CURRENT ELECTRICITY

- OHM'S LAW
- KIRCHHOFF'S LAW

01. A current of 16mA flows through a conductor. The number of electrons flowing per second is,

(1) 10^{14} (2) 10^{15}

(3) 10^{-17} (4) 10^{17}

Solution (1):-

$I = 16\ m\ A,\ e = 1.6X10^{-19}C,$

$n = ?$

$I = q / t = ne / t \text{ or } n = It / e$

$= 16X10^{-3}X1 / 1.6X10^{-19}$

$= 10X10^{16}$

$= 10^{17}$ electrons.

Ans: (4)

02. In a conductor drift velocity is v_d. If the same current is set up in a conductor of radius 3r, then drift velocity will be

(1) v_d

(2) $3\,v_d$

(3) $v_d / 3$

(4) $v_d / 9$

Solution (2):- Drift velocity ,

$v_d = I / n e A$ or $v_d \alpha 1/A$

or $v_d \alpha 1/\Pi r^2$ ---------- (1)

And $v^1_d \alpha 1/\Pi(3r)^2$

$v^1_d \alpha 1/9 \Pi r^2$ ---------- (2)

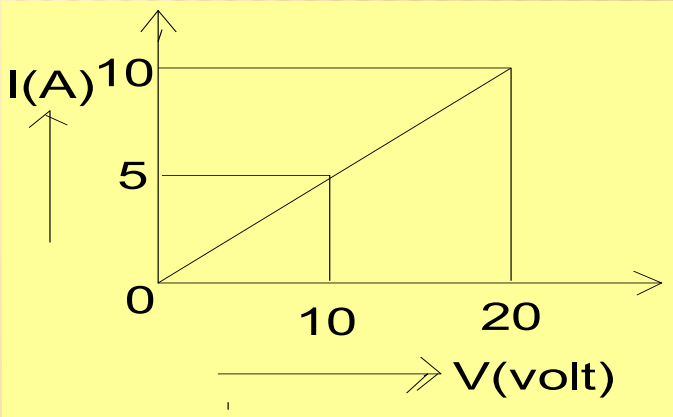
(2/1) $v^1_d / v_d = 1/9$ or $v^1_d = v_d / 9$

Ans: (4).

03. The variation of current against voltage for a conductor is as shown in the fig. The resistance of the conductor is

(1) 1Ω (2) 2Ω

(3) 4Ω (4) 0.5Ω



Solution(3) :-

slope = (10-5) / (20 -10) = 5/10 = 1/2;

Reciprocal of slope is resistance

= 2Ω

Answer: (2)

04. A 6V battery is connected to a 10 Ω resistor. If the current flowing in the conductor is 0.5 A, the internal resistance is

(1) 1Ω (2) 1.5Ω

(3) 2Ω (4) 0.5Ω

Solution(4):-

$$I = E / R + r$$

$$\text{or } 0.5 = 6 / 10 + r$$

$$\text{or } 5 + 0.5\, r = 6$$

$$0.5\, r = 1$$

$$\text{or } r = 1 / 0.5 = 2\ \Omega.$$

Ans: (3)

05. A color coded resistor has red-red-orange-silver on it.

Its resistance value is

(1) $2200 \pm 5\%\Omega$ (2) $22000 \pm 10\%\Omega$

(3) $2200 \pm 20\%\Omega$ (4) $22000 \pm 20\%\Omega$

Solution(5) :-

Red- Red-Orange-Silver

2 2 10^3 ± 10%

Resistance value is 2200 ± 10%

Ans: (2)

06. The specific resistance of a conductor

(1) varies with its length

(2) varies with its mass

(3) varies with its cross-sectional area

(4) does not depend on its length, area of cross section and mass

Solution(6)

Specific resistance of a conductor does not depend on its dimensions and mass.

Ans : (4)

07. A wire has a resistance of 5 Ω. A second wire of the same material has twice the length and half the radius of cross-section to that of original wire. The resistance of the second wire is.

(1) 80Ω (2) 40Ω (3) 20Ω

(4) 10Ω

Solution(7):-

Resistance $R=5= \rho l / A = \rho l / \Pi r^2$ --(1)

Resistance $R^1 = \rho\ 2\ l / \Pi(r/2)^2$

$= 8\ \rho\ l / \Pi r^2$ ---(2)

From (1) $R^1 = 8R = 8X5 = 40\ \Omega.$

Ans (2)

08. A piece of copper and a piece of silicon are cooled from room temperature to 5^0c. then

(1) resistance of copper increases while that of silicon decreases

(2) resistance of copper decreases while that of silicon increases

(3) resistance of both copper and silicon decreases

(4) resistance of both copper and silicon increases

Solution(8):-

Copper is a conductor and silicon is a semiconductor. When both are cooled resistance of copper decreases and that of silicon increases.

Answer: (2)

09. The effective resistance of two resistors in parallel is 12/7 Ω. If one of the resistors is disconnected, the resistance becomes 4 Ω. The resistance of the other resistor is

(1) 7/12Ω (2) 12/7Ω

(3) 3Ω (4) 4Ω

Solution(9)

$R_1R_2/ R_1 + R_2 = 12/7$;

$R_1 = 4\ \Omega \quad R_2 = ?$

$4R_2/ 4 + R_2 = 12/7$

or $28\ R_2 = 48 + 12\ R_2$

$16\ R_2 = 48$ Or $R_2 = 48/16 = 3\ \Omega$

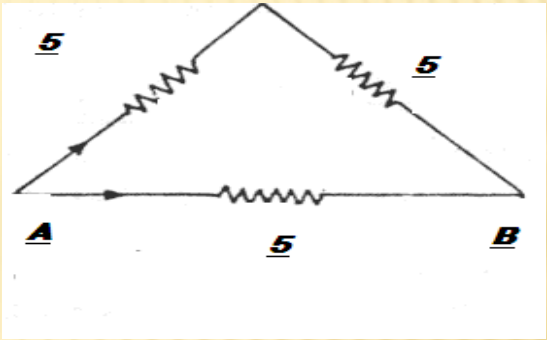
Answer: (3)

10. Three resistors of 5 Ω each are connected to form a triangle. The effective resistance between any two corners is

(1) 15Ω (2) 10Ω

(3) 5/3Ω (4) 10/3Ω

Solution(10)



effective resistance of 5 Ω & 5Ω between

AB = 5+5 =10 Ω

effective resistance of 10 Ω & 5Ω between

A &B= (10X5)/(10+5) = 50/15 = 10/3 Ω

Answer(4)

11. The internal resistance of a cell of emf 2V is 0.2 Ω. It is connected to a resistance of 3.8 Ω. The terminal p.d. is

(1) 1.95V (2) 2.0V

(3) 1.9VΩ (4) 0.1V

Solution(11):-

Terminal p.d $V = ER / R+r$

$= (2 \times 3.8) / (3.8 + 0.2)$

$= 7.6/4 = 1.9V$

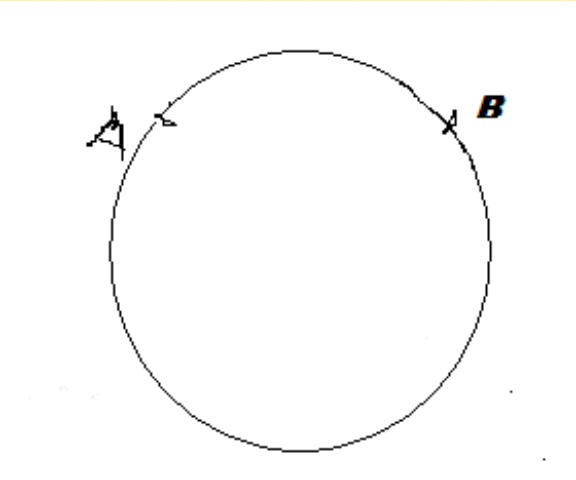
Answer: (3)

12. A wire of resistance 12 Ω is bent into a circle. The effective resistance between any two points separated by a distance of ¼ th circumference on the circle is

(1) 3/8Ω (2) 8/3Ω

(3) 9/4Ω (4) 4/9Ω

Solution(12):-



effective resistance between A & B

$= (9X3)/(9+3) = 27 / 12 = 9 / 4\ \Omega$

Answer: (3)

13. In an experiment to determine internal resistance of a cell using a potentiometer, it is observed that the balance point is at 0.2 m when the cell is shunted by 5 Ω and 0.3m when the cell is shunted by 10 Ω . The internal resistance of the cell is

(1) 1Ω (2) 1.5Ω

(3) 10Ω (4) 15Ω

Solution(13):-

$r = R(l_1/l_2 - 1) = 5(l_1/0.2 - 1) = 5/0.2\,(l_1 - 0.2)$

$r = 25(l_1 - 0.2)$ ----------(1)

Similarly $r = 100/3\,(l_1 - 0.3)$ ----------(2)

from (1) and (2),

$25(l_1 - 0.2) = 100/3\,(l_1 - 0.3)$

Solving $l_1 = 0.6m$

Substituting for l_1 in equation (1)

$r = 10\ \Omega$

Answer: (3)

14. Three electric bulbs of 25W, 60W and 100W are connected in series to ac mains. Which bulb glows brighter?

(1) 25 W bulb

(2) 60 W bulb

(3) 100 W bulb

(4) All bulbs glow equally bright

Solution(14):-

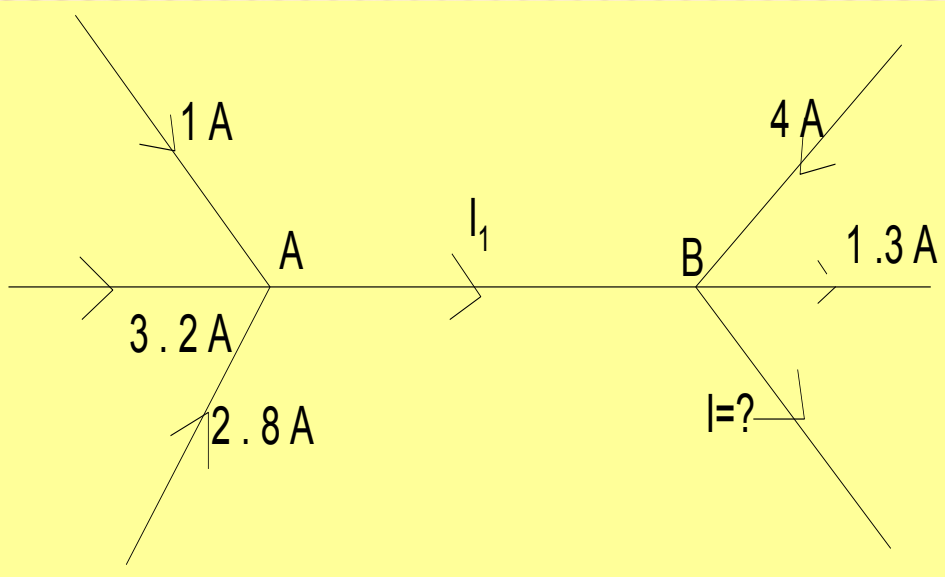
In series combination same current flows through all the bulbs so that bulb having greater resistance glows brighter (I^2R) . Since lower wattage bulbs has greater resistance($R=V^2/ W$). 25W bulb glows brighter

Answer: (1)

15. In the figure shown, current I is

(1) 12.3 A (2) 1.7 A

(3) 10.7 A (4) 9.7 A



Solution(15):-

Applying KCL

at node A $1+3.2+2.8-I_1=0$ or $I_1 = 7A$

Similarly

at node B $7+4-1.3-I=0$

or $I = 9.7$ A

Ans: (4)

16. We have three resistances of values 2 Ω, 3 Ω and 6 Ω. Which of the following combination will give an effective resistance of 4 Ω?

(1) All the three resistances in parallel

(2) 2 Ω resistance in series with parallel combination of 3 Ω and 6 Ω resistance

(3) 3 Ω resistance in series with parallel combination of 2 Ω and 6 Ω resistance

(4) 6 Ω resistance in series with parallel combination of 2 Ω and 3 Ω resistance

Solution(16):-

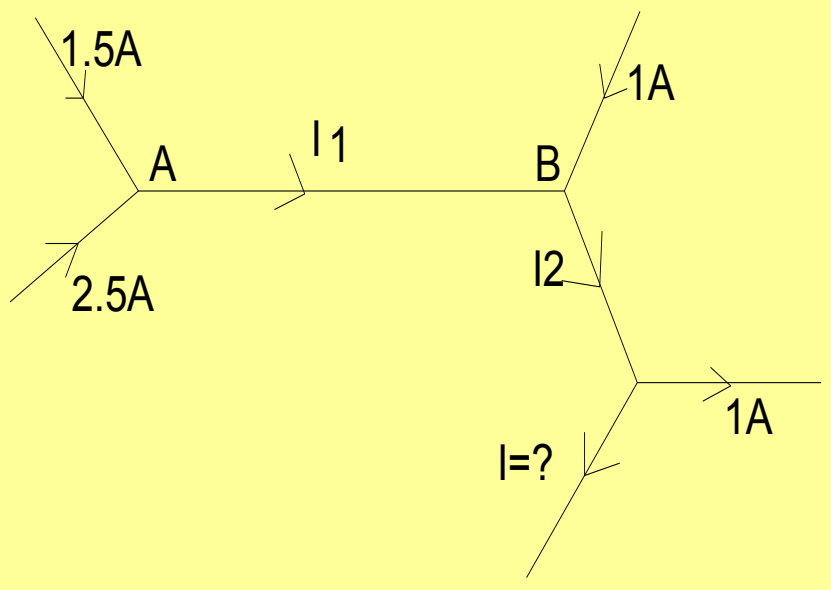
$R = 2+(6X3)/ (6+3)$

$= 2+ 18 / 9$

$= 2+2 = 4\ \Omega$

Answer: (2)

17. Current I in the figure is



(1) 6A (2) 3A

(3) 4A (4) 2A

Solution(17):-

Applying KCL at node A

$1.5 + 2.5 - I_1 = 0$ or $I_1 = 4A$

At node B, $4 + 1 - I_2 = 0$

$\therefore \quad I_2 = 5A$

At node c, $\quad 5 - I - 1 = 0$

$\therefore \quad I = 4A$

Answer: (3)

18. Four identical resistors are first connected in parallel and then in series. The ratio of resultant resistance of the first combination to the second will be

(1) 1 / 16 times (2) 1 / 4 times

(3) 4 times (4) 16 times.

Solution(18):-

Let R be the resistance

i) in parallel $R_p = R/n = R/4$ -------(1)

ii) in series $R_s = n R = 4R$ ---------(2)

equation (1/2)

$R_p / R_s = R/4 \times 1/4R = 1/16$

Answer: (1)

19. Certain substances lose their electrical resistance completely at finite low temperatures. Such substances are called

(1) Dielectrics

(2) Super-conductors

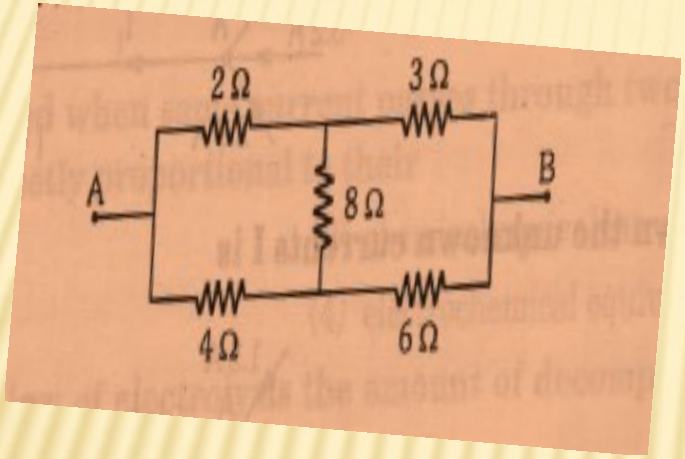
(3) Semi conductors

(4) Perfect conductors

Solution(19):-

Answer: (2)

20. The equivalent resistance between A and B in the following fig is



(1) 6Ω (2) 15Ω

(3) 20/3Ω (4) 10/3Ω

Solution(20):-

$$P/Q = 2/3 \quad \& \quad R/S = 4/6 = 2/3$$

Thus, network is like a balanced network i.e. pd's at C and D are equal and 8 Ω resistor does not take part in conduction

Therefore effective resistance between

A & B is $R = 50/15 = 10/3\ \Omega$

Answer: (4)

21. An electric current is passed through a circuit containing two wires of the same material , connected in parallel. If the lengths and radii of the wires are in the ratio of 4/3 and 2/3, then the ratio of currents passing through the wires will be

(1) 3 (2) 1/3

(3) 8/9 (4) 2

Solution(21):-

$$R_1 \alpha \ l_1 / A_1;$$

$$R_2 \alpha \ l_2 / A_2;$$

$$R_1 / R_2 = (l_1 / A_1) \ / \ (l_2 / A_2)$$

$$= (4 / 3) \ X \ r_2^2 / r_1^2 = (4 / 3) X (9 / 4) = 3 / 1$$

$$R_1 / R_2 = l_2 / l_1 = 3 / 1$$

$$l_1 / l_2 = 1/3$$

Ans: (2)

22. In a meter bridge experiment null point is obtained at 20 cm from one end of the wire, when resistance X is balanced against another resistance Y. If X < Y, then where will the new position of null point from the same end, if one decides to balance a resistance of 4X against Y?

(1) 50 cm (2) 80 cm

(3) 40 cm (4) 70cm

Solution(22):-

Case 1 $l / 1-l = X / Y$

$0.2/0.8 = X/Y$ ----------(1)

$l^1 / 1-l^1 = 4X/Y$---------(2)

from 1 &2 $l^1 / 4(1-l^1) = 0.2/0.8$

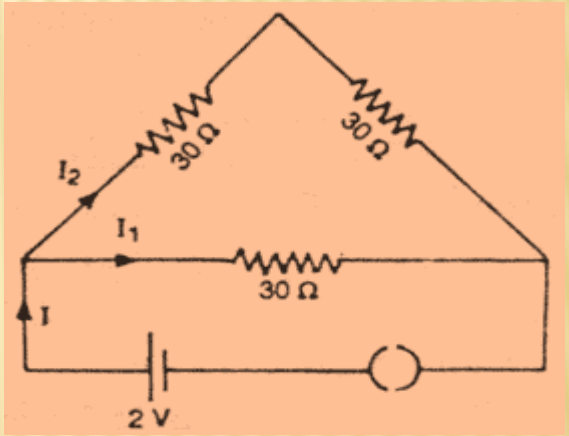
$l^1 = 1-l^1$

$2l^1 = 1$

$l^1 = 1/2$ m $= 50$cm

Ans: (1)

23. A 2 Volt battery with negligible internal resistance is connected in a circuit as shown in fig. The current I_2 in the circuit will be



(1) 1/10A (2) 1/30A

(3) 1/45A (4) 1/15A

Solution(23):-

$Rp = R_1R_2 / R_1 + R_2$

$Rp = (60X30) / (60+30) = 20\ \Omega$

$\therefore I = E / Rp = 2 / 20 = 1 / 10A$

$\therefore I_2 = (1 / 10)30 / 90 = 1 / 30\ A$

Answer: (2)

24. A current of I flows in a wire of circular cross section with the free electrons travelling with a drift velocity v. What is the drift velocity of electrons When a current 2I flows in another wire of twice the radius and of the same material?

(1) 2v (2) v

(3) v/2 (4) v/4

Solution(24):-

$$I = n\ e\ A\ v_d$$

$$I = n\ e\ A\ v = ne\ \Pi r^2\ v$$

$$2I = ne\ \Pi 4r^2\ v^1$$

$$\therefore\ v^1 = v/2$$

Ans : (3)

25. A piece of copper wire is cut in to ten equal parts. These parts are connected in parallel. The joint resistance of the parallel combination will be equal to the original resistance of the uncut wire, multiplied by a factor of

(1) 0.01 (2) 0.1

(3) 1 (4) 10

Solution(25):-

Let R be the resistance of the uncut wire,

Then resistance of each part = R/10

When they are connected in parallel

$R_p = (R/10) \times 1/10 = R/100 = 0.01\ R$

$n\ R = 0.01\ R$

$\therefore \quad n = 0.01$

Answer: (1)

26. Using the resistors R_1 and R_2 singly ,in series and in parallel, we can get 4, 5, 20 and 25 Ω then R_1 and R_2 are

(1) 4, 5 (2) 20, 25

(3) 5, 20 (4) 4, 25

Solution(26):-

By data, If $R_1 = 4$ and $R_2 = 5$

Then Rs = 9 and Rp = 20/9

If $R_1 = 5$ and $R_2 = 20$

Rs = 25 and Rp = 4

Therefore R_1 and $R_2 = 5$ and 20Ω

Answer : (3)

27. The resistance of 20cm long wire is 5 Ω. If it is stretched to 40cm length, the new resistance in ohm is

(1) 5 (2) 10

(3) 20 (4) 40

Solution(27):-

When a wire is stretched to n times its initial length, the resistance becomes n^2 times its initial value.

$$n = 40/20 = 2$$

Therefore new resistance

$$R_1 = 2^2 R = 4R = 4X5 = 20\ \Omega$$

Answer: (3)

28. Resistivity of iron is 10^{-7} Ω-m. The resistance of an iron wire is 1 Ω. If its diameter is halved and length doubled , the resistivity in Ω-m will be equal to

1) 10^{-7}

2) $2x10^{-7}$

3) $3x\ 10^{-7}$

4) $4x\ 10^{-7}$

Solution(28):-

$$\rho = \Pi d^2 R / 4L;$$

resistivity is independent of dimensions

$$\therefore \rho = 10^{-7}\ \Omega\ m$$

Answer: (1)

29. If an electron makes 25×10^{15} rev/s around the nucleus of an atom in a orbit of radius 1 Å unit the equivalent current is nearly

1) 2×10^{-2} A
2) 4×10^{-3} A
3) 1.6×10^{-4} A
4) 10^{-3} A

Solution(29):-

Since an electron makes 25×10^{15} rev/s,

It is equivalent to the no. of electrons flowing in 1 sec $= 25 \times 10^{15}$

$\therefore I = q / t = 25X10^{15}X1.6X10^{-19}/1$

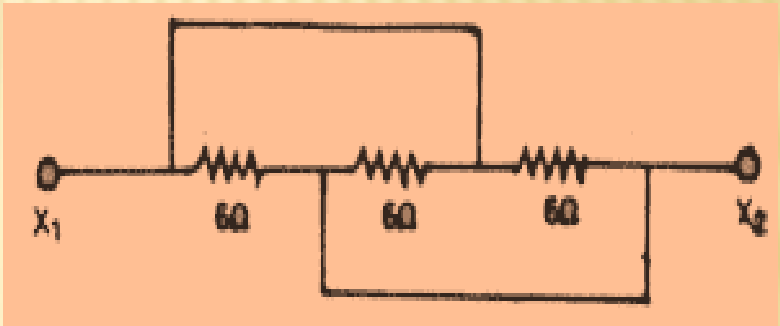
$= 40X10^{-4} = 4 \times 10^{-3}A$

Answer: (2)

30. Three resistors each equal to 6 ohm are connected as shown in the fig. The equivalent resistance between x_1 & x_2 is

(1) 6 (2) 18

(3) 2 (4) 4



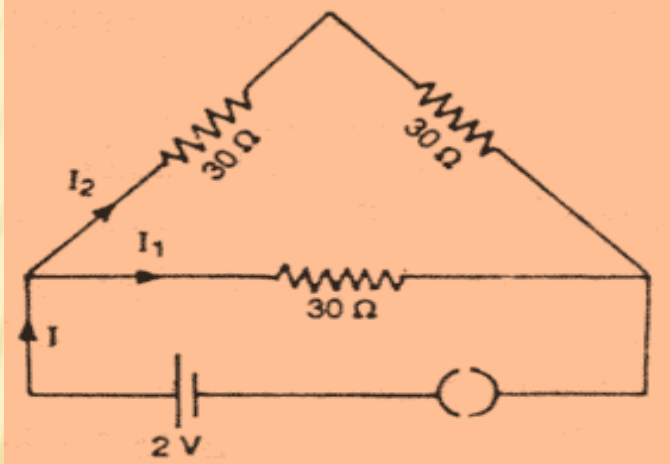
Solution(30):-

$$1/Rp = 1/6 + 1/6 + 1/6 = 3/6$$

$$\therefore Rp = 2\ \Omega$$

Answer: (3)

31. In the circuit shown below, the current I is



(1) 1 / 45 A

(2) 1 / 15 A

(3) 1 / 10 A

(4) 1 / 5 A.

Solution(31):-

Resistance between

A & B = (60X30) / (60+30) = 20 Ω

Current I = 2/20 = 0.1 A

Answer: (3)

32. An electric kettle takes 4A current at 220V. How much time will it take to boil 1 kg of water from temperature 20^0c? The temperature of boiling water is 100^0c.

(1) 8.4min (2) 12.6min

(3) 4.2min (4) 6.3min

Solution(32): -

$$Q = m\,c\,\theta = V\,I\,t \ ,$$

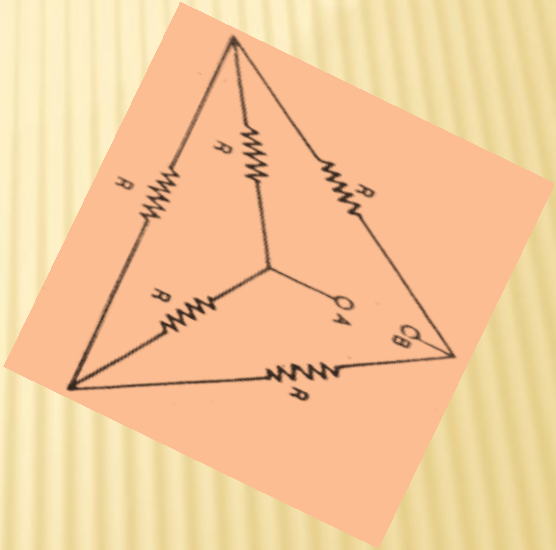
$$t = m\,c\,\theta / V\,I$$

$$= 1X\ 4200\ X\ 80/\ 220X4 = 381$$

$$s = 6.3 \text{ min.}$$

Answer: (4)

33. In the network shown, each resistance is R ohm. The equivalent resistance between A & B is



1) R/2
2) R
3) 2R
4) 3R

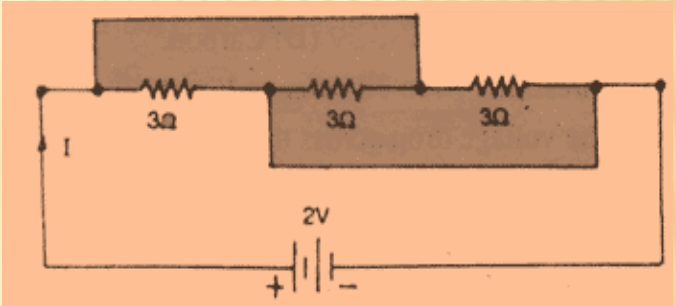
Solution(33):-

It is a balanced network

$\therefore R_{AB} = 2R \times 2R/4R = R$

Answer: (2)

34. . For the circuit shown below the current I flowing through the circuit will be



(1)1 / 2 A (2) 1 A

(3) 2 A (4) 4 A.

Solution(34):-

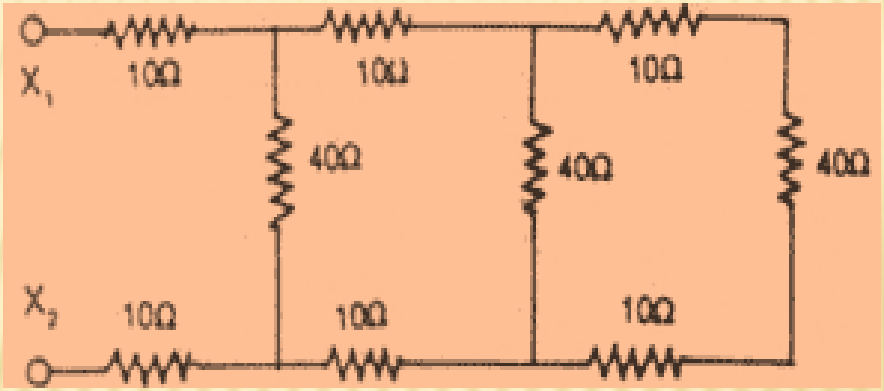
All the three resistors are in parallel

$\therefore R_{AB} = 3/3 = 1\Omega$

$I=V/R = 2/1 = 2A$

Answer: 3

35. The equivalent resistance at the points X_1 and X_2 in the circuit shown below



(1) 60 ohm
(2) 40 ohm
(3) 80 ohm
(4) 20 ohm.

Solution(35):-

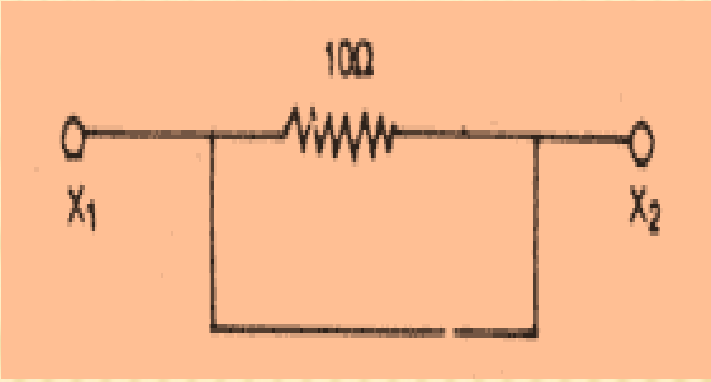
$R_1 = (60X\ 40)/(60+40)=24$

$R_{AB} = (44X40)/(84 + 20)$

$= 40\ \Omega$

Answer: (2)

36. Resistance between X_1 and X_2 is



(1) 10 ohm (2) greater than 10 ohm
(3) 0 (4) less than 10 ohm.

Solution 36 .

Answer: (3)

37. Which of the following carbon coded resistor has value of 10 k ohm with 20% tolerance?

(1) Brown, black, orange and silver stripes

(2) black ,Brown, orange and silver stripes

(3) black, Brown, orange and gold stripes

(4) Brown, black, orange and no tolerance band.

Solution 37 .

Answer: (4)

38.An electric kettle has two coils. when one coil is connected to the ac mains, the water in the kettle boils in 10 minutes. When the other coil is used, the same quantity of water takes 15 minutes to boil. How long will it take for the same quantity of water to boil if the two coils are connected in parallel?

(1) 24min (2) 18min
(3) 12min (4) 6min

Solution 38.

Let H be the quantity of heat energy needed to boil the given quantity of water . If R_1 & R_2 are the resistances of coils and V is the applied voltage, then

$H = V^2t_1 / R_1 = V^2t_2 / R_2$ or $R_2 / R_1 = t_2 / t_1 = 15 / 10 = 3 / 2$

Contd..

When the coils are connected in parallel, the combined resistance is

$$R = R_1R_2 / R_1+R_2$$

If the water takes t minutes to boil, then

$$V^2t / R = v^2t_1 / R_1 \text{ or } t = t_1R/R_1$$

$$= t_1X(R_1R_2 / R_1+R_2)X1/ R_1$$

$$= 10X (2X3/2+3) X1/10 = 6min$$

Answer: 4

39. An electric bulb has a rating of 500W, 100V. It is used in a circuit having a 200 V supply. What resistance must be connected in series with the bulb so that it delivers 500W?

1) 10 Ω
2) 20 Ω
3) 30 Ω
4) 40 Ω

Solution 39:-

The current flowing in the bulb of 500W operating at 100V is

$I = 500/ 100 = 5A$

Resistance of the bulb = 100/5 = 20 Ω (say R_1)

To deliver 50 W, the current in the bulb must remain 5A when it is operated with 200 V supply. The resistance R to be connected in series for this purpose is

$$200 / R_1+R_2 = 5A$$

Or $R_1+R_2 = 40$ or $R+20 = 40$ or $R = 20\ \Omega$

40. A metal wire has a resistance of 2.00 Ω at 50^0c and 2.04 Ω at 100^0c. What is the temperature coefficient of resistance of the metal?

1) $10/49 \times 10^{-3} K^{-1}$
2) $20/49 \times 10^{-3} K^{-1}$
3) $30/49 \times 10^{-3} K^{-1}$
4) $40/49 \times 10^{-3} K^{-1}$

Solution 40:-

The temperature coefficient of resistance of the conductor is

$$\alpha = R_2 - R_1 / R_1 t_2 - R_2 t_1$$

$$\therefore \alpha = (2.04 - 2.00) / (2 \times 100 - 2.04 \times 50)$$

$$= 0.04 / 200 - 102$$

$$= 0.04 / 98 = 40 / 98 \times 10^{-3}$$

$$= 20 / 49 \times 10^{-3} \ K^{-1}$$

Answer: (2)

41. Three equal resistors are connected in series with a battery, dissipate P watts of power. What will be the power dissipated if the same resistances are connected in parallel across the same battery?

1) P
2) 3P
3) 9P
4) 27P

Solution 41:-

Let R be the value of each resistance and V, the voltage of the battery. When the three resistances are connected in series, the power dissipated is $P = V^2 / 3R$

When they are connected in parallel, the power dissipated is

$$P^1 = 3V^2 / R$$

$$\therefore \quad P^1 = 9P$$

Answer 3

42. A and B are two points on a uniform ring of resistance R. The $\angle AOB = \theta$, where θ is the centre of the ring. The equivalent resistance between A and B is

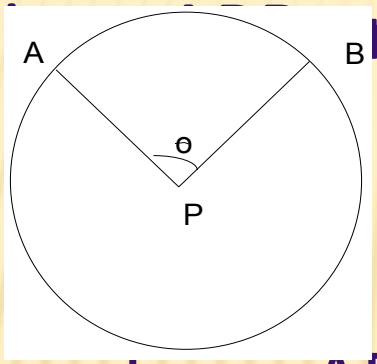
1) $R/4\pi^2 (2\pi - \theta)\theta$ 2) $R(1 - \theta/2\pi)$

3) $R\theta/2\pi$ 4) $R(2\pi - \theta)/4\pi$

Solution(42)

Resistance per unit length $\rho = R/2\pi r$

Lengths of sect nd AQB are $r\theta$ and $r(2\pi - \theta)$



Resistances of sections APB and AQB are

$R_1 = \rho\, r\, \theta = (R/2\pi r)\, r\, \theta = (R/2\pi)\ \theta$ and

$R_2 = (R/2\pi r)\, r(2\pi - \theta) = (R/2\pi)\,(2\pi - \theta)$

As R_1 and R_2 are in parallel between A and B,

$R_p = R_1R_2 / R_1+R_2$

$=(R /2\pi)\theta X(R/2\pi)(2 \pi- \theta)/(R /2\pi)\theta+(R/2\pi)(2 \pi- \theta)$

$=R^2 (\theta (2 \pi- \theta) / 2\pi) / R2 \pi$

$= R/4\pi^2 (2 \pi- \theta) \theta$

Answer: (1)

43. An electric lamp marked 60W-220V is used on an average 5 hours a day in month of 30 days. Cost of electric power consumed at the rate of Rs. 2 per unit is

1) 30/-
2) 18/-
3) 9/-
4) 27/-

Solution 43:-

Number of units consumed = power in watt X

number of hours / 1000

= 60X5X30 /1000 = 9

∴ cost = 9X2= Rs. 18/-

Answer (2)

44. A wire of length 10m and resistance 20 Ω is connected in series with a battery of emf 3V (negligible internal resistance) and a resistance of 10 Ω . The potential drop across the wire in Vm^{-1}

1) 1.0 2) 0.02

3) 0.2 4) 0.01

Solution 44:-

current in the circuit I= V/ R_s

= 3/ 20+10 = 3/ 30 = 0.1 A

Potential drop across the wire = V_1 = I X 20

= 0.1 X 20 = 2V

Potential drop across the wire =

potential drop / length of wire

=2/10=0.2 Vm^{-1}

Answer.(3)

45. Four resistances 15, 12, 4, and 10 Ω are connected in cyclic order to form wheat stone network. The resistance to be connected in parallel with 10 Ω to balance the network is

1) 5 Ω
2) 10 Ω
3) 8 Ω
4) 20 Ω

Solution 45:-

X is the resistance connected in parallel with 10 Ω

$P/Q = R_p / S$; $15/12 = R_p / 4$; $R_p = 5$

$10 \times X / 10 + X = 5$; $10X = 50 + 5X$

$X = 10\ \Omega$

Answer : (2)

THANK YOU