ONE MARK QUESTIONS

1. If the charge on an electron be 1.6×10^{-19}C, find the approximate number of electrons in 1 C.

Ans : [CBSE 2016]

1.6×10^{-19}C charge is of $= 1$ electron and

1 C charge is of $= \dfrac{1}{1.6 \times 10^{-19}}$ electron

No. of electrons $= 6.25 \times 10^{18}$

2. List any two factors on which resistance of a conductor depends.

Ans : [CBSE 2016]

Resistance of a conductor:

a. is directly proportional to its length

$$R \propto \rho \qquad \qquad ...(1)$$

b. is inversely proportional to its area of cross section.

$$R \propto \frac{1}{A} \qquad \qquad ...(2)$$

Combining (1) and (2), we get

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

3. What is the SI unit of electric potential?

Ans : [Delhi 2016]

Volt is the SI unit of electric potential.

4. When is potential difference between two points said to be 1 volt?

Ans : [Delhi 2016]

Potential difference betweeen two point is said to be 1 Volt if the amount of work done in bringing 1 C charge between them is 1 J.

5. State Ohm's law.

Ans : [Delhi 2016]

If the physical conditions of a conductor remain same then current through a conductor is directly proportional to the potential difference b/w the two ends of the conductor.

$$I \propto V \Rightarrow V = IR$$

6. Mention one reason why tungsten is used for making filament of electric lamp.

Ans : [CBSE 2015]

Tungsten is used for making filament because of its high melting point and low resistivity.

7. (a) Name the instrument/device used to measure electric current in a circuit.

(b) How is an ammeter connected in a circuit to measure current flowing through it?

Ans : [CBSE 2015]

a. Ammeter is used to measure electric current.

b. Ammeter is connected in series in an electric circuit.

8. In an electric circuit, state the relationship between the direction of conventional current and the direction of flow of electrons.

Ans : [CBSE 2015]

Electrons flows from negative terminal to positive terminal where as current flows from +ve terminal to $-$ve terminal in external circuit i.e. Conventional current and electrons flow are opposite to each other.

9. How does the resistivity of alloys compare with those of pure metals from which they may have been formed?

Ans : [All India 2014]

The resistivity of pure metals is lesser than resistivity of alloys with which these alloys are made.

10. Write SI unit of resistivity.

Ans : [CBSE 2014]

Ohm-m

11. State a difference between the wire used in the element of an electric heater and in a fuse wire.

Ans : [CBSE 2014]

The wire used in element of electric heater has high resistance and high melting point where as a fuse wire has a low resistance and low melting point.

12. Power of a lamp is 60 W. Find the energy in joules consumed by it in 1 s.

Ans : [CBSE 2014]

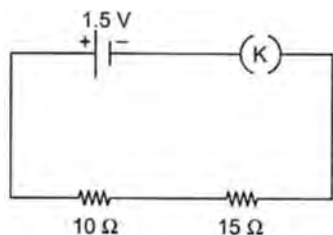$$P = 60\,\text{W},\ t = 1\,\text{s}$$
$$\text{Energy} = (VI)t$$
$$E = P \times t = 60 \times 1\,\text{J}$$
$$E = 60\,\text{J}$$

13. Draw a schematic diagram of a circuit consisting of a cell of 1.5 V, 10 ohm resistor and 15 ohm resistor and a plug key all connected in series.

Ans : [CBSE 2011]

Schematic diagram is shown below.

14. Why do we use copper and aluminium wire for transmission of electric current?

Ans : [CBSE 2011]

Copper and aluminium wires are used for electric transmission due to their low resistivity.

15. Give an example of a metal which is the best conductor of heat.

Ans : [CBSE 2011]

Gold, Silver, Copper etc. metals are good conductor of heat.

16. Define electric circuit. Distinguish between open and closed circuit.

Ans : [CBSE 2010]

Electric circuit is the arrangement in which electric current can flow when circuit is switched on. In open circuit there is no flow of current as the switch is off. In closed circuit a current flows in the circuit when switch is on.

17. What is the lowest resistance that can be obtained by combining four coils of resistances 4 Ω, 8 Ω, 12 Ω and 24 Ω?

Ans : [CBSE 2010]

If the resistances are combined in parallel then we shall get the lowest resistance. In parallel combination:

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

18. Nichrome is used to make the element of electric heater. Why?

Ans : [CBSE 2010]

Nichrome is used to make element of electric heater because nichrome is an alloy which has high melting point and high resistances.

19. happens to the resistance of a conductor when the length of the conductor is reduced to half?

Ans : [CBSE 2010]

Resistance is directly proportional to the length of the conductor. If length becomes half the resistance also become half of its initial value.

**20.** What happens to the resistance of a conductor when temperature is increased?

Ans : [CBSE 2010]

The resistance of a conductor increases with rise in temperature.

21. Draw a schematic diagram of an electric circuit consisting of a battery of two cells each of 1.5 V, 5 Ω, 10 Ω and 15 Ω resistors and a plug key, all connected in series.

Ans : [CBSE 2000]

Schematic diagram of electric circuit con¬taining cells, key and three resistances.
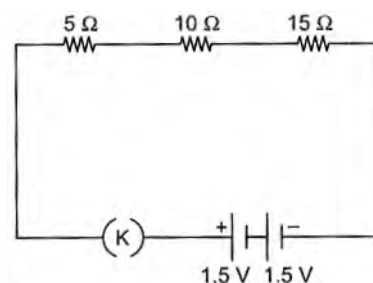
22. Out of the two, a toaster of 1 kW and an electric heater of 2 kW, which has a greater resistance?

Ans : [CBSE 2006]

As $R = \dfrac{V^2}{P}$. If V is constant. Then $R \propto \dfrac{1}{P}$ i.e. more power, lesser be the resistance and vice versa.

Toaster has lesser power (1 KW) than electric heater (2 KW) therefore resistance of toaster is more than resistances of heater.

23. Why is tungsten metal selected for making filaments of incandescent lamps?

Ans : [CBSE 2005]

Tungsten has high resistance and high melting point.

24. A wire of resistance 5 Ω is bent in the form of a closed circle. What is the resistance between two points at the ends of any diameter of the circle?

Ans : [CBSE 2005]

$$R = 5\,\Omega$$

It can be assumed as two semi circular elements are connected across diameter AB.

Total resistances of couple wire 5 Ω. Resistance of two semicircular elements $= \dfrac{5}{2}\,\Omega$

Both the elements are connected in parallel.

$$\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{2}{5} + \frac{2}{5} = \frac{4}{5}$$

or $$R' = \frac{5}{4}\,\Omega$$

25. Why is much less, heat generated in long electric

cables than in filaments of electric bulbs?

Ans : [CBSE 2005]

As heat produced $= I^2 R t$

Electric cables are made of thick good conductor where as filaments are made of thin tungsten wire whose resistances is high. The resistance of electric cables is very less. So heat produced in cable is much lesser than filaments.

26. State which has a higher resistance a 50 W or a 25 W lamp bulb and how many times?

Ans : [CBSE 2005]

We have $\quad P_1 = 50\,\text{W}$

$$P_2 = 25\,\text{W}$$

Let their resistances are R_1 and R_2 respectively.

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

$$R_1 = \frac{V^2}{50}\,\Omega \text{ and } R_2 = \frac{V^2}{25}\,\Omega$$

$$\frac{R_1}{R_2} = \frac{25}{50} = \frac{1}{2}$$

or $\quad R_1 = \frac{1}{2}R_2$

i.e. 50 W bulbs has $\frac{1}{2}$ resistance than 25 W bulb.

27. Define resistivity of a material.

Ans : [CBSE 2004]

We have $\quad R = \rho\frac{l}{A}$

Resistivity, $\quad \rho = R\frac{A}{l}$
If
$A = 1,\ l = 1$ then $\rho = R$ i.e. resistivity of a material is the resistance of a conductor of this material whose length and area of cross- section both are unity.

or

Resistivity of a material is the resistance of a conductor of this material whose volume is unity.

28. A cylinder of a material is 10 cm long and has a cross-section of 2 cm². If its resistance along the length be 20 ohm, what will be its resistivity in number and units?

Ans : [CBSE 2004]

$$l = 10 \text{ cm}, A = 2\,\text{cm}^2$$

$$R = 20 \text{ ohm}$$

$$R = \rho\frac{l}{A}$$

or $\quad \rho = R\frac{A}{l} = 20 \times \frac{2}{10}\,\Omega\,\text{cm}$

$$\rho = 4\,\Omega - \text{cm}$$

TWO MARKS QUESTIONS

29. The amount of charge passing through a cell in four second is 12 C. Find the current supplied by cell.

Ans : [CBSE 2016]

Given: $\quad t = 4\,\text{s}$

$$Q = 12\,\text{C}$$

$$I = \frac{Q}{t} = \frac{12}{4}\,\text{A} = 3\,\text{A}$$

30. Calculate the number of electrons that would flow per second through the cross- section of a wire when 1 A current flows in it.

Ans : [CBSE 2016]

Given: $\quad I = 1\,\text{A},\ t = 1\,\text{s}$

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

$$Q = 1\,\text{A} \times 1\,\text{s} \quad (Q = 1 \text{ coulomb})$$

But $\quad Q = ne$

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

$$= 6.25 \times 10^{18} \text{ electrons}$$

31. Name the device/instrument used to measure potential difference. How is it connected in an electric circuit?

Ans : [CBSE 2016]

The device which is used to measure potential difference is voltmeter. Voltmeter is connected in parallel in an electric circuit.

32. How much current will an electric bulb of resistance 1100 Ω draw from a 220 V source? If a heater of resistance 100 Ω is connected to the same source instead of the bulb, calculate the current drawn by the heater.

Ans : [All India 2016]

Resistance of bulb, $R = 1100\,\Omega$

$$V = 220 \text{ volt}$$

$$V = IR \text{ or } I = \frac{V}{R}$$

$$I = \frac{220}{1100} = \frac{1}{5}\,\text{A}$$

When heater is connected with the same source then

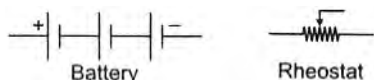$$I = \frac{V}{R} = \frac{220}{100} = 2.2\,\text{A}$$

33. (a) What are the values of mA and μA?
(b) Draw the symbols of battery and rheostat.

Ans : [All India 2015]

$1\,mA = 1\ \text{milli ampere} = 10^{-3}\ \text{A}$
$1\,\mu\text{A} = 1\ \text{micro ampere} = 10^{-6}\ \text{A}$

Battery   Rheostat

34. Give reason for the following:
   a. Tungsten used almost exclusively for filament of electric lamp.
   b. Why do we use copper and aluminium wires for transmission of electric current?

Ans :   [CBSE 2015]

   a. Tungsten is used in making the filament of electric lamp because it has high resistivity and high melting point.
   b. The copper and aluminium have low resistivity and high conductivity.

35. What is the resistance of an ideal voltmeter?

Ans :   [CBSE 2014]

The resistance of an ideal voltmeter is infinite.

36. State the factors on which the heat produced in a current carrying conductor depends. Give one practical application of this effect.

Ans :   [Delhi 2014]

We know that $H = VIt$ or $H = I^2Rt$
Heat produced in a current carrying conductor
$H \propto I^2$ (Square of the current in the circuit)
$\propto R$ (Resistance of the conductor)
$\propto t$ (Time for which current is passed in conductor)
This effect applied in electric heater.

37. List in a tabular form two differences between a voltmeter and an ammeter.

Ans :   [CBSE 2014]

|	**Voltmeter**	**Ammeter**
1.	It is used to measure P.D. across two points in an electric circuit.	It is used to measure electric current in an electric circuit.
2.	Its resistance is very high.	Its resistance is very low.
3.	An voltmeter is connected in parallel in an electric circuit.	An ammeter is connected in series in an electric circuit.

38. Given below is a circuit showing current flowing in it. Identify each component A, B, C, D of this circuit.
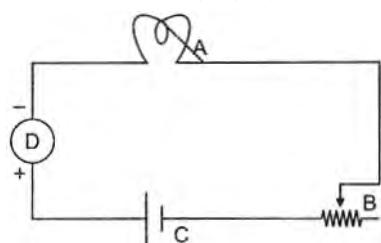
Ans :   [CBSE 2014]

Circuit

A — Bulb (load)
B — Rheostat
C — Cell
D — Ammeter (being in series)
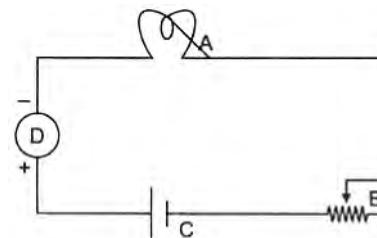
39. A large number of free electrons are present in metals yet no current flows in the absence of electric potential across it. Explain the statement with reason.

Ans :   [CBSE 2014]

Though there are large number of free electron present in a conductor, but their motion is random motion in the absence of potential difference. Their average velocity is zero. Hence there is no current flowing in conductor. But when a potential difference is applied across the ends of the conductor, it sets the electrons to move in a direction. The motion of charge produces an electric current in the conductor.

40. Out of the two wires X and Y shown below. Which one has greater resistance. Justify your answer.
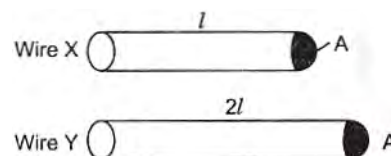
Ans :   [CBSE 2014]

If X and Y are of same material
    then length of wire $X = l$
    Area of cross-section $= A$
$$R_X = \rho\frac{l}{A}$$
Similarly, $R_Y = \rho\frac{2l}{A}$
$$\frac{R_Y}{R_X} = 2$$
or $R_Y = 2R_X$
wire Y has two times resistance than that of wire X.

41. Elements of electric toasters and electric iron are made of an alloy rather than a pure metal. Give two reasons to justify the statement.

Ans :   [CBSE 2014]

   a. Alloys have higher resistivity than their constituents pure metals.
   b. At high temperature alloys do not oxidise.

42. A thick wire and a thin wire of the same material are successively connected to the same circuit to find their respective resistance. Which one will have lower resistance? Give reason.

Ans :   [CBSE 2014]

As resistance $\propto \frac{1}{A}$ i.e. more area of cross-section lesser

the resistance and vice versa. So thick wire has lower resistance.

43. Mention two special features of the material to be used as element of an electric iron.

Ans : [CBSE 2014]

A material to be used as element of an electric iron must have (i) high melting point, (ii) high resistivity.

44. Find the resistance of bulb rated as 100W-250V.

Ans : [CBSE2014]

We have, $P = 100$ W

$V = 250$ Volt

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

$$R = \frac{(250)^2}{100} = \frac{250 \times 250}{100} = 625 \, \Omega$$

45. Why do the wires connecting an electric heater to the mains not glow while its heating element does?

Ans : [CBSE 2011]

Connecting wire has low resistivity or good conductivity, i.e. resistance of these wires is negligible hence no heat is produced while heating element is of an alloy whose resistivity is high, due to high resistance heat is produced in the element.

46. In the circuit diagram shown, the two resistance wires A and B are of same area of cross-section and same material, but A is longer than B. Which ammeter A_1 or A_2 will indicate higher reading for current? Give reason.
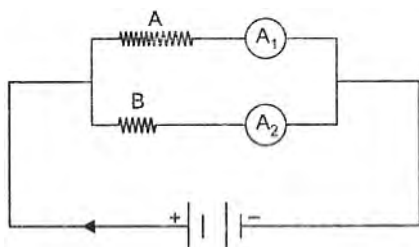
Ans : [CBSE 2011]

Length of A is greater than B. Area of cross-section of A and B is same.

Therefore resistance of A > resistance of $B[\because R \propto l]$.

Current in A is lesser than current in B. Hence A_2 will give higher reading.
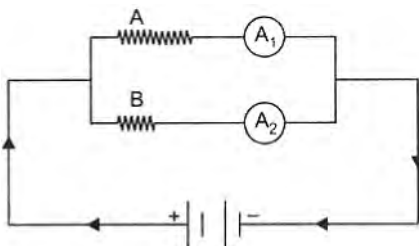
47. Mention the condition under which charges can move in a conductor. Name the device which is used to maintain this condition in an electric circuit.
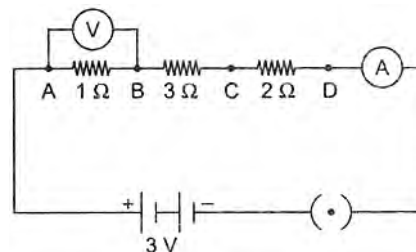
Ans : [CBSE 2012]

When a potential difference is applied across the two

ends of the conductor, charges (electrons) will move in the conductor.

Potential difference is applied by a cell to maintain the charge to move.

48. How would the reading of voltmeter (V) change, if it is connected between B and C? Justify your answer.

Ans : [CBSE 2011]

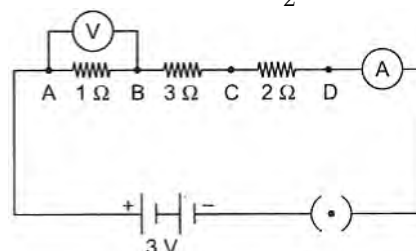$1\Omega, 3\Omega, 2\Omega$ resistances are connected in series.

$$R = R_1 + R_2 + R_3$$

$$= 1 + 3 + 2 = 6 \, \Omega$$

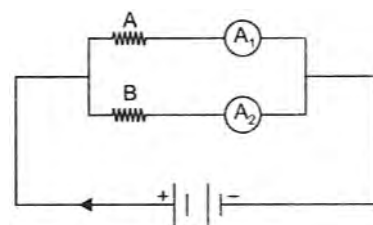$$I = \frac{V}{R} = \frac{3}{6} = \frac{1}{2} \text{A}$$

Current in each resistance is same, i.e. $\frac{1}{2}$ A.

Voltage across B & C $= \frac{1}{2} \times 3 = \frac{3}{2}$ Volt.

$$V_{BC} = \frac{3}{2} \text{ Volt.}$$

49. In the circuit diagram shown, the two resistance wires A and B are of same length and same material, but A is thicker than B. Which ammeter A_1 or A_2 will indicate higher reading for current? Give reason.
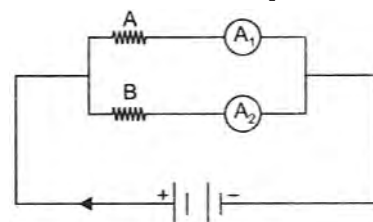

Ans : [CBSE 2011]

Length of A and B is same. A is thicker than B.

Hence $R_A < R_B \left[\because R \propto \frac{1}{\text{A}}\right]$

Current in A_1 is more than current in A_2 i.e., reading in A_1 is higher than reading in A_2.

50. Tungsten is used almost exclusively for filaments of electric bulb. List two reasons.
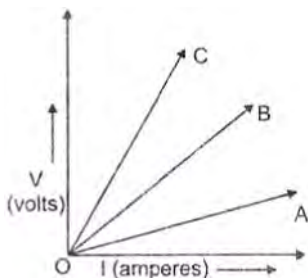
Ans : [CBSE 2011]

(1) high resistivity (2) high melting point and does not oxidise at very high temperature.

51. Three V-I graphs are drawn individually for two resistors and their series combination. Out of A, B, C which one represents the graph for series combination of the other two. Give reason
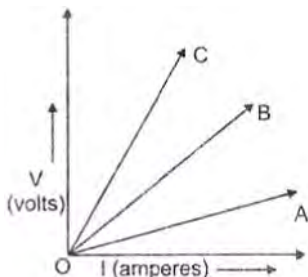
Ans :

More slope of V-I graph means more resistance, slope of C is maximum. Hence its resistance is maximum. So it is for series combination of two resistors.

52. State the factors on which the resistance of a cylindrical conductor depends. How will resistance of a conductor change if it is stretched so that its length is doubled?

Ans : [CBSE 2010]

Resistance of cylindrical conductor depends upon its length and cross- sectional area.

When conductor is stretched its radius decreases but the volume of the conductor in both the cases will be same. If length is stretched to twice.

$$l_2 = 2l_1$$

As

$$l_1 A_1 = l_2 A_2$$

$$l_1 A_1 = 2l_1 A_2$$

$$\frac{A_1}{A_2} = 2$$

Now,

$$R_1 = \rho \frac{l_1}{A_1}$$

and

$$R_2 = \rho \frac{l_2}{A_2} = \rho \frac{2l_1}{A_2}$$

$$\frac{R_2}{R_1} = 2 \times \frac{A_1}{A_2} = 2 \times 2 = 4$$

$$R_2 = 4R_1$$

53. (a) What material is used in making the filament of an electric bulb?

(b) Name the characteristics which make it suitable for this.

Ans : [CBSE 2010]

a. Tungsten is used in making filament.

b. Its high resistivity and high melting point.

54. How are ammeters and voltmeters connected in a circuit? What do they help us measure?

Ans : [CBSE 2010]

An ammeter which measure the current in a circuit is connected in series. Voltmeter is used to measure potential difference across a conductor so it is connected in parallel to it.

55. The following table gives the resistivity of three samples:

Sample	A	B	C
Resistivity	$1.6 \times 10^{-5}\Omega m$	$5.2 \times 10^{-5}\Omega m$	$100 \times 10^{-4}\Omega m$

Which of them is suitable for heating elements of electrical appliances and why?

Ans : [CBSE 2010]

The resistivity of C sample is maximum so it is suitable for making heating element.

56. a. Give reason why tungsten is used for making filament of electric lamps.

b. The elements of heating electrical appliances are made-up of an alloy rather than pure metal.

Ans : [CBSE 2010]

a. Due to (1) high resistivity and high melting point tungsten is used for making filaments of electric lamp.

b. high resistivity, and high melting point than their constituents pure metals which do not oxidise at high temperature.

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

a. What happens to the glow of the other two bulbs when the bulb B_1 gets fused?

b. What happens to the reading of A_1 A_2, A_3 and A when the bulb B_1 gets fused?
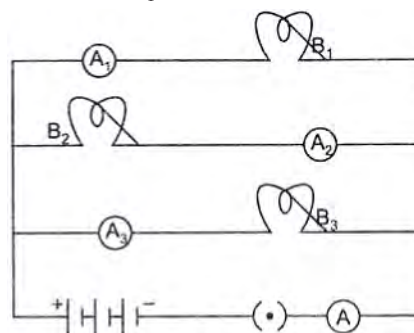
Ans : [CBSE2010]

a. The other two bulbs will glow even if B_1 gets fused. There is no change in glow of B_2 and B_3.

Here $V = 4.5\,\text{V}$

and $I = 3\,\text{A}$

$$R_P = \frac{V}{I} = \frac{4.5}{3}$$

$$R_P = 1.5\,\Omega$$

For parallel combination

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

$$\frac{1}{1.5} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R}$$

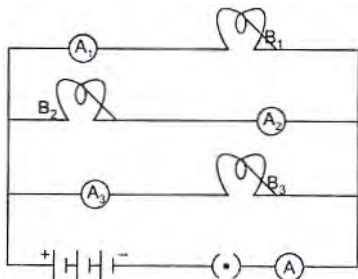$$\frac{1}{1.5} = \frac{3}{R} \Rightarrow R = 4.5\,\Omega$$

For B_2, $\qquad 4.5 = I \times 4.5$
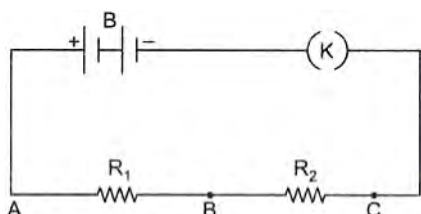
$\qquad\qquad\qquad 1A = I$

For B_3, $\qquad 4.5 = I \times 4.5\ \ 1A = I$

Current in Ammeter, $\quad (A) = 1A + 1A = 2A$

58. (a) Draw a circuit diagram to show how two resistors are connected in series.

(b) In a circuit, if the two resistors of 5 ohm and 10 ohm are connected in series, how does the current passing through the two resistors compare?

Ans : [C8SE 2006)

a.

b. In series combination of resistances, the current remains same.

59. A bulb is rated at 5.0 V, 100 mA. Calculate its (a) power and (b) resistance.

Ans : [CBSE 2006]

Rating of bulb, $\quad V = 5.0$ Volt.

$$I = 100\,\text{mA}$$

$$I = 100 \times 10^{-3}\,\text{A}$$

$$I = 0.1\,\text{A}$$

a. $\quad$ Power of bulb $= V \times I$

$$P = 5.0 \times 0.1\,\text{W} = 0.5\text{W}$$

b. $\qquad V = IR,$

$$R = \frac{V}{I} = \frac{5.0}{0.1}\Omega = 50\,\Omega$$

60. An electric bulb draws a current of 0.2 A when the voltage is 220 volts. Calculate the amount of charge flowing through it in one hour.

Ans : [CBSE 2004]

Given: $\quad I = 0.2\,\text{A}$

$$V = 220\ \text{Volt}$$

$$t = 1\ \text{hr.}$$

$$Q = ?$$

$$I = \frac{Q}{t}\ \text{or}\ Q = I \times t$$

$$Q = 0.2\text{A} \times 1\,\text{hr} = 0.2 \times 60 \times 60\ \text{A} - \text{s}$$

$$= 720\,\text{C}$$

61. An electric iron draws a current of 0.5 A when the voltage is 200 volt. Calculate the amount of electric charge flowing through it in one hour.

Ans : [CBSE 2004]

We have $\quad I = 0.5\,\text{A}$

$$V = 200\ \text{volt}$$

$$t = 1\,\text{hr} = 3600\ \text{s}$$

$$Q = I \times t = 0.5 \times 3600\ \text{A} - \text{s} = 1800\,\text{C}$$

62. An electric appliance draws a current of 0.4 A when the voltage is 200 volt. Calculate the amount of charge flowing through it in one hour.

Ans : [CBSE 2004]

$$Q = It$$

Given, $\quad I = 0.4\,\text{A}$

$$V = 200\ \text{Volt}$$

$$t = 1\ \text{hr} = 3600\,\text{s}$$

$\therefore \qquad\qquad Q = 0.4 \times 3600\,\text{C}$

$$Q = 1440\,\text{C}$$

THREE MARKS QUESTIONS

63. 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?

Ans : [CBSE 2017]

or

(a) Write Joule's law of heating.

(b) Two bulbs, one rated 100 W; 220 V, and the other 60 W; 220 V are connected in parallel to electric mains supply. Find the current drawn by two bulbs from the line if the supply voltage is 220 V.
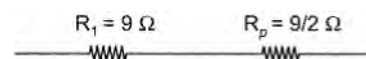
Ans : [CBSE 2017]

i.
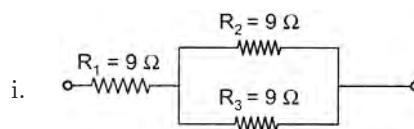
Resistor R_2 and R_3 are in parallel combination.

$$\therefore \qquad\qquad \frac{1}{R_p} = \frac{1}{9} + \frac{1}{9} = \frac{2}{9}\,\Omega$$

or $\qquad\qquad R_p = \frac{9}{2}\,\Omega$

Now R_1 and R_p are in series.

$$\therefore \qquad\qquad R_{eq} = R_1 + R_p = 9 + \frac{9}{2} = \frac{27}{2}\,\Omega$$

$$R_{eq} = 13.5\,\Omega$$

ii. To get 6 Ω resistance R_1 and R_2 are in Series

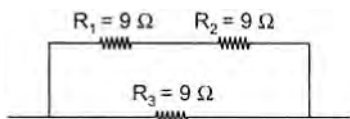$$\therefore \qquad\qquad R_s = 9 + 9 = 18\,\Omega$$

R_s and R_3 are in parallel so,

$$\frac{1}{R_{eq.}} = \frac{1}{R_s} + \frac{1}{R_3}$$

$$\frac{1}{R_{eq.}} = \frac{1}{18} + \frac{1}{9} = \frac{1+2}{18} = \frac{3}{18}$$

and $\qquad R_{eq.} = 6\,\Omega$

R$_1$ = 9 Ω   R$_2$ = 9 Ω

R$_3$ = 9 Ω

or

a. **Joules Law of Heating :** When a current I is passed through a resistor R for time t then heat produced

$$H \propto I^2$$
$$\propto R$$
$$\propto t$$
$$H \propto I^2 Rt$$

or $\qquad H = I^2 Rt$

b. Given two bulbs of 100 W–200 V and 60W–220 V. Current in 1st bulb:

$$I_1 = \frac{P_1}{V} = \frac{100}{220}A = \frac{5}{11} = 0.45\,A$$

Current in second bulb.

$$I_2 = \frac{P_2}{V} = \frac{60}{220}A = \frac{3}{11}\,A = 0.27\,A$$

64. (a) List the factors on which the resistance of a conductor in the shape of a wire depends.
(b) Why are metals good conductors of electricity whereas glass is a bad conductor of electricity? Give reason.
(c) Why are alloys commonly used in electrical heating devices? Give reason.

Ans : [CBSE 2017]

a. Factors on which resistance of a wire depends:
i. Resistance is directly proportional to length.
ii. Resistance is inversely proportional to area of cross-section.

$$R \propto l,\ R \propto \frac{1}{A}$$

$$R \propto \frac{l}{A}\ \text{or}\ R = \rho\frac{l}{A}$$

b. Metal are good conductor due to having large number of free electrons and their low resistivity. Glass is a bad conductor because it has no free electrons and its resistivity is higher.
c. Alloys are commonly used in electrical heating devices due to their high resistivity and high melting point which produces more heat.

65. V-I graphs for two wires A and B are shown in the figure. If both the wires are made of the same material and are of equal thickness, which of the two is of more length? Give justification for your answer.

Ans : [CBSE 2016]

We know for identical wire more length more resistance and vice versa slope of wire A is more than B. Hence

resistance of A is more and its length also.
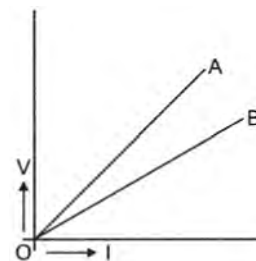
66. What is meant by "electrical resistance" of a conductor? State how resistance of a conductor is affected when
a. a low current passes through it for a short duration;
b. a heavy current passes through it for about 30 seconds.

Ans : [CBSE 2016]

Electrical resistance is the property of a conductor by virtue of which it opposes the flow of current through it. It is equal to the ratio of the potential difference applied across its ends to the current flowing through it.

$$R = \frac{V}{I}$$

a. When a low current is passed for a short duration, through a conductor, heat produced is almost negligible and hence no appreciable change in its resistance.
b. When heavy current is passed through the conductor for 30 s. Conductor may be get heated and its resistance and resistivity change.

67. Name and define the SI unit of current. Calculate the number of electrons that flow through a conductor in 1 second to constitute a current of 1 ampere. (Charge on an electron $= 1.6 \times 10^{-19}$ coulomb)

Ans : [CBSE 2016]

SI unit of current is Ampere (A)

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

If $q = 1$ C, $t = 1$ s

then $\qquad I = 1\,A$

If 1 C charge flows in 1 s in a conductor then magnitude of current is said to be 1A.
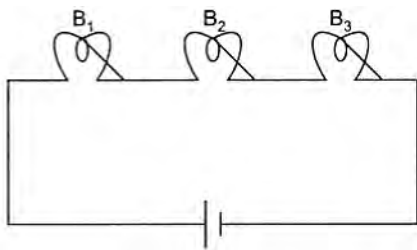
$$q = ne$$

$$n = \frac{q}{e} = \frac{I \times t}{e}$$

$$= \frac{1A \times 1s}{1.6 \times 10^{-19}} = \frac{100}{16} \times 10^{18}$$

$$= 6.25 \times 10^{18}$$

68. Electric current flows through three lamps when arranged in (a) a series (b) a parallel. If the filament of one lamp breaks. Explain what happens to the other two lamps in both the cases.
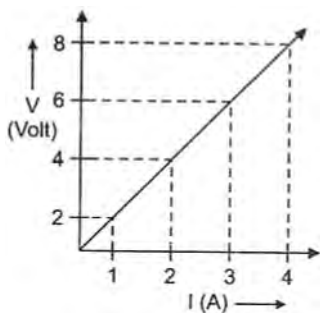
Ans : [CBSE 2015]

a. In series combination if the filament of one lamp breaks then the circuit will be broken and hence other lamps stops glowing.

b. In parallel combination of lamps if the element of one lamp breaks then other two will continue to glow.
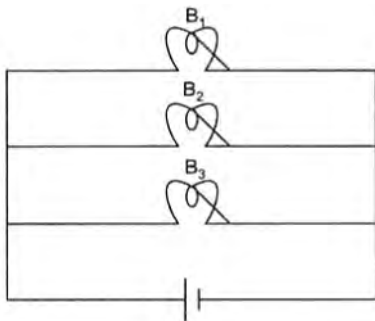
69. Study the V-I graph for a resistor as shown in the figure and prepare a table showing the values of I (in amperes) corresponding to four different values of V (in volts). Find the value of current for $V = 10$ volts. How can we determine the resistance of the resistor from this graph?

Ans : [CBSE 2015]

When $V = 10$ volt from the graph

$$R = \frac{\Delta V}{\Delta I} = \frac{8-6}{4-3}\,\Omega = 2\,\Omega$$
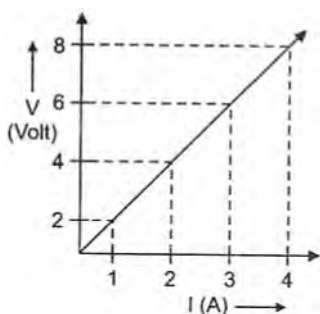
when $V = 10$ volt

then $V = IR$

or $I = \frac{V}{R} = \frac{10}{2}\,\text{A} = 5\text{A}$

70. Find the number of electrons transferred between two points kept at a potential difference of 20 V if 40 J of work is done.

Ans : [All India 2015]

Given: $V = 20$ Volt

$W = 40\,\text{J}$

$W = P \times t$

$= V \times I \times t$

$= V \times \frac{Q}{t} \times t$

or $W = V \times Q$

$40 = 20 \times Q$

or $Q = 2\text{C}$

$ne = Q$

$n = \frac{Q}{e} = \frac{2}{1.6 \times 10^{-19}}$

$= 1.25 \times 10^{19}$

71. Name and define SI unit of resistance. Calculate the resistance of a resistor if the current flowing through it is 200 mA, when the applied potential difference is 0.8 V.

Ans : [Delhi 2014]

a. SI unit of resistance is ohm (Ω)

$$1\,\Omega = \frac{1\,\text{V}}{1\,\text{A}}$$

b. The resistance of a conductor is said to be 1 ohm if a current of one amp flows through it when a potential differences of 1 volt is applied across it.

c. $R = \frac{V}{I} = \frac{0.8}{200 \times 10^{-3}} = 4\,\Omega$

72. (a) Explain why a conductor offers resistance to the flow of current.
(b) Differentiate between conductor, resistor and resistance.

Ans : [CBSE2014]

a. When a current is passed through a conductor, the atoms or molecule of the conductor produce an hindrance in the path of flow of electron. This hindrance in the path of flow of charge is called resistance of the conductor.

b. A substance which allow to pass the charges through them easily is called a conductor.
Resistor : A conductor having some value of resistance is called a resistor.
Resistance : It is the property of any conductor by virtue of which it opposes the flow of charge through it.

73. A piece of wire of resistance 6 Ω is connected to battery of 12 V. Find the amount of current flowing through it. Now, the same wire is redrawn by stretching it to double its length. Find the resistance of the new (redrawn) wire.

Ans : [CBSE2014]

Given: $R = 6\,\Omega$

$V = 12$ Volt

$I = ?$

$$I = \frac{V}{R} = \frac{12}{6} \text{ A} \Rightarrow I = 2\text{A}$$

When length becomes twice $= 2$ L

area of cross-section $= \text{A}_2$

then

$$L_1 A_1 = L_2 A_2$$

or

$$LA_1 = 2LA_2$$

or

$$\frac{A_2}{A_1} = \frac{1}{2}$$

$$R_1 = \rho \frac{L}{A_1}$$

$$R_2 = \rho \frac{2L}{A_2} \Rightarrow \frac{R_2}{R_1} = 2 \times \frac{A_1}{A_2}$$

$$\frac{R_2}{R_1} = 2 \times 2 = 4$$

$$R_2 = 4R_1$$

New resistance becomes four times.

74. A wire of length l and resistance R is stretched so that the length is doubled and area of cross-section is halved. How will its:

a. Resistance change?

b. Resistivity change?

Ans : [CBSE 2010, 2014]

a. Let initial length, area of cross-section and resistance of wire are l, A and R respectively. When length is stretched two times, let its area of cross-section becomes A'. Its initial volume of wire = final volume of the wire.

$$Al = A'2l$$

or

$$\frac{A'}{A} = \frac{1}{2} \text{ or } A' = \frac{A}{2}$$

$$R' = \rho \frac{(2l)}{A'} = \rho \frac{2l \times 2}{A}$$

$$= 4\rho \frac{l}{A}$$

$$= 4\,\text{R}$$

b. Resistivity does not change because it is property of the material of a conductor.

75. A nichrome wire has a resistance of 10 Ω Find the resistance of another nichrome wire, whose length is three times and area of cross-section four times the first wire.

Ans : [CBSE 2014]

We have $R = 10\,\Omega$

$$l_1 = l$$

$$A_1 = A$$

$$R = \rho \frac{l}{A} = 10\,\Omega$$

or

$$\frac{l}{A} = \frac{10}{\rho}$$
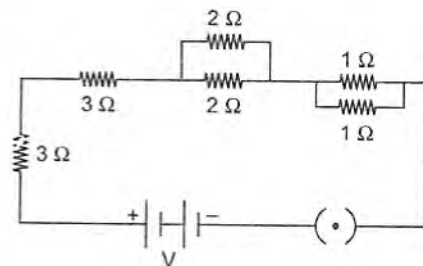
For new wire,

$$L_2 = 3l$$

$$A_2 = 4\text{A}$$

$$R_2 = \rho \frac{3l}{4\,\text{A}} = \frac{3}{4}\rho \frac{l}{A}$$

$$R_2 = \frac{3}{4}R = \frac{3}{4} \times 10 = \frac{15}{2}\,\Omega$$

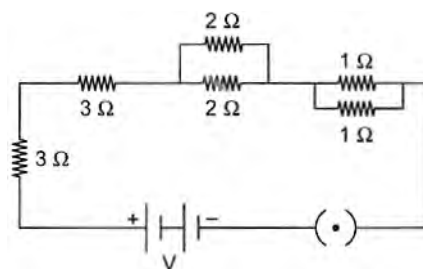$$R_2 = 7.5\,\Omega$$

76. Find the equivalent resistance of the following circuit:

Ans :

In the given circuit $2\,\Omega, 2\,\Omega$ resistances are in parallel.
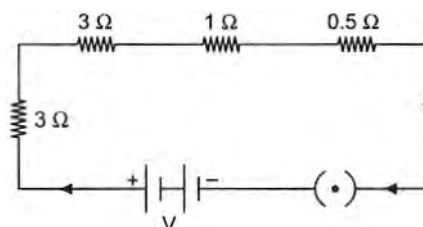
$$R_p = 1\,\Omega$$

$1\Omega, 1\Omega$ resistances also are in parallel.

$$R_p' = 0.5\,\Omega$$

The circuit can be reduced as,

Now all resistances are in series combination.

$$R = 3 + 3 + 1 + 0.5 = 7.5\,\Omega$$

77. A hot plate of an electric oven connected to a 220 V line has two resistors A and B each of $22\,\Omega$ resistance. These resistors may be used separately, in series or in parallel. Find the current flowing in all the three cases.

Ans : [CBSE 2014]

Given, $V = 220$ Volt

$$R_A = 22\,\Omega$$

$$R_B = 22\,\Omega$$

a. Current in resistances separately?

$$= \frac{220}{22}\text{ A} = 10\text{ A}$$

b. Current in series combination

$$R_S = 22 + 22 = 44\,\Omega$$

$$I_S = \frac{220}{44} = 5\text{ A}$$

c. Current in parallel combination

$$\frac{1}{R_P} = \frac{1}{22} + \frac{1}{22} = \frac{2}{22}\,\Omega$$

$$\Rightarrow \qquad R_P = 11\,\Omega$$

$$I_P = \frac{220}{11} = 20 \text{ A}$$

78. An electric kettle of 2 kW works for 2 h daily. Calculate the (a) energy consumed in SI and commercial units (b) cost of running it in the month of June at the rate of ₹3.00 per unit.

Ans : [CBSE 2014]

(a) Given: $P = 2\,\text{kW} = 2000 \text{ W}$

$$t = 2\,\text{h}$$

Electric energy, $E = P \times t = 2 \times 2 = 4$ kWh

(b) Total energy consumed in month of June (having 30 days)

Electric kettle $= (4 \times 30)$ kWh $= 120$ kWh

$= 120$ units.

Cost of running electric kettle:

$$= ₹120 \times 3 = ₹360$$

79. Two lamps, one is rated 100 W at 220 V, and the other 60 W at 220 V, are connected in parallel to a 220 V supply. Find the current drawn from the supply line.

Ans : [CBSE 2014]

Given: Lamp one 100 W, 220 V, Lamp 2 60 W, 220 V.
Let their resistances are R_1 and R_2

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

$$R_1 = \frac{220 \times 220}{100}\,\Omega = 484\,\Omega$$

$$= \frac{220 \times 220}{60}\,\Omega = \frac{2420}{3}\,\Omega$$

In circuit R_1 and R_2 are connected in parallel.

$$\frac{1}{R} = \frac{1}{484} + \frac{3}{2420}$$

$$R = \frac{605}{2}\,\Omega$$

$$I = \frac{V}{R} = \frac{220 \times 2}{605}\text{A} = 0.727 \text{ A}$$

80. Two bulbs A and B are rated as 90W–120V and 60W–120V respectively. They are connected in parallel across a 120V source. Find the current in each bulb. Which bulb will consume more energy?

Ans : [CBSE 2014]

First Bulb: 90 W–120 V

$$R_1 = \frac{V^2}{P_1} = \frac{120 \times 120}{90} = 160\,\Omega$$

$$I_1 = \frac{V}{R_1} = \frac{120}{160} = 0.75 \text{ A}$$

Second Bulb: 60W–120V

$$R_2 = \frac{V^2}{P_2} = \frac{120 \times 120}{60}$$

$$R_2 = 240\,\Omega$$

$$I_2 = \frac{V}{R_2} = \frac{120}{240}$$

$$I_2 = 0.5\text{A}$$

Power of first bulb has more power than second bulb,

so first bulb will consume more energy.

81. Draw the nature of V–I graph for a nichrome wire. (V-Potential difference, I-Current)
A metallic wire of 625 mm length offers a $4\,\Omega$ resistance. If the resistivity of the metal is 4.8×10^{-7} ohm-metre, then calculate the area of cross-section of the wire.

Ans : [CBSE 2013]

V–I graph for nichrome wire
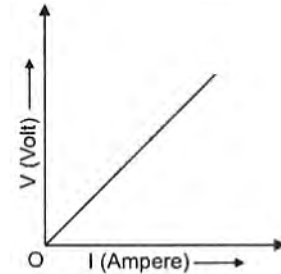
Given: $l = 625$ mm $= 0.625$ m

$$R = 4\,\Omega$$

$$\rho = 4.8 \times 10^{-7} \text{ Ohm-m}$$

$$A = ?$$

$$R = \rho\frac{l}{A} \text{ or } A = \rho\frac{l}{R}$$
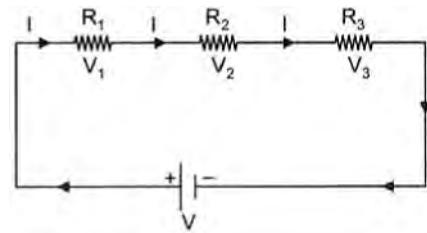
$$A = 4.8 \times 10^{-7} \times \frac{0.625}{4}$$

$$= 0.75 \times 10^{-7}\,\text{m}^2$$

82. Derive the relation $R = R_1 + R_2 + R_3$ when three resistors R_1, R_2 and R_3 are connected in series in an electric circuit.

Ans : [CBSE 2012]

Three resistors R_1, R_2 and R_3 are connected in series. Therefore current in each resistor is same. Let current in the circuit is I.

Applied total potential = Sum of the potentials across each resistor

$$V = V_1 + V_2 + V_3$$

$$IR_{eq} = IR_1 + IR_2 + IR_3$$

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

83. (a) Nichrome wire of length L and radius R has resistance of 10 Ω. How would the resistance of the wire change when:
  (i) Only length of the wire is doubled?
  (ii) Only diameter of the wire is doubled? Justify your answer.
  (b) Why element of electrical heating devices are made-up of alloys?

Ans : [CBSE 2012]

a. R = 10 Ω of length L, and area of cross-section A.
i. When only length is doubled $R' = 20\,\Omega$
ii. When only diameter is doubled.

$$R \propto \frac{1}{A} \propto \frac{1}{D^2}$$

$$R'' \propto \frac{1}{(2D)^2}$$

$$R'' \propto \frac{1}{4D^2}$$

$$R'' = \frac{R}{4}$$

$$R'' = \frac{10}{4} = 2.5\,\Omega$$

b. Alloys have high resistivity more than their constituent pure metals and do not oxide at high temperature easily.

84. Resistivity of two elements A and B are $= 1.62 \times 10^{-8}\,\Omega m$ and $520 \times 10^{-8}\,\Omega m$ respectively. Out of these two, name the element that can be used to make:
a. filament of electric bulb.
b. wires for electrical transmission lines. Justify your answer in each case.

Ans : [CBSE 2012]

Given: $\rho_A = 1.62 \times 10^{-8}\,\Omega m$

$\rho_B = 520 \times 10^{-8}\,\Omega m$

a. For filament of electric bulb resistivity must be higher i.e. $520 \times 10^{-8}\,\Omega m$. So element B is used for filament.
b. For electric transmission resistivity must be lower which is of element A.

85. State Ohm's law. Calculate the resistance of a conductor, if the current flowing through it is 0.2 A when the applied potential difference is 0.8 V.

Ans : [CBSE 2012]

If the physical conditions of a conductor are kept same then current is directly proportional to the potential difference across the ends of the conductor $V \propto I$.

$$V = RI$$
$$I = 0.2\,\text{A}$$
$$V = 0.8\,\text{Volt.}$$
$$R = ?$$
$$R = \frac{V}{I} = \frac{0.8}{0.2}\,\Omega$$
$$R = 4\,\Omega$$

86. (a) Why are copper or aluminium wires generally used for electrical transmission and distribution purposes?
(b) Two wires, one of copper and other of manganin, have equal lengths and equal resistances. Which wire is thicker? Given that resistivity of copper is lower than that of manganin.

Ans : [CBSE 2011]

a. Copper or aluminium wires are used for transmission and distribution of electricity due to their low resistivity and high conductivity.

b. We know that $R = \rho\frac{l}{A}$

$$\rho \propto A$$

Thicker the wire, more the resistivity. The resistivity of manganin is more than copper. So manganin wire is thicker than copper.

87. Two conducting wires of same material, equal length and equal diameter are connected in series. How does the heat produced by the combination of resistance change?

Ans : [CBSE 2010]

Let the resistances of two wires are R each.
Heat produced by individual resistor

$$H' = \frac{V^2}{R}t$$

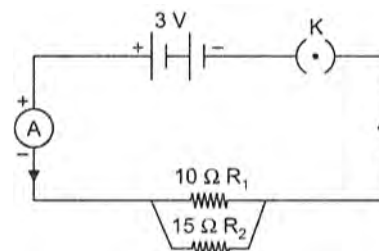Resistance is series, $R_S = R + R = 2R$
Heat produced by combination of resistors

$$H' = \frac{V^2}{2R}t$$

$$\frac{H'}{H} = \frac{1}{2}$$

$$H' = \frac{H}{2}$$

88. Study the following circuit and answer the following questions:

a. State the type of combination of the two resistors in the circuit.
b. How much current would flow through: (1) 10 Ω resistor and (2) 15 Ω resistor?
c. What would be the ammeter reading?

Ans : [CBSE 2010]

a. 10 Ω and 15 Ω are in parallel combination.
b. Potential difference across each is 3V.

$$I \text{ in } 10\,\Omega \text{ resistor} = \frac{3}{10} = 0.3\,\text{A}$$

$$I \text{ in } 15\,\Omega \text{ resistor} = \frac{3}{15} = 0.2\,\text{A}$$

$$I = 0.3 + 0.2 = 0.5\ \text{A}$$

89. Define electric current and state its SI unit. With the help of Ohm's law explain the meaning of 1 Ohm resistance.

Ans : [CBSE 2010]

Electric current may be defined as the rate of flow of charge through a circuit. Its SI unit is Ampere.
According to Ohm's law $V = IR$

$$R = \frac{V}{I}$$

If $V = 1$ Volt, $I = 1\,\text{A}$ then $R = 1$ ohm.
A conductor has a resistance of 1 Ohm if a current of

one amp flows through it when a potential difference of 1 volt is applied across it.

90. (a) What is the total resistance of n resistors each of resistance 'R' connected in: (i) series? (ii) parallel?
(b) Calculate the resultant resistance of 3 resistors $3\,\Omega, 4\,\Omega$ and $12\,\Omega$ connected in parallel.

Ans : [CBSE 2010]

a. In series combination

$$R_S = R_1 + R_2 + \ldots R_n$$
$$R_S = R + R \ldots n \text{ times}$$
$$R_S = nR$$

In parallel combination:

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \frac{1}{R_n}$$
$$= \frac{1}{R} + \frac{1}{R} + \frac{1}{R} + \ldots + n \text{ times}$$
$$= \frac{1 + 1 + \ldots n \text{ times}}{R}$$

or
$$\frac{1}{R_P} = \frac{n}{R}$$
$$R_P = \frac{R}{n}$$

b. Given:
$$R_1 = 3\,\Omega$$
$$R_2 = 4\,\Omega$$
$$R_3 = 12\,\Omega$$
$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$
$$= \frac{1}{3} + \frac{1}{4} + \frac{1}{12}$$
$$= \frac{4 + 3 + 1}{12} = \frac{8}{12} = \frac{2}{3}$$
$$R = \frac{3}{2}\,\Omega = 1.5\,\Omega$$

91. (a) State Ohm's law. Express it mathematically.
(b) Write symbols used in electric circuits to represent:
  (i) variable resistance.
  (ii) voltmeter.
(c) An electric bulb is rated 220 V and 100 W. When it is operated on 110 V, what will be the power consumed?

Ans : [CBSE 2010]

a. Ohm's Law states that if the physical conditions of a conductor are kept constant then current passing through a conductor is directly proportional to the potential difference across its ends.

$$V \propto I \text{ or } V = RI$$

b. ⎯⎯⎺⎺⎺⎯⎯ A variable resistor

c. Given rating of bulb 220 V – 100 W

$$R = ?$$

Power consumed = ? when $V = 110$ Volt

$$R = \frac{V^2}{P} = \frac{220 \times 220}{100} = 484\,\Omega$$

Power at 110 volt

$$P = \frac{V^2}{R} = \frac{110 \times 110}{484}$$

$$P = \frac{100}{4}\,\text{W}$$
$$P = 25\,\text{W}$$

92. (a) How is the direction of electric current related to the direction of flow of electrons in a wire?
(b) Calculate the current in a circuit, if 500 C of charge passes through it in 10 minutes.

Ans : [CBSE 2009]

a. The direction of flow of electrons is opposite to the direction of conventional current.

b. $Q = 500\,\text{C}$, $t = 10$ mts $= 10 \times 60 = 600\,\text{s}$

$$I = \frac{Q}{t} = \frac{500}{600}\,\text{A}$$
$$I = 0.83\,\text{A}$$

93. (a) Define the term 'volt'.
(b) State the relation between work, charge and potential difference for an electric circuit. Calculate the potential difference between the two terminals of a battery, if 100 joules of work is required to transfer 20 coulombs of charge from one terminal of the battery to the other.

Ans : [CBSE 2009]

a. Potential difference b/w two points in an electric field is said to be 1 volt if the amount of work done in bringing a unit positive charge from one point to another point is 1 J.

b. Given: $W = 100\,\text{J}$, Q $= 20\,\text{C}$, $V = ?$

As
$$V = \frac{W}{Q} \Rightarrow V = \frac{100}{20}\,\text{JC}^{-1}$$
$$V = 5\,\text{JC}^{-1}$$
$$V = 5 \text{ Volt.}$$

94. State the formula co-relating the electric current flowing in a conductor and the voltage applied across it. Also, show this relationship by drawing a graph.
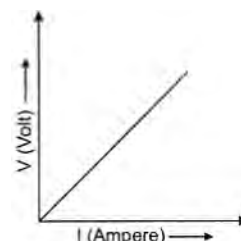
What would be the resistance of a conductor, if the current flowing through it is 0.35 ampere when the potential difference across it is 1.4 volt?

Ans : [CBSE 2004]

$$V = IR$$

i.e., $$V \propto I$$

If we plot a graph b/w V and I, it is straight line.

Graph b/w V and I:

Given: $I = 0.35\,\text{A}$
$V = 1.4$ Volt.

$$R = \frac{V}{I} = \frac{1.4}{0.35} \text{ Ohm}$$
$$R = 4\,\Omega$$

95. The value of current (I) flowing through a given resistor of resistance (R), for the corresponding values of potential difference (V) across the resistor are as given below :

V	0.5	1.0	1.5	2.0	2.5	3.0	4.0	5.0
I	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8

Plot a graph between current (I) and potential difference (V) and determine the resistance (R) of the resistor.

Ans :   [CBSE 2018]


Plotting of correct graph
Calculation of resistance
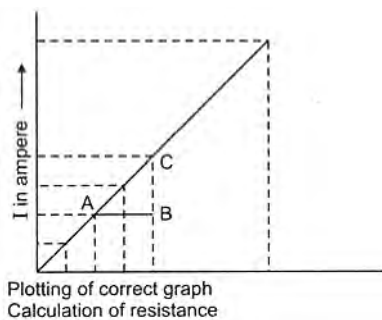
96. Draw a labelled circuit diagram showing three resistors R1, R2 and R3 connected in series with a battery (E), a rheostat (Rh), a plug key (K) and an ammeter (A) using standard circuit symbols. Use this circuit to show that the same current flows through every part of the circuit. List two precautions you would observe while performing the experiment.

Ans :   [CBSE 2016]

By changing the position of ammeter, measure the current in it. Every time the magnitude of current is found same i.e., in series combination the current in every part of the circuit, remains same.
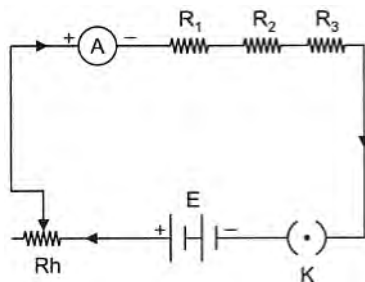

Precaution:
a. Connect the ammeter in series with battery.
b. All connection must be tight.
c. Current must not be greater than the range of ammeter.

97. (a) Derive the formula for the calculation of work done when current flows through a resistor.
(b) One electric bulb is rated 40 W and 240 V and other 25 W and 240 V. Which bulb has higher resistance and how many times?

Ans :   [CBSE 2016]

a. Let R is the resistance of the resistor in which I current is passed for a time t by applying a p.d. (V) across the resistor.
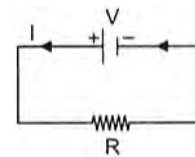
The work done in bringing a charge Q from one end to another of the conductor

$$W = QV$$

But

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

$$Q = It$$

$$W \quad VIt$$

b. 40 W–240 V   25 W–240 V

$$P_1 = \frac{V_1^2}{R_1} \qquad R_2 = \frac{V_2^2}{P_2}$$

$$R_1 = \frac{V_1^2}{P_1} \qquad R_2 = \frac{240 \times 240}{25}\,\Omega$$

$$R_1 = \frac{240 \times 240}{40}\,\Omega$$

$$\frac{R_1}{R_2} = \frac{25}{40} \text{ or } \frac{R_1}{R_2} = \frac{5}{8}$$

$R_1 < R_2$ i.e., Resistance of 25 W bulb is more than 40 W bulb.

98. a. What is meant by saying that the potential difference between two points is 1 volt?
b. Why does the connecting cord of an electrical heater not glow while the heating element does?
c. Electrical resistivity of some substance at 20°C are given below:

Silver	$1.60 \times 10^{-8}\,\Omega m$
Copper	$1.62 \times 10^{-8}\,\Omega m$
Tungsten	$5.2 \times 10^{-8}\,\Omega m$
Iron	$10.0 \times 10^{-8}\,\Omega m$
Mercury	$94.0 \times 10^{-8}\,\Omega m$
Nichrome	$100 \times 10^{-6}\,\Omega m$

Answer the following questions in relation to them:
i. Among silver and copper which one is better conductor? Why?
ii. Which material would you advise to use in electrical heating device? Why?

Ans :   [CBSE 2016]

a. If the amount of work done in bringing a unit positive charge from one point to another is 1 J in an electric field then potential difference b/w the two points is said to be 1 volt.

$$1V = \frac{1J}{1C}$$

b. Connected cord of an electrical heater does not glow because this is of copper metal, which has low resistivity and good conductivity. Heating element glows due to its high resistivity or poor conductivity.
c. (i) The resistivity of silver is lesser than copper so it is a good conductor.
(ii) The resistivity of nichrome is maximum in the given table so nichrome will be advised to use

in electrical heating device.

99. (a) Name an instrument that measures electric current in a circuit. Define unit of electric current.
(b) What are the following symbols mean in an electric circuit?

(i) —⋀⋀— (ii) —(•)—

(c) Draw a closed circuit diagram consisting of 0.5 m long nichrome wire XY, an , ammeter, a voltmeter, four cells of 1.5 V and a plug key.

Ans : [CBSE 2015]

a. Ammeter.
If IC charge flows in an electric circuit is 1 s then the current is said to be 1 A.
b. (i) Rheostat (ii) Closed key

c.
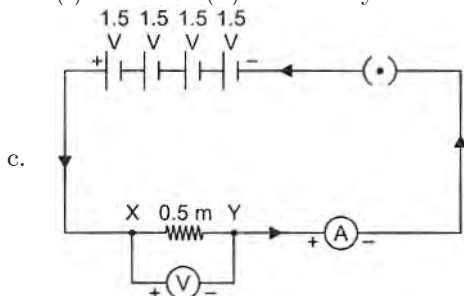
100. What is meant by resistance of a conductor? Name and define its SI unit. List the factors on which the resistance of a conductor depends. How is the resistance of a wire affected if:
a. its length is doubled,
b. its radius is doubled?

Ans : [CBSE 2015]

Property of any conductor by virtue of which it opposes the flow of current in the conductor is called its resistance.
SI unit of resistance is Ohm. If by applying a potential difference of 1 volt the current in the conductor is 1 A. Then the resistance of the conductor is said to be 1 ohm.
Factor affecting resistances:
a. If length is double then resistance also becomes doubled.
b. If radius is doubled then area $A = \pi(2r)^2$ becomes 4 times, then the resistance becomes 1/4.

101. What do you mean by heating effect of electric current? Explain the production of heat in a resistor by flow of electric current through it. Name two devices based on heating effect of current.

Ans : [All India 2015]

When current is passed through a conductor, heat is produced. Production of heat in a conductor on passing the current is called heating effect of current. When a current is passed in a conductor by applying a potential difference, electrons get accelerated and collide with the atoms of the conductor. During the collision there is a loss of kinetic energy. This loss in K.E. appears in the form of heat energy in the conductor 1. Electric heater, 2. Bulb.

102. (a) Name an instrument that measures potential difference between two points in a circuit. Define the unit of potential difference in terms of SI unit

of charge and work. Draw the circuit symbols for (i) variable resistor, (ii) a plug key which is closed one.
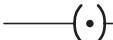(b) Two electric circuits I and II are shown below "
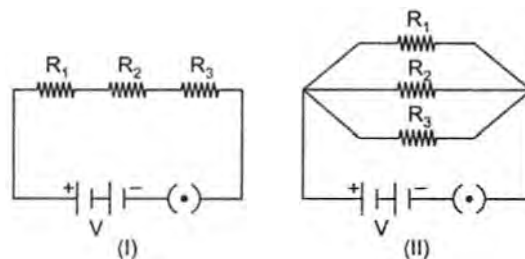
(i) Which of the two circuits has more resistance?
(ii) Through which circuit more current passes?
(iii) In which circuit, the potential difference across each resistor is equal?
(iv) If $R_1 > R_2 > R_3$ in which circuit more heat will be produced in R_1 as compared to other two resistors?

Ans : [CBSE 2014]

a. Voltmeter
The amount of work done in bringing a unit positive charge from one point to another in an electric field is said to be potential difference

$$V = \frac{W}{Q}$$

(i) —⋀⋀— Variable resistance
(ii) —(•)— Closed key.

b. (i) In series combination resistance is more than parallel combination.
(ii) Lesser the resistance more the current in circuit i.e., in parallel (II) current is max.
(iii) In parallel combination (II)
(iv) More heat in (I) across R_1.

103. When a high resistance voltmeter is connected directly across an electric bulb, its reading is 2 V. An electric cell is sending the current of 0.4 ampere (measured by an ammeter) in the electric circuit.
a. Draw the circuit.
b. Find the resistance of the electric bulb,
c. State the law that is applied for making these calculation. If a graph is plotted between V and I, show the nature of the graph obtained.
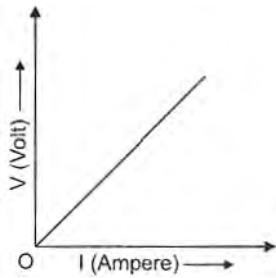
Ans : [Delhi 2014]

a.
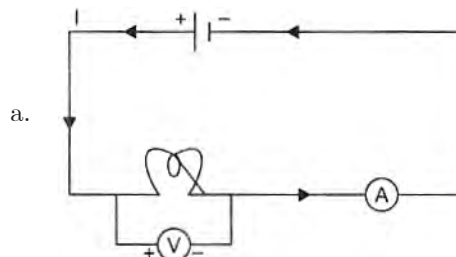
b. $V = 2$ Volt, $I = 0.4$ A
$$R = \frac{V}{I} = \frac{2}{0.4} \text{ ohm or } R = 5 \text{ ohm}$$

c. **Ohm's law:** If the physical conditions of a conductor is kept constant then current in the circuit is directly proportional to the potential difference

applied across the ends of the conductor.

Since $V \propto I$

Hence graph between V and I is a straight line for a conductor. Which passes through the origin O of the graph.

104. Draw a schematic diagram of an electric circuit (in the "on" position) consisting of a battery of five cells of 2 V each, a 5 Ω resistor, a 8 Ω resistor, a 12 Ω resistor and a plug key, all connected in series. An ammeter is put in the circuit to measure the electric current through the resistors and a voltmeter is connected so as to measure the potential difference across the 12 Ω resistor.

Calculate the reading shown by the: (a) ammeter (b) voltmeter in the below electric circuit.

Ans : [CBSE 2014]

Resistors of 5 Ω, 8 Ω, 12 Ω all the connected in series. Hence,

$$R_S = R_1 + R_2 + R_3$$
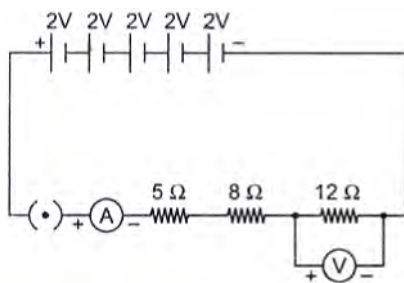$$= (5 + 8 + 12)\,\Omega$$
$$R_S = 25\,\Omega$$

As
$$V = IR$$
$$I = \frac{V}{R} = \frac{10}{25}\,\text{A}$$
$$I = 0.4\,\text{A}$$

a. Ammeter reading is 0.4 A.

b. $V = IR$

Potential drop across 12 Ω resistance
$$V = 0.4 \times 12 = 4.8\,\text{Volt.}$$

105. (a) Explain how does a cell maintain current in a circuit.
(b) In the circuit given below the resistance of the path xTy = 2 Ω and that of xZy = 6 Ω
  (i) Find the equivalent resistance between x and y.
  (ii) Find the current in the main circuit.
  (iii) Calculate the current that flows through the path xTy and xZy.
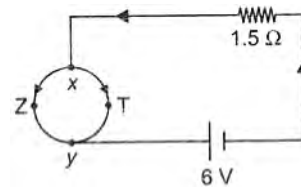
Ans :

a. Potential difference b/w the two terminals of a cell is produced due to chemical reaction in the cell. This potential difference maintains a current in the circuit.
b. (i) The resistance b/w XZY and XTY are in parallel combination. Their equivalent resistance.

$$\frac{1}{R_{xy}} = \frac{1}{2} + \frac{1}{6}$$
$$R_{xy} = \frac{3}{2} = 1.5\,\Omega$$

(ii) Net resistance of the circuit
$$R = 1.5 + 1.5 = 3.0\,\Omega$$
Hence,
$$I = \frac{V}{R} = \frac{6}{3}$$
$$I = 2.0\,\text{A}$$

(iii) P.D. across X, Y points
$$V = IR_{xy} = 2 \times 1.5 = 3.0\,\text{V}$$
$$I \text{ in } 2\,\Omega \text{ resistor} = \frac{3.0}{2} = 1.5\,\text{A}$$
$$I \text{ in } 6\,\Omega \text{ resistor} = \frac{3.0}{6} = 0.5\,\text{A}$$

106. (a) State the commercial unit of electric energy and find its relation with its SI unit.
(b) The current through a resistor is made three times its initial value. Calculate how it will affect the heat produced in the resistor.
(c) Find the increase in the amount of heat generated in a conductor if another conductor of double resistance is connected in the circuit keeping all other factors unchanged.

Ans : [CBSE 2014]

a. Commercial unit of electric energy = kWh
$$1\,\text{kWh} = 3.6 \times 10^6\,\text{J}$$
b. Initial heat generated in the
$$\text{resistor} = I^2Rt$$
$$H_1 = I^2Rt \qquad \qquad ...(1)$$
when current is made three times i.e. $3I$ now heat generated
$$H_2 = (3I)^2Rt \qquad \qquad ...(2)$$
$$H_2 = 9I^2Rt$$
In later case, heat generated is 9 times the initial heat generated.
c. If another conductor of $2R$ is connected in series then total resistance $= R + 2R = 3R$.
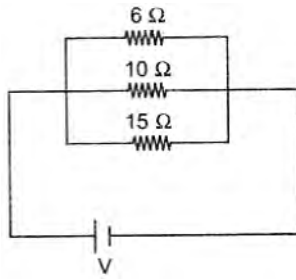Now heat generated $H = I^2(3R)t$
$$H = 3I^2Rt$$
In this case, heat generated is three times.

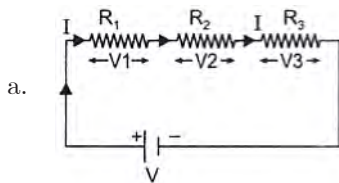**107.** (a) Derive an expression to find the equivalent resistance of three resistors connected in series.

Also, draw the schematic diagram of the circuit.

(b) Find the equivalent resistance of the following circuit:
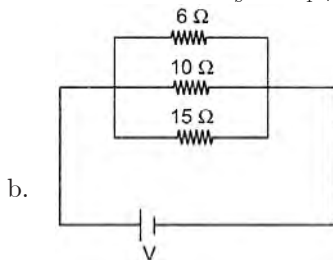

Ans : [CBSE 2013]

a.

If the equivalent resistance is R_s

then, $\qquad V = IR_s$

But, $\qquad V = V_1 + V_2 + V_3$

$\qquad\qquad R_s = R_1 + R_2 + R_3$

b.

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

$$= \frac{1}{6} + \frac{1}{10} + \frac{1}{15} = \frac{5 + 3 + 2}{30}$$

$$= \frac{10}{30}$$

$$R_p = 3\,\Omega$$

108. (a) Name and state the law that gives relationship between the current through a conductor and the potential difference across its two terminals. Also, express this law mathematically.

(b) Draw the V-I graph for this law. Justify your answer.

(c) Write the name and use of the circuit components whose symbols are given below.
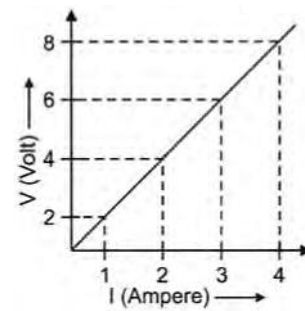
(i) ——ᱼᐱ⋎ᱻ—— (ii) ——(•)——

Ans : [CBSE 2013]

a. The law is Ohm's law.
   If the physical conditions of a conductor is kept constant then current through it is directly proportional to the potential difference applied across it.

$$V \propto I \text{ or } V = RI$$

b. Since $V \propto I$ so a graph b/w V and I is a straight line.

c. (i) Symbol is of variable resistor and it is used to regulate the current.
   (ii) Plug key is closed. When plug key is closed current flows through the circuit.

109. Define resistance of a conductor. State the factors on which resistance of a conductor depends. Name the device which is often used to change the resistance without changing the voltage source in an electric circuit.

Calculate the resistance of 50 m length of wire of cross-sectional area 0.01 square mm and of resistivity $5 \times 10^{-8}\,\Omega m$.

Ans : [CASE 20131

Resistance is the opposition offered in the path of flow of current by the atoms or molecules of a conductor. Factors affecting resistances:

a. length $R \propto l$

b. area of cross-section $R \propto \dfrac{1}{A}$

c. nature of material.
   Rheostat is used to change the current in the circuit without changing the voltage source.

Given: $\qquad l = 50$ m
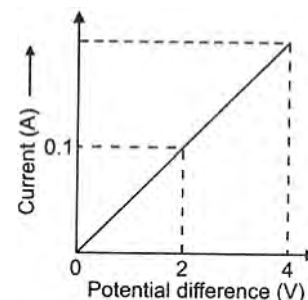
$\qquad\qquad A = 0.01\,\text{mm}^2 = 0.01 \times 10^{-6}\,\text{m}^2$

$\qquad\qquad \rho = 5 \times 10^{-8}\,\Omega m$

As $\qquad R = \rho\dfrac{l}{A} = 5 \times 10^{-8} \times \dfrac{50}{0.01 \times 10^{-6}}$

$\qquad\qquad R = 250\,\Omega$

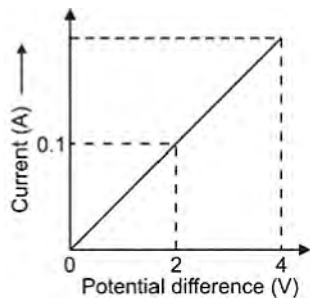**110.** (a) Calculate the resistance of the wire using graph.

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

(c) Define electric power, Derive relation between power, potential difference and resistance.

Ans : [CBSE 2012]

a. $\qquad\qquad R = \dfrac{\Delta V}{\Delta I} = \dfrac{2 - 0}{0.1 - 0}\,\Omega$

$\qquad\qquad R = 20\,\Omega$

b. Resistance of the circuit to carry a current of 5A on 220V.

$$R = \frac{220}{5} = 44\,\Omega$$

Let n resistors of $176\,\Omega$ are connected whose equivalent resistance is $44\,\Omega$.

$$\frac{176}{n} = 44 \text{ or } n = \frac{176}{44}$$

$$n = 4$$

a. The rate of electrical energy is consumed in a circuit is called electric power

$$P = \frac{W}{t} = \frac{I^2 R t}{t}$$

$$P = I^2 R \text{ But } I = \frac{V}{R}$$

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

111. (a) Three resistors R_1, R_2 and R_3 are connected in parallel and the combination is connected to battery, ammeter, voltmeter and key. Draw suitable circuit diagram. Obtain an expression for the effective resistance of the combination of resistors in parallel.

(b) Why are electric bulbs filled with chemically inactive nitrogen or argon?

(c) What is meant by the statement that the rating of a fuse in a circuit is 5 A?

Ans : [CBSE 2012]

a. Let equivalent (effective) resistance is R

then $\qquad I = \frac{V}{R}$
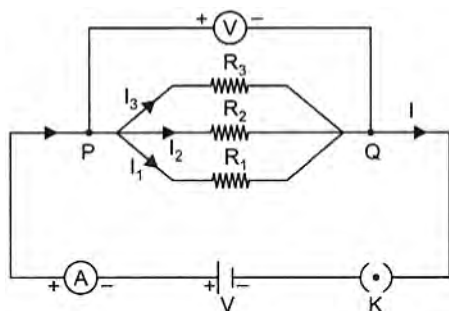
Similarly, $\qquad I_1 = \frac{V}{R_1}$

$$I_2 = \frac{V}{R_2} \text{ and } I_3 = \frac{V}{R_3}$$

But $\qquad I = I_1 + I_2 + I_3$

or $\qquad \frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$

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

b. To prevent oxidising the filament due to high temperature.

c. The current in the fuse wire must not exceed 5 A otherwise it will melt.

112. (a) In the circuit shown connect a nichrome wire of length "L" between points X and Y and note the ammeter reading.

(i) When this experiment is repeated by inserting another nichrome wire of the same thickness but twice the length (2L), what changes are observed in the ammeter reading?

(ii) State the changes that are observed in the ammeter reading if we double the area of cross-section without changing the length in the above experiment. Justify your answer in both the cases.

(b) "Potential difference between points A and B in an electric field is 1V". Explain the statement.
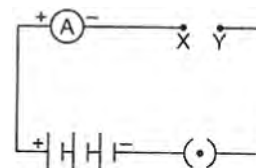
Ans : [CBSE 2012]

a. (i) The resistance of two times long wire also becomes two times so current decreases in the circuit.

(ii) If area of the nichrome wire is doubled then its resistance decreases and hence current increases in the circuit.

b. Potential difference b/w A and B is 1 volt means that 1 J of work is to be done in moving a unit positive charge (+ 1C) from point A to B.

113. Draw a circuit diagram for a circuit consisting of a battery of five cells of 2 volts each, a $5\,\Omega$ resistor, a $10\,\Omega$ resistor and a $15\,\Omega$ resistor, an ammeter and a plug key; all connected in series. Also, connect a voltmeter to record the potential difference across the $15\,\Omega$ resistor and calculate:

a. the electric current passing through the above circuit and

b. potential difference across $5\,\Omega$ resistor when the key is closed.

Ans : [CBSE 2012]
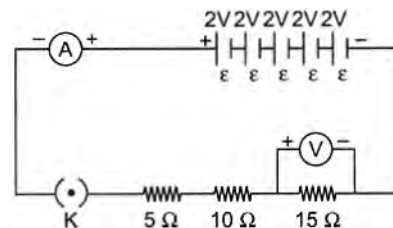
a. Net effective resistance of the circuit.

$$R\;(5 + 10 + 15)\,\Omega = 30\,\Omega$$

Current in the circuit

$$I = \frac{n\varepsilon}{R} = \frac{5 \times 2}{30}\,\text{A} = \frac{1}{3}\,\text{A}$$

$$I = 0.33\,\text{A}$$

b. P.D. across $5\,\Omega$ resistor $V = IR$

$$V = 0.33 \times 5 = 1.65 \text{ Volt.}$$

$$V = 1.65 \text{ Volt.}$$

114. (a) What is an electric circuit?

(b) Calculate the number of electron that flow per second to constitute a current of one ampere. Charge on an electron is $1.6 \times 10^{-19}\,C$.

(c) Draw an electric circuit for studying Ohm's law. Label the circuit component used to measure electric current and potential difference.

Ans : [CBSE 2012]

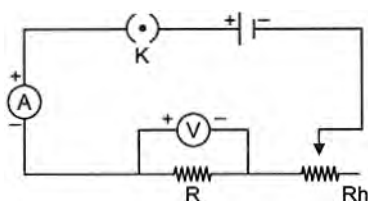a. A continuous path in which current can flow when switch i6 plugged in.

b. $Q = It$ or $ne = It \Rightarrow n = \dfrac{I \cdot t}{e}$

Given: $I = 1A$, $t = 1s$

$$n = \frac{1 \times 1}{1.6 \times 10^{-19}}$$

$$n = 6.25 \times 10^{18} \text{ electrons}$$

c. K–Plug key, (A)–Ammeter, (V)–Voltmeter, Rh–Rheostat

115. (a) Define potential difference between two points in a conductor.

(b) Name the instrument used to measure the potential difference in a circuit. How is it connected?

(c) A current of 2 A passes through a circuit for 1 minute. If potential difference between the terminals of the circuit is 3 V, what is the work done in transferring the charges?

Ans : [CBSE 2012]

a. Electric potential is the amount of work done in bringing a unit positive charge from one point to another.

b. Voltmeter. It is connected in parallel in the circuit.

c. $I = 2A$, $t = 1$ min. $= 60\,s$, $V = 3\,V$

$$W = VQ = V(It)$$

$$W = 3 \times 2 \times 60\,J$$

$$W = 360\,J$$

116. State Ohm's law. Write the mathematical representation of Ohm's law. Use this relationship to define 1 ohm. List two disadvantages of connecting different electrical appliances in series.

Ans : [CBSE 2012]

If the physical conditions of a conductor are kept constant then current is directly proportional to the potential difference applied across it.

Mathematical representation of Ohm's law $V = IR$.

$$\frac{V}{I} = R$$

$$\frac{1\,\text{Volt}}{1\,\text{Ampere}} = 1\,\text{ohm}$$

If by applying a potential difference of 1 volt across a conductor, the current is 1A then the resistance of the conductor is said to be 1 ohm.

Two disadvantages of connecting electrical appliance in series.

a. If one appliance fails to operate then the circuit is broken and other devices also will not operate.

b. Different devices require different amount of current to operate but in series combination, same current is supplied to all electrical appliances.

117. Define power. State the difference between 1 watt and 1 watt hour. Establish the relationship between unit of electric energy and SI unit of energy. An electric heater rated 1000 W/220 V operates 2 hours daily. Calculate the cost of energy to operate for 30 days at the rate of Rs 5.00 per kWh.

Ans : [CBSE 2012]

Electric Power: P is defined as the rate at which electric energy is consumed in an electric circuit.

1 watt is the power consumed by an electric appliance that carries 1A current when a potential difference of 1 volt is applied across it. Whereas 1 Wh. is the unit of electric energy, which is consumed by an electric appliance of 1 W power in one hour.

Commercial unit of electric energy is kWh.

$$1 \text{ kWh} = 1000\,\text{W} \times 60 \times 60\,\text{s}$$

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

Energy consumed by heater in one month

$$= 1000\,\text{W} \times 2\text{h} \times 30 \text{ days} = 60\,\text{kWh}$$

$$= 60 \text{ units}$$

Total cost @₹5/-kWh $= 5 \times 60 = $ ₹300

118. (a) Why is the series arrangement not used for domestic circuits?

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

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

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

(e) Why does the cord of an electric heater not glow while the heating element does?

Ans : [CBSE 2010]

a. In the series arrangement if any device fails to work, circuit will be broken and other devices stop working. In series combination current remains same. Where as different devices requires different current.

b. Tungsten is used due to its high resistivity and high melting point.

c. Alloys have higher resistivity than their pure constituent and hence produces more heat.

d. Copper and aluminium are good conductors and have low values of resistivity so these are used for electric transmission.

e. Cords core made up of good conductor with low resistivity where as heating elements are made up of alloys of higher resistivity to produce more heat.

119. (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?

(i) ——⩗⩗⩘—— (ii) ——(•)——

(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 this 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:
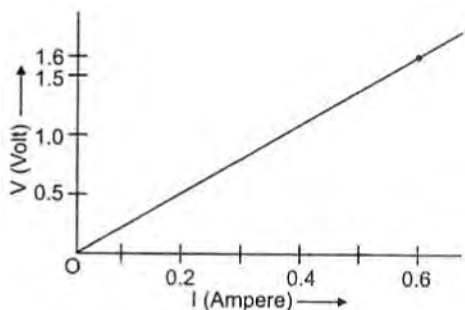
What would be the values of V/I ratios when the potential difference is 0.8 V, 1.2 V and 1.6 V respectively? What conclusion do you draw from these values?

Ans : [Delhi 2008]

a. **Ammeter:** Ampere is the unit of current. If one coulomb charge flows in a circuit in 1 s then the current in the circuit will be 1 Ampere. (A)

b. (i) Variable resistor (ii) closed key

c. (i)

(ii)
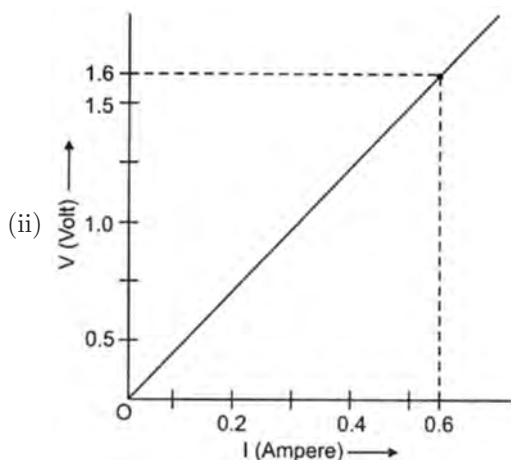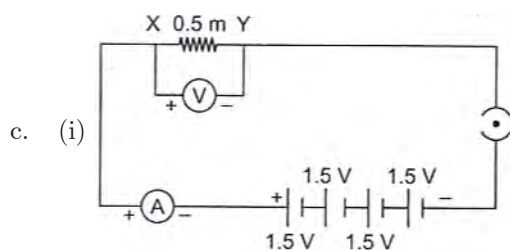
The graph b/w V and I is a straight line.

$$R = \frac{V}{I} = \frac{1.6 - 0}{0.6 - 0} = \frac{1.6}{0.6} = 2.67\,\Omega$$

120. (a) (i) What is meant by saying that the potential difference between two points is 1 volt?

(ii) How much energy is given to 5 coulomb of charge passing through a 12 V battery?

(b) Describe an activity with necessary electric circuit drawn to study the factors on which the resistance of a conducting wire depends.

Ans : [CBSE 2008]

a. (i) Potential difference b/w the two points is 1 volt mean if we bring a unit positive charge (+ 1C) from one point to other point then amount of work done is 1 J, W = VQ.

(ii) Given: Q =5 C, V =12 V, W =12 × 5 = 60 J

b. Activity to study the factors of affecting resistance of the conductor—Take a cell, an ammeter, manganin wires of different length and different area of cross- section and key. Connect an ammeter, a manganin wire of (say) 10 cm long to a cell through a plug key.

(i). Now closed the key and note the current in the circuit with the help of ammeter.

(ii). Now replace the manganin wire with another manganin wire of twice the area of cross-section and again measure the current in the circuit with the help of ammeter.

(iii).Now repeat the activity by taking a copper wire of same length same area of cross-section, and note down the current in each case. You will find that current in the circuit in each case is different. Which shows that resistance depends upon (1) nature of material (2) length of the conductor and (3) area of cross-section.
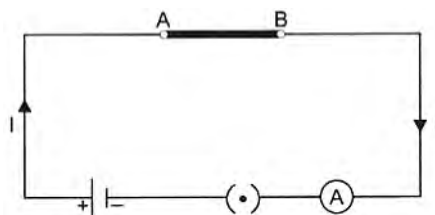

121. (a) What do the following symbols represent in a circuit? Write the name and one function of each.

(i) ——⩗⩗⩘—— (ii) ——⤙——

(b) Draw a schematic diagram of a circuit consisting of a battery of 12 V, three resistors of 5 Ω, 10 Ω and 20 Ω connected in parallel, an ammeter to measure the total current through the circuit, a voltmeter to measure the potential difference across the combination of resistors.

(c) State any one advantage of connecting electrical devices in parallel with the mains instead of connecting them in series in a household circuit.

Ans : [CBSE 2008]

a. (i) Variable resistor used to change the current in circuit.

(ii) Wires crossing each other which are not connected together. It is used when large number of connections are to be made with the help of wires out joining them.

b.
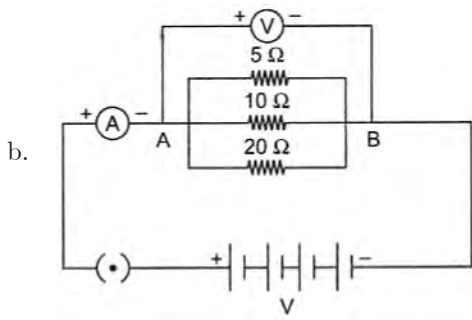
c. (i) Let the devices are connected in series if one devices fails to work, the circuit will be broken and all devices stop working, which is not in the case of parallel combination. In parallel combination if one device fails others keep working.

(ii) In parallel combination the voltage will be same across each device.

122. An electric iron has a rating of 750 W; 200 V. Calculate:

a. the current required.

b. the resistance of its heating element,

c. energy consumed by the iron in 2 hours.

Ans :   [CBSE2016]

Rating of iron is 750 W–200V.

$$P = 750 \, \text{W}, \, V = 200 \, \text{Volt.}$$

a. $$P = VI \text{ or } I = \frac{P}{V}$$

$$I = \frac{750}{200} = 3.75 \, \text{A}$$

b. $$\text{Resistance} = \frac{V}{I} = \frac{200}{3.75} = 53.3 \, \text{Volt.}$$

c.   Energy consumed in 2 hr $= P \times t$

$$E = 750 \times 2 \, \text{Wh} = 1500 \, \text{Wh}$$

123. A piece of wire is redrawn, without change in volume so that its radius is halved. Compare the new resistance with the original resistance.

Ans :   [CBSE2016]

Let $$l_1 = l$$

$$A_1 = \pi r_1^2 = \pi r^2$$

New length $= l_2$

$$A_2 = \pi \left(\frac{r}{2}\right)^2 = \frac{\pi r^2}{4}$$

Given: Volume is same

$$l_1 A_1 = l_2 A_2$$

$$l \times \pi r^2 = l_2 \frac{\pi r^2}{4} \text{ or } l_2 = 4l$$

$$R_1 = \rho \frac{l}{(\pi r^2)} \text{ and}$$

$$R_2 = \rho \frac{4l}{\pi \frac{r^2}{4}} = 16\rho \frac{l}{\pi r^2}$$

$$R_2 = 16R_1$$

124. The potential difference across the terminals of a cell is 1.5 volt. If it is connected with a resistance of 30 ohms, calculate the current flowing through the circuit.

Ans :   [CBSE2016]

Given: $$V = 1.5 \, \text{volt.}$$

$$R = 30 \, \Omega$$

$$I = \frac{V}{R} = \frac{1.5}{30} = \frac{1}{20} = 0.05 \, \text{A}$$

125. When two resistors of resistances R_1 and R_2 are connected in parallel, the net resistance is 3 Ω. When connected in series, its value is 16 Ω. Calculate the values of R_1 and R_2.

Ans :   [All India 2016]

R_1 and R_2 are in parallel combination.

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

$$\frac{R_1 \times R_2}{R_1 + R_2} = 3 \qquad \qquad ...(1)$$

When R_1 and R_2 are in series combination.

$$R_s = R_1 + R_2 = 16 \, \Omega$$

$$R_1 + R_2 = 16 \qquad \qquad ...(2)$$

Solving eq. (1) and eq. (2)

$$R_1^2 - 16R_1 + 48 = 0$$

$$(R_1 - 4)(R_1 - 12) = 0$$

$$R_1 = 4 \, \Omega, 12 \, \Omega$$

$$R_2 = 12 \, \Omega \text{ or } 4 \, \Omega$$

126. 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.

Ans :   [CBSE 2015]

Given: $$I = 0.5 \, \text{A}$$

$$t = 10 \times 60 \, \text{s}$$

$$I = \frac{Q}{t} \text{ or } Q = It$$

$$Q = 0.5 \times 10 \times 60 \, \text{C}$$

$$Q = 300 \, \text{C}$$

127. (a) How much current will an electric bulb draw from a 220 V source, if the resistance of the bulb filament is 1200 ohm?

(b) How much current will an electric heater coil draw from a 220 V source, if the resistance of the heater coil is 100 ohm?

Ans :   [CBSE 2015]

(a) Given: $V = 220$ V

$$R = 1200 \text{ ohm}$$

As $$V = IR$$

$$220 = I \times 1200 \text{ or } I = \frac{220}{1200} \text{A}$$

$$I = 0.18 \, \text{A}$$

(b) $$V = 220 \, \text{V}$$

$$R = 100 \text{ ohm}$$

$$I = \frac{V}{R} = \frac{220}{100} \, \text{A}$$

$$I = 2.2 \, \text{A}$$

128. The potential difference between the terminals of an electric heater is 60 V when it draws a current of 4 A from the source. What current will the heater draw, if

the potential difference is increased to 120 V?

Ans :

$$V = 60\,\text{V},\ I = 4\text{A}$$

$$R = \frac{V}{I} = \frac{60}{4} = 15\,\Omega$$

when

$$V = 120\,\text{V},\ R = 15\,\Omega$$

then,

$$I' = \frac{V}{R} = \frac{120}{15}$$

$$I' = 8\text{A}$$

129. Resistance of a metal wire of length 1 m is $26\,\Omega$ at 20°C. If the diameter of the wire is 0.3 mm, what will be the resistivity of the metal at that temperature?

Ans :

We have $\quad l = 1\,\text{m}$

$$R = 26\ \text{ohm}$$

$$t = 20°\text{C}$$

$$r = 0.15\ \text{mm}$$

$$\rho = ?$$

As

$$R = \rho \frac{l}{A}$$

$$\rho = R \times \frac{A}{l} = R \times \frac{\pi r^2}{l}$$

$$\rho = 26 \times \frac{22}{7} \times \frac{(0.15 \times 10^{-3})^2}{1}$$

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

130. A $4\,\Omega$ resistance wire is doubled on itself. Calculate the new resistance of the wire.

Ans : [CBSE 2015]

Let the initial length $= l$

Initial resistance $= 4\,\Omega$

when it is doubled on itself, length becomes half and area becomes double $(=2A)$

$$R_1 = \rho \frac{l_1}{A_1} \qquad\qquad ...(1)$$

$$4 = \rho \frac{l}{A}$$

$$R_2 = \rho \frac{l_2}{A_2} \qquad\qquad ...(2)$$

$$R_2 = \rho \frac{\frac{l}{2}}{2A}$$

$$R_2 = \rho \frac{l}{4A} \qquad\qquad ...(3)$$

Dividing (3) by eq. (1)

$$\frac{R_2}{R_1} = \rho \frac{l}{4A} \times \frac{A_1}{\rho l_1} = \frac{l}{4A} \times \frac{A}{l}$$

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

$$R_2 = 1\,\Omega$$

131. An electric iron consumes energy at a rate of 840 W when heating is at the maximum rate and 360 W when the heating is at the minimum. The voltage is 220 V. What are the current and the resistance in each case?

Ans : [CBSE 2015]

As $\qquad\qquad P = V \times I$

a. When heating is at maximum rate

$$P = 840\ \text{W}$$

$$I = \frac{840}{220} = 3.8\ \text{A}$$

and

$$R = \frac{V}{I} = \frac{220}{3.8} = 57.7\,\Omega$$

b. When heating is at minimum rate

$$P = 360\ \text{W}$$

$$I = \frac{360}{220} = 1.64\ \text{A}$$

and,

$$\text{Resistance} = \frac{220}{1.64} = 1.34.15\ \Omega$$

132. In a household, 5 tube lights of 40 W each are used for 5 hours and an electric press of 500 W for 4 hour everyday. Calculate the total energy consumed by the tube lights and press in a month of 30 days.

Ans : [CBSE 2013]

$$\text{Power of 1 tube} = 40\ \text{W}$$

$$\text{Power of 5 tubes} = 5 \times 40\ \text{W} = 200\ \text{W}$$

Energy consumed by 5 tubes in 5 hr. per day

$$= 200 \times 5 = 1000\ \text{Wh}$$

Energy consumed by electric press per day

$$= 500\ \text{W} \times 4\ \text{hr}$$

$$= 2000\ \text{Wh}$$

Total energy consumed per day

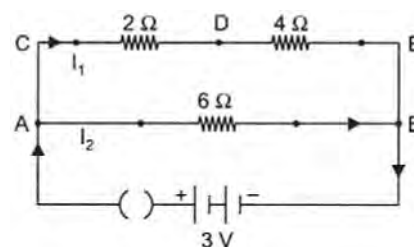$$= (1000 + 2000)\text{Wh}$$

$$= 3000\ \text{Wh} = 3\ \text{kWh}$$

Total energy consumed in 30 days

$$= 3 \times 30\ \text{kWh}$$

$$= 90\ \text{kWh}$$

133. In the circuit shown below, calculate:
a. total resistance in arm CE,
b. total current drawn from the battery, and
c. current in each arm, i.e., AB and CE of the circuit.

Ans : [CBSE 2013]

a. Total resistance in arm CE

$$= (2 + 4)\,\Omega = 6\,\Omega$$

b. CE arm and AB arm in parallel.

effective resistance, $\qquad \frac{1}{R} = \left(\frac{1}{6} + \frac{1}{6}\right)$

$$R = 3\,\Omega$$

Total current in the circuit $[\because V = 3\text{V given}]$

$$I = \frac{V}{R} = \frac{3}{3} = 1\text{A}$$

c. Resistance of CE and AB arms is same $= 6\,\Omega$

Current in each arm $= \frac{3}{6} = \frac{1}{2}\ \text{A}$

$$I = 0.5\,\text{A}$$

134. An electric heater rated 1200 W operates 2 hour per day. Find the cost of the energy required to operate it for 30 days at Rs 5.00 per unit.

Ans : [CBSE 2013]

Rating of heater $= 1200\,\text{W}$

$$t_1 = 2 \text{ hr per day}$$

Total time (t) for 30 days

$$= t_1 \times 30 = 2 \times 30$$
$$= 60 \text{ hrs}$$

Energy consumed in one month (30 days)

$$= P \times t = 1200 \times 60$$
$$= 72000 \text{ Wh}$$
$$= 72 \text{ kWh}$$

Cost of energy consumed in 30 days

$$= ₹72 \times 5 = ₹360$$

135. Two electric lamps of 100 W and 25 W respectively are joined in parallel to a supply of 200 V. Calculate the total current flowing through the circuit.

Ans : [CBSE 2012]

Bulbs 100 W 25 W

$$V = 200\text{ V } 200\text{ V}$$
$$\text{Total } P = P_1 + P_2$$
$$= 100 + 25 = 125 \text{ W}$$
$$I = \frac{P}{V} = \frac{125}{200}\,\text{A}$$
$$I = 0.625 \text{ A}$$

136. Two identical resistors, each of resistance 2 Ω are connected in turn: (i) in series, and (ii) in parallel to a battery of 12 V. Calculate the ratio of power consumed in the two cases.

Ans : [CBSE 2015]

Given: $R_1 = R_2 = 2\,\Omega$

(i) In series $R_S = 2 + 2 = 4\,\Omega$

Power consumed in series:

$$P_S = \frac{V^2}{R_S} = \frac{12 \times 12}{4}\,\text{W}$$
$$P_S = 36 \text{ W}$$

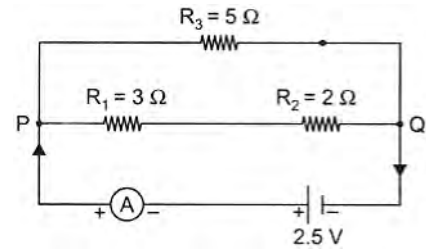(ii) In parallel combination $\frac{1}{R_p} = \frac{1}{2} + \frac{1}{2}$

$$R_P = 1\,\Omega$$
$$P_P = \frac{V^2}{R_P} = \frac{12 \times 12}{1}\,\text{W}$$
$$P_P = 144 \text{ W}$$

137. In the given circuit, calculate (a) total resistance of the circuit, and (b) current shown by the ammeter.

Ans : [CBSE 2012]

a. 3 Ω and 2 Ω resistors are in series their effective resistance $3 + 2 = 5\ \Omega$ is in parallel to 5 Ω resistance.

$$\text{Net resistance} = \frac{5}{2} = 2.5\,\Omega$$

b.
$$I = \frac{V}{R} = \frac{2.5}{2.5}$$
$$I = 1\text{A}$$

138. An electric heater rated 600 W operates 6 hours per day. Find the cost to operate it for 30 days at Rs. 3.00 per unit.

Ans : [CBSE 2012]

Given: $P = 600 \text{ W}$

$$t = 6 \text{ hr per day}$$

no. of days $= 30$

Energy consumed by the heater

$$= P \times t$$
$$= 600\text{ W} \times 6\frac{\text{hr}}{\text{day}} \times 30\,\text{days}$$
$$= 108000 \text{ Wh}$$
$$= 108 \text{ kWh}$$

Total cost @₹3/- $= ₹108 \times 3 = ₹324$

139. Three resistors of $5\,\Omega, 10\,\Omega$, and $15\,\Omega$ are connected in series and the combination is connected to battery of 30 V. Ammeter and voltmeter are connected in the circuit. Draw a circuit diagram to connect all the devices in proper correct order. What is the current flowing and potential difference across 10 Ω resistance?

Ans : [CBSE 2012]

Effective resistance of the circuit

$$R = 5 + 10 + 15 = 30\,\Omega$$
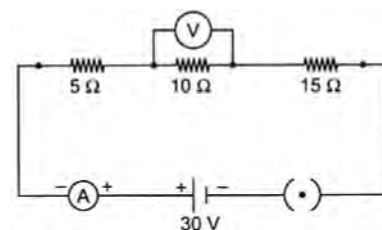
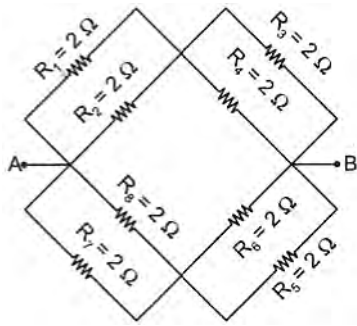Current in the circuit, $\quad I = \frac{V}{R} = \frac{30}{30}\,\text{A}$

$$I = 1\,\text{A}$$

Current in 10 Ω resistor $= 1\,\text{A}$

Potential difference across 10 Ω resistor
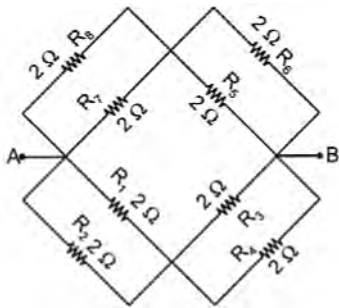
$$V = IR = 1 \times 10$$
$$V = 10 \text{ Volt}$$

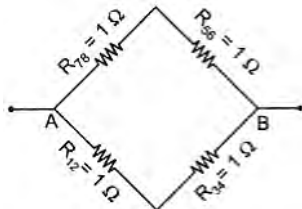**140.** Find the equivalent resistance across the two ends A and B of this circuit.

Ans :

The pairs of R_1 and R_2; R_3 and R_4 ; R_5 and R_6 and R_7, and R_8 are in parallel
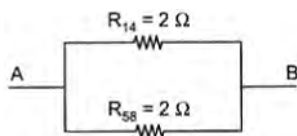Their equivalent resistance $= 1\,\Omega$ each.

Now R_{12} and R_{34} are in series $R_{14} = 1 + 1 = 2\,\Omega$ and R_{56} and R_{78} are in series

$$R_{56} = 1 + 1 = 2\,\Omega$$

Hence network can be reduced further as

Now R_{14} and R_{58} are in parallel
Net equivalent resistance of the network

$$= \frac{1}{2} + \frac{1}{2} = 1\,\Omega$$

141. A hot plate of an electric oven, connected to a 220 V line. It has two resistance coils A and B each of the $30\,\Omega$ which may be used separately, in series or in parallel. Find the value of the current required in each of the three cases.

Ans : [CBSE 2012]

$$V = 220\,\text{Volt}$$
$$R_A = R_B = 30\,\Omega$$

a. When both are used separately.
   Then current drawn by each
$$I = \frac{V}{R} = \frac{220}{30} = 7.3\,\text{A}$$

b. When two coils are connected in series then total

resistance of coils
$$= 30 + 30 = 60\,\Omega$$
$$I = \frac{220}{60} = 3.66\,\text{A}$$

c. When two coils are connected in parallel then total resistance
$$= \frac{30}{2} = 15\,\text{A}$$

Now current, $I = \frac{220}{15} = 14.67\,\text{A}$

142. A piece of wire having resistance R is cut into four equal parts,
a. How will the resistance of each part compare with the original resistance?
b. If the four parts are placed in parallel, how will the joint resistance compare with the resistance of the original wire?

Ans :

a. When wire is cut in equal pieces then resistance on one piece $= \frac{R}{4}$
b. Effective resistance in parallel combination of these four pieces of resistance $\frac{R}{4}$ each.
$$\frac{1}{R_p} = \frac{4}{R} + \frac{4}{R} + \frac{4}{R} + \frac{4}{R} = \frac{16}{R}$$
$$R_p = \frac{R}{16}$$

143. A wire is 1.0 m long, 0.2 mm in diameter and has a resistance of 10 Ω. Calculate the resistivity of its material.

Ans : [CBSE 2011]

$$L = 1.0\,\text{m}$$
$$D = 0.2\,\text{mm}$$
$$r = \frac{D}{2} = \frac{0.2}{2} = 0.1\,\text{mm}$$
$$r = 0.1 \times 10^{-3}\,\text{m}$$
$$R = 10\,\Omega$$
$$R = \rho\frac{l}{A} \text{ or } \rho = \frac{R \times A}{\rho}$$
$$\rho = 10 \times \frac{\pi r^2}{l}$$
$$10 = \frac{3.14 \times \left(0.1 \times 10^{-3}\right)^2}{1.0}$$
$$\rho = 3.14 \times 10^{-7}\,\Omega\text{m}$$

144. The rating of an electric heater is 1100 W, 220 V. Calculate its resistance when it operates at 220 V. Also, calculate the energy consumed in kWh in the month of November, if the heater is used daily for four hours at the rated voltage.
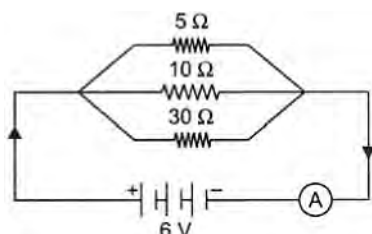
Ans : [CBSE 2010]

$$P = 1100\,\text{W}$$
$$V = 220\,\text{V}$$
$$R = \frac{V^2}{P} = \frac{220 \times 220}{1100}\,\Omega = \frac{484}{11}\,\Omega = 44\,\Omega$$

Total energy consumed in the month of Nov. (i.e. 30 days) @ 4 hr per day.

$$E = P \times t$$
$$= 1100 \times 4 \times \text{hr} \times 30$$
$$= 1100 \times 120 \text{ Wh}$$
$$E = 132 \text{ kWh}$$

145. (a) For the circuit shown in the diagram, calculate:
    (i) value of current through the 30 Ω resistor.
    (ii) total resistance of the circuit.
  (b) Give two advantages of connecting electrical devices in parallel with battery.

Ans :   [CBSE 2010]

a. Potential across each resistor = 6 V.
  (i) I in 30 Ω resistor,
$$= \frac{V}{R} = \frac{6}{30} = \frac{1}{5} \text{ A}$$
$$= 0.2 \text{ A}$$
 (ii) All in parallel,
$$\frac{1}{R_p} = \frac{1}{30} + \frac{1}{10} + \frac{1}{5} = \frac{1+3+6}{30}$$
$$= \frac{10}{30}$$
$$R_p = 3 \, \Omega$$

b. (i) Voltage across each appliance remains
  (ii) If any appliance fails to work other appliances continue to work.

146. Three 2 Ω resistors, A, B and C, are connected as shown in figure. Each of them dissipates energy and can withstand a maximum power of 18 W without melting. Find the maximum current that can flow through the three resistors.
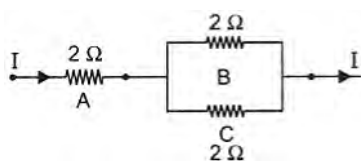
Ans :   [CBSE 2010]
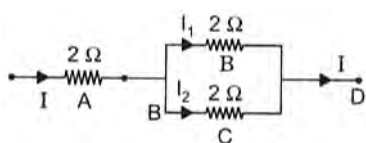
Given maximum power of the network
$$P = 18 \text{ W}$$
Maximum current in 2 Ω resistor.

from $\qquad P = I^2 R$ or $I^2 = \dfrac{P}{R}$
$$I^2 = \frac{18}{2} = 9$$
$$I = 3\text{A}$$

Resistor 2 Ω, 2 Ω are equal and in parallel combination so current of 3 A will be distributed equally.
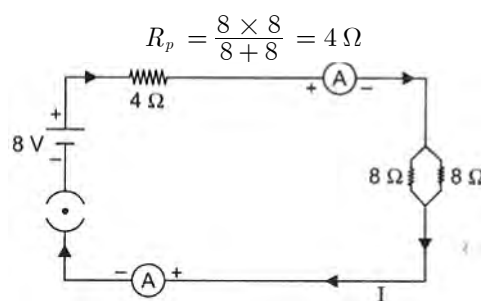
$$I_1 = I_2 = 1.5 \text{ A}$$

147. 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 4 Ω resistor.
  c. Potential difference across 4 Ω resistor.
  d. Power dissipated in 4 Ω resistor.
  e. Difference in ammeter readings, if any.

Ans :
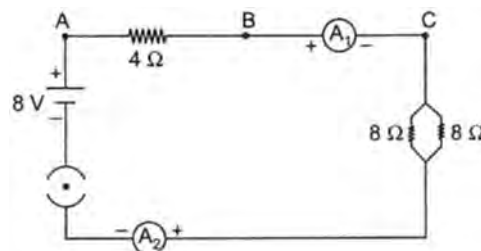
a. 8 Ω and 8 Ω resistors are in parallel
$$R_p = \frac{8 \times 8}{8 + 8} = 4 \, \Omega$$

b. Total resistance of the circuit
$$= (4 + 4) \, \Omega = 8 \, \Omega$$
Current in 4 Ω resistor
$$I = \frac{8}{8} = 1 \text{ A}$$
c. Potential difference across 4 Ω resistor
$$V = IR = 1 \times 4 = 4 \text{ Volt.}$$
d. Power dissipated in 4 Ω resistor
$$P = I^2 R = (1)^2 \times 4 \text{ W}$$
$$P = 4 \text{ W}$$
e. Both the ammeters are in series in the circuit so current will be same in both ammeters. Hence no difference in the reading of two ammeter.

148. Calculate the resistance of an electric bulb which allows a 10 A current when connected to a 220 V power source.

Ans :   [CBSE 2009]

$$I = 10 \text{ A}$$
$$V = 220 \text{ Volt.}$$
$$\text{Resistance of bulb} = \frac{V}{I} = \frac{220}{10} = 22 \, \Omega$$

149. An electric lamp is marked 100 W, 220 V. It is used for 5 hours daily. Calculate: (i) its resistance while glowing, (ii) energy consumed in kWh per day.

Ans :   [CBSE 2007]

Electric Iron 100W — 220 V

Used for time, $\qquad t = 5$ hr. daily

(i)
$$R = \frac{V^2}{P} = \frac{220 \times 220}{100} = 484\,\Omega$$

(ii) Energy consumed by iron per day
$$= P \times t = 100 \times 5 \text{ Wh}$$
$$= 500 \text{ Wh} = 0.5 \text{ kWh}$$

150. A torch bulb is rated 5 V and 500 mA. Calculate its (i) power (ii) resistance and (iii) energy consumed when it is lighted for 4 hours.
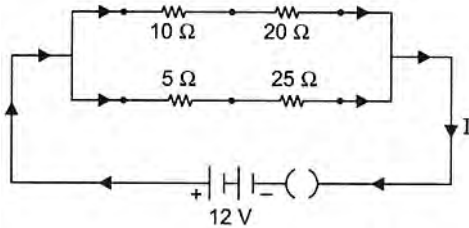
Ans : [CBSE 2005]

Given: 5V—500 mA

(i)
$$\text{Power} = V \times I = 5 \times 500 \times 10^{-3}$$
$$= 2.5 \text{ W}$$

(ii)
$$\text{Resistance} = \frac{V}{I} = \frac{5}{500 \times 10^{-3}} = 10\,\Omega$$

(iii) Energy consumed in four hrs.
$$= 2.5 \times 4 \times 60 \times 60$$
$$= 10 \times 3600 \text{ W.s.}$$
$$= 3.6 \times 10^4 \text{ J}$$

151. If a 12 V battery is connected to the arrangement of resistances given below, calculate:
a. the total effective resistance of the arrangement and
b. the total current flowing in the circuit.

Ans : [CBSE 2005]

a. 10 Ω and 20 Ω are in series
$$R_{s1} = 10 + 20 = 30\,\Omega$$
5 Ω and 25 Ω are in series
$$R_{s2} = 5 + 25 = 30\,\Omega$$
30 Ω and 30 Ω are in parallel.
$$\frac{1}{R_p} = \frac{1}{30} + \frac{1}{30} = \frac{2}{30}$$
$$R_p = 15\,\Omega$$

(ii)
$$I = \frac{V}{R_P} = \frac{12}{15} = 0.8 \text{ A}$$

152. An electric bulb is rated at 200 V–100 W. What is its resistance? Five such bulbs bum for 4 hours. What is the electrical energy consumed? Calculate the cost, if the rate is 50 paise unit.

Ans :

$$V = 200 \text{ V}$$
$$P = 100 \text{ W}$$

(a)
$$P = \frac{V^2}{R}$$

$$R = \frac{(200)^2}{100}\,\Omega = \frac{40000}{100} = 400\,\Omega$$

(b) Energy consumed in 4 hrs. by one bulb.

$$= P \times t = 100 \times 4 = 400 \text{ Wh}$$
$$= 0.4 \text{ kWh}$$

Total energy consumed by 5 similar bulb
$$= 5 \times 0.4 = 2 \text{ kWh}$$

Cost ₹ 0.50 per unit $= ₹2 \times 0.50 = ₹1$