Chapter 16

Current Electricity

1. Statement 1: The temperature dependence of resistance is usually given as $R = R_0(1 + \alpha\Delta t)$. The resistance of a wire changes from 100 Ω to 150 Ω when its temperature is increased from 27°C to 227°C. This implies that $\alpha = 2.5 \times 10^{-3}$/°C.

   Statement 2: $R = R_0(1 + \alpha\Delta t)$ is valid only when the change in the temperature ΔT is small and $\Delta R = (R - R_0) << R_0$. **[AIEEE-2009]**

   (1) Statement 1 is true, statement 2 is true; Statement 2 is the correct explanation of Statement 1

   (2) Statement 1 is true, Statement 2 is true; Statement 2 is not the correct explanation of Statement 1

   (3) Statement 1 is false, Statement 2 is true

   (4) Statement 1 is true, Statement 2 is false

2. Two conductors have the same resistance at 0°C but their temperature coefficients of resistance are α_1 and α_2. The respective temperature coefficients of their series and parallel combinations are nearly **[AIEEE-2010]**

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

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

3. Combination of two identical capacitors, a resistor R and a dc voltage source of voltage 6 V is used in an experiment on a $(C - R)$ circuit. It is found that for a parallel combination of the capacitor the time in which the voltage of the fully charged combination reduces to half its original voltage is 10 second. For series combination, the time needed for reducing the voltage of the fully charged series combination by half is **[AIEEE-2011]**

   (1) 2.5 second (2) 20 second

   (3) 10 second (4) 5 second

4. The current in the primary circuit of a potentiometer is 0.2 A. The specific resistance and cross-section of the potentiometer wire are 4×10^{-7} ohm metre and 8×10^{-7} m^2 respectively. The potential gradient will be equal to **[AIEEE-2011]**

   (1) 0.1 V/m (2) 0.2 V/m

   (3) 1 V/m (4) 0.5 V/m

5. If 400 Ω of resistance is made by adding four 100 Ω resistances of tolerance 5%, then the tolerance of the combination is **[AIEEE-2011]**

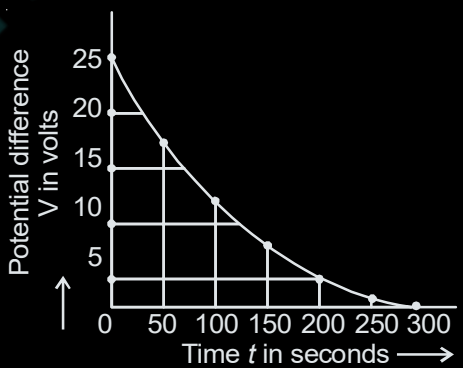
   (1) 15% (2) 20%

   (3) 5% (4) 10%

6. Two electric bulbs marked 25 W - 220 V and 100 W - 220 V are connected in series to a 440 V are connected in series to a 440V supply. Which of the bulbs will fuse? **[AIEEE-2012]**

   (1) 100 W (2) 25 W

   (3) Neither (4) Both

7. 

   The figure shows an experimental plot for discharging of a capacitor in an R-C circuit. The time constant τ of this circuit lies between **[AIEEE-2012]**

   (1) 0 and 50 s

   (2) 50 sec and 100 s

   (3) 100 sec and 150 s

   (4) 150 sec and 200 s

8. The supply voltage to a room is 120 V. The resistance of the lead wires is 6 Ω. A 60 W bulb is already switched on. What is the decrease of voltage across the bulb, when a 240 W heater is switched on in parallel to the bulb? **[JEE (Main)-2013]**

   (1) Zero (2) 2.9 volt

   (3) 13.3 volt (4) 10.04 volt

9. *This question has Statement I and Statement II. Of the four choices given after the Statements, choose the one that best describes the two Statements.*

Statement - I : Higher the range, greater is the resistance of ammeter.

Statement - II : To increase the range of ammeter, additional shunt needs to be used across it.

[JEE (Main)-2013]

(1) Statement - I is true, Statement - II is true, Statement - II is the correct explanation of Statement-I.

(2) Statement - I is true, Statement - II is true, Statement - II is not the correct explanation of Statement-I.

(3) Statement - I is true, Statement - II is false.

(4) Statement - I is false, Statement - II is true.

10. In a large building, there are 15 bulbs of 40 W, 5 bulbs of 100 W, 5 fans of 80 W and 1 heater of 1 kW. The voltage of the electric mains is 220 V. The minimum capacity of the main fuse of the building will be **[JEE (Main)-2014]**

(1) 8 A (2) 10 A

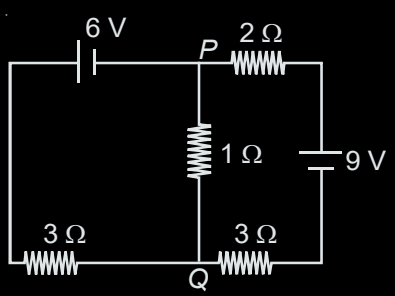
(3) 12 A (4) 14 A

11. When 5 V potential difference is applied across a wire of length 0.1 m, the drift speed of electrons is 2.5×10^{-4} ms^{-1}. If the electron density in the wire is 8×10^{28} m^{-3}, the resistivity of the material is close to **[JEE (Main)-2015]**

(1) 1.6×10^{-8} Ωm (2) 1.6×10^{-7} Ωm

(3) 1.6×10^{-6} Ωm (4) 1.6×10^{-5} Ωm

12. In the circuit shown, the current in the 1 Ω resistor is **[JEE (Main)-2015]**



(1) 1.3 A, from *P* to *Q*

(2) 0 A

(3) 0.13 A, from *Q* to *P*

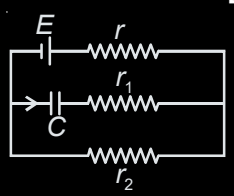
(4) 0.13 A, from *P* to *Q*

13. A galvanometer having a coil resistance of 100 Ω gives a full scale deflection, when a current of 1 mA is passed through it. The value of the resistance, which can convert this galvanometer into ammeter giving a full scale deflection for a current of 10 A, is **[JEE (Main)-2016]**

(1) 2 Ω (2) 0.1 Ω

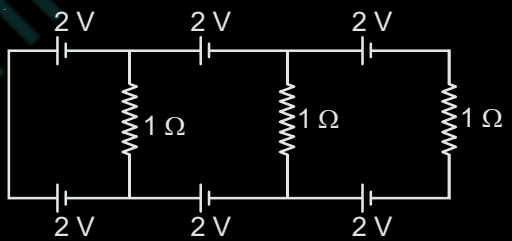
(3) 3 Ω (4) 0.01 Ω

14. In the given circuit diagram when the current reaches steady state in the circuit, the charge on the capacitor of capacitance *C* will be **[JEE (Main)-2017]**



(1) CE (2) $CE\frac{r_1}{(r_2+r)}$

(3) $CE\frac{r_2}{(r+r_2)}$ (4) $CE\frac{r_1}{(r_1+r)}$

15. 

In the above circuit the current in each resistance is **[JEE (Main)-2017]**

(1) 1 A (2) 0.25 A

(3) 0.5 A (4) 0 A

16. When a current of 5 mA is passed through a galvanometer having a coil of resistance 15 Ω, it shows full scale deflection. The value of the resistance to be put in series with the galvanometer to convert it into a voltmeter of range 0-10 V is **[JEE (Main)-2017]**

(1) 1.985×10^3 Ω (2) 2.045×10^3 Ω

(3) 2.535×10^3 Ω (4) 4.005×10^3 Ω

17. Which of the following statements is false? **[JEE (Main)-2017]**

(1) Wheatstone bridge is the most sensitive when all the four resistances are of the same order of magnitude

(2) In a balanced Wheatstone bridge if the cell and the galvanometer are exchanged, the null point is disturbed

(3) A rheostat can be used as a potential divider

(4) Kirchhoff's second law represents energy conservation

18. Two batteries with e.m.f 12 V and 13 V are connected in parallel across a load resistor of 10 Ω. The internal resistances of the two batteries are 1 Ω and 2 Ω respectively. The voltage across the load lies between **[JEE (Main)-2018]**

(1) 11.6 V and 11.7 V

(2) 11.5 V and 11.6 V

(3) 11.4 V and 11.5 V

(4) 11.7 V and 11.8 V

19. In a potentiometer experiment, it is found that no current passes through the galvanometer when the terminals of the cell are connected across 52 cm of the potentiometer wire. If the cell is shunted by a resistance of 5 Ω, a balance is found when the cell is connected across 40 cm of the wire. Find the internal resistance of the cell.

[JEE (Main)-2018]

(1) 1 Ω (2) 1.5 Ω

(3) 2 Ω (4) 2.5 Ω

20. On interchanging the resistances, the balance point of a meter bridge shifts to the left by 10 cm. The resistance of their series combination is 1 kΩ. How much was the resistance on the left slot before interchanging the resistances?

[JEE (Main)-2018]

(1) 990 Ω (2) 505 Ω

(3) 550 Ω (4) 910 Ω

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

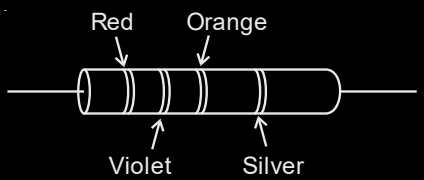
[JEE (Main)-2019]

(1) 0.5% (2) 2.0%

(3) 2.5% (4) 1.0%

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

[JEE (Main)-2019]

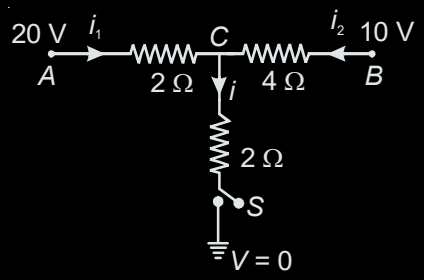


(1) 27 kΩ, 20% (2) 270 Ω, 5%

(3) 27 kΩ, 10% (4) 270 Ω, 10%

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

[JEE (Main)-2019]



(1) 2 A (2) 5 A

(3) 4 A (4) 3 A

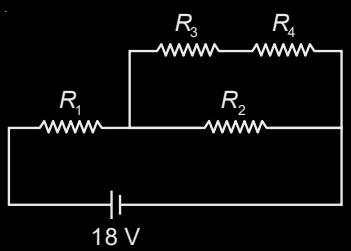
24. A carbon resistance has a following colour code. What is the value of the resistance?

[JEE (Main)-2019]

(1) 6.4 MΩ ± 5 % (2) 5.3 MΩ ± 5 %

(3) 64 kΩ ± 10 % (4) 530 kΩ ± 5 %

25. In the given circuit the internal resistance of the 18 V cells 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 5 V, then the value of R_2 will be **[JEE (Main)-2019]**

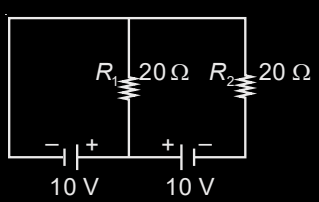


(1) 230 Ω (2) 450 Ω

(3) 550 Ω (4) 300 Ω

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

[JEE (Main)-2019]



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

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

27. 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 **[JEE (Main)-2019]**

(1) 20 mA (2) 0.4 mA

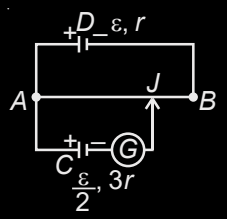
(3) 100 mA (4) 63 mA

28. 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 **[JEE (Main)-2019]**

(1) 4 Ω (2) 12 Ω

(3) 8 Ω (4) 2 Ω

29. 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 $\frac{\varepsilon}{2}$ and internal resistance 3*r* is connected. The length *AJ* at which the galvanometer as shown in fig. shows no deflection is **[JEE (Main)-2019]**

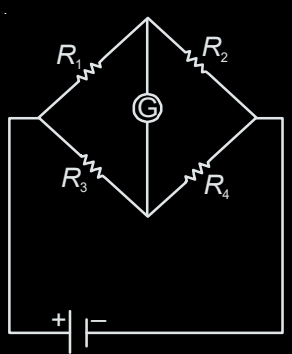


(1) $\frac{11}{12}L$ (2) $\frac{11}{24}L$

(3) $\frac{5}{12}L$ (4) $\frac{13}{24}L$

30. 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 80 Ω and 40 Ω 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 **[JEE (Main)-2019]**



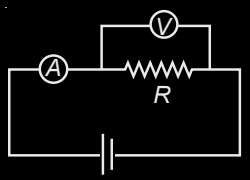
(1) Brown, Blue, Black

(2) Red, Green, Brown

(3) Grey, Black, Brown

(4) Brown, Blue, Brown

31. The actual value of resistance *R*, shown in the figure is 30 Ω. 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 **[JEE (Main)-2019]**



(1) 570 Ω (2) 600 Ω

(3) 350 Ω (4) 35 Ω

32. 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 11 V is connected across it is **[JEE (Main)-2019]**

(1) 11×10^{-5} W (2) 11×10^{5} W

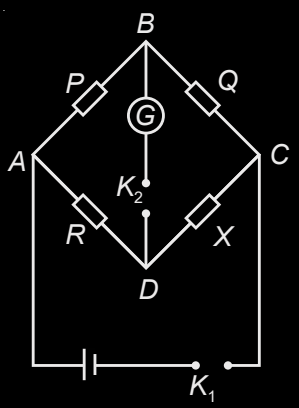
(3) 11×10^{-3} W (4) 11×10^{-4} W

33. Two equal resistances 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 **[JEE (Main)-2019]**

(1) 60 W (2) 30 W

(3) 120 W (4) 240 W

34. In a Wheatstone bridge (see fig.), Resistances *P* and *Q* are approximately equal. When *R* = 400 Ω, the bridge is balanced. On interchanging *P* and *Q*, the value of *R*, for balance, is 405 Ω. The value of *X* is close to **[JEE (Main)-2019]**

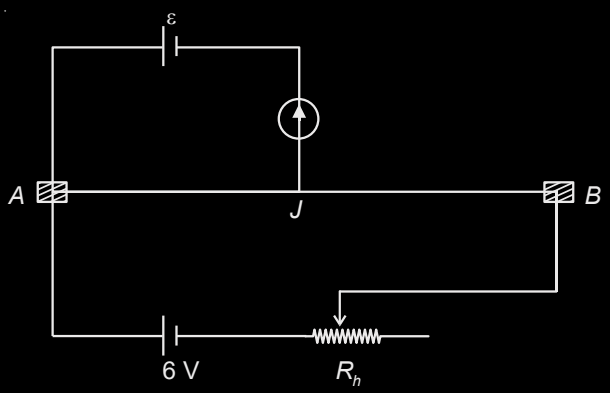


(1) 404.5 ohm (2) 401.5 ohm

(3) 402.5 ohm (4) 403.5 ohm

35. The resistance of the metre bridge AB in given figure is 4 Ω. 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

[JEE (Main)-2019]



(1) 0.6 V (2) 0.5 V

(3) 0.3 V (4) 0.4 V

36. A galvanometer having a resistance of 20 Ω and 30 divisions on both sides has figure of merit 0.005 ampere/division. The resistance that should be connected in series such that it can be used as a voltmeter upto 15 volt, is **[JEE (Main)-2019]**

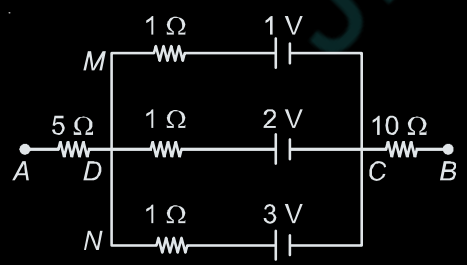
(1) 100 Ω

(2) 125 Ω

(3) 80 Ω

(4) 120 Ω

37. In the circuit shown, the potential difference between A and B is **[JEE (Main)-2019]**

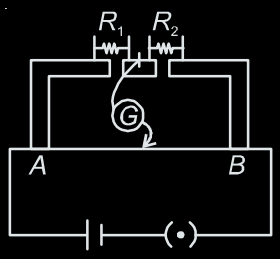


(1) 6 V (2) 3 V

(3) 2 V (4) 1 V

38. 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 10 Ω 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) Ω such that the null point shifts back to its initial position is

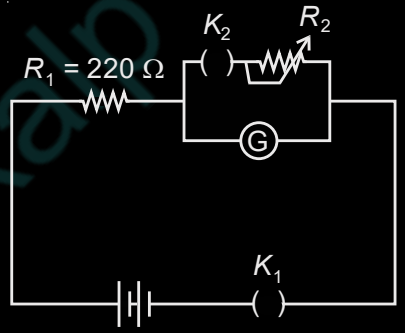
[JEE (Main)-2019]



(1) 60 Ω (2) 30 Ω

(3) 40 Ω (4) 20 Ω

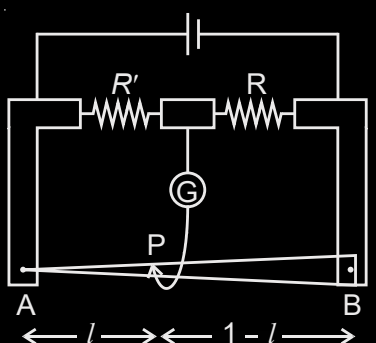
39. The galvanometer deflection, when key K_1 is closed but K_2 is open, equal θ_0 (see figure). On closing K_2 also and adjusting R_2 to 5 Ω, the deflection in galvanometer becomes $\frac{\theta_0}{5}$. The resistance of the galvanometer is, then given by [Neglect the internal resistance of battery] **[JEE (Main)-2019]**



(1) 22 Ω (2) 25 Ω

(3) 5 Ω (4) 12 Ω

40. In a meter bridge, the wire of length 1 m has a non-uniform cross-section such that, the variation $\frac{dR}{dl}$ of its resistance R with length l is $\frac{dR}{dl} \propto \frac{1}{\sqrt{l}}$. 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 ? **[JEE (Main)-2019]**



(1) 0.2 m (2) 0.35 m

(3) 0.25 m (4) 0.3 m

41. 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 5 Ω. The value of R, to give an potential difference of 5 mV across 10 cm of potentiometer wire, is

[JEE (Main)-2019]

(1) 480 Ω (2) 490 Ω

(3) 495 Ω (4) 395 Ω

42. 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

[JEE (Main)-2019]

(1) P_1 = 9 W, P_2 = 16 W

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

(3) P_1 = 16 W, P_2 = 9 W

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

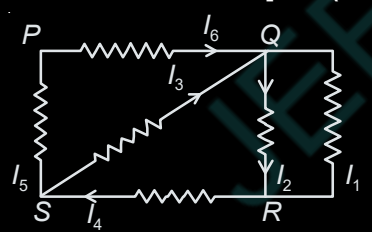
43. A galvanometer, whose resistance is 50 ohm, has 25 divisions in it. When a current of 4×10^{-4} A passes through it, its needle(pointer) deflects by one division. To use this galvanometer as a voltmeter of range 2.5 V, it should be connected to a resistance of **[JEE (Main)-2019]**

(1) 6250 ohm (2) 250 ohm

(3) 200 ohm (4) 6200 ohm

44. In the given circuit diagram, the currents, I_1= – 0.3 A, 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

[JEE (Main)-2019]



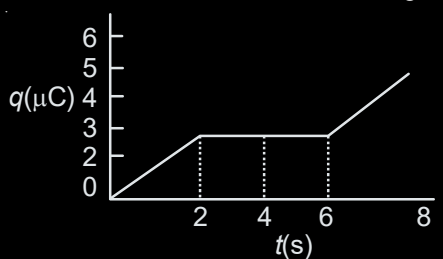
(1) 1.1 A, 0.4 A, 0.4 A

(2) 1.1 A, – 0.4 A, 0.4 A

(3) 0.4 A, 1.1 A, 0.4 A

(4) –0.4 A, 0.4 A, 1.1 A

45. The charge on a capacitor plate in a circuit, as a function of time, is shown in the figure



What is the value of current at t = 4 s?

[JEE (Main)-2019]

(1) 2 μA (2) Zero

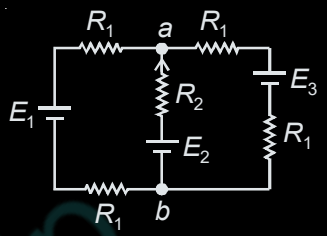
(3) 3 μA (4) 1.5 μA

46. 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 **[JEE (Main)-2019]**

(1) 400 Ω (2) 500 Ω

(3) 300 Ω (4) 100 Ω

47. For the circuit shown, with R_1 = 1.0 Ω, 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) **[JEE (Main)-2019]**



(1) 2.7 (2) 3.7

(3) 2.3 (4) 3.3

48. 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 : **[JEE (Main)-2019]**

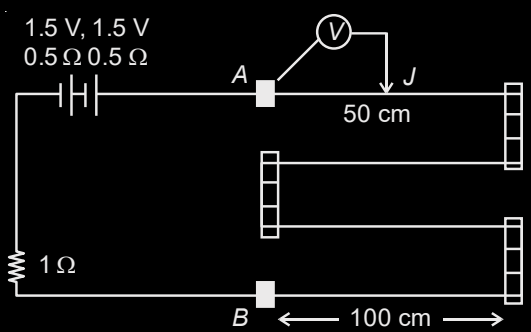
(1) R = 1000 r

(2) R = r

(3) R = 2r

(4) R = 0.001 r

49. 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: **[JEE (Main)-2019]**



(1) 0.75 V

(2) 0.50 V

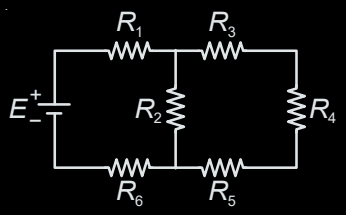
(3) 0.20 V

(4) 0.25 V

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

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

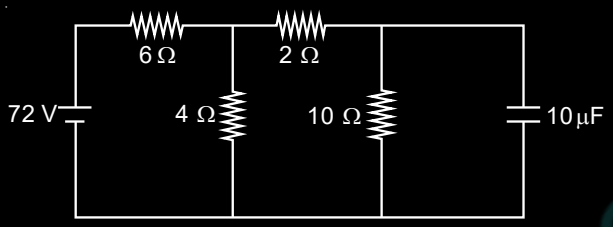
[JEE (Main)-2019]



(1) $\frac{13}{24}$ (2) $\frac{9}{32}$

(3) $\frac{20}{3}$ (4) $\frac{7}{18}$

51. Determine the charge on the capacitor in the following circuit. **[JEE (Main)-2019]**

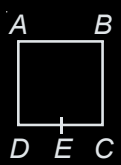


(1) 200 μC (2) 60 μC

(3) 10 μC (4) 2 μC

52. 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) **[JEE (Main)-2019]**



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

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

53. A moving coil galvanometer has resistance 50 Ω and it indicates full deflection at 4 mA 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 **[JEE (Main)-2019]**

(1) 10 V (2) 20 V

(3) 15 V (4) 40 V

54. 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

[JEE (Main)-2019]

(1) $\frac{5}{3}\ \Omega$ (2) $\frac{5}{2}\ \Omega$

(3) $\frac{7}{2}\ \Omega$ (4) $\frac{12}{5}\ \Omega$

55. 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? **[JEE (Main)-2019]**

(1) 0.2 ohm (2) 0.002 ohm

(3) 0.5 ohm (4) 0.02 ohm

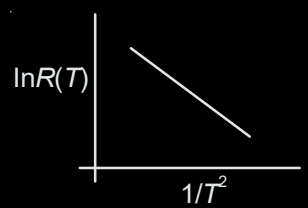
56. In a conductor, if the number of conduction electrons per unit volume is 8.5×10^{28} m^{-3} and mean free time is 25 fs (femto second), its approximate resistivity is ($m_e = 9.1 \times 10^{-31}$ kg)

[JEE (Main)-2019]

(1) 10^{-5} Ωm (2) 10^{-6} Ωm

(3) 10^{-7} Ωm (4) 10^{-8} Ωm

57. 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 : **[JEE (Main)-2019]**

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

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

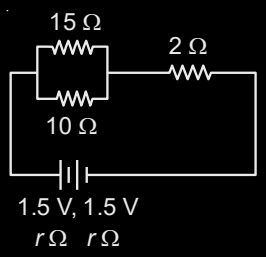
58. A moving coil galvanometer allows a full scale current of 10^{-4} A. A series resistance of 30 KΩ is required to convert the above galvanometer into a voltmeter of range 0 – 5 V. Therefore the value of shunt resistance required to convert the above galvanometer into an ammeter of range 0–10 mA is:

[JEE (Main)-2019]

(1) 200 Ω (2) 500 Ω

(3) 100 Ω (4) 10 Ω

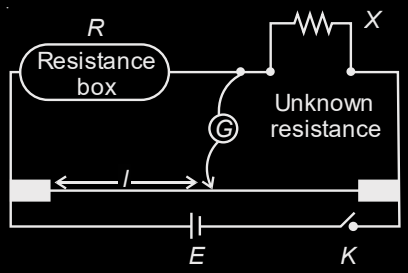
59. In the given circuit, an ideal voltmeter connected across the 10 Ω resistance reads 2 V. The internal resistance *r*, of each cell is : **[JEE (Main)-2019]**



(1) 0.5 Ω (2) 0 Ω

(3) 1.5 Ω (4) 1 Ω

60. In a meter bridge experiment, the circuit diagram and the corresponding observation table are shown in figure. **[JEE (Main)-2019]**



Sl. 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) 3 (2) 2

(3) 1 (4) 4

61. A current of 5 A passes through a copper conductor (resistivity = 1.7×10^{-8} Ω m) of radius of cross-section 5 mm. Find the mobility of the charges if their drift velocity is 1.1×10^{-3} m/s.

[JEE (Main)-2019]

(1) 1.3 m^2/Vs (2) 1.8 m^2/Vs

(3) 1.5 m^2/Vs (4) 1.0 m^2/Vs

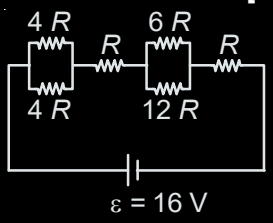
62. Space between two concentric conducting spheres of radii *a* and *b* (*b* > *a*) is filled with a medium of resistivity ρ. The resistance between the two spheres will be: **[JEE (Main)-2019]**

(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) $\frac{\rho}{4\pi}\left(\frac{1}{a}+\frac{1}{b}\right)$

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

[JEE (Main)-2019]



(1) 8 Ω (2) 1 Ω

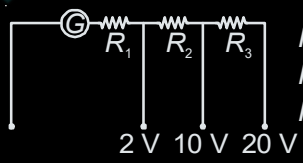
(3) 16 Ω (4) 6 Ω

64. A galvanometer of resistance 100 Ω 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 : **[JEE (Main)-2019]**

(1)

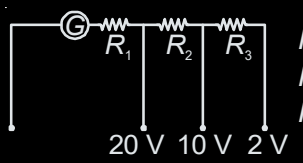
$R_1 = 1900\ \Omega$
$R_2 = 8000\ \Omega$
$R_3 = 10000\ \Omega$

(2)



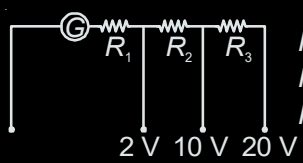
$R_1 = 1900\ \Omega$
$R_2 = 9900\ \Omega$
$R_3 = 19900\ \Omega$

(3)



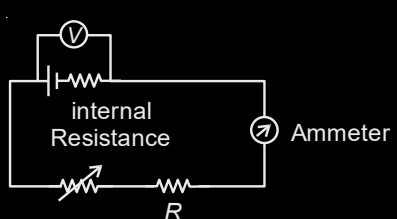
$R_1 = 19900\ \Omega$
$R_2 = 9900\ \Omega$
$R_3 = 1900\ \Omega$

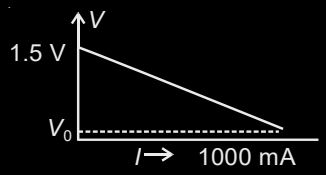
(4)



$R_1 = 2000\ \Omega$
$R_2 = 8000\ \Omega$
$R_3 = 10000\ \Omega$

65. 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 : **[JEE (Main)-2019]**





If V_0 is almost zero, identify the correct statement :

(1) The emf of the battery is 1.5 V and its internal resistance 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 value of the resitance R is 1.5 Ω

(4) The potential difference across the battery is 1.5 V when it sends a current of 1000 mA

66. 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,

[JEE (Main)-2019]

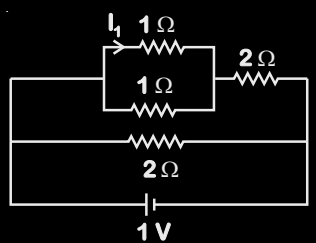
(1) $R_A R_V = G^2 \text{and} \frac{R_A}{R_V} = \left(\frac{I_g}{I_0 - I_g}\right)^2$

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

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

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

67. The current I_1 (in A) flowing through 1 Ω resistor in the following circuit is **[JEE (Main)-2020]**



(1) 0.5 (2) 0.4

(3) 0.25 (4) 0.2

68. In a building there are 15 bulbs of 45 W, 15 bulbs of 100 W, 15 small fans of 10 W and 2 heaters of 1 kW. The voltage of electric main is 220 V. The minimum fuse capacity (rated value) of the building will be **[JEE (Main)-2020]**

(1) 15 A (2) 10 A

(3) 20 A (4) 25 A

69. The length of a potentiometer wire is 1200 cm and it carries a current of 60 mA. For a cell of emf 5 V and internal resistance of 20 Ω, the null point on it is found to be at 1000 cm. The resistance of whole wire is **[JEE (Main)-2020]**

(1) 80 Ω (2) 100 Ω

(3) 60 Ω (4) 120 Ω

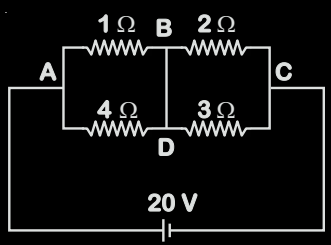
70. A galvanometer having a coil resistance 100 Ω gives a full scale deflection when a current of 1 mA is passed through it. What is the value of the resistance which can convert this galvanometer into a voltmeter giving full scale deflection for a potential difference of 10 V? **[JEE (Main)-2020]**

(1) 10 $k\Omega$ (2) 9.9 $k\Omega$

(3) 8.9 $k\Omega$ (4) 7.9 $k\Omega$

71. In the given circuit diagram, a wire is joining points B and D. The current in this wire is

[JEE (Main)-2020]



(1) 0.4 A (2) 4 A

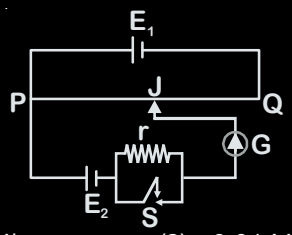
(3) 2 A (4) zero

72. Consider four conducting materials copper, tungsten, mercury and aluminium with resistivity ρ_C, ρ_T, ρ_M and ρ_A respectively **[JEE (Main)-2020]**

(1) $\rho_M > \rho_A > \rho_C$ (2) $\rho_C > \rho_A > \rho_T$

(3) $\rho_A > \rho_M > \rho_C$ (4) $\rho_A > \rho_T > \rho_C$

73. A potentiometer wire PQ of 1 m length is connected to a standard cell E_1. Another cell E_2 of emf 1.02 V is connected with a resistance 'r' and switch S (as shown in figure). With switch S open, the null position is obtained at a distance of 49 cm from Q. The potential gradient in the potentiometer wire is **[JEE (Main)-2020]**

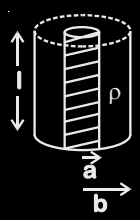


(1) 0.04 V/cm (2) 0.01 V/cm

(3) 0.02 V/cm (4) 0.03 V/cm

74. Model a torch battery of length *l* to be made up of a thin cylindrical bar of radius '*a*' and a concentric thin cylindrical shell of radius '*b*' filled in between with an electrolyte of resistivity ρ (see figure). If the battery is connected to a resistance of value *R*, the maximum Joule heating in *R* will take place for

[JEE (Main)-2020]



(1) $R = \frac{\rho}{\pi l}\ln\left(\frac{b}{a}\right)$ (2) $R = \frac{2\rho}{\pi l}\ln\left(\frac{b}{a}\right)$

(3) $R = \frac{\rho}{2\pi l}\ln\left(\frac{b}{a}\right)$ (4) $R = \frac{\rho}{2\pi l}\left(\frac{b}{a}\right)$

75. Which of the following will NOT be observed when a multimeter (operating in resistance measuring mode) probes connected across a component, are just reversed? **[JEE (Main)-2020]**

(1) Multimeter shows NO deflection in both cases i.e., before and after reversing the probes if the chosen component is capacitor

(2) Multimeter shows NO deflection in both cases i.e., before and after reversing the probes if the chosen component is metal wire

(3) Multimeter shows a deflection, accompanied by a splash of light out of connected component in one direction and NO deflection on reversing the probes if the chosen component is LED

(4) Multimeter shows an equal deflection in both cases i.e. before and after reversing the probes if the chosen component is resistor

76. Two resistors 400 Ω and 800 Ω are connected in series across a 6 V battery. The potential difference measured by a voltmeter of 10 kΩ across 400 Ω resistor is close to

[JEE (Main)-2020]

(1) 2.05 V (2) 1.8 V

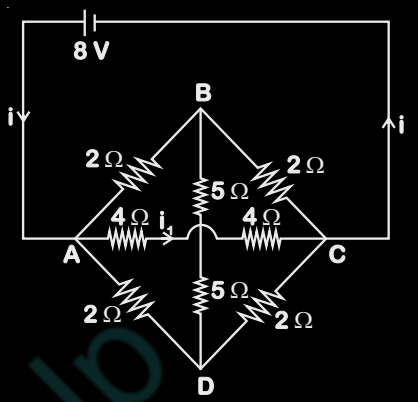
(3) 2 V (4) 1.95 V

77. A battery of 3.0 V is connected to a resistor dissipating 0.5 W of power. If the terminal voltage of the battery is 2.5 V, the power dissipated within the internal resistance is **[JEE (Main)-2020]**

(1) 0.10 W (2) 0.072 W

(3) 0.50 W (4) 0.125 W

78. The value of current i_1 flowing from *A* to *C* in the circuit diagram is **[JEE (Main)-2020]**



(1) 1 A (2) 4 A

(3) 5 A (4) 2 A

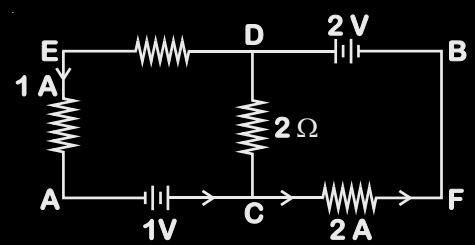
79. A galvanometer of resistance *G* is converted into a voltmeter of range 0 – 1 V by connecting a resistance R_1 in series with it. The additional resistance that should be connected in series with R_1 to increase the range of the voltmeter to 0 – 2 V will be **[JEE (Main)-2020]**

(1) *G* (2) R_1

(3) $R_1 + G$ (4) $R_1 - G$

80. In the circuit, given in the figure currents in different branches and value of one resistor are shown. Then potential at point *B* with respect to the point *A* is

[JEE (Main)-2020]



(1) +1 V (2) –2 V

(3) +2 V (4) –1 V

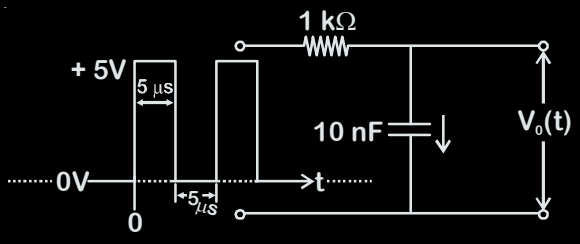
81. A galvanometer is used in laboratory for detecting the null point in electrical experiments. If, on passing a current of 6 mA it produces a deflection of 2°, its figure of merit is close to

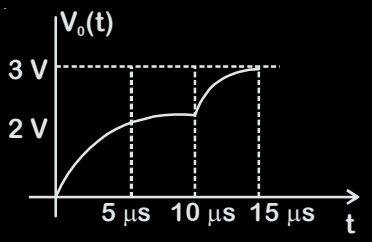
[JEE (Main)-2020]

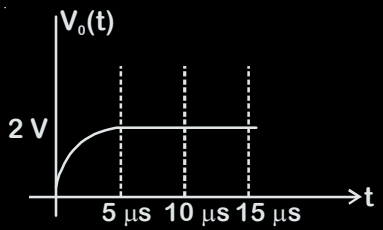
(1) 6×10^{-3} A/div. (2) 666° A/div.

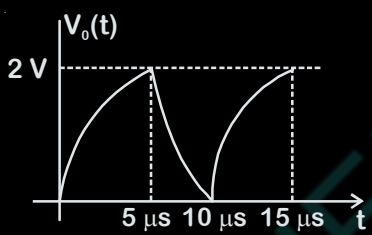
(3) 3×10^{-3} A/div. (4) 333° A/div.

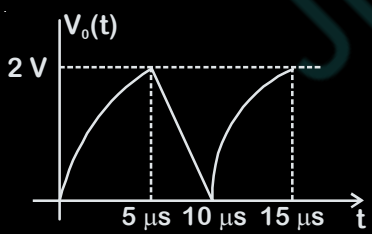
82. For the given input voltage waveform $V_{in}(t)$, the output voltage waveform $V_0(t)$, across the capacitor is correctly depicted by **[JEE (Main)-2020]**



(1)


(2)


(3)


(4)


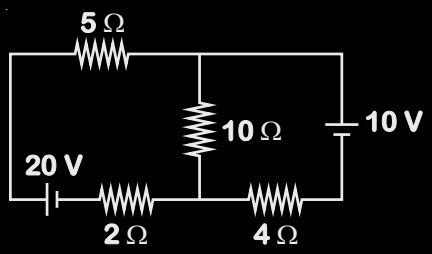
83. A circuit to verify Ohm's law uses ammeter and voltmeter in series or parallel connected correctly to the resistor. In the circuit **[JEE (Main)-2020]**

(1) Ammeter is always connected in series and voltmeter in parallel

(2) Both ammeter and voltmeter must be connected in parallel

(3) Ammeter is always used in parallel and voltmeter is series

(4) Both ammeter and voltmeter must be connected in series

84.


In the figure shown, the current in the 10 V battery is close to **[JEE (Main)-2020]**

(1) 0.36 A from negative to positive terminal

(2) 0.42 A from positive to negative terminal

(3) 0.71 A from positive to negative terminal

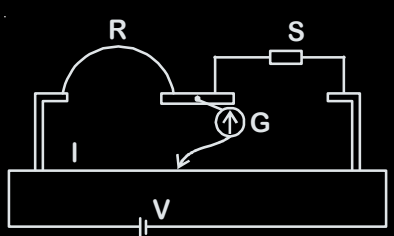
(4) 0.21 A from positive to negative terminal

85. The balancing length for a cell is 560 cm in a potentiometer experiment. When an external resistance of 10 Ω is connected in parallel to the cell, the balancing length changes by 60 cm. If the internal resistance of the cell is $\frac{N}{10}\Omega$, where N is an integer then value of N is _____. **[JEE (Main)-2020]**

86. Four resistances of 15 Ω, 12 Ω, 4 Ω and 10 Ω respectively in cyclic order to form Wheatstone's network. The resistance that is to be connected in parallel with the resistance of 10 Ω to balance the network is _____ Ω. **[JEE (Main)-2020]**

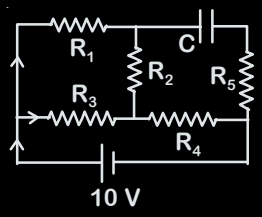
87. The series combination of two batteries, both of the same emf 10 V, but different internal resistance of 20 Ω and 5 Ω, is connected to the parallel combination of two resistors 30 Ω and R Ω. The voltage difference across the battery of internal resistance 20 Ω is zero, the value of R (in Ω) is _____. **[JEE (Main)-2020]**

88. In a meter bridge experiment S is a standard resistance. R is a resistance wire. It is found that balancing length is l = 25 cm. If R is replaced by a wire of half length and half diameter that of R of same material, then the balancing distance l' (in cm) will now be _____. **[JEE (Main)-2020]**

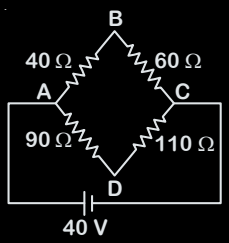


89. An ideal cell of emf 10 V is connected in circuit shown in figure. Each resistance is 2 Ω. The potential difference (in V) across the capacitor when it is fully charged is _____.

[JEE (Main)-2020]



90. Four resistances 40 Ω, 60 Ω, 90 Ω and 110 Ω make the arms of a quadrilateral *ABCD*. Across *AC* is a battery of emf 40 V and internal resistance negligible. The potential difference across *BD* in *V* is _____. **[JEE (Main)-2020]**



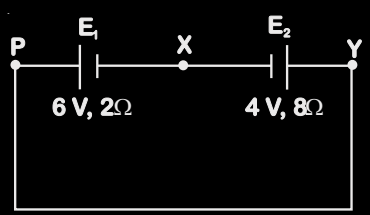
91. A current through a wire depends on time as $i = \alpha_0 t + \beta t^2$ where α_0 = 20 A/s and β = 8 As^{-2}. Find the charge crossed through a section of the wire in 15 s. **[JEE (Main)-2021]**

(1) 2100 C (2) 11250 C

(3) 2250 C (4) 260 C

92. A cell E_1 of emf 6 V and internal resistance 2 Ω is connected with another cell E_2 of emf 4 V and internal resistance 8 Ω (as shown in the figure). The potential difference across points X and Y is:

[JEE (Main)-2021]



(1) 3.6 V (2) 10.0 V

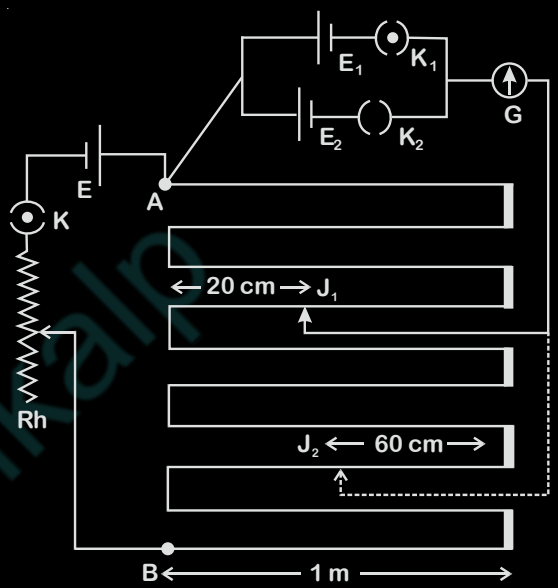
(3) 5.6 V (4) 2.0 V

93. A cylindrical wire of radius 0.5 mm and conductivity 5×10^7 S/m is subjected to an electric field of 10 mV/m. The expected value of current in the wire will be $x^3\pi$ mA. The value of x is ____ .

[JEE (Main)-2021]

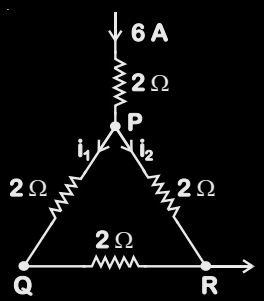
94. In the given circuit of potentiometer, the potential difference E across AB (10 m length) is larger than E_1 and E_2 as well. For key K_1 (closed), the jockey is adjusted to touch the wire at point J_1 so that there is no deflection in the galvanometer. Now the first battery (E_1) is replaced by second battery (E_2) for working by making K_1 open and K_2 closed. The galvanometer gives then null deflection at J_2. The value of $\frac{E_1}{E_2}$ is $\frac{a}{2}$, where a = _____.

[JEE (Main)-2021]

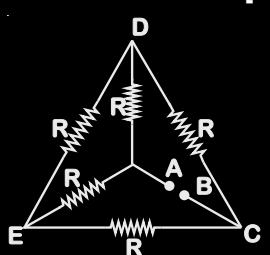


95. A current of 6 A enters one corner P of an equilateral triangle PQR having 3 wires of resistance 2 Ω each and leaves by the corner R. The current i_1 in ampere is _____.

[JEE (Main)-2021]



96. Five equal resistances are connected in a network as shown in figure. The net resistance between the points A and B is : **[JEE (Main)-2021]**



(1) $\frac{R}{2}$ (2) $\frac{3R}{2}$

(3) R (4) 2R

97. In an electrical circuit, a battery is connected to pass 20 C of charge through it in a certain given time. The potential difference between two plates of the battery is maintained at 15 V. The work done by the battery is _____ J. **[JEE (Main)-2021]**

98. A conducting wire of length 'l', area of cross-section A and electric resistivity ρ is connected between the terminals of a battery. A potential difference V is developed between its ends, causing an electric current.

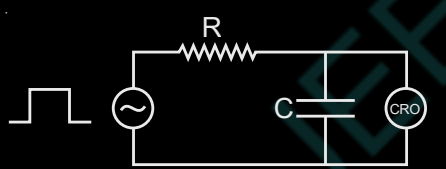
If the length of the wire of the same material is doubled and the area of cross-section is halved, the resultant current would be :

[JEE (Main)-2021]

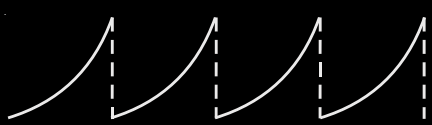
(1) $4\frac{VA}{\rho l}$ (2) $\frac{3}{4}\frac{VA}{\rho l}$

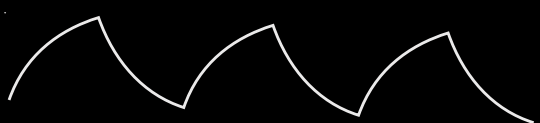
(3) $\frac{1}{4}\frac{\rho l}{VA}$ (4) $\frac{1}{4}\frac{VA}{\rho l}$

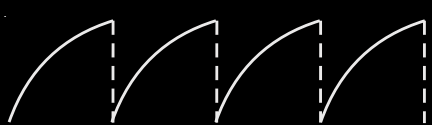
99. An RC circuit as shown in the figure is driven by a AC source generating a square wave. The output wave pattern monitored by CRO would look close to : **[JEE (Main)-2021]**



(1) 

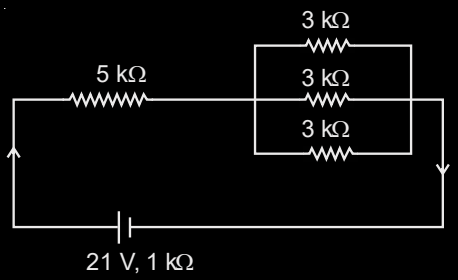
(2) 

(3) 

(4) 

100. In the figure given, the electric current flowing through the 5 kΩ resistor is x mA.

[JEE (Main)-2021]



The value of x to the nearest integer is _____

101. A resistor develops 500 J of thermal energy in 20 s when a current of 1.5 A is passed through it. If the current is increased from 1.5 A to 3 A, what will be the energy developed in 20 s?

[JEE (Main)-2021]

(1) 2000 J

(2) 1000 J

(3) 1500 J

(4) 500 J

102. For an ideal heat engine, the temperature of the source is 127°C. In order to have 60% efficiency the temperature of the sink should be _____ °C. (Round off to the nearest integer)

[JEE (Main)-2021]

103. A current of 10 A exists in a wire of cross-sectional area of 5 mm^2 with a drift velocity of 2×10^{-3} ms^{-1}. The number of free electrons in each cubic meter of the wire is _____

[JEE (Main)-2021]

(1) 2×10^{25}

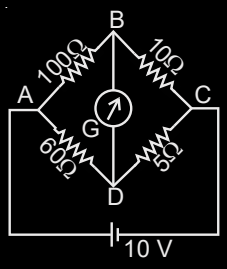
(2) 1×10^{23}

(3) 625×10^{25}

(4) 2×10^{6}

104. The equivalent resistance of series combination of two resistors is 's'. When they are connected in parallel, the equivalent resistance is 'p'. If s = np, then the minimum value for n is _____. (Round off to the nearest integer) **[JEE (Main)-2021]**

105. The four arms of a Wheatstone bridge have resistances as shown in the figure. A galvanometer of 15Ω resistance is connected across BD. Calculate the current through the galvanometer when a potential difference of 10 V is maintained across AC. **[JEE (Main)-2021]**



(1) 2.44 μA

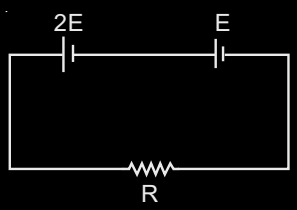
(2) 4.87 μA

(3) 2.44 mA

(4) 4.87 mA

106. Two cells of emf 2E and E with internal resistance r_1 and r_2 respectively are connected in series to an external resistor R (see figure). The value of R, at which the potential difference across the terminals of the first cell becomes zero is

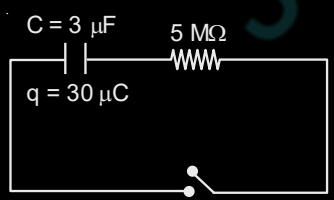
[JEE (Main)-2021]



(1) $r_1 + r_2$ (2) $r_1 - r_2$

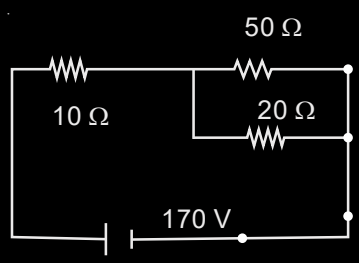
(3) $\frac{r_1}{2} + r_2$ (4) $\frac{r_1}{2} - r_2$

107. The circuit shown in the figure consists of a charged capacitor of capacity 3 μF and a charge of 30 μC. At time t = 0, when the key is closed, the value of current flowing through the 5 MΩ resistor is 'x' μA. **[JEE (Main)-2021]**



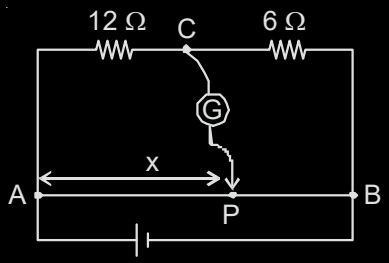
The value of 'x' to the nearest integer is _____.

108. The voltage across the 10 Ω resistor in the given circuit is x volt. **[JEE (Main)-2021]**



The value of 'x' to the nearest integer is _____.

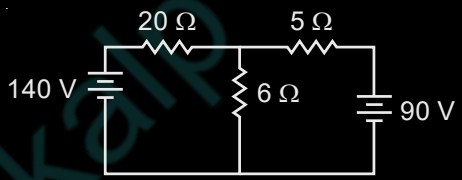
109. Consider a 72 cm long wire AB as shown in the figure. The galvanometer jockey is placed at P on AB at a distance x cm from A. The galvanometer shows zero deflection. **[JEE (Main)-2021]**



The value of x, to the nearest integer, is _____.

110. Two wires of same length and thickness having specific resistances 6 Ω cm and 3 Ω cm respectively are connected in parallel. The effective resistivity is ρΩ cm. The value of ρ, to the nearest integer, is _____. **[JEE (Main)-2021]**

111.



The value of current in the 6 Ω resistance is

[JEE (Main)-2021]

(1) 8 A (2) 10 A

(3) 6 A (4) 4 A

112. A current of 5 A is passing through a non-linear magnesium wire of cross-section 0.04 m^2. At every point, the direction of current density is at an angle of 60° with the unit vector of area of cross-section. The magnitude of electric field at every point of the conductor is:

(Resistivity of magnesium $\rho = 44 \times 10^{-8}$ Ωm)

[JEE (Main)-2021]

(1) 11×10^{-5} V/m

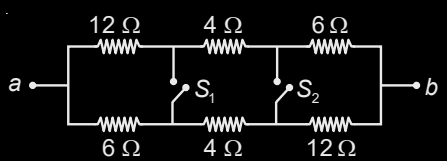
(2) 11×10^{-2} V/m

(3) 11×10^{-3} V/m

(4) 11×10^{-7} V/m

113. In the given figure switches S_1 and S_2 are in open condition. The resistance across *ab* when the switches S_1 and S_2 are closed is _____ Ω.

[JEE (Main)-2021]

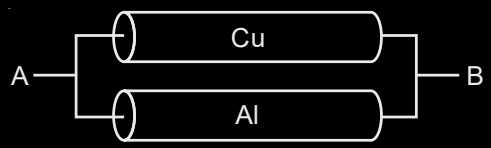


114. A Copper (Cu) rod of length 25 cm and cross-sectional area 3 mm^2 is joined with a similar Aluminium (Al) rod as shown in figure. Find the resistance of the combination between the ends A and B.

(Take Resistivity of Copper = 1.7×10^{-8} Ωm

Resistivity of Aluminium = 2.6×10^{-8} Ωm)

[JEE (Main)-2021]



(1) 0.0858 mΩ

(2) 1.420 mΩ

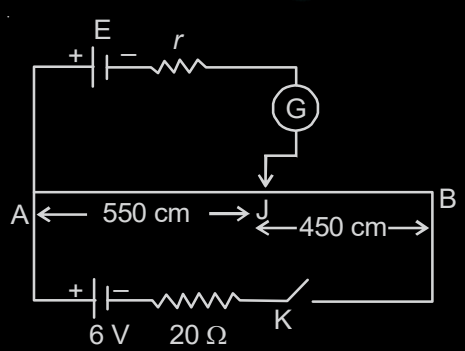
(3) 0.858 mΩ

(4) 2.170 mΩ

115. In an electric circuit, a cell of certain emf provides a potential difference of 1.25 V across a load resistance of 5 Ω. However, it provides a potential difference of 1 V across a load resistance of 2 Ω.

The emf of the cell is given by $\frac{x}{10}$ V. Then the value of x is _____. **[JEE (Main)-2021]**

116. In the given figure, there is a circuit of potentiometer of length AB = 10 m. The resistance per unit length is 0.1 Ω per cm. Across AB, a battery of emf E and internal resistance 'r' is connected. The maximum value of emf measured by this potentiometer is **[JEE (Main)-2021]**



(1) 5 V

(2) 2.25 V

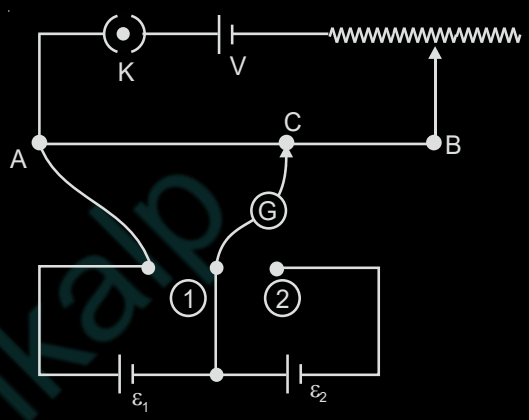
(3) 2.75 V

(4) 6 V

117. An electric bulb rated as 200 W at 100 V is used in a circuit having 200 V supply. The resistance 'R' that must be put in series with the bulb so that the bulb delivers the same power is _____ Ω.

[JEE (Main)-2021]

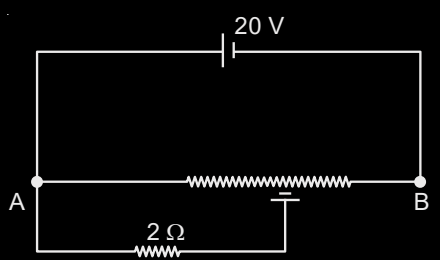
118. In the given potentiometer circuit arrangement, the balancing length AC is measured to be 250 cm. When the galvanometer connection is shifted from point (1) to point (2) in the given diagram, the balancing length becomes 400 cm.The ratio of the emf of two cells, $\frac{\varepsilon_1}{\varepsilon_2}$ is **[JEE (Main)-2021]**



(1) $\frac{3}{2}$ (2) $\frac{5}{3}$

(3) $\frac{8}{5}$ (4) $\frac{4}{3}$

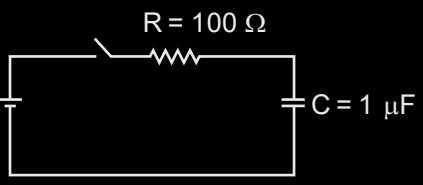
119. The given potentiometer has its wire of resistance 10 Ω. When the sliding contact is in the middle of the potentiometer wire, the potential drop across 2 Ω resistor is **[JEE (Main)-2021]**



(1) 5 V (2) 10 V

(3) $\frac{40}{9}$ V (4) $\frac{40}{11}$ V

120. A 16 Ω wire is bent to form a square loop. A 9 V supply having internal resistance of 1 Ω is connected across one of its sides. The potential drop across the diagonals of the square loop is _____ $\times 10^{-1}$ V. **[JEE (Main)-2021]**



121. A capacitor of capacitance C = 1 μF is suddenly connected to a battery of 100 volt through a resistance R = 100 Ω. The time taken for the capacitor to be charged to get 50 V is :

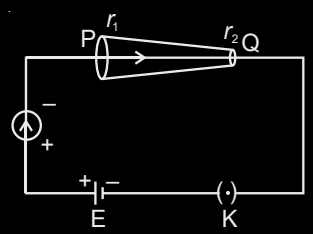
[Take ln2 = 0.69] **[JEE (Main)-2021]**

(1) 0.30×10^{-4} s (2) 1.44×10^{-4} s

(3) 0.69×10^{-4} s (4) 3.33×10^{-4} s

122. In the given figure, a battery of emf E is connected across a conductor PQ of length '*l*' and different area of cross-sections having radii r_1 and $r_2 (r_2 < r_1)$.

[JEE (Main)-2021]



Choose the correct option as one moves from P to Q

(1) All of these

(2) Electron current decreases

(3) Electric field decreases

(4) Drift velocity of electron increases

123. In Bohr's atomic model, the electron is assumed to revolve in a circular orbit of radius 0.5 Å. If the speed of electron is 2.2×10^6 m/s, then the current associated with the electron will be ___ $\times$ 10^{-2} mA. [Take π as $\frac{22}{7}$] **[JEE (Main)-2021]**

124. The resistance of a conductor at 15°C is 16 Ω and at 100°C is 20 Ω. What will be the temperature coefficient of resistance of the conductor?

[JEE (Main)-2021]

(1) $0.010°C^{-1}$

(2) $0.003°C^{-1}$

(3) $0.033°C^{-1}$

(4) $0.042°C^{-1}$

125. For the circuit shown, the value of current at time t = 3.2 s will be _____ A. **[JEE (Main)-2021]**

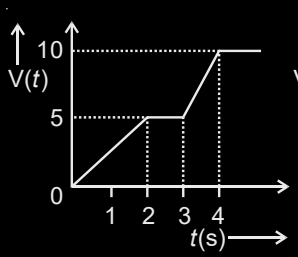


Figure 1

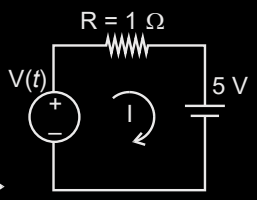


Figure 2

[Voltage distribution V(t) is shown by Fig. (1) and the circuit is shown in Fig. (2)]

126. What equal length of an iron wire and a copper-nickel alloy wire, each of 2 mm diameter connected parallel to give an equivalent resistance of 3 Ω ?

(Given resistivities of iron and copper-nickel alloy wire are 12 μΩ cm and 51 μΩ cm respectively)

[JEE (Main)-2021]

(1) 110 m (2) 90 m

(3) 97 m (4) 82 m

127. The material filled between the plates of a parallel plate capacitor has resistivity 200 Ωm. The value of capacitance of the capacitor is 2 pF. If a potential difference of 40 V is applied across the plates of the capacitor, then the value of leakage current flowing out of the capacitor is: (given the value of relative permittivity of material is 50)

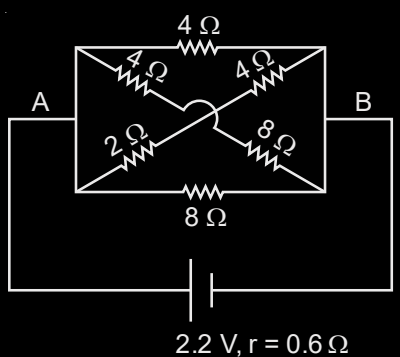
[JEE (Main)-2021]

(1) 9.0 μA (2) 9.0 mA

(3) 0.9 μA (4) 0.9 mA

128. In the given figure, the emf of the cell is 2.2 V and if internal resistance is 0.6 Ω. Calculate the power dissipated in the whole circuit :

[JEE (Main)-2021]



(1) 1.32 W (2) 4.4 W

(3) 2.2 W (4) 0.65 W

129. If you are provided a set of resistances 2 Ω, 4 Ω, 6 Ω and 8 Ω. Connect these resistances so as to obtain an equivalent resistance of $\frac{46}{3}$ Ω.

[JEE (Main)-2021]

(1) 2 Ω and 6 Ω are in parallel with 4 Ω and 8 Ω in series

(2) 4 Ω and 6 Ω are in parallel with 2 Ω and 8 Ω in series

(3) 6 Ω and 8 Ω are in parallel with 2 Ω and 4 Ω in series

(4) 2 Ω and 4 Ω are in parallel with 6 Ω and 8 Ω in series

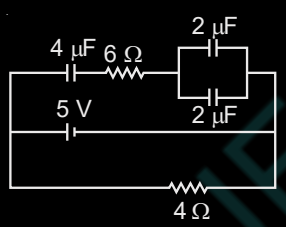
130. An electric bulb of 500 watt at 100 volt is used in a circuit having a 200 V supply. Calculate the resistance R to be connected in series with the bulb so that the power delivered by the bulb is 500 W. **[JEE (Main)-2021]**

(1) 5 Ω (2) 30 Ω

(3) 20 Ω (4) 10 Ω

131. Calculate the amount of charge on capacitor of 4 μF. The internal resistance of battery is 1 Ω:

[JEE (Main)-2021]



(1) Zero (2) 8 μC

(3) 4 μC (4) 16 μC

132. Five identical cells each of internal resistance 1 Ω and emf 5 V are connected in series and in parallel with an external resistance 'R'. For what value of 'R', current in series and parallel combination will remain the same? **[JEE (Main)-2021]**

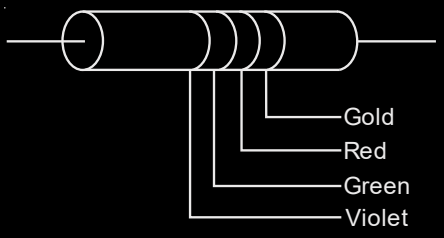
(1) 10 Ω (2) 5 Ω

(3) 1 Ω (4) 25 Ω

133. First, a set of n equal resistors of 10 Ω each are connected in series to a battery of emf 20 V and internal resistance 10 Ω. A current I is observed to flow. Then, the n resistors are connected in parallel to the same battery. It is observed that the current is increased 20 times, the value of n is ____.

[JEE (Main)-2021]

134. The colour coding on a carbon resistor is shown in the given figure. The resistance value of the given resistor is: **[JEE (Main)-2021]**



(1) (7500 ± 750) Ω

(2) (5700 ± 375) Ω

(3) (5700 ± 285) Ω

(4) (7500 ± 375) Ω

135. For full scale deflection of total 50 divisions, 50 mV voltage is required in galvanometer. The resistance of galvanometer if its current sensitivity is 2 div/mA will be **[JEE (Main)-2021]**

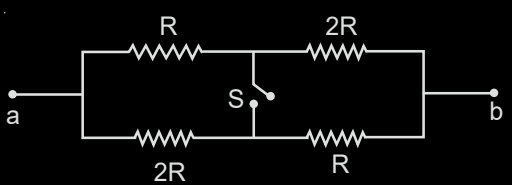
(1) 4 Ω

(2) 2 Ω

(3) 5 Ω

(4) 1 Ω

136. The ratio of the equivalent resistance of the network (shown in figure) between the points a and b when switch is open and switch is closed is x : 8. The value of x is ____. **[JEE (Main)-2021]**



137. Consider a galvanometer shunted with 5 Ω resistance and 2% of current passes through it. What is the resistance of the given galvanometer?

[JEE (Main)-2021]

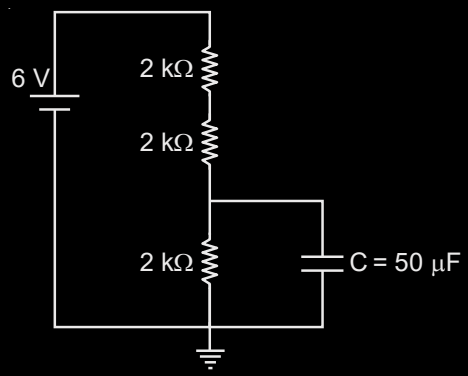
(1) 344 Ω

(2) 245 Ω

(3) 226 Ω

(4) 300 Ω

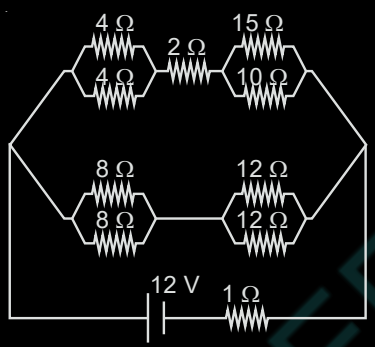
138. A capacitor of 50 μF is connected in a circuit as shown in figure. The charge on the upper plate of the capacitor is _____ μC. **[JEE (Main)-2021]**



139. A square shaped wire with resistance of each side 3 Ω is bent to form a complete circle. The resistance between two diametrically opposite points of the circle in unit of Ω will be _____

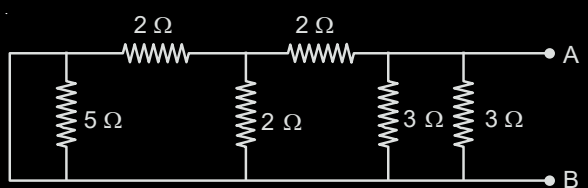
[JEE (Main)-2021]

140. The voltage drop across 15 Ω resistance in the given figure will be _____ V. **[JEE (Main)-2021]**



141. The equivalent resistance of the given circuit between the terminals A and B is:

[JEE (Main)-2021]



(1) 3 Ω (2) 1 Ω

(3) $\frac{9}{2}$ Ω (4) 0 Ω

142. A resistor dissipates 192 J of energy in 1 s when a current of 4 A is passed through it. Now, when the current is doubled, the amount of thermal energy dissipated in 5 s is _____ J.

[JEE (Main)-2021]

143. A capacitor is connected to a 20 V battery through a resistance of 10 Ω. It is found that the potential difference across the capacitor rises to 2 V in 1 μs. The capacitance of the capacitor is ____ μF.

Given $\ln\left(\frac{10}{9}\right) = 0.105$ **[JEE (Main)-2021]**

(1) 0.95 (2) 1.85

(3) 9.52 (4) 0.105

144. A uniform heating wire of resistance 36 Ω is connected across a potential difference of 240 V. The wire is then cut into half and a potential difference of 240 V is applied across each half separately. The ratio of power dissipation in first case to the total power dissipation in the second case would be 1: *x*, where *x* is _____.

[JEE (Main)-2021]

145. Two identical cells each of emf 1.5 V are connected in parallel across a parallel combination of two resistors each of resistance 20 Ω. A voltmeter connected in the circuit measures 1.2 V. The internal resistance of each cell is **[JEE (Main)-2022]**

(1) 2.5 Ω

(2) 4 Ω

(3) 5 Ω

(4) 10 Ω

146. In a potentiometer arrangement, a cell gives a balancing point at 75 cm length of wire. This cell is now replaced by another cell of unknown emf. If the ratio of the emf's of two cells respectively is 3 : 2, the difference in the balancing length of the potentiometer wire in above two cases will be _____ cm.

[JEE (Main)-2022]

147. An electric bulb is rated as 200 W. What will be the peak magnetic field at 4 m distance produced by the radiations coming from this bulb? Consider this bulb as a point source with 3.5% efficiency.

[JEE (Main)-2022]

(1) 1.19×10^{-8}T

(2) 1.71×10^{-8}T

(3) 0.84×10^{-8}T

(4) 3.36×10^{-8}T

148. A potentiometer wire of length 10 m and resistance 20 Ω is connected in series with a 25 V battery and an external resistance 30 Ω. A cell of emf E in secondary circuit is balanced by 250 cm long potentiometer wire. The value of E (in volt) is $\frac{x}{10}$. The value of x is ___. **[JEE (Main)-2022]**

149. A teacher in his physics laboratory allotted an experiment to determine the resistance (G) of a galvanometer. Students took the observations for $\frac{1}{3}$ deflection in the galvanometer. Which of the below is true for measuring value of G?

[JEE (Main)-2022]

(1) $\frac{1}{3}$ deflection method cannot be used for determining the resistance of the galvanometer.

(2) $\frac{1}{3}$ deflection method can be used and in this case the G equals to twice the value of shunt resistance(s)

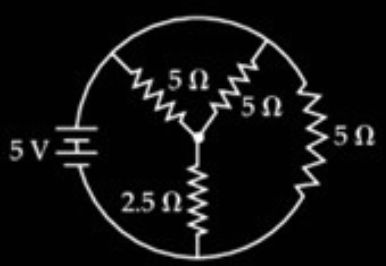
(3) $\frac{1}{3}$ deflection method can be used and in this case, the G equals to three times the value of shunt resistance(s)

(4) $\frac{1}{3}$ deflection method can be used and in this case the G value equals to the shunt resistance(s)

150. A resistor develops 300 J of thermal energy in 15 s, when a current of 2 A is passed through it. If the current increases to 3 A, the energy developed in 10 s is _____ J. **[JEE (Main)-2022]**

151. The total current supplied to the circuit as shown in figure by the 5 V battery is _____A.

[JEE (Main)-2022]



152. Two cells of same emf but different internal resistances r_1 and r_2 are connected in series with a resistance *R*. The value of resistance *R*, for which the potential difference across second cell is zero, is:

[JEE (Main)-2022]

(1) $r_2 - r_1$ (2) $r_1 - r_2$

(3) r_1 (4) r_2

153. If n represents the actual number of deflections in a converted galvanometer of resistance *G* and shunt resistance *S*. Then the total current I when its figure of merit is *K* will be **[JEE (Main)-2022]**

(1) $\frac{KS}{(S+G)}$ (2) $\frac{(G+S)}{nKS}$

(3) $\frac{nKS}{(G+S)}$ (4) $\frac{nK(G+S)}{S}$

154. A 72 Ω galvanometer is shunted by a resistance of 8 Ω. The percentage of the total current which passes through the galvanometer is

[JEE (Main)-2022]

(1) 0.1%

(2) 10%

(3) 25%

(4) 0.25%

155. A cell, shunted by a 8 Ω resistance, is balanced across a potentiometer wire of length 3 m. The balancing length is 2 m when the cell is shunted by 4 Ω resistance. The value of internal resistance of the cell will be ___ Ω. **[JEE (Main)-2022]**

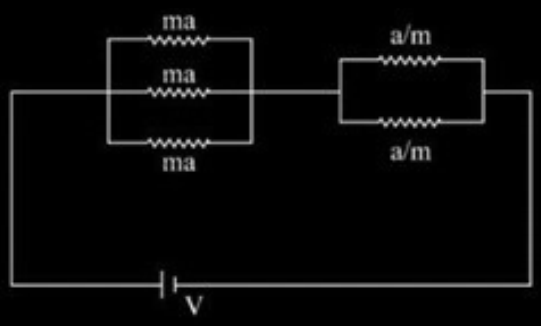
156. The current density in a cylindrical wire of radius 4 mm is 4×10^6 Am^{-2}. The current through the outer portion of the wire between radial distances $\frac{R}{2}$ and R is _____ π A. **[JEE (Main)-2022]**

157. The current density in a cylindrical wire of radius r = 4.0 mm is 1.0×10^6 A/m^2. The current through the outer portion of the wire between radial distances $\frac{r}{2}$ and r is xπ A; where x is _____

[JEE (Main)-2022]

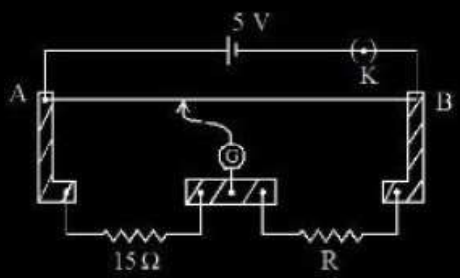
158. In the given circuit '*a*' is an arbitrary constant. The value of *m* for which the equivalent circuit resistance is minimum, will be $\sqrt{\frac{x}{2}}$. The value of *x* is_____.

[JEE (Main)-2022]

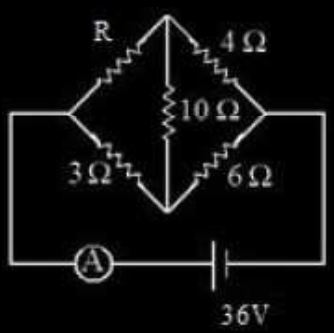


159. A meter bridge setup is shown in the figure. It is used to determine an unknown resistance *R* using a given resistor of 15 Ω. The galvanometer (G) shows null deflection when tapping key is at 43 cm mark from end A. If the end correction for end A is 2 cm, then the determined value of R will be ___ Ω.

[JEE (Main)-2022]



160. Current measured by the ammeter Ⓐ in the reported circuit when no current flows through 10 Ω resistance, will be ___ A. **[JEE (Main)-2022]**



161. Resistance of the wire is measured as 2 Ω and 3 Ω at 10°C and 30°C respectively. Temperature co-efficient of resistance of the material of the wire is:

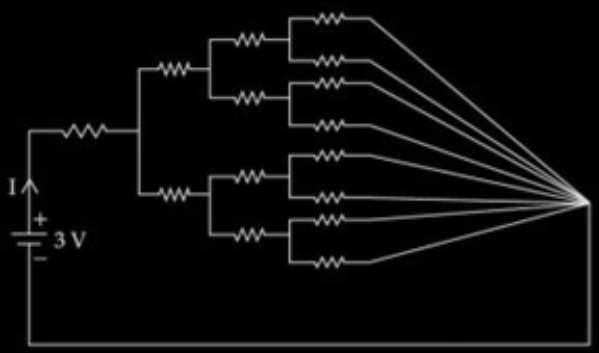
[JEE (Main)-2022]

(1) $0.033°C^{-1}$ (2) $-0.033°C^{-1}$

(3) $0.011°C^{-1}$ (4) $0.055°C^{-1}$

162. All resistances in figure are 1 Ω each. The value of current 'I' is $\frac{a}{5}$ A. The value of a is _____.

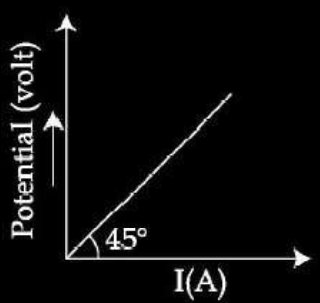
[JEE (Main)-2022]



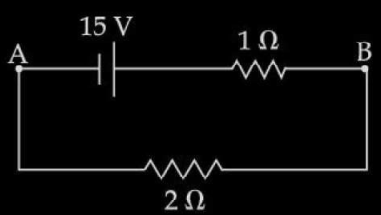
163. Two coils require 20 minutes and 60 minutes respectively to produce same amount of heat energy when connected separately to the same source. If they are connected in parallel arrangement to the same source; the time required to produce same amount of heat by the combination of coils, will be ___ min. **[JEE (Main)-2022]**

164. The variation of applied potential and current flowing through a given wire is shown in figure. The length of wire is 31.4 cm. The diameter of wire is measured as 2.4 cm. The resistivity of the given wire is measured as x × 10^{-3} Ω cm. The value of x is____.

[Take π = 3.14] **[JEE (Main)-2022]**



165. For the network shown below, the value of $V_B - V_A$ is _____ V. **[JEE (Main)-2022]**



166. A capacitor is discharging through a resistor R. Consider in time t_1, the energy stored in the capacitor reduces to half of its initial value and in time t_2, the charge stored reduces to one eighth of its initial value. The ratio $\frac{t_1}{t_2}$ will be **[JEE (Main)-2022]**

(1) $\frac{1}{2}$ (2) $\frac{1}{3}$

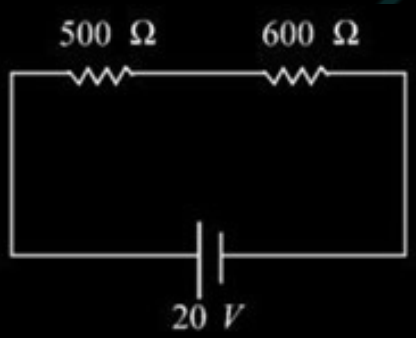
(3) $\frac{1}{4}$ (4) $\frac{1}{6}$

167. The combination of two identical cells, whether connected in series or parallel combination provides the same current through an external resistance of 2 Ω. The value of internal resistance of each cell is **[JEE (Main)-2022]**

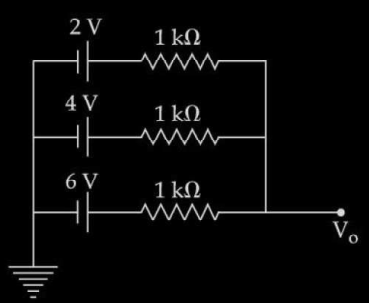
(1) 2 Ω (2) 4 Ω

(3) 6 Ω (4) 8 Ω

168. Two resistors are connected in series across a battery as shown in figure. If a voltmeter of resistance 2000 W is used to measure the potential difference across 500 W resistor, the reading of the voltmeter will be _____ V **[JEE (Main)-2022]**

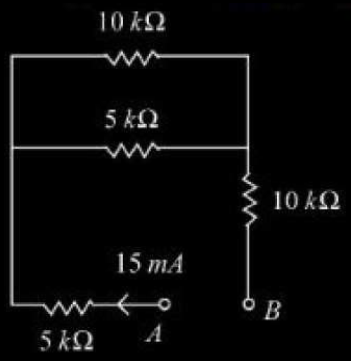


169. In the given figure, the value of V_0 will be _____ V. **[JEE (Main)-2022]**



170. Eight copper wire of length l and diameter d are joined in parallel to form a single composite conductor of resistance R. If a single copper wire of length $2l$ have the same resistance (R) then its diameter will be _____ d. **[JEE (Main)-2022]**

171. A current of 15 mA flows in the circuit as shown in figure. The value of potential difference between the points A and B will be **[JEE (Main)-2022]**



(1) 50 V

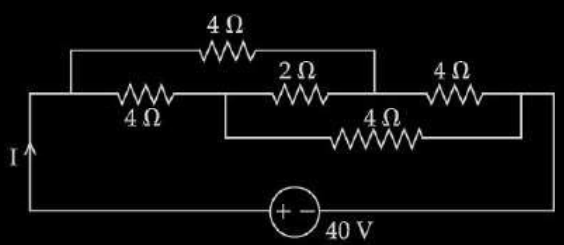
(2) 75 V

(3) 150 V

(4) 275 V

172. In a potentiometer arrangement, a cell of emf 1.20 V gives a balance point at 36 cm length of wire. This cell is now replaced by another cell of emf 1.80 V. The difference in balancing length of potentiometer wire in above conditions will be _____ cm. **[JEE (Main)-2022]**

173. The current I in the given circuit will be **[JEE (Main)-2022]**



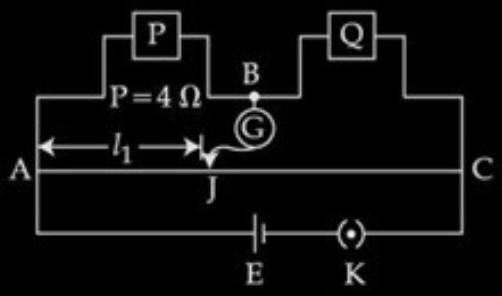
(1) 10 A

(2) 20 A

(3) 4 A

(4) 40 A

174. Resistances are connected in a meter bridge circuit as shown in the figure. The balancing length l_1 is 40 cm. Now an unknown resistance x is connected in series with P and new balancing length is found to be 80 cm measured from the same end. Then the value of x will be _____ Ω. **[JEE (Main)-2022]**



175. Two sources of equal emfs are connected in series. This combination is connected to an external resistance R. The internal resistances of the two sources are r_1 and r_2 ($r_1 > r_2$). If the potential difference across the source of internal resistance r_1 is zero, then the value of R will be : **[JEE (Main)-2022]**

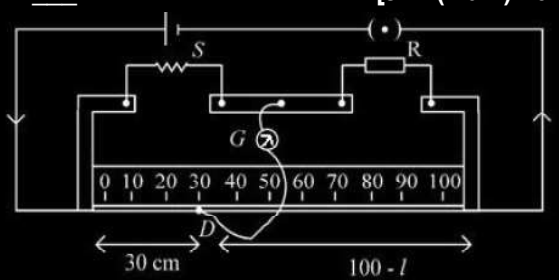
(1) $r_1 - r_2$

(2) $\frac{r_1 r_2}{r_1 + r_2}$

(3) $\frac{r_1 + r_2}{2}$

(4) $r_2 - r_1$

176. In a meter bridge experiment, for measuring unknown resistance 'S', the null point is obtained at a distance 30 cm from the left side as shown at point D. If R is 5.6 kΩ, then the value of unknown resistance 'S' will be ___Ω. **[JEE (Main)-2022]**



177. A 1 m long copper wire carries a current of 1 A. If the cross section of the wire is 2.0 mm^2 and the resistivity of copper is 1.7×10^{-8} Ωm, the force experienced by moving electron in the wire is ___ $\times 10^{-23}$ N.

(Charge on electron = 1.6×10^{-19} C)

[JEE (Main)-2022]

178. (A) The drift velocity of electrons decreases with the increase in the temperature of conductor.

(B) The drift velocity is inversely proportional to the area of cross-section of given conductor.

(C) The drift velocity does not depend on the applied potential difference to the conductor.

(D) The drift velocity of electron is inversely proportional to the length of the conductor.

(E) The drift velocity increases with the increase in the temperature of conductor.

Choose the correct answer from the options given below **[JEE (Main)-2022]**

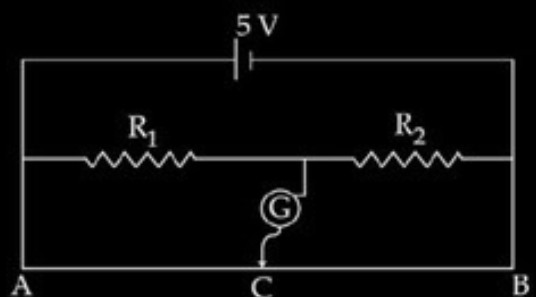
(1) (A) and (B) only

(2) (A) and (D) only

(3) (B) and (E) only

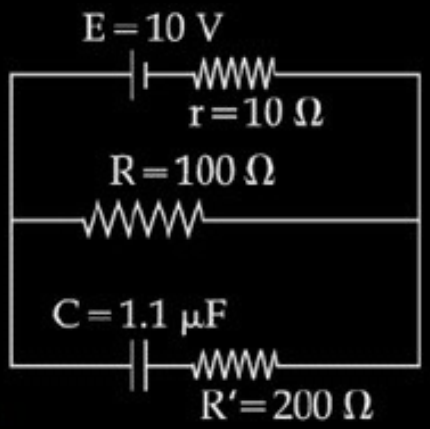
(4) (B) and (C) only

179. In the given figure of meter of bridge experiment, the balancing length AC corresponding to null deflection of the galvanometer is 40 cm. The balancing length, if the radius of the wire AB is doubled, will be _____ cm. **[JEE (Main)-2022]**



180. As show in the figure, in the steady state, the charge stored in the capacitor is _____ × 10^{-6} C,

[JEE (Main)-2022]



181. The current sensitivity of a galvanometer can be increased by : **[JEE (Main)-2022]**

(A) Decreasing the number of turns

(B) Increasing the magnetic field

(C) Decreasing the area of the coil

(D) Decreasing the torsional constant of the spring

Choose the **most appropriate** answer from the options given below :

(1) (B) and (C) only

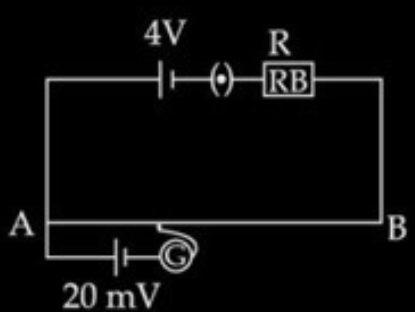
(2) (C) and (D) only

(3) (A) and (C) only

(4) (B) and (D) only

182. As shown in the figure, a potentiometer wire of resistance 20 Ω and length 300 cm is connected with resistance box (R.B.) and a standard cell of emf 4 V. For a resistance '*R*' of resistance box introduced into the circuit, the null point for a cell of 20 mV is found to be 60 cm. The value of '*R* ' is Ω.

[JEE (Main)-2022]



183. Given below are two statements:

[JEE (Main)-2022]

Statement I : A uniform wire of resistance 80 Ω is cut into four equal parts. These parts are now connected in parallel. The equivalent resistance of the combination will be 5 Ω.

Statement II : Two resistances 2*R* and 3*R* are connected in parallel in a electric circuit. The value of thermal energy developed in 3*R* and 2*R* will be in the ratio 3 : 2.

In the light of the above statements, choose the **most appropriate** answer from the option given below.

(1) Both statement I and statement II are correct

(2) Both statement I and statement II are incorrect

(3) Statement I is correct but statement II is incorrect

(4) Statement I is incorrect but statement II is correct

184. An electrical bulb rated 220 V, 100 W, is connected in series with another bulb rated 220 V, 60 W. If the voltage across combination is 220 V, the power consumed by the 100 W bulb will be about ____ W.

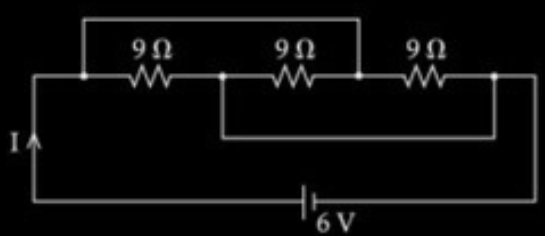
[JEE (Main)-2022]

185. Two metallic wires of identical dimensions are connected in series. If σ_1 and σ_2 are the conductivities of these wires respectively, the effective conductivity of the combination is : **[JEE (Main)-2022]**

(1) $\frac{\sigma_1\sigma_2}{\sigma_1+\sigma_2}$ (2) $\frac{2\sigma_1\sigma_2}{\sigma_1+\sigma_2}$

(3) $\frac{\sigma_1+\sigma_2}{2\sigma_1\sigma_2}$ (4) $\frac{\sigma_1+\sigma_2}{\sigma_1\sigma_2}$

186. The current *I* flowing through the given circuit will be _____A. **[JEE (Main)-2022]**



187. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**.

[JEE (Main)-2022]

Assertion A: Alloys such as constantan and manganin are used in making standard resistance coils.

Reason R: Constantan and manganin have very small value of temperature coefficient of resistance.

In the light of the above statements, choose the correct answer from the options given below.

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**.

(2) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**.

(3) **A** is true but **R** is false.

(4) **A** is false but **R** is true.

188. A 1 m long wire is broken into two unequal parts *X* and *Y*. The *X* part of the wire is stretched into another wire *W*. Length of *W* is twice the length of *X* and the resistance of *W* is twice that of *Y*. Find the ratio of length of *X* and *Y*. **[JEE (Main)-2022]**

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

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

189. A wire of resistance R_1 is drawn out so that its length is increased by twice of its original length. The ratio of new resistance to original resistance is :

[JEE (Main)-2022]

(1) 9 : 1 (2) 1 : 9

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

190. A potentiometer wire of length 300 cm is connected in series with a resistance 780 Ω and a standard cell of emf 4 V. A constant current flows through potentiometer wire. The length of the null point for cell of emf 20 mV is found to be 60 cm. The resistance of the potentiometer wire is _____ Ω.

[JEE (Main)-2022]

191. What will be the most suitable combination of three resistors $A = 2\ \Omega$, $B = 4\ \Omega$, $C = 6\ \Omega$ so that $\left(\frac{22}{3}\right)\Omega$ is equivalent resistance of combination?

[JEE (Main)-2022]

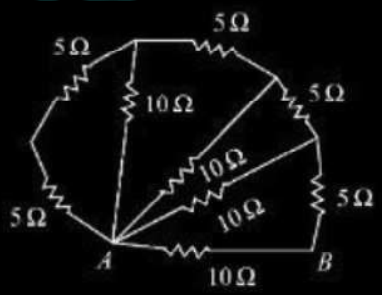
(1) Parallel combination of A and C connected in series with B

(2) Parallel combination of A and B connected in series with C

(3) Series combination of A and C connected in parallel with B

(4) Series combination of B and C connected in parallel with A

192. The equivalent resistance between points *A* and *B* in the given network is: **[JEE (Main)-2022]**

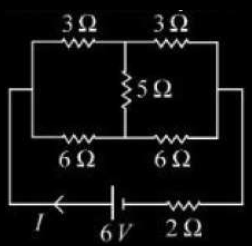


(1) 65 Ω (2) 20 Ω

(3) 5 Ω (4) 2 Ω

193. A battery of 6 V is connected to the circuit as shown below. The current *I* drawn from the battery is

[JEE (Main)-2022]



(1) 1 A (2) 2 A

(3) $\frac{6}{11}$ A (4) $\frac{4}{3}$ A

❑ ❑ ❑

Chapter 16

Current Electricity

1. Answer (3)

As relation $R = R_0(1 + \alpha\Delta t)$ is valid only when $\Delta R << R_0$.

Hence statement 1 is false and statement 2 is true.

2. Answer (1)

$R_S = R_1 + R_2$

$$\frac{dR_S}{dT} = \frac{dR_1}{dT} + \frac{dR_2}{dT}; \quad R\alpha_s = R_1\alpha_1 + R_2\alpha_2$$

As $R_1 = R_2 \Rightarrow R = R_1 + R_2 = 2R_1$

$$\Rightarrow \quad \alpha = \frac{\alpha_1 + \alpha_2}{2}$$

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_P^2}\frac{dR_P}{dT} = \frac{1}{R_1^2}\frac{dR_1}{dT} + \frac{1}{R_2^2}\frac{dR_2}{dT}$$

$$\frac{\alpha_P}{R_P} = \frac{\alpha_1}{R_1} + \frac{\alpha_2}{R_2}$$

$$\Rightarrow \quad \alpha_P = \frac{\alpha_1 + \alpha_2}{2}$$

3. Answer (1)

$\tau_{parallel} = R(2C)$

$$\tau_{series} = R\left(\frac{C}{2}\right)$$

$$\Rightarrow \quad \tau_{series} = \frac{\tau_{parallel}}{4}$$

4. Answer (1)

$$\frac{V}{l} = \frac{iR}{l}$$

$$= \frac{\rho}{A} i$$

$$= \frac{4\times10^{-7}\times0.2}{8\times10^{-7}}$$

= 0.1 V/m

5. Answer (3)

$R = R_1 + R_2 + R_3 + R_4$

$\Delta R = \Delta R_1 + \Delta R_2 + \Delta R_3 + \Delta R_4$

$\Delta R = 5 + 5 + 5 + 5 = 20\ \Omega$

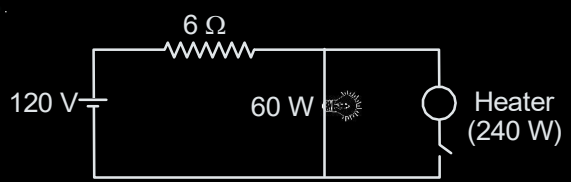
$R = 400\ \Omega$

$$\frac{\Delta R}{R}\times100 = 5\%$$

6. Answer (2)

7. Answer (3)

8. Answer (4)



Assuming that both bulb and the heater has a rating of 120 V

$$R_{bulb} = \frac{120\times120}{60} = 240\ \Omega$$

$R_{heater} = 60\ \Omega$

Initial current is $i = \frac{120}{240+6} = \frac{120}{246}$

New current is

$$i' = \frac{120}{48+6}\times\frac{60}{60+240} = \frac{120}{54}\times\frac{1}{5} = \frac{24}{54}$$

$\Rightarrow$ Decrease in voltage

$$= 240\times\left(\frac{120}{246} - \frac{24}{54}\right) = 10.4\ \text{V}$$

Nearest answer is (4)

9. Answer (4)

Statement - I is false as shunt is added in parallel.

10. Answer (3)

$15 \times 40 + 5 \times 100 + 5 \times 80 + 1000 = V \times I$

$600 + 500 + 400 + 1000 = 220\ I$

$$I = \frac{2500}{220} = 11.36$$

$I = 12$ A.

11. Answer (4)

$$V = IR = I\,\rho\frac{l}{A}$$

$$\Rightarrow \rho = \frac{VA}{Il} = \frac{VA}{lneAv_d} = \frac{V}{l \times n \times e \times v_d}$$

$$\Rightarrow \rho = \frac{5}{0.1 \times 2.5 \times 10^{-19} \times 1.6 \times 10^{-19} \times 8 \times 10^{28}}$$

$= 1.6 \times 10^{-5}\ \Omega$m

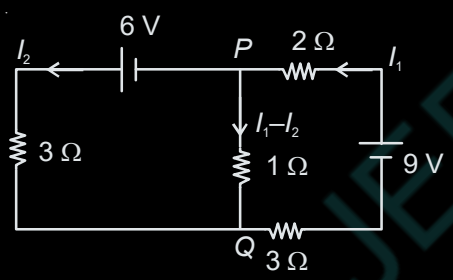
12. Answer (3)

From KVL,

$9 = 6I_1 - I_2$ ...(i)

$6 = 4I_2 - I_1$ ...(ii)

Solving, $I_1 - I_2 = -0.13$A



13. Answer (4)

$I_g = 10^{-3}$ A

$R_g = 100\ \Omega$

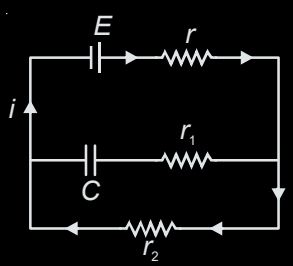
R_S (shunt resistance) $= \dfrac{I_g(R_g)}{I - I_g} = 0.01\ \Omega$

14. Answer (3)

In steady state, flow of current through capacitor will be zero.

$$i = \frac{E}{r + r_2}$$

$$V_C = i\,r_2 C = \frac{Er_2C}{r + r_2}$$



$$V_C = CE\,\frac{r_2}{r + r_2}$$

15. Answer (4)

The potential difference in each loop is zero.

$\therefore$ No current will flow.

16. Answer (1)

$i_g = 5 \times 10^{-3}$ A

$G = 15\ \Omega$

Let series resistance be R.

$V = i_g(R + G)$

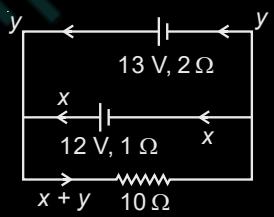
$10 = 5 \times 10^{-3}\ (R + 15)$

$R = 2000 - 15 = 1985 = 1.985 \times 10^3\ \Omega$

17. Answer (2)

In a balanced Wheatstone bridge, the null point remains unchanged even if cell and galvanometer are interchanged.

18. Answer (2)



Applying KVL in loops

$12 - x - 10(x + y) = 0$

$\Rightarrow\ 12 = 11x + 10y$ ...(i)

$13 = 10x + 12y$ ...(ii)

Solving $x = \dfrac{7}{16}$A, $y = \dfrac{23}{32}$A

$V = 10(x + y) = 11.56$ V

Aliter : $r_{eq} = \dfrac{2}{3}\Omega$, $R = 10\ \Omega$

$$\frac{E_{eq}}{r_{eq}} = \frac{E_1}{r_1} + \frac{E_2}{r_2} \Rightarrow E_{eq} = \frac{37}{3}\text{ V}$$

$$V = \frac{E_{eq}}{R + r_{eq}}R = 11.56\text{ V}$$

19. Answer (2)

$\because\ E \propto I_1$

and $E - ir \propto I_2$

$$\therefore\ \frac{E}{E - ir} = \frac{I_1}{I_2}$$

$$\Rightarrow \frac{E}{E-\left(\frac{E}{r+5}\right)\times r}=\frac{52}{40}$$

$$\Rightarrow \frac{r+5}{5}=\frac{13}{10}$$

$\Rightarrow r = 1.5\ \Omega$

20. Answer (3)

$$\frac{R_1}{R_2}=\frac{l}{(100-l)}$$

$$\frac{R_2}{R_1}=\frac{(l-10)}{(110-l)}$$

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

$11000 + l^2 - 210l = l^2 - 10l$

$\Rightarrow l = 55$ cm

$$R_1=R_2\left(\frac{55}{45}\right)$$

$R_1 + R_2 = 1000\ \Omega$

$R_1 = 550\ \Omega$

21. Answer (4)

Al = Constant

$$R=\rho\frac{l}{A}$$

$$\frac{\Delta R}{R}=\frac{\Delta l}{l}+\frac{\Delta A}{A}$$

$$\Rightarrow \frac{\Delta R}{R}=\frac{2\Delta l}{l}=2\times 0.5\%$$

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

22. Answer (3)

R V O S

↓ ↓ ↓ ↓

2 7 3 ±10%

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

23. Answer (2)

$20 - 2i_1 - 2(i_1 + i_2) = 0 \Rightarrow 20 - 2i_1 = 10 - 4i_2$

$$10 - 4i_1 - 2(i_1 + i_2) = 0 \Rightarrow \frac{10-2i_1}{4}=i_2$$

$\therefore\ 20 = 2i_1 + 2i_1 + 2i_2 \Rightarrow 20 = 4i_1 + 5 - i_1$

$\Rightarrow 3i_1 = 15\ \ \therefore\ i_1 = 5$ and $i_2 = 0$

$i_1 + i_2 = 5$ A

24. Answer (4)

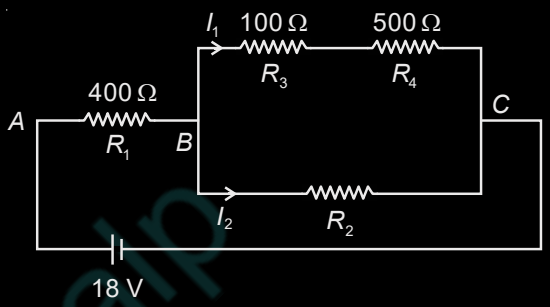
G O Y Golden

↓ ↓ ↓

$R = 5\ \ 3 \times 10^4 \pm 5\ \%$

$= (530\ \text{k}\Omega \pm 5\ \%)$

25. Answer (4)



$$I_1=\frac{5}{500}=0.01\,\text{A}$$

$$V_B - V_C = 600\, I_1 = 6\ \text{V}$$

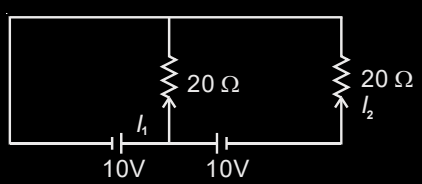
$$\Rightarrow V_A - V_B = 12\ \text{V}$$

$$\Rightarrow I_1 + I_2 = \frac{12}{400} = 0.03\ \text{A}$$

$$\Rightarrow I_2 = 0.03 - 0.01 = 0.02\ \text{A}$$

$$\Rightarrow R_2 = \frac{6}{0.02} = 300\ \Omega$$

26. Answer (3)



$10 - I_1 \times 20 = 0$

$I_1 = 0.5$ A

$I_2 \times 20 = 0$

$I_2 = 0$

27. Answer (1)

G B R Br

Resistance $= 50 \times 10^2 \pm 1\%$

$\rho = I^2R$

$2 = 5000 \times I^2$

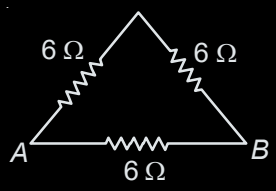
$$\frac{4}{10000} = I^2$$

$$I = \frac{2}{100}$$

I = 20 mA

28. Answer (1)

$$R_{AB} = \frac{12 \times 6}{12 + 6} = 4\ \Omega$$



29. Answer (4)

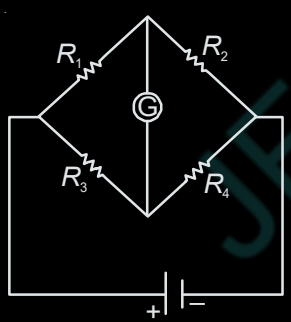
$$\phi = \frac{\varepsilon}{13r}\frac{12r}{L} = \frac{12\varepsilon}{13L}$$

$$\frac{\varepsilon}{2} = \phi L' = \frac{12}{13L}\varepsilon \cdot L'$$

$$\Rightarrow\ L' = \frac{13L}{24}$$

30. Answer (4)

$R_1(O,R,B) = 320\ \Omega$



$R_2 = 80\ \Omega$

$R_4 = 40\ \Omega$

Clearly, $\frac{R_1}{R_2} = \frac{R_3}{R_4}\ \Rightarrow\ R_3 = \frac{320 \times 40}{80}$

$R_3 = 160\ \Omega\ \ \therefore\ \ 16 \times 10^1$

$\Rightarrow$ Colour for R_3 $\Rightarrow$ Brown, Blue, Brown

31. Answer (1)

$$R' = \frac{R \cdot R_V}{R + R_V},\ R' = \frac{95}{100} \times 30 = 28.5$$

$$\Rightarrow\ 28.5 = \frac{30R_V}{30 + R_V}$$

$$\Rightarrow\ 855 + 28.5R_V = 30R_V$$

$$\Rightarrow\ R_V = \frac{855}{1.5}$$

$$\Rightarrow\ R_V = 570\ \Omega$$

32. Answer (1)

I^2R = 4.4 watt

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

$P_{(\text{dissipated})}$ for V = 11 volt

$$P = \frac{V^2}{R} = \frac{11 \times 11 \times 4 \times 10^{-6}}{4.4}$$

$$P = \frac{11 \times 11 \times 4 \times 10^{-6} \times 10}{44}$$

$= 1.1 \times 10^{-4}$ watt

$= 11 \times 10^{-5}$ watt

33. Answer (4)

When in series $P_0 = \frac{P_1P_2}{P_1 + P_2}$ = 60 W

$$P_0 = \frac{P}{2}\ \ P = 120 \text{ watt}$$

When in parallel $P_0' = 2P = 2 \times 120 = 240$ W

34. Answer (3)

$$\frac{P}{R} = \frac{Q}{X}$$

$$\frac{P}{400} = \frac{Q}{X}$$

$$\frac{Q}{405} = \frac{P}{X}\ \Rightarrow P = \frac{QX}{405}$$

$$\frac{QX}{400 \times 405} = \frac{Q}{X}$$

$$X = \sqrt{400 \times 405}$$

$X = 402.5\ \Omega$

35. Answer (3)

Case 1 :

$$E_1 = \frac{6 \times 4x}{4 + 2}$$

$$E_2 = \frac{6 \times 4x}{4 + 6}$$

$6 \times 0.5 = E_2$

$E_2 = 0.3$ V

36. Answer (3)

Full scale deflection current, $I_g = 30 \times 0.005 = 0.15$ A

$15 = (20 + R) \times 0.15$

$\Rightarrow R = 80\ \Omega$

37. Answer (3)

$$\frac{1}{r_{eq}} = 3$$

$$r_{eq} = \frac{1}{3}\ \Omega$$

$$\frac{E_{eq} \times 3}{1} = \frac{1}{1} + \frac{2}{1} + \frac{3}{1} = 6$$

$\Rightarrow E_{eq} = 2$ V

38. Answer (1)

$$\frac{R_1}{R_2} = \frac{40}{60} = \frac{2}{3}$$

$$\frac{R_1 + 10}{R_2} = 1$$

$$\Rightarrow \frac{R_1}{R_1 + 10} = \frac{2}{3}$$

$\Rightarrow R_1 = 20\ \Omega$

Now $\frac{30 \times R}{30 + R} = 20$

$\Rightarrow 30R = 600 + 20R$

$\Rightarrow R = 60\ \Omega$

39. Answer (1)

$\theta \propto i$, let $R_G = R$

$$i_1 = \frac{V}{220 + R} = k \times \theta_0$$

$$i_2 = \frac{V}{220 + \frac{5 \times R}{5 + R}} \times \frac{5}{R + 5} = k \times \frac{\theta_0}{5}$$

$$\Rightarrow \frac{1}{220 \times (5 + R) + 5R} \times \frac{5}{1} = \frac{1}{(220 + R) \times 5}$$

$$\Rightarrow \frac{1}{45R + 220} = \frac{1}{5 \times (220 + R)}$$

$\Rightarrow R = 22\ \Omega$

40. Answer (3)

$$\frac{dR}{dl} = \frac{K}{\sqrt{l}}$$

$$\int_0^R dR = K \int_0^l \frac{dl}{\sqrt{l}}$$

$$\Rightarrow R = 2K\sqrt{l}$$

$$\therefore \frac{R'}{R'} = \frac{2K\sqrt{l}}{2K(1 - \sqrt{l})}$$

$$\Rightarrow 2\sqrt{l} = 1$$

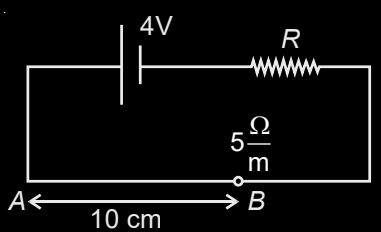
$$\Rightarrow l = \frac{1}{4} = 0.25\ \text{m}$$

41. Answer (4)

$V_{AB} = 5 \times 10^{-3}$

$R_{AB} = 0.5\ \Omega$

$$\therefore i = \frac{V_{AB}}{R_{AB}} = 10^{-2}\ \text{A}$$



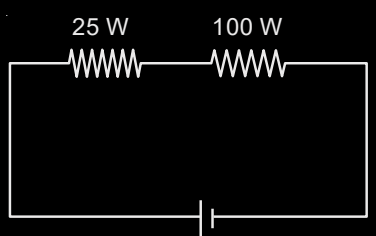
$$\Rightarrow i = \frac{4}{R + 5} = 10^{-2}$$

$\therefore R + 5 = 400\ \Omega$

$\Rightarrow R = 395\ \Omega$

42. Answer (4)

$$\frac{1}{P} = \frac{1}{25} + \frac{1}{100}$$



$\Rightarrow P = 20$ W

$\because$ Power $\propto R$

$P_1 = \frac{PR_1}{R_1 + R_2} = 16\,W$

$\Rightarrow P_2 = 4$ W

43. Answer (3)

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

$= 10^{-2}$ A

$V = I_g(R + 50)$

$R = 200\ \Omega$

44. Answer (1)

At Node S

$I_4 = I_3 + I_5$

$I_4 = I_3 + 0.4$

$0.8 - 0.4 = I_3,\ I_3 = 0.4$ A

At Node R

$I_1 + I_2 = I_4$

$-0.3 + I_2 = 0.8$

$I_2 = 1.1$ A

at Node Q

$I_3 + I_6 = I_1 + I_2$

$0.4 + I_6 = -0.3 + 1.1$

$I_6 = 0.4$ A

45. Answer (2)

$I = \frac{dq}{dt}$ = slope of q - t graph.

46. Answer (2)

200 Ω = Red + Black + Brown

Green $\equiv$ 5

So, Green + Black + Brown $\equiv 500\ \Omega$

47. Answer (4)

$v = \frac{E_1r_2r_3 + E_2r_3r_1 + E_3r_1r_2}{r_1r_2 + r_2r_3 + r_3r_1}$

$= \frac{2(2\times2) + 4(2\times2) + 4(2\times2)}{4+4+4}$

$= \frac{40}{12} = \frac{10}{3} = 3.3$ volt

48. Answer (2)

For maximum power in external resistance, Internal resistance = External resistance

$\Rightarrow R = r$

49. Answer (4)

Resistance of potentiometer wire, $R_p = 400 \times 0.01$

$= 4\ \Omega$

$\Rightarrow I = \frac{3}{6} = 0.5$ A

$\Rightarrow$ Reading of voltmeter = $I\,R_{AJ}$

$= 0.5 \times 50 \times 0.01$

$= 0.25$ V

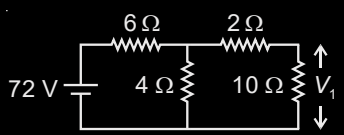
50. Answer (2)

Equivalent resistance of the given circuit

$R_{eq} = 45 + \frac{10\times50}{10+50} = \left(45 + \frac{50}{6}\right)\Omega = \frac{160}{3}\Omega$

$\therefore I = \frac{15}{\frac{160}{3}} = \frac{9}{32}$ A

51. Answer (1)



At steady state current through capacitor is zero.

$V_C = V_1$

$V_1 = \frac{5}{6} \times V_0 \times \frac{3}{9}$

$V_1 = \frac{5\times72\times3}{6\times9} = 20$ V

$Q_1 = CV_1 = 200\ \mu C$

52. Answer (4)

$R_1 = \frac{R}{8},\ R_2 = \frac{7R}{8}$

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

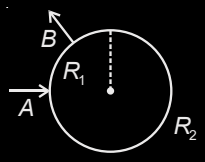
$R_{eq} = \frac{7R}{64}$

53. Answer (2)

$V = I_g\,(R_s + R_g)$

$= 4 \times 10^{-3}\ [5050] \approx 20$ V

54. Answer (1)



$$R_0 = \rho\frac{l}{A} = 3\ \Omega$$

Now, if $l = 2l$

Then, $A = \frac{A}{2}$

$$\therefore \quad R = \frac{\rho 2l \times 2}{A} = 12\ \Omega$$

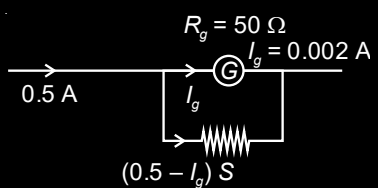
$$R_1 = \frac{12}{6} = 2\ \Omega$$

$R_2 = 10\ \Omega$

$$\therefore \quad \frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{10} = \frac{6}{10}$$

$$\therefore \quad R_{eq} = \frac{5}{3}\ \Omega$$

55. Answer (1)



We have,

$$I_g R_g = (0.5 - I_g)\ S$$

$$\Rightarrow \quad (0.002)\ (50) = (0.5 - I_g)\ S$$

$$\Rightarrow \quad S \simeq \frac{0.002 \times 50}{0.5} = 0.2\ \Omega$$

56. Answer (4)

$$J = \eta e v_d \qquad \because \quad v_d = \frac{eE\tau}{m}$$

$$\therefore \quad J = \frac{\eta e \cdot eE \cdot \tau}{m} = \sigma\vec{E}$$

$$J = \frac{\eta e^2 \tau}{m} \cdot E = \sigma\vec{E}$$

$$\therefore \quad \rho = \frac{m}{\eta e^2 \tau}$$

$$= \frac{9.1 \times 10^{-31}}{8.5 \times 10^{28} \times (1.6 \times 10^{-19})^2 \times 25 \times 10^{-15}}\ \Omega\ \text{m}$$

$$= \frac{9.1}{8.5 \times 2.56 \times 25} \times 10^{(-59+53)}$$

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

57. Answer (2)

$$\ln R(T) = a - \frac{a}{b} - \frac{1}{T^2}$$

a, b are constant

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

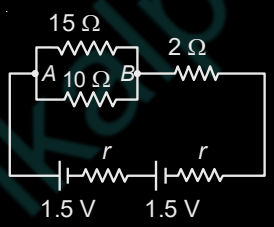
58. Answer (1)

10 mA × s

= 0.1 × 20 × 10^3

59. Answer (1)

For the given circuit



Given that V_{AB} = 2 V

$$\therefore \quad I = \frac{2}{15} + \frac{2}{10} = \frac{1}{3}\ A$$

Also $\quad I(2r + 2) = 1.5 + 1.5 - V_{AB}$

$\Rightarrow \quad 2r + 2 = (3 - 2)3$

$$\Rightarrow \quad r = \frac{1}{2}\ \Omega$$

60. Answer (4)

$$\frac{R}{X} = \frac{l}{100 - l}$$

Using the above expression

$$X = \frac{R(100 - l)}{l}$$

for case (a) $x = \frac{100 \times 40}{60} = \frac{2000}{3}\ \Omega$

for case (b) $x = \frac{100 \times 87}{13} = \frac{8700}{13}\ \Omega$

for case (c) $x = \frac{10 \times 98.5}{1.5} = \frac{1970}{3}\ \Omega$

for case (d) $x = \frac{1\times 99}{1} = 99\ \Omega$

Clearly we can see that the value of x calculate in case (d) is inconsistent than other cases.

61. Answer (4)

Mobility $(\mu) = \frac{v_d}{E}$

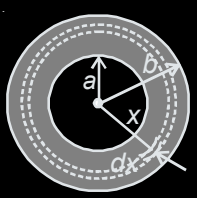
and resistivity $(\rho) = \frac{E}{j} = \frac{EA}{I}$

$\therefore \quad \mu = \frac{v_d A}{i\rho}$

$= \frac{1.1\times 10^{-3}\times \pi \times \left(5\times 10^{-3}\right)^2}{5\times 1.7\times 10^{-8}}$

$\mu = 1.0\,\frac{m^2}{Vs}$

62. Answer (1)



$dR = \frac{(\rho)(dx)}{4\pi x^2}$

$R = \int dR$

$= \left(\frac{\rho}{4\pi}\right) = \int_a^b \frac{dx}{x^2}$

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

63. Answer (1)

$R_{eq} = 2R + R + 4R + R = 8R$

$P = \frac{v^2}{R_{eq}} \Rightarrow \frac{16\times 16}{8R} = 4$ watt

$\frac{16\times 16}{4\times 8} = R \Rightarrow R = 8\ \Omega$

64. Answer (1)

For R_1

$\because \quad I_g = 10^{-3}$ A

$\therefore \quad 10^{-3}(R_1 + 100) = 2\ V \Rightarrow R_1 = 1900\ \Omega$

For R_2

$10^{-3}(R_1 + R_2 + 100) = 10\ V$

$\Rightarrow \quad R_1 + R_2 + 100 = 10000$

$\Rightarrow \quad R_2 = 8000\ \Omega$

For R_3

$10^{-3}(R_1 + R_2 + R_3 + 100) = 20\ V$

$\Rightarrow \quad R_1 + R_2 + R_3 + 100 = 20 \times 1000$

$\Rightarrow \quad R_3 = 10000\ \Omega$

65. Answer (1)

$V = \frac{ER}{R + r}$

for $R = \infty$, $V = E = 1.5$ V

for $R = 0$, $I = E/r = 1$

$r = 1.5\ \Omega$

66. Answer (1)

$V = I_g(R_V + G) = GI_0 \qquad ...(1)$

$(I_0 - I_g)R_A = I_g G \qquad ...(2)$

From (1), $R_v = \frac{G(I_0 - I_g)}{I_g}$

From (2), $R_A = \frac{I_g G}{I_0 - I_g}$

$\Rightarrow \quad R_A R_V = G^2$

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

67. Answer (4)

$R_{eq} = \frac{(2 + 0.5)\times 2}{4.5} = \frac{2.5\times 2}{4.5} = \frac{10}{9}\ \Omega$

$$\therefore\ I = \frac{1}{\left(\frac{10}{9}\right)} = \frac{9}{10}\ \text{A}$$

$$\therefore\ I_1 = \frac{1}{2} \times \frac{2}{2+2.5} \times \frac{9}{10}$$

$$I_1 = \frac{1}{5}\ \text{A} = 0.2\ \text{A}$$

68. IAnswer (3)

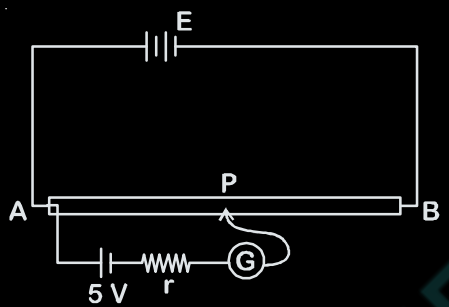
P = VI

$$\Rightarrow\ I_{\text{main}} = 15 \times \frac{45}{220} + 15 \times \frac{100}{220} + 15 \times \frac{10}{220} + 2 \times \frac{10^3}{220}$$

$$\Rightarrow\ I_{\text{main}} = \frac{15 \times 155 + 2000}{220} = 19.66\ \text{A}$$

Answer is 20 A

69. Answer (2)



R → resistance

Potential gradient for the potentiometer wire 'AB' is

$$-\frac{dV}{d\ell} = \left[\frac{60 \times R}{\ell_{AB}}\right]^{mv}/_{m}$$

$$\therefore\ V_{AP} = \left(-\frac{dV}{d\ell}\right)\ell_{AP} = \frac{60 \times R}{1200} \times 1000\ \text{mV}$$

$\therefore\ V_{AP} = 50\ R\ \text{mV}$

Also, $V_{AP} = 5$ V (for balance point at P)

$$\therefore\ R = \frac{5}{50 \times 10^{-3}} = 100\ \Omega$$

70. Answer (2)

V = 10 volt

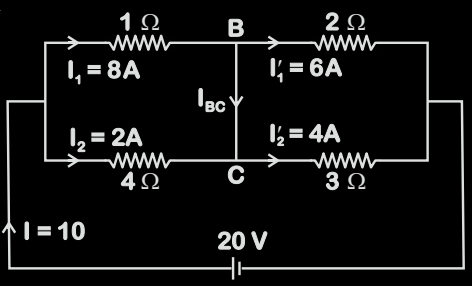
When 1 mA current will be flowing

$\therefore\ 10 = 1 \times 10^{-3}\ (100 + R_0)$

$\Rightarrow\ 10000 - 100 = 9900\ \Omega = R_0$

$\Rightarrow\ R_0 = 9.9\ \text{k}\Omega$

71. Answer (3)



$$I = \frac{E}{R_{eq}} = \frac{E}{2},\ \text{Req} = 2\ \Omega$$

I = 10 A

$$I_1 = \frac{4}{5}I,\ I_2 = \frac{1}{5}I$$

$I_1 = 8$ A, $I_2 = 2$ A

$$I_1' = \frac{3}{5} \times 10 = 6\ A$$

$$I_2' = 4\ A$$

$\Rightarrow\ I_{BC} = 8 - 6 = 2$ A

72. Answer (1)

$\rho_M = 98 \times 10^{-8}$

$\rho_A = 2.80 \times 10^{-8}$

$\rho_C = 1.72 \times 10^{-8}$

$\rho_T = 5.65 \times 10^{-8}$

$\rho_M > \rho_T > \rho_A > \rho_C$

73. Answer (3)

$$\text{Potential gradient} = \frac{\text{Potential drop}}{\text{length}}$$

$$= \frac{1.02}{100 - 49}\ \frac{\text{V}}{\text{cm}}$$

$$= 0.02\ \frac{\text{V}}{\text{cm}}$$

74. Answer (3)

$$\text{Power in external } R = \left(\frac{\varepsilon}{r+R}\right)^2 R$$

This power is maximum, when R = r

$$r = \int_a^b \rho \frac{dx}{2\pi x l}$$

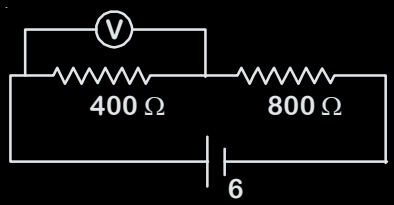
$$r = \frac{\rho}{2\pi l} \ln \frac{b}{a}$$

75. Answer (1)

Theory based

76. Answer (4)

$$\text{Voltmeter Reading} = \frac{I \times 400R}{400 + R}$$



$$I = \frac{6}{\frac{400R}{400+R} + 800}$$

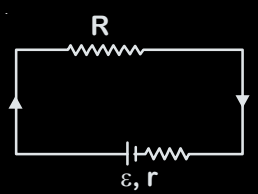
Putting the value of R, we get

Reading = 1.95 V

77. Answer (1)

$i^2R = 0.5$

$iR = 2.5$



$\Rightarrow$ i = 0.2 A & R = 12.5 Ω

$V = \varepsilon - ir$

$2.5 = 3.0 - 0.2\ r$

$\Rightarrow$ r = 2.5 Ω

Power dissipated in internal resistance

$= i^2r = 0.1$ W

78. Answer (1)

$\varepsilon - i_1R - i_1R = 0$

$8 - 4i_1 - 4i_1 = 0$

$i_1 = 1$ A

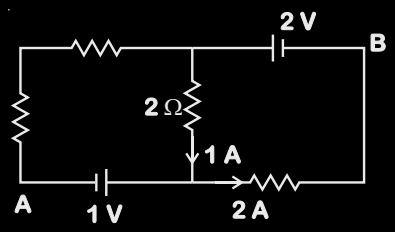
79. Answer (3)

$i_g(G + R_1) = 1$

$i_g(G + R_1 + R') = 2$

$\Rightarrow$ $R' = G + R_1$

80. Answer (1)



$V_B + 2 - 2 \times 1 - 1 = V_A$

$\Rightarrow$ $V_B - V_A = 3 - 2 = 1V$

81. Answer (3)

$$\text{Figure of merit} = \frac{\text{Current}}{\text{Deflection}}$$

82. Answer (1)

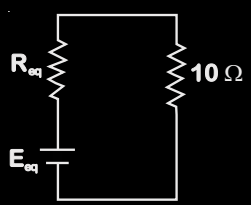
$\tau = RC = 10\ \mu s$

For $0 < t < 5\ \mu s$, it will get charged. For $5 < t < 10\ \mu s$ potential is constant and again gets charged after that.

83. Answer (1)

Ammeter is always connected in series and voltmeter is connected in parallel.

84. Answer (4)



$$\frac{1}{R_{eq}} = \frac{1}{4} + \frac{1}{7} \Rightarrow R_{eq} = \frac{28}{11}\Omega$$

Circuit can be reduced to

$$\frac{11E_{eq}}{28} = \frac{20}{7} + \frac{10}{4}$$

$$E_{eq} = \frac{150}{11}\text{V}$$

$$I = \frac{\frac{150}{11}}{\frac{28}{11} + 10} = \frac{150}{138}\text{ A}$$

$$\frac{1500}{138} = 10 + 4I$$

$$I = \frac{30}{138}\text{A}$$

85. Answer (12)

$\varepsilon = \phi\, 560$ ...(i)

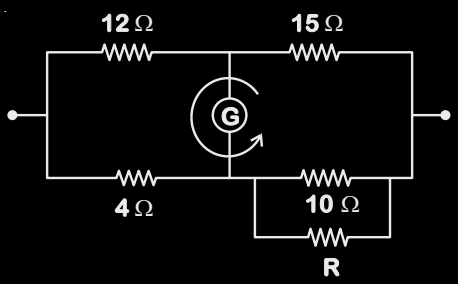
$\frac{\varepsilon}{r+10}10 = \phi\, 500$ ...(ii)

$\Rightarrow \frac{r+10}{10} = \frac{56}{50} \Rightarrow 50r + 500 = 560$

$\Rightarrow r = \frac{6}{5}\Omega = \frac{N}{10}\Omega$

$\Rightarrow$ N = 12

86. Answer (10)



Wheatstone bridge balance condition

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

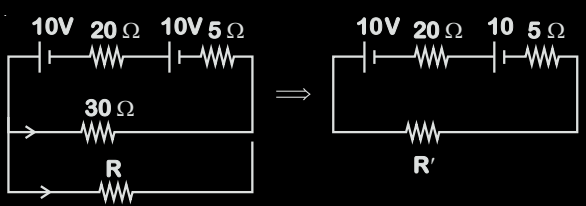
$\Rightarrow \frac{15}{4} = \frac{15}{\frac{10R}{10+R}}$

$\Rightarrow \frac{10R}{10+R} = \frac{15\times 4}{12} = 5$

$\Rightarrow$ 2R = 10 + R

$\Rightarrow$ R = 10 Ω

87. Answer (30.00)



$R' = \frac{30\,R}{30+R}$ $\quad\therefore\quad I = \frac{20}{R'+25}$

Also $10 = \frac{20\times 20}{R'+25}$ $\quad\Rightarrow$ R′ + 25 = 40

$\Rightarrow R' = 15 = \frac{30\,R}{30+R}$ $\quad\Rightarrow$ 30 + R = 2R

$\Rightarrow$ R = 30 Ω

88. Answer (40)

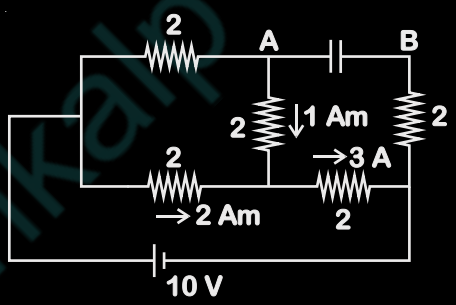
$\frac{S}{R} = \frac{75}{25} = 3$

R′ = 2R

$\frac{S}{2R} = \frac{3}{2} = \frac{100-l'}{l'}$

l′ = 40 cm

89. Answer (8)



After solving the circuit we got the final current distribution as shown in the above diagram. So potential difference between A and B is

0 + (2 × 3) + (2 × 1) = 8 volt

90. Answer (2)

$V_B = \frac{40\times 60}{100} = 24$ volt

$V_D = \frac{40\times 110}{200} = 22$ volt

$\therefore\quad \Delta V = V_B - V_D = 2$ volt

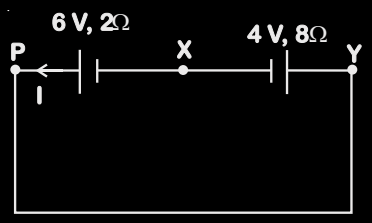
91. Answer (2)

$i = \alpha_0 t + \beta t^2$

$\int dq = \int_0^{15} \left(20t + 8t^2\right) dt$

$\Rightarrow q = 20\times\left(\frac{15^2 - 0^2}{2}\right) + \frac{8}{3}\left(15^3 - 0^3\right)$

92. Answer (3)



$I = \frac{6-4}{10} = 0.2$ A

$V = 6 - 0.2 \times 2$

$= 5.6$ V

93. Answer (5)

$J = \sigma E$

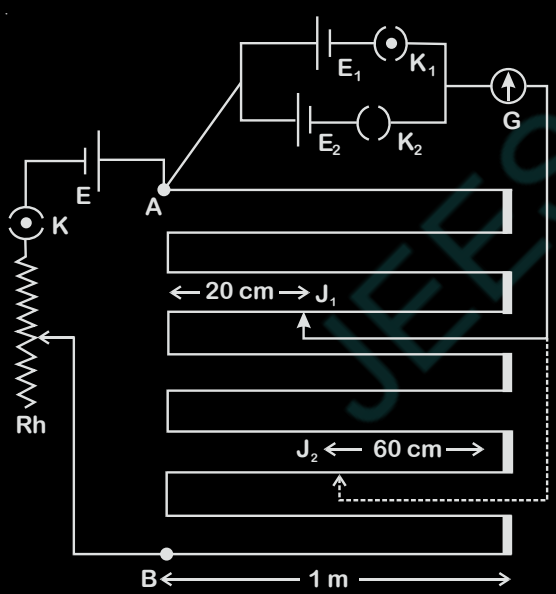
$i = \sigma EA$

$= 5 \times 10^7 \times 10 \times 10^{-3} \times \pi \times (0.5 \times 10^{-3})^2$

$= 5^3 \pi \times 10^{-3}$ A

$= 125\pi$ mA

94. Answer (1)



As per given circuit diagram, null deflection will not occur.

However if we reverse polarity of cell E, then as per given information.

$\frac{E_1}{E_2} = \frac{l_1}{l_2} = \frac{3.8}{7.6} = \frac{1}{2}$

95. Answer (2)

$4i_1 = 2i_2$ ... (i)

$i_1 + i_2 = 6$ ... (ii)

$\Rightarrow i_1 = 2$ A

96. Answer (3)

E and D are at same potential

So, $\frac{1}{R_{eq}} = \frac{1}{2R} + \frac{1}{2R}$

$R_{eq} = R$

97. Answer (300)

$W = q\Delta V$

$= 20 \times 15$

$= 300$ J

98. Answer (4)

$R_1 = \frac{\rho l}{A}$

$R_2 = \frac{\rho \times (2l)}{\left(\frac{A}{2}\right)} = 4\frac{\rho l}{A}$

$\therefore I = \frac{V}{R_2} = \frac{V}{\left(\frac{4\rho l}{A}\right)}$

$\Rightarrow I = \frac{1}{4}\frac{VA}{\rho l}$

99. Answer (3)

For positive cycle capacitor will get charge and for zero input capacitor will discharge.

100. Answer (3)

$i = \frac{E}{R_{eq}} = \frac{21}{5+1+1}$mA $= 3$mA

101. Answer (1)

$H_1 = i_1^2 R \Delta t$

$H_2 = i_2^2 R \Delta t$

$\Rightarrow \frac{H_1}{H_2} = \frac{i_1^2}{i_2^2}$

$\Rightarrow \frac{500}{H_2} = \left(\frac{1}{2}\right)^2$

$\Rightarrow H_2 = 2000$ J

102. Answer (–113)

$$\eta = 1 - \frac{T_L}{T_H}$$

$$0.6 = 1 - \frac{T_L}{400}$$

T_L = 160 K

= –113°C

103. Answer (3)

$$\because \quad V_d = \frac{I}{Ane}$$

$$\Rightarrow \quad n = \frac{I}{AeV_d}$$

$$= \frac{10}{5\times10^{-6}\times1.6\times10^{-19}\times2\times10^{-3}} = 625\times10^{25}$$

104. Answer (4)

$s = R_1 + R_2$

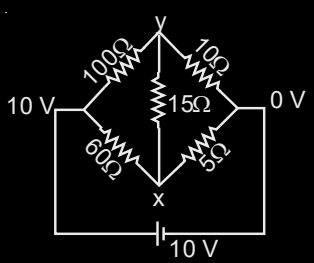
$$p = \frac{R_1R_2}{R_1+R_2}$$

Given $(R_1 + R_2) = n\left(\frac{R_1R_2}{R_1+R_2}\right)$

$$n = \frac{(R_1+R_2)^2}{R_1R_2} = \left(\frac{R_1}{R_2}+\frac{R_2}{R_1}+2\right)$$

$n \geq 4$

105. Answer (4)



$$\frac{10-x}{60}+\frac{0-x}{5}+\frac{y-x}{15}=0$$

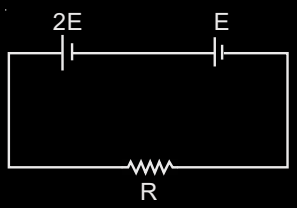
and, $\frac{10-y}{100}+\frac{0-y}{10}+\frac{x-y}{15}=0$

$\Rightarrow x = 0.79\,V,\ y = 0.865$

$$\therefore i_{BD} = \left(\frac{y-x}{15}\right)$$

$= 4.87 \times10^{-3}$A

106. Answer (4)



$$i = \frac{3E}{R+r_1+r_2}$$

$V_T = 2E - ir_1 = 0$

$$\Rightarrow 2E = \frac{3E}{R+r_1+r_2}\times r_1$$

$$\Rightarrow R + r_1 + r_2 = \frac{3r_1}{2}$$

$$\Rightarrow R = \frac{r_1}{2} - r_2$$

107. Answer (2)

Potential difference across resistance at t = 0

$$= \frac{Q}{C} = 10\ V$$

$$\Rightarrow \quad I = \frac{10}{R} = \frac{10}{5\times10^6} = 2\times10^{-6}\,A = 2\,\mu A$$

108. Answer (70)

$$V_{10} = \frac{170\times10}{10+\frac{1000}{70}} = 70\ V$$

109. Answer (48)

$$\frac{12}{6} = \frac{x}{(72-x)}$$

$\Rightarrow$ x = 48 cm

110. Answer (4)

$$R = \frac{R_1\,R_2}{R_1+R_2}$$

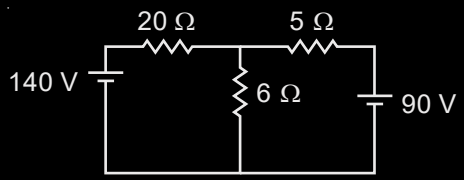
$$\frac{\rho(l)}{2A} = \frac{\left(\frac{\rho_1 l}{A}\right)\left(\frac{\rho_2 l}{A}\right)}{\frac{\rho_1 l}{A}+\frac{\rho_2 l}{A}}$$

$$\frac{\rho}{2}=\frac{\rho_1\rho_2}{\rho_1+\rho_2}\Rightarrow\frac{\rho}{2}=\frac{\rho_1\rho_2}{(\rho_1+\rho_2)}=2$$

$\Rightarrow \rho = 4$

111. Answer (2)

$$\frac{E_1}{r_1}+\frac{E_2}{r_2}=\frac{E_{eq}}{r_{eq}}$$



$$\Rightarrow \frac{140}{20}+\frac{90}{5}=\frac{E_{eq}}{4}$$

$\Rightarrow E_{eq} = 100$ V, $r_{eq} = 4\ \Omega$

$$\Rightarrow I=\frac{100}{6+4}=10\text{ A}$$

112. Answer (1)

$I = 5A$, $A = 0.04\ m^2$

$\vec{J}\cdot\vec{A} = I$

$JA\cos60° = I$

$$J=\frac{2I}{A}=\frac{2\times5}{4\times10^{-2}}=\frac{10^3}{4}\text{ A/m}^2$$

$J = \sigma E$

$$J=\frac{E}{\rho}=\frac{10^3}{4}$$

$E = 11 \times 10^{-5}$ V/m

113. Answer (10)

$$R_{ab}=\frac{12\times6}{12+6}+\frac{4\times4}{4+4}+\frac{6\times12}{6+12}$$

$= 10\ \Omega$

114. Answer (3)

$$R_{Cu}=\frac{\rho_{Cu}\times\ell}{A}$$

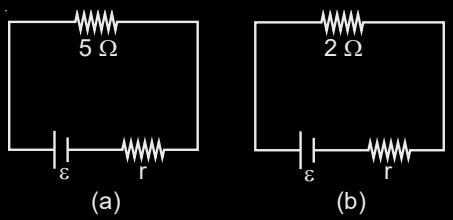
$$R_{Al}=\frac{\rho_{Al}\times\ell}{A}$$

$$R_{Eq}=\frac{\rho_{Cu}\times\rho_{Al}}{\rho_{Cu}+\rho_{Al}}\times\left(\frac{\ell}{A}\right)$$

$$=\frac{1.7\times10^{-8}\times2.6\times10^{-8}}{(1.7+2.6)\times10^{-8}}\times\frac{0.25}{3\times10^{-6}}$$

$= 0.856\ m\Omega$

115. Answer (15)



In case, (a) $\varepsilon=\frac{1.25}{5}(5+r)$

$\Rightarrow 4\varepsilon = 5 + r$ ...(1)

In case (b), $\varepsilon=\frac{1}{2}(2+r)$

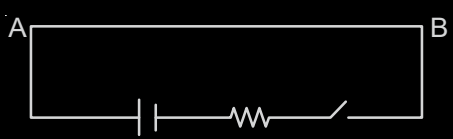
$\Rightarrow 2\varepsilon = 2 + r$ ...(2)

From equation (1) & (2)

$2\varepsilon = 3 \Rightarrow \varepsilon = 1.5$

or $x = 15$

116. Answer (1)



Resistance of AB wire = 10 × 100 × 0.1 = 100 Ω

$$\text{current through AB}=\frac{6}{20+100}=\frac{6}{120}$$

$$\text{P.D. across AB}=\frac{6}{120}\times100=5\text{ V}$$

117. Answer (50)

$$200=\frac{(100)^2}{R}$$

$R = 50\ \Omega$

Same amount of resistance must be put in series to have potential drop half of the total potential difference.

$R_{req} = 50\ \Omega$

118. Answer (2)

$\varepsilon_1 \propto 250$

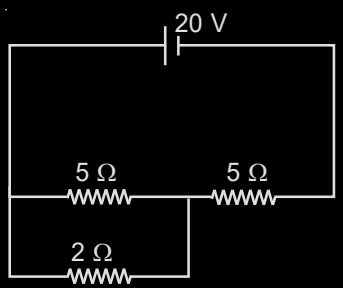
$\varepsilon_1 + \varepsilon_2 \propto 400$

$\Rightarrow \quad \frac{\varepsilon_1 + \varepsilon_2}{\varepsilon_1} = \frac{400}{250} = \frac{8}{5}$

$\Rightarrow \quad 1 + \frac{\varepsilon_2}{\varepsilon_1} = \frac{8}{5}$

$\Rightarrow \quad \frac{\varepsilon_2}{\varepsilon_1} = \frac{3}{5} \Rightarrow \frac{\varepsilon_1}{\varepsilon_2} = \frac{5}{3}$

119. Answer (3)

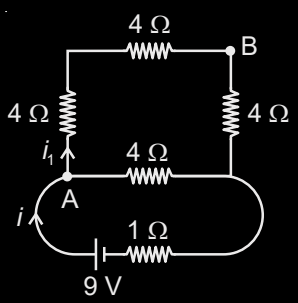


$R_1 = \frac{10}{7}, \; R_2 = 5$

$\Rightarrow \frac{R_1}{R_2} = \frac{2}{7}$

$V_{2\Omega} = \frac{2}{9} \times 20 = \frac{40}{9} V$

120. Answer (45)



$i = \frac{9}{\frac{4 \times 12}{4 + 12} + 1} = \frac{9}{4} A$

$i_1 = \frac{9}{16} A$

$V_A - V_B = i_1 \times R$

$= \frac{9}{16} \cdot 8 = \frac{9}{2} V$

$= 4.5 \; V$

121. Answer (3)

$50 = 100\left(1 - e^{-\frac{t}{RC}}\right)$

$\Rightarrow \quad t = RC \; \ln 2$

$= 100 \times 10^{-6} \times (0.69)$

$= 0.69 \times 10^{-4} \; s$

122. Answer (4)

On moving from P to Q

Current density increase

$J = \sigma E$

Electric field increase

Hence, drift velocity increases.

123. Answer (112)

$i = \frac{qv}{2\pi r}$

$= \frac{1.6 \times 10^{-19} \times 2.2 \times 10^6}{2 \times \pi \times 0.5 \times 10^{-10}}$

$= 112 \times 10^{-5} \; A$

124. Answer (2)

$R_t = R_0[1 + \alpha(\Delta T)]$

$20 = 16[1 + \alpha(85)]$

$\alpha = \frac{4}{16 \times 85}$

$= 0.003°C^{-1}$

125. Answer (1)

$V(3.2) = 6V$

$I = \frac{6 - 5}{1} \; A = 1 \; A$

126. Answer (3)

$\frac{1}{R_{eq.}} = \frac{1}{R_1} + \frac{1}{R_2}$

$\Rightarrow \quad \frac{1}{3} = \frac{A}{\rho_i l} + \frac{A}{\rho_{cu} \times l}$

$\Rightarrow \quad \frac{1}{3} = \frac{A}{l}\left[\frac{1}{\rho_i} + \frac{1}{\rho_{cu}}\right]$

$$\Rightarrow I = 3 \times \frac{\pi \times 4 \times 10^{-6}}{4}\left[\frac{1}{12 \times 10^{-8}} + \frac{1}{51 \times 10^{-8}}\right]$$

= 96.97 m

≈ 97 m

127. Answer (4)

Here, $C = \frac{K\varepsilon_0 A}{d}$

and $R = \frac{\rho d}{A}$

$\Rightarrow$ $RC = \rho K\varepsilon_0$

$\Rightarrow$ $R = \frac{\rho K\varepsilon_0}{C}$

So, $I = \frac{V}{R} = \frac{40 \times 2 \times 10^{-12}}{200 \times 50 \times 8.85 \times 10^{-12}}$

= 0.9 mA

128. Answer (3)

All the resistances are connected in parallel.

$$\frac{1}{R_{eq}} = \frac{1}{12} + \frac{1}{4} + \frac{1}{6} + \frac{1}{8}$$

$$= \frac{3}{12} + \frac{3}{8}$$

$$R_{eq} = \frac{8}{5}\Omega$$

$$I = \frac{2.2}{\left(\frac{8}{5} + 0.6\right)} = 1\,A$$

Power = I^2R

= 2.2 W

129. Answer (4)

Consider option (4)

$$\frac{2 \times 4}{2 + 4} + 6 + 8 = \frac{46}{3}\Omega$$

130. Answer (3)

$$R = \frac{V^2}{P}$$

R = 20 Ω

Let resistance to be connected in series be R_S

$$I = \frac{200}{20 + R_S}$$

$I^2R = 500$

I = 5 A

R_S = 20 Ω

131. Answer (2)

C_{eq} = 2 μF

$Q = C_{eq}V$, $V = 5 - \frac{5}{5} \times 1 = 4$ volt

$\Rightarrow Q = 2 \times 4 = 8$ μC

132. Answer (3)

For parallel combination

$$I_1 = \frac{E_{eq}}{r_{eq} + R} = \frac{5}{\left(\frac{1}{5} + R\right)}$$

For series combination

$$I_2 = \frac{5 \times 5}{5 + R}$$

$$I_1 = I_2 \Rightarrow \frac{25}{1 + 5R} = \frac{25}{5 + R}$$

$\Rightarrow$ R = 1 Ω

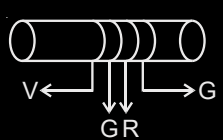
133. Answer (20)

$$I_1 = \frac{20}{10(n+1)} = \frac{2}{n+1}$$

$$I_2 = \frac{20}{10 + \frac{10}{n}} = \frac{2n}{n+1}$$

$I_2 = 20I_1 \Rightarrow n = 20$

134. Answer (4)



R = 75 × 100 ± 5%

$\Rightarrow$ R = 7.5 kΩ ± 5%

$\Rightarrow$ R = (7500 ± 375) Ω

135. Answer (2)

Current sensitivity = 2 div/mA

So full scale current $= \frac{50}{2}$ mA

= 25 mA

Full scale voltage = 50 mV

So, resistance $= \frac{V}{I} = 2\Omega$

136. Answer (9)

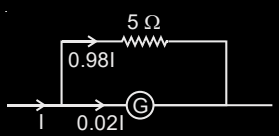
R_{eq} when switch is closed = $\frac{4R}{3}$

R_{eq} when switch is open = $\frac{3R}{2}$

$$\frac{R_{open}}{R_{close}} = \frac{\frac{3R}{2}}{\frac{4R}{3}} = \frac{9}{8}$$

137. Answer (2)

By KVL



$0.98I \times 5 = 0.02I \times R_G$

$R_G = 245\ \Omega$

138. Answer (100)

In steady state

$$i = \frac{V}{R_{eq}} = 10^{-3} \text{ ampere}$$

$Q = CV_C = 50 \times 10^{-3} \times 2 \times 10^3\ \mu C$

$= 100\ \mu C$

139. Answer (3)

$$R_{eq} = \frac{\frac{R}{2}\frac{R}{2}}{\frac{R}{2}+\frac{R}{2}} = \frac{R}{4} = 3\ \Omega$$

where R $\rightarrow$ resistance of complete wire.

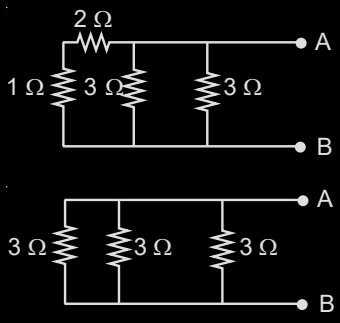
140. Answer (6)

Current through cell = 2A

$$V_{15\Omega} = \frac{10 \times 6}{2+2+6} = 6 \text{ V}$$

141. Answer (2)

On simplification



$$\frac{1}{R_{AB}} = \frac{1}{3}+\frac{1}{3}+\frac{1}{3}$$

$R_{AB} = 1\ \Omega$

142. Answer (3840)

$I_1^2 R_1(t_1) = 192$

$I_2^2 R_1(t_2) = X$

$$\frac{192}{X} = \frac{1}{20} \Rightarrow X = 3840 \text{ J}$$

143. Answer (1)

$$V = \frac{Q}{C}$$

$$V = V_0\left(1 - e^{-t/RC}\right)$$

$$2 = 20\left(1 - e^{-\frac{10^{-6}}{10C}}\right)$$

$\Rightarrow$ C = 0.95 μF

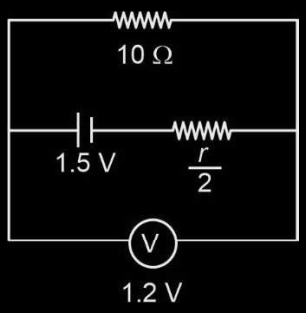
144. Answer (4)

$$P_1 = \frac{V^2}{R}$$

$$P_2 = \frac{V^2}{R/2} \times 2 = 4\frac{V^2}{R}$$

$$\frac{P_1}{P_2} = \frac{1}{4}$$

145. Answer (3)



$$\frac{1.5\times 10}{10+\frac{r}{2}} = 1.2$$

$\Rightarrow r = 5\,\Omega$

146. Answer (25)

At balancing point, we know that emf is proportional to the balancing length. i.e.,

emf $\propto$ balancing length

Now, let the emf's be 3ε and 2ε.

$\Rightarrow 3\varepsilon = k(75)$ …(1)

and $2\varepsilon = k(l)$ …(2)

$\Rightarrow l = 50$ cm

$\Rightarrow$ Difference is (75 – 50) cm = 25 cm.

147. Answer (2)

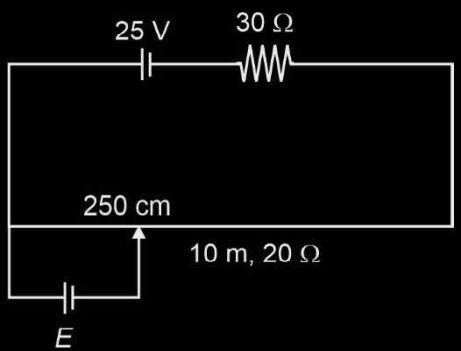
$$200\times\frac{1}{4\pi\times 16}\times\frac{3.5}{100} = \frac{B_0^2}{2\mu_0}C$$

$\mu_0 = 4\pi \times 10^{-7}$ Tm/A

$C = 3 \times 10^8$ m/sec

$\Rightarrow B_0 = 1.71 \times 10^{-8}$ T

148. Answer (25)



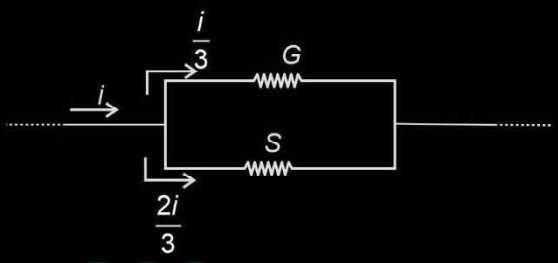
$$\therefore\quad E = I\times\left(\frac{20}{4}\right) = \frac{25}{(30+20)}\times\left(\frac{20}{4}\right)$$

$$= \frac{1}{2}\times 5 = 2.5 \text{ volts}$$

$$= \frac{25}{10} \text{ volts}$$

149. Answer (2)

The circuit for the given situation is:



Since G and S are in parallel,

$$\Rightarrow \frac{i}{3}\times G = \frac{2i}{3}\times S$$

$\Rightarrow G = 2S$

$\Rightarrow G$ equals twice the value of shunt resistance.

150. Answer (450)

$300 = I^2R\times 15$

$\Rightarrow R = 5$ W

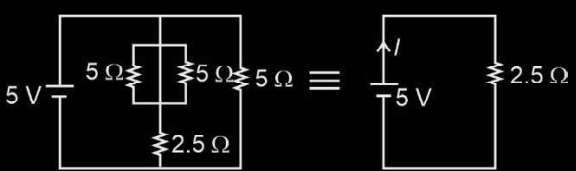
Now $I_2^2Rt_2$

$= 9 \times 5 \times 10$

$= 450$ J

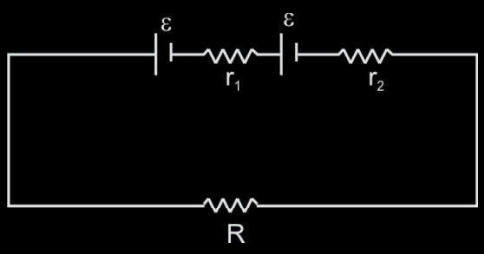
151. Answer (2)

The equivalent circuit is



$$\Rightarrow I = \frac{5}{2.5} = 2 \text{ A}$$

152. Answer (1)



$$I = \frac{2\varepsilon}{R + r_1 + r_2}$$

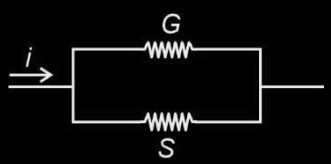
As per the question,

$$\frac{2\varepsilon}{R + r_1 + r_2} \times r_2 - \varepsilon = 0$$

$$\Rightarrow \quad R = r_2 - r_1$$

153. Answer (4)

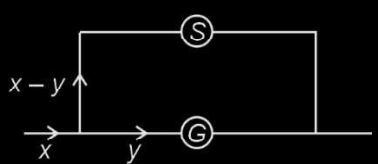
According to the information, current through galvanometer = nK



$$\Rightarrow \frac{S}{S+G} i = nK$$

$$\Rightarrow i = \frac{nK(S+G)}{S}$$

154. Answer (2)



From the given setup

$$y \times R_G = (x - y)(R_s)$$

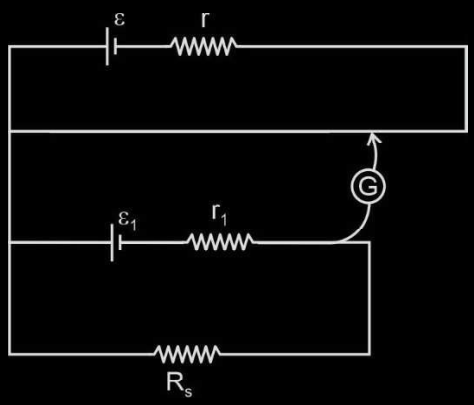
$$\Rightarrow \quad y \times 72 = (x - y) \times 8$$

$$\Rightarrow \quad 9y = x - y$$

$$\Rightarrow \quad y = \frac{x}{10} \text{ or } 10\% \text{ of } x$$

Option (2)

155. Answer (8)



$$\frac{\varepsilon_1 8}{r_1 + 8} 3c$$

$$\frac{\varepsilon_1 4}{r_1 + 4} 2c$$

$$\Rightarrow \quad \frac{2(r_1 + 4)}{r_1 + 8} = \frac{3}{2}$$

$$\Rightarrow \quad r_1 = 8\ \Omega$$

156. Answer (48)

$i = A \times j$

$$= \pi\left(R^2 - \frac{R^2}{4}\right) j$$

$$= \frac{3\pi R^2}{4} \times j$$

$$= \frac{3\pi \times \left(4 \times 10^{-3}\right)^2}{4} \times 4 \times 10^6$$

$= 48\pi$

157. Answer (12)

$i = A \times j$

$$= \pi\left(R^2 - \frac{R^2}{4}\right) j$$

$$= \frac{3\pi R^2}{4} \times j$$

$$= \frac{3\pi \times \left(4 \times 10^{-3}\right)^2}{4} \times 1.0 \times 10^6$$

$= 12\pi$

158. Answer (3)

$$R_{net} = \frac{ma}{3} + \frac{a}{2m}$$

$$= a\left[\frac{m}{3} + \frac{1}{2m} - \frac{2}{\sqrt{6}} + \frac{2}{\sqrt{6}}\right]$$

$$= a\left[\left(\sqrt{\frac{m}{3}} - \frac{1}{\sqrt{2m}}\right)^2 + \sqrt{\frac{2}{3}}\right]$$

This will be minimum when $\sqrt{\frac{m}{3}} = \frac{1}{\sqrt{2m}}$

or $m = \sqrt{\frac{3}{2}}$ so $x = 3$

159. Answer (19)

$$\frac{43+2}{15} = \frac{57}{R}$$

$$R = \frac{57 \times 15}{45} = 19\ \Omega$$

160. Answer (10)

For $I_{10} = 0$

$$\frac{R}{3} = \frac{4}{6}$$

$$\Rightarrow\ R = 2\ \Omega$$

$$\Rightarrow\ I_A = \frac{36 \times (6+9)}{6 \times 9}$$

$$= \frac{36 \times 15}{6 \times 9} = 10\ \text{A}$$

161. Answer (1)

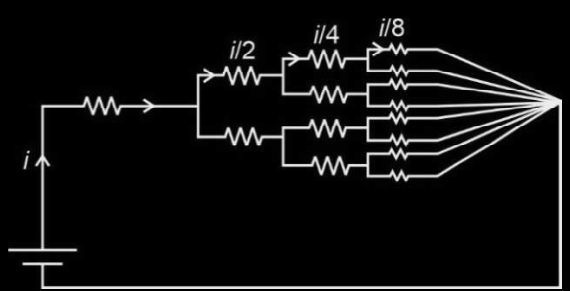
$R_{10} = 2 = R_0(1 + \alpha \times 10)$

$R_{30} = 3 = R_0(1 + \alpha \times 30)$

On solving

$\alpha = 0.033/°C$

162. Answer (8)



Let the current is i

Using kirchhoff's law

$$iR + \frac{i}{2}R + \frac{i}{4}R + \frac{i}{8}R = 3$$

$$i = \frac{3 \times 8}{15} = \frac{8}{5}\text{A}$$

So $a = 8$

163. Answer (15)

$$H = \frac{V^2}{R} \cdot \Delta t$$

$$\Rightarrow\ H = \frac{V^2}{R_1} \cdot 20 = \frac{V^2}{R_2} \cdot 60 \quad \ldots(\text{i})$$

Also, $H = \frac{V^2}{\left[\frac{R_1 R_2}{R_1 + R_2}\right]} \cdot \Delta t$

$$= \frac{4}{3} \cdot \frac{V^2}{R_1} \cdot \Delta t \qquad [\because\ R_2 = 3R_1]$$

$$\Rightarrow\ \Delta t = 15$$

164. Answer (144)

Resistance = $\tan 45° = 1\ \Omega$

$$\Rightarrow\ 1 = \frac{\rho l}{A}$$

$$\Rightarrow\ \rho = \frac{\pi(1.2\ \text{cm})^2}{31.4\ \text{cm}} = 1.44 \times 10^{-1}\ \Omega\text{cm}$$

$$\Rightarrow\ x = 144$$

165. Answer (10)

$$V_B - V_A = i \times 2 = \frac{15}{1+2} \times 2$$

$$\Rightarrow\ V_B - V_A = 10\ \text{volts}$$

166. Answer (4)

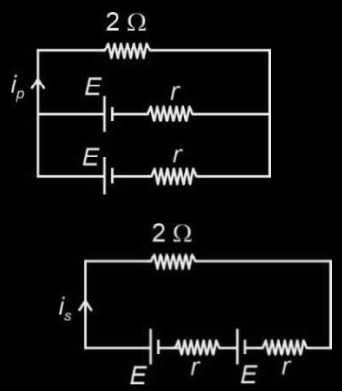
For a discharging capacitor when energy reduces to half the charge would become $\frac{1}{\sqrt{2}}$ times the initial value.

$$\Rightarrow \left(\frac{1}{2}\right)^{1/2} = e^{-t_1/\tau}$$

Similarly, $\left(\frac{1}{2}\right)^{3} = e^{-t_2/\tau}$

$$\Rightarrow \frac{t_1}{t_2} = \frac{1}{6}$$

167. Answer (A)



From diagram

$$i_p = \frac{E}{2+\frac{r}{2}} \text{ and } i_s = \frac{2E}{2+2r}$$

given $i_p = i_s$

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

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

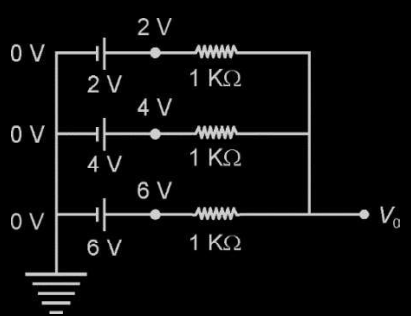
$r = 2\ \Omega$

168. Answer (8)

$$\text{New } R_{\text{eff}} = \frac{2000\times 500}{2500} + 600\ \Omega = 1000\ \Omega$$

$$\Rightarrow \text{ Reading of voltmeter} = \frac{400}{1000}\times 20 = 8 \text{ volts}$$

169. Answer (4)



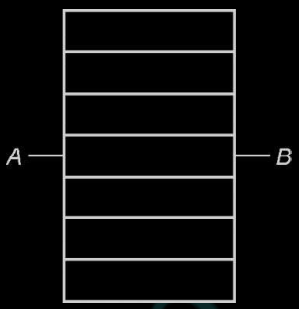
Using Kirchhoff's junction rule.

$$\frac{2-V_0}{1} + \frac{4-V_0}{1} + \frac{6-V_0}{1} = 0$$

$12 - 3V_0 = 0$

$V_0 = 4$ V

170. Answer (4)



$RAB = R$

$$R = \frac{1}{8}(\text{Resistance of one wire})$$

$$= \frac{1}{8}\rho\frac{l}{\pi\frac{d^2}{4}} = \frac{\rho l}{2\pi d^2}$$

Resistance of copper wire of length $2l$ and diameter $x = R$.

$$\rho\frac{2l}{\pi\frac{x^2}{4}} = R$$

$$\frac{8\rho l}{\pi x^2} = \frac{\rho l}{2\pi d^2}$$

$16d^2 = x^2$

$x = 4d$

171. Answer (4)

$$\text{Effective } R = \left[5 + \frac{5\times 10}{5+10} + 10\right]\ \text{k}\Omega$$

$$= \frac{275}{15}\ \text{k}\Omega$$

$$\Rightarrow \Delta V_{AB} = 15\ \text{mA}\times\frac{275}{15}\ \text{k}\Omega$$

$= 275$ V

172. Answer (18)

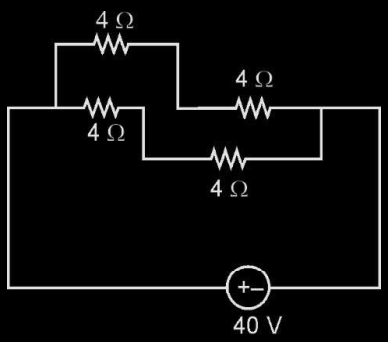
$E \propto l$

$$\frac{1.2}{1.8} = \frac{36}{l'}$$

$$l' = \frac{3}{2} \times 36 = 54 \text{ cm}$$

$\Delta l = l' - l = 54 - 36 = 18$ cm

173. Answer (1)



The grouping of resistance is a wheatstone bridge

So, $R_{net} = 4\ \Omega$

So, $i = \frac{V}{R_{net}} = 10$ A

174. Answer (20)

$$\frac{P}{40} = \frac{Q}{60} \quad \ldots(1)$$

$$\frac{P + x}{80} = \frac{Q}{20} \quad \ldots(2)$$

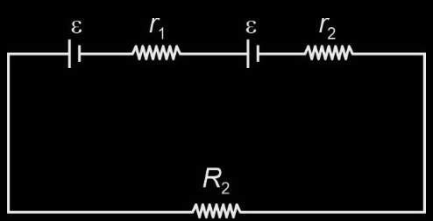
$$\frac{P}{P + x} \times \frac{80}{40} = \frac{20}{60}$$

$$\frac{4}{4 + x} \times 2 = \frac{1}{3}$$

$24 = 4 + x$

$x = 20$

175. Answer (1)



$$\Delta V = 0 \Rightarrow \frac{2\varepsilon}{r_1 + r_2 + R} r_1 = \varepsilon$$

$\Rightarrow R = r_1 - r_2$

176. Answer (2400)

$$\frac{R}{S} = \frac{70}{30}$$

$$S = \frac{3}{7} \times 5.6 \times 10^3 = 2.4 \times 10^3 \Omega$$

$= 2400\ \Omega$

177. Answer (136)

$I = nev_dA$

$$J = \frac{E}{\rho}$$

$$F = eE = \frac{1.7 \times 1.6 \times 10^{-19} \times 10^{-8}}{2 \times 10^{-6}}$$

$= 136 \times 10^{-23}$ N

178. Answer (1)

V_d decreases with increase in temperature and V_d is inversely proportional to the area of cross section.

179. Answer (40)

Even if the radius of wire is doubled, the balancing point would not change as $\frac{x}{l - x} = \frac{R_1}{R_2}$, which is not including a term of area.

180. Answer (10)

At steady state potential difference across capacitor

$$V_c = \frac{10 \times 100}{110} \text{V}$$

$Q = CV_c$

$$= \frac{1.1 \times 10^{-6} \times 10 \times 100}{110} \text{C} = 10\ \mu\text{C}$$

181. Answer (4)

$NiAB = k\theta$

$$\Rightarrow \frac{\theta}{i} = \frac{NAB}{k}$$

$\Rightarrow$ Sensitivity increases if $B\uparrow$ and $k\downarrow$

182. Answer (780)

l = 3m, R_w = 20 Ω

ε_0 = 4V

$$\frac{4\times 20}{20+R}\times\frac{60}{300}=20\times10^{-3}$$

$$\frac{4}{20+R}=5\times10^{-3}$$

20 + R = 800

R =780 Ω

183. Answer (3)

Statement I : $R_{1\text{ part}}=\frac{80}{4}=20\ \Omega$

$$\Rightarrow\quad R_{\text{eff}}=\frac{20}{4}=5\ \Omega$$

Statement II : Ratio $=\dfrac{\frac{(\Delta V)^2}{3R}}{\frac{(\Delta V)^2}{2R}}$

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

184. Answer (14)

$$P_{100}=\frac{V^2}{R_{100}}\Rightarrow R_{100}=\frac{V^2}{P_{100}}$$

$$P_{60}=\frac{V^2}{R_{60}}\Rightarrow R_{60}=\frac{V^2}{P_{60}}$$

$$P_{\text{net}}=\frac{V^2}{R_{60}+R_{100}}=\frac{P_{60}P_{100}}{P_{60}+P_{100}}=\frac{60\times100}{160}=37.5$$

This power developed is proportional to resistance.

So, $P'_{60}=P_{\text{net}}\times\frac{60}{160}=37.5\times\frac{60}{160}\simeq14$ W

185. Answer (2)

$R = R_1 + R_2$

$$\Rightarrow\quad\frac{l_1+l_2}{\sigma A}=\frac{l_1}{\sigma_1 A}+\frac{l_2}{\sigma_2 A}$$

$$\Rightarrow\quad\frac{2}{\sigma}=\frac{1}{\sigma_1}+\frac{1}{\sigma_2}$$

$$\Rightarrow\quad\sigma=\frac{2\sigma_1\sigma_2}{\sigma_1+\sigma_2}$$

186. Answer (2)

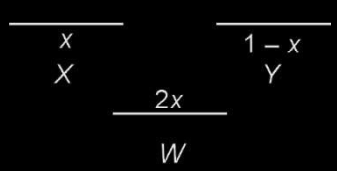
All 9 Ω resistances are in parallel

R_{eq} = 3 Ω

187. Answer (1)

Since they have low temperature coefficient of resistance, their resistance remains almost constant.

188. Answer (2)



$R_w = 2R_y$

$$\rho\frac{2x}{\frac{A}{2}}=\frac{2\rho(1-x)}{A}$$

$4x = 2(1 – x)$

$$\frac{x}{1-x}=\frac{1}{2}$$

189. Answer (1)

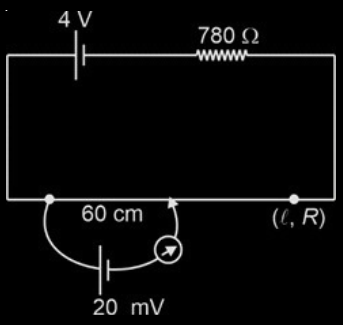
$$R=\frac{\rho l}{A}\qquad\ldots(1)$$

Al = constant …(2)

$\Rightarrow\ R\propto l^2$

$\Rightarrow$ Ratio = 3^2 = 9

190. Answer (20)



ℓ = 300 cm

$\varepsilon = Kx$

$$20\times10^{-3} = \left(\frac{4\times R}{780+R}\times\frac{1}{300}\right)60$$

$$\boxed{R = 20}$$

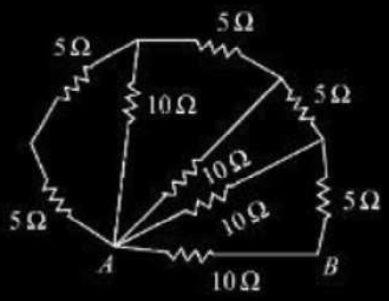
191. Answer (2)

$$R_{eq} = \frac{2\times4}{2+6}+6 = \frac{22}{3}$$

$\Rightarrow$ A and B are in parallel and C is in series.

192. Answer (3)

Initially 5 Ω and 5 Ω are in series and then in parallel with 10 Ω this pattern continues thus



R_{net} = 5 Ω

193. Answer (A)

Balanced wheatstone

$$\Rightarrow \quad R_{eff} = \frac{3\times6}{3+6}\times2+2$$

= 6 Ω

$$\Rightarrow \quad I = \frac{V}{R} = 1\text{ A}$$

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