CURRENT ELECTRICITY

1. A wire of length 10 cm and radius $\sqrt{7}\cdot 10^{-4}\,m$ connected across the right gap of a meter bridge. When a resistance of 4.5 Ω is connected on the left gap by using a resistance box, the balance length is found to be at 60 cm from the left end. If the resistivity of the wire is R $\times 10^{-7}\Omega$m, then value of R is :

(1) 63   (2) 70

(3) 66   (4) 35

2. A wire of resistance R and length L is cut into 5 equal parts. If these parts are joined parallely, then resultant resistance will be :

(1) $\dfrac{1}{25}R$ (2) $\dfrac{1}{5}R$

(3) 25 R   (4) 5 R

3. Wheatstone bridge principle is used to measure the specific resistance (S_1) of given wire, having length L, radius r. If X is the resistance of wire, then specific resistance is : $S_1 = X\left(\dfrac{\pi r^2}{L}\right)$. If the length of the wire gets doubled then the value of specific resistance will be :

(1) $\dfrac{S_1}{4}$ (2) $2S_1$

(3) $\dfrac{S_1}{2}$ (4) S_1

4. A current of 200 $\propto$A deflects the coil of a moving coil galvanometer through 60°. The current to cause deflection through $\dfrac{\pi}{10}$ radian is :

(1) 30 $\propto$A

(2) 120 $\propto$A

(3) 60 $\propto$A

(4) 180 $\propto$A

5. Three voltmeters, all having different internal resistances are joined as shown in figure. When some potential difference is applied across A and B, their readings are V_1, V_2 and V_3. Choose the correct option.
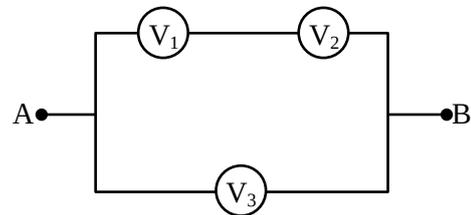
(1) $V_1 = V_2$ (2) $V_1 \neq V_3 - V_2$

(3) $V_1 + V_2 > V_3$ (4) $V_1 + V_2 = V_3$

6. The electric current through a wire varies with time as $I = I_0 + \beta t$. where $I_0 = 20$ A and $\beta = 3$ A/s. The amount of electric charge crossed through a section of the wire in 20 s is :

(1) 80 C   (2) 1000 C

(3) 800 C   (4) 1600 C

7. A galvanometer having coil resistance 10 Ω shows a full scale deflection for a current of 3mA. For it to measure a current of 8A, the value of the shunt should be:
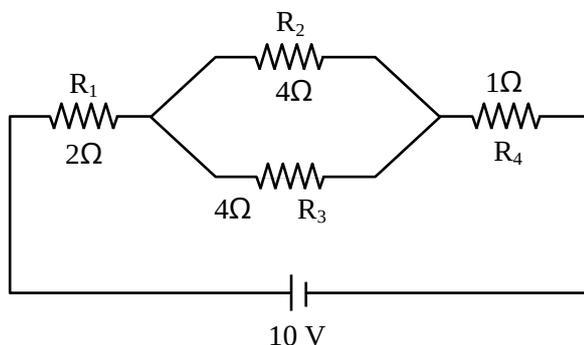
(1) $3 \times 10^{-3}\Omega$

(2) $4.85 \times 10^{-3}\Omega$

(3) $3.75 \times 10^{-3}\Omega$

(4) $2.75 \times 10^{-3}\Omega$

8. The deflection in moving coil galvanometer falls from 25 divisions to 5 division when a shunt of 24Ω is applied. The resistance of galvanometer coil will be :
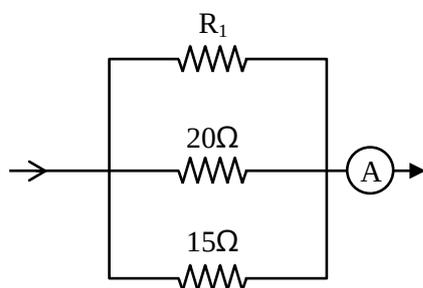
(1) 12Ω

(2) 96Ω
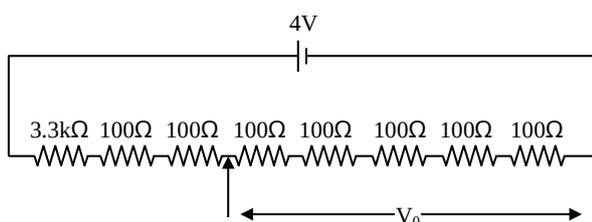
(3) 48Ω

(4) 100Ω

9. In the given circuit, the current in resistance R_3 is :

(1) 1 A

(2) 1.5 A

(3) 2 A

(4) 2.5 A

10. In the given circuit, the current flowing through the resistance $20\,\Omega$ is 0.3 A, while the ammeter reads 0.9 A. The value of R_1 is _____ Ω.

**11.** A potential divider circuit is shown in figure. The output voltage V_0 is

(1) 4V

(2) 2 mV

(3) 0.5 V

(4) 12 mV

12. An electric toaster has resistance of $60\,\Omega$ at room temperature (27°C). The toaster is connected to a 220 V supply. If the current flowing through it reaches 2.75 A, the temperature attained by toaster is around :

(if $\alpha = 2 \cdot 10^{-4}/^\circ$ C)

(1) 694ºC

(2) 1235ºC

(3) 1694ºC

(4) 1667ºC

13. Two cells are connected in opposition as shown. Cell E_1 is of 8 V emf and $2\,\Omega$ internal resistance; the cell E_2 is of 2 V emf and 4 Ω internal resistance. The terminal potential difference of cell E_2 is:
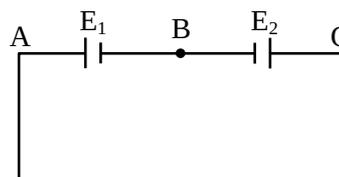
14. When a potential difference V is applied across a wire of resistance R, it dissipates energy at a rate W. If the wire is cut into two halves and these halves are connected mutually parallel across the same supply, the same supply, the energy dissipation rate will become:

(1) 1/4W   (2) 1/2W

(3) 2W   (4) 4W

15. Two resistance of 100 Ω and 200 Ω are connected in series with a battery of 4 V and negligible internal resistance. A voltmeter is used to measure voltage across 100 Ω resistance, which gives reading as 1 V. The resistance of voltmeter must be_____Ω.

16. Two conductors have the same resistances at 0°C but their temperature coefficients of resistance are α_1 and α_2. The respective temperature coefficients for their series and parallel combinations are :

(1) $\alpha_1 + \alpha_2, \dfrac{\alpha_1 + \alpha_2}{2}$

(2) $\dfrac{\alpha_1 + \alpha_2}{2}, \dfrac{\alpha_1 + \alpha_2}{2}$

(3) $\alpha_1 + \alpha_2, \dfrac{\alpha_1 \alpha_2}{\alpha_1 + \alpha_2}$

(4) $\dfrac{\alpha_1 + \alpha_2}{2}, \alpha_1 + \alpha_2$

17. Equivalent resistance of the following network is _____ Ω.

18. The resistance per centimeter of a meter bridge wire is r, with $X\,\Omega$ resistance in left gap. Balancing length from left end is at 40 cm with 25 Ω resistance in right gap. Now the wire is replaced by another wire of 2r resistance per centimeter. The new balancing length for same settings will be at

(1) 20 cm

(2) 10 cm

(3) 80 cm

(4) 40 cm

19. By what percentage will the illumination of the lamp decrease if the current drops by 20%?

(1) 46%   (2) 26%

(3) 36%   (4) 56%

20. In the following circuit, the battery has an emf of 2 V and an internal resistance of $\dfrac{2}{3}\,\Omega$. The power consumption in the entire circuit is_____W.

21. The reading in the ideal voltmeter (V) shown in the given circuit diagram is :

(1) 5V   (2) 10V

(3) 0 V   (4) 3V

22. A galvanometer has a resistance of 50 Ω and it allows maximum current of 5 mA. It can be converted into voltmeter to measure upto 100 V by connecting in series a resistor of resistance

(1) 5975 Ω (2) 20050 Ω

(3) 19950 Ω (4) 19500 Ω

23. The current in a conductor is expressed as $I = 3t^2 + 4t^3$, where I is in Ampere and t is in second. The amount of electric charge that flows through a section of the conductor during t = 1s to t = 2s is _____ C.

24. In an ammeter, 5% of the main current passes through the galvanometer. If resistance of the galvanometer is G, the resistance of ammeter will be :

(1) $\dfrac{G}{200}$ (2) $\dfrac{G}{199}$

(3) 199 G   (4) 200 G

25. To measure the temperature coefficient of resistivity α of a semiconductor, an electrical arrangement shown in the figure is prepared. The arm BC is made up of the semiconductor. The experiment is being conducted at 25°C and resistance of the semiconductor arm is 3 mΩ. Arm BC is cooled at a constant rate of 2°C/s. If the galvanometer G shows no deflection after 10s, then α is :
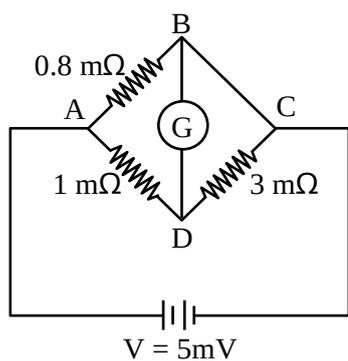
(1) $-2 \times 10^{-2}\,°C^{-1}$

(2) $-1.5 \times 10^{-2}\,°C^{-1}$

(3) $-1 \times 10^{-2}\,°C^{-1}$

(4) $-2.5 \times 10^{-2}\,°C^{-1}$

26. In a metre-bridge when a resistance in the left gap is 2Ω and unknown resistance in the right gap, the balance length is found to be 40 cm. On shunting the unknown resistance with 2Ω, the balance length changes by :

(1) 22.5 cm

(2) 20 cm

(3) 62.5 cm

(4) 65 cm

27. The resistances of the platinum wire of a platinum resistance thermometer at the ice point and steam point are 8 Ω and 10 Ω respectively. After inserting in a hot bath of temperature 400°C, the resistance of platinum wire is :

(1) 2 Ω (2) 16 Ω

(3) 8 Ω (4) 10 Ω

28. To measure the internal resistance of a battery, potentiometer is used. For R = 10Ω, the balance point is observed at ℓ = 500 cm and for R = 1 Ω the balance point is observed at ℓ = 400 cm. The internal resistance of the battery is approximately:

(1) 0.2 Ω (2) 0.4 Ω

(3) 0.1 Ω (4) 0.3 Ω

29. Twelve wires each having resistance 2Ω are joined to form a cube. A battery of 6 V emf is joined across point a and c. The voltage difference between e and f is _____V.
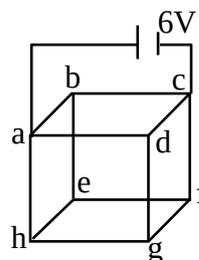

30. An electric bulb rated 50 W – 200 V is connected across a 100 V supply. The power dissipation of the bulb is :

(1) 12.5 W   (2) 25 W

(3) 50 W   (4) 100 W

31. Two wires A and B are made up of the same material and have the same mass. Wire A has radius of 2.0 mm and wire B has radius of 4.0 mm. The resistance of wire B is 2Ω. The resistance of wire A is _____Ω.

32. In the given figure $R_1 = 10\Omega$, $R_2 = 8\Omega$, $R_3 = 4\Omega$ and $R_4 = 8\Omega$. Battery is ideal with emf 12V. Equivalent resistant of the circuit and current supplied by battery are respectively.
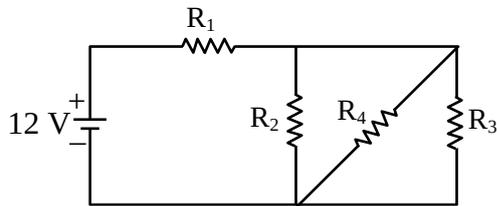
(1) 12 Ω and 11.4 A
(2) 10.5 Ω and 1.14 A
(3) 10.5 Ω and 1 A
(4) 12 Ω and 1 A

33. In the experiment to determine the galvanometer resistance by half-deflection method, the plot of $\dfrac{1}{\theta}$ vs the resistance (R) of the resistance box is shown in the figure. The figure of merit of the galvanometer is .... $\times 10^1$ A/division. [The source has emf 2V].
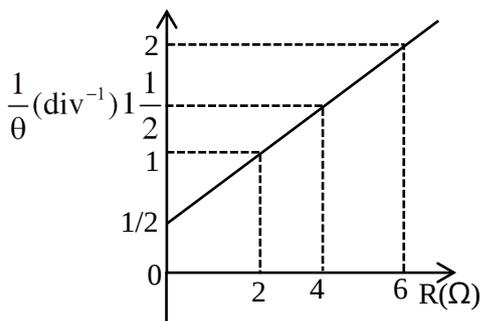
34. A galvanometer of resistance 100 Ω when connected in series with 400 Ω measures a voltage of upto 10 V. The value of resistance required to convert the galvanometer into ammeter to read upto 10 A is $x \times 10^{-2}$ Ω. The value of x is :

(1) 2   (2) 800
(3) 20   (4) 200

35. The ratio of heat dissipated per second through the resistance 5 Ω and 10 Ω in the circuit given below is :
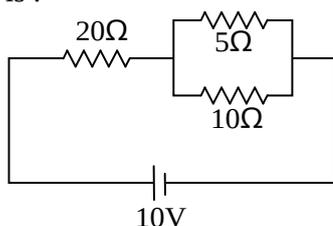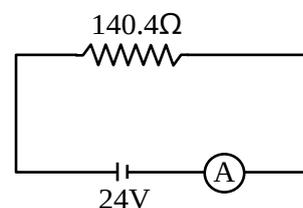

(1) 1 : 2   (2) 2 : 1
(3) 4 : 1   (4) 1 : 1

36. A wire of resistance 20 Ω is divided into 10 equal parts. A combination of two parts are connected in parallel and so on. Now resulting pairs of parallel combination are connected in series. The equivalent resistance of final combination is _____ Ω.

37. The value of unknown resistance (x) for which the potential difference between B and D will be zero in the arrangement shown, is :

(1) 3 Ω   (2) 9 Ω
(3) 6 Ω   (4) 42 Ω
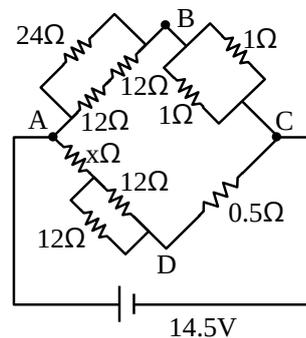
38. A wire of resistance R and radius r is stretched till its radius became r/2. If new resistance of the stretched wire is x R, then value of x is _____.

39. The number of electrons flowing per second in the filament of a 110 W bulb operating at 220 V is : (Given $e = 1.6 \times 10^{-19}$ C)

(1) 31.25×10^{17} (2) 6.25×10^{18}
(3) 6.25×10^{17} (4) 1.25×10^{19}

40. In the given figure an ammeter A consists of a 240Ω coil connected in parallel to a 10 Ω shunt. The reading of the ammeter is _____ mA.

41. In the given circuit, the terminal potential difference of the cell is :

(1) 2 V　　　　　　(2) 4 V

(3) 1.5 V　　　　　(4) 3 V

42. Resistance of a wire at 0 °C, 100 °C and t °C is found to be 10 Ω, 10.2 Ω and 10.95 Ω respectively. The temperature t in Kelvin scale is_____.

43. A heater is designed to operate with a power of 1000 W in a 100 V line. It is connected in combination with a resistance of 10 Ω and a resistance R, to a 100 V mains as shown in figure. For the heater to operate at 62.5 W, the value of R should be …………….Ω.

44. A galvanometer has a coil of resistance 20Ω with a full scale deflection at 20∝A. The value of resistance to be added to use it as an ammeter of range (0–20) mA is:

(1) 0.40 Ω　　　　　(2) 0.20 Ω

(3) 0.50 Ω　　　　　(4) 0.10 Ω

45. The equivalent resistance between A and B is:

(1) 18 Ω　　　　　(2) 25 Ω

(3) 27 Ω　　　　　(4) 19 Ω

46. The current flowing through the 1 Ω resistor is $\dfrac{n}{10}$ A. The value of n is _____.

47. To determine the resistance (R) of a wire, a circuit is designed below, The V-I characteristic curve for this circuit is plotted for the voltmeter and the ammeter readings as shown in figure. The value of R is …………Ω.

48. The effective resistance between *A* and *B*, if resistance of each resistor is *R,* will be

(1) $\dfrac{2}{3}R$　　　　　(2) $\dfrac{8R}{3}$

(3) $\dfrac{5R}{3}$　　　　　(4) $\dfrac{4R}{3}$

49. At room temperature (27ºC), the resistance of a heating element is 50Ω. The temperature coefficient of the material is 2.4×10^{-4} ºC^{-1}. The temperature of the element, when its resistance is 62 Ω, is …………. ºC.

SOLUTIONS

1. **Ans. (3)**

Sol. For null point,

$$\frac{4.5}{60} = \frac{R}{40}$$

Also, $R = \frac{\rho\ell}{A} = \frac{\rho\ell}{\pi r^2}$

$$4.5 \cdot 40 = \rho \cdot \frac{0.1}{\pi \cdot 7 \cdot 10^{-8}} \cdot 60$$

$$\rho = 66 \cdot 10^{-7} \Omega \cdot m$$

2. **Ans. (1)**

Sol. Resistance of each part $= \frac{R}{5}$

Total resistance $= \frac{1}{5} \cdot \frac{R}{5} = \frac{R}{25}$

3. **Ans. (4)**

Sol. As specific resistance does not depends on dimension of wire so, it will not change.

4. **Ans. (3)**

Sol. $i \propto \theta$ (angle of deflection)

$$\therefore \frac{i_2}{i_1} = \frac{\theta_2}{\theta_1} \Rightarrow \frac{i_2}{200 \propto A} = \frac{\pi/10}{\pi/3} = \frac{3}{10}$$

$$\Rightarrow i_2 = 60 \propto A$$

5. **Ans. (4)**

Sol. From KVL,

$V_1 + V_2 - V_3 = 0 \Rightarrow V_1 + V_2 = V_3$

6. **Ans. (2)**

Sol. Given that

Current $I = I_0 + \beta t$

$I_0 = 20A$; $\beta = 3A/s$

$I = 20 + 3t$; $\quad \frac{dq}{dt} = 20 + 3t$

$$\int_0^q dq = \int_0^{20}(20 + 3t)dt \text{ ; } q = \int_0^{20}20dt + \int_0^{20}3tdt$$

$$q = \left[20t + \frac{3t^2}{2} \right]_0^{20} = 1000 \text{ C}$$

7. **Ans. (3)**

Sol. Given $G = 10\,\Omega$

$I_g = 3mA$; $I = 8A$

In case of conversion of galvanometer into ammeter.
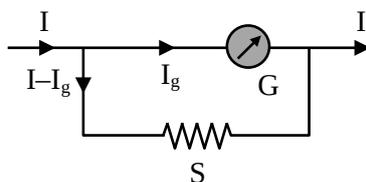
We have $I_g G = (I - I_g)S$

$$S = \frac{I_g G}{I - I_g} \text{ ; } S = \frac{(3 \cdot 10^{-3})10}{8 - 0.003}$$

$$= 3.75 \times 10^{-3}\Omega$$

8. **Ans. (2)**

Sol. Let x = current/division
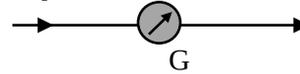
After applying shunt
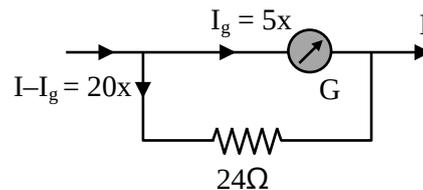
Now $5x \times G = 20x \times 24$

$G = 4 \times 24$

$G = 96\Omega$

9. **Ans. (1)**

Sol.
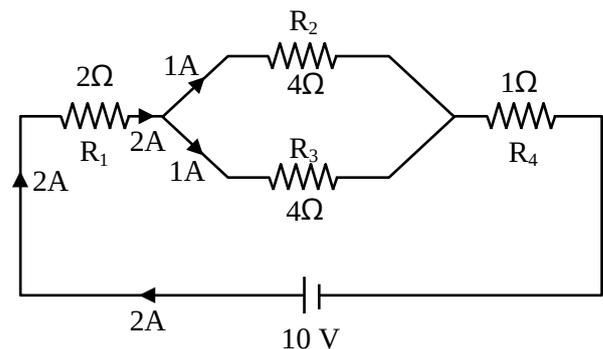
$R_{eq} = 2\Omega + 2\,\Omega + 1\,\Omega = 5\,\Omega$

$$i = \frac{V}{R_{eq}} = \frac{10}{5} = 2A$$

Current in resistance $R_3 = 2 \cdot \left(\frac{4}{4+4} \right)$

$$= 2 \cdot \frac{4}{8} = 1A$$

10. **Ans. (30)**

Sol.
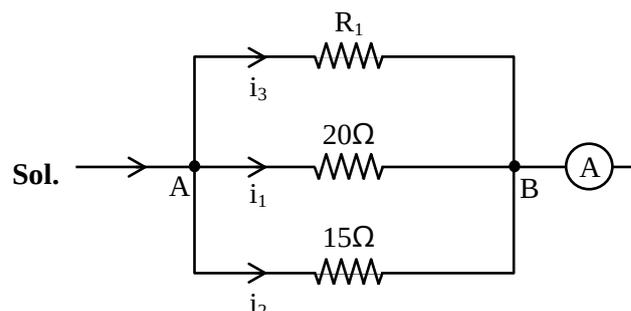
Given, $i_1 = 0.3$ A, $i_1 + i_2 + i_3 = 0.9$ A

So, $V_{AB} = i_1 \times 20\Omega = 20 \times 0.3$ V $= 6$ V

$i_2 = \dfrac{6V}{15\Omega} = \dfrac{2}{5}$ A ; $i_1 + i_2 + i_3 = \dfrac{9}{10}$ A

$\dfrac{3}{10} + \dfrac{2}{5} + i_3 = \dfrac{9}{10}$; $\dfrac{7}{10} + i_3 = \dfrac{9}{10}$

$i_3 = 0.2$ A

So, $i_3 \times R_1 = 6$ V

$(0.2)R_1 = 6$

$R_1 = \dfrac{6}{0.2} = 30\ \Omega$

11. Ans. (3)

Sol. $R_{eq} = 4000\,\Omega$

$i = \dfrac{4}{4000} = \dfrac{1}{1000}$ A

$V_0 = i.R = \dfrac{1}{1000} \cdot 500 = 0.5$ V

12. Ans. (3)

Sol. $R_{T=27} = 60\Omega$, $R_T = \dfrac{220}{2.75} = 80\Omega$

$R = R_0(1 + \alpha\Delta T)$

$80 = 60[1 + 2 \times 10^{-4}(T - 27)]$

$T \approx 1694^\circ C$

13. Ans. (6)

Sol.
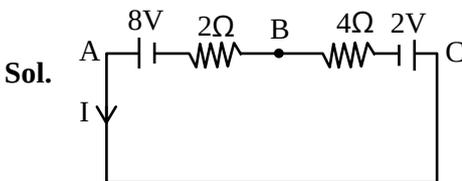
$I = \dfrac{8-2}{2+4} = \dfrac{6}{6} = 1A$

Applying Kirchhoff from C to B

$V_C - 2 - 4 \cdot 1 = V_B$

$V_C - V_B = 6V = 6V$

14. Ans. (4)

Sol. $\dfrac{v^2}{R} = W$ ....(i)

$\dfrac{v^2}{\dfrac{1}{2}\left(\dfrac{R}{2}\right)} = W'$ ....(ii)

From (i) & (ii), we get

$W' = 4W$

15. Ans. (200)

Sol.
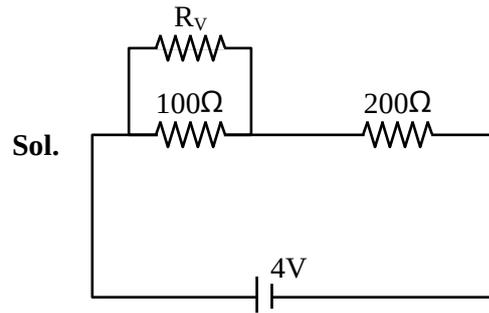
$\dfrac{R_v 100}{R_v + 100} = \dfrac{200}{3}$

$3R_v = 2R_v + 200$

$R_v = 200$

16. Ans. (2)

Sol. **Series :**

$R_{eq} = R_1 + R_2$

$2R(1 + \alpha_{eq}\Delta\theta) = R(1 + \alpha_1\Delta\theta) + R(1 + \alpha_2\Delta\theta)$

$2R(1 + \alpha_{eq}\Delta\theta) = 2R + (\alpha_1 + \alpha_2)R\Delta\theta$

$\alpha_{eq} = \dfrac{\alpha_1 + \alpha_2}{2}$

Parallel :

$\dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$

$\dfrac{1}{\dfrac{R}{2}(1 + \alpha_{eq}\Delta\theta)} = \dfrac{1}{R(1 + \alpha_1\Delta\theta)} + \dfrac{1}{R(1 + \alpha_2\Delta\theta)}$

$\dfrac{2}{1 + \alpha_{eq}\Delta\theta} = \dfrac{1}{1 + \alpha_1\Delta\theta} + \dfrac{1}{1 + \alpha_2\Delta\theta}$

$\dfrac{2}{1 + \alpha_{eq}\Delta\theta} = \dfrac{1 + \alpha_2\Delta\theta + 1 + \alpha_1\Delta\theta}{(1 + \alpha_1\Delta\theta)(1 + \alpha_2\Delta\theta)}$

$2\left[(1 + \alpha_1\Delta\theta)(1 + \alpha_2\Delta\theta)\right]$

$= \left[2 + (\alpha_1 + \alpha_2)\Delta\theta\right]\left[1 + \alpha_{eq}\Delta\theta\right]$

$2[1 + \alpha_1\Delta\theta + \alpha_2\Delta\theta + \alpha_1\alpha_2\Delta\theta]$
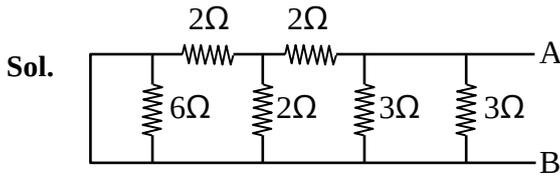
$= 2 + 2\alpha_{eq}\Delta\theta + (\alpha_1 + \alpha_2)\Delta\theta + \alpha_{eq}(\alpha_1 + \alpha_2)\Delta\theta^2$

Neglecting small terms

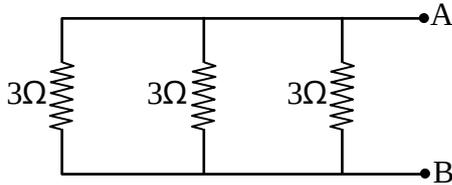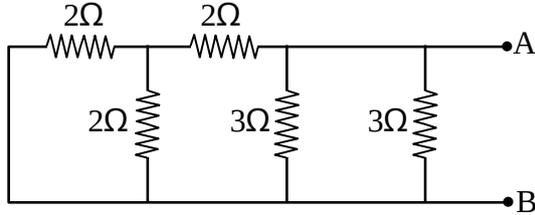$2 + 2(\alpha_1 + \alpha_2)\theta = 2 + 2\alpha_{eq}\Delta\theta + (\alpha_1 + \alpha_2)\Delta\theta$

$(\alpha_1 + \alpha_2)\Delta\theta = 2\alpha_{eq}\Delta\theta$

$\alpha_{eq} = \dfrac{\alpha_1 + \alpha_2}{2}$

17. **Ans. (1)**

Sol.

6Ω is short circuit

$R_{eq} = 3 \cdot \dfrac{1}{3} = \Omega$

18. **Ans. (4)**

Sol.

$\dfrac{25}{r\ell_1} = \dfrac{X}{r\ell_2}$ .....(i)

$\dfrac{25}{2r\ell'_1} = \dfrac{X}{2r\ell'_2}$ ..... (ii)
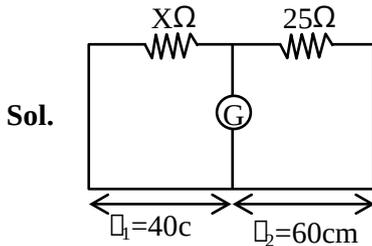
From (i) and (ii)

$\ell'_2 = \ell_2 = 40$ cm

19. **Ans. (3)**

Sol. $P = i^2 R$

$P_{int} = I^2_{int} R$

$P_{final} = \left(0.8\, I_{int}\right)^2 R$

% change in power =

$\dfrac{P_{final} - P_{int}}{P_{int}} \cdot 100 = (0.64 - 1) \cdot 100 = -36\%$

20. **Ans. (3)**

Sol. $R_{eq} = \dfrac{4}{3}\Omega$

$\therefore P = \dfrac{V^2}{R_{eq}} = \dfrac{4}{4/3} = 3$ W

21. **Ans. (3)**

Sol. $i = \dfrac{E_{eq}}{r_{eq}} = \dfrac{8 \cdot 5}{8 \cdot 0.2}$

$I = 25A$

$V = E - ir$

$= 5 - 0.2 \times 25 = 0$

22. **Ans. (3)**

Sol.
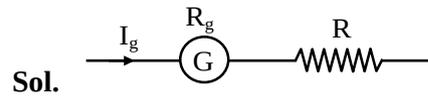
$R = \dfrac{V}{I_g} - R_g = \dfrac{100}{5 \cdot 10^{-3}} - 50$

$= 20000 - 50$

$= 19950\Omega$

23. **Ans. (22)**

Sol. $q = \int\limits_1^2 i\, dt = \int\limits_1^2 (3t^2 + 4t^3)dt$

$q = \left(t^3 + t^4\right)\Big|_1^2$; $q = 22C$

24. **Ans. NTA (1)**

Allen (Bonus)

Sol.
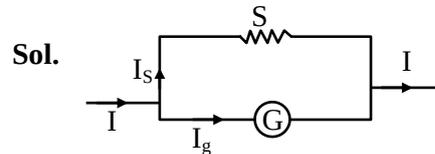
$I_S S = I_g G$

$\dfrac{95}{100} IS = \dfrac{5I}{100} G$; $S = \dfrac{G}{19}$

$R_A = \dfrac{SG}{S+G} = \dfrac{\dfrac{G^2}{19}}{\dfrac{20G}{19}}$

$R_A = \dfrac{G}{20}$

25. **Ans. (3)**

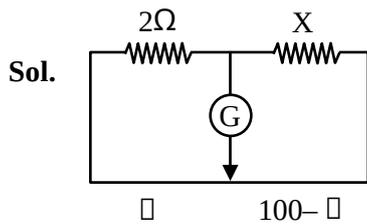**Sol.** For no deflection $\dfrac{0.8}{1} = \dfrac{R}{3}$

$\Rightarrow R = 2.4m\Omega$

Temperature fall in 10s = 20°C

$R = R\alpha\, t$

$\alpha = \dfrac{\Delta R}{R\Delta} = \dfrac{-0.6}{3 \cdot 20} = -10^{-2}C^{-1}$

9

26. Ans. (1)

Sol.

First case $\dfrac{2}{40} = \dfrac{X}{60} \Rightarrow X = 3\Omega$

In second case $X' = \dfrac{2 \cdot 3}{2+3} = 1.2\Omega$

$\dfrac{2}{\ell} = \dfrac{1.2}{100 - \ell}$

$200 - 2\ell = 1.2\ell$

$\ell = \dfrac{200}{3.2} = 62.5\,cm$

Balance length changes by 22.5 cm

27. Ans. (2)

Sol. Given $R_0 = 8\Omega$, $R_{100} = 10\Omega$

$\therefore R_{100} = R_0(1 + \alpha\Delta T)$

Also, $R_{400} = R_0(1 + \alpha\Delta T^1)$

$\therefore 10 = 8(1 + \alpha \times 100) \Rightarrow 100\alpha = \dfrac{1}{4}$

$\therefore R_{400} = 8(1 + 400\alpha) = 8(1 + 1) = 16\Omega$

Hence option (2)

28. Ans. (4)

Sol. Let potential gradient be λ.

$\therefore i \times 10 = \lambda \times 500 = \varepsilon - ir_s$

$\Rightarrow 500\lambda = \varepsilon - 50\lambda r_s$

Also,

$i' \times 1 = \lambda \times 400 = \varepsilon - i'r_s$

$\Rightarrow 400\lambda = \varepsilon - 400\lambda r_s$

$\therefore 100\lambda = 350\lambda\, r_s \Rightarrow r_s = \dfrac{10}{35} \approx 0.3\Omega$

Hence option (4)

29. Ans. (1)
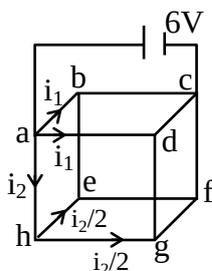
Sol.

From symmetry, current through e-b & g-d = 0

$\therefore R_{eq} = \dfrac{3}{4} \cdot R = \dfrac{3}{2}\Omega$

$\therefore$ Current through battery $= \dfrac{6 \cdot 2}{3} = 4A$

$i_2 = \dfrac{4}{8} \cdot 2 = 1A$

$\therefore \Delta V$ across e-f $= \dfrac{i_2}{2} \cdot R = \dfrac{1}{2} \cdot 2 = 1V$

30. Ans. (1)

Sol. Rated power & voltage gives resistance

$R = \dfrac{V^2}{P} = \dfrac{(200)^2}{50} = \dfrac{40000}{50}$

$R = 800$

$P = \dfrac{(V_{applied})^2}{R} = \dfrac{(100)^2}{800}$

$P = 12.5$ watt

Hence option 1 is correct.

31. Ans. (32)

Sol. $\because R = \dfrac{\rho\ell}{A} = \dfrac{\rho V}{A^2}$ $\therefore \dfrac{R_A}{R_B} = \dfrac{A_B^2}{A_A^2} = \dfrac{r_B^4}{r_A^4}$

$\Rightarrow \dfrac{R_A}{2} = \left[\dfrac{4 \cdot 10^{-3}}{2 \cdot 10^{-3}}\right]^4$

$\Rightarrow R_A = 32\,\Omega.$

32. Ans. (4)

Sol. Here R_2, R_3, R_4 are in parallel

$\dfrac{1}{R_{234}} = \dfrac{1}{R_2} + \dfrac{1}{R_3} + \dfrac{1}{R_4}$

$R_{234} = 2\Omega$

R_{234} is in series with R_1 so

$R_{eq} = R_{234} + R_1 = 2 + 10 = 12\Omega$

$i = \dfrac{12}{12} = 1\,Amp$

33. Ans. (5)

Sol. $i = K\theta$

$\dfrac{2}{G+R} = K\theta$

$\Rightarrow \dfrac{1}{\theta} = \dfrac{(G+R)K}{2} = R\left(\dfrac{K}{2}\right) + \dfrac{KG}{2}$

Slope $= \dfrac{K}{2} = \dfrac{1}{4} \Rightarrow K = 0.5 = 5 \cdot 10^{-1}A$

34. Ans. (3)

Sol. $i_g = \dfrac{10}{400 + 100} = 20 \cdot 10^{-3}\,A$
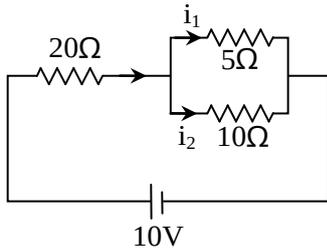
For ammeter

Let shunt resistance = S

$i_g R = (i - i_g)S$

$20 \times 10^{-3} \times 100 = 10\,S$

$S = 20 \times 10^{-2}\,\Omega$
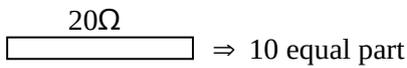
35. Ans. (2)

Sol.

$$\frac{i_1}{i_2} = \frac{10}{5} = \frac{2}{1}$$

$$\frac{P_1}{P_2} = \frac{i_1^2 R_1}{i_2^2 R_2} = \left(\frac{2}{1}\right)^2 \cdot \frac{5}{10} = \frac{2}{1}$$

36. Ans. (5)

$\Rightarrow$ 10 equal part
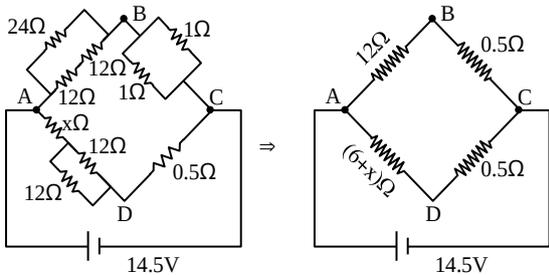
Sol.

Each part has resistance = 2Ω

2 parts are connected in parallel so, R = 1Ω

Now, there will be 5 parts each of resistance 1Ω, they are connected in series.

$R_{eq} = 5R$, $R_{eq} = 5\Omega$

37. Ans. (3)

In case of balanced Wheatstone Bridge

$$\frac{V_{AB}}{V_{AD}} = \frac{V_{BC}}{V_{CD}} \Rightarrow \frac{12}{6+x} = \frac{0.5}{0.5}$$

x = 6 Ω

38. Ans. (16)

Sol. We know $R = \frac{\rho l}{A}$, $R \propto \frac{l}{r^2}$

As we starch the wire, its length will increase but its radius will decrease keeping the volume constant

$V_i = V_f$

$$\pi r^2 l = \pi \frac{r^2}{4} l_f ; \; l_f = 4l$$

$$\frac{R_{new}}{R_{old}} = \left| \frac{4l}{\frac{r^2}{4}} \right| \frac{r^2}{l} = 16$$

$R_{new} = 16R$ ∴ x = 16

39. Ans. (1)

Sol. Power (P) = V.I

$\Rightarrow 110 = (220)(I) \Rightarrow I = 0.5$ A

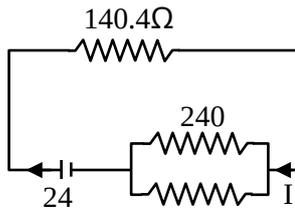Now, $I = \frac{n \, e}{t}$

$\Rightarrow 0.5 = \left(\frac{n}{t}\right)(1.6 \times 10^{-19})$

$\Rightarrow \frac{n}{t} = \frac{0.5}{1.6 \cdot 10^{-19}} \Rightarrow \boxed{\frac{n}{t} = 31.25 \cdot 10^{17}}$

40. Ans. (160)

Sol.

$$Req = 140.4 + \frac{240 \cdot 10}{240 + 10}$$
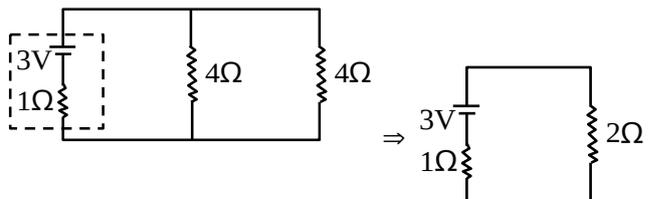
$$Req = 140.4 + \frac{2400}{250}$$

Req. = 150Ω

∴ Current in ammeter

$$= \frac{24}{150} = 160 \text{ mA}$$

41. Ans. (1)

Sol.

$$i = \frac{3}{1+2} = 1A$$

$v = E - ir = 3 - 1 \times 1 = 2V$

42. **Ans. (748)**

Sol. $R = R_0(1 + \alpha\Delta T)$

$$\frac{\Delta R}{R_0} = \alpha\Delta T$$

Case-I

$0\ ^\circ C \rightarrow 100\ ^\circ C$

$$\frac{10.2 - 10}{10} = \alpha(100 - 0) \qquad ..... (1)$$

Case-II

$0\ ^\circ C \rightarrow t\ ^\circ C$

$$\frac{10.95 - 10}{10} = \alpha(t - 0) \qquad ...... (2)$$

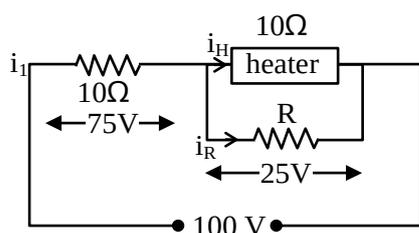$$\Rightarrow \frac{t}{100} = \frac{0.95}{0.2} = 475^\circ\ C$$

$t = 475 + 273 = 748\ K$

43. **Ans. (5)**

Sol. $R_{heater} = \dfrac{V^2}{P} = \dfrac{(100)^2}{1000} = 10\Omega$

For heater $P = \dfrac{V^2}{R} \Rightarrow V = \sqrt{PR}$

$V = \sqrt{62.5 \cdot 10}$

$V = 25\ v$

$i_1 = \dfrac{75}{10} = 7.5A, \quad i_H = \dfrac{25}{10} = 2.5\ A.$

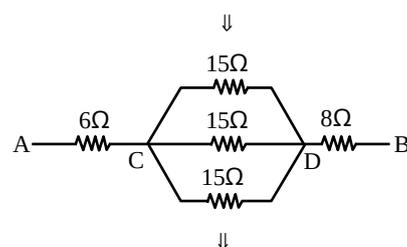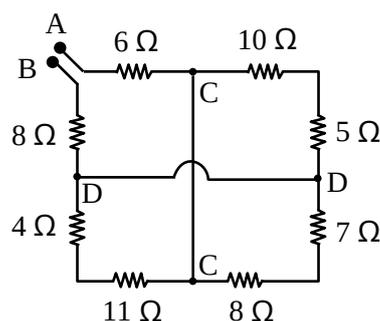$i_R = i_1 - i_H = 5$

$V = IR$

$R = \dfrac{25}{5} = 5\Omega$

44. **Ans. (2)**

Sol. $G = 200\ \Omega$

$i_g = 20\ \mu A$
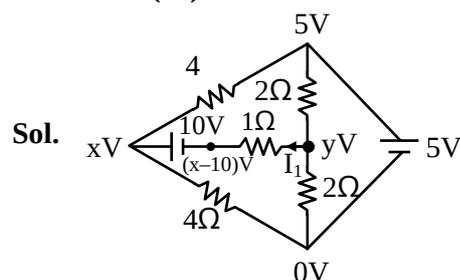
$i = i_g\left(\dfrac{G}{S} + 1\right)$

$\Rightarrow 20 \times 10^{-3} = 20 \times 10^{-6}\left(\dfrac{200}{S} + 1\right)$

$\Rightarrow \dfrac{200}{S} = 999 \Rightarrow S \approx 0.2\ \Omega$

45. **Ans. (4)**

Sol.

$\Rightarrow R_{eq} = 6\Omega + 5\Omega + 8\Omega = 19\Omega$

46. **Ans. (25)**

Sol.

$$\frac{y-5}{2} + \frac{y-0}{2} + \frac{y-x+10}{1} = 0$$

$y - 5 + y + 2y - 2x + 20 = 0$

$4y - 2x + 15 = 0 \quad ....(i)$

$$\frac{x-5}{4} + \frac{x-0}{4} + \frac{x-10-y}{1} = 0$$

$x - 5 + x + 4x - 40 - 4y = 0$

$\begin{aligned} 6x - 4y - 45 &= 0 \quad ..(i) \\ \underline{-2x + 4y + 15 &= 0 \quad ..(ii)} \\ 4x - 30 &= 0 \end{aligned}$

$x = \dfrac{15}{2}$ & $4y - 15 + 15 = 0$

$y = 0$

$i = \dfrac{y - x + 10}{1}$

$i = \dfrac{0 - 7.5 + 10}{1}$

$i = 2.5A = \dfrac{n}{10}A$; $n = 25$

47. **Ans. (2500)**

Sol. $Req = \dfrac{10^4 R}{10^4 + R}$

E = 4V, I = 2mA

$I = \dfrac{E}{Req} \Rightarrow \cdot 2 \times 10^{-3} = \dfrac{4\left(10^4 + R\right)}{10^4 R}$
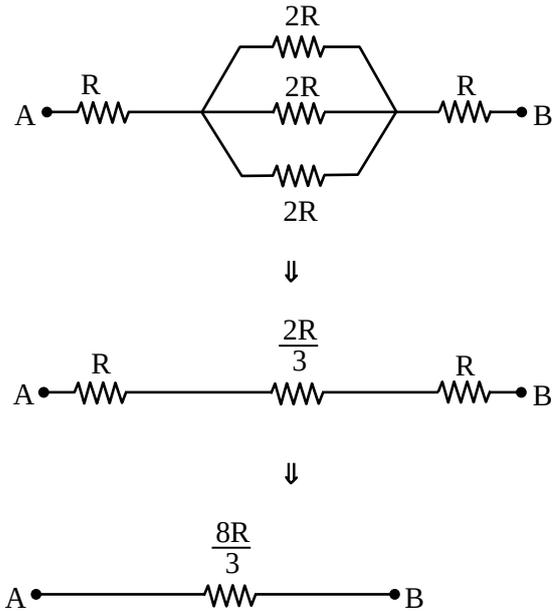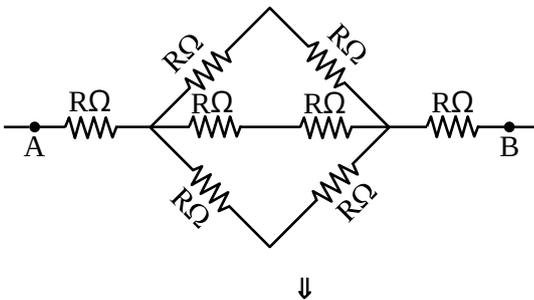
$\Rightarrow 20R = 40000 + 4R$

16R = 40000

R = 2500Ω

48. **Ans. (2)**

Sol. From symmetry we can remove two middle resistance.

New circuit is

⇓

⇓

⇓

49. **Ans. (1027)**

Sol. $R = R_0(1 + \alpha \Delta T)$

$62 = 50 [1 + 2.4 \times 10^{-4} \, T]$

T = 1000°C

$\Rightarrow T - 27° = 1000°C$

$\boxed{T = 1027°C}$