Date: 25/9/2021

Q1. What does an electric circuit mean?

Q2. Define the unit of current.

Q3. Name a device that helps to maintain a potential difference across a conductor.

Q4. What is meant by saying that the potential difference between two points is 1 V?

Q5. How is a voltmeter connected in the circuit to measure the potential difference between two points?

Q6. 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 $\frac{R}{R'}$

(a) $\frac{1}{25}$ (b) $\frac{1}{5}$ (c) 5 (d) 25

Q7. Two conducting wires of the same material and of equal lengths and equal diameters are first connected in series and then parallel in a circuit across the same potential difference. The ratio of heat produced in series and parallel combinations would be:

(a) 1 : 2 (b) 2 : 1 (c) 1 : 4 (d) 4 : 1

Q8. What determines the rate at which energy is delivered by a current?

Q9. Which of the following terms does not represent electrical power in a circuit?

(a) I^2R (b) IR^2 (c) VI (d) $\frac{V^2}{R}$

Q10. An electric bulb is 220 V and 100 W. When it is operated on 110 V, the power consumed will be:

(a) 100 W (b) 75 W (c) 50 W (d) 25 W

Q11. Calculate the number of electrons constituting one coulomb of charge.

Q12. How much energy is given to each coulomb of charge passing through a 6 V battery?

Q13. Let the resistance of an electrical component remains 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?

Q14. 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.

Q15. On what factors does the resistance of conductor depend?

Q16. Will current flow more easily through a thick wire or a thin wire of the same material, when connected to the same source? Why?

Q17. Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal?

Q18. Use the data in Table 12.2 (NCERT textbook) to answer the following:

(a) Which among iron and mercury is a better conductor?

(b) Which material is the best conductor?

Q19. Why does the cord of an electric heater not glow while the heating element does?

Q20. A battery of 9 V is connected in series with resistors of 0.2 Ω, 0.3 Ω, 0.4 Ω, 0.5 Ω and 12 Ω respectively. How much current would flow through the 12 Ω resistor?

Q21. Draw a schematic diagram of a circuit consisting of a battery of three cells of 2 V each, a 5 Ω resistor, an 8 Ω resistor, and a 12 Ω resistor, and a plug key, all connected in series.

Q22. Compute the heat generated while transferring 96000 coulomb of charge in one hour through a potential difference of 50 V.

Q23. An electric iron of resistance 20 Ω takes a current of 5 A. Calculate the heat developed in 30 s.

Q24. An electric heater of resistance 8 Ω draws 15 A from the service mains for 2 hours. Calculate the rate at which heat is developed in the heater.

Q25. An electric motor takes 5 A from a 220 V line. Determine the power of the motor and the energy consumed in 2 h.

Q26. Which uses more energy, a 250 W TV set in 1 hour, or a 1200 W toaster in 10 minutes?

Q27. 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.

Q28. 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 is doubled?

Q29. Draw a schematic diagram of a circuit consisting of a battery of three cells of 2 V each, a 5 Ω resistor, an 8 Ω resistor, and a 12 Ω resistor, and a plug key, all connected in series, putting in an ammeter to measure the current through the resistors and a voltmeter to measure the potential difference across the 12 Ω resistor. What would be the readings in the ammeter and the voltmeter?

Q30. Judge the equivalent resistance when the following are connected in parallel:

(a) 1 Ω and 10^6 Ω (b) 1 Ω and 10^3 Ω and 10^6 Ω

Q31. 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?

Q32. What are the advantages of connecting electrical devices in parallel with the battery instead of connecting them in series?

Q33. 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?

Q34. What is (a) the highest, (b) the lowest total resistance that can be secured by combinations of four coils of resistances 4 Ω, 8 Ω, 12 Ω and 24 Ω?

Q35. How many 176 Ω resistors (in parallel) are required to carry 5 A on a 220 V line?

Q36. Show how you would connect three resistors, each of resistance 6 Ω, so that the combination has a resistance of (a) 9 Ω, (b) 4 Ω.

Q37. Compare the power used in the 2 Ω resistor in each of the following circuits: (a) a 6 V battery in series with 1 Ω and 2 Ω resistors, and (b) a 4 V battery in parallel with 12 Ω and 2 Ω resistors.

Q38. 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?

Q39. Two lamps, one rated 100 W at 220 V, and the other 60 W at 220 V, are connected in parallel to electric mains supply. What current is drawn from the line if the supply voltage is 220 V?

Q40. A hot plate of an electric oven connected to a 220 V line has two resistance coils A and B, each of 24 Ω resistance, which may be used separately, in series, or in parallel. What are the currents in the three cases?

Q41. Explain the following:

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

(b) Why are the conductors of electric heating devices, such as bread-toasters and electric irons, made of an alloy rather than a pure metal?

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

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

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

Date: 25/9/2021

S1. An electric circuit is a continuous and closed path for flow of an electric current. If the electric circuit is complete, electric current can flow through the circuit. If the circuit is broken anywhere or switch of the circuit is turned off, the current stops flowing.

S2. SI unit of electric current is 1 ampere. Current is said to be 1 ampere (1 A), if 1 coulomb charge flows per second across a cross-section of a conductor.

S3. Potential difference across a conductor can be maintained by means of a battery consisting of one or more cells.

S4. The potential difference between two points is said to be 1 volt, if 1 joule of work is to be done for moving a charge of 1 coulomb from one point to another.

S5. A voltmeter is always connected in parallel to the circuit across those two points, potential difference between which is to be measured.

S6. (d) 25.

[***Hint:*** When a wire of resistance R is cut in five equal parts, resistance of each part $R_1 = \frac{R}{5}\,\Omega$. Now, all these pieces are joined in parallel, hence

$$\frac{R}{R'} = \frac{1}{R_1} + \frac{1}{R_1} + \text{.... 5 times} = \frac{5}{R_1} \quad \text{or} \quad R' = \frac{R_1}{5} = \frac{1}{5} \times \frac{R}{5} = \frac{R}{25}$$

$$\therefore \qquad \frac{R}{R'} = \frac{R}{(R/25)} = 25.]$$

S7. **(c)** 1 : 4

[***Hint:*** As two conducting wires have equal lengths, equal diameters (*i.e.*, equal cross-section area) and are of the same material, their resistances are same. Thus, $R_1 = R_2 = R$ (say). In series arrangement, $R_s = R_1 + R_2 = 2R$ and in parallel arrangement

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{R} + \frac{1}{R} = \frac{2}{R} \quad \text{or} \quad R_p = \frac{R}{2}$$

When joined across a voltage source in series heat produced in time t

$$H_s = \frac{V^2}{R_s} \cdot t = \frac{V^2 t}{(2R)} = \frac{V^2 t}{2R}$$

and heat produced in parallel arrangement

$$H_p = \frac{V^2}{R_p} \cdot t = \frac{V^2 t}{\left(\frac{R}{2}\right)} = \frac{2V^2 t}{R}$$

$$\therefore \qquad \frac{H_s}{H_p} = \frac{\frac{V^2 t}{2R}}{\frac{2V^2 t}{R}} = \frac{1}{4} \quad \text{or} \quad H_s : H_p = 1 : 4]$$

S8. Electric power determines the rate at which energy is delivered by a current.

S9. **(b)** IR^2.

[***Hint:*** Electrical poweer $P = VI = I^2R = \frac{V^2}{R}$. However, IR^2 does not represent the power.]

S10. **(d)** 25 W.

[***Hint:*** As rating of bulb is 220 V, 100 W, here $P = VI = \frac{V^2}{R}$.

$\therefore$ Resistance of bulb filament $R = \frac{V^2}{P} = \frac{220 \times 220}{100} = 484\,\Omega$.

When the bulb is operated at a voltage $V' = 110$ V, the power consumed is

$$P' = \frac{V'^2}{P} = \frac{110 \times 110}{484} = 25\text{ W.}]$$

S11. We know that value of charge on an electron $e = 1.6 \times 10^{-19}$ C.

$\therefore$ Number of electrons constituting 1 C of charge

$$n = \frac{Q}{e} = \frac{1\text{C}}{1.6 \times 10^{-19}\text{ C}} = 6.25 \times 10^{18}.$$

S12. Given that potential difference V = 6 V

Charge Q = 1 C

$\therefore$ Energy given = Total work done W = Q . V = 1 C × 6 V = 6 J.

S13. It is given that resistance R of the electrical component remains constant but the potential difference across the two ends of the component decreases to half of its value *i.e.*, $V' = \frac{V}{2}$.

Hence, as per Ohm's law new current $I' = \frac{V'}{R} = \frac{V/2}{R} = \frac{V}{2R} = \frac{I}{2}$.

So, the new current also decreases to half of its original value.

S14. Given that voltage of baterry $V = 12$ V

Circuit $I = 2.5$ mA $= 2.5 \times 10^{-3}$ A

$\therefore$ Value of resistance $R = \frac{V}{I} = \frac{12}{2.5 \times 10^{3}} = 4800\,\Omega = 4.8 \times 10^3\,\Omega = 4.8\,\text{k}\Omega$.

S15. The resistance of a conductor depends on (i) its length, (ii) its area of cross-section, and (iii) the nature of the material of the conductor.

In fact, resistance of a conductor is directly proportional to its length ($R \propto L$) and is inversely proportional to its cross-section area $\left(R \propto \frac{1}{A}\right)$. Thus,

$$R \propto \frac{L}{A}, \quad R = \frac{\rho \cdot L}{A},$$

where ρ is a constant indicating the nature of the material of conductor and is known as the resistivity of material of conductor.

S16. The current flow more easily through a thick wire as compared to a thin wire of the same material, when connected to the same source. It is due to the reason that resistance of a thick wire is less than that of a thin wire.

S17. Coils of electric toasters and electric irons are made of an alloy (generally nichrome) due to the following two reasons:

(a) Resistivity of an alloy is generally higher than that of pure metals, hence for a given resistance we need a coil of lesser length.

(b) At high temperature, an alloy does not oxidise (burn) readily. Hence, coil of an alloy has longer life.

S18. (a) Iron is a better conductor than mercurry because resistivity of iron is less than that of mercury.

(b) Silver is the best conductor because its resistivity is the least.

S19. Cord and the electric heater are joined in series and carry same current when joined to voltage source. As resistance of cord is extremely smal as compared to that of heater element, hence heat produced $H = I^2Rt$ is extremely small in cord but much larger in heater element. So, the heating element begins to glow but cord does not glow.

S20. Here potential difference $V = 9\,\text{V}$

Resistance joined in series are $R_1 = 0.2\,\Omega$, $R_2 = 0.3\,\Omega$, $R_3 = 0.4\,\Omega$, $R_4 = 0.5\,\Omega$ and $R_5 = 12\,\Omega$

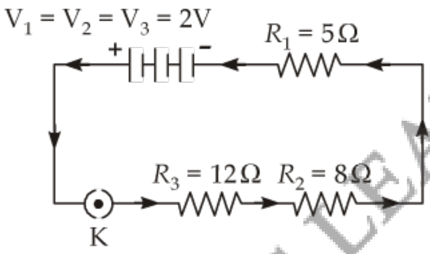
$\therefore$ Total series resistance $R_s = R_1 + R_2 + R_3 + R_4 + R_5$

$$= 0.2 + 0.3 + 0.4 + 0.5 + 12 = 13.4\,\Omega$$

$\therefore$ Current in the circuit $I = \dfrac{V}{R_s} = \dfrac{9\,\text{V}}{13.4\,\Omega} = 0.67$ A.

In a series circuit same current flows through all the resistances, hence current of 0.67 A will flow through $12\,\Omega$ resistor.

S21. The schematic diagram of the circuit is shown in following figure.



S22. Here charge transferred $Q = 96000\,\text{C}$, $t = 1$ hour $= 60 \times 60\,\text{s} = 3600\,\text{s}$ and potential difference $V = 50\,\text{V}$.

$\therefore$ Heat generated $H = VIt = V.Q = 50 \times 96000 = 4800000\,\text{J}$

$$= 4.8 \times 10^6\,\text{J}.$$

S23. It is given that resistance of electric iron $R = 20\,\Omega$, current drawn by electric iron $I = 5$ A and time $t = 30\,\text{s}$.

S24. Given that resistance of electric heater $R = 8\,\Omega$

Current drawn by heater $I = 15$ A

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

$$= (15)^2 \times 8 = 1800\,\text{W}.$$

S25. It is given that current drawn by electric motor $I = 5$ A, the line voltage $V = 220\,\text{V}$ and time $t = 2\,\text{h}$.

$\therefore$ Power of the motor $P = VI = 220\,\text{V}\ \ 5\,\text{A} = 1100\,\text{W}$

and the energy consumed $E = Pt = 1100\,\text{W} \times 2\,\text{h} = 2200\,\text{W h}$ or $2.2\,\text{kW h}$.

S26. Energy used by a TV set of power $P_1 = 250\,\text{W}$ in time $t_1 = 1\,\text{h}$

$$E_1 = P_1 t_1 = 250\,\text{W} \times 1\,\text{h} = 250\,\text{Wh}$$

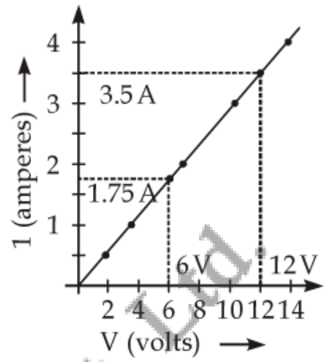
and energy used by a toaster of power $P_2 = 120$ W in time $t_2 = 10$ min $= \frac{10}{60}\,\text{h} = \frac{1}{6}\,\text{h}$

$$E_2 = \text{P}_2 t = 1200\,\text{W} \times \frac{1}{6}\,\text{h} = 200\ \text{Wh}$$

Thus, it is evident that TV set has used more energy.

S27. From the given data the *I-V* graph has been plotted, which is a straight line as shown in figure.

To find resistance of the given resistor we take two points *A* and *B* on the graph, then



$$\text{Resistance of resistor } R = \frac{V_A - V_B}{I_A - I_B}$$

$$= \frac{12V - 6V}{3.6A - 1.8A}$$

$$= \frac{6V}{1.8A} = 3.3\,\Omega.$$

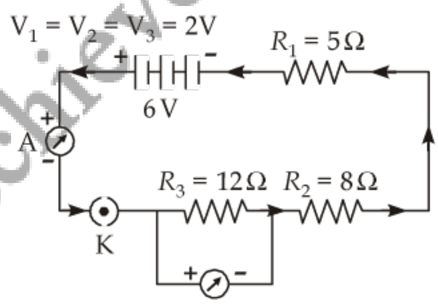
S28. It is given that diameter of wire $D = 0.5\,\text{mm} = 5 \times 10^{-4}\,\text{m}$, resistivity $\rho = 1.6 \times 10^{-8}\,\Omega\,\text{m}$ and resistance $R = 10\,\Omega$.

As $$R = \frac{\rho L}{A} = \frac{4\rho L}{\pi D^2}, \quad \text{hence} \quad L = \frac{\pi D^2 R}{4\rho}$$

∴ Length of wire $$L = \frac{22 \times (5 \times 10^{-4})^2 \times 10}{7 \times 4 \times 1.6 \times 10^{-8}} = 122.5\,\text{m}$$

If the diameter of wire is doubled $D' = 2D$ and hence, $A' = \frac{\pi D'^2}{4} = \frac{\pi}{4}(2D^2) = 4 \times \frac{\pi D^2}{4} = 4A$.

S29. The redrawn circuit is shown in figure. Here, ammeter A has been joined in series of the circuit and voltmeter *V* is joined in parallel to $12\,\Omega$ resistor.



Here total voltage of battery $V = 3 \times 2\,\text{V} = 6\,\text{V}$

Total resistance of series arrangement

$$R = R_1 + R_2 + R_3$$
$$= 5 + 8 + 12 = 25\,\Omega$$

∴ Ammeter reading = current flowing in the circuit

$$I = \frac{V}{R} = \frac{6\,\text{V}}{25\,\Omega} = 0.24\,\text{A}$$

∴ Voltmeter reading = Potential difference across $12\,\Omega$ resistor

$$V' = IR_3 = 0.24 \times 12 = 2.88\,\text{V}.$$

S30. When resistances R_1, R_2, R_3, ... are joined in parallel arrangement R_p is given by

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$$

(a) When $R_1 = 1\,\Omega$ and $R_2 = 10^6\,\Omega$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ... = 1 + 10^{-6} = 1$$

$\Rightarrow$ $R_p = 1\,\Omega.$

(b) When $R_1 = 1\,\Omega$, $R_2 = 10^3\,\Omega$ and $R_3 = 10^6\,\Omega$

$$\frac{1}{R_p} = \frac{1}{1} + \frac{1}{10^3} + \frac{1}{10^6} = 1 + 10^{-3} + 10^{-6} = 1$$

$\therefore$ $R_p = 1\,\Omega.$

S31. Here, voltage of given voltage source $V = 220\,\text{V}$.

As three gadgets of resistances $R_1 = 100\,\Omega$, $R_2 = 50\,\Omega$ and $R_3 = 500\,\Omega$ have been connected in parallel across the voltage source, hence their equivalent resistance R_p is given by

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

$\Rightarrow$ $R_p = \frac{500}{16}\,\Omega = 31.25\,\Omega.$

$\therefore$ Resistance of electric iron, which draws as much current as all three appliances (lamp, toaster and water filter) taken together $= R = R_p = 31.25\,\Omega$.

Current passing through electric iron $I = \frac{V}{R} = \frac{220\,\text{V}}{31.25\,\Omega} = 7.04\,\text{A}$.

S32. Advantages of connecting electrical devices in parallel with the battery are as follows:

(a) Voltages across each electrical device is same and the device can take current as per its resistance.

(b) Separate on/off switches can be applied across each device.

(c) Total resistance in parallel circuit decreases, hence, a greater current may be drawn from the cell.

(d) If one electrical device is damaged, then other devices continue to work properly.

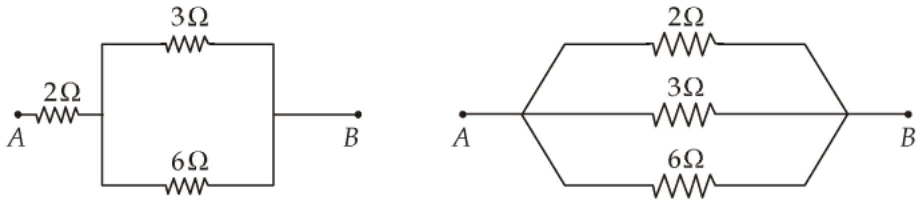
S33. (a) If we connect resistances of 3 Ω and 6 Ω in parallel and then resistance of 2 Ω is connected in series of the combination, the total resistance of combination is 4 Ω as shown in figure (a). If combined resistance of the parallel grouping of 3 Ω and 6 Ω resistances be R', then

$$\frac{1}{R'} = \frac{1}{3}+\frac{1}{6}=\frac{2+1}{6}=\frac{3}{6}=\frac{1}{2}$$

$\Rightarrow$ $R' = 2\,\Omega,$

and total resistance of entire combination

$$R = 2 + R' = 2 + 2 = 4\,\Omega.$$



(a) **(b)**

(b) If all the three resistances are joined in parallel as shown in figure (b), we have

$$\frac{1}{R} = \frac{1}{2}+\frac{1}{3}+\frac{1}{6}=\frac{3+2+1}{6}=\frac{6}{6}=1$$

$\Rightarrow$ $R = 1\,\Omega.$

S34. (a) To obtain highest resistance, all the four resistances must be connected in series arrangement. In that case resultant resistance R_s is given by:

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

(b) To obtain lowest resistance, all the four resistances must be connected in parallel arrangement. In that case the resultant resistance R_p is given by:

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

$\Rightarrow$ $R_p = \frac{24}{12}\,\Omega = 2\,\Omega.$

S35. Let n resistors of 176 Ω are joined in parallel. Then their combined resistance R_p is given by

$$\frac{1}{R_p} = \frac{1}{176}+\frac{1}{176}\ldots n \text{ times} = \frac{n}{176} \quad or \quad R_p = \frac{176}{n}\,\Omega$$

It is given that $V = 220\,\text{V}$ and $I = 5\,\text{A}.$

$\therefore$ $R_p = \frac{V}{I}$ or $\frac{176}{n}=\frac{220}{5}=44$

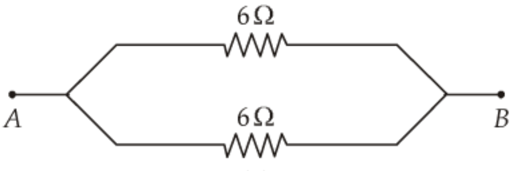
$\Rightarrow$ $n = \frac{176}{44} = 4$ *i.e.*, 4 resistors should be joined in parallel.

S36. It is given here that $R_1 = R_2 = R_3 = 6\,\Omega$.

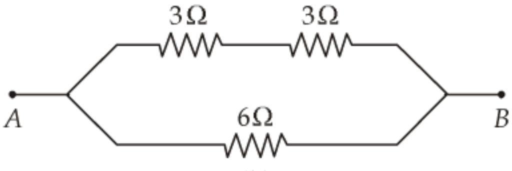
(a) To get a net resistance of $9\,\Omega$ we join three resistances as shown in figure (a). Here resistance of parallel combination of two $6\,\Omega$ resistors is

$$\frac{1}{R'} = \frac{1}{6}+\frac{1}{6}=\frac{2}{6}=\frac{1}{3} \Rightarrow R' = 3\Omega$$

$\therefore$ Net resistance = $R' + 6 = 3 + 6 = 9$



(a)



(b)

(b) To get a net resistance of $4\,\Omega$ we join three resistances as shown in figure (b). Here the combination of two resistors in series, having a combined resistance $R_0 = 6 + 6 = 12\,\Omega$, is joined in parallel with the third resistance of $6\,\Omega$. Hence, the net resistance will be

$$\frac{1}{R} = \frac{1}{12}+\frac{1}{6}=\frac{1+2}{12}=\frac{3}{12}=\frac{1}{4} \Rightarrow R = 4\Omega.$$

S37. (a) When a $2\,\Omega$ resistor is joined to a 6 V battery in series with $1\,\Omega$ and $2\,\Omega$ resistors, total resistance of the combination

$$R_s = 2 + 1 + 2 = 5$$

$\therefore$ Current in the circuit $I_1 = \dfrac{6\text{ V}}{5\Omega} = 1.2\text{ A}$

$\therefore$ Power used in the $2\,\Omega$ resistor $P_1 = I_1^2 R = (1.2)^2 \times 2 = 2.88\text{ W}$.

(b) When $2\,\Omega$ resistor is joined to a 4 V battery in parallel with $12\,\Omega$ and $2\,\Omega$ resistors, current flowing in $2\,\Omega$ resistor is independent of the other resistors.

$\therefore$ Current flowing through $2\,\Omega$ resistor $I_2 = \dfrac{4\text{ V}}{2\Omega} = 2\text{ A}$

$\therefore$ Power used in the $2\,\Omega$ resistor $P_2 = I_2^2 R = (2)^2 \times 2 = 8\text{ W}$

$$\therefore \quad \frac{P_1}{P_2} = \frac{2.88\text{ W}}{8\text{ W}} = 0.36 : 1.$$

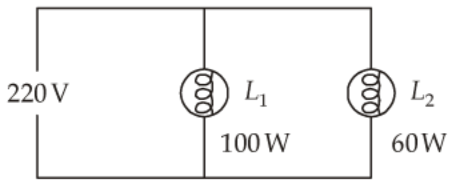
S38. As each bulb is rated as 10 W, it draws a current

$$I = \frac{P}{V} = \frac{10\text{ W}}{220\text{ V}} = \frac{1}{22}\text{ A}.$$

As the maximum allowable current is Imax = 5 A and all lamps are connected in parallel, hence, maximum number of bulbs joined in parallel with each other

$$n = \frac{I_{\max}}{I} = \frac{5\text{ A}}{\frac{1}{22}\text{ A}} = 5 \times 22 = 110.$$

S39. Current drawn by 1st lamp rated 100 W at 220 V



$$I_1 = \frac{P_1}{V} = \frac{100}{220} = \frac{5}{11}\text{ A}$$

and current drawn by 2nd lamp rated 60 W at 220 V

$$I_2 = \frac{P_2}{V} = \frac{60}{220} = \frac{3}{11}\text{ A}$$

In parallel arrangement the total current $I = I_1 + I_2 = \dfrac{5}{11} + \dfrac{3}{11} = \dfrac{8}{11}\text{ A} = 0.73\text{ A}$.

S40. It is given that potential difference $V = 220\,\text{V}$.

Resistance of coil A (R_A) = Resistance of coil B (R_B) = $24\,\Omega$

(a) When either coil A or B is used separately, the current

$$I = \frac{V}{R_A} = \frac{V}{R_B} = \frac{220\,\text{V}}{24\,\Omega} = 9.2\,\text{A}$$

(b) When the two coils are used in series, total resistance

$$R_S = R_A + R_B = 24 + 24 = 48\,\Omega$$

$\therefore$ Current flowing $I = \dfrac{V}{R_S} = \dfrac{220\,\text{V}}{48\,\Omega} = 4.6\,\text{A}.$

(c) When the two coils are used in parallel, total resistance R_p is given by

$$\frac{1}{R_p} = \frac{1}{R_A} + \frac{1}{R_B} = \frac{1}{24} + \frac{1}{24} = \frac{2}{24} = \frac{1}{12}$$

$\Rightarrow$ $R_p = 12\,\Omega$

$\therefore$ Current flowing $I = \dfrac{V}{R_p} = \dfrac{220\,\text{V}}{12\,\Omega} = 18.3\,\text{A}.$

S41. (a) For filament of electric lamp we require a strong metal with high melting point. Tungsten is used exclusively for filament of electric lamps because its melting point is extremely high (3380° C).

(b) Conductors of electric heating devices are made of an alloy rather than a pure metal due to the following reasons:

(i) Resistivity of an alloy is generally higher than that of pure metals, hence for a given resistance we need a conductor of less length.

(ii) At high temperatures, an alloy does not oxidise (burn) readily. Hence, heating element prepared from an alloy has longer life.

(c) Series arrangement is not used for domestic circuits due to the following reasons:

(i) In series arrangement same current will flow through all the appliances, which is not required.

(ii) Total resistance of domestic circuit will be sum of the resistances of all appliances and hence current drawn by the circuit will be less.

(iii) We cannot use independent on/off switches with individual appliances.

(iv) All appliances are to be used simultaneously even if we do not need them.

(d) Resistance (R) of a wire is inversely proportional to its cross-section area (A). Thus:

$$R \propto \frac{1}{\text{A}}.$$

(e) Copper and aluminium wires are usually employed for electricity transmission because these are extremely good conductors having a low value of resistivity. Moreover, these are ductile and can be drawn in the form of fine wires.