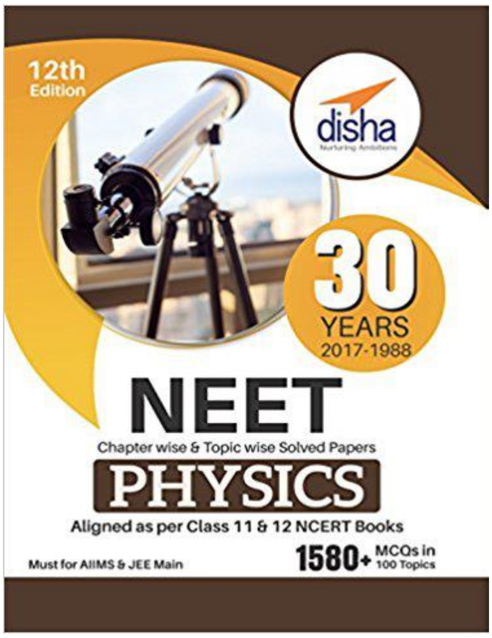
Previous Years Problems on Current Electricity for NEET

This Chapter " Previous Years Problems on Current Electricity for NEET" is taken from our Book:



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Product Name : 30 Years NEET Chapter-wise & Topic-wise Solved Papers Physics (2017 - 1988)

Product Description : • NEET Chapter-wise + Topic-wise Solved Papers Physics is the thoroughly revised and updated 12th edition and it contains the past year papers of NEET 2017 to 1988 distributed in 28 Topics.

• The Questions have been arranged from 2017 to 1988 such that the students encounter the latest questions first. Further each chapter has been further divided into 3-4 topics each.

• The Topics have been arranged exactly in accordance to the NCERT books so as to make it 100 percent convenient to Class 11 and 12 students.

• The fully solved CBSE Mains papers of 2011 and 2012 (the only Objective CBSE Mains paper held) have also been incorporated in the book topic-wise.

• The book also contains NEET 2013 along with the Karnataka NEET 2013 paper.

• The detailed solutions of all questions are provided at the end of each chapter to bring conceptual clarity.

• The book contains around 1600+ milestone problems in Physics

Chapter

17 Current Electricity

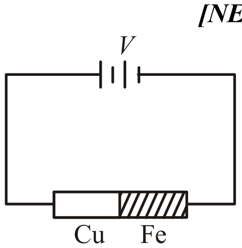
Topic 1: Electric Current, Drift of Electrons, Ohm's Law, Resistance & Resistivity

1. The resistance of a wire is 'R' ohm. If it is melted and stretched to 'n' times its original length, its new resistance will be :- ***[2017]***
   (a) $\frac{R}{n}$ (b) n^2R
   (c) $\frac{R}{n^2}$ (d) nR

2. Across a metallic conductor of non-uniform cross section a constant potential difference is applied. The quantity which remains constant along the conductor is : ***[2015]***
   (a) current (b) drift velocity
   (c) electric field (d) current density

3. A wire of resistance 4 Ω is stretched to twice its original length. The resistance of stretched wire would be ***[2013]***
   (a) 4 Ω (b) 8 Ω
   (c) 16 Ω (d) 2 Ω

4. Two rods are joined end to end, as shown. Both have a cross-sectional area of 0.01 cm^2. Each is 1 meter long. One rod is of copper with a resistivity of 1.7×10^{-6} ohm-centimeter, the other is of iron with a resistivity of 10^{-5} ohm-centimeter.
   How much voltage is required to produce a current of 1 ampere in the rods? ***[NEET Kar. 2013]***



   (a) 0.117 V (b) 0.00145 V
   (c) 0.0145 V (d) 1.7×10^{-6} V

5. A wire of a certain material is stretched slowly by ten per cent. Its new resistance and specific resistance become respectively: ***[2008]***
   (a) 1.2 times, 1.3 times
   (b) 1.21 times, same
   (c) both remain the same
   (d) 1.1 times, 1.1 times

6. The electric resistance of a certain wire of iron is *R*. If its length and radius are both doubled, then
   (a) the resistance and the specific resistance, will both remain unchanged ***[2004]***
   (b) the resistance will be doubled and the specific resistance will be halved
   (c) the resistance will be halved and the specific resistance will remain unchanged
   (d) the resistance will be halved and the specific resistance will be doubled

7. A 6 volt battery is connected to the terminals of the three metre long wire of uniform thickness and resistance of 100 ohm. The difference of potential between two points on the wire separated by a distance of 50 cm will be ***[2004]***
   (a) 1.5 volt (b) 3 volt
   (c) 3 volt (d) 1 volt

8. The resistivity (specific resistance) of a copper wire ***[2002]***
   (a) increases with increase in its temperature
   (b) decreases with increase in its cross-section
   (c) increases with increase in its length
   (d) increases with increase in its cross-section

9. Si and Cu are cooled to a temperature of 300 K, then resistivity? ***[2001]***
   (a) For Si increases and for Cu decreases
   (b) For Cu increases and for Si decreases
   (c) Decreases for both Si and Cu
   (d) Increases for both Si and Cu

10. A wire has a resistance of 3.1Ω at 30ºC and a resistance 4.5Ω at 100ºC. The temperature coefficient of resistance of the wire **[2001]**
(a) 0.0064 ºC^{-1} (b) 0.0034 ºC^{-1}
(c) 0.0025 ºC^{-1} (d) 0.0012 ºC^{-1}

11. The resistance of a discharge tube is **[1999]**
(a) zero (b) ohmic
(c) non-ohmic (d) infinity

12. There are three copper wires of length and cross sectional area (L, A), $(2L, \frac{1}{2}A)$, $(\frac{1}{2}L, 2A)$. In which case is the resistance minimum? **[1997]**
(a) It is the same in all three cases
(b) Wire of cross-sectional area $2A$
(c) Wire of cross-sectional area A
(d) Wire of cross-sectional area $\frac{1}{2}A$

13. If the resistance of a conductor is 5 Ω at 50ºC and 7Ω at 100ºC, then the mean temperature coefficient of resistance (of the material) is **[1996]**
(a) 0.001/ºC (b) 0.004/ºC
(c) 0.006/ºC (d) 0.008/ºC

14. If a negligibly small current is passed through a wire of length 15 m and of resistance 5Ω having uniform cross-section of 6×10^{-7} m^2, then coefficient of resistivity of material, is **[1996]**
(a) 1×10^{-7} Ω-m (b) 2×10^{-7} Ω-m
(c) 3×10^{-7} Ω-m (d) 4×10^{-7} Ω-m

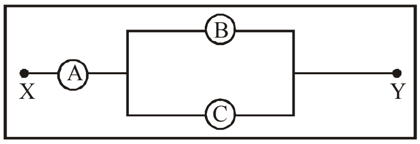
15. If a wire of resistance R is melted and recasted to half of its length, then the new resistance of the wire will be **[1995]**
(a) R / 4 (b) R / 2
(c) R (d) 2R

16. The velocity of charge carriers of current (about 1 amp) in a metal under normal conditions is of the order of **[1991]**
(a) a fraction of mm/sec
(b) velocity of light
(c) several thousand metres/second
(d) a few hundred metres per second

17. The masses of the three wires of copper are in the ratio of 1 : 3 : 5 and their lengths are in the ratio of 5 : 3 : 1. The ratio of their electrical resistance is **[1988]**
(a) 1 : 3 : 5 (b) 5 : 3 : 1
(c) 1 : 25 : 125 (d) 125 : 15 : 1

Topic 2: Combination of Resistances

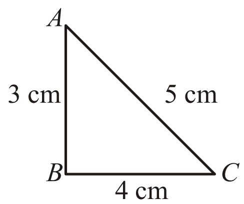
18. A, B and C are voltmeters of resistance R, 1.5 R and 3R respectively as shown in the figure. When some potential difference is applied between X and Y, the voltmeter readings are V_A, V_B and V_C respectively. Then **[2015]**



(a) $V_A \neq V_B = V_C$ (b) $V_A = V_B \neq V_C$
(c) $V_A \neq V_B \neq V_C$ (d) $V_A = V_B = V_C$

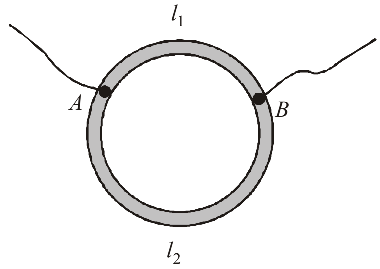
19. Two metal wires of identical dimension are connected in series. If σ_1 and σ_2 are the conductivities of the metal wires respectively, the effective conductivity of the combination is : **[2015 RS]**
(a) $\frac{\sigma_1 + \sigma_2}{2\sigma_1\sigma_2}$ (b) $\frac{\sigma_1 + \sigma_2}{\sigma_1\sigma_2}$
(c) $\frac{\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$ (d) $\frac{2\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$

20. A 12 cm wire is given a shape of a right angled triangle ABC having sides 3 cm, 4 cm and 5 cm as shown in the figure. The resistance between two ends (AB, BC, CA) of the respective sides are measured one by one by a multi-meter. The resistances will be in the ratio of **[NEET Kar. 2013]**



(a) 3 : 4 : 5 (b) 9 : 16 : 25
(c) 27 : 32 : 35 (d) 21 : 24 : 25

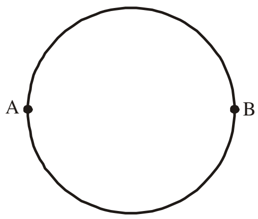
21. A ring is made of a wire having a resistance R_0 = 12 Ω. Find the points A and B as shown in the figure, at which a current carrying conductor should be connected so that the resistance R of the sub-circuit between these points is equal to $\frac{8}{3}\Omega$. **[2012]**



(a) $\frac{l_1}{l_2}=\frac{5}{8}$ (b) $\frac{l_1}{l_2}=\frac{1}{3}$

(c) $\frac{l_1}{l_2}=\frac{3}{8}$ (d) $\frac{l_1}{l_2}=\frac{1}{2}$

22. A wire of resistance 12 ohms per meter is bent to form a complete circle of radius 10 cm. The resistance between its two diametrically opposite points, A and B as shown in the figure, is **[2009]**



(a) 3Ω (b) $6\pi\Omega$

(c) 6Ω (d) $0.6\pi\Omega$

23. When a wire of uniform cross–section a, length l and resistance R is bent into a complete circle, resistance between any two of diametrically opposite points will be **[2005]**

(a) $\frac{R}{4}$ (b) $4R$

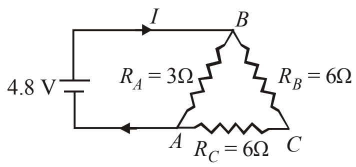
(c) $\frac{R}{8}$ (d) $\frac{R}{2}$

24. Resistances n, each of r ohm, when connected in parallel give an equivalent resistance of R ohm. If these resistances were connected in series, the combination would have a resistance in ohms, equal to **[2004]**

(a) nR (b) n^2R

(c) R/n^2 (d) R/n

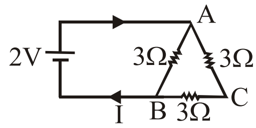
25. The current (I) in the given circuit is **[1999]**



(a) 1.6 A (b) 2.0 A

(c) 0.32 A (d) 3.2 A

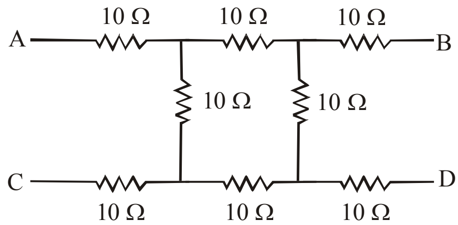
26. The current in the following circuit is **[1997]**



(a) $1A$ (b) $\frac{2}{3}A$

(c) $\frac{2}{9}A$ (d) $\frac{1}{8}A$

27. What will be the equivalent resistance of circuit shown in figure between two points A and D **[1996]**



(a) 10Ω (b) 20Ω

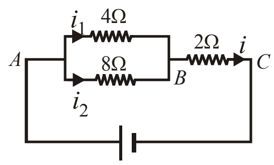
(c) 30Ω (d) 40Ω

28. Two wires of the same metal have same length, but their cross-sections are in the ratio 3:1. They are joined in series. The resistance of thicker wire is 10Ω. The total resistance of the combination will be **[1995]**

(a) $10\,\Omega$ (b) $20\,\Omega$

(c) $40\,\Omega$ (d) $100\,\Omega$

29. In the circuit shown in Fig, the current in $4\,\Omega$ resistance is 1.2 A. What is the potential difference between B and C. **[1994]**



(a) 3.6 volt (b) 6.3 volt

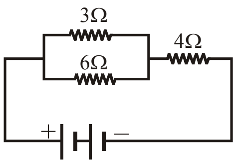
(c) 1.8 volt (d) 2.4 volt

30. Three resistances each of $4\,\Omega$ are connected to form a triangle. The resistance between any two terminals is **[1993]**

(a) $12\,\Omega$ (b) $2\,\Omega$

(c) 6Ω (d) $8/3\Omega$

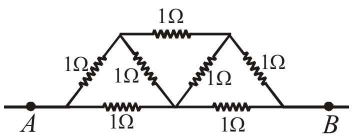
31. Current through 3 Ω resistor is



0.8 amp., then potential drop through 4Ω resistor is
(a) 9.6 V (b) 2.6 V **[1993]**
(c) 4.8 V (d) 1.2 V

32. You are given several identical resistances each of value $R = 10\Omega$ and each capable of carrying a maximum current of one ampere. It is required to make a suitable combination of these resistances of 5Ω which can carry a current of 4 ampere. The minimum number of resistances of the type R that will be required for this job is **[1990]**
(a) 4 (b) 10
(c) 8 (d) 20

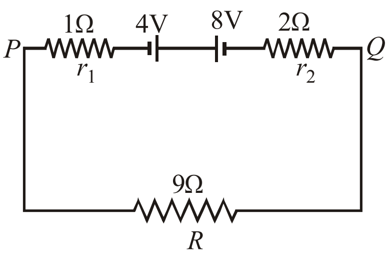
33. In the network shown in the Fig, each resistance is 1Ω. The effective resistance between A and B is **[1990]**



(a) $\frac{4}{3}\Omega$ (b) $\frac{3}{2}\Omega$
(c) 7 Ω (d) $\frac{8}{7}\Omega$

34. n equal resistors are first connected in series and then connected in parallel. What is the ratio of the maximum to the minimum resistance ? **[1989]**
(a) n (b) $1/n^2$
(c) n^2 (d) $1/n$

35. Two batteries of emf 4 V and 8V with internal resistance 1 Ω and 2 Ω are connected in a circuit with a resistance of 9 Ω as shown in figure. The current and potential difference between the points P and Q are **[1988]**

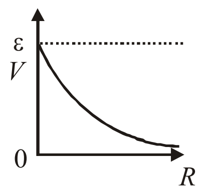


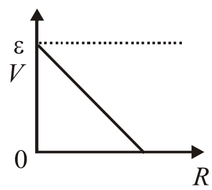
(a) $\frac{1}{3}A$ and 3 V (b) $\frac{1}{6}A$ and 4 V
(c) $\frac{1}{9}A$ and 9 V (d) $\frac{1}{12}A$ and 12V

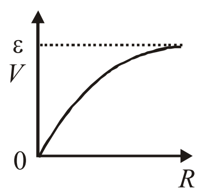
Topic 3: Kirchhoff's Laws, Cells, Thermo emf & Electrolysis

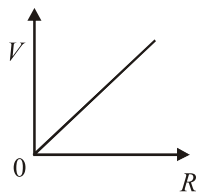
36. The internal resistance of a 2.1 V cell which gives a current of 0.2 A through a resistance of 10 Ω is **[2013]**
(a) 0.5 Ω (b) 0.8 Ω
(c) 1.0 Ω (d) 0.2 Ω

37. Cell having an emf ε and internal resistance r is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by : **[2012M]**

(a)


(b)


(c)


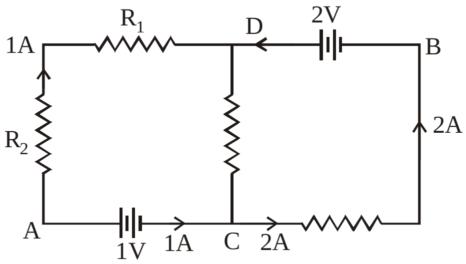
(d)


38. A current of 2A flows through a 2Ω resistor when connected across a battery. The same battery supplies a current of 0.5 A when connected across a 9Ω resistor. The internal resistance of the battery is **[2011]**
(a) 0.5 Ω (b) 1/3 Ω
(c) 1/4 Ω (d) 1 Ω

39. The rate of increase of thermo–e.m.f. with temperature at the neutral temperature of a thermocouple **[2011]**
(a) is positive
(b) is zero
(c) depends upon the choice of the two materials of the thermocouple
(d) is negative

40. A thermocouple of negligible resistance produces an e.m.f. of 40 μV/°C in the linear range of temperature. A galvanometer of resistance 10 ohm whose sensitivity is 1μA/div, is employed with the termocouple. The smallest value of temperature difference that can be detected by the system will be **[2011M]**
(a) 0.5°C (b) 1°C
(c) 0.1°C (d) 0.25°C

41. In the circuit shown in the figure, if potential at point A is taken to be zero, the potential at point B is **[2011M]**



(a) –1V (b) +2V
(c) –2V (d) +1V

42. In producing chlorine by electrolysis 100 *kW* power at 125 *V* is being consumed. How much chlorine per minute is liberated? (E.C.E. of chlorine is 0.367×10^{-6} kg/C) **[2010]**
(a) 1.76×10^{-3} *kg* (b) 9.67×10^{-3} *kg*
(c) 17.61×10^{-3} *kg* (d) 3.67×10^{-3} *kg*

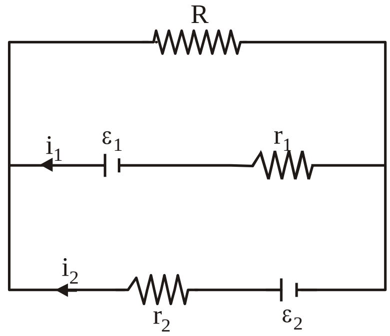
43. Consider the following two statements:
(A) Kirchhoff's junction law follows from the conservation of charge.
(B) Kirchhoff's loop law follows from the conservation of energy.
Which of the following is correct? **[2010]**
(a) Both (A) and (B) are wrong
(b) (a) is correct and (B) is wrong
(c) (a) is wrong and (B) is correct
(d) Both (A) and (B) are correct

44. The thermo e.m.f E in volts of a certain thermocouple is found to vary with temperature difference θ in °C between the two junctions according to the relation **[2010]**

$$E = 30\theta - \frac{\theta^2}{15}$$

The neutral temperature for the thermocouple will be
(a) 30° C (b) 450° C
(c) 400 ° C (d) 225° C

45. See the electric circuit shown in the figure.



Which of the following equations is a correct equation for it? **[2009]**
(a) $\varepsilon_2 - i_2 r_2 - \varepsilon_1 - i_1 r_1 = 0$
(b) $-\varepsilon_2 - (i_1 + i_2)R + i_2 r_2 = 0$
(c) $\varepsilon_1 - (i_1 + i_2)R + i_1 r_1 = 0$
(d) $\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0$

46. A student measures the terminal potential difference (V) of a cell (of emf E and internal resistance r) as a function of the current (I) flowing through it. The slope and intercept, of the graph between V and I, then, respectively, equal: **[2009]**
(a) – r and E (b) r and – E
(c) – E and r (d) E and – r

47. A cell can be balanced against 110 cm and 100 cm of potentiometer wire, respectively with and without being short circuited through a resistance of 10Ω. Its internal resistance is **[2008]**
(a) 1.0 ohm (b) 0.5 ohm
(c) 2.0 ohm (d) zero

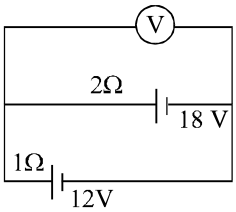
48. A steady current of 1.5 amp flows through a copper voltameter for 10 minutes. If the electrochemical equivalent of copper is 30×10^{-5} g coulomb^{-1}, the mass of copper deposited on the electrode will be **[2007]**
(a) 0.50 g (b) 0.67 g
(c) 0.27 g (d) 0.40 g.

49. In producing chlorine through electrolysis, 100 watt power at 125 V is being consumed. How much chlorine per minute is liberated? E.C.E. of chlorine is 0.367×10^{-6} kg/ coulomb. **[2006]**
(a) 21.3 mg (b) 24.3 mg
(c) 13.6 mg (d) 17.6 mg

50. Kirchhoff's first and second laws for electrical circuits are consequences of **[2006]**
(a) conservation of electric charge and energy respectively
(b) conservation of electric charge
(c) conservation of energy and electric charge respectively
(d) conservation of energy

51. Two cells, having the same e.m.f., are connected in series through an external resistance R. Cells have internal resistances r_1 and r_2 ($r_1 > r_2$) respectively. When the circuit is closed, the potential difference across the first cell is zero. The value of R is **[2006]**
(a) $\frac{r_1 + r_2}{2}$ (b) $\frac{r_1 - r_2}{2}$
(c) $r_1 + r_2$ (d) $r_1 - r_2$

52. Two batteries, one of emf 18 volt and internal



resistance 2Ω and the other of emf 12 volt and internal resistance 1Ω, are connected as shown. The voltmeter V will record a reading of
(a) 30 volt (b) 18 volt **[2005]**
(c) 15 volt (d) 14 volt

53. A battery is charged at a potential of 15V for 8 hours when the current flowing is 10A. The battery on discharge supplies a current of 5A for 15 hours. The mean terminal voltage during discharge is 14V. The "watt-hour" efficiency of the battery is **[2004]**
(a) 87.5% (b) 82.5%
(c) 80% (d) 90%

54. The potential difference between the terminals of a cell in an open circuit is 2.2 V. When a resistor of 5Ω is connected across the terminals of the cell, the potential difference between the terminals of the cell is found to be 1.8 V. The internal resistance of the cell is **[2002]**
(a) $\frac{7}{12}\Omega$ (b) $\frac{10}{9}\Omega$
(c) $\frac{9}{10}\Omega$ (d) $\frac{12}{7}\Omega$

55. In electrolysis, the amount of mass deposited or liberated at an electrode is directly proportional to **[2000]**
(a) square of electric charge
(b) amount of charge
(c) square of current
(d) concentration of electrolyte

56. A car battery has e.m.f. 12 volt and internal resistance 5×10^{-2} ohm. If it draws 60 amp current, the terminal voltage of the battery will be **[2000]**
(a) 15 volt (b) 3 volt
(c) 5 volt (d) 9 volt

57. If nearly 10^5 coulombs liberate 1 gm-equivalent of aluminium, then the amount of aluminium (equivalent weight 9), deposited through electrolysis in 20 minutes by a current of 50 amp. will be **[1998]**
(a) 0.6 gm (b) 0.09 gm
(c) 5.4 gm (d) 10.8 gm

58. Kirchoff's first law, i.e. $\Sigma i = 0$ at a junction, deals with the conservation of **[1992, 1997]**
(a) charge (b) energy
(c) momentum (d) angular momentum

59. Direct current is passed through a copper sulphate solution using platinum electrodes. The elements liberated at the electrodes are **[1993]**
(a) copper at anode and sulphur at cathode
(b) sulphur at anode and copper at cathode
(c) oxygen at anode and copper at cathode
(d) copper at anode and oxygen at cathode

60. Faraday's laws are consequence of conservation of **[1991]**
(a) energy
(b) energy and magnetic field
(c) charge
(d) magnetic field

Topic 4: Heating Effects of Current

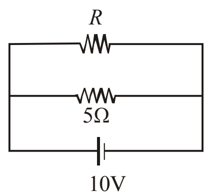
61. The charge flowing through a resistance R varies with time t as Q = at – bt^2, where a and b are positive constants. The total heat produced in R is: **[2016]**
(a) $\frac{a^3R}{6b}$ (b) $\frac{a^3R}{3b}$
(c) $\frac{a^3R}{2b}$ (d) $\frac{a^3R}{b}$

62. Two cities are 150 km apart. Electric power is sent from one city to another city through copper wires. The fall of potential per km is 8 volt and the average resistance per km is 0.5 Ω. The power loss in the wires is : ***[2014]***
(a) 19.2 W (b) 19.2 kW
(c) 19.2 J (d) 12.2 kW

63. Ten identical cells connected in series are needed to heat a wire of length one meter and radius '*r*' by 10ºC in time '*t*'. How many cells will be required to heat the wire of length two meter of the same radius by the same temperature in time '*t*'? ***[NEET Kar. 2013]***
(a) 10 (b) 20
(c) 30 (d) 40

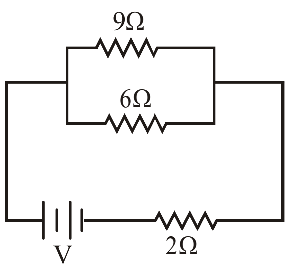
64. If voltage across a bulb rated 220 Volt-100 Watt drops by 2.5% of its rated value, the percentage of the rated value by which the power would decrease is : ***[2012]***
(a) 20% (b) 2.5%
(c) 5% (d) 10%

65. The power dissipated in the circuit shown in the figure is 30 Watts. The value of *R* is: ***[2012M]***



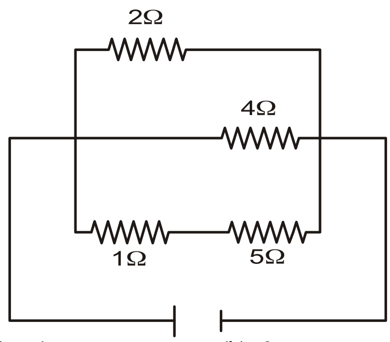
(a) 20 Ω (b) 15 Ω
(c) 10 Ω (d) 30 Ω

66. If power dissipated in the 9-Ω resistor in the circuit shown is 36 watt, the potential difference across the 2-Ω resistor is ***[2011]***



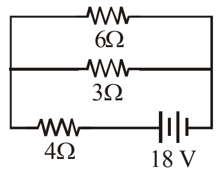
(a) 4 volt (b) 8 volt
(c) 10 volt (d) 2 volt

67. A current of 3 amp flows through the 2Ω resistor shown in the circuit. The power dissipated in the 5-Ω resistor is: ***[2008]***



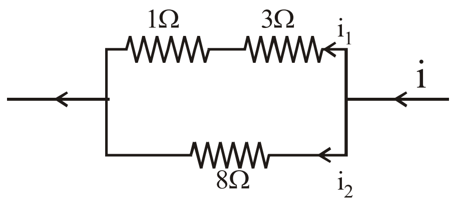
(a) 4 watt (b) 2 watt
(c) 1 watt (d) 5 watt

68. The total power dissipated in watts in the circuit shown here is ***[2007]***



(a) 40 (b) 54
(c) 4 (d) 16

69. Power dissipated across the 8Ω resistor in the circuit shown here is 2 watt. The power dissipated in watt units across the 3Ω resistor is



(a) 1.0 (b) 0.5 ***[2006]***
(c) 3.0 (d) 2.0

70. A 5–ampere fuse wire can withstand a maximum power of 1 watt in the circuit. The resistance of the fuse wire is ***[2005]***
(a) 0.04 ohm (b) 0.2 ohm
(c) 5 ohm (d) 0.4 ohm

71. When three identical bulbs of 60 watt, 200 volt rating are connected in series to a 200 volt supply, the power drawn by them will be
(a) 20 watt (b) 60 watt ***[2004]***
(c) 180 watt (d) 10 watt

72. In India electricity is supplied for domestic use at 220 V. It is supplied at 110 V in USA. If the resistance of a 60 W bulb for use in India is R, the resistance of a 60 W bulb for use in USA will be ***[2004]***

(a) R/2 (b) R
(c) 2R (d) R/4

73. An electric kettle has two heating coils. When one of the coils is connected to an a.c. source, the water in the kettle boils in 10 minutes. When the other coil is used, the water boils in 40 minutes. If both the coils are connected in parallel, the time taken by the same quantity of water to boil will be ***[2003]***

(a) 15 min (b) 8 min
(c) 4 min (d) 25 min

74. Two 220 volt, 100 watt bulbs are connected first in series and then in parallel. Each time the combination is connected to a 220 volt a.c. supply line. The power drawn by the combination in each case respectively will be ***[2003]***

(a) 50 watt, 200 watt (b) 50 watt, 100 watt
(c) 100 watt, 50 watt (d) 200 watt, 150 watt

75. Fuse wire is a wire of ***[2003]***

(a) low resistance and high melting point
(b) high resistance and high melting point
(c) high resistance and low melting point
(d) low resistance and low melting point

76. If 25W, 220 V and 100 W, 220 V bulbs are connected in series across a 440 V line, then ***[2001]***

(a) only 25W bulb will fuse
(b) only 100W bulb will fuse
(c) both bulbs will fuse
(d) none of these

77. A battery of 10 V and internal resistance 0.5Ω is connected across a variable resistance R. The value of R for which the power delivered is maximum is equal to ***[2001, 1992]***

(a) 0.25Ω (b) 0.5Ω
(c) 1.0Ω (d) 2.0Ω

78. Two electric bulbs, one of 200 V, 40W and other of 200 V, 100W are connected in a domestic circuit. Then ***[2000]***

(a) they have equal resistance
(b) the resistance of 40W bulb is more than 100W bulb
(c) the resistance of 100W bulb is more than 40 W bulb
(d) they have equal current through them

79. Three equal resistors connected across a source of e.m.f. together dissipate 10 watt of power. What will be the power dissipated in watts if the same resistors are connected in parallel across the same source of e.m.f.? ***[1998]***

(a) 10 (b) $\frac{10}{3}$
(c) 30 (d) 90

80. A 5°C rise in temperature is observed in a conductor by passing a current. When the current is doubled the rise in temperature will be approximately ***[1998]***

(a) 10°C (b) 16°C
(c) 20°C (d) 12°C

81. A (100 W, 200 V) bulb is connected to a 160V power supply. The power consumption would be ***[1997]***

(a) 125 W (b) 100 W
(c) 80 W (d) 64 W

82. A heating coil is labelled 100 W, 220 V. The coil is cut in half and the two pieces are joined in parallel to the same source. The energy now liberated per second is ***[1995]***

(a) 25 J (b) 50 J
(c) 200 J (d) 400 J

83. A 4 μF capacitor is charged to 400 volts and then its plates are joined through a resistance of 1k Ω. The heat produced in the resistance is ***[1994]***

(a) 0.16 J (b) 1.28 J
(b) 0.64 J (d) 0.32 J

84. Two identical batteries each of e.m.f 2V and internal resistance 1Ω are available to produce heat in an external resistance by passing a current through it. The maximum power that can be developed across R using these batteries is ***[1990]***

(a) 3.2 W (b) 2.0 W
(c) 1.28 W (d) $\frac{8}{9}$W

85. Forty electric bulbs are connected in series across a 220 V supply. After one bulb is fused the remaining 39 are connected again in series across the same supply. The illumination will be ***[1989]***

(a) more with 40 bulbs than with 39
(b) more with 39 bulbs than with 40
(c) equal in both the cases
(d) in the ratio $40^2 : 39^2$

86. A current of 2 A, passing through a conductor produces 80 J of heat in 10 seconds. The resistance of the conductor in ohm is ***[1989]***
(a) 0.5 (b) 2
(c) 4 (d) 20

Topic 5: Wheatstone Bridge & Different Measuring Instruments

87. A potentiometer is an accurate and versatile device to make electrical measurements of E.M.F. because the method involves ***[2017]***
(a) Potential gradients
(b) A condition of no current flow through the galvanometer
(c) A combination of cells, galvanometer and resistances
(d) Cells

88. A potentiometer wire is 100 cm long and a constant potential difference is maintained across it. Two cells are connected in series first to support one another and then in opposite direction. The balance points are obtained at 50 cm and 10 cm from the positive end of the wire in the two cases. The ratio of emf's is : ***[2016]***
(a) 5 : 1 (b) 5 : 4
(c) 3 : 4 (d) 3 : 2

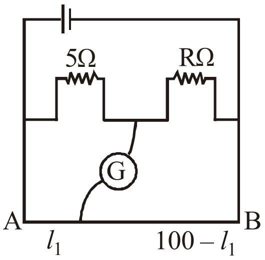
89. A potentiometer wire has length 4 m and resistance 8Ω. The resistance that must be connected in series with the wire and an accumulator of e.m.f. 2V, so as to get a potential gradient 1 mV per cm on the wire is ***[2015]***
(a) 40 Ω (b) 44 Ω
(c) 48 Ω (d) 32 Ω

90. A potentiometer wire of length L and a resistance r are connected in series with a battery of e.m.f. E_0 and a resistance r_1. An unknown e.m.f. E is balanced at a length l of the potentiometer wire. The e.m.f. E will be given by : ***[2015 RS]***

(a) $\dfrac{E_0 r}{(r+r_1)} \cdot \dfrac{l}{L}$ (b) $\dfrac{E_0 l}{L}$

(c) $\dfrac{LE_0 r}{(r+r_1)l}$ (d) $\dfrac{LE_0 r}{l r_1}$

91. The resistances in the two arms of the meter bridge are 5Ω and RΩ, respectively. When the resistance R is shunted with an equal resistance, the new balance point is at 1.6 l_1. The resistance 'R' is : ***[2014]***

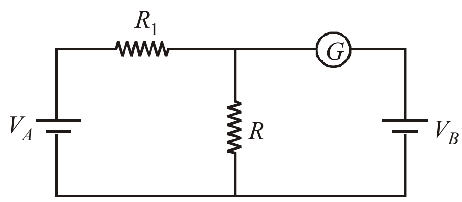


(a) 10Ω (b) 15Ω
(c) 20Ω (d) 25Ω

92. A potentiometer circuit has been set up for finding the internal resistance of a given cell. The main battery used across the potentiometer wire, has an emf of 2.0 V and a negligible internal resistance. The potentiometer wire itself is 4m long, When the resistace R, connected across the given cell, has values of
(i) infinity (ii) 9.5Ω
The balancing lengths', on the potentiometer wire are found to be 3 m and 2.85 m, respectively. The value of internal resistance of the cell is ***[2014]***
(a) 0.25Ω (b) 0.95Ω
(c) 0.5Ω (d) 0.75Ω

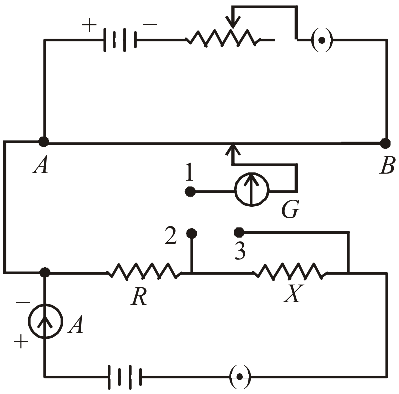
93. The resistance of the four arms P, Q, R and S in a Wheatstone's bridge are 10 ohm, 30 ohm, 30 ohm and 90 ohm, respectively. The e.m.f. and internal resistance of the cell are 7 volt and 5 ohm respectively. If the galvanometer resistance is 50 ohm, the current drawn from the cell will be ***[2013]***
(a) 0.2 A (b) 0.1 A
(c) 2. 0 A (d) 1. 0 A

94. In the circuit shown the cells *A* and *B* have negligible resistances. For $V_A = 12V$, $R_1 = 500\Omega$ and $R = 100\Omega$ the galvanometer (*G*) shows no deflection. The value of V_B is : ***[2012]***



(a) 4 *V* (b) 2 *V*
(c) 12 *V* (d) 6 *V*

95. A potentiometer circuit is set up as shown. The potential gradient, across the potentiometer wire, is k volt/cm and the ammeter, present in the circuit, reads 1.0 A when two way key is switched off. The balance points, when the key between the terminals (i) 1 and 2 (ii) 1 and 3, is plugged in, are found to be at lengths l_1 cm and l_2 cm respectively. The magnitudes, of the resistors R and X, in ohms, are then, equal, respectively, to **[2010]**

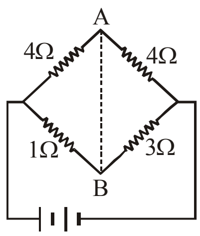


(a) $k(l_2 - l_1)$ and $k\,l_2$
(b) $k\,l_1$ and $k(l_2 - l_1)$
(c) $k(l_2 - l_1)$ and $k\,l_1$
(d) $k\,l_1$ and $k\,l_2$

96. Three resistances P, Q, R each of 2Ω and an unknown resistance S form the four arms of a Wheatstone bridge circuit. When a resistance of 6Ω is connected in parallel to S the bridge gets balanced. What is the value of S? **[2007]**

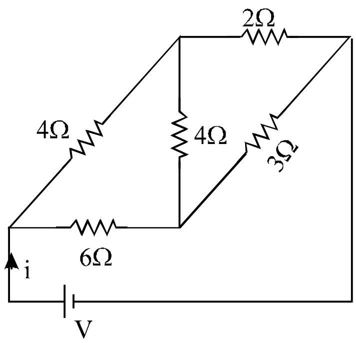
(a) 3Ω (b) 6Ω
(c) 1Ω (d) 2Ω

97. In the circuit shown, if a conducting wire is connected between points A and B, the current in this wire will **[2006]**



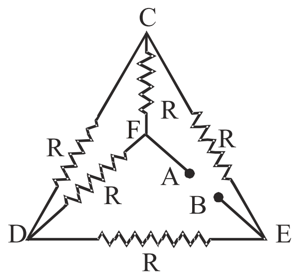
(a) flow in the direction which will be decided by the value of V
(b) be zero
(c) flow from B to A
(d) flow from A to B

98. For the network shown in the Fig. the value of the current i is **[2005]**



(a) $\frac{9V}{35}$ (b) $\frac{18V}{5}$ (c) $\frac{5V}{9}$ (d) $\frac{5V}{18}$

99. Five equal resistances each of resistance R are connected as shown in the figure. A battery of V volts is connected between A and B. The current flowing in $AFCEB$ will be **[2004]**



(a) $\frac{2V}{R}$ (b) $\frac{3V}{R}$
(c) $\frac{V}{R}$ (d) $\frac{V}{2R}$

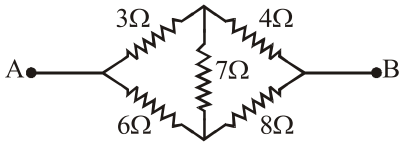
100. In a Wheatstone's bridge all the four arms have equal resistance R. If the resistance of the galvanometer arm is also R, the equivalent resistance of the combination as seen by the battery is **[2003]**

(a) $2R$ (b) $\frac{R}{4}$
(c) $\frac{R}{2}$ (d) R

101. If specific resistance of a potentiometer wire is 10^{-7} Ωm, the current flow through it is 0.1 A and the cross-sectional area of wire is 10^{-6} m^2 then potential gradient will be ***[2001]***
(a) 10^{-2} volt/m (b) 10^{-4} volt/m
(c) 10^{-6} volt/m (d) 10^{-8} volt/m

102. Potentiometer measures potential more accurately because ***[2000]***
(a) it measures potential in the open circuit
(b) it uses sensitive galvanometer for null deflection
(c) it uses high resistance potentiometer wire
(d) it measures potential in the closed circuit

103. Five resistances have been connected as shown in the figure. The effective resistance between A and B is ***[2000]***



(a) $\frac{14}{3}\Omega$ (b) $\frac{20}{3}\Omega$
(c) 14Ω (d) 21Ω

104. In a metre-bridge, the balancing length from the left end when standard resistance of 1 Ω is in right gap is found to be 20 cm. The value of unknown resistance is ***[1999]***
(a) 0.25Ω (b) 0.4Ω
(c) 0.5Ω (d) 4Ω

ANSWER KEY															
1	(b)	**13**	(a)	**25**	(b)	**37**	(c)	**49**	(d)	**61**	(a)	**72**	(d)	**83**	(d)	**94**	(b)
2	(a)	**14**	(b)	**26**	(a)	**38**	(b)	**50**	(a)	**62**	(b)	**73**	(b)	**84**	(b)	**95**	(b)
3	(c)	**15**	(a)	**27**	(c)	**39**	(b)	**51**	(d)	**63**	(b)	**74**	(a)	**85**	(b)	**96**	(a)
4	(a)	**16**	(a)	**28**	(c)	**40**	(d)	**52**	(d)	**64**	(c)	**75**	(c)	**86**	(b)	**97**	(c)
5	(b)	**17**	(d)	**29**	(a)	**41**	(d)	**53**	(a)	**65**	(c)	**76**	(a)	**87**	(b)	**98**	(d)
6	(c)	**18**	(d)	**30**	(d)	**42**	(c)	**54**	(b)	**66**	(c)	**77**	(b)	**88**	(d)	**99**	(d)
7	(d)	**19**	(d)	**31**	(c)	**43**	(d)	**55**	(b)	**67**	(d)	**78**	(b)	**89**	(d)	**100**	(d)
8	(a)	**20**	(c)	**32**	(c)	**44**	(d)	**56**	(d)	**68**	(b)	**79**	(c)	**90**	(a)	**101**	(a)
9	(b)	**21**	(d)	**33**	(d)	**45**	(d)	**57**	(c)	**69**	(c)	**80**	(d)	**91**	(b)	**102**	(a)
10	(a)	**22**	(a)	**34**	(c)	**46**	(a)	**58**	(a)	**70**	(a)	**81**	(d)	**92**	(c)	**103**	(a)
11	(c)	**23**	(a)	**35**	(a)	**47**	(a)	**59**	(c)	**71**	(a)	**82**	(b)	**93**	(a)	**104**	(a)
12	(b)	**24**	(b)	**36**	(a)	**48**	(c)	**60**	(a)								

Hints & Solutions

1. (b) We know that, $R = \frac{\rho\ell}{A}$

or $R = \frac{\rho\ell^2}{\text{Volume}} \Rightarrow R \propto \ell^2$

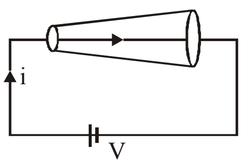
According to question $\ell_2 = n\ell_1$

$$\frac{R_2}{R_1} = \frac{n^2 l_1^2}{l_1^2}$$

or, $\frac{R_2}{R_1} = n^2$

$\Rightarrow R_2 = n^2 R_1$

2. (a) Here, metallic conductor can be considered as the combination of various conductors connected in series. And in series combination current remains same.



3. (c) Resistance $R = \frac{\rho\ell}{A}$

$\because \ell' = 2\ell$

$\therefore A' = \frac{A}{2}$

$\therefore R' \rho \frac{2\ell}{\frac{A}{2}} = 4R = 4 \times 4\,\Omega = 16\,\Omega$

Therefore the resistance of new wire becomes $16\,\Omega$

4. (a) Copper rod and iron rod are joined in series.

$$\therefore R = R_{Cu} + R_{Fe} = (\rho_1 + \rho_2)\frac{\ell}{A} \quad \left(\because R = \rho\frac{\ell}{A}\right)$$

From ohm's law $V = RI$

$= (1.7 \times 10^{-6} \times 10^{-2} + 10^{-5} \times 10^{-2}) \div 0.01 \times 10^{-4}$ volt

$= 0.117$ volt ($\because I = 1A$)

5. (b) Resistance of a wire is given by $R = \rho\frac{l}{a}$

If the length is increased by 10% then new length $l' = l + \frac{1}{10} = \frac{11}{10}l$

In that case, area of cross-section of wire would decrease by 10%

$\therefore$ New area of cross-section

$$A' = A - \frac{A}{10} = \frac{9}{10}A$$

$$\therefore R' = \rho\frac{\ell'}{A'} = \rho\frac{\frac{1}{10}l}{\frac{9}{10}A}$$

$R' = \frac{11}{9}\rho\frac{l}{R}$ $\qquad R' = 1.21R$

Thus the new resistance increases by 1.21 times. The specific resistance (resistivity) remains unchanged as it depends on the nature of the material of the wire.

6. (c) $R = \frac{\rho\ell_1}{A_1}$, now $\ell_2 = 2\ell_1$

$A_2 = \pi(r_2)^2 = \pi(2r_1)^2 = 4\pi r_1^2 = 4A_1$

$$\therefore \quad R_2 = \frac{\rho(2\ell_1)}{4A_1} = \frac{\rho\ell_1}{2A_1} = \frac{R}{2}$$

$\therefore$ Resistance is halved, but specific resistance remains the same.

7. (d) $R \,\alpha\, \ell$

For 300 cm, $R = 100\,\Omega$

For 50 cm, $R' = \frac{100}{300} \times 50 = \frac{50}{3}\Omega$

$\therefore IR = 6$

$$\Rightarrow IR' = \frac{6}{R} \times R' = \frac{6}{100} \times \frac{50}{3} = 1 \text{ volt.}$$

8. (a) Resistivity of copper wire increases with increase in temprature as $\rho_t = \rho_0(1 + \alpha t)$

Copper being a metal has positive coefficient of resistivity.

9. (b) Conductivity of semiconductor increases with increase in temperature while conductivity of metal decreases with increase in temperature.

10. (a) $R_1 = 3.1\ \Omega$ at $t = 30°C$
$R_2 = 4.5\ \Omega$ at $t = 100°C$
We have, $R = R_0(1 + \alpha t)$
$\therefore R_1 = R_0[1 + \alpha(30)]$
$R_2 = R_0[1 + \alpha(100)]$

$$\Rightarrow \frac{R_1}{R_2} = \frac{1+30\alpha}{1+100\alpha}$$

$$\Rightarrow \frac{3.1}{4.5} = \frac{1+30\alpha}{1+100\alpha} \Rightarrow \alpha = 0.0064°C^{-1}$$

11. (c) In discharge tube the current is due to flow of positive ions and electrons. Moreover, secondary emission of electrons is also possible. So V-I curve is non-linear; hence resistance is non-ohmic.

12. (b) $R = \rho\frac{l}{A}$

$$R_1 = \rho\frac{L}{A} \qquad ...(1)$$

$$R_2 = \rho\frac{2L}{A} \times 2 \qquad ...(2)$$

$$R_3 = \rho\frac{L}{2.2A} = \frac{\rho L}{4A} \qquad ...(3)$$

$\Rightarrow R_3 < R_1 < R_2$

13. (a) As we know that resistance varies with temperature as
$R = R_0[1 + \alpha t]$
Ist Case : $5 = R_0[1 + \alpha(50)]$ ....(I)
IInd Case : $7 = R_0[1 + \alpha(100)]$ .....(II)

Divide (I) by (II), $\frac{5}{7} = \frac{1+50\alpha}{1+100\alpha}$

$5 + 500\alpha = 7 + 350\alpha$

$150\,\alpha = 2 \Rightarrow \alpha = \frac{2}{150} = 0.001/°C$

14. (b) Given : Length of wire $(l) = 15$m
Area (A) $= 6 \times 10^{-7}\ m^2$
Resistance (R) $= 5\Omega$.
We know that resistance of the wire material

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

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

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

[where ρ = coefficient of resistivity]

15. (a) Initial resistance $(R_1) = R$; Initial length is ℓ_1 and final length $(\ell_2) = 0.5\,\ell$. Volume of a wire $= \ell . A$. Since the volume of the wire remains the same after recasting, therefore $\ell_1 . A_1 = \ell_2 A_2$

or $\frac{\ell_1}{\ell_2} = \frac{A_2}{A_1}$ or $\frac{\ell}{0.5\ell} = \frac{A_2}{A_1}$ or $\frac{A_2}{A_1} = 2$.

We also know that resistance of a wire (R)

$R = \rho \times \frac{\ell}{A}$. ; $R \propto \frac{\ell}{A}$

$$\therefore \frac{R_1}{R_2} = \frac{\ell_1}{\ell_2} \times \frac{A_2}{A_1} = \frac{\ell}{0.5\ell} \times 2 = 4$$

or , $R_2 = \frac{R_1}{4} = \frac{R}{4}$.

[Alt : When wires are drawn from same volume but with different area of cross-section, then

$$R \propto \frac{1}{(\text{Area of cross-section})^2}$$

16. (a)

17. (d) $R = \frac{\rho l}{\pi r^2}$. But $m = \pi r^2 ld \therefore \pi r^2 = \frac{m}{ld}$

$$\therefore R = \frac{\rho l^2 d}{m},\ R_1 = \frac{\rho l_1^2 d}{m_1},\ R_2 = \frac{\rho l_2^2 d}{m_2}$$

$$R_3 = \frac{\rho l_3^2 d}{m_3}$$

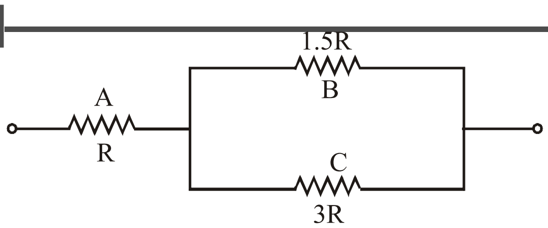
$$R_1 : R_2 : R_3 = \frac{l_1^2}{m_1} : \frac{l_2^2}{m_2} : \frac{l_3^2}{m_3}$$

$$R_1 : R_2 : R_3 = \frac{25}{1} : \frac{9}{3} : \frac{1}{5} = 125 : 15 : 1$$

18. (d) Effective resistance of B and C

$$= \frac{R_B \cdot R_C}{R_B + R_C} = \frac{1.5R \times 3R}{1.5R + 3R} = \frac{4.5R^2}{4.5R} = R$$

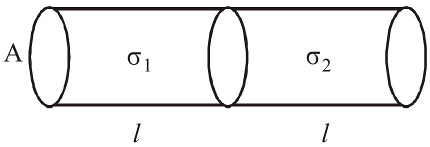
i.e., equal to resistance of voltmeter A.



In parallel potential difference is same so, $V_B = V_C$ and in series current is same

So, $V_A = V_B = V_C$

19. (d) In figure, two metal wires of identical dimension are connected in series



$$R_{eq} = \frac{l}{\sigma_1 A} + \frac{l}{\sigma_2 A} = \frac{l_{eq}}{\sigma_{eq} A_{eq}}$$

$$\frac{2l}{\sigma_{eq} A} = \frac{l}{A}\left(\frac{\sigma_1 + \sigma_2}{\sigma_1 \sigma_2}\right)$$

$$\therefore \sigma_{eq} = \frac{2\sigma_1\sigma_2}{\sigma_1 + \sigma_2}$$

20. (c) Resistance is directly proportional to length

$$\frac{1}{R_{AB}} = \frac{1}{3} + \frac{1}{4+5} = \frac{(4+5)+3}{(3)(4+5)}$$

$$R_{AB} = \frac{3 \times (4+5)}{3 + (4+5)} = \frac{27}{12}$$

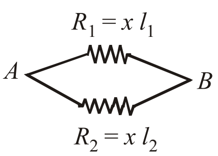
Similarly,

$$R_{BC} = \frac{4 \times (3+5)}{4 + (3+5)} = \frac{32}{12}$$

$$R_{AC} = \frac{5 \times (3+4)}{5 + (3+4)} = \frac{35}{12}$$

$\therefore R_{AB} : R_{BC} : R_{AC} = 27 : 32 : 35$

21. (d) Let x is the resistance per unit length then



equivalent resistance $R = \dfrac{R_1 R_2}{R_1 + R_2}$

$$\frac{(x_1 l_1)(x_2 l_2)}{x l_1 + x l_2}$$

$$\Rightarrow \frac{8}{3} = x\frac{l_1 l_2}{l_1 + l_2}$$

$$\frac{8}{3} = x\frac{l_1}{\frac{l_1}{l_2} + 1} \qquad ...(i)$$

also $R_0 = x l_1 + x\, l_2$

$12 = x(l_1 + l_2)$

$$12 = x l_2\left(\frac{l_1}{l_2} + 1\right) \qquad ...(ii)$$

$$\frac{(i)}{(ii)} \Rightarrow \frac{\frac{8}{3}}{\frac{12}{1}} = \frac{\dfrac{x l_1}{\left(\frac{l_1}{l_2}+1\right)}}{x l_2\left(\frac{l_1}{l_2}+1\right)} = \frac{l_1}{l_2\left(\frac{l_1}{l_2}+1\right)^2}$$

$$\left(\frac{l_1}{l_2}+1\right)^2 \times \frac{8}{36} = \frac{l_1}{l_2}$$

$$(y^2 + 1 + 2y) \times \frac{8}{36} = y \text{ (where } y = \frac{l_1}{l_2})$$

$8y^2 + 8 + 16y = 36y$

$\Rightarrow 8y^2 - 20y + 8 = 0$

$\Rightarrow 2y^2 - 5y + 2 = 0$

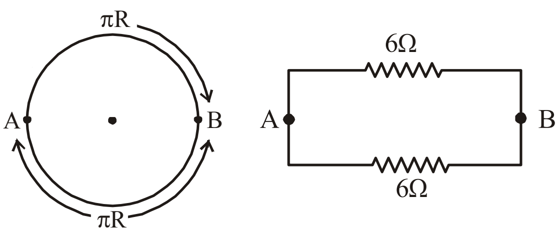
$\Rightarrow 2y^2 - 4y - y + 2 = 0$

$\Rightarrow 2y\,(y - 2) - 1(y - 2) = 0$

$\Rightarrow (2y - 1)\,(y - 2) = 0$

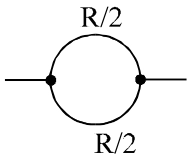
$$\Rightarrow y = \frac{l_1}{l_2} = \frac{1}{2} \text{ or } 2$$

22. (a)



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

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

23. (a) 

$$R_{eq} = \frac{R_1R_2}{R_1+R_2} = \frac{\left(\frac{R}{2}.\frac{R}{2}\right)}{\frac{R}{2}+\frac{R}{2}} \quad \therefore R_{eq} = \frac{R}{4}$$

24. (b) $R = \dfrac{r}{n} \Rightarrow r = nR$

When connected in series, $R_{eq} = nr$
$= n\,(nR) = n^2R$

25. (b) In circuit, R_B and R_C are in series, so, $R_s = 6+6 = 12\ \Omega$. This $12\ \Omega$ resistance is in parallel with $R_A = 3\ \Omega$,

So, equivalent resistance of circuit

$$R = \frac{3\times 12}{3+12} = \frac{36}{15} = \frac{12}{5}\Omega$$

$\therefore$ Current in circuit, $I = \dfrac{V}{R}$

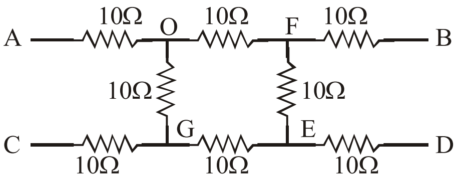
$$= \frac{4.8}{\left(\frac{12}{5}\right)} = \frac{4.8\times 5}{12} = 2\text{A}$$

26. (a) Resistance of ACB, $R' = 3\Omega + 3\Omega = 6\Omega$.
For net resistance between A and B; $R' = 6\Omega$ and 3Ω are in parallel.

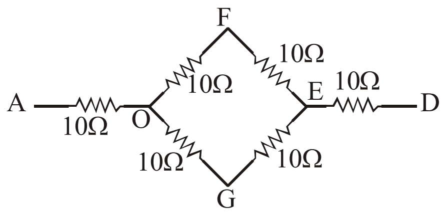
$$R_{AB} = \frac{3\times 6}{3+6} = \frac{18}{9} = 2\Omega$$

Current in circuit $(I) = \dfrac{E}{R_{AB}} = \dfrac{2}{2} = 1A$

27. (c)



Equivalent Circuit



Equivalent Resistance of circuit

$$= 10\Omega + \frac{20\times 20}{20+20} + 10 = 10+10+10 = 30\Omega$$

28. (c) Length of each wire $= \ell$; Area of thick wire $(A_1) = 3A$; Area of thin wire $(A_2) = A$ and resistance of thick wire $(R_1) = 10\ \Omega$. Resistance

$$(R) = \rho\frac{\ell}{A} \propto \frac{1}{A} \text{ (if } \ell \text{ is constant)}$$

$$\therefore \frac{R_1}{R_2} = \frac{A_2}{A_1} = \frac{A}{3A} = \frac{1}{3}$$

or, $R_2 = 3R_1 = 3\times 10 = 30\ \Omega$

The equivalent resistance of these two resistors in series

$= R_1 + R_2 = 30 + 10 = 40\Omega$.

29. (a) The potential difference across 4Ω resistance is given by

$V = 4\times i_1 = 4\times 1.2 = 4.8$ volt

So, the potential across 8Ω resistance is also 4.8 volt.

Current $i_2 = \dfrac{V}{8} = \dfrac{4.8}{8} = 0.6$ amp

Current in 2Ω resistance $i = i_1 + i_2$

$\therefore i = 1.2 + 0.6 = 1.8$ amp

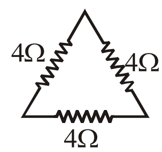
Potential difference across 2Ω resistance

$V_{BC} = 1.8\times 2 = 3.6$volts

30. (d) The two resistances are connected in series and the resultant is connected in parallel with the third resistance.

$$\therefore R' = 4\ \Omega + 4\ \Omega = 8\Omega \text{ and } \frac{1}{R''} = \frac{1}{8} + \frac{1}{4} = \frac{3}{8}$$

or $R'' = \dfrac{8}{3}\Omega$



31. (c) Voltage across 3 Ω resistance = 3 × 0.8 = 2.4V This voltage is the same across 6 Ω resistance. Hence current through this resistance

$$i = \frac{V}{R} = \frac{2.4}{6} = 0.4\,\text{amp}$$

Total current in the circuit
$= 0.8 + 0.4 = 1.2$ amp
Voltage across 4 Ω resistance
$= 4 \times 1.2 = 4.8$ volts

32. (c) To carry a current of 4 ampere, we need four paths, each carrying a current of one ampere. Let r be the resistance of each path. These are connected in parallel. Hence, their equivalent resistance will be r/4. According to the given problem $\frac{r}{4} = 5$ or $r = 20\Omega$.

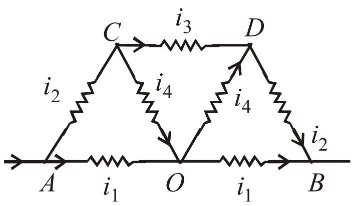
For this propose two resistances should be connected. There are four such combinations. Hence, the total number of resistance $= 4 \times 2 = 8$.

33. (d) At A current is distributed and at B currents are collected. Between A and B, the distribution is symmetrical. It has been shown in the figure. It appears that current in AO and OB remains same. At O, current i_4 returns back without any change. If we detach O from AB there will not be any change in distribution.
Now, CO & OD will be in series hence its total resistance = 2Ω
It is in parallel with CD, so, equivalent resistance

$$= \frac{2\times 1}{2+1} = \frac{2}{3}\Omega$$

This equivalent resistance is in series with AC & DB, so, total resistance

$$= \frac{2}{3} + 1 + 1 = \frac{8}{3}\Omega$$



Now $\frac{8}{3}\Omega$ is parallel to AB, that is, 2Ω, so total resistance

$$= \frac{8/3 \times 2}{8/3 + 2} = \frac{16/3}{14/3} = \frac{16}{14} = \frac{8}{7}\Omega$$

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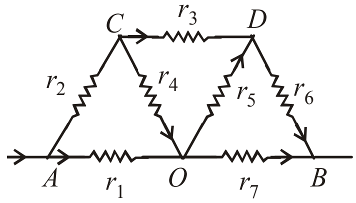


Between C & D, the equivalent resistance is given by

$$1/r = \frac{1}{r_3} + \frac{1}{(r_4 + r_5)} = 1 + \frac{1}{2} = \frac{3}{2}$$

Equivalent resistance along

$$ACDB = 1 + \frac{2}{3} + 1 = \frac{8}{3}$$

∴ Effective resistance between A and B is

$$\frac{1}{R} = \frac{3}{8} + \frac{1}{2} = \frac{7}{8} \text{ or } R = \frac{8}{7}\Omega]$$

34. (c) In series, $R_s = nR$

In parallel, $\frac{1}{R_p} = \frac{1}{R} + \frac{1}{R} + \ldots n$ terms

$\therefore R_s/R_p = n^2/1 = n^2$

35. (a) $I = \frac{8-4}{1+2+9} = \frac{4}{12} = \frac{1}{3}A$;

$$V_P - V_Q = 4 - \frac{1}{3} \times 3 = 3\,\text{volt}$$

36. (a) Given : emf ε = 2.1 V
I = 0.2 A, R = 10Ω
Internal resistance r = ?
From formula.
$\varepsilon - Ir = V = IR$
$2.1 - 0.2r = 0.2 \times 10$
$2.1 - 0.2\,r = 2$ or $0.2\,r = 0.1$

$$\Rightarrow r = \frac{0.1}{0.2} = 0.5\,\Omega$$

ALTERNATE : $i = \frac{\varepsilon}{r+R} \Rightarrow 0.2 = \frac{2.1}{r+10}$

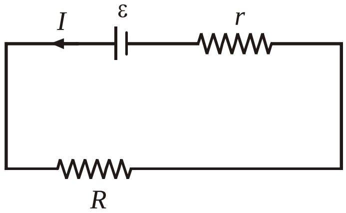
$$\Rightarrow 2.1 = 0.2\,r + 2 \Rightarrow r = \frac{1}{2} = 0.5\,\Omega$$

37. (c) The current through the resistance R

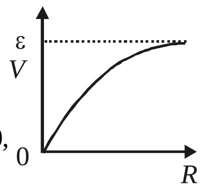
$$I = \left(\frac{\varepsilon}{R+r}\right)$$

The potential difference across R

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



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



when $R = 0$, $V = 0$,
$R = \infty$, $V = \varepsilon$
Thus V increases as R increases upto certain limit, but it does not increase further.

38. (b) Let the internal resistance of the battery be r. Then the current flowing through the circuit is given by

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

In first case,

$$2 = \frac{E}{2+r} \qquad ...(1)$$

In second case,

$$0.5 = \frac{E}{9+r} \qquad ...(2)$$

From (1) & (2),
$4 + 2r = 4.5 + 0.5\,r$

$$\Rightarrow 1.5\,r = 0.5 \Rightarrow r = \frac{1}{3}\ \Omega.$$

39. (b) We have,
$e = at + bt^2$

$$\Rightarrow \frac{de}{dt} = a + 2bt$$

At neutral temperature,

$$t = -\frac{a}{2b}$$

$$\therefore \frac{de}{dt} = 0$$

40. (d) 1 division = 1μA

Current for 1°C = $\frac{40\mu V}{10} = 4\mu A$

$1\mu A = \frac{1}{4}\,°C = 0.25°C.$

41. (d) Current from D to C = 1A
$\therefore V_D - V_C = 2 \times 1 = 2V$
$V_A = 0$ $\quad\therefore V_C = 1V,\ \therefore V_D - V_C = 2$
$\Rightarrow V_D - 1 = 2 \quad \therefore V_D = 3V$
$\therefore V_D - V_B = 2 \quad \therefore 3 - V_B = 2\ \therefore V_B = 1V$

42. (c) $I = \frac{P}{V} = \frac{100\times10^3}{125}A = \frac{10^5}{60}A$
$E.C.E. = 0.367 \times 10^{-6}\ kg\ C^{-1}$
Charge per minute = $(I \times 60)\,C$

$$= \frac{10^5 \times 60}{125}C = \frac{6\times10^6}{125}C$$

$\therefore$ Mass liberated

$$= \frac{6\times10^6}{125} \times 0.367 \times 10^{-6}$$

$$= \frac{6\times1000\times0.367\times10^{-3}}{125}$$

$= 17.616 \times 10^{-3}\ kg$

43. (d) Junction law follows from conservation of charge and loop law is the conservation of energy

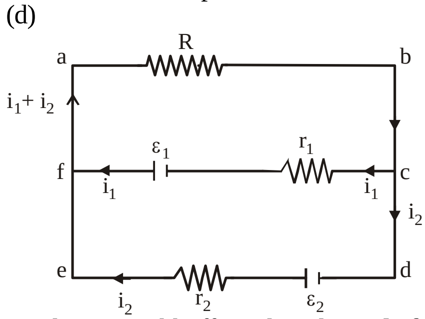
44. (d) $E = 30\theta - \frac{\theta^2}{15}$

For neutral temperature, $\frac{dE}{d\theta} = 0$

$$0 = 30 - \frac{2}{15}\theta$$

$\therefore \theta = 15 \times 15$
$= 225°\ C$
Hence, neutral temperature is 225°C.

45. (d)



Applying Kirchhoff 's rule in loop **abcfa**
$\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0.$

46. (a) The terminal potential difference of a cell is given by V + Ir = E

$V = V_A - V_B$

or $V = E - Ir$

$\Rightarrow \frac{dV}{dI} = -r$, Also for, i = 0 then V = E

$\therefore$ slope = – r, intercept = E

47. (a) Here $E > \frac{ER}{R+r}$, hence the lengths 110 cm and 100 cm are interchanged.

Without being short-circuited through R, only the battery E is balanced.

$$E = \frac{V}{L} \times l_1 = \frac{V}{L} \times 110 .....(i)$$

When R is connected across E, $Ri = \frac{V}{L} \times l_2$

or, $R\left(\frac{E}{R+r}\right) = \frac{V}{L} \times 100 .....(ii)$

Dividing (i) by (ii), we get

$$\frac{R+r}{R} = \frac{110}{100}$$

or, 100 R + 100 r = 110 R

or, 10 R = 100 r

$$\therefore\ r = \frac{10R}{100} = \frac{10 \times 10}{100} (\because R = 10\Omega)$$

$\Rightarrow r = 1\Omega$.

48. (c) We have, $m = ZIt$

where, Z is the electrochemical equivalent of copper.

$\Rightarrow m = 30 \times 10^{-5} \times 1.5 \times 10 \times 60$

= 0.27 gm.

49. (d) Power = $V \times I$

$$I = \frac{Power}{V} = \frac{100}{125}$$

E.C.E. of chlorine is 0.367×10^{-6} kg/coulomb

Charge passing in one minute $= \frac{100}{125} \times 60$

= 48 coulomb

Chlorine precipitated = $0.367 \times 10^{-6} \times 48$

= 17.6×10^{-6} kg

= 17.6 mg

50. (a) Kirchhoff ' s first law deals with conservation of electrical charge & the second law deals with conservation of electrical energy.

51. (d) Current in the circuit

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

P.D. across first cell = $E - ir_1$

$$= E - \frac{2E \times r_1}{(r_1 + r_2) + R}$$

Now, $E = \frac{2Er_1}{(r_1 + r_2) + R} = 0$

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

$R = r_1 - r_2$

52. (d) $V = \dfrac{\frac{E_1}{r_1} + \frac{E_2}{r_2}}{\frac{1}{r_1} + \frac{1}{r_2}} = \dfrac{\frac{18}{2} + \frac{12}{1}}{\frac{1}{2} + \frac{1}{1}} = 14V$

(Since the cells are in parallel).

53. (a) Efficiency is given by $\eta = \frac{output}{input}$

$$= \frac{5 \times 15 \times 14}{10 \times 8 \times 15} = 0.875 \text{ or } 87.5\ \%$$

54. (b) $E = V + ir$

$$2.2 = 1.8 + \frac{1.8}{5} \times r$$

$$\Rightarrow r = \frac{10}{9}\Omega$$

55. (b) By Faraday's Ist Law

Amount deposited (m) = Zit = Zq

$m \propto q$

Amount deposited is directly proportional to charge.

56. (d) $E = V + Ir$

$12 = V + 60 \times 5 \times 10^{-2}$

$12 = V + 3$

$\Rightarrow V = 9$ volt

57. (c) $m = Zit$, $9 = Z \times 10^5$, $Z = 9 \times 10^{-5}$

Again,

$m = Zit = 9 \times 10^{-5} \times 50 \times 20 \times 60 = 5.4$ gm

58. (a) We know from the Kirchhoff 's first law that the algebraic sum of the current meeting at any junction in the circuit is zero (i.e. $\Sigma i = 0$) or the total charge remains constant. Therefore, Kirchhoff's first law at a junction deals with the conservation of charge.

59. (c) In the electrolysis of $CuSO_4$, oxygen is liberated at anode and copper is deposited at cathode.

60. (a) Faraday's laws are based on the conversion of electrical energy into mechanical energy; which is in accordance with the law of conservation of energy.

61. (a) **Given:** Charge $Q = at - bt^2$

$\therefore$ Current $i = \frac{\partial Q}{\partial t} = a - 2bt$

$\{\text{for } i = 0 \Rightarrow t = \frac{a}{2b}\}$

From joule's law of heating, heat produced $dH = i^2 Rdt$

$$H = \int_0^{a/2b} (a - 2bt)^2 \, Rdt$$

$$H = \left. \frac{(a-2bt)^3 R}{-3 \times 2b} \right|_0^{\frac{a}{2b}} = \frac{a^3 R}{6b}$$

62. (b) Total resistance $R = (0.5\ \Omega/\text{km}) \times (150\ \text{km})$ $= 75\ \Omega$

Total voltage drop $= (8\ \text{V/km}) \times (150\ \text{km})$ $= 1200\ \text{V}$

$$\text{Power loss} = \frac{(\Delta V)^2}{R} = \frac{(1200)^2}{75}\ \text{W}$$

$= 19200\ \text{W} = 19.2\ \text{kW}$

63. (b) Resistance is directly proportionl to length of the wire. As length is doubled so mass is doubled and resistance is doubled.

We have

$$\frac{(10E)^2}{R} t = mS\Delta T, \ \text{Now } \frac{(nE)^2 t}{2R} = (2m)S\Delta T$$

$$\Rightarrow \frac{n^2 E^2 t}{2R} = 2 \frac{10^2 E^2 t}{R}$$

$\Rightarrow n = 20$

64. (c) Resistance of bulb is constant

$$P = \frac{V^2}{R} \Rightarrow \frac{\Delta p}{p} = \frac{2\Delta V}{V} + \frac{\Delta R}{R}$$

$$\frac{\Delta p}{p} = 2 \times 2.5 + 0 = 5\%$$

65. (c) The power dissipated in the circuit.

$$P = \frac{V^2}{R_{eq}} \qquad ...(i)$$

$v = 10$ volt

$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{5} = \frac{5+R}{5R}$$

$$R_{eq} = \left(\frac{5R}{5+R}\right)$$

$P = 30$ W

Substituting the values in equation (i)

$$30 = \frac{(10)^2}{\left(\frac{5R}{5+R}\right)}$$

$$\frac{15R}{5+R} = 10$$

$15R = 50 + 10R$

$5R = 50$

$R = 10\ \Omega$

66. (c) We have,

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

$$\Rightarrow 36 = \frac{V^2}{9}$$

$\Rightarrow V = 18V$

Current passing through the 9Ω resistor is

$$i_1 = \frac{V}{R} = \frac{18}{9} = 2A$$

The 9Ω and 6Ω resistors are in parallel, therefore

$$i_1 = \frac{6}{9+6} \times i$$

where i is the current delivered by the battery.

$$\therefore i = \frac{2 \times 15}{6} = 5A$$

Thus, potential difference across 2Ω resistor is

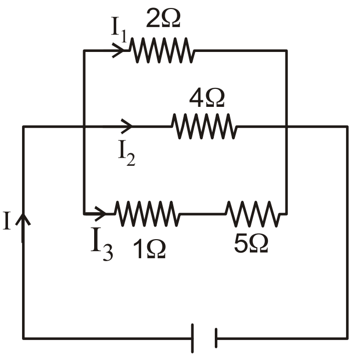
$V = iR$

$= 5 \times 2$

$= 10V$

67. (d) Clearly, 2Ω, 4Ω and $(1+5)\Omega$ resistors are in parallel. Hence, potential difference is same across each of them.

$\therefore I_1 \times 2 = I_2 \times 4 = I_3 \times 6$



Given $I_1 = 3A$ $\quad\therefore I_1 \times 2 = I_3 \times 6$

Given $I_1 = 3A$.

$\therefore$ $I_1 \times 2 = I_3 \times 6$ provides

$$I_3 = \frac{I_1 \times 2}{6} = \frac{3 \times 2}{6} = 1A.$$

Now, the potential across the 5Ω resistor is $V = I_3 \times 5 = 1 \times 5 = 5V$.

$\therefore$ the power dissipated in the 5Ω resistor

$$P = \frac{V^2}{R} = \frac{5^2}{5} = 5\,\text{watt}.$$

68. (b) Power dissipated $= P$

$$= \frac{V^2}{R} = \frac{(18)^2}{6} = 54\text{ W}$$

69. (c) Power $= V.I = I^2R$

$$i_2 = \sqrt{\frac{\text{Power}}{R}} = \sqrt{\frac{2}{8}} = \sqrt{\frac{1}{4}} = \frac{1}{2}\text{ A}$$

Potential over 8Ω = $Ri_2 = 8 \times \frac{1}{2} = 4V$

This is the potential over parallel branch. So,

$$i_1 = \frac{4}{4} = 1\text{ A}$$

Power of 3Ω $= i_1^2R = 1 \times 1 \times 3 = 3W$

70. (a) $R = \frac{P}{I^2} = \frac{1}{25} = 0.04\Omega$

71. (a) $\frac{1}{P_{eq}} = \frac{1}{P_1} + \frac{1}{P_2} + \frac{1}{P_3}$ or $\frac{1}{P_{eq}} = \frac{3}{60}$

$\Rightarrow P_{eq} = 20$ watt.

72. (d) $P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P} = \frac{(220)^2}{60} = \frac{4(110)^2}{60}$

$$R' = \frac{(110)^2}{60} = \frac{R}{4}$$

73. (b) Time $= \frac{10 \times 40}{10 + 40} = \frac{400}{50} = 8\text{ min}$

74. (a) Power $\propto \frac{1}{\text{Resistance}}$

In series combination, resistance doubles.
Hence, power will be halved.
In parallel combination, resistance halves.
Hence, power will be doubled.

75. (c) **Fuse wire :** It is used in a circuit to control the maximum current flowing in circuit. It is a thin wire having **high resistance** and is made up of a material with **low melting point**.

76. (a) As for an electric appliance $R = (V_s^2/W)$, so for same specified voltage V_s

$$\frac{R_{25}}{R_{100}} = \frac{100}{25} = 4$$

i.e, $R_{25} = 4R$ with $R_{100} = R$

Now in series potential divides in proportion to resistance.

So, $V_1 = \frac{R_1}{(R_1 + R_2)} V$

i.e., $V_{25} = \frac{4}{5} \times 440 = 352V$

and $V_2 = \frac{R_2}{(R_1 + R_2)} V$

i.e., $V_{100} = \frac{1}{5} \times 440 = 88V$

From this, it is clear that voltage across 100 W bulb (= 88 V) is lesser than specified (220 V) while across 25 W bulb (= 352 V) is greater than specified (220 V), so, 25 W bulb will fuse.

77. (b) Power is maximum when $r = R$, $R = r = 0.5\Omega$.

78. (b) $R_1 = \frac{V^2}{P_1} = \frac{200 \times 200}{40} = 1000\,\Omega$

$$R_2 = \frac{V^2}{P_2} = \frac{200 \times 200}{100} = 400\,\Omega$$

$\therefore R_1$ (for 40W) $> R_2$ (for 100 W)

79. (d) In series, Equivalent resistance $= 3R$

$$\text{Power} = \frac{V^2}{3R} \Rightarrow 10 = \frac{V^2}{3R} \Rightarrow V^2 = 30R$$

In parallel, $\frac{1}{R'} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} = \frac{3}{R}$

$\therefore$ Equivalent resistance $R' = \frac{R}{3}$

$\therefore$ Power $= \frac{V^2}{R'} = \frac{30R}{R/3} = 90$ W

80. (c) Since $H \propto I^2$, doubling the current will produce 4 times heat. Hence, the rise in temperature will also be 4 times i.e., rise in temperature $= 4 \times 5 = 20°C$.

81. (d) Power = 100 W, Voltage = 200 V
Resistance of bulb

$= \frac{V^2}{P} = \frac{200 \times 200}{100} = 400\,\Omega$

When bulb is applied across 160 V,

Current in bulb $= \frac{160}{400} A$

Power consumption = VI $= 160 \times \frac{160}{400} = 64$W

82. (d) Power of heating coil = 100 W and voltage (V) = 220 volts. When the heating coil is cut into two equal parts and these parts are joined in parallel, then the resistance of the coil is reduced to one-fourth of the previous value. Therefore energy liberated per second becomes 4 times i.e., 4 × 100 = 400 J.

83. (d) The energy stored in the capacitor

$= \frac{1}{2}CV^2 = \frac{1}{2} \times 4 \times 10^{-4} \times 400 \times 400 = 0.32\,J$;

This energy will be converted into heat in the resistor.

84. (b) For maximum current, the two batteries should be connected in series. The current will be maximum when external resistance is equal to the total internal resistance of cells i.e. 2Ω. Hence power devloped across the resistacne R will be

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

85. (b) Since, the voltage is same for the two combinations, therefore $H \propto \frac{1}{R}$. Hence, the combination of 39 bulbs will glow more.

86. (b) $H = I^2Rt$

or $R = \frac{H}{(I^2t)} = \frac{80}{(2^2 \times 10)} = 2\Omega$

87. (b) Reading of potentiometer is accurate because during taking reading it does not draw any current from the circuit.

88. (d) When two cells are connected in series i.e., $E_1 + E_2$ the balance point is at 50 cm. And when two cells are connected in opposite direction i.e., $E_1 - E_2$ the balance point is at 10 cm. According to principle of potential

$$\frac{E_1 + E_2}{E_1 - E_2} = \frac{50}{10}$$

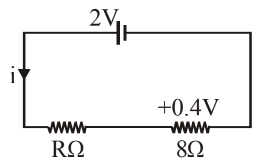
$$\Rightarrow \frac{2E_1}{2E_2} = \frac{50+10}{50-10} \Rightarrow \frac{E_1}{E_2} = \frac{3}{2}$$

89. (d) Total potential difference across potentiometer wire
$= 10^{-3} \times 400$ volt $= 0.4$ volt

potential gradient $= \frac{1\text{mv}}{\text{cm}}$

$= 10^{-3}$ v/cm $= 10^{-1} \frac{\text{v}}{\text{m}}$

Let resistance of RΩ connected in series.



So, $\frac{2}{R+8} = \frac{10^{-1} \times 4}{8} = \frac{1}{20}$

$\Rightarrow$ R + 8 = 40 or, R = 32 Ω

90. (a) EMF, E = Kl where K $= \frac{V}{L}$ potential gradient

$$K = \frac{V}{L} = \frac{iR}{L} = \left(\frac{E_0 r}{r + r_1}\right)\frac{l}{L}$$

So, $E = Kl = \frac{E_0 r l}{(r + r_1)L}$

91. (b) This is a balanced wheatstone bridge condition,

$$\frac{5}{R} = \frac{\ell_1}{100 - \ell_1} \text{ and } \frac{5}{R/2} = \frac{1.6\ell_1}{100 - 1.6\ell_1}$$

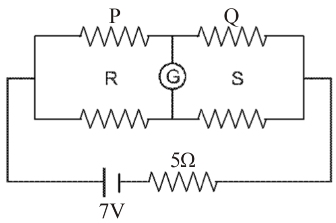
$\Rightarrow$ R = 15 Ω

92. (c) Internal resistance of the cell,

$$r=\left(\frac{E-V}{V}\right)R=\left(\frac{\ell_1-\ell_2}{\ell_2}\right)R$$

$$=\left(\frac{3-2.85}{2.85}\right)\times(9.5)\,\Omega=0.5\,\Omega$$

93. (a) Given : V = 7 V
r = 5Ω

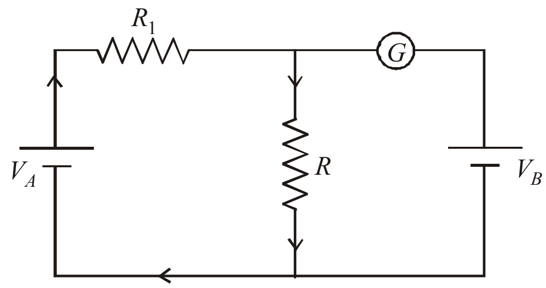


$$R_{eq}=\frac{40\times120}{40+120}\,\Omega$$

$$I=\frac{V}{R}=\frac{7}{5+\frac{40\times120}{40+120}}$$

$$=\frac{7}{5+30}=\frac{1}{5}=0.2\,A.$$

94. (b)



Since deflection in galvanometer is zero so current will flow as shown in the above diagram.

$$\text{current } I=\frac{V_A}{R_1+R}=\frac{12}{500+100}=\frac{12}{600}$$

$$\text{So}\quad V_B=IR=\frac{12}{600}\times100=2V$$

95. (b) (i) When key between the terminals 1 and 2 is plugged in,
P.D. across $R = IR = k\,l_1$
$\Rightarrow\ R = k\,l_1$ as $I = 1A$

(ii) When key between terminals 1 and 3 is plugged in,
P.D. across $(X+R) = I(X+R) = k\,l_2$
$\Rightarrow\ X + R = k\,l_2$
$\therefore\ X = k\,(l_2 - l_1)$
$\therefore\ R = kl_1$ and $X = k\,(l_2 - l_1)$

96. (a) A balanced wheatstone bridge simply requires

$$\frac{P}{Q}=\frac{R}{S}\Rightarrow\frac{2}{2}=\frac{2}{S}$$

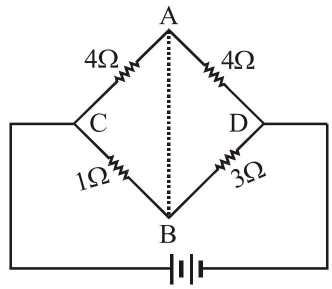
Therefore, S should be 2Ω.
A resistance of 6Ω is connected in parallel.
In parallel combination,

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

$$\frac{1}{2}=\frac{1}{6}+\frac{1}{S}$$

$\Rightarrow S = 3\Omega$

97. (c) Current will flow from B to A



Potential drop over the resistance CA will be more due to higher value of resistance. So potential at A will be less as compared with at B. Hence, current will flow from B to A.

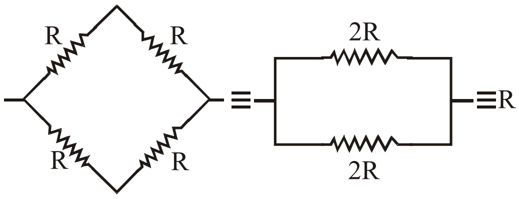
98. (d) It is a balanced Wheatstone bridge. Hence resistance 4Ω can be eliminated.

$$\therefore\ R_{eq}=\frac{6\times9}{6+9}=\frac{18}{5}$$

$$\therefore\ i=\frac{V}{R_{eq}}=\frac{5V}{18}$$

99. (d) A balanced Whestone's bridge exists between A & B.
$\therefore R_{eq} = R$
Current through circuit = V/R
Current through AFCEB = V/2R

100. (d) Since, Wheatstone's bridge is balanced, then resistance of galvanometer will be uneffective.



101. (a) Potential gradient = Potential fall per unit length. In this case resistance of unit length.

$$R = \frac{\rho l}{A} = \frac{10^{-7} \times 1}{10^{-6}} = 10^{-1}\Omega$$

Potential fall across R is

$$V = I.R = 0.1 \times 10^{-1} = 0.01 \text{ volt/m.}$$

$$= 10^{-2} \text{ volt / m}$$

102. (a) Potentiometer measures potential current more accurately because it measure potential in open circuit and hence error in potential due to internal resistance is removed.

103. (a) It is a balanced wheatstone bridge $\left(\because \frac{3}{4} = \frac{6}{8}\right)$, so the 7Ω resistance is ineffective.

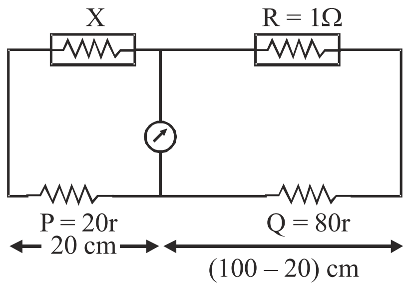
Equivalent resistance of 3Ω and 4Ω = 3 + 4 = 7Ω (series)

Equivalent resistance of 6Ω and 8Ω = 6 + 8 = 14Ω (series)

Equivalent resistance of 7Ω and 14Ω (parallel)

$$= \frac{7 \times 14}{7 + 14} = \frac{14}{3}\Omega$$

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



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