Chapter-17 : Current Electricity

1. **(d)** If E be electric field, then current density $j = \sigma E$

Also we know that current density $j = \frac{i}{A}$

Hence j is different for different area of cross-sections. When j is different, then E is also different. Thus E is not constant. The drift velocity υ_d is given by $\upsilon_d = \frac{j}{ne}$ = different for different j values. Hence only current i will be constant.

2. **(c)** $v_d = \frac{I}{neA}$ Here, $I = 5.4A$, $n = 8.4 \times 10^{28}$, per m^3

$A = 10^{-6} m^2$, $e = 1.6 \times 10^{-19} C$

$\therefore\ v_d = \dfrac{5.4}{8.4\times10^{28}\times1.6\times10^{-19}\times10^{-6}} = 0.4\,\text{mm/s}$

3. **(a)** By stretching, the volume of wire remains constant.

$A\times\ell = A'\times\ell' \Rightarrow \pi r^2\times\ell = \pi\dfrac{r^2}{4}\times\ell'$

$\Rightarrow \ell' = 4\ell$

Now $R = \dfrac{\rho\ell}{A},\ R' = \dfrac{\rho\ell'}{A'} = \dfrac{\rho 4\ell}{A/4} = 16\ R.$

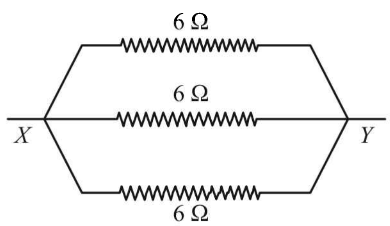
4. **(c)** Current, $I = \dfrac{\text{Charge}}{\text{Time}}$

as charge $q = n\times1.6\times10^{-19}$

$10^{-3}\,\text{amp} = \dfrac{n\times1.6\times10^{-19}}{1\ \text{sec}}$

$n = 6.25\times10^{15}.$

5. **(d)** The equivalent circuit is given below :



The equivalent resistance is given by

$\dfrac{1}{R} = \dfrac{1}{6}+\dfrac{1}{6}+\dfrac{1}{6} = \dfrac{3}{6} = \dfrac{1}{2}$

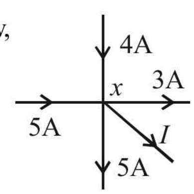
$\Rightarrow R_{eq} = 2\Omega$

6. **(d)** Equivalent resistance of parallel resistors is always less than any of the member of the resistance system.

7. **(c)** Short circuit current

$i_{SC} = \dfrac{E}{r} \Rightarrow 3 = \dfrac{1.5}{r} \Rightarrow r = 0.5\Omega$

8. **(b)** According to Kirchhoff's first law,
$(+5A)+(+4A)+(-3A)$
$+(-5A)+I = 0$
$\Rightarrow I = -1\ A$
– ve sign shows that current is flowing away from x



9. **(a)** $R_{20} = 20\,\Omega,\ R_{500} = 60$

$R_t = R_0(1+\alpha t)$

$\dfrac{R_{20}}{R_{500}} = \dfrac{R_0(1+\alpha\times20)}{R_0(1+\alpha\times500)}$

$\Rightarrow \dfrac{20}{60} = \dfrac{1+20\alpha}{1+500\alpha} \Rightarrow 1+500\,\alpha = 3+60\,\alpha$

$\Rightarrow 500\,\alpha - 60\,\alpha = 2 \Rightarrow \alpha = \dfrac{2}{440} = \dfrac{1}{220}$

$\dfrac{R_{20}}{R_t} = \dfrac{R_0\left(1+\dfrac{1}{220}\times20\right)}{R_0\left(1+\dfrac{1}{220}\times t\right)}$

$\dfrac{20}{25} = \dfrac{1+\dfrac{1}{11}}{1+\dfrac{t}{220}} \Rightarrow \dfrac{4}{5} = \dfrac{12/11}{1+t/220} \Rightarrow 1+\dfrac{t}{220} = \dfrac{15}{11}$

$\Rightarrow t = 80°C.$

10. **(b)** $I = \dfrac{E}{R+r}$

$V = \dfrac{E}{R+r}R. \qquad [\because V = IR]$

$\Rightarrow r = \dfrac{(E-V)}{V}R.$

11. **(d)** ϕ (Potential gradient) $\downarrow \Rightarrow$ Sensitivity $\uparrow$

$\phi = \dfrac{IR}{\ell}$

12. **(b)** The resistance of metal decreases with decrease of temperature while for semiconductors, resistance increases when temperature decreases.

13. **(d)** $P_1 = 100\,W, P_2 = 200\,W$

$R_1 = \dfrac{V^2}{P_1} = \dfrac{220\times220}{100} = 22\times22\Omega$

$R_2 = \dfrac{220\times220}{200} = 22\times11\Omega$

$\therefore\ R_1 : R_2 = 2 : 1$

14. **(b)** The resistance of bulb,

$R = \dfrac{V^2}{P} = \dfrac{(220)^2}{100} = 484\ \Omega$

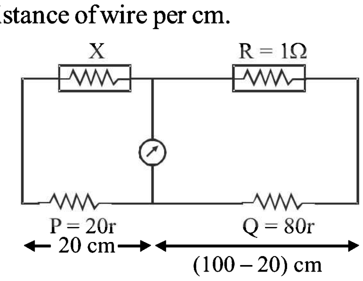
The current in bulb when on 110 V line

$= \dfrac{V}{R} = \dfrac{110}{484}A$

Power consumed by bulb in 110 V line

$= VI = \dfrac{110}{484}\times110 = 25W.$

15. **(a)** Let unknown resistance be X. Then condition of Wheatstone's bridge gives $\dfrac{X}{R} = \dfrac{20r}{80r}$, where r is resistance of wire per cm.



$\therefore X = \dfrac{20}{80}\times R = \dfrac{1}{4}\times1 = 0.25\Omega$

16. **(b)** Given: $\dfrac{\ell_1}{\ell_2} = \dfrac{4}{3}$ and $\dfrac{r_1}{r_2} = \dfrac{2}{3}$

Since the two wires are connected in parallel, potential remains same. i.e.,

V = constant.
IR = Constant

i.e., $I_1R_1 = I_2R_2 \Rightarrow \frac{I_1}{I_2} = \frac{R_2}{R_1}$ ..... (i)

But we know that, $R = \frac{\rho\ell}{A}$

$$\therefore \frac{R_1}{R_2} = \left(\frac{\ell_1}{A_1}\right)\left(\frac{A_2}{\ell_2}\right) = \left(\frac{\ell_1}{\ell_2}\right)\left(\frac{A_2}{A_1}\right)$$

$$= \left(\frac{\ell_1}{\ell_2}\right)\left(\frac{r_2}{r_1}\right)^2 \quad (\text{since area, } A = \pi r^2)$$

$$= \left(\frac{4}{3}\right)\left(\frac{3}{2}\right)^2 = 3$$

Substitute this value in equation (i) we get, $\frac{I_1}{I_2} = \frac{1}{3}$.

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

18. **(b)** Given : Length of wire (l) = 15m
Area (A) = 6×10^{-7} m^2
Resistance (R) = 5Ω.
We know that resistance of the wire material

$$R = \rho\frac{l}{A} \Rightarrow 5 = \rho \times \frac{15}{6\times10^{-7}} = 2.5\times10^{7}\rho$$

$$\Rightarrow \rho = \frac{5}{2.5\times10^{7}} = 2\times10^{-7}\ \Omega - m$$

[where ρ = coefficient of resistivity]

19. **(c)** All the lamps have been connected in parallel. Therefore, each operates at the same voltage of 220 V.

$\therefore$ Current drawn by each lamp $= \frac{220}{220} = 1$ A

$\therefore$ Total current drawn by lamps = 5000 A.

20. **(b)** $r = \frac{\ell_1 - \ell_2}{\ell_2} \times R\Omega$

Here, $\ell_1 = 125$ cm, $\ell_2 = 100$ cm, R = 2Ω.

$\therefore$ r = 0.5Ω

21. **(c)** $H = P \times t = \frac{210\times5\times60}{4.2} = 15000$ cal.

22. **(a)** Current through each bulb is same because these are connected in series.

since $\left(R = \frac{V^2}{P}\right)$, resistance of 40 W bulb is more, hence greater heat is produced in the 40 W bulb, it glows brightest

$H = I^2Rt$

23. **(b)** $R_1 = R_0[1 + \alpha \times 100] = 100$ ....(i)
$R_2 = R_0[1 + \alpha \times T] = 200$ ....(ii)
On dividing we get

$$\frac{200}{100} = \frac{1+\alpha T}{1+100\alpha} \Rightarrow 2 = \frac{1+0.005T}{1+100\times0.005}$$

$\Rightarrow T = 400°C$

24. **(a)** Here, the factor by which the length is changed is

$$n = \frac{\ell'}{\ell} = 3.$$

The new resistance R' is given by

$$R' = R\,(n^2) = 5(3)^2 = 45\Omega.$$

25. **(c)** If a heater boils m kg water in time t_1 and another heater boils the same water in t_2, then both connected in series will boil the same water in time $t_s = t_1 + t_2$ and if in parallel $t_p = \frac{t_1t_2}{t_1+t_2}$ [Use time taken ∝ Resistance]

26. **(b)** 50 = 10 [R + r]
R + r = 5Ω
50 = 40 . R $\left[\because I = \frac{10}{.25} = 40A\right]$
γ = 3.75 Ω

27. **(d)** Resistance of heater $R_h = \frac{V^2}{P} = \frac{100\times100}{1000} = 10\Omega$

$$\therefore \text{total resistance of circuit} = 10 + \frac{10\times R}{10+R} = \frac{100+20R}{10+R}$$

$$\text{Current in heater} = I.\frac{R}{10+R} = \frac{100}{\frac{100+20R}{10+R}} \times \frac{R}{10+R} = \frac{5\times R}{5+R}$$

$\therefore$ power $P = I^2R_h$

$$62.5 = \left(\frac{5R}{5+R}\right)^2 \times 10$$

$\therefore$ R = 5Ω

28. **(b)** Given : $\frac{\ell_1}{\ell_2} = \frac{d_1}{d_2} = \frac{\rho_1}{\rho_2} = \frac{1}{2}$

Resistance of the wire,

$$R = \rho\frac{\ell}{A} = \rho\frac{\ell}{\pi(d/2)^2} = \frac{4\rho\ell}{\pi d^2} \left[\because A = \pi r^2 = \pi\left(\frac{d}{2}\right)^2\right]$$

$$\therefore \frac{R_1}{R_2} = \frac{\rho_1\ell_1}{d_1^2} \times \frac{d_2^2}{\rho_2\ell_2} = \left(\frac{\rho_1}{\rho_2}\right)\left(\frac{\ell_1}{\ell_2}\right)\left(\frac{d_2}{d_1}\right)^2$$

i.e., $\frac{10}{R_2} = \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)(2)^2$

$$\frac{10}{R_2} = 1 \Rightarrow R_2 = 10\Omega$$

29. **(c)** $i = \frac{2-1.5}{20} = \frac{1}{40}A$

$$E_A = 2 - ir = 2 - \frac{1}{40} \times 5 = 1.875V$$

$$E_B = 1.5 + ir = 1.625V$$

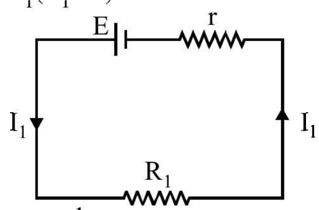
30. **(d)** $I = neAv_d = 2\times10^{21}\times1.6\times10^{-19}\times10\times0.25\times10^{-3}$
$= 2\times1.6\times0.25 = \frac{8}{10} = 0.8\text{ A}$

31. **(a)** $r = \left(\frac{l_1}{l_2}-1\right)R = \left(\frac{125}{100}-1\right)2 = 0.25\times2 = 0.5\,\Omega$

32. **(d)** Let E and r be the emf and internal resistance of a battery respectively.
In the first case

Current flowing in the circuit $I_1 = \frac{E}{R_1+r}$

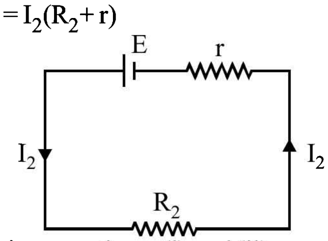
or $E = I_1(R_1+r)$



In the second case

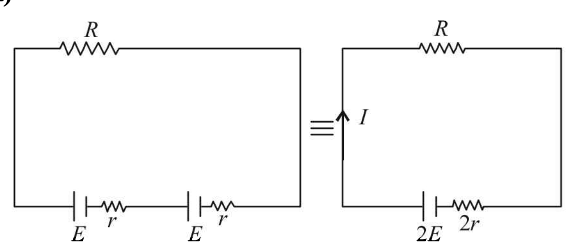
Current flowing in the circuit $I_2 = \frac{E}{R_2+r}$

or $E = I_2(R_2+r)$



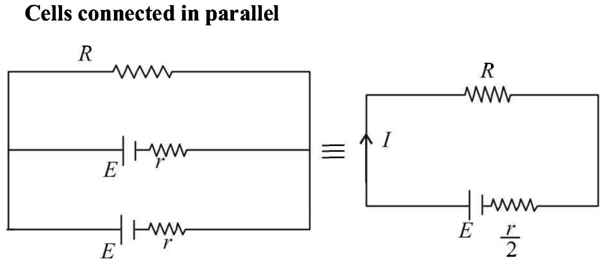
Equating equations. (i) and (ii), we get
$I_1(R_1+r) = I_2(R_2+r) \Rightarrow I_1R_1 + I_1r = I_2R_2 + I_2r$
$I_1R_1 - I_2R_2 = (I_2-I_1)r \Rightarrow (I_2-I_1)r = I_1R_1 - I_2R_2$
$r = \frac{I_1R_1 - I_2R_2}{I_2-I_1}$

33. **(a)** **Cells connected in series**



$J_1 = I^2R = \left(\frac{2E}{2r+R}\right)^2.R$ ...(1)

Cells connected in parallel



$J_2 = I^2R = \left(\frac{E}{R+\frac{r}{2}}\right)^2\times R$ ...(2)

Given $J_1 = 2.25\,J_2$

$\frac{(2E)^2}{(2r+R)^2}.R = 2.25\frac{E^2}{(R+\frac{r}{2})^2}.R$

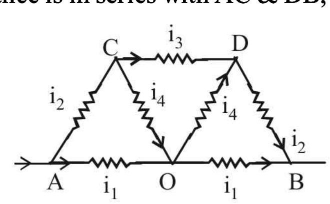
$\therefore \frac{4}{(2r+R)^2} = \frac{2.25}{\left(R+\frac{r}{2}\right)^2}$

$\therefore 4[R+0.5]^2 = 2.25[2+R]^2$ $[\because r = 1\Omega]$
$\therefore 2(R+0.5) = 1.5(2+R)$
$\therefore R = 4\Omega$

34. **(c)** ABD, ACD are in series. They are connected in parallel
i.e., $\frac{1}{6}+\frac{1}{6}=\frac{1}{3}$ i.e, $R = 3\Omega$

35. **(c)** $i = neAv_d$
$\Rightarrow v_d = \frac{i}{ne\,A} = \frac{100}{10^{28}\times1.6\times10^{-19}\times3.14\times10^{-4}}$
$= \frac{100\times10^{-5}}{1.6\times3.14} = 0.2\times10^{-3} = 2\times10^{-4}$ m/s

36. **(d)** At A current is distributed and at B currents are collected. Between A and B, the distribution is symmetrical. It has been shown in the figure. It appears that current in AO and OB remains same. At O, current i_4 returns back without any change. If we detach O from AB there will not be any change in distribution. Now, CO & OD will be in series hence its total resistance $= 2\Omega$
It is in parallel with CD, so, equivalent resistance
$= \frac{2\times1}{2+1} = \frac{2}{3}\Omega$
This equivalent resistance is in series with AC & DB, so, total resistance
$= \frac{2}{3}+1+1 = \frac{8}{3}\Omega$



Now $\frac{8}{3}\Omega$ is parallel to AB, that is, 2Ω, so total resistance
$= \frac{8/3\times2}{8/3+2} = \frac{16/3}{14/3} = \frac{16}{14} = \frac{8}{7}\Omega$

37. **(a)** The potential difference across 4Ω resistance is given by
$V = 4\times i_1 = 4\times1.2 = 4.8$ volt
So, the potential across 8Ω resistance is also 4.8 volt.
Current $i_2 = \frac{V}{8} = \frac{4.8}{8} = 0.6$ amp

Current in 2Ω resistance $i = i_1 + i_2$
$\therefore i = 1.2 + 0.6 = 1.8$ amp
Potential difference across 2Ω resistance
$V_{BC} = 1.8 \times 2 = 3.6$ volts

38. (c) $P = I^2R$. Hence $\frac{dP}{P} = \frac{2dI}{I}$. Since $\frac{dI}{I} = 1\%$.

Hence $\frac{dP}{P} = 2\%$.

39. (c) $P = V^2/R$

$\Rightarrow R = V^2/P = 4 \times 10^4/100 = 400\ \Omega.$

$S = 10^4/200 = 0.5 \times 10^2 = 50\ \Omega.$

$R/S = 8$

40. (a) As voltage of appliance remains constant, the amount of heat produced is given by,

$$H = \frac{V^2}{R}t \qquad \ldots \text{(i)}$$

when resistance is reduced by 20%, new resistance is $R' = R - 0.2\ R = 0.8\ R$

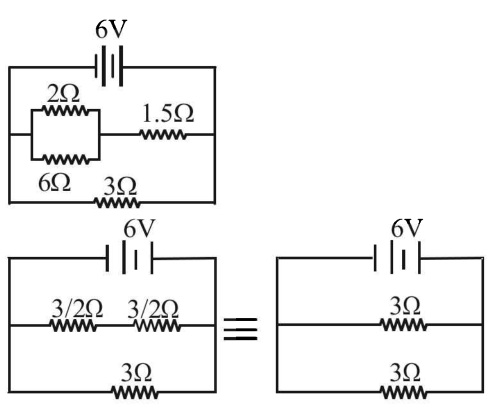
$$H' = \frac{V^2}{0.8R}t' \qquad \ldots \text{(ii)}$$

Equating Eqs. (i) and (ii), we get

$$\frac{V^2}{R}t = \frac{V^2}{0.8R}t'$$

$\Rightarrow t' = 0.8t = 0.8 \times 12 = 9.6$ min

41. (a)



hence $R_{eq} = 3/2$; $\quad \therefore I = \frac{6}{3/2} = 4A$

42. (b) According to the condition of balancing

$\frac{55}{20} = \frac{R}{80} \Rightarrow R = 220\Omega$

43. (c) $L \propto l$

$\frac{L_1}{L_2} = \frac{l_1}{l_2}$

$\frac{10}{11} = \frac{2.5}{l_2}$

$10 l_2 = 2.5 \times 11$

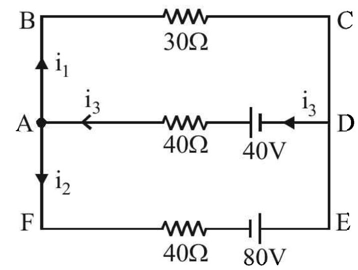
$l_2 = \frac{2.5 \times 11}{10} = 2.75\,\text{m}$

44. (a) In series circuit it is always preferable to use formula I^2R, because I throughout is same.

$I = \frac{120}{6+9} = 8$

$\therefore P = I^2R = 64 \times 6 = 384$

45. (b) The circuit can be simplified as follows :



Applying KCL at junction A

$i_3 = i_1 + i_2$ ...(i)

Applying Kirchoff's voltage law for the loop ABCDA

$-30i_1 - 40i_3 + 40 = 0$

$\Rightarrow -30i_1 - 40(i_1 + i_2) + 40 = 0$

$\Rightarrow 7i_1 + 4i_2 = 4$ ...(ii)

Applying Kirchoff's voltage law for the loop ADEFA

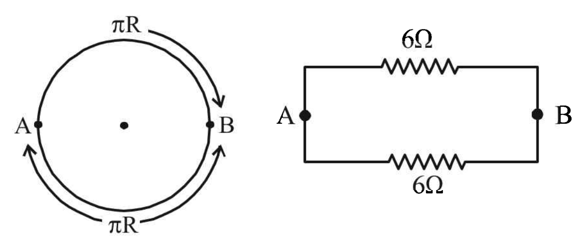
$-40i_2 + 40i_3 + 80 + 40 = 0$

$\Rightarrow -40i_2 - 40(i_1 + i_2) = -120$

$\Rightarrow i_1 + 2i_2 = 3$ ...(iii)

On solving eq. (ii) and (iii) $i_1 = -0.4$ A

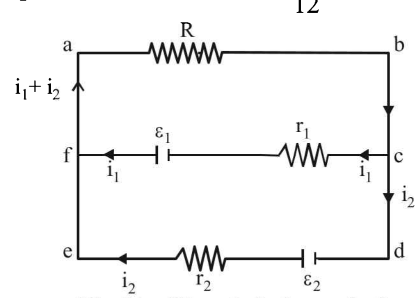
46. (a)



The resistance of length 2πR is 12Ω. Hence the resistance of length πR is 6Ω. Thus two resistances of 6Ω can be represented as shown in fig. 2.

$\therefore$ Equivalent resistance $R = \frac{6 \times 6}{12} = 3\Omega$

47. (d)



Applying Kirchhoff 's rule in loop **abcfa**

$\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0.$

48. (c) Total power consumed by electrical appliances in the building, $P_{total} = 2500$ W

Watt = Volt × ampere

$\Rightarrow 2500 = V \times I \Rightarrow 2500 = 220I \Rightarrow I \approx 12$ A

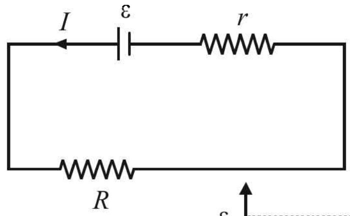
(Minimum capacity of main fuse)

49. (c) The current through the resistance R

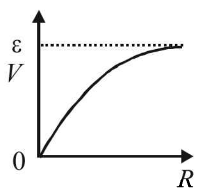
$$I = \left(\frac{\varepsilon}{R+r}\right)$$

The potential difference across R

$$V = IR = \left(\frac{\varepsilon}{R+r}\right)R$$



$$V = \frac{\varepsilon}{\left(1+\frac{r}{R}\right)}$$



when $R = 0$, $V = 0$,

$R = \infty$, $v = \varepsilon$

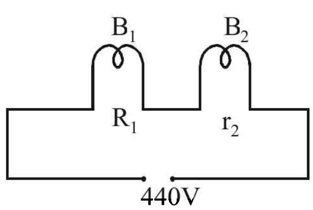
Thus V increases as R increases upto certain limit, but it does not increase further.

50. (c) The current upto which bulb of marked 25W -220V, will

not fuse $I_1 = \frac{W_1}{V_1} = \frac{25}{220}$ Amp

Similarly, $I_2 = \frac{W_2}{V_2} = \frac{100}{220}$ Amp

The current flowing through the circuit



$$I = \frac{440}{R_{eff}}$$

$R_{eff} = R_1 + R_2$

$$R_1 = \frac{V_1^2}{P_1} = \frac{(220)^2}{25}\ ;\ R_2 = \frac{V_2^2}{P} = \frac{(220)^2}{100}$$

$$I = \frac{440}{\frac{(220)^2}{25} + \frac{(220)^2}{100}} = \frac{440}{(220)^2\left[\frac{1}{25} + \frac{1}{100}\right]}$$

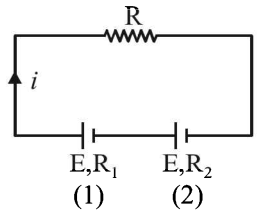
$$I = \frac{40}{220}\text{ Amp}$$

$$\because I_1\left(=\frac{25}{220}A\right) < I\left(=\frac{40}{220}A\right) < I_2\left(=\frac{100}{200}A\right)$$

Thus the bulb marked 25W-220 will fuse.

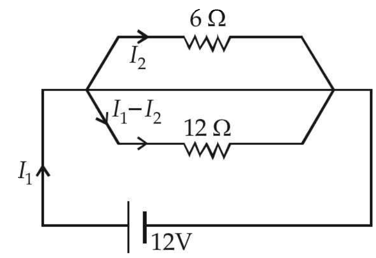
51. (d) $i = \frac{2E}{R + R_1 + R_2}$

From cell (2) $E = V + iR_2 = 0 + iR_2$



$$\Rightarrow E = \frac{2E}{R + R_1 + R_2} \times R_2 \Rightarrow R = R_2 - R_1$$

52. (d) The given circuit is an extension of wheatstone bridge, therefore points P and Q are at the same potential and point S and T are also at the same potential. Therefore no current passes through PQ and ST and the circuit reduces to as shown



$$I_1 = \frac{12}{4} \qquad \left[\because\ R_{eq} = \frac{6\times12}{6+12}\right]$$

$= 3A$

$$\therefore\ I_2 = 3\left[\frac{12}{6+12}\right] = 2A$$

As P and Q are equipotential and potential at S is less than the potential at P (potential drops across a resistance as current passes through it), therefore $V_S < V_Q$.

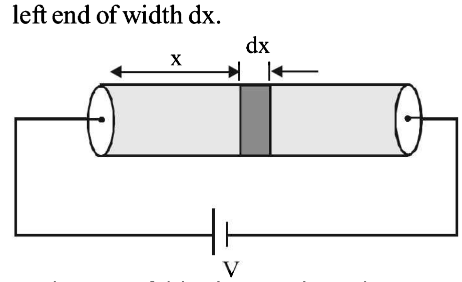
53. (d) A balanced Wheatstone' bridge exists between A & B.

$R_{eq} = R$

current through circuit is V/R

current through AFCEB = V/2R

54. (a) Consider an element part of solid at a distance x from left end of width dx.



Resistance of this elemental part is,

$$dR = \frac{\rho dx}{\pi a^2} = \frac{\rho_0 x dx}{\pi a^2}$$

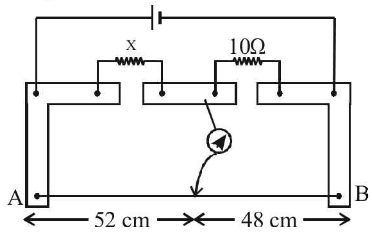
$$R = \int dR = \int_0^L \frac{\rho_0 x dx}{\pi a^2} = \frac{\rho_0 L^2}{2\pi a^2}$$

Current through cylinder is, $I = \frac{V}{R} = \frac{V \times 2\pi a^2}{\rho_0 L^2}$

Potential drop across element is, $dV = I\,dR = \frac{2V}{L^2} x\,dx$

$E(x) = \frac{dV}{dx} = \frac{2V}{L^2} x$

55. (b) At Null point



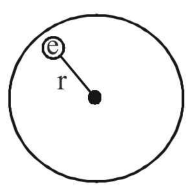
$\frac{X}{\ell_1} = \frac{10}{\ell_2}$

Here $\ell_1 = 52 + \text{End correction} = 52 + 1 = 53$ cm

$\ell_2 = 48 + \text{End correction} = 48 + 2 = 50$ cm

$\therefore \frac{X}{53} = \frac{10}{50} \qquad \therefore X = \frac{53}{5} = 10.6\Omega$

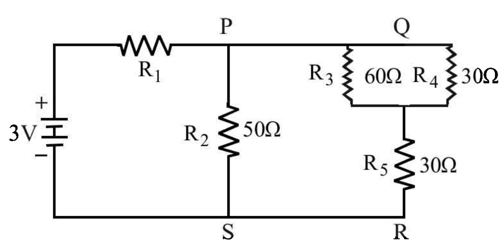
56. (a) $eE = m_e\omega^2 r$



$\Rightarrow V = \int E\,dr = \frac{m_e\omega^2}{e}\int_0^R r\,dr$

$\Rightarrow V = \frac{m_e\omega^2 R^2}{2e} \Rightarrow A = 2$

57. (a)



Net resistance between Q & R =

$R' = \frac{60 \times 30}{60 + 30} + 30 = 50\Omega$

So, equivalent resistance

$R_{eq} = \frac{50 \times 50}{50 + 50} + 50 = 75\Omega$

Current in the circuit is $I = \frac{3}{75} = \frac{1}{25}$ A

Potential drop across $R_1 = 50 \times \frac{1}{25} = 2V$

$\therefore$ Potential difference across PS or QR is same and given by = 3 – 2 = 1 volt

Current across QR $= \frac{1}{50}$ A

Potential drop across R_5 is given by

$\frac{1}{50} \times 30 = 0.6\,V$

Hence, potential drop across R_4 is $= 1 - 0.6 = 0.4\,V$

58. (d) $R_1 = R_0[1 + \alpha_1\Delta t]$; $\quad R_2 = R_0[1 + \alpha_2\Delta t]$

In Series, $R = R_1 + R_2$

$= R_0[2 + (\alpha_1 + \alpha_2)\Delta t] = 2R_0\left[1 + \left(\frac{\alpha_1 + \alpha_2}{2}\right)\Delta t\right]$

$\therefore \alpha_{eq} = \frac{\alpha_1 + \alpha_2}{2}$

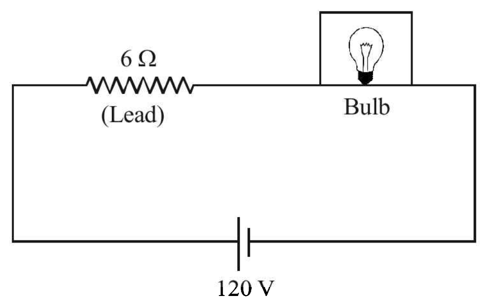
In Parallel, $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{R_0[1 + \alpha_1\Delta t]} + \frac{1}{R_0[1 + \alpha_2\Delta t]}$

$\Rightarrow \frac{1}{\frac{R_0}{2}(1 + \alpha_{eq}\Delta t)} = \frac{1}{R_0(1 + \alpha_1\Delta t)} + \frac{1}{R_0(1 + \alpha_2\Delta t)}$

$2(1 - \alpha_{eq}\Delta t) = (1 - \alpha_1\Delta t)(1 - \alpha_2\Delta t)$

$\therefore \alpha_{eq} = \frac{\alpha_1 + \alpha_2}{2}$

59. (d)



Power of bulb = 60 W (given)

Resistance of bulb $= \frac{120 \times 120}{60} = 240\Omega \quad \left[\because P = \frac{V^2}{R}\right]$

Power of heater = 240W (given)

Resistance of heater $= \frac{120 \times 120}{240} = 60\Omega$

Voltage across bulb before heater is switched on,

$V_1 = \frac{240}{246} \times 120 = 117.73$ volt

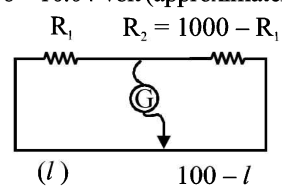
Voltage across bulb after heater is switched on,

$V_2 = \frac{48}{54} \times 120 = 106.66$ volt

Hence decrease in voltage

$V_1 - V_2 = 117.073 - 106.66 = 10.04$ Volt (approximately)

60. (c) $R_1 + R_2 = 1000$

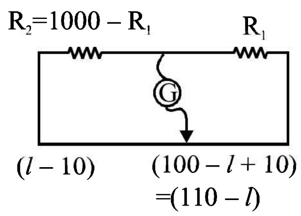


$\Rightarrow R_2 = 1000 - R_1$

On balancing condition

$R_1(100 - l) = (1000 - R_1)l$ ...(i)

On Interchanging resistance balance point shifts left by 10 cm



On balancing condition

$(1000 - R_1)(110 - l) = R_1 (l - 10)$

or, $R_1 (l - 10) = (1000 - R_1)(110 - l)$ ...(ii)

Dividing eqn (i) by (ii)

$$\frac{100 - l}{l - 10} = \frac{l}{110 - l}$$

$\Rightarrow$ $(100 - l)(110 - l) = l(l - 10)$

$\Rightarrow$ $11000 - 100l - 110l + l^2 = l^2 - 10l$

$\Rightarrow$ $11000 = 200l$

or, $l = 55$

Putting the value of 'l' in eqn (i)

$R_1 (100 - 55) = (1000 - R_1)\,55$

$\Rightarrow$ $R_1 (45) = (1000 - R_1)\,55$

$\Rightarrow$ $R_1 (9) = (1000 - R_1)\,11$

$\Rightarrow$ $20\,R_1 = 11000$

$\therefore$ $R_1 = 550 K\Omega$