$V_X - V_Q = \frac{5}{2} \times 2 = 5V$ ...(ii)

On solving (i) and (ii) $V_P - V_Q = -2.5\ volt,\ V_Q > V_P$.

Short Trick : $(V_P - V_Q) = \frac{i}{2}(R_2 - R_1)$

$= \frac{5}{2}(2-3) = -2.5$

$\Rightarrow V_Q > V_P$

13. (c) $R_{t_1} = R_1(1+\alpha_1 t)$ and $R_{t_2} = R_2(1+\alpha_2 t)$

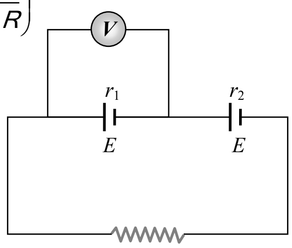
Also $R_{eq} = R_{t_1} + R_{t_2} \Rightarrow R_{eq} = R_1 + R_2 + (R_1\alpha_1 + R_2\alpha_2)t$

$\Rightarrow R_{eq} = (R_1 + R_2)\left\{1 + \left(\frac{R_1\alpha_1 + R_2\alpha_2}{R_1 + R_2}\right).t\right\}$

So $\alpha_{eff} = \frac{R_1\alpha_1 + R_2\alpha_2}{R_1 + R_2}$

14. (b) Let the voltage across any one cell is V, then

$V = E - ir = E - r_1\left(\frac{2E}{r_1 + r_2 + R}\right)$



But $V = 0$

$\Rightarrow E - \frac{2Er_1}{r_1 + r_2 + R} = 0$

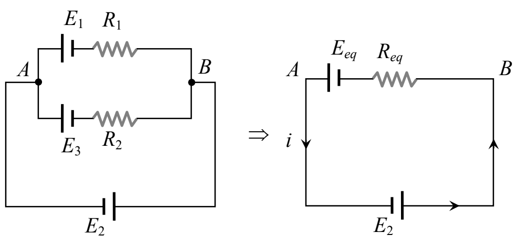
$\Rightarrow r_1 + r_2 + R = 2r_1$

$\Rightarrow R = r_1 - r_2$

15. (b) Emf $E = 5V$, Internal resistance $r = \frac{5}{10} = 0.5\Omega$

Current through the resistance $i = \frac{5}{(2+0.5)} = 2A$

16. (b) The given circuit can be redrawn

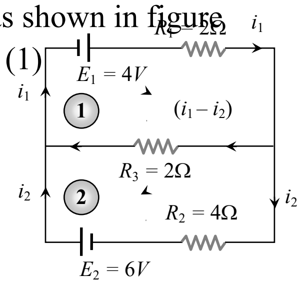


$E_{eq} = \frac{E_1R_2 + E_2R_1}{R_1 + R_2} = \frac{2\times4 + 2\times4}{4+4} = 2V$ and

$R_{eq} = \frac{4}{2} = 2\Omega$. Current $i = \frac{2+2}{2} = 2A$ from A to B through E_2.

17. (b) Applying Kirchhoff's law for the loops (1) and (2) as shown in figure

For loop (1)



$-2i_1 - 2(i_1 - i_2) + 4 = 0 \Rightarrow 2i_1 - i_2 = 2$ ...(i)

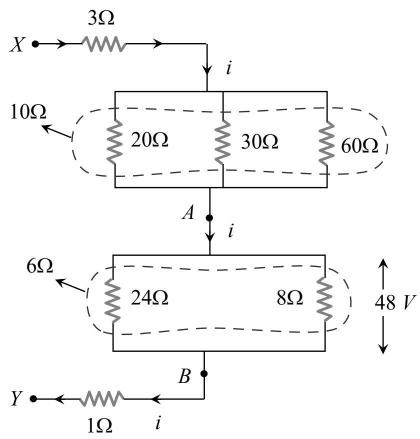
For loop (2)

$-2(i_1 - i_2) + 4i_2 - 6 = 0 \Rightarrow -i_1 + 3i_2 = 3$ ...(ii)

On solving equation (i) and (ii) $i_1 = 1.8A$.

18. (b) To convert a galvanometer into an ammeter, a shunt $S = \frac{I_g}{I - I_g}G$ is connected in parallel with it. To convert a galvanometer into a voltmeter, a resistance $R = \frac{V}{I_g} - G$ is connected in series with it.

19. (a) The given circuit can be redrawn as follows



Resistance between A and B $= \frac{24\times8}{32} = 6\,\Omega$

Current between A and B = Current between X and Y $= i = \frac{48}{6} = 8A$

Resistance between X and Y $= (3+10+6+1) = 20\,\Omega$

$\Rightarrow$ Potential difference between X and $Y = 8 \times 20 = 160\ V$

20. (d) $R_1 + R_2 = R_1(1+\alpha t) + R_2(1-\beta t)$

$\Rightarrow R_1 + R_2 = R_1 + R_2 + R_1\alpha t - R_2\beta t \Rightarrow \frac{R_1}{R_2} = \frac{\beta}{\alpha}$

21. (d) Current density of drifting electrons $j = nev$

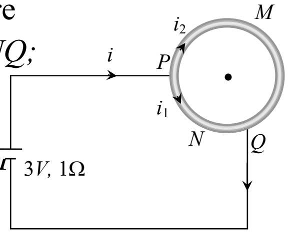
$n = 5\times10^7\ cm^{-3} = 5\times10^7\times10^6\ m^{-3}$.

$v = 0.4\ ms^{-1},\ e = 1.6\times10^{-19}\ C \Rightarrow j = 3.2\times10^{-6}\ Am^{-2}$

Current density of ions = (4 – 3.2) × 10^{-6} = $0.8\times10^{-6}\,\frac{A}{m^2}$

This gives v for ions = 0.1 ms^{-1}.

22. (a) In the following figure



Resistance of part PNQ;

$R_1 = \frac{10}{4} = 2.5\Omega$ and

Resistance of part PMQ

$R_2 = \frac{3}{4}\times10 = 7.5\Omega$

$R_{eq} = \frac{R_1R_2}{R_1+R_2} = \frac{2.5\times7.5}{(2.5+7.5)} = \frac{15}{8}\Omega$.

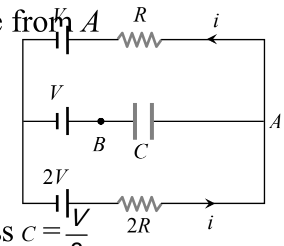
Main Current $i = \frac{3}{\frac{15}{8}+1} = \frac{24}{23}A$

So, $i_1 = i\times\left(\frac{R_2}{R_1+R_2}\right) = \frac{24}{23}\times\left(\frac{7.5}{2.5+7.5}\right) = \frac{18}{23}A$

and $i_2 = i - i_1 = \frac{24}{23} - \frac{18}{23} = \frac{6}{23}A$.

23. (c) As I is independent of R_6, no current flows through R_6 this requires that the junction of R_1 and R_2 is at the same potential as the junction of R_3 and R_4. This must satisfy the condition $\frac{R_1}{R_2} = \frac{R_3}{R_4}$, as in the Wheatstone bridge.

24. (c) Moving anticlockwise from A



$-iR - V + 2V - 2iR = 0$

or $3iR = V$ or $i = \frac{V}{3R}$

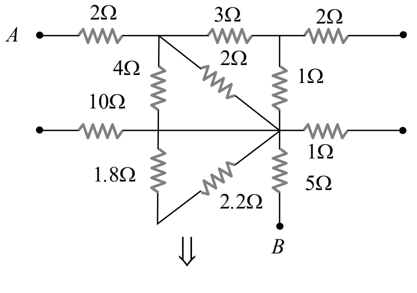
$V_A - V_B = iR + V - V = iR$

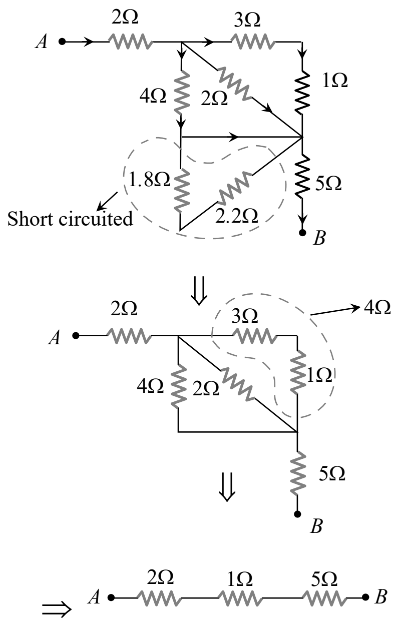
⇒ Potential drop across $C = \frac{V}{3}$

25. (b) Let R and m be the resistance and mass of the first wire, then the second wire has resistance $2R$ and mass $2m$. Let E = emf of each cell, S = specific heat capacity of the material of the wire. For the first wire, current $i_1 = \frac{3E}{R}$ and $i_1^2Rt = mS\Delta T$

For the second wire, $i_2 = \frac{NE}{2R}$ and $i_2^2(2R)t = 2mS\Delta T$. Thus, $i_1 = i_2$ or $N = 6$.

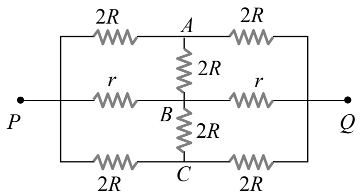
26. (b)





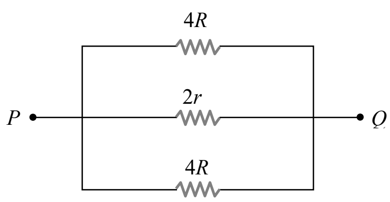
$R_{AB} = 8\Omega$.

27. (a)



In a circuit, any circuit element placed between points at the same potential can be removed, without affecting the rest of the circuit. Here, by symmetry, points A, B and C are at same potential, for any potential difference between P and Q.

The circuit can therefore be reduced as shown below



Effective resistance $R_{eq} = \frac{2Rr}{R+r}$.

28. (d) Potential difference between A and B

$V_A - V_B = 1\times1.5$

⇒ $V_A - 0 = 1.5V \Rightarrow V_A = 1.5V$

Potential difference between B and C

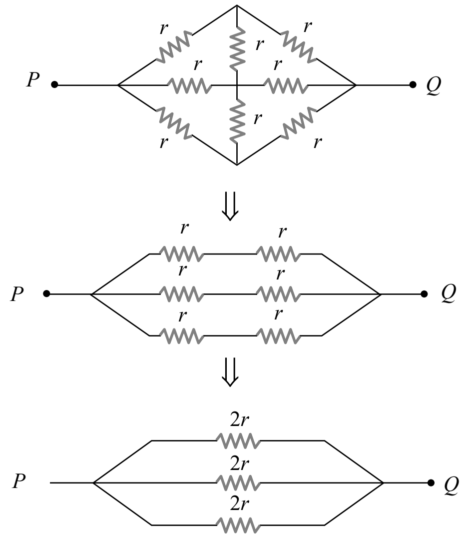
$V_B - V_C = 1 \times 2.5 = 2.5\,V$

$\Rightarrow 0 - V_C = 2.5\,V \Rightarrow V_C = -2.5\,V$

Potential difference between C and D

$V_C - V_D = -2\,V \Rightarrow -2.5 - V_D = -2 \Rightarrow V_D = -0.5\,V.$

29. (b) The given circuit can be simplifies as follows



$R = \frac{2r}{3} = \frac{2}{3} \times \frac{3}{2} = 1\Omega$.

30. (b) $dQ = Idt \Rightarrow Q = \int_{t=2}^{t=3} Idt = \left[2\int_2^3 tdt + 3\int_2^3 t^2 dt\right]$

$= [t^2]_2^3 + [t^3]_2^3 = (9-4) + (27-8) = 5 + 19 = 24C$.

31. (d) $i = \frac{E_1 + E_2 + E_3 + ... + E_n}{(r_1 + r_2 + r_3 + ... + r_n)}$

$= \frac{1.5(r_1 + r_2 + r_3 + ... + r_n)}{(r_1 + r_2 + r_3 + ... + r_n)} = 1.5A$.

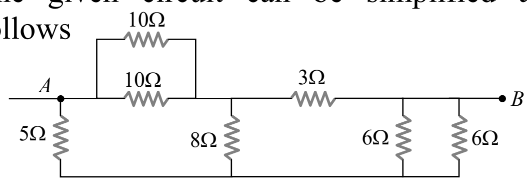
32. (a) Balancing length is independent of the cross sectional area of the wire.

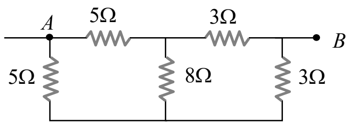
33. (a) $\frac{R_1}{R_2} = \frac{(1+\alpha t_1)}{(1+\alpha t_2)} \Rightarrow \frac{10}{R_2} = \frac{(1+5\times 10^{-3}\times 20)}{(1+5\times 10^{-3}\times 120)} \Rightarrow$

$R_2 \approx 15\Omega$

Also $\frac{i_1}{i_2} = \frac{R_2}{R_1} \Rightarrow \frac{30}{i_2} = \frac{15}{10} \Rightarrow i_2 = 20\,mA$

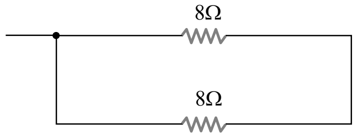
34. (b) The given circuit can be simplified as follows



⇒ 

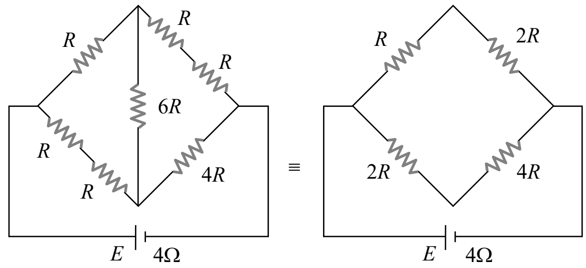
Now it is a balance Wheatstone bridge.

So,



$\Rightarrow R_{AB} = \frac{8\times 8}{8+8} = \frac{64}{16} = 4\Omega$

35. (c) The equivalent network is

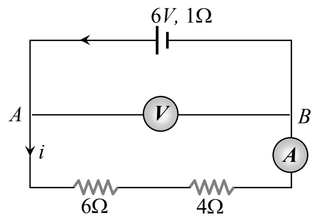


Clearly, the network of resistances is a balanced Wheatstone bridge. So R_{AB} is given by

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

For maximum power transfer $2R = 4\Omega \Rightarrow$ $R = \frac{4}{2} = 2\Omega$

36. (c) The given circuit can be redrawn as follows



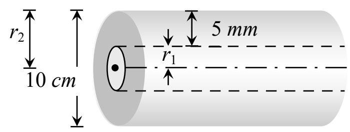
Current $i = \frac{6}{6+4+1} = \frac{6}{11}A$

P.D. between A and B, $V = \frac{6}{11} \times 10 = \frac{60}{11}V$.

37. (a) By using $R = \rho.\frac{l}{A}$; here $A = \pi(r_2^2 - r_1^2)$

Outer radius $r_2 = 5cm$

Inner radius $r_1 = 5 - 0.5 = 4.5\ cm$



So $R = 1.7 \times 10^{-8} \times \frac{5}{\pi\{(5\times 10^{-2})^2 - (4.5\times 10^{-2})^2\}}$

$= 5.6 \times 10^{-5}\Omega$

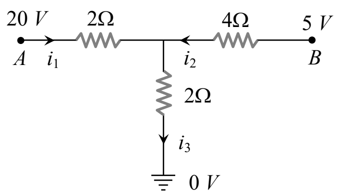
38. (a) Here $R_{XWY} = \frac{R}{2\pi r}\times(r\alpha) = \frac{R\alpha}{2\pi}$ $\left(\because \alpha = \frac{l}{r}\right)$

and $R_{XZY} = \frac{R}{2\pi r}\times r(2\pi-\alpha) = \frac{R}{2\pi}(2\pi-\alpha)$

$$R_{eq} = \frac{R_{XWY}R_{XZY}}{R_{XWY}+R_{XZY}} = \frac{\frac{R\alpha}{2\pi}\times\frac{R}{2\pi}(2\pi-\alpha)}{\frac{R\alpha}{2\pi}+\frac{R(2\pi-\alpha)}{2\pi}} = \frac{R\alpha}{4\pi^2}(2\pi-\alpha)$$

39. (d) Battery is short circuited so potential difference is zero.

40. (a) Let V be the potential of the junction as shown in figure. Applying junction law, we have



or $\frac{20-V}{2}+\frac{5-V}{4} = \frac{V-0}{2}$

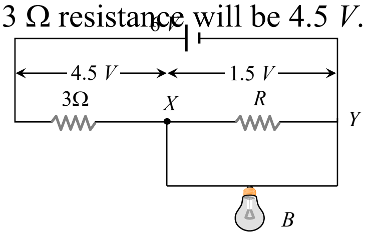
or $40-2V+5-V = 2V$ or $5V = 45 \Rightarrow V = 9V$

$\therefore\ i_3 = \frac{V}{2} = 4.5A$

41. (a) $E = xl = i\rho l \Rightarrow$

$i = \frac{E}{\rho l} = \frac{E}{\rho l} = \frac{2.4\times10^{-3}}{1.2\times5} = 4\times10^{-4}A.$

42. (b) When bulb glows with full intensity, then voltage across it will be 1.5 V and voltage across 3 Ω resistance will be 4.5 V.



Current through 3 Ω resistance $i = \frac{4.5}{3} = 1.5A$

Same current will flow between X and Y

So $V_{XY} = iR_{XY} \Rightarrow 1.5 = 1.5R_{XY} \Rightarrow R_{XY} = 1\Omega$

43. (a) In figure (b) current through $R_2 = i - \frac{i}{10} = \frac{9i}{10}$

Potential difference across R_2 = Potential difference across R $\Rightarrow R_2\times\frac{9}{10}i = R\times\frac{i}{10}$ *i.e.*

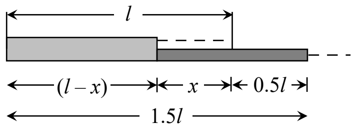
$R_2 = \frac{R}{9} = \frac{11}{9}\Omega$

$$R_{eq} = \frac{R_2\times R}{(R_2+R)} = \frac{\frac{11}{9}\times\frac{11}{1}}{\frac{11}{9}+\frac{11}{1}} = \frac{11}{10}\Omega$$

Total circuit resistance $= \frac{11}{10}+R_1 = R = 11 \Rightarrow$

$R_1 = 9.9\Omega$

44. (a) Let l be the original length of wire and x be its length stretched uniformly such that final length is 1.5 l



Then $4R = \rho\frac{(l-x)}{A}+\rho\frac{(0.5l+x)}{A'}$ where

$A' = \frac{x}{(0.5l+x)}A$

$\therefore\ 4\rho\frac{l}{A} = \rho\frac{l-x}{A}+\rho\frac{(0.5l+x)^2}{xA}$

or $4l = l-x+\frac{1}{4}\frac{l^2}{x}+\frac{x^2}{x}+\frac{lx}{x}$ or $\frac{x}{l} = \frac{1}{8}$

45. (b) In series : Potential difference $\propto R$

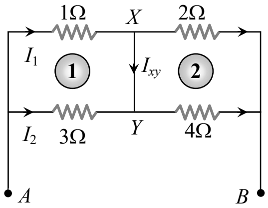
When only S_1 is closed $V_1 = \frac{3}{4}E = 0.75E$

When only S_2 is closed $V_2 = \frac{6}{7}E = 0.86E$

and when both S_1 and S_2 are closed combined resistance of $6R$ and $3R$ is $2R$

$\therefore\ V_3 = \left(\frac{2}{3}\right)E = 0.67E \Rightarrow V_2 > V_1 > V_3$

46. (c)



$-i_1+0\times i_{xy}+3i_2 = 0$ *i.e.* $i_1 = 3i_2$ ......(i)

Also $-2(i_1-i_{xy})+4(i_2+i_{xy}) = 0$

i.e. $2i_1-4i_2 = 6i_{xy}$ ....(ii)

Also $V_{AB}-1\times i_1-2(i_1-i_{xy}) = 0 \Rightarrow 50 = i_1+2(i_1-i_{xy})$

$= 3i_1-2i_{xy}$ .... (iii)

Solving (i), (ii) and (iii), $i_{xy} = 2A$

47. (b) Let n be the number of wrongly connected cells.

Number of cells helping one another $= (12 - n)$

Total e.m.f. of such cells $= (12 - n)E$

Total e.m.f. of cells opposing = nE

Resultant e.m.f. of battery $= (12 - n)E - nE = (12 - 2n)E$

Total resistance of cells = $12r$

($\because$ resistance remains same irrespective of connections of cells)

With additional cells

(a) Total e.m.f. of cells when additional cells help battery = $(12 - 2n)E + 2E$

Total resistance = $12r + 2r = 14r$

$\therefore \frac{(12-2n)E + 2E}{14r} = 3$ ......(i)

(b) Similarly when additional cells oppose the battery

$\frac{(12-2n)E - 2E}{14r} = 2$ ......(ii)

Solving (i) and (ii), $n = 1$

48. (a) All the conductors have equal lengths. Area of cross-section of A is $\{(\sqrt{3}\,a)^2 - (\sqrt{2}\,a)^2\} = a^2$

Similarly area of cross-section of B = Area of cross-section of $C = a^2$

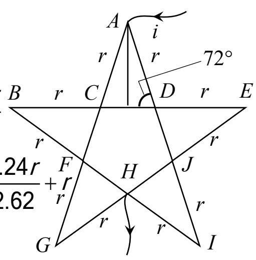
Hence according to formula $R = \rho \frac{l}{A}$; resistances of all the conductors are equal *i.e.* $R_A = R_B = R_C$

49. (b) Resistance of CD *arm* = $2r \cos 72^\circ = 0.62r$

Resistance of CBFC branch

$\frac{1}{R} = \frac{1}{2r} + \frac{1}{0.62r} = \frac{1}{r}\left(\frac{2.62}{2 \times 0.62}\right)$

$\frac{1}{R} = \frac{2.62}{1.24r}$ $\therefore R = \frac{1.24r}{2.62}$



Equivalent $R = 2R + r = 2 \times \frac{1.24r}{2.62} + r$

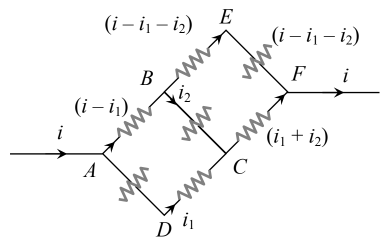
$= r\left(\frac{2.48}{2.62} + 1\right) = 1.946r$

Because the star circuit is symmetrical about the line AH

$\therefore$ Equivalent resistance between A and H

$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{R} \Rightarrow R_{eq} = \frac{R}{2} = \frac{1.946}{2} r = 0.973r$

50. (a)



Applying Kirchoff's law in mesh $ABCDA$

$-10(i - i_1) - 10i_2 + 20i_1 = 0 \Rightarrow 3i_1 - i_2 = i$ ....(i)

and in mesh $BEFCB$

$-20(i - i_1 - i_2) + 10(i_1 + i_2) + 10i_2 = 0$

$\Rightarrow 3i_1 + 4i_2 = 2i$ ......(ii)

From equation (i) and (ii) $i_1 = \frac{2i}{5}, i_2 = \frac{i}{5} \Rightarrow i_{AD} = \frac{2i}{5}$

51. (d) Let the current in 12 Ω resistance is i

Applying loop theorem in closed mesh $AEFCA$

$12i = -E + E = 0 \quad \therefore i = 0$

52. (b) Current flowing in the circuit $i = \frac{E}{R} = \frac{10 - 4}{20 + 10} = \frac{1}{5}A$

P.D. across $AC = \frac{1}{5} \times 20 = 4\,V$

P.D. across $AN = 4 + 4 = 8V$

53. (a) If two resistances are R_1 and R_2 then $S = R_1 + R_2$ and $P = \frac{R_1 R_2}{(R_1 + R_2)}$

From given condition $S = nP$ *i.e.*

$(R_1 + R_2) = n\left(\frac{R_1 R_2}{R_1 + R_2}\right)$

$\Rightarrow (R_1 + R_2)^2 = n\,R_1 R_2 \Rightarrow (R_1 - R_2)^2 + 4R_1 R_2 = nR_1 R_2$

So $n = 4 + \frac{(R_1 - R_2)^2}{R_1 R_2}$. Hence minimum value of n is 4.

54. (b) Voltage sensitivity $= \frac{\text{Current sensitivity}}{\text{Resistance of galvanometer G}}$

$\Rightarrow G = \frac{10}{2} = 5\,\Omega$.

Here $i_g =$ Full scale deflection current $= \frac{150}{10} = 15\,mA$.

V = Voltage to be measured = 150 × 1 = 150 V.

Hence $R = \frac{V}{i_g} - G = \frac{150}{15 \times 10^{-3}} - 5 = 9995\Omega$.

Graphical Questions

1. (a) For ohmic resistance $V \propto i \Rightarrow V = Ri$ (here R is constant)

2. (d) From the curve it is clear that slopes at points A, B, C, D have following order $A > B > C > D$.
and also resistance at any point equals to slope of the V-i curve.
So order of resistance at three points will be $R_A > R_B > R_C > R_D$

3. (a) Slope of the V-i curve at any point equal to resistance at that point. From the curve slope for T_1 > slope for T_2
$\Rightarrow R_{T_1} > R_{T_2}$. Also at higher temperature resistance will be higher so $T_1 > T_2$

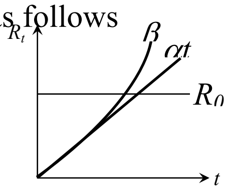
4. (c) For portion CD slope of the curve is negative *i.e.* resistance be negative.

5. (d) Slope of V-i curve $= R\left(=\frac{\rho l}{A}\right)$. But in given curve axis of i and V are interchanged. So slope of given curve $= \frac{1}{R}\left(=\frac{A}{\rho l}\right)$ *i.e.* with the increase in length of the wire. Slope of the curve will decrease.

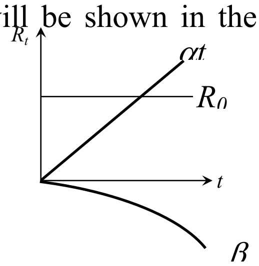
6. (c) $E = \frac{iR}{L} = \frac{i.\rho}{A} = \frac{neAv_d\rho}{A} \Rightarrow v_d \propto E$ (Straight line)
$P = i^2 R = \left(\frac{EA}{\rho}\right)^2 R \Rightarrow P \propto E^2$ (Symmetric parabola)
Also $P \propto i^2$ (parabola)
Hence all graphs a, b, d are correct and c is incorrect.

7. (b) When we move in the direction of the current in a uniform conductor, the potential difference decreases linearly. When we pass through the cell, from it's negative to it's positive terminal, the potential increases by an amount equal to it's potential difference. This is less than it's emf, as there is some potential drop across it's internal resistance when the cell is driving current.

8. (b) Since the value of R continuously increases, both α and β must be positive.
Actually the components of the given equation are as follows



It α is positive, β is negative, the component will be shown in the following graph.



In this case, the value of R will not increase continuously. Hence the correct option is (c).

9. (d) Slope of V-i curve = resistance. Hence $R = \frac{1}{1} = 1\Omega$

10. (a) At point A the slope of the graph will be negative. Hence resistance is negative.

11. (b) E.m.f. is the value of voltage, when no current is drawn from the circuit so $E = 2V$.
Also r = slope $= \frac{2}{5} = 0.4\Omega$

12. (d) For conversion of a galvanometer into a voltmeter
$\frac{V}{R+G} = i_g \Rightarrow \frac{V}{R_V} = i_g$; where $R_V = R + G$ =
Total resistance $\Rightarrow R_V = \frac{V}{i_g} \Rightarrow R_V \propto V$

13. (a) According to ohm's law $V = iR$
$\Rightarrow \log_e V = \log_e i + \log_e R \Rightarrow \log_e i = \log_e V - \log_e R$
The graph between $\log_e I$ and $\log_e V$ will be a straight line which cut $\log_e V$ axis and it's gradient will be positive.

14. (c) As we know, for conductors resistance ∝ Temperature.

From figure $R_1 \propto T_1 \Rightarrow \tan\theta \propto T_1 \Rightarrow \tan\theta = kT_1$ … (i)

and $R_2 \propto T_2 \Rightarrow \tan(90^o - \theta) \propto T_2 \Rightarrow \cot\theta = kT_2$ ….(ii)

From equation (i) and (ii)

$k(T_2 - T_1) = (\cot\theta - \tan\theta)$

$$(T_2 - T_1) = \left(\frac{\cos\theta}{\sin\theta} - \frac{\sin\theta}{\cos\theta}\right) = \frac{(\cos^2\theta - \sin^2\theta)}{\sin\theta\cos\theta} = 2\cot 2\theta$$

$\Rightarrow (T_2 - T_1) \propto \cot 2\theta$

15. (b) Let resistivity at a distance 'x' from left end be $\rho = (\rho_0 + ax)$. Then electric field intensity at a distance 'x' from left end will be equal to $E = \frac{i\rho}{A} = \frac{i(\rho_0 + ax)}{A}$ where i is the current flowing through the conductor. It means $E \propto \rho$ or E varies linearly with distance 'x'. But at $x = 0$, E has non-zero value. Hence (b) is correct.

16. (d) At an instant approach the student will choose $\tan\theta$ will be the right answer. But it is to be seen here the curve makes the angle θ with the V-axis. So it makes an angle $(90 - \theta)$ with the i-axis.

So resistance = slope = $\tan(90 - \theta) = \cot\theta$.

17. (d) Short circuited current $i = \frac{nE}{nr} = \frac{E}{r}$ *i.e.* i doesn't depend upon n.

18. (b) Here internal resistance is given by the slope of graph *i.e.* $\frac{x}{y}$. But conductance $= \frac{1}{\text{Resistance}} = \frac{y}{x}$

19. (a) $R_{Parallel} < R_{Series}$. From graph it is clear that slope of the line A is lower than the slope of the line B. Also slope = resistance, so line A represents the graph for parallel combination.

20. (b) To make range n times, the galvanometer resistance should be G/n, where G is initial resistance.

Assertion and Reason

1. (d) Resistivity of a semiconductor decreases with the temperature. The atoms of a semiconductor vibrate with larger amplitudes at higher temperatures thereby increasing it's conductivity not resistivity.

2. (d) It is quite clear that in a battery circuit, the point of lowest potential is the negative terminal of the battery and the current flows from higher potential to lower potential.

3. (b) The temperature co-efficient of resistance for metal is positive and that for semiconductor is negative.

In metals free electrons (negative charge) are charge carriers while in P-type semiconductors, holes (positive charge) are majority charge carriers.

4. (a) Here, $E = 2V$, $1 = \frac{2}{2} = 1A$ and $r = 1\Omega$

Therefore, $V = E - ir = 2 - 1 \times 1 = 1V$

5. (a) It is clear that electrons move in all directions haphazardly in metals. When an electric field is applied, each free electron acquire a drift velocity. There is a net flow of charge, which constitute current. In the absence of electric field this is impossible and hence, there is no current.

6. (c) The metallic body of the electrical appliances is connected to the third pin which is connected to the earth. This is a safety precaution and avoids eventual electric shock. By doing this the extra charge flowing through the metallic body is passed to earth and avoid shocks. There is nothing such as reducing of the heating of connecting wires by three pin connections.

7. (b) On increasing temperature of wire the kinetic energy of free electrons increase and so they collide more rapidly with each other and hence their drift velocity decreases. Also when temperature increases, resistivity increase and resistivity is inversely proportional to conductivity of material.

8. (c) In a conductor there are large number of free electrons. When we close the circuit, the electric field is established instantly with the speed of electromagnetic wave which cause electron drift at every portion of the circuit. Due to which the current is set up in the entire circuit instantly. The current which is set up does not wait for the electrons flow from one end of the conductor to the another end. It is due to this reason, the electric bulb glows immediately when switch is on.

9. (a) Resistance wire $R=\rho\frac{l}{A}$. where ρ is resistivity of material which does not depend on the geometry of wire. Since when wire is banded, resistivity, length and area of cross-section do not change, therefore resistance of wire also remain same.

10. (c) The resistance of the galvanometer is fixed. In meter bridge experiments, to protect the galvanometer from a high current, high resistance is connected to the galvanometer in order to protect it from damage.

11. (a) Voltameter measures current indirectly in terms of mass of ions deposited and electrochemical equivalent of the substance $\left(I=\frac{m}{Zt}\right)$. Since value of *m* and *Z* are measured to 3rd decimal place and 5th decimal place respectively. The relative error in the measurement of current by voltmeter will be very small as compared to that when measured by ammeter directly.

12. (a) When current flows through a conductor it always remains uncharged, hence no electric field is produced outside it.

13. (b) Here assertion and reason both are correct but the reason is not the correct explanation of assertion.

14. (a) Sensitivity $\propto \frac{1}{\text{Potential gradient}} \propto (\text{Length of wire})$

15. (a) If either the e.m.f. of the driver cell or potential difference across the whole potentiometer wire is lesser than the e.m.f. of the experimental cell, then balance point will not obtained.

16. (d) Because there is no special attractive force that keeps a person stuck with a high power line. The actual reason is that a current of the order of 0.05 *A* or even less is enough to bring disorder in our nervous system. As a result of it, the affected person may lose temporarily his ability to exercise his nervous control to get himself free from the high power line.

17. (a) Due to high electrical conductivity of copper, it conducts the current without offering much resistance. The copper being diamagnetic material does not get magnetised due to current through it and hence does not disturb the current in the circuit.