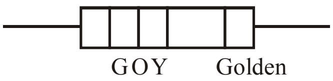
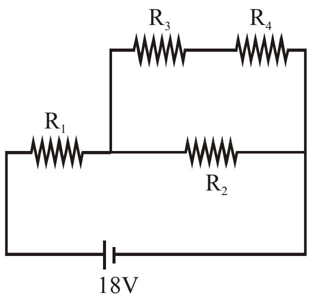
CURRENT ELECTRICITY

1. A carbon resistance has a following colour code. What is the value of the resistance ?



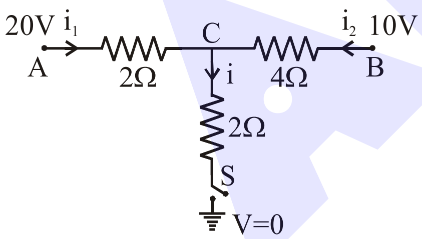
(1) 1.64 MΩ ± 5% (2) 530 kΩ ± 5%
(3) 64 kΩ ± 10% (4) 5.3 MΩ ± 5%

2. In the given circuit the internal resistance of the 18 V cell is negligible. If R_1 = 400 Ω, R_3 = 100 Ω and R_4 = 500 Ω and the reading of an ideal voltmeter across R_4 is 5V, then the value R_2 will be:



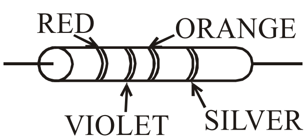
(1) 300 Ω (2) 230 Ω
(3) 450 Ω (4) 550 Ω

3. When the switch S, in the circuit shown, is closed, then the value of current *i* will be :



(1) 3 A (2) 5 A (3) 4 A (4) 2 A

4. A resistance is shown in the figure. Its value and tolerance are given respectively by:



(1) 27 KΩ, 20% (2) 270 KΩ, 5%
(3) 270 KΩ, 10% (4) 27 KΩ, 10%

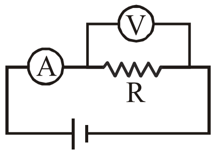
5. A copper wire is stretched to make it 0.5% longer. The percentage change in its electrical resistance if its volume remains unchanged is:

(1) 2.5% (2) 0.5%
(3) 1.0% (4) 2.0%

6. Drift speed of electrons, when 1.5 A of current flows in a copper wire of cross section 5 mm, is v. If the electron density in copper is 9×10^{28} /m^3 the value of v in mm/s is close to (Take charge of electron to be $=1.6 \times 10^{-19}$C)

(1) 0.2 (2) 3 (3) 2 (4) 0.02

7. The actual value of resistance R, shown in the figure is 30Ω. This is measured in an experiment as shown using the standard formula $R = \frac{V}{I}$, where V and I are the readings of the voltmeter and ammeter, respectively. If the measured value of R is 5% less, then the internal resistance of the voltmeter is :



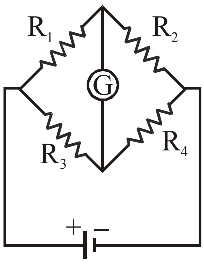
(1) 350Ω (2) 570Ω (3) 35 Ω (4) 600 Ω

8. A current of 2 mA was passed through an unknown resistor which dissipated a power of 4.4 W. Dissipated power when an ideal power supply of 11V is connected across it is :

(1) 11×10^{-5} W
(2) 11×10^{-4} W
(3) 11×10^{5} W
(4) 11×10^{-3} W

9. The Wheatstone bridge shown in Fig. here, gets balanced when the carbon resistor used as R_1 has the colour code (Orange, Red, Brown). The resistors R_2 and R_4 are 80Ω and 40Ω, respectively.

Assuming that the colour code for the carbon resistors gives their accurate values, the colour code for the carbon resistor, used as R_3, would be :



(1) Red, Green, Brown

(2) Brown, Blue, Brown

(3) Grey, Black, Brown

(4) Brown, Blue, Black

10. A uniform metallic wire has a resistance of 18 Ω and is bent into an equilateral triangle. Then, the resistance between any two vertices of the triangle is :

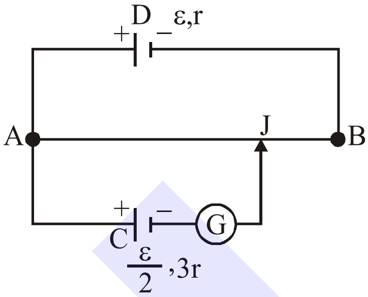
(1) 8 Ω (2) 12 Ω (3) 4 Ω (4) 2Ω

11. A 2 W carbon resistor is color coded with green, black, red and brown respectively. The maximum current which can be passed through this resistor is :

(1) 63 mA (2) 0.4 mA

(3) 100 mA (4) 20 mA

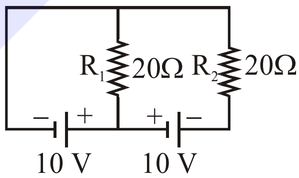
12. A potentiometer wire AB having length L and resistance 12 r is joined to a cell D of emf ε and internal resistance r. A cell C having emf ε/2 and internal resistance 3r is connected. The length AJ at which the galvanometer as shown in fig. shows no deflection is :



(1) $\frac{5}{12}L$ (2) $\frac{11}{24}L$

(3) $\frac{11}{12}L$ (4) $\frac{13}{24}L$

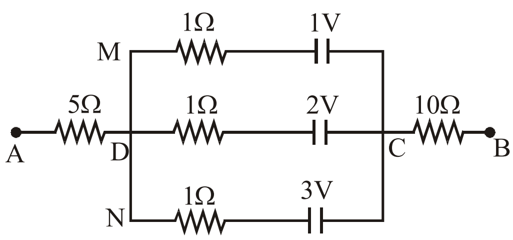
13. In the given circuit the cells have zero internal resistance. The currents (in Amperes) passing through resistance R_1, and R_2 respectively, are:



(1) 2, 2 (2) 0,1

(3) 1,2 (4) 0.5,0

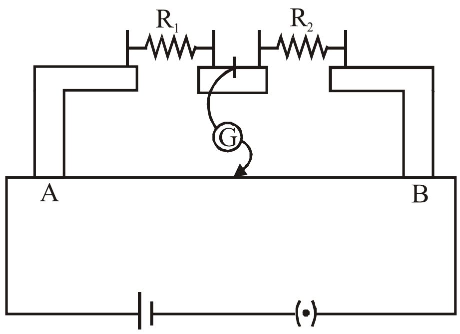
14. In the circuit , the potential difference between A and B is :-



(1) 6 V (2) 1 V

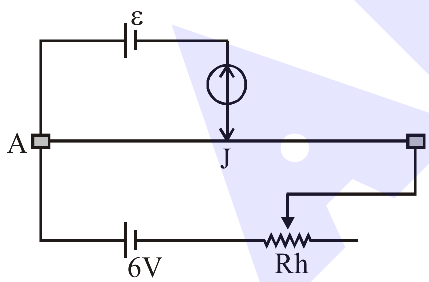
(3) 3 V (4) 2 V

15. In the experimental set up of metre bridge shown in the figure, the null point is obtained at a distance of 40 cm from A. If a 10Ω resistor is connected in series with R_1, the null point shifts by 10 cm. The resistance that should be connected in parallel with $(R_1 + 10)\Omega$ such that the null point shifts back to its initial position is



(1) 40 Ω (2) 60 Ω
(3) 20 Ω (4) 30Ω

16. The resistance of the meter bridge AB is given figure is 4Ω. With a cell of emf ε = 0.5 V and rheostat resistance R_h = 2 Ω the null point is obtained at some point J. When the cell is replaced by another one of emf $\varepsilon = \varepsilon_2$ the same null point J is found for R_h = 6 Ω. The emf ε_2 is;

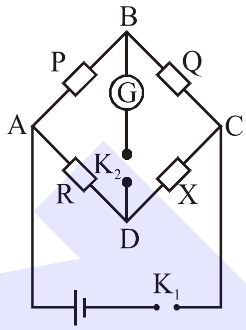


(1) 0.6 V (2) 0.5 V
(3) 0.3 V (4) 0.4 V

17. Two equal resistance when connected in series to a battery, consume electric power of 60 W. If these resistances are now connected in parallel combination to the same battery, the electric power consumed will be :

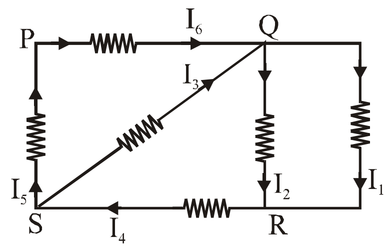
(1) 60 W (2) 240 W
(3) 30 W (4) 120 W

18. In a Wheatstone bridge (see fig.), Resistances P and Q are approximately equal. When R = 400 Ω, the bridge is equal. When R = 400 Ω, the bridge is balanced. On inter-changing P and Q, the value of R, for balance, is 405 Ω. The value of X is close to :



(1) 403.5 ohm (2) 404.5 ohm
(3) 401.5 ohm (4) 402.5 ohm

19. In the given circuit diagram, the currents, I_1 =–0.3A, I_4 = 0.8 A and I_5 = 0.4 A, are flowing as shown. The currents I_2,I_3 and I_6,respectively, are :



(1) 1.1 A, 0.4 A, 0.4 A
(2) –0.4 A, 0.4 A, 1.1 A
(3) 0.4 A, 1.1 A, 0.4 A
(4) 1.1 A,–0.4 A, 0.4 A

20. A galvanometer, whose resistance is 50 ohm, has 25 divisions in it. When a current of 4×10^{-4} A passes through it, its needle (pointer) deflects by one division. To use this galvanometer as a voltmeter of range 2.5 V, it should be connected to a resistance of:

(1) 6250 ohm (2) 250 ohm
(3) 200 ohm (4) 6200 ohm

21. Two electric bulbs, rated at (25 W, 220 V) and (100 W, 220 V), are connected in series across a 220 V voltage source. If the 25 W and 100 W bulbs draw powers P_1 and P_2 respectively, then:

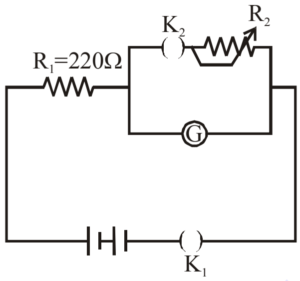
(1) P1 = 9 W, P_2 = 16 W

(2) P_1 = 4 W, P_2 = 16W

(3) P_1 = 16 W, P_2 = 4W

(4) P_1 16 W, P_2 = 9W

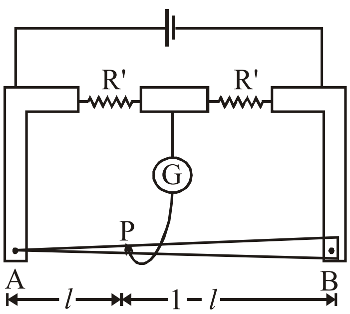
22. The galvanometer deflection, when key K_1 is closed but K_2 is open, equals θ_0 (see figure). On closing K_2 also and adjusting R_2 to 5Ω, the deflection in galvanometer becomes $\frac{\theta_0}{5}$. The resistance of the galvanometer is, then, given by [Neglect the internal resistance of battery]:



(1) 12Ω (2) 25Ω

(3) 5Ω (4) 22Ω

23. In a meter bridge, the wire of length 1 m has a non-uniform cross-section such that, the variation $\frac{dR}{d\ell}$ of its resistance R with length ℓ is $\frac{dR}{d\ell} \propto \frac{1}{\sqrt{\ell}}$. Two equal resistances are connected as shown in the figure. The galvanometer has zero deflection when the jockey is at point P. What is the length AP?



(1) 0.25 m (2) 0.3m

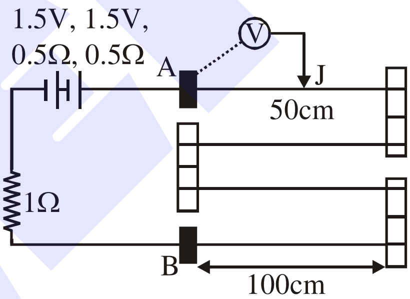
(3) 0.35 m (4) 0.2 m

24. An ideal battery of 4 V and resistance R are connected in series in the primary circuit of a potentiometer of length 1 m and resistance 5Ω. The value of R, to give a potential difference of 5 mV across 10 cm of potentiometer wire, is :

(1) 490 Ω (2) 480 Ω

(3) 395 Ω (4) 495 Ω

25. In the circuit shown, a four-wire potentiometer is made of a 400 cm long wire, which extends between A and B. The resistance per unit length of the potentiometer wire is r = 0.01 Ω/cm. If an ideal voltmeter is connected as shown with jockey J at 50 cm from end A, the expected reading of the voltmeter will be :-



(1) 0.20 V (2) 0.25 V

(3) 0.75 V (4) 0.50V

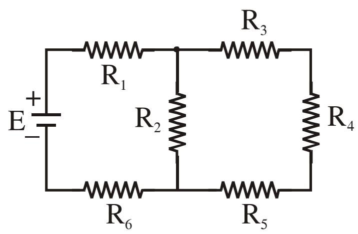
26. A cell of internal resistance r drives current through an external resistance R. The power delivered by the cell to the external resistance will be maximum when :-

(1) R = 1000 r (2) R = 0.001 r

(3) R = 2r (4) R = r

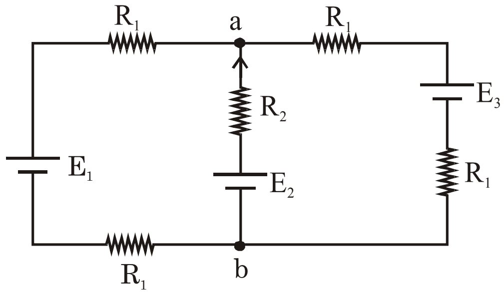
27. In the figure shown, what is the current (in Ampere) drawn from the battery ? You are given:

R_1 = 15Ω, R_2 = 10 Ω, R_3 = 20 Ω, R_4 = 5Ω, R_5= 25Ω, R_6 = 30 Ω, E = 15 V



(1) 7/18 (2) 13/24 (3) 9/32 (4) 20/3

28. For the circuit shown, with R_1 = 1.0Ω, R_2 = 2.0 Ω, E_1 = 2 V and E_2 = E_3 = 4 V, the potential difference between the points 'a' and 'b' is approximately (in V) :



(1) 2.7 (2) 3.3
(3) 2.3 (4) 3.7

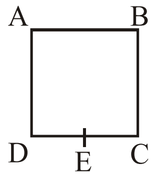
29. A 200 Ω resistor has a certain color code. If one replaces the red color by green in the code, the new resistance will be :
(1) 100 Ω (2) 400 Ω
(3) 500 Ω (4) 300 Ω

30. A metal wire of resistance 3 Ω is elongated to make a uniform wire of double its previous length. This new wire is now bent and the ends joined to make a circle. If two points on this circle make an angle 60° at the centre, the equivalent resistance between these two points will be :-
(1) $\frac{12}{5}\Omega$ (2) $\frac{5}{3}\Omega$ (3) $\frac{5}{2}\Omega$ (4) $\frac{7}{2}\Omega$

31. The resistance of a galvanometer is 50 ohm and the maximum current which can be passed through it is 0.002 A. What resistance must be connected to it in order to convert it into an ammeter of range 0 – 0.5 A ?
(1) 0.2 ohm (2) 0.002 ohm
(3) 0.02 ohm (4) 0.5 ohm

32. In a conductor, if the number of conduction electrons per unit volume is 8.5×10^{28} m^{-3} and mean free time is 25*fs* (femto second), it's approximate resistivity is :-
($m_e = 9.1 \times 10^{-31}$ kg)
(1) 10^{-5} Ωm (2) 10^{-6} Ωm
(3) 10^{-7} Ωm (4) 10^{-8} Ωm

33. A wire of resistance R is bent to form a square ABCD as shown in the figure. The effective resistance between E and C is :
(E is mid-point of arm CD)



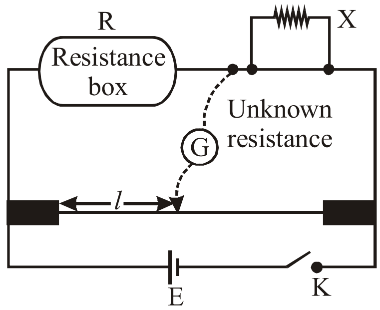
(1) R (2) $\frac{1}{16}$R
(3) $\frac{7}{64}$R (4) $\frac{3}{4}$R

34. A moving coil galvanometer has resistance 50Ω and it indicates full deflection at 4mA current. A voltmeter is made using this galvanometer and a 5 kΩ resistance. The maximum voltage, that can be measured using this voltmeter, will be close to :
(1) 10 V (2) 20 V
(3) 40 V (4) 15 V

35. Space between two concentric conducting spheres of radii a and b (b > a) is filled with a medium of resistivity ρ. The resistance between the two spheres will be :
(1) $\frac{\rho}{4\pi}\left(\frac{1}{a}-\frac{1}{b}\right)$ (2) $\frac{\rho}{2\pi}\left(\frac{1}{a}-\frac{1}{b}\right)$
(3) $\frac{\rho}{2\pi}\left(\frac{1}{a}+\frac{1}{b}\right)$ (4) $\frac{\rho}{4\pi}\left(\frac{1}{a}+\frac{1}{b}\right)$

36. A current of 5 A passes through a copper conductor (resistivity = 1.7×10^{-8} Ωm) of radius of cross-section 5 mm. Find the mobility of the charges if their drift velocity is 1.1×10^{-3} m/s.
(1) 1.3 m^2/Vs (2) 1.5 m^2/Vs
(3) 1.8 m^2/Vs (4) 1.0 m^2/Vs

37. In a meter bridge experiment, the circuit diagram and the corresponding observation table are shown in figure

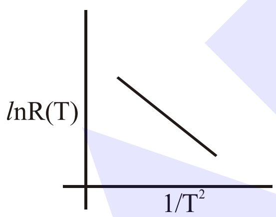


SI. No.	R(Ω)	l(cm)
1.	1000	60
2.	100	13
3.	10	1.5
4.	1	1.0

Which of the readings is inconsistent?

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

38. In an experiment, the resistance of a material is plotted as a function of temperature (in some range). As shown in the figure, it is a straight line. One may conclude that :



(1) $R(T) = \frac{R_0}{T^2}$ (2) $R(T) = R_0 e^{-T^2/T_0^2}$

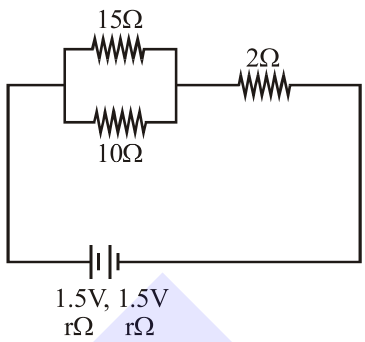
(3) $R(T) = R_0 e^{-T_0^2/T^2}$ (4) $R(T) = R_0 e^{T^2/T_0^2}$

39. A moving coil galvanometer allows a full scale current of 10^{-4}A. A series resistance of 2 MΩ is required to convert the above galvanometer into a voltmeter of range 0-5 V. Therefore the value of shunt resistance required to convert the above galvanometer into an ammeter of range 0-10 mA is :

(1) 200 Ω (2) 100 Ω

(3) 10 Ω (4) 500 Ω

40. In the given circuit, an ideal voltmeter connected across the 10Ω resistance reads 2V. The internal resistance r, of each cell is :



(1) 1Ω (2) 1.5Ω (3) 0Ω (4) 0.5Ω

41. A moving coil galvanometer, having a resistance G, produces full scale deflection when a current I_g flows through it. This galvanometer can be converted into (i) an ammeter of range 0 to I_0 ($I_0 > I_g$) by connecting a shunt resistance R_A to it and (ii) into a voltmeter of range 0 to V($V = GI_0$) by connecting a series resistance R_V to it. Then,

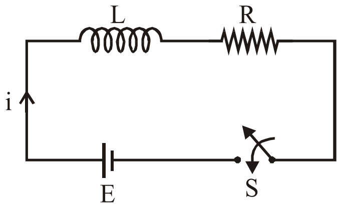
(1) $R_A R_V = G^2\left(\frac{I_g}{I_0 - I_g}\right)$ and $\frac{R_A}{R_V} = \left(\frac{I_0 - I_g}{I_g}\right)^2$

(2) $R_A R_V = G^2$ and $\frac{R_A}{R_V} = \left(\frac{I_g}{I_0 - I_g}\right)^2$

(3) $R_A R_V = G^2$ and $\frac{R_A}{R_V} = \frac{I_g}{(I_0 - I_g)}$

(4) $R_A R_V = G^2\left(\frac{I_0 - I_g}{I_g}\right)$ and $\frac{R_A}{R_V} = \left(\frac{I_g}{I_0 - I_g}\right)^2$

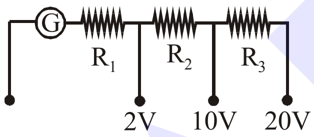
42. Consider the LR circuit shown in the figure. If the switch S is closed at t = 0 then the amount of charge that passes through the battery between t = 0 and t = $\frac{L}{R}$ is :



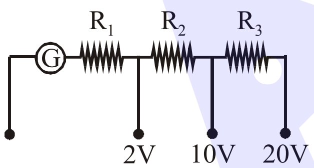
(1) $\frac{EL}{7.3R^2}$ (2) $\frac{EL}{2.7R^2}$

(3) $\frac{7.3EL}{R^2}$ (4) $\frac{2.7EL}{R^2}$

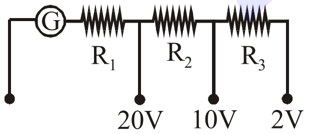
43. A galvanometer of resistance 100Ω has 50 divisions on its scale and has sensitivity of 20 μA/division. It is to be converted to a voltmeter with three ranges, of 0–2 V, 0–10 V and 0–20 V. The appropriate circuit to do so is :

(1)


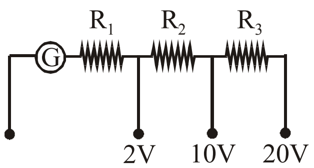
R_1 = 1900 Ω
R_2 = 9900 Ω
R_3 = 19900 Ω

(2)


R_1 = 2000 Ω
R_2 = 8000 Ω
R_3 = 10000 Ω

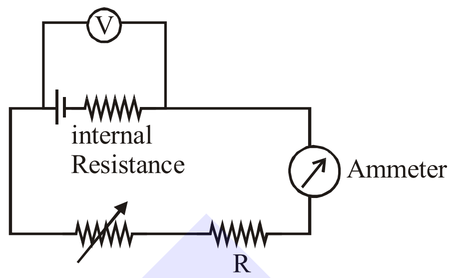
(3)


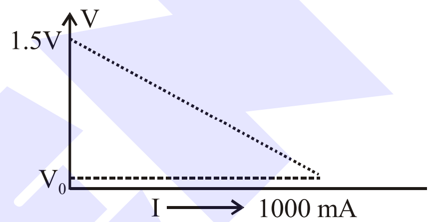
R_1 = 19900 Ω
R_2 = 9900 Ω
R_3 = 1900 Ω

(4)


R_1 = 1900 Ω
R_2 = 8000 Ω
R_3 = 10000 Ω

44. To verify Ohm's law, a student connects the voltmeter across the battery as, shown in the figure. The measured voltage is plotted as a function of the current, and the following graph is obtained:

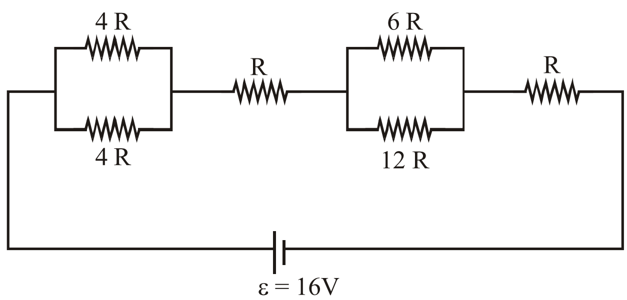




If V_0 is almost zero, identify the correct statement:

(1) The value of the resistance R is 1.5 Ω
(2) The emf of the battery is 1.5 V and the value of R is 1.5 Ω
(3) The emf of the battery is 1.5 V and its internal resistance is 1.5 Ω
(4) The potential difference across the battery is 1.5 V when it sends a current of 1000mA.

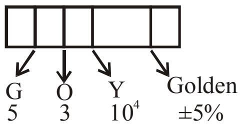
45. The resistive network shown below is connected to a D.C. source of 16V. The power consumed by the network is 4 Watt. The value of R is :



(1) 8Ω (2) 6Ω (3) 1Ω (4) 16Ω

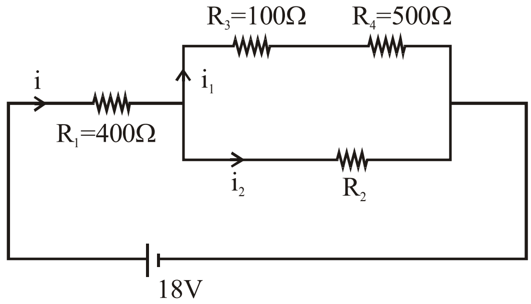
SOLUTION

1. Ans. (2)



$R = 53 \times 10^4 \pm 5\% = 530\ k\Omega \pm 5\%$

2. Ans. (1)



$V_4 = 5V$

$$i_1 = \frac{V_4}{R_4} = 0.01\text{ A}$$

$V_3 = i_1R_3 = 1V$

$V_3 + V_4 = 6V = V_2$

$V_1 + V_3 + V_4 = 18V$

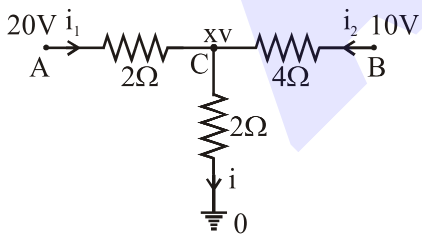
$V_1 = 12\ V$

$$i = \frac{V_1}{R_1} = 0.03\text{Amp.}$$

$i_2 = 0.02$ Amp $\qquad V_2 = 6V$

$$R_2 = \frac{V_2}{i_2} = \frac{6}{0.02} = 300\Omega$$

3. Ans. (2)



Let voltage at C = xv

KCL : $i_1 + i_2 = i$

$$\frac{20-x}{2} + \frac{10-x}{4} = \frac{x-0}{2}$$

$\Rightarrow x = 10$

and i = 5 amp.

4. Ans. (4)

Color code :

Red violet orange silver

$R = 27 \times 10^3\ \Omega \pm 10\%$

$= 27\ K\Omega \pm 10\%$

5. Ans. (3)

$R = \frac{\rho\ell}{A}$ and volume (V) = $A\ell$.

$$R = \frac{\rho\ell^2}{V}$$

$$\Rightarrow \frac{\Delta R}{R} = \frac{2\Delta\ell}{\ell} = 1\%$$

6. Ans. (4)

$I = neAv_d$

$$\Rightarrow v_d = \frac{I}{neA} = \frac{1.5}{9\times10^{28}\times1.6\times10^{-19}\times5\times10^{-6}}$$

= 0.02 m/s

7. Ans. (2)

$$0.95\ R = \frac{RR_\upsilon}{R+R_\upsilon}$$

$0.95 \times 30 = 0.05\ R_\upsilon$

$R_\upsilon = 19 \times 30 = 570\ \Omega$

8. Ans. (1)

$P = I^2R$

$4.4 = 4 \times 10^{-6}\ R$

$R = 1.1 \times 10^6\ \Omega$

$$P' = \frac{11^2}{R} = \frac{11^2}{1.1}\times10^{-6} = 11\times10^{-5}W$$

9. Ans. (2)

$R_1 = 32 \times 10 = 320$

for wheat stone bridge

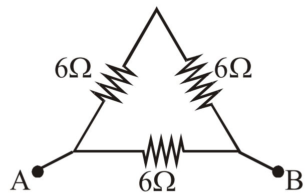
$$\Rightarrow \frac{R_1}{R_3} = \frac{R_2}{R_4}$$

$$\frac{320}{R_3} = \frac{80}{40}$$

$R_3 = 160$

Brown Blue Brown

10. Ans. (3)



R_{eq} between any two vertex will be

$$\frac{1}{R_{eq}}=\frac{1}{12}+\frac{1}{6}\Rightarrow R_{eq.}=4\Omega$$

11. Ans. (4)

$P = i^2R$.

$\therefore$ for i_{max}, R must be minimum

from color coding $R = 50\times10^2\Omega$

$\therefore$ $i_{max} = 20mA$

12. Ans. (4)

$$i=\frac{\varepsilon}{13r}$$

$$i\left(\frac{x}{L}12r\right)=\frac{\varepsilon}{2}$$

$$\frac{\varepsilon}{13r}\left[\frac{x}{L}.12r\right]=\frac{\varepsilon}{2}\Rightarrow \boxed{x=\frac{13L}{24}}$$

13. Ans. (4)

$$i_1=\frac{10}{20}=0.5A$$

$$i_2=0$$

14. Ans. (4)

Potential difference across AB will be equal to battery equivalent across CD

$$V_{AB}=V_{CD}=\frac{\frac{E_1}{r_1}+\frac{E_2}{r_2}+\frac{E_3}{r_3}}{\frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3}}=\frac{\frac{1}{1}+\frac{2}{1}+\frac{3}{1}}{\frac{1}{1}+\frac{1}{1}+\frac{1}{1}}$$

$$=\frac{6}{3}=2V$$

15. Ans. (2)

$$\frac{R_1}{R_2}=\frac{2}{3} \quad \ldots\ldots(i)$$

$$\frac{R_1+10}{R_2}=1 \Rightarrow R_1+10=R_2 \quad \ldots\ldots(ii)$$

$$\frac{2R_2}{3}+10=R_2$$

$$10=\frac{R_2}{3}\Rightarrow R_2=30\Omega$$

& $R_1 = 20\Omega$

$$\frac{\frac{30\times R}{30+R}}{30}=\frac{2}{3}$$

$R = 60\ \Omega$

16. Ans. (3)

Potential gradient with $R_h = 2\Omega$

is $\left(\frac{6}{2+4}\right)\times\frac{4}{L}=\frac{dV}{dL}$; $L=100\,cm$

Let null point be at ℓ cm

thus $\varepsilon_1 = 0.5V = \left(\frac{6}{2+4}\right)\times\frac{4}{L}\times\ell$ ...(1)

Now with $R_h = 6\Omega$ new potential gradient is

$\left(\frac{6}{4+6}\right)\times\frac{4}{L}$ and at null point

$$\left(\frac{6}{4+6}\right)\left(\frac{4}{L}\right)\times\ell=\varepsilon_2 \quad ...(2)$$

dividing equation (1) by (2) we get

$\frac{0.5}{\varepsilon_2}=\frac{10}{6}$ thus $\varepsilon_2 = 0.3$

17. Ans. (2)

In series condition, equivalent resistance is 2R

thus power consumed is $60W=\frac{\varepsilon^2}{2R}$

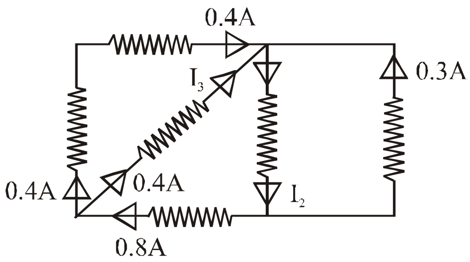
In parallel condition, equivalent resistance is R/2 thus new power is

$$P'=\frac{\varepsilon^2}{(R/2)}$$

or $P'=4P=240W$

18. Ans. (4)

19. Ans. (1)



From KCL, $I_3 = 0.8 - 0.4 = 0.4A$

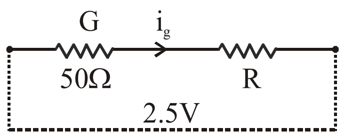
$I_2 = 0.4 + 0.4 + 0.3$

$= 1.1\ A$

$I_6 = 0.4A$

20. Ans. (3)

$I_g = 4 \times 10^{-4} \times 25 = 10^{-2}\ A$



$2.5 = (50 + R)\ 10^{-2}\ \therefore\ R = 200\ \Omega$

21. Ans. (3)

$$R_1 = \frac{220^2}{25}$$

$$R_2 = \frac{220^2}{100}$$

$$L = \frac{220}{R_1 + R_2}$$

$P_1 = i^2 R_1$

$P_2 = i^2\ (R_2 = 4W)$

$$= \frac{220^2}{\left(\frac{220^2}{25} + \frac{220^2}{100}\right)} \times \frac{220^2}{25}$$

$$= \frac{400}{25} = 16W$$

22. Ans. (4)

case I $\quad i_g = \frac{E}{220 + R_g} = C\theta_0 \quad$ ..(i)

Case II

$$i_g = \left(\frac{E}{220 + \frac{5R_g}{5 + R_g}}\right) \times \frac{5}{(R_g + 5)} = \frac{C\theta_0}{5} \quad ..(ii)$$

$$\Rightarrow \frac{5E}{225R_g + 1100} = \frac{C\theta_0}{5} \quad ..(ii)$$

$$\frac{E}{220 + R_g} = C\theta \quad ...(i)$$

$$\Rightarrow \frac{225R_g + 1100}{1100 + 5R_g} = 5$$

$\Rightarrow 5500 + 25R_g = 225R_g + 1100$

$200R_g = 4400$

$R_g = 22\Omega$

Ans. – 4

23. Ans. (1)

For the given wire : $dR = C\frac{d\ell}{\sqrt{\ell}}$,

where C = constant.

Let resistance of part AP is R_1 and PB is R_2

$\therefore \quad \frac{R'}{R'} = \frac{R_1}{R_2}$ or $R_1 = R_2$ By balanced WSB concept.

Now $\quad \int dR = c\int \frac{d\ell}{\sqrt{\ell}}$

$$\therefore R_1 = C\int_0^{\ell} \ell^{-1/2} d\ell = C.2.\sqrt{\ell}$$

$$R_2 = C\int_{\ell}^{1} \ell^{-1/2} d\ell = C.(2 - 2\sqrt{\ell})$$

Putting $R_1 = R_2$

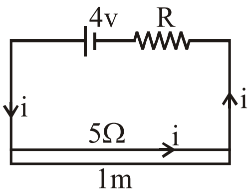
$C2\sqrt{\ell} = C\ (2 - 2\sqrt{\ell})$

$\therefore 2\sqrt{\ell} = 1$

$\sqrt{\ell} = \frac{1}{2}$

i.e. $\ell = \frac{1}{4}$ m $\quad \Rightarrow \quad$ 0.25 m

24. Ans. (3)



Let current flowing in the wire is i.

$\therefore \quad i = \left(\frac{4}{R+5}\right)A$

If resistance of 10 m length of wire is x

then $x = 0.5\ \Omega = 5 \times \frac{0.1}{1}\Omega$

$\therefore \quad \Delta V$ = P. d. on wire = i. x

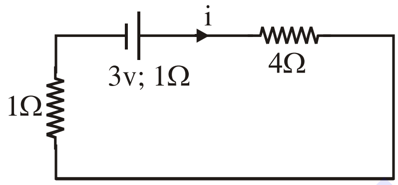
$5 \times 10^{-3} = \left(\frac{4}{R+5}\right)\cdot(0.5)$

$\therefore \quad \frac{4}{R+5} = 10^{-2}$ or $R + 5 = 400\ \Omega$

$\therefore R = 395\ \Omega$

25. Ans. (2)

Sol.



Resistance of wire AB = $400 \times 0.01 = 4\Omega$

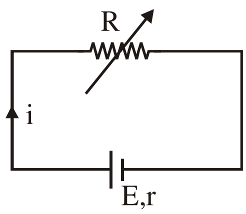
$i = \frac{3}{6} = 0.5A$

Now voltmeter reading = i (Resistance of 50 cm length)

= (0.5A) (0.01×50) = 0.25 volt

26. Ans. (4)

Sol.



Current $i = \frac{E}{r+R}$

Power generated in R

$P = i^2R$

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

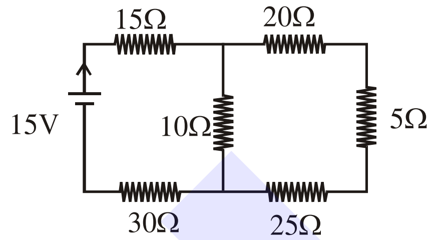
for maximum power $\frac{dP}{dR} = 0$

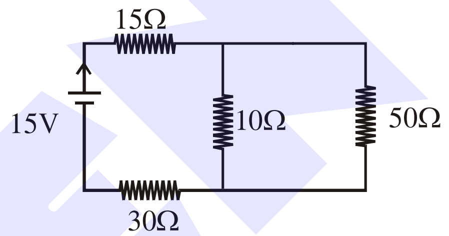
$$E^2\left[\frac{(r+R)^2 \times 1 - R \times 2(r+R)}{(r+R)^4}\right] = 0$$

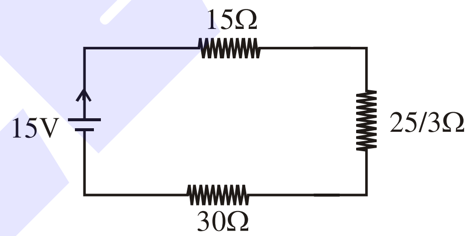
$\Rightarrow r = R$

27. Ans. (3)

Sol.







$R_{eq} = 15 + \frac{25}{3} + 30 = \frac{45+25+90}{3} = \frac{160}{3}$

$I = \frac{E}{R_{eq}} = \frac{15 \times 3}{160} = \frac{9}{32}$ amp.

28. Ans. (2)

Sol. $E_{eq} = \dfrac{\frac{E_1}{2R_1} + \frac{E_2}{R_2} + \frac{E_3}{2R_1}}{\frac{1}{2R_1} + \frac{1}{R_2} + \frac{1}{2R_1}}$

$$= \frac{\frac{2}{2} + \frac{4}{2} + \frac{4}{2}}{\frac{1}{2} + \frac{1}{2} + \frac{1}{2}}$$

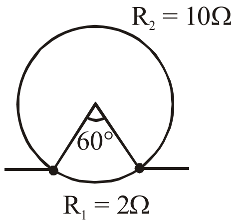
$$= \frac{5}{\frac{3}{2}} = \frac{10}{3} = 3.3$$

29. Ans. (3)

Sol. When red is replaced with green 1^{st} digit changes to 5 so new resistance will be 500Ω

30. Ans. (2)

Sol.



$$R = \frac{\rho \ell^2}{A \ell D} d = \frac{\rho d \ell^2}{m}$$

$R \propto \ell^2$

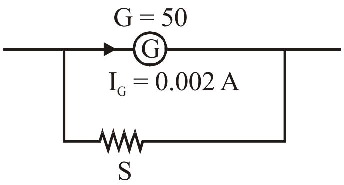
$R = 12\Omega$ (new resistance of wire)

$R_1 = 2\Omega \quad R_2 = 10\Omega$

$$R_{eq} = \frac{10 \times 2}{10 + 2} = \frac{5}{3}\Omega.$$

31. Ans. (1)

Sol.



$S(0.5 - 0.002) = 50 \times 0.002$

$$S = \frac{50 \times 0.002}{(0.5 - 0.002)} = \frac{0.1}{0.498} = 0.2$$

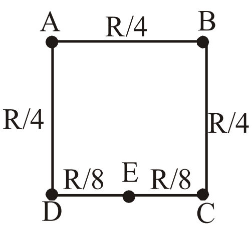
32. Ans. (4)

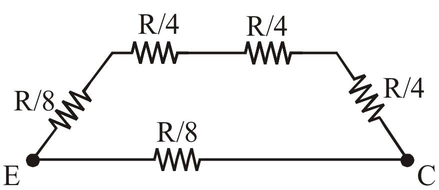
Sol. $\rho = \dfrac{m}{ne^2\tau}$

$= 1.67 \times 10^{-8} \Omega m$

33. Ans. (3)

Sol.





$$\frac{1}{R_{eq}} = \frac{8}{7R} + \frac{8}{R}$$

$$\frac{1}{R_{eq}} = \frac{8 + 56}{7R}$$

$$R_{eq} = \frac{7R}{64}$$

Option (3)

34. Ans. (2)

Sol. $G = 50\ \Omega$

$S = 5000\ \Omega$

$i_g = 4 \times 10^{-3}$

$V = i_g (G + S)$

$V = 4 \times 10^{-3} (50 + 5000)$

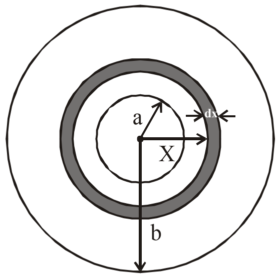
$= 4 \times 10^{-3}(5050)$

$= 20.2$ volt

Option (2)

35. Ans. (1)

Sol. $dR = \rho . \dfrac{dx}{4\pi x^2}$



$$\int dR = \rho . \int_a^b \frac{dx}{4\pi x^2}$$

$$R = \frac{\rho}{4\pi}\left[-\frac{1}{x}\right]_a^b$$

$$R = \frac{\rho}{4\pi}\left(\frac{1}{a} - \frac{1}{b}\right)$$

36. Ans. (4)

Sol. $\mu = \dfrac{V_d}{E} \qquad E = \rho J$

$$= \frac{1.1 \times 10^{-3}}{1.7 \times 10^{-8} \times \dfrac{5}{\pi \times 25 \times 10^{-6}}}$$

$$= \frac{1.1 \times 10^{-3} \times \pi \times 25 \times 10^{-6}}{1.7 \times 10^{-8} \times 5} \approx 1.01 m^2 / Vs$$

37. Ans. (1)

Sol. as $x = \dfrac{R(100-\ell)}{\ell}$

for (1) $x = \dfrac{1000\times(100-60)}{40} \approx 667$

for (2) $x = \dfrac{100\times(100-13)}{13} \approx 669$

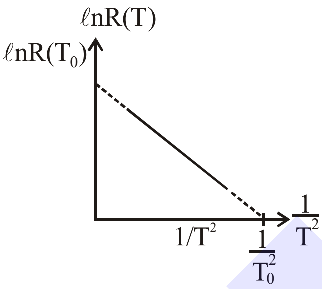
for (3) $x = \dfrac{10\times(100-1.5)}{98.5} \approx 656$

for (4) $x = \dfrac{1\times(100-1)}{1} \approx 95$

So option (4) is completely different hence correct Ans. (4)

38. Ans. (3)

Sol. $$\frac{\frac{1}{T^2}}{\frac{1}{T_0^2}} + \frac{\ell n(T)}{\ell nR(T_0)} = 1$$



$$\Rightarrow \ \ell nR(T) = [\ell nR(T_0)]\left(1-\frac{T_0^2}{T^2}\right)$$

$$\Rightarrow \ R(T) = R_0 e^{\left(-\frac{T_0^2}{T^2}\right)}$$

39. Ans. (Bonus)

Sol. $200 + 10^{-4}\,G = 5$

$G = -ve$

So answer is Bonus

40. Ans. (4)

Sol. $R_{eq} = \dfrac{15\times10}{25} + 2 + 2r$

$= 8 + 2r$

$i = \dfrac{3}{8+2r}$

$2 = i\,R_{eq} = \dfrac{3}{8+2r}\times 6$

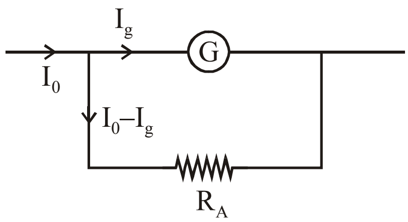
$16 + 4r = 18$

$\Rightarrow r = 0.5\ \Omega$

41. Ans. (2)

Sol. When galvanometer is used as an ammeter shunt is used in parallel with galvanometer.

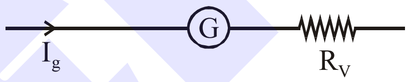
$\therefore$



$\therefore\ I_gG = (I_0 - I_g)R_A$

$\therefore\ R_A = \left(\dfrac{I_g}{I_0 - I_g}\right)G$

When galvanometer is used as a voltmeter, resistance is used in series with galvanometer.



$I_g(G + R_V) = V = GI_0$ (given $V = GI_0$)

$\therefore\ R_V = \dfrac{(I_0 - I_g)G}{I_g}$

$\therefore\ R_AR_V = G^2$ & $\dfrac{R_A}{R_V} = \left(\dfrac{I_g}{I_0 - I_g}\right)^2$

42. Ans. (2)

Sol. $q = \int I\,dt$

$$q = \int_0^{L/R} \frac{E}{R}\left[1 - e^{\frac{-Rt}{L}}\right]dt$$

$$q = \frac{EL}{R^2}\frac{1}{e}$$

$$q = \frac{EL}{2.7R^2}$$

43. Ans. (4)

Sol. $20 \times 50 \times 10^{-6} = 10^{-3}$ Amp.

$$V_1 = \frac{2}{10^{-3}} = 100 + R_1$$

$1900 = R_1$

$$V_2 = \frac{10}{10^{-3}} = (2000 + R_2)$$

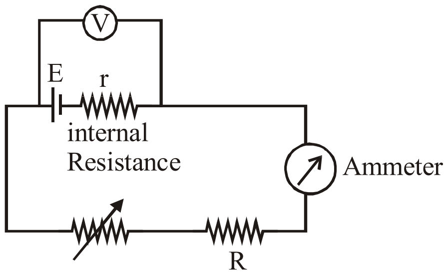
$R_2 = 8000$

$$V_3 = \frac{20}{10^{-3}} = 10 \times 10^3 + R_3$$

$10 \times 10^3 = R_3$

44. Ans. (3)

Sol.



$V = E - Ir$

when $V = V_0 = 0 \Rightarrow 0 = E - Ir$

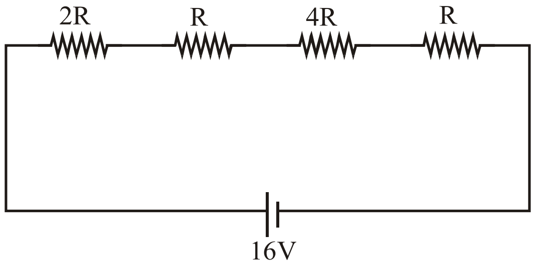
$\therefore\ E = r$

when $I = 0$, $V = E = 1.5V$

$\therefore\ r = 1.5\Omega$.

45. Ans. (1)

Sol.



$$P = \frac{16^2}{8R} = 4 \quad \therefore R = 8\Omega$$