ [1 Mark]
   This current will flow through each of the resistors.

   Potential difference across 6Ω resistance can be found by applying ohm's law for it.
   $V_1 = IR_1$
   $V_1 = 2 \times 6 = 12\ V$ [1 MARK]

2. In a premise, 5 bulbs each of 100 W, 2 fans each of 60 W, 2 A.Cs each of 1.5 kW are used for 5 h per day. Find:

(a) total power consumed per day,

(b) total power consumed in 30 days.

(c) total electric energy consumed in 30 days.

(d) the cost of electricity at the rate of Rs 6.25 per unit.

[5 Marks]
[Electric Power]

Solution:

Power consumed by
5 bulbs = 5×100 = 500 W
2 fans = 2×60 = 120 W
2 A.C = $2 \times 1.5 \times 1000$ = 3000 W

(a) Total power consumed per day = 3620 W [1 Mark]

(b) Total power consumed in 30 days, P = $30 \times \frac{3620}{1000}$ = 108.6 kw [1 Mark]

(c) Electric energy is used for 5 h per day.
Total electrical energy consumed in 30 days =$P \times t$ = 108.6×5 = 543 kWh [1 Mark]

(d) Cost of electricity = Total electrical energy consumed (in kWh) x Cost of 1 unit (1 kWh) = 543×6.25 = Rs. 3393.75 [2 Mark]

3. Two lamps, one rated 100 W at 220 V, and the other 60 W at 220 V, are connected in parallel to an electric mains supply. What current is drawn from the line if the supply voltage is 220 V?

[3 Marks]

[NCERT Exercise]

[Electric Power & Combination of resistors]

Solution:

Both the bulbs are connected in parallel.

Therefore, the potential difference across each of them will be 220 V, because no division of voltage occurs in a parallel circuit.

Current drawn by the bulb of rating 100 W is given by,

$Power = Voltage \times Current$

$Current = \frac{Power}{Voltage} = \frac{100}{220} A$ [1 Mark]

Current drawn by the bulb of rating 60 W is given by,

$Power = Voltage \times Current$

$Current = \frac{Power}{Voltage} = \frac{60}{220} A$ [1 Mark]

Hence, current drawn from the line = $\frac{100}{220} + \frac{60}{220} = 0.727 A$ [1 Mark]

4. 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.

[2 marks]

[NCERT Exercise]

[Ohm's law]

Solution:

Resistance (R) of a resistor is given by Ohm's law as,

V = IR

$R = \frac{V}{I}$ (1 Mark)

Where, potential difference, V = 12 V

Current in the circuit, $I = 2.5\, mA = 2.5 \times 10^{-3}\, A$

$R = \frac{12}{2.5 \times 10^{-3}} = 4.8 \times 10^{3}\, \Omega = 4.8\, k\Omega$ (1 Mark)

Therefore, the resistance of the resistor is $4.8\, k\Omega$.

5. A copper wire has diameter 2 mm and resistivity of $3.14 \times 10^{-7}\ \Omega\ m$. What will be the length of this wire to make its resistance $10\ \Omega$?
[3 Marks]

Solution:
Given,
Diameter, $d = 2\ mm = 0.002\ m$
Resistivity, $\rho = 3.14 \times 10^{-7}\ \Omega\ m$
Resistance, $R = 10\ \Omega$
[1 Mark]

We know that
$$R = \rho\frac{l}{A}$$
$$\therefore l = \frac{RA}{\rho}$$
Also,
Area of cross-section of the wire,
$$A = \pi\left(\frac{d}{2}\right)^2$$

$$\therefore l = \frac{R\pi\left(\frac{d}{2}\right)^2}{\rho}$$
$$= \frac{10\times3.14\times(\frac{0.002}{2})^2}{3.14\times10^{-7}}$$
$$= \frac{10\times3.14\times(0.001)^2}{3.14\times10^{-7}}$$
$$= \frac{10\times3.14\times(10)^{-6}}{3.14\times10^{-7}}$$
$$= \frac{10\times3.14\times10}{3.14} = 100\ m$$

$\therefore$ length of the wire = 100 m
[2 Marks]

6. A hot plate of an electric oven connected to a 220 V line has two resistance coils A and B, each of 24Ω resistances, which may be used separately, in series, or in parallel. What are the currents in the three cases?

[3 Marks]
[NCERT Exercise]
[Combination of resistors]

Solution:

Supply voltage, V = 220 V
Resistance of one coil, $R = 24\Omega$
(i) Coils are used separately
According to Ohm's law, $V = I_1 R_1$
Where, I_1 is the current flowing through the coil
$I_1 = \frac{V}{R_1} = \frac{220}{24} = 9.166A$
Therefore, 9.16 A current will flow through the coil when used separately.
[1 mark]

(ii) Coils are connected in series
Total resistance, $R_2 = 24\Omega + 24\Omega = 48\Omega$
According to Ohm's law, $V = I_1 R_2$
Where, I_2 is the current flowing through the series circuit
$I_2 = \frac{V}{R_2} = \frac{220}{48} = 4.58A$
Therefore, 4.58 A current will flow through the circuit when the coils are connected in series. [1 mark]

(iii) Coils are connected in parallel
Total resistance, $R_3 = \frac{1}{\frac{1}{24} + \frac{1}{24}} = \frac{24}{2} = 12\Omega$
According to Ohm's law, $V = I_3 R_3$
Where, I_3 is the current flowing through the circuit $I_3 = \frac{V}{R_3} = \frac{220}{12} = 18.33A$
Therefore, 18.33 A current will flow through the circuit when coils are connected in parallel. [1 mark]

7. 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 three appliances, and what is the current through it?
[3 Marks]
[Previous Year question : 2016]
[Combination of Resistors]

Solution:

Given information

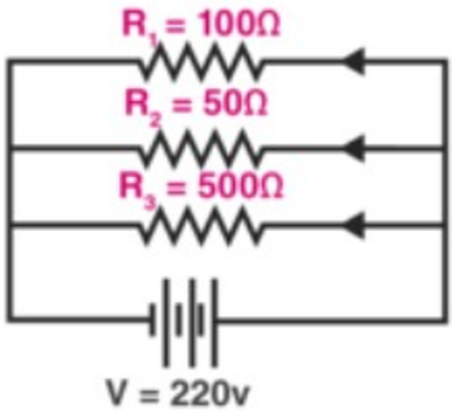
Resistance of electric lamp (R1) = 100 Ω

Resistance of toaster (R2) = 50 Ω

Resistance of water filter (R3) = 500 Ω

Potential difference of the source (V) = 220 V

[1 Mark]



Total resistance (R) can be calculated as:

1/R = 1/R1 + 1/R2 + 1/R3

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

R = 500 /16 Ω = 31.25 Ω [1 Mark]

According to the Ohm's law, V =IR

220 = I × 31.25 è I = 220 / 31.25 = 7.04 A [1 Mark]

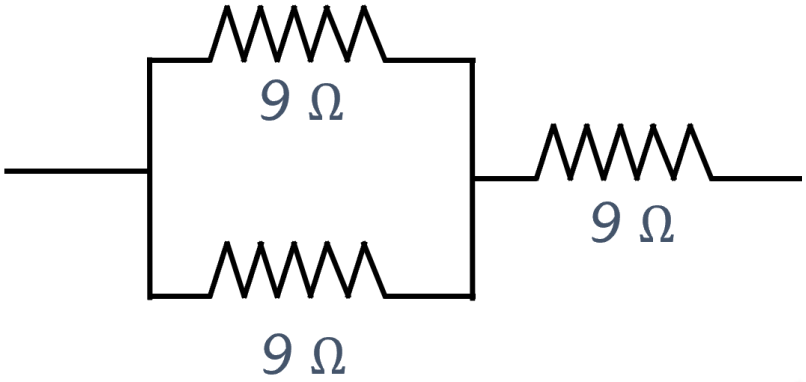
Therefore, the resistance is 31.25 Ω and the current is 7.04 A.

8. 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.
[2marks]
[Previous Year Question : 2015]
[Combination of Resistors]

Solution:

(i) To get an equivalent resistance of 13.5 Ω and 6 Ω, the resistances should be connected as shown in the figures:

For 13.5 Ω:



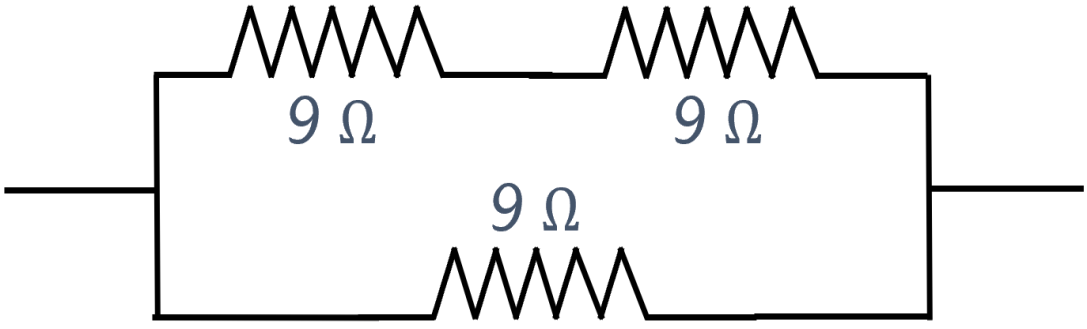
So, 1/RP = 1/R1 + 1/R2

= 1/9 + 1/9

= 2/9 è RP = 9/2 Ω = 4.5 Ω

RP + R3 = 9 Ω + 4.5 Ω = 13.5 Ω [1mark]

For 6 Ω:



Rs = 9+9 = 18 Ω

Now both the resistors are in parallel with each other so,

= 1/18 + 1/9

= 3/18

1/R = 1/6 Ω

R = 6 Ω [1mark]

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

[2 marks]

[NCERT Exercise]

[Heating effect of electric current]

Solution:
Energy consumed by an electrical appliance is given by the expression, H = Pt
Where power of the appliance = P and time = t
Energy consumed by a TV set of power 250 W in 1 h = $250 \times 3600 = 9 \times 10^5 J$
Energy consumed by a toaster of power 1200 W in 10 minutes = $1200 \times 600 = 7.2 \times 10^5 J$
Therefore, the energy consumed by a 250 W TV set in 1 h is more than the energy consumed by a toaster of power 1200 W in 10 minutes.
[2 marks]

10. Explain why is the tungsten used almost exclusively for filament of electric lamps?

[1 mark]

[NCERT Exercise]

[Resistivity]

Solution:
Tungsten is an alloy which has a very high melting point and very high resistivity so it does not burn or melt easily at a high temperature.
[1 mark]