Section A

● **Write the answer of the following questions. [Each carries 1 Mark]** **[20]**

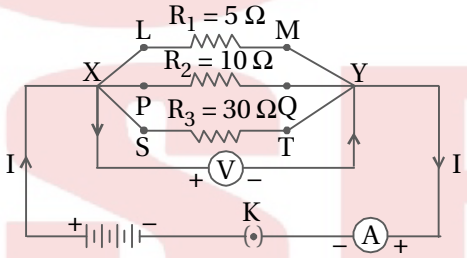
1. How much number of electrons in 1.6 C.
2. If an electric current of 4.8 A passes through a electric appliance, then the number of electrons passing through it per second will be ..... .
3. $\frac{\text{coloumb}}{\text{second}}$ = ...
4. ..... is a unit of electric energy.
5. The minimum equivalent resistance of 5 resistors each having resistance of $\frac{1}{5}\,\Omega$ is ..... .
6. An ammeter is connected in series with the component of circuit for measurement of current.
7. In circuit current and electric resistance are proportional to each other.
8. Three bulbs of 100 W, 60 W and 40 W are arranged in decreasing order as R_{100}, R_{60} and R_{40}.
9. Watt hour is a unit of power.
10. There should be low resistance of voltmeter and high resistance of ammeter.
11. Which one of the following substance has the most free electrons ?
    (A) Copper (B) Glass (C) Rubber (D) Iron
12. Which one of the following formula indicate the voltage ?
    (A) $\frac{\text{work}}{\text{current} \times \text{time}}$ (B) $\frac{\text{work} \times \text{time}}{\text{current}}$
    (C) work × charge (D) work × charge × time
13. Equivalent resistance between the points X and Y in the given circuit is ..... Ω.

    (A) 2

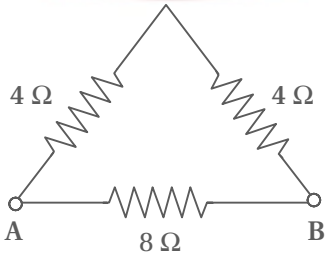
    (B) 3

    (C) 10

    (D) 30

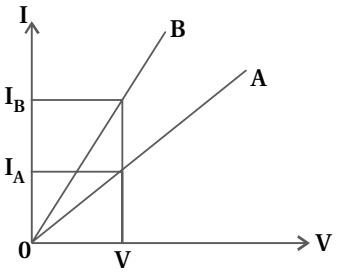


14. What is the total resistance between point A and point B for a given below circuit ?
    (A) 4 Ω
    (B) 8 Ω
    (C) 2 Ω
    (D) 16 Ω



15. Which of the following is the correct symbol of rheostat ?
    (A)  (B)  (C)  (D) A and B both
16. A graph of current verses electric potential is shown for conductor A and B. Which one has more

resistance ?



17. In what direction the direction of unidirectional current is taken ?

18. Write the relation between watt, volt and ampere.

19. If the potential difference across a resistor is doubled, then what is the effect on current passing through it ?

20. Give the resistance of an ideal ammeter.

Section B

● **Write the answer of the following questions.** [Each carries 2 Marks] **[24]**

21. 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 ? Using Table 12.2, predict the material of the wire.

22. An electric refrigerator rated 400 W operates 8 hour/day. What is the cost of the energy to operate it for 30 days at ₹ 3.00 per kWh ?

23. What is called watt hour and define kilowatt ?

24. Define the unit of potential difference volt and by which instrument it can be measured ?

25. A current of 0.5 A is drawn by a filament of an electric bulb for 10 minutes. Find the amount of electric charge that flows through the circuit.

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

27. 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 ?

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

29. 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 ?

30. 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.

31. When 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.

32. 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 ?

Section C

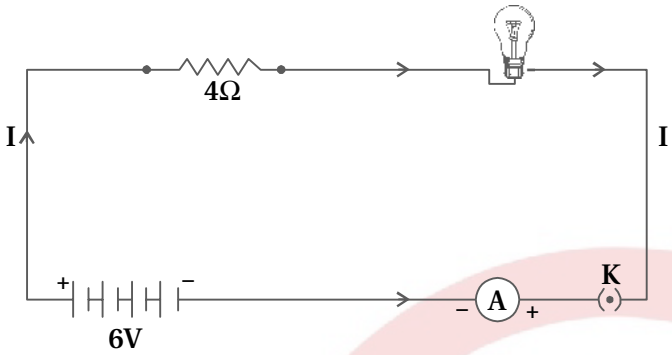
● **Write the answer of the following questions.** [Each carries 3 Marks] **[12]**

33. Write the useful practical application of heating effect of electric current.

34. Draw a diagram of an electric circuit and name the instrument for measurement of electric current.

35. 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 ?

36. An electric lamp, whose resistance is 20 Ω and a conductor of 4 Ω resistance are connected to a 6 V battery, see Figure. Calculate (a) the total resistance of the circuit. (b) the current through the circuit and (c) the potential difference across the electric lamp and conductor.

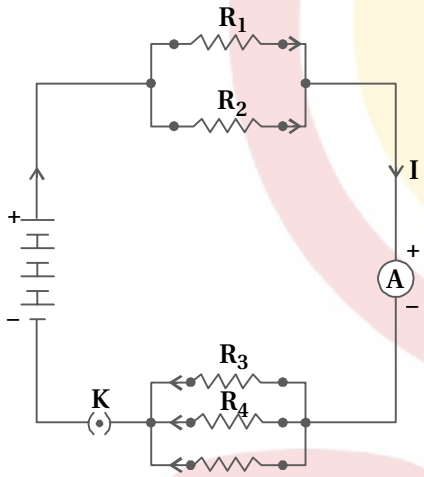


An electric lamp connected in series with a resistor of 4 Ω to a 6 V battery

Section D

● **Write the answer of the following questions. [Each carries 4 Marks]** **[4]**

37. If in Fig. R_1 = 10 Ω, R_2 = 40 Ω, R_3 = 30 Ω, R_4 = 20 Ω, R_5 = 60 Ω and a 12 V battery is connected to the arrangement. Calculate (a) the total resistance in the circuit and (b) the total current flowing in the circuit.



An electric circuit showing the combination of series and parallel resistors

CHAPTER:11

OPEN STUDENT FOUNDATION
STD 10 : SCIENCE
IMPORTANT QUESTION DAY 11

Date : 28/02/24

Section A

● **Write the answer of the following questions.** [Each carries 1 Mark] **[20]**

1. How much number of electrons in 1.6 C.

➠ 10^{19} electron

1 C = 6.25×10^{18} electron then

1.6 C = (?)

$6.25 \times 10^{18} \times 1.6 = 10 \times 10^{18} = 10^{19}$ electron

2. If an electric current of 4.8 A passes through a electric appliance, then the number of electrons passing through it per second will be ..... .

➠ 3×10^{19} electron

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

$$\therefore n = \frac{It}{e} = \frac{4.8 \times 1}{1.6 \times 10^{-19}}$$

$\therefore n = 3 \times 10^{19}$ electron

3. $\frac{\text{coloumb}}{\text{second}}$ = ...

➠ ampere

4. ..... is a unit of electric energy.

➠ joule

5. The minimum equivalent resistance of 5 resistors each having resistance of $\frac{1}{5}\,\Omega$ is ..... .

➠ $\frac{1}{25}\,\Omega$

$$R_P = \frac{R}{n} = \frac{1/5}{5} = \frac{1}{25}\,\Omega$$

6. An ammeter is connected in series with the component of circuit for measurement of current.

➠ True

7. In circuit current and electric resistance are proportional to each other.

➠ False

8. Three bulbs of 100 W, 60 W and 40 W are arranged in decreasing order as R_{100}, R_{60} and R_{40}.

➠ False

9. Watt hour is a unit of power.

➠ Ans : (A)

10. There should be low resistance of voltmeter and high resistance of ammeter.

➠ False

11. Which one of the following substance has the most free electrons ?

(A) Copper (B) Glass (C) Rubber (D) Iron

Ans. (A) Copper

12. Which one of the following formula indicate the voltage ?

(A) $\frac{\text{work}}{\text{current} \times \text{time}}$ (B) $\frac{\text{work} \times \text{time}}{\text{current}}$

(C) work × charge (D) work × charge × time

Ans. (A) $\frac{\text{work}}{\text{current} \times \text{time}}$

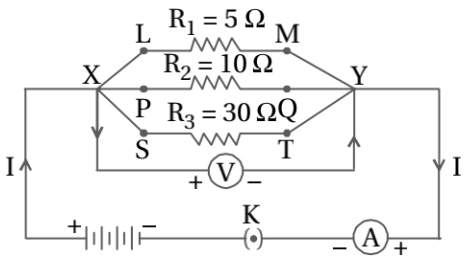
13. Equivalent resistance between the points X and Y in the given circuit is ..... Ω.

(A) 2

(B) 3

(C) 10

(D) 30



Ans. (B) 3

➠ Equivalent resistance when connected in parallel

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

$$= \frac{1}{5} + \frac{1}{10} + \frac{1}{30}$$

$$= \frac{6+3+1}{30} = \frac{10}{30}$$

$\therefore R_p = 3\ \Omega$

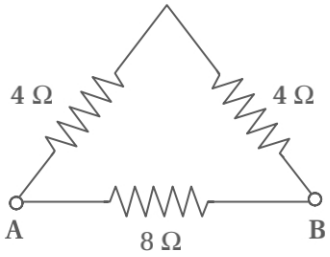
14. What is the total resistance between point A and point B for a given below circuit ?

(A) 4 Ω

(B) 8 Ω

(C) 2 Ω

(D) 16 Ω



Ans. (A) 4 Ω

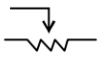
➠ Total resistance

$$\therefore \frac{1}{R_{AB}} = \frac{1}{8} + \frac{1}{4+4}$$

$$\therefore \frac{1}{R_{AB}} = \frac{2}{8}$$

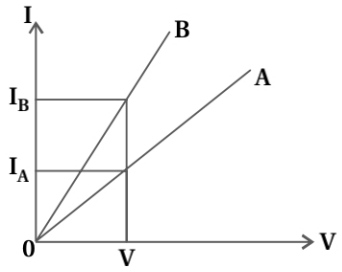
$\therefore R_{AB} = 4\ \Omega$

15. Which of the following is the correct symbol of rheostat ?

(A)  (B)  (C)  (D) A and B both

Ans. (D) A and B both

16. A graph of current verses electric potential is shown for conductor A and B. Which one has more resistance ?



➠ Resistance of A, $R_A = \frac{V}{I_A}$

Resistance of B, $R_B = \frac{V}{I_B}$

But $I_A < I_B$ hence $R_A > R_B$

17. In what direction the direction of unidirectional current is taken ?

➠ In the direction of motion of positive charge OR in opposite direction of flow of electrons.

18. Write the relation between watt, volt and ampere.

➠ $P = VI$

$\therefore$ Watt = volt × ampere

19. If the potential difference across a resistor is doubled, then what is the effect on current passing through it ?

➠ In $V = IR$, R is same

$\therefore V \propto I$, hence if V becomes double, I also becomes double.

20. Give the resistance of an ideal ammeter.

➠ An ideal ammeter has a zero resistance.

Section B

● **Write the answer of the following questions.** [Each carries 2 Marks] **[24]**

21. 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 ? Using Table 12.2, predict the material of the wire.

➠ Here R = 26 Ω, Diameter d = 0.3 mm = 3×10^{-4} m, Length of wire l = 1 m

$$\text{Now } \rho = \frac{RA}{l} = \frac{R\pi d^2}{4l} = \frac{26 \times \pi^2}{4l} \qquad [\because A = \pi r^2]$$

$$= \frac{26 \times 3.14 \times (3 \times 10^{-4})^2}{4\,(1)} = 183.69 \times 10^{-8}$$

$$\approx 1.84 \times 10^{-6}\ \Omega\ \text{m}$$

➠ The reisitivity of the metal at 20 °C is 1.84×10^{-6} Ω m. From Table 12.2, we see that this is the resistivity of manganese.

22. An electric refrigerator rated 400 W operates 8 hour/day. What is the cost of the energy to operate it for 30 days at ₹ 3.00 per kWh ?

➠ Power P = 400 W, t = 8 hour, n days = 30 days, cost = ₹ 3

➠ Total electric energy used by refrigerator in 30 days

$W = Ptn$

= 400 W × 8 hour × 30 days

= 96000 W h = 96 kW h

➠ Cost of 1 unit = ₹ 3

then cost of 96 unit = (?)

$$\frac{3 \times 96}{1} = ₹\ 288$$

23. What is called watt hour and define kilowatt ?

➠ One watt hour is the energy consumed when 1 watt of power is used for 1 hour.

➠ The practical unit of electric energy is kilowatt hour (kWh).

➠ **Definition of 1 kWh** : The energy consumed by power consumption of 1 kWh during 1 hour.

➠ The electric energy consumption of 1 kWh is called **1 unit**.

∴ 1 unit = 1 kWh = 1000 watt × 3600 second

= 3.6×10^6 watt second = 3.6×10^6 Joule

24. Define the unit of potential difference volt and by which instrument it can be measured ?

➠ One volt is the potential difference between two points in a current carrying conductor when 1 joule of work is done to move a charge of 1 coulomb from one point to the other.

$$\therefore\ 1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}}$$

∴ 1 V = 1 J C^{-1}

➠ Potential difference is measured by means of an instrument called the voltmeter. The voltmeter is always connected in parallel across the points between which the potential difference is to be measured.

25. A current of 0.5 A is drawn by a filament of an electric bulb for 10 minutes. Find the amount of electric charge that flows through the circuit.

➠ Here, I = 0.5 A, t = 10 min = 600 s

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

∴ Q = It = 0.5 A × 600 s = 300 C

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

➠ Here resistance of heater R = 8 Ω, current I = 15 A,

Rate of energy in heater P = I^2R

= $(15)^2 \times 8$

= 225 × 8

= 1800 W

27. 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 ?

➠ Here P_1 = 100 W

P_2 = 60 W

P = P_1 + P_2 = 100 + 60 = 160 W

V = 220 V

$\therefore I = \frac{P}{V} = \frac{160}{220} = 0.73$ A

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

➠ (i) $V = 6$ V

$R_1 = 1\ \Omega$, $R_2 = 2\ \Omega$,

The equivalent resistance of series combination R_1 and R_2 is

$R_s = R_1 + R_2 = 1 + 2 = 3\ \Omega$

➠ Current in the circuit $I = \frac{V}{R_s}$

$$I = \frac{6}{3} = 2 \text{ A}$$

$\therefore$ Power $P = I^2R_s = (2)^2 \times 3 = 4 \times 3 = 12$ W

(ii) $R_1 = 12$ V, $R_2 = 2\ \Omega$, $V = 4$ V

Voltage is same in parallel connection

$\therefore$ Current in 2 Ω resistance $I_1 = \frac{V}{R_2} = \frac{4V}{2\Omega} = 2$ A

$\therefore$ Electric power in 2 Ω resistance $P_2 = I^2_1\ R_2$

$= (2)^2 \times 2$

$= 8$ W

29. 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 ?

➠ Here, $P = 10$ W, No. of bulbs = n

$V = 220$ V

Now, $I = \frac{P}{V} = \frac{10}{220} = \frac{1}{22}$ A

If n bulbs of 5 A current connected then

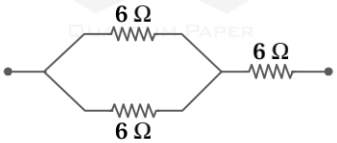
$I = \frac{1}{22}$ A

$5 = \frac{1}{22}\ n$

$\therefore n = 110$ bulbs

30. 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.

➠ (i) For getting 9 Ω resistance : Two resistances each of 6 Ω connecting parallel and then third resistance of 6 Ω connect with it in series.



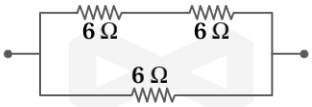
$\therefore \frac{1}{R_P} = \frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3}$

$\therefore \quad R_P = 3\ \Omega$

Now, $R_{total} = R_P + 6$

$= 3 + 6 = 9\ W$

➠ (ii) For getting 4 Ω : Two resistance each of 6 Ω connecting in series then third resistance of 6 Ω connect with it in parallel.



$\therefore \quad R_S = 6 + 6 = 12\ \Omega$

Now equivalent resistance R_{total} of parallel connection of R_S and 6 Ω.

$$\therefore \quad \frac{1}{R_{total}} = \frac{1}{R_S} + \frac{1}{6} = \frac{1}{12} + \frac{1}{6}$$

$$= \frac{1+2}{12} = \frac{3}{12} = \frac{1}{4}$$

$\therefore \quad R_{total} = 4\ \Omega$

31. When 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.

➠ Here, $V = 12\ V$

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

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

32. 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 ?

➠ Here diameter of wire $D = 0.5\ mm = 5 \times 10^{-4}\ m$

$\therefore$ Radius of wire $r = 2.5 \times 10^{-4}\ m$

Resistivity $\rho = 1.6 \times 10^{-8}\ \Omega\ m$

Resistance $R = 10\ \Omega$

Length l = ?

➠ Resistance $R = \frac{\rho l}{A}$

$$\therefore \quad l = \frac{R \times \pi r^2}{\rho} \qquad [\because A = \pi r^2]$$

$$= \frac{10 \times 3.14 \times (2.5 \times 10^{-4})^2}{1.6 \times 10^{-8}} = 122.65\ m$$

$\therefore \quad l \approx 122.7$ must have length of wire

➠ Now, $R = \frac{\rho l}{\frac{\pi D^2}{4}}$

$\therefore$ In $R = \frac{4\rho l}{\pi D^2}$

$\therefore R \propto \frac{1}{D^2}$ where $\frac{4\rho l}{\pi}$ is constant

$\therefore \frac{R_2}{R_1} = \left(\frac{D_1}{D_2}\right)^2$

$\therefore R_2 = R_1 \times \left(\frac{1}{2}\right)^2$

$\therefore R_2 = 10 \times \frac{1}{4}$

$\therefore R_2 = \frac{10}{4}\ \Omega$

➠ If the diameter is doubled, then the resistance becomes one-fourth of its original value.

Section C

● **Write the answer of the following questions.** [Each carries 3 Marks] **[12]**

33. Write the useful practical application of heating effect of electric current.

➠ The generation of heat in a conductor is an inevitable consequence of electric current. In many cases, it is undesirable as it converts useful electric energy into heat because electric energy obtained by charges dissipated into heat energy is called ohmic loss or ohmic losses.

➠ Heat produced in the circuit can increase the temperature of the components and alter their properties.

➠ Heating effect of electric current has many useful applications like electric iron, electric toaster, electric oven, electric kettle and electric heater etc.

➠ The electric heating is also used to produce light as in an electric bulb. Here, the filament must retain as much as of the heat generated as possible, so that it gets very hot and emits light. For filament of bulb tungsten metal (melting point 3380 °C) is used.

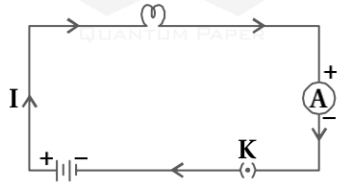
➠ The filament should be thermally isolated, by using insulating support.

➠ Moreover, the bulbs are filled with chemically inactive nitrogen and argon gases to prolong the life of filament.

➠ Most of the power consumed by the filament appears as heat, but a small part of it is in the form of light radiated.

34. Draw a diagram of an electric circuit and name the instrument for measurement of electric current.

➠ Figure shows the schematic diagram of a typical electric circuit containing a cell, an electric bulb, an ammeter and a plug key.



A schematic diagram of an electric circuit comprising – cell, electric bulb, ammeter and plug key

➠ Instrument which measure current in the circuit is known as ammeter.

➠ It is always connected in series with circuit through which the current is to be measured.

➠ The electric current flows in the circuit from the positive terminal of the cell to the negative terminal of the cell through the bulb and ammeter.

35. 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 ?

➠ Here V = 220 V, R_A = 24 Ω, R_B = 24 Ω

➠ (i) Current in plates when used separately,

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

(ii) When both resistors connected in series

$$I = \frac{V}{R_A + R_B} = \frac{220}{24 + 24}$$

$$I = \frac{220}{48}$$

$$I = 4.6 \text{ A}$$

(iii) When both resistors connected in parallel, the equivalent resistance in parallel

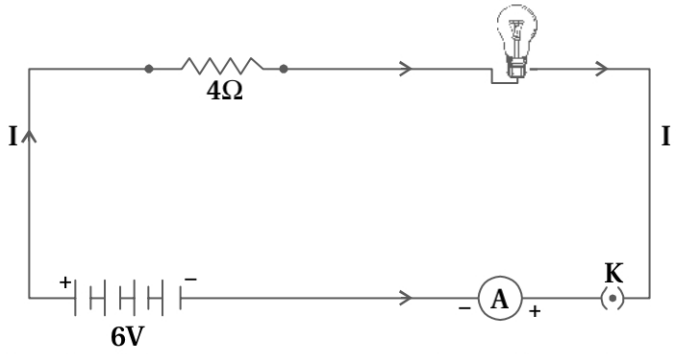
$$\frac{1}{R_P} = \frac{1}{R_A} + \frac{1}{R_B} = \frac{1}{24} + \frac{1}{24}$$

$$\frac{1}{R_P} = \frac{2}{24} = \frac{1}{12}$$

$$\therefore R_P = 12 \ \Omega$$

Now, $I = \frac{V}{R_P} = \frac{220}{12} = 18.3$ A

36. An electric lamp, whose resistance is 20 Ω and a conductor of 4 Ω resistance are connected to a 6 V battery, see Figure. Calculate (a) the total resistance of the circuit. (b) the current through the circuit and (c) the potential difference across the electric lamp and conductor.



An electric lamp connected in series with a resistor of 4 Ω to a 6 V battery

➠ Here resistance of lamp R_1 = 20 Ω, Resistance of conductor R_2 = 4 Ω

(a) The total resistance in the circuit

$$R = R_1 + R_2 = 20 + 4 = 24 \ \Omega$$

The total potential difference across the two terminals of the battery V = 6 V

(b) Now by ohm's law V = IR

$$\therefore I = \frac{V}{R_s} = \frac{6V}{24\Omega}$$

$$\therefore I = 0.25 \text{ A}$$

(c) Potential difference across the electric lamp

$V_1 = 20 \times 0.25 = 5$ V and

Potential difference across the conductor

$V_2 = 4 \times 0.25 = 1.0$ V

$\therefore$ The potential difference across the two ends of series connection of electric lamp and conductor.

$V = V_1 + V_2 = 5 + 1 = 6$ V

➠ A potential difference of 6 V across the battery terminals will cause a current of 0.25 A in the circuit. Let this equivalent resistance be R.

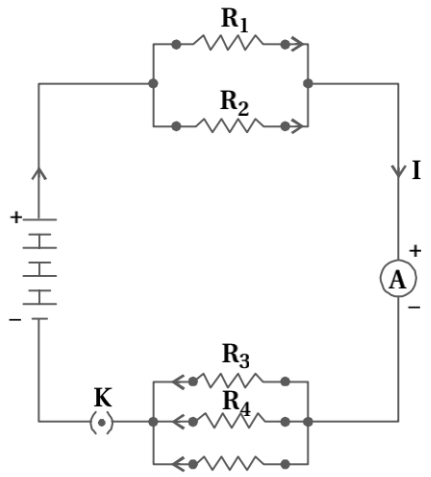
$$\therefore R = \frac{V}{I} = \frac{6}{0.25} = 24\ \Omega$$

Hence, the magnitude of equivalent resistance is equal to the sum of the two resistances.

Section D

● **Write the answer of the following questions. [Each carries 4 Marks]** **[4]**

37. If in Fig. $R_1 = 10\ \Omega$, $R_2 = 40\ \Omega$, $R_3 = 30\ \Omega$, $R_4 = 20\ \Omega$, $R_5 = 60\ \Omega$ and a 12 V battery is connected to the arrangement. Calculate (a) the total resistance in the circuit and (b) the total current flowing in the circuit.



An electric circuit showing the combination of series and parallel resistors

➠ Here $R_1 = 10\ \Omega$, $R_2 = 40\ \Omega$

Both are in parallel, let its equivalent resistance R'

$$\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{1}{10} + \frac{1}{40} = \frac{4+1}{40} = \frac{5}{40} = \frac{1}{8}$$

$\therefore$ $R' = 8\ \Omega$ and $R_3 = 30\ \Omega$, $R_4 = 20\ \Omega$ and $R_5 = 60\ \Omega$.

All three are in parallel. Let its equivalent resistance is R''.

$$\frac{1}{R''} = \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5}$$

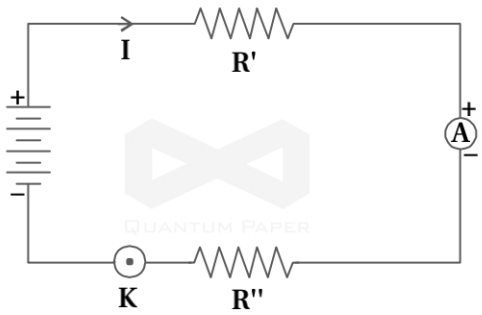
$$= \frac{1}{30} + \frac{1}{20} + \frac{1}{60}$$

$$= \frac{2+3+1}{60} = \frac{6}{60}$$

$$= \frac{1}{10}$$

$\therefore$ $R'' = 10\ \Omega$

➠ Thus the total resistance $R = R' + R'' = 8 + 10 = 18\ \Omega$



➠ Current in the circuit (from ohm's law)

$$I = \frac{V}{R} = \frac{12\ V}{18\ \Omega}$$

$$= 0.6666\ A$$

$$\approx 0.67\ A$$