PHYSICS

BOOKS - MODERN PUBLISHERS PHYSICS (HINGLISH)

CURRENT ELECTRICITY

Solved Examples

1. If current in a conductor linearly drops to zero from initial magnitude i_0 in time interval t_0 what amount of charge must have passed through the conductor ?

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2. The frequency of revolution of electrons of electron in its orbit arount some nucleus is 3×10^{15} revolutions per seconds .

If we consider the motion of electron as one loop of current , what should be the magnitude of equivalent electric current ?

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3. The speed of electron in a circular orbit of 0.5Å, around the proton in a hydrogen atom is 2×10^6 m/s.

Calculate the equivalent currrent assuming motion of electron as one current loop.

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4. The variation of current for an interval of 20 seconds is shown in the graph. Calculate the amount of charge that must have flown in this interval of time

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5. If a charge flowing through a cross section of wire can be written as $q = 5t^2 + 8tC$, then calculate the electric current at t=0 and t=2s. Calculate the amount of charge that must have flown in the interval of 2 seconds starting from t=0 and also calculate the average electric current for this interval.

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6. Assume two copper rods A and B are connected to each other at one end. Lengths of the rods ar equal.

Radii of cross section of A and B are 2 mm and 4 mm respectively. If the current density in A is $9 \times 10^5 A / m^2$ then calculate the current density in B.

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7. If one mole of electrons is passing from point P to another point Q on a straight metal wire in time interval of 1 ms, then what will be the magnitude of current in the wire ? What is the direction of current ?

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8. How many electrons should flow per seconds to constitute a current of magnitude one ampere ?

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9. An incandescent lamp draws a current of 0.5 ampere.

How many electrons are passing through the filament of lamp every hour ?

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10. We know that copper is a conductor of electricity due to presence of free electrons in it. Assume that on an average each copper atom provides one free electron. Find the number of free electrons per unit valume of copper. The density of copper is approximately 9,000 kg $/m^3$ and its atomic mass is 63.5 u.

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11. There is a copper wire of radius 1mm and it carries a current of 2 ampere, calculate the drift speed of electrons assuming there are 8.5×10^{28} free electrons per metre cube.

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12. A copper wire of cross sectional area $0.5mm^2$ carries a currents of 1A . Assume that each copper atom contributes one free electron . The density of copper is 9,000 kg/m^3 and atomic mass is 63.5 u. if v_d is drift speed of electrons. Now assume that one copper atom is kept at temperature 300 K and it develops thermal motion. Let v_{rms} be the root mean square speed of copper atom at given temperature . find the ratio v_{rms}/v_d (HInt: Treat copper atom like a mono-atomic gas particle for the calculation of v_{rms})

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13. A metallic wire A of radius 1 mm is joined at one end with another metallic wire B of radius 2 mm .

when a battery is connected between two free ends of this composite wire, a currents of 20 A flows through it.

Calculate the currents density in wire A and also calculate the drift speed of electrons in wire B , if material of B has 9×10^{29} free electrons per unit volume.

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14. The mobility of electrons is defined as the drift velocity acquird by electrons when a unit electric field is applied.

Let a potential diffrence of 120 V be applied across a straight conductor of length 1m. What will be the drift speed of electrons if the mobility of electrons is given to be $6 \times 10^{-6} m^2 V^{-1} s^{-1}$?

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15. There is a conducting wire of length l and radius of cross section r. The number of free electrons per unit volume of the conductor is n and the mobility of electrons is μ. A battery of potential difference V is connected across its length. Find electric current flowing through the wire. Assume e as the magnitude of charge on electron.

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16. There is one rod of metal whose electrical resistance is R. What will be the new resistance if the rod is stretched to

(a) double its initial length?

(b) increase its length by double of its initial length ?

Assume that density of material remains constant.

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17. There is one hollow pipe of metal of length L . The inner radius of the pipe is r_1 and the outer radius is r_2 . The resistivity of material of pipe is ρ. Find the resistance.

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18. A thin copper rod of radius 1mm having an electrical resistance of 100Ω is connected to battery of emf 12 volts and negligible internal resistance through a wire of negligible resistance. Calculate current density in the wire. Also , calculate the number of electrons entering one and of the rod per seconds.

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19. The resistivity of copper is approximately $1.67 \times 10^{-8} \Omega m.$ Calculate the electrical resistance of a hollow tube made of copper of external radius 20 cm and length 20 cm . The thickness of copper is 50 mm .

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20. The current density in a conductor is $5A/m^2$ when an electric field of 50 V/m is applied across it. Calculate the conductivity of the material.

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21. The electrical resistance of a 5 m long wire is 3Ω Calculate the electrical resistivity and conductivity of material if its cross section is $0.03mm^2$.

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22. We have a 100 m long thin copper wire of resistance 100Ω it is melted to make a small rod of length 10 m.

what will be the new resistance ?

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23. We have one wire of resistance R_1 and it is stretched to n times its initial length to change its resistance to R_2 calculate R_2 / R_1 .

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24. Two cylinders P and Q of equal mass are made from the same metal. If the radius of P is n times the radius of Q , then calculate ratio of their resistances.

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25. A wire made of material A has resistance R_1 another wire made of material B having P time the length and q times the radius of first wire has resistance R_2 . If resistivity of B is r times that of A, then calculate R_2 / R_1 .

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26. Current flowing in two wires A and B of the same length is same when the same potential difference is applied across them. If conductivity of A is n times to that of B, then calculate the ratio of radii of cross section of the two wires.

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27. Calculate the drift speed developed in a metal wire when V potential difference is applied across length l of the wire. The number of free electrons per unit volume is n and conductivity of the material is σ.

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28. The resistivity of material of a wire is $2 \times 10^{-8} \Omega m$ and the number of free electrons per unit volume is 9×10^{28} per m^3 . Calculate the relaxation time which is defined as the average time interval between two successive collisions.

Also calculate the mean free path of electron (distance covered by electron between two successive collisions) if the drift velocity of electrons is $1.7 \times 10^{-4} m / s$.

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29. The density of silver is 10.5 g/cc and its atomic mass is approximately 108 g . Assume each atom contributes one free electron and calcute the number of free electrons per unit volume for the silver. Resistivity of the silver is $1.6 \times 10^{-8} \Omega$m.

What potential difference must be applied across the silver wire of length 0.1 m and area of cross section $1 mm^2$ so that a current of 2A flows through it ? what will be the current density for the wire and drift speed of electrons ?

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30. Using the microscopic form of Ohm's law $(J = \sigma E)$, prove that conductivity of a metal can be written as $\sigma = \mathrm{ne}\mu$. Here n is the number of free electrons per unit volume and μ is mobility of free electrons . In case of semiconductors there are two types of conduction particles, one is free electrons and the other is known as a hole. Charge on the hole may be assumed to be equal and opposite of that on electron. The number density of free electrons and holes in the semiconducting material are n and p respectively. Assuming μ_e and μ_h as mobility of free electrons and holes respectively , write the exopression of conductivity of the semiconducting material.

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31. The temperature coefficient of resistance of a material is $0.004^\circ C^{-1}$. Let R_0 be the resistance of a wire made from this material at $0^\circ C$. What should be the temperature of this object so that its resistance increases by $2R_0$?

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32. The resistance of a thin metallic cylinder changes from $4.25\Omega \text{to} 4.75\Omega$ when its temperture is incrased from $10^\circ C \rightarrow 110^\circ C$. Calculate the resistance of the same object when it is kept at temperature $0^{\circ}C$. Also calculate the temperature coefficient of resistance.

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33. The temperature coefficient of resistance of tungsten is $0.0045^{\circ}C^{-1}$. A standard resistance made from this material is rated to have resistance 2Ω but it is found that resistance is 2.115Ω when measured at $40^{\circ}C$. If we assume that the difference is due to unknown temperature at which resistance rating is done, then calculate this temperature.

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34. Calculate the effective resistance between A and B in the given circuit. All resistances shown are R.

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35. There is one rod of length L. the resistivity of its material is given by $\rho = \alpha x + \beta$. Here x is the distance of α point on rod from one of its ends. Assume A as the area of cross section of rod. Find the electrical resistance of the rod.

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36. A metallic wire with resistance λ per unit length is bent to form α circle of radius R. Calculate the effective resistance between the effective resistance between the points P and Q , making an angle of 90° with each other at the centre.

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37. Calculate the current drawn from the battery in the following circuit.

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38. Calculate the equivalent resistance between A and B in the following network.

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39. Two resistance R_1 and R_2 when connected in series produce equivalent resistance equal to x. and when the same two resistance are connected in parallel then equivalent resistance becomes y. Calculate the product of magnitudes of R_1 and R_2 in terms of x and y.

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40. Two resistors of 5 Ω and 10Ω are connected in parallel to a battery of emf 16 V and a current of 4 A is drawn from the battery . How will you explain the given magnitude of current ? Do you see any discrepancy in the given magnitude of current ?

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41. Two identical rectangular $(l \times b)$ metal plates P and Q of same thickness are connected in series as shown in the figure and α current I is passed through the combination.

Let V_P and V_Q be the potential difference developed across both the plates. find V_P / V_Q. The material is same for both the plantes.

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42. We have a wire of uniform cross section and its electrical resistance is R . This wire is cut in n equal parts and each part is stretched so that its length becomes equal to the length of the original wire. Now all these parts are connected in parallel. Calculate the equivalent resistance now.

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43. Find the equivalent resistance between A and B .

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44. A capacitor of $10\mu F$ is connected between the points P and Q of the following circuit. Calculate energy stored by the capacitor in steady state condition.

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45. Find eqvivalenet resistance between points P and Q for the following network of resistances.

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46. All resistors are having same resistance R. Find the equivalent resistance between points A and D.

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47. Find the equivalent resistance between P and Q for the following network of circuit. All resistacnes are identical having the same resistance R

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48. Calculate the electric current drawn from battery in the given circuit.

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49. Three colour strips of a colour -coded resistor in order are blue, orange green. What current will flow through it when a battery of 100 volt is connected across it ?

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50. A battery of negligile internal resistance connected in a circuit is maintaining a current of 5 A and it is found that battery does a work of 800 J in an interval of 2 minutes. What is the emf of the battery ?

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51. Potential difference across the terminal of α battery drops by 1 V when α current of 1 A is drawn from its positive terminal by connecting it to α circuit . What is the internal resistacne of the battery ?

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52. A battery of unknown emf and internal resistance is given to a student for the experiment. When student connects the battery to an external resistance of 10Ω then 1A current flows through the circuit and when the same is connected to 15Ω resistance then 0.75 A current flows through the circuit . Calculate the emf and internal resistance of the given battery.

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53. We have a chargeable battery of emf 12 V and internal resistance of 1Ω The battery can take a maximum of 20 A current during the charging process. If we have a charger, which can maintain a potential difference of 60 V, then what resistance is needed to be connected in series with the charger to charge the given battery ?

what terminal potential difference do you expect across the terminal of battery being charged ?

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54. The terminal potential difference (V) between the terminals of a battery depends on current (i) according to the following relation.

$V = 8 - 3i$

What is the emf of the battery ? What is the internal resistance of battery ?

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55. Calculate heat produced in five minutes across a resistor of 20Ω when 3A current flows through it .

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56. The rating of an electric bulb is 220 V-100 W. if a rated voltage is applied then how many electrons will pass through the filament in one second ?

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57. An electric iron is rated as 220 V-850W. What is the resistance of its heating element ? How much current will it draw when the rated voltage is applied on it ?

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58. The efficiency of a motor is defined as the ratio of mechanical power output to that with input electric power. The motor is designed to operate at 100 V and it draws a current of 15 A . If output mechanical power of motor is 800 W, then calculate the efficiency of motor .

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59. The rating of a heating element is 220 V-1,000 W. if the heating elements is stretched to double of its initial length then what will be the power rating for the same voltage ?

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60. The stamp on an electic bulb reads 220V-60 W. if the supply voltage available is 100 V then what current will be drawn by the bulb ?

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61. Two bulbs are rated as 220 V-100W and 220 V-60 W. How much power will be consumed when both of them are connected in series across the supply of 220 V ?

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62. One heater coil takes time t_1 to heat a glass of water and another takes time t_2 to heat the same amount of water. How much time will it take to heat the same amount of water when the two are connected in series and when the two are connected in parallel ? voltage applied is same in all cases.

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63. State the characterisitics of fuse wire.

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64. If a fuse wire of certain material blows at 10 A current, then what should be the radius of the fuse wire made from same material which blows at 20 A ?

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65. Find the potential difference across each cell and the rate of energy dissipated in R in the given figure .

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66. The circuit diagram in figure below has two cells ε_1 and ε_2 with emfs 4 V and 2V respectively, each one having an internal resistance of 2Ω The external resistance R is of 8Ω Find the magnitude and direction of currents flowing through the two cells .

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67. Apply Kirchhoff's rules to the loops ACBPA and ACBQA to write the expressions for the currents I_1, I_2 and I_3 in the network shown in the figure below.

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68. In the network of resistors , connected to a battery of negligible internal resistance, find the equivalent resistance between the points A and B . If 1 A current is drawn from battery then what is the emf of battery

?

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69. Calculate the current flowing through each of the cells shown in the circuit below. Also calculate the potential difference across each cell.

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70. For the circuit shown here Calculate the potential difference between B and D

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71. Determine the currents flowing through the galvanometer G of the Wheatstone bridge as shown in the figure below, in the unbalanced position of bridge.

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72. Find the equivalent resistance between the terminals A and B in the network shown below Given the value of each resistance R is of 5Ω Also, calculate the current in the arm CF.

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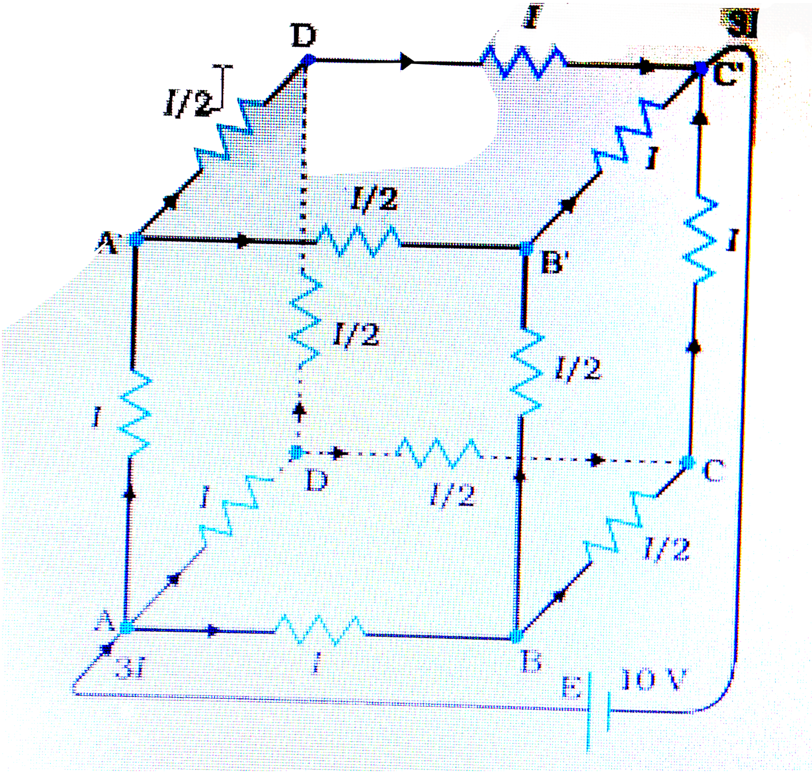
73. Battery of 10 V and negligible internal resistance is connected across the diagonally opposite corners of a cubical network consisting of 12 resistors each of resistance 1Ω (Fig. 3.23). Determine the equivalent resistance of the network and the current along each edge of the cube.



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74. Find the current supplied by battery of 12 V in the following circuit diagram . What is the potential difference across the 10Ω resistor ?

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75. Find the electric current drawn from a battery of emf 12 V for the following circuit. Consider the capacitor to by fully charged.

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76. Calculate I, i_1, i_2 and i_3 for the following circuit.

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77. Two batteries of emfs E_1 and E_2 are connected to drive current in external resistance R , as shown in the given figure. The internal resistances are r_1 and r_2 respectively .

Calculate the electric current flowing through external resistance R , and then evaluate the emf and internal resistance of one single battery that can replace the two used in circuit .

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78. A battery is formed by connecting three cells in series .

The emfs of cells are 5 V, 2.5 V and 1.5 V and their internal resistance are $0.5\Omega, 0.05\Omega \text{ and } 0.45\Omega$ respectively.

This battery is connected across a load resistance of 5Ω what current will be supplied by the battery ? if the cell of emf 1.5 V were connected with reverse polarity then what would have been the current supplied by the battery ?

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79. A resistance of 1Ω is connected to a battery of emf 2 V and internal resistance 0.4Ω what current is flowing through the circuit ? If another battery of double the emf is connected in series with the earlier one then current flowing in the circuit becomes double . what should be the internal resistance of battery ?

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80. A resistance of 97Ω is connected to a battery of emf 10 V . To measure the current passing in the circuit, an ammeter is inserted in series with the resistance. It is found that the ammeter reads 100 mA. What is the internal resistance of the battery if 2Ω is the resistance of ammeter ?

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81. How can we convert a galvanometer into an ammeter ?

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82. The wheatstone bridge shown in the given figure shows no deflection in the galvanometer joined between the point Q and S. calculate the values of X.

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83. Calculate the current drawn from the battery by the network of resistors shown in the figure.

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84. All resistors in the following network are identical and having a resistacne R . Find the equivalent resistance between A and B as shown.

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85. Find the current drawn from the battery in the following circuit.

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86. Each resistor in the circuit has a resistance of 10Ω what currents is flowing through the battery ?

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87. Find the value of the unknown resistance X, in the following circuit, if no current flows through the section PO. Also calculate the current drawn by the circuit from the battery of emf 5V and negligible internal resistance .

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88. Find the equivalent resistance between the points A and B of the network shown in the figure given below.

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89. In a metre bridge experimental set-up, shown in the figure below, the null point D is obtained at a distance of 40 cm from end A of the metre bridge wire. If a resistance of 10Ω is connected in series with X, null point is obtained at AD= 60 cm . Caluclate the values of X and Y.

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90. An unknown resistance is connected in a left gap of a metre bridge . The balance point is obtained when a resistance of 10Ω is taken out from the resistance box in the right gap. On increasing the resistance from the resistance box by 12.5Ω the balance point shifts by 20 cm.

find the unknown resistance.

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91. A resistance $R = 2\Omega$ is connected to one of the gaps in a metre bridge ,which uses a wire of length 1m. An unknown resistance $X > 2\Omega$ is connected in the other gap as shown in the figure. The balance point is noticed at l from the positive end of the battery. on interchanging R and X, it is found that the balancing point further shifts by 20 cm (away from end A). Neglecting the end correction, calculate the value of unknown resistance X used

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92. An ideal voltmeter and ammeter are connected in a circuit as shown in the figure. When the key is open, the voltmeter reads 24 V and when it is closed then the ammeter reads 0.5 Amp.

Calculate emf and internal resistance of the battery.

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93. A galvanometer shows full scale deflection when a current of 1 mA is passed through it . The resistance of the coil used in galvanometer is 100Ω How will you convert it into an ammeter which should be able to measure the current up to 5 A ?

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94. A galvanometer shows full-scale deflection when current of 1 mA is passed through it. Resistance of the coil used in the galvanometer is 100Ω what maximum potential difference can be measured if it is used as a voltmeter ? How will you modify it to measure potential difference up to 2 V ?

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95. A galvanomter scale is divided into 100 equal divisions. The current sensitivity is 10 divisions per mA and voltage sensitivity is 5 divisions per mV. How will you convert it to read (i) 8 A for full scale and (ii) 1 division per volt ?

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96. A 10 m long potentiometery wire has a resistance of 20Ω it is connected to a battery of emf 6 V and internal resistance 4Ω find the potential gradient along the wire.

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97. A constant voltage of 3 V is supplied to a potentiometer wire. A cell of emf 2 V is balanced by a voltage drop across 416 cm of the wire. Find the total length of the potentiometer wire.

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98. Calculate the current through branch EF in the circuit shown below.

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99. Why are we getting zero current in the branch EF of the previous example ?

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100. In figure given a long uniform potentiometer wire AB is having a constant potential gradient along its length. The null points for the two primary cells of emfs ε_1 and ε_2 are connected in the manner shown are obtained at a distance of 120 cm and 300 cm from the end A. Find (i) $\varepsilon_1 / \varepsilon_2$ and (ii) position of null point for the cell ε_1.

How is the sensitivity of potentiometer increased ?

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101. Two cells of emf ε_1 and ε_2 are connected together in two ways shown here. The balance points in a given potentiometer experiment for these two combinations of cells are found to be at 351.0 cm and 70.2 cm respectively. Calculate the ratio of the emfs of the two cells

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102. A potentiometer wire AB of length 1 m is driven by a cell of emf $\varepsilon_1 = 2$ V as shown in the following figure.

when a cell of emf ε_2 is connected across AC, when AC=70 cm ,no current flows from ε_2. Find (i) the potential gradient along AB and (ii) the emf (ε_2) of the cell connected across AC.

Consider that the internal resistance of the cell ε_1 is negligible

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103. In the circuit diagram given below, a uniform wire AB of length 100 cm and resistance 15ω is used as a potentiometer wire. It is connected to a cell of emf 2 V and a resistor R. Another cell of emf 75 mV and a galvanometer G are connected across AC such that the balance point is obtained at 30 cm mark from end A. Calculate the value of resistance R.

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104. A potentiometer wire PQ of 1m length is connected to a standard cell ε_1 . Another cell ε_2 of emf 1.02 V is connected as shown in the circuit diagram with a resistance r and a switch, S. with switch S open, the null position is obtained at a distance of 51 cm from P.

(a) Calculate (i) potential gradient of the potentiometer wire and (ii) emf of the cell ε_1 .(b) when the switch S is closed ,will the null point move towards P or towards Q? Give reason

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105. A battery E_1 of emf 4 V and a variable resistance Rh are connected in series with the wire AB of the potentiometer .

The length of the wire of the potentiometer is 1 metre.

When the cell E_2 of emf 1.5 volt is connected between points A and C , no current flows through E_2 Length of AC=60 cm .

(i) Find the potential difference between the ends A and B of the potentiometer.

(ii) Would the method work if battery E_1 is replaced by a cell of emf of 1 V ?

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106. AB is 1m long uniform wire of 20Ω resistance. Other data areas shown in the circuit diagram given below. Calculate (i) the potential - gradientalong AB and (ii) length AO of the wire when galvanometer shows no deflection.

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Practice Problems

1. Calculate the number of electrons passing through a lamp in one minute, if the current is 100 mA.

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2. Calculate the current passing through a conductor (made up of Cu) if 1 mole of electrons flows through it in 1 hour.

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3. How many electrons constitute current of one ampere ?

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4. An electron revolves aroung a nucleus in a circular orbit of radius 0.60Å.

Find the equivalent electric current in the orbit if it completes 5.4×10^{15} revolutions in one second. Given charge on electrons is $1.6 \times 10^{-19} C$.

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5. Calculate the amount of current passing through a wire at t=9 s, if the electric charge passing through a cross section of wire in t time is given as $q(t) = 7t^2 + 9t - 2$.

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6. Calculate the resistance of a hollow cylinder made of copper with inner radius 3 cm and outer radius 3.5 cm and is 12 cm long. (Speciffic resistance of copper is $1.68 \times 10^{-8} \Omega m$)

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7. A conducting wire carrying 1 A of current is connected across a battery of 2V. Find the number of electrons flowing through the wire per second.

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8. Electron density in a copper wire is $8.0 \times 10^{22} cm^{-3}$. Calculate the relaxation time for electrons if the resistivity of copper is $1.68 \times 10^{-8} \Omega m$ at room temperature.

(Massof electron is $9.1 \times 10^{-31} kg$.)

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9. A condutor of length l is stretched such that its length increases by 10 % calculate the percentage change in the resistance of the conductor.

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10. A conductor of mass 0.50 kg and density $9 \times 10^3 kgm^{-3}$ has a resistance of 0.015Ω . Calculate the length of the conductor if its shape is cylindrical and the resistivity of its material is $1.8 \times 10^{-7} \Omega m$.

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11. Calculate the electrical conductivity of 2.15 m long conductor with area of cross section $5 \times 10^{-6} m^2$, if resistance of the conductor is 2Ω.

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12. A wire of 15Ω resistance is gradually stretched to double in original length. it is then cut into two equal parts .These parts are then connected in parallel across a 3.0 volt battery. Find the current draw from the battery .

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13. A conductor has resistance of 5Ω at $60^{\circ}C$ and 6Ω at $100^{\circ}C$. Find (i) the mean temperatures coefficient of resistance of the material of conductor and (ii) resistance at $0^{\circ}C$.

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14. A conducting wire has a resistance of $5\Omega \text{at} 0^{\circ}C$ and $5.6\Omega \text{at} 100^{\circ}C$. When the wire is inserted in a hot bath with temperature $T^{\circ}C$, its resistance is 5.9Ω. What is the value of T ?

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15. A current of 5 A flows through a conductor $25^{\circ}C$, when connected to a power supply of 100 V . At what temperature the current will drop to 2A , if it remains connected to the power supply (Temperature coefficient of conductor is $0.005^{\circ}C^{-1}$.)

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16. Resistance of two wires A and B at $10^{\circ}C$ are 3.8Ω and 4.0Ω respectively . If temperature coefficient of resistance for wire A and B are $4.8 \times 10^{-3}K^{-1}$ and $3.8 \times 10^{-3}K^{-1}$ respectively, calculate the temperature at which resistance of both the wires are equal. Ignore thermal expansion.

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17. A conductor of uniform area of cross section A has a variable resistivity along its length. What will be the resistance of the conductor if $\rho = \rho_0(1 + \alpha x^2)$, at length l.

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18. Calculate the resistance and electrical conductivity of a 2m long copper wire of cross sectional area $0.01mm^2$. Givne resistivity of copper is $1.78 \times 10^{10}\Omega m.$

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19. A conductor of resistance 25Ω of diameter 0.2 mm is connected to a battery of 200 V . Calculate the current density for the conductor.

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20. A conductor of resistance R and conductance G is stretched to twice its original length keeping its volume constant. Calculate the new resistance and the conductance of the conductor.

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21. At room temperature $(27.0^{\circ} C)$ the resistance of a heating element is 100Ω. What is the temperature of the element if the resistance is found to be 117Ω, given that the temperature coefficient of the material of the resistor is $1.70 \times 10^{-4} .^{\circ} C^{-1}$.

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22. A discharge tube is connected to a power supply of 200 V . Calculate the effective resistance of the tube if the number of protons drifting through a section per second is 1.5×10^{18} and the number of electrons drifting in opposite direction through auother cross section per second is 2.0×10^{18}.

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23. Find the current flowing through a copper wire of length 15 cm ,with area of cross section $10^{-2} cm^2$, when it is connected to a power supply of 2V.

Given : Electron density of copper is $8.8 \times 10^{22} cm^{-3}$ and electron mobility is $4 \times 10^{-6} m^{-2} V^{-1} s^{-1}$.

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24. Electron density in a conductor of area of cross section $0.006 cm^2$ is $8.0 \times 10^{22} cm^{-3}$. Calculate the drift velocity of electron in the wire if a current of 2 flows through it.

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25. Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area $2.0 \times 10^{-7} m^2$ carrying a current of 3.0 A. Assume that each copper atom contributes roughly one conduction electron. The density of copper is$9.0 \times 10^3 kg / m^3$, and its atomic mass is 63.5 u.

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26. Find the average drift velocity of electrons if a wire of cross sectional area $0.01 cm^2$ is carrying a current of 1 A. Given one cubic centimetre contributes 7×10^{24} free electrons.

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27. Find the average drift wire with area of cross section $0.01cm^2$,connected across a battery of 2 V carries a current of 0.4 A. Calculate the mobility of electrons if number density of electrons in copper is $7.8 \times 10^{28} m^{-3}$.

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28. Calculate the relaxation time of electron in previous problem. Given mass of electron is $9.1 \times 10^{-31} kg$.

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29. Six identical resistance of resistance 20Ω each are connected in the form of a hexagon across a battery of 3 V. Find the current through the battery when the battery is connected (i) between any two adjacent vertices. (ii) across any two opposite vertices.

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30. Calculate the effective resistance for the given combination between the points A and B

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31. Three identical resistances of 2Ω are connected through a metallic wire as shown in the adjoining figure. Calculate the effective resistance between the points A and B .

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32. Given the resistances of 1Ω, 2Ω and 3Ω. How will you combine them to get an equivalent resistance of

(i) $\frac{11}{3}\Omega$?

(ii) $\frac{11}{5}\Omega$?

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33. A parallel combination of three resistors takes a current of 5 A from a 20 V supply. If the resistors are of $10\Omega \text{ and } 8\Omega$ find the value of the third resistor.

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34. Write the sequence of coloours in a carbon resistor having resistance $25 \times 10^6 \Omega \pm 10 \%$.

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35. Calculate the voltage across a colour-coded carbon resistor with colours yellow, green and brown in a sequence if current of 1mA is passed through it .

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36. The resistance of a colour-coded carbon resistance is 670 Omega\` . Find the colour of second band of the resistor.

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37. Three resistors with conductanes G_1, G_2 and G_3 are connected as shown in the figure. Calculate the effective conductance between points A and B .

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38. In the previous problem, calculate the effective conductance if all the three resistors are connected in series.

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39. A wire of uniform cross section of resistance 16Ω is divided into four pieces in the ratio of 1 : 2 : 3 : 4 and ll the four resistros are connected in the form of a square . Calculate the current drawn from the battery, if a battery of emf 10 V and internal resistance 0.5Ω is connected across the resistor with least resistance.

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40. Calculate the electric power of an electric bulb of resistance 400Ω connected to a 220 V supply.

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41. An electric pump of 0.8 hp is used in water supply system in a house. Calculate the amount of current drawn by it , if it is connected to 220 V power supply.

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42. In the previous problem, calculate the units of energy consumed per day if the electric motor is used for 3 hours a day.

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43. Calculate the resistance of an electric heater of 1 kW if it operates on a 220 V power supply.

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44. In the previous problem, calculate the change in power taken by electric heater if the voltage supply connected to heater drops from 220 V to 190 V.

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45. Calculate the percentage change in power of an electric heater if the current supplied to it decreases by 2 % .

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46. A current of 5 ampere flows in a 10 -ohm resistor. Calculate the rate of heat energy produced in the resistor.

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47. An electric bulb is rated as 220 V-55 W. find the value of its resistance.

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48. An electric bulb with rating 200 W, 50V is connected to a source of 120 V.

A resistance R is connected in series to the bulb, so that the bulb delivers 200W . Calculate the value of R.

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49. Three electric bulbs with markings 100 V-150 W, 100V-400W and 100V-500W are connected in series along power supply of 100V. Calculate the current in the circuit through each bulb.

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50. Three identical cells of emf 2 V and internal resistances 0.20Ω are connected in series. The combination is further connected to an external resistor of 6Ω . Calculate the current through 6Ω resistor.

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51. Three identical cells of emf 4.0 V are connected in parallel. The combination is further connected to two identical resistors of 5Ω in series as shown in the figure. Calculate the internal resistance of each cell if the terminal voltage of the cells are 3.2 V .

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52. Arrange six identical cells of emf 2 V and internal resistance 0.5Ω such that maximum current is passed through the external resistance of (i) 0.001Ω and (ii) 250Ω . What will be the value of current in each case ?

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53. Arrange 32 identical cells of emf 2 V each with internal resistance 0.5Ω such current passing through an external resistance of 1Ω is maximum. what will be the value of current ?

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54. Calculate the current passing through each resistor in the given circuit as shown in figure

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55. Use the kirchhoff's rule to calculate the current through each resistor in the given circuit as shown in figure.

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56. A cell of emf ε and internal resistance r is connected across a variable load resistance R. It is found that when $R = 4\Omega$ the current is $1A$ and when R is increased to 9Ω, the current reduces to $0.5A$. Find the value of the emf ε and internal resistance$r$

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57. Two cells of 5 V and 10 V and internal resistances 0.8Ω and 1.2Ω respectively are joined in parallel to each other. The combination is further connected to an external resistance of 10Ω as shown in the figure. Find the current through each cell

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58. Three identical cells each of 2 V and unknow internal resistance are connected in parallel. This combination is connected to a 5 ohm resistor. IF the terminal voltage across the cell is 1.5 volt, what is the internal resistance of each cell?

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59. Two cells of 1.5 V and 2 V , having internal resistances of 1Ω and 2Ω respectively, are connected in parallel so as to read the current in the same direction through an external resistance of 5Ω . The current in the external resistance will be

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60. Three cells of emfs $\varepsilon_1 = 1.5V, \varepsilon_2 = 2.0v$ and $\varepsilon_3 = 3.0V$ having internal resistances $r_1 = 0.3\Omega r_2 = 0.4\Omega$ and $r_3 = 0.6\Omega$ respectively are connected in parallel . Find out the equivalent emf and the equivalent resistance of a cell which can replace this combination.

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61. Twelve identical resistances of resistance 2Ω are connected in a cubical pattern as shown in the figure.

A battery of 10 V is connected across the diagonally opposite corners of the combination. Calculate the equivalent resistance of the network and current drawn from the battery.

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62. Twelve identical wires of resistance 2Ω are connected in a form of cubical pattern. A battery of 12 V and a key is connected to the network as shown in the figure . Find the total resistance of the network , when the key is open.

View Text Solution

63. Five resistors are connected as shown in the figure. Find the net resistance between the points X and Y.

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64. Three identical resistors of resistance 12Ω are connected with a battery of 5 V with a rheostart, as shown in the figure. What is the

maximum and minimum possible reading of the ammeter, if the maximum resistance of rheostat is 24Ω ?

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65. In the metre bridge shown in adjoining figure , the null point is found at a distance of 33.7 cm from A. if now a resistance of 12Ω is connected in parallel with S, the null point occurs at 51.9 cm. Determine the values of R and S.

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66. Two unknown resistors X and Y are connected in the left and right gaps of a metre bridge and the null point if found at 33.5 cm from the zero of the metre scale. When a shunt resistance of 5Ω is connected with the resistance X, the null point is shifted to the point at a distance of 12.5

cm from the zero . Calculate the values of X and Y.

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67. A voltmeter of resistance 998Ω is connected across a cell of emf 2 V and internal resistance 2Ω. Find the p.d. across the voltmeter, that across the terminals of the cell and percentage error in the reading of the voltmeter.

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68. When a current of 5 mA is passed through a galvanometer of resistance 30Ω ,it shows a full -scale deflection. To convert it into a voltmeter, which can read voltage up to 7V, it is connected to a resistance R in series . What is the value of R ? Also calculate the resistance of the voltmeter.

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69. In the previous problem, the galvanometer is converted to an ammeter, which can read the current up to 1.5 A, and it is connected to a shunt of resistance R. what is the value of R ? Also calculate the resistance of ammeter.

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70. Calculate the potential gradient of a potentiometer wire of length 5 m ,if resistance of the wire is 5Ω and current of 1.2 mA flows through it.

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71. A resistance of X is connected to a potentiometer of resistance R and a battery of voltage 5 V is connected to the potentiometer. Calculate the current and voltage drawn from the potentiometer by the circuit when the slide contact is in the middle of the potentiometer wire.

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Conceptual Questions

1. According to the definition of conductivity $(\sigma = J / E)$, electric field is being considered to exist inside a conductor but according to electrostatics of conductor , electric field cannot exist inside its volume. Explain the difference and state the condradiction if any.

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2. Copper and silver are two materials often used for making audio cables. Silver has a slighly lower resistivity than copper. For a given length of audio cable of a standard resistance, which of the cables (silver or copper cable) will be made thinner ?

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3. What will be resistivity of a copper wire B compared to another copper wire A of triple its length and double its diameter ?

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4. Two wires made of same material but of different diameters are connected in series in a circuit. The current flows in the combination of wires. When the current flows from the wire with larger diameter to the one with smaller diameter, what happens to the drift velocity of electrons ?

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5. A resistor is connected across a battery and current flows through it. Compare the potential energy of an electron before entering the resistor be that after leaving the resistor.

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6. Two identical bulbs A and B are connected in series across a source of emf E. now, bulb B is removed from the circuit. Compare the brightness of bulb A in both arrangements .

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7. Why can current persist in a superconductor in the absence of any applied voltage ?

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8. If superconductors conduct electricity without any power loss in the form of heat , why can't we replace the conductors used in everyday circuit to eliminate undersirable loss of power ?

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9. The drift velocity of electrons inside a conductor carrying current is of the order of $10^{-4} m/s$, which means that the electrons flow very slowly through the conductor. Then why does it not require hours for a light bulb to turn on after pressing the switch ?

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10. A number of identical light bulbs are connected to a battery. Will the brightness of bulbs increases or decreases when more bulbs are connected in a parallel connection ? Will the battery last longer after connecting more bulbs ?

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11. For charging a battery of emf E_1 , another battery of emf $E_2(E_2 > E_1)$ is connected with their positive terminals connected together. Due to this , direction of current in battery with emf E_1 is revorsed .

Does it mean that the emf is also reversed ? Give reason.

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12. A warning of high voltage is usually displayed instead of high current near an electrical equipment or transmission lines but it is actually the current that surges through a body in contact with the equipement . Why don't we rather use the warnings of high current ?

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13. Suppose your car's headlights are turned on when you start the ignition. Will the headlights become dimmer or brighter while the car is starting ? Explain with proper reasoning .

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14. A resistor consists of four identical metal strips connected as shown in the adjoining figure.

The resistor is connected across a battery and an ammeter is connected in series with it. Now one of the metal strips is cut out. Will the reading of the ammeter increase or decrease ? why ?

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15. What is thermal motion of free electrons ? Why does it not amount to any current ?

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16. Arrange aluminum, silver copper and iron in the increasing order of conductivity.

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17. give examples of materials whose electrical resistivity decreases with increases in temperature.

Watch Video Solution

18. What is the effect of temperature on the resistivity of alloys ?

Watch Video Solution

19. What is a fuse wire ?

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20. Explain that magniture of current which can melt a fuse wire is independent of its length.

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21. Why does the resistivity of metal increase with an increase in temperature ?

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22. Explain free electron model of conduction.

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23. Name the charge carriers responsible for conduction of electricity in a metal object semiconductor, electrolytic cell, hydrogen discharge tube and superconductor.

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24. Why is Manganin one of the preferred materials to make standard resistances ?

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Watch Video Solution

25. How do you differentiate between an ohmic and a non-ohmic resistor ?

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26. Can we say that all free electrons move in the same direction in a conductor when some potential difference is applied across it ?

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27. FORCE ON CURRENT CARRYING CONDUCTOR IN MAGNETIC FIELD

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28. Electric field inside a conductor is always zero. Is this statement true of false?

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29. We know that electric current flows through a conductor only when some electric field is applied across it. This electric field applied constant force on electrons. But the motion of electrons is not accelerated . Why ?

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30. IF the electron drift speed is so small and the electron's charge is also small,then how can we still obtain a large amount of current in a conductor?

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31. Let a potential difference V be applied across a cylindrical conductor of length l and radius r. how is the drift velocity of electrons affected if

1. Length 1 of conductor is doubled ?

2. Potential difference V is doubled ?

3. Radius r is doubled ?

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32. We prefer magainin wire to make a potentiometer. Why do not we use copper instead ?

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33. How does the internal resistance of a battery changes with temperature ?

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34. How is the internal resistance of a battery affected by the separation of its electrodes and their surface area ?

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35. Can the terminal potential difference of a cell exceed its e.m.f. ?

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Tough And Tricky Problems

1. A wire of length l and area A is connected to an ideal battery . The drift speed of electrons is v. If the wire is twisted to half its length, what will be the new drift speed ?

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2. There are two wires P and Q made of the same material and both have the same mass . The radius of wire P is half the radius of the wire Q. the resistance of P is 24Ω. Find the resistance of Q.

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3. The resistance of a conductor at $20^{\circ} C \text{is} 6.3 \Omega \text{ and } \text{at} 100^{\circ} C$ it is 7.5Ω. Calculate the resistance of the conductor at $0^{\circ} C$ and its temperature coefficient of resistance .

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4. A heating element using nichrome connected to a 115 V supply draws a current of 1.6A which settles after a few seconds to a steady value of 1.4 A. What is the steady temperature of the heatinf element it the room temperature is $30^{\circ} C$? Temperature coefficient of resistance of nichrome averaged over the temperature range involved is $1.7 \times 10^{-4} .^{\circ} C^{-1}$.

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5. Let a fixed amount of power be transmitted from an electricity power station to a nearby city. Suppose you have two options before starting and electricity supply. You can use either high voltage or low voltage to supply electricity.

which one would you choose keeping in mind that there are transmission losses due to resistance of electric cables used for supply ?

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6.

(a) Calculate I_1 and I_2 in terms of I as shown in Fig(i)

(b) Calculate V_1 and V_2 in terms of V as shown in Fig (ii).

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7. We have two heating coils A and B .

Coil A takes time t_1 to boil one cup of water and coil B takes time t_2 to do it.

Find the time taken to boil one cup of water if (a) A and B are connected in parallel (b) A and B are connected in series with each other.

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8. Find the current in the branch BD of the following circuit. Also calculate the equivalent resistance between points A and B .

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9. Calculate the equivalent resistance between points A and C, in the circuit given below.

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10. The resistance of all the resistors in the following network is R . Find equivalent resistance between A and E .

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11. The resistance of all the resistors in the following network is R. Find the equivalent resistance between A and F.

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12. Calculate the potential difference between A and B.

The emf of the battery is V and internal resistance is zero. All resistances are equal to R.

View Text Solution

13. Calculate the equivalent resistance between points A and F in the following network.

All resistors are equal to R.

View Text Solution

View Text Solution

14. Calculate the equivalent resistance between points A and S in the folloiwng circuit. All resistors have a resistance equal to R.

View Text Solution

15. Calculate $V_A - V_B$ for the following circuit.

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16. Calculate the current drawn from the cell. All resistors have same resistance R. The emf of the battery is V without any internal resistance. Find the potential differnce across one of the middle resistros.

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17. Find the potential difference between points A and H.

View Text Solution

18. Find the potential difference between points A and B.

View Text Solution

19. Find the potential difference between points A and B.

View Text Solution

20. Here is one metal object , whose electrical resistivity is ρ. The cross section of the object is circular and its radius changes linearly from a to

b. The length of the object is l . Find the resistance of wire .

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21. Here is one network of resistances as shown in the figure. An infinite number of similar links are there. Calculate the equivalent resistance between A and B.

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22. Here is one network of resistances as shown in the figure. An infinite numbers of links are present. The magnitude of resistances in every subsequent link is doubled. Calculate the equivalent resistance between A and B.

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23. Here is one potentiometer wire AB of length 108 cm. A battery of emf 12 volts and a negligible internal resistance is connected across AB., the resistance of wire AB is 540Ω .

The positive terminal of 9 V battery is connected to point A and negative terminal to a metal jockey J. The internal resistance of this battery is 2Ω. Assume potential at point B is zero.

1. What will be potential at point A ?

2. what will be potential at point J ?

3. Let P be a point at a distance x from A. what will be potential of P ? For what value of x, the potential of point J and P will be the same ?

4. If the value of x is same as that calculated in part 3, then what current will flow through the 9 V battery if P and J are connected to each other ?

5. If x is 54 cm , and point P and J are connected to each other, then calculate the current through a battery of emf 9 V.

1. The storage battery of a car has an emf of 12 V. If the inernal resistance of the battery of 0.4Ω, What is the maximum current that can be drawn from the battery ?

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2. A battery of emf 10 v and internal resistane 3Ω is connected to a resistor. If the current in the circuit is 0.5 A, what is the resistane of the resistors ? What is the terminal voltage of the battery when the circuit is closed ?

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3. Three resistors of $1\Omega, 2\Omega \text{ and } 3\Omega$ are combined in series. (i) What is the total resistance of the combination ? (ii) If the combination is connected to a battery of emf 12 V and negligible internal resistance, obtain the potential dropo across each resistor.

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4. (a) Three resistors $2\Omega, 4\Omega$ and 5Ω are combined in parallel. What is the total resistance of the combination ?

(b) If the combination is connected to a battery of emf 20 V and negligible internal resistance, determine the current through each resistor, and the total current drawn from the battery.

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5. At room temperature $(27.0^{\circ} C)$ the resistance of a heating element is 100Ω. What is the temperature of the element if the resistance is found to be 117Ω, given that the temperature coefficient of the material of the resistor is $1.70 \times 10^{-4} .^{\circ} C^{-1}$.

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6. A negligibly small current is passed through a wire of length 15 cm and uniform cross-section $6.0 \times 10^{-7} m^2$ and its resistance is measured to be 5.0Ω. What is the resistivity of the material at the temperature of the experiment ?

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7. A silver wire has a resistance of 2.1Ω at $27.5^\circ C \& 2.7\Omega$ at $100^\circ C$ Determine the temperature coefficient of resistivity of silver.

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8. A heating element using nichrome connected to a 230 V supply draws an initial current of 3.2 A which settles after a few seconds to a steady value of 2.8 A. What is the steady temperature of the heating element if the room temperature is $27^\circ C$? Temperature coefficient of resistance of

nichrome averaged over the temperature range involved is $1.70 \times 10^{-4} C^{-1}$.

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9. Determine the current in each branch of the following network:

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10. (a) In a metre bridge shows in given figure the balance point is found to be at 39.5 cm from the end A, when the resistor Y is of 12.5Ω. Determine the resistance of X. Why are the connections between resistors in a Wheatstone or metre bridge made of thick copper strips?

(b) Determine the balance point of the metre bridge if X and Y are interchanged.

(c) Waht happens if the galvanometer and cell are interchanged at the balance point of the bridge? Would the galvanometer show any current?

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11. A storage battery of emf 8.0 V and internal resistance 0.5Ω is being charged by a 120V dc supply using a series resistor of 15.5Ω. what in the terminal voltage of the battery during charging ? What is the purpose of having a series resistor in the charging circuit?

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12. In a potentiometer arrangment, a cell of emf 1.25 V gives a balance point at 35.0 cm length of the wire. If the cell is replaced by another cell and the balance point shifts to 63.0 cm`, what is the emf of the second cell ?

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13. The number density of free electrons in a copper conductor is estimated at $8.5 \times 10^{28} m^{-3}$. How long does an electron take to drift from one end of a wire 3.0 m long to its other end? The area of cross-section of the wire is $2.0 \times 10^{-6} m^2$ and it is carrying a current of 3.0A.

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Ncert Solved Ncert Additional Exercises

1. The earth's surface has a negative surface charge density of $10^{-9} Cm^{-2}$. The potential difference of 400 kV between the top of the atmosphere and the surface results (due to low conductivity of the lower atmosphere) in a current of only 1800 A over the entire globe. If there were no mechanism of sustaining atmosphereic electric field , how much time (roughly) would be required to neutralise the earth's surface ? (This never happens in practice because there is a mechanism to replenish electric charges namely the continual thunder storms and lightning in different parts of the globe). Radius of the earth $= 6.37 \times 10^6 m.$

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2. (a) Six lead-acid type of secondary cells, each of emf 2.0 V and internal resistance 0.015Ω are joined in series to provide a supply to a resistance of 8.5Ω. What are the currents drawn from the supply, and its terminal voltage?

(b) A secondary cell after long use has an emf 1.9 V and a large internal resistance of 380Ω. What maximum current can be drawn from the cell? Could the cell drive the starting motor of a car?

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3. Two wires of equal length, one of aluminium and the other of copper have the same resistance. Which of the two wires is lighter ? Hence explain why aluminium wires are prefered for overhead power cables ? Given $\rho Al = 2.63 \times 10^{-8} \Omega m \rho Cu = 0.72 \times 10^{-8} \Omega m$, relative density of Al=2.7 and that of Cu =8.9.

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4. What can you draw the following observations on a resistor made of alloy magnin?

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5. Answer the following questions : (a) A steady current flows in a metallic conductor of non-uniform cross-section. Explain which of these quantities is constant along the conductor : current, current density, electric field and drift speed ?

(b) Is Ohm's law universally applicable for all conducting elements ? If not, give examples of elements which do not obey Ohm's law.

(c) A low voltage supply from which one needs high currents must have low internal resistance, why ?

(d) A high tension (HT) supply of say $6kV$ must have a very large internal resistance. why ?

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6. Choose the correct alternatives :

(a) Alloys of metals usually have (greater/less) resistivity than that of their constituent metals.

(b) Alloys usually have much (lower/higher) temperature coefficients of resistance than pure metals.

(c) The resistivity of the alloy manganin in (nearly independent of/ increase rapidly) with increase of temperature.

(d) The resistivity of a typical insulator (e.g. amber) is greater than that of a metal by a factor of the order of $\left(10^{22} \text{ or } 10^{3}\right)$.

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7. (a) Given n resistors each of the resistance R, how will you combine them to get the

(i) maximum,

(ii) minimum effective resistance? What is the ratio of the maximum to minimum resistance?

(b) Given the resistances of 1Ω, 2Ω, and 3Ω, how will we combine them to get an equivalent resistance of

(i) $\dfrac{11}{3}\Omega$ (ii) (i) $\dfrac{11}{5}\Omega$ (iii) (i) $\dfrac{6}{11}\Omega$?

(c) Determine the equivalent resistance of the following networks shown in fig. (a) and (b):

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8. Determine the current drawn from a 12 V supply with internal resistance 0.5Ω by the following infinite network shown in the given figure. Each resistor has 1Ω resistance.

.

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9. The fugure given below shows a potentiometer with a cell of 2.0 V and internal resistance 0.40Ω maintaining a potential drop across the resistor wire Ab. A standard cell, which maintains a constant emf of 1.02 V (for very moderate currents upto a few mA), gives a balance point at 6.73 cm length of the wire. To ensure very low currents drawn from the standard cell, a very high resistance of $600k\Omega$ is put in series with it, which is shorted close to the balance point. The standard cell is then replaced by a cell of unknown emf E and the balance point found similarly turns out to be 82.3 cm length of wires.

(a) What is the value of E?

(b) What purpose does the high resistance of $600k\Omega$ have?

(c) Is the balance point affected by this high resistance?

(d) Is the balance point affected by the internal resistance of the driver cell?

(e) Would the method work in the above situation if the driver cell of the potentiometer had an emf of 1.0 V instead of 2.0 V?

(f) Would the circuit work well for determining extremely small emf say of the order of a few mV (suchas the typical emf of a thermocouple)? If not, how you modify the circuit?

10. The given figure shows a potentiometer circuit for comparison of two resistances. The balance point with a standard resistor $R = 10.0\Omega$ is found to be 58.3 cm while that with the unknown resistance X is 68.5 cm . Determine the value of X. What might you do if you failed to find a balance point with the given cell of emf E?

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11. The given figure shows a 2.0 V potentiometer used for the determination of internal resistance of a 1.5 V cell. The balance point of the cell in open circuit is 76.3 cm. When a resistor of 9.5Ω is used in external circuit of the cell, the balance point shifts to 64.8 cm length of the potentiometer wire. Determine the internal resistance of the cell.

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1. Is the motion of a charge across junction momentum conserving ? Why or why not ?

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2. The relaxation time τ is nearly independent of applied electric field E whereas it changes significiantly with temperature T. First fact is (in part) responsible for Ohm's law whereas the second fact leads to variation of p with temperature. Elaborate why ?

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3. What are the advantages of the nll-point method in a Wheatstone bridge ? What additional measurements would be required to calculate R_{unknown} by any other method ?

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4. What is the advantages of using thick metallic strips to join wires in a potentiometer ?

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5. For wiring in the home, one uses Cu wires or $A1$ wires. What considerations are involved in this ?

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6. Why are alloys used for making standard resistance coils?

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7. Power P is to be delivered to a device via transmission cables having resistance R_c. If V is the voltage across R and I the current through it , find the power wasted and how can it be reduced.

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8. In the following figure AB is a potentiometer wire. If the value of R is increased, in which direction will the balance point J shift?

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9. While doing an experiment with a potentiometer (Refer the given figure) it was found that the deflection is one sided and (i) the deflection decreased while moving from one end A of the wire to the end B, (ii) the deflection increased while the jockey was moved towards the end B.

Which terminal positive or negative of the cell E_1, is connected at X in case (i) and how is E_1 related to E?

(ii) Which terminal of the cell E_1 is connected at X in case (ii)?

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10. A cell of emf E and internal resistance r is connected across an external resistance R. Plot a graph showing the variation o $P.D.$ Across R, verses 'R`.

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Ncert Solved Ncert Exemplar Problems Subjective Questions Short Answers Type Questions

1. First a set of n equal resistors of R each are connected in series to a battery of emf E and internal resistance R. 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 10 times. What is 'n'?

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2. Let there be n resistors $R_1 \ldots R_n$ with $R_{\max} = \max\left(R_1 \ldots R_n\right)$ and $R_{\min} = \min\left\{R_1 \ldots R_n\right\}$. Show that when they are connected in parallel the resultant resistance $R_p = R_{\min}$ and when they are connected in series, the resultant resistance $R_S > R_{\max}$. Interpret the result physically.

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3. The circuit in the following figure shows two cells connected in opposition to each other. Cell E_1 is of 6 V and internal resistance 2Ω, the cell E_2 is of emf 4 V and internal resistance 8Ω. Find the potentail difference between the points A and B.

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4. Two cells of the same emf E but internal resistance r_1 and r_2 are connected in series to an external resistor R (Refer the figure given below). What should be the value of R so that the potential difference across the terminals of the first cell becomes zero?

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5. Two conductors are made of the same material and have the same length. Conductor A is a solid wire of diameter $1mm$. Conductor B is a hollow tube of outer diameter $2mm$ and inner diameter $1mm$. Find the ratio of resistance R_A to R_B.

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6. Suppose there is a circuit consister of only resistance and batteries , suppose one is to double (or increase it to in n-times)all voltage and all resistances , show that currents are unalatered

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Higher Order Thinking Skills Advanced Level

1. Consider the following circuit in which a switch is initially opened and a capactior has no charge on its plates.

Calculate the electric current coming out from the postive terminal of battery immediately after the switch is closed and again long after the switch is closed.

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2. In the following circuit a switch is initially connected to point A for a long time and them it is shifted to connect it to point B.

What will be the instantaneous current in the branch of the capacitor immediately after the switch is connected to point B?

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3. A metal wire of length l is connected to an ideal battery of emf V and it is found that drift velocity acquired by the electrons is v_d. If the same wire is stretched to double its length then what will be the drift velocity of electrons?

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4. There is one metal wire of length l, which is broken in two parts of unequal length. One part is called A and the other, B. When the length of A is stretched to double its length then its resistance becomes equal to that of B. What is the original ratio of length of A to that of B?

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5. There are 10 identical bubls conneted in series across a battery. The rate at which electric energy is consumed is x. Now when only 8 bubls are connected across the same supply then what will be the effect of electric energy consumed?

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6. The specific resistance of a material of wire changes as $\rho = \rho_0 x$ along the length of the conductor whose area of cross section is constant and equal to A. Here x is the distance of point on conductor from one end of the wire. Calculate its electric resistance. (Given the length of the wire is L)

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7. Find the reading of ammeter in the following circuit.

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8. We have n identical light bubls, which draw a power P when connected across supply of 220V. If all of them is series are connected to 220V supply then power drawn is P_1 and when all of them are connected in parallel them power drawn is P_2, Find P_2 / P_1

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9. Prove that the current at which a fuse will melt is independent of the length of its wire.

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10. The temperature coefficient of a material is 4×10^{-4} per $^\circ C$. Calculate the temperature at which resistance of the conductor becomes 40% more than its value of $0^\circ C$.

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Revision Exercises Very Short Answer Questions

1. State Kirchhoff' voltage law

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2. A steady current flows in a metallic conductor of non-uniform cross section. Are current and current density constant along the conductor?

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3. Are the paths of electrons straight lines between successive collisions with the positive ions of metal in the presence of electric field?

Watch Video Solution

4. Draw a graph representing the change in specific resistance with temperature.

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5. If the length of a wire conductor is doubled by stretching it, keeping the potential difference across it constant, by what factor does the drift speed of the electron change?

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6. If potential difference V applied across a conductor increased to 3V, how will the drift velocity of the electrons change?

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7. When a potential difference is applied across the ends of a conductor, how is the drift velocity of the electrons related to the relaxation time?

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8. How is the drift velocity in a conductor affected with the rise in temperature?

Watch Video Solution

9. Define the term 'mobility' of charge carriers. Write its S.I. unit.

Watch Video Solution

10. How will you represent a resistance of $3700\Omega \pm 5\%$ using colour code?

Watch Video Solution

11. How does the mobility of electrons in a conductor change, if the potential difference applied across the conductor is doubled, keeping the length and temperature of the conductor constant ?

Watch Video Solution

12. A wire of resistivity is stretched to double its length. What will be its new resistivity?

Watch Video Solution

13. Two wires of equal length one of copper and other of manganin have the same resistance. Which wire is thicker?

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14. Show that equivalent resistance in parallel combination is always less than each of the individual resistances connected in the combination.

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15. Draw a graph to show the variation of resistance of a metal wire as a function of its diameter, keeping length and temperature constant.

Watch Video Solution

16. Define the term electrical conductivity of a metallic wire. Write its SI unit.

Watch Video Solution

17. EMF of an electrical cell is 2 volt. A 10Ω resistance is joined at its two ends then potential difference is measured 1.6 volt. Find out the internal resistance and lost volt.

Watch Video Solution

18. How does the conductivity of a metallic conductor vary with temperature?

Watch Video Solution

19. Discuss the effect of temperature on the resistance of (i) metals (ii) semiconductors and (iii) insulators.

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20. For metal conductors, the electrical resistivity decreases with the rise in temperature.Is it true?

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21. Out of copper and nichrome, which has the larger value of temperature coefficient of resistance?

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22. Two wires P and Q of same diameter and same length are joined in parallel and the combination is connected across a battery. The resistance of P i.e. R_P is greater than resistance of Q i.e., R_Q. Which wire will became hotter.

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23. The graph given below shows the variation of resistance of mercury in the temperature range $0 < T < 4K$. Name the phenomenon shown in the graph.

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24. Of metals and alloys, which has greater value of temperature co-efficient of resistance ?

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25. Plot a graph showing variation of current versus voltage for the material GaAs

Watch Video Solution

26. A student obtains resistances 3, 4, 12 and 16 Ohm using only two metallic resistors either separately or joined together. What is the resistance of each of the resistors?

Watch Video Solution

27. Two students A and B were asked to pick a resistor of $15k\Omega$ from a collection of carbon resistors. A picked a resistor with bands of colour: brown, green, orange while B choose a resistor with bands black, green, red. Who picked the correct resistor? Explain.

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28. A wire of resistance 5Ω is drawn out so that its length is increased by twice its original length. Calculate its new resistance.

Watch Video Solution

29. What is the largest voltage you can safely put across a resistor marked 98 ohm $-0.5W$?

Watch Video Solution

30. Two conductors, one having resistance R and another 3R are connected in turn across a d.c. source. If the rate of heat produced in the two conductors is Q_1 and Q_2 respectively, then find their ratio.

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31. Out of the two bubls marked 25W and 100W, which one has the higher resistance, if voltage rating is same?

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32. A 150W and a 600W bulbs are joined in parallel to the mains. Out of the two bulbs, which one will drawn more current ? Voltage rating is same for both.

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33. Write two special characteristics a wire of electric heater should have.

Watch Video Solution

34. The emf of a cell is always greater than its terminal voltage. Why? Give reason.

Watch Video Solution

35. Name the device used for measuring the internal resistance of a secondary cell.

Watch Video Solution

36. Given three resistors of resistances $1\Omega, 2\Omega$ and 3Ω. How will you combine them to get an equivalent resistance of $\frac{11}{5}\Omega$?

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37. The plot of the variation of potential difference across a combination of three identical cells in series versus current is as shown below. What is the emf of each cell?

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38. Two cells of emfs ε_1 and ε_2 and internal resistances r_1 and r_2 respectively are connected in parallel . Obtain expressions for the equivalent (i) resistance and , (ii) emf of the combination.

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39. Obtain the condition for bridge balance in Wheatstone's bridge.

Watch Video Solution

40. What is the condition for a Wheatstone bridge to be most sensitive?

Watch Video Solution

41. What is the principle of working of meterbridge?

Watch Video Solution

42. Assertion: A slide wire bridge is also called a metrebridge.

Reason: It is because, the length of wire in a slide wire bridge is one metre.

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43. What do a voltmeter connected to two terminals of a cell read: the emf or the terminal potential difference?

Watch Video Solution

44. How can the sensitivity of a potentiometer be increased?

Watch Video Solution

45. Assertion A potentiometer is preferred over that of a voltmeter for measurement of emf of a cell

Reason potentiometer does not draw any current from the cell.

Watch Video Solution

46. Why do we prefer potentiometer with a longer bridge wire?

Watch Video Solution

Revision Exercises Additional Questions

1. Domestic electrical wiring has three wires

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2. Electron volt is a unit of :

A. energy

B. potential

C. current

D. charge

Answer: A

Watch Video Solution

3. State the condition under which Ohm's law is not obeyed in a conductor.

A. electrolytes

B. discharge tubes

C. vacuum tubes

D. All of these

Answer: D

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4. Krichhoff's first and second laws are respectively based on law of conservation of

A. momentum and energy

B. charge and energy

C. mass and energy

D. None of these

Answer: B

Watch Video Solution

5. Resistance of a conductor increases with the rise of temperature, because

A. relaxation time decreases

B. relaxation time increases

C. electron density decreases

D. electron density increases.

Answer: A

Watch Video Solution

6. Which of the following quantities do not change when a resistor connected to a battery is heated due to the current?

A. Resistance

B. Resistivity

C. Drift velocity

D. Number of free electrons

Answer: D

Watch Video Solution

7. Write the dimensional formula for electrical resistance?

A. $[ML^2T^{-3}A^{-1}]$

B. $[ML^2T^{-3}A^{-2}]$

C. $[ML^3T^{-3}A^{-2}]$

D. $[ML^2T^{-3}A]$

Answer: B

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8. How does the resistivity of a conductor depend upon temperature electrical conductivity ?

A. its material

B. its cross sectional area

C. All of the above

D. None of these

Answer: A

Watch Video Solution

9. What will be the change in resistance of a constantan wire when its radius is made half and length reduced to one-fourth of its original length ?

A. 4R

B. $\frac{R}{4}$

C. R

D. 2R

Answer: C

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10. The resistance of a conductor increases with

A. Increase in length

B. Increase in temperature

C. Decrease in cross sectional area

D. All of these

Answer: D

Watch Video Solution

11. In a Wheatstone's brigde 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 b the battery is

A. $\frac{R}{4}$

B. $\frac{R}{2}$

C. R

D. 2R

Answer: C

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Revision Exercises Fill In The Blanks

1. The SI unit of currents is ....

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2. Breaking force per unit area of cross section of a wire is called

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3. The average velocity of electrons in a conductor in the absence of electric field is

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4. ....is defined as drift velocity of charge developed per unit applied electric field.

View Text Solution

5. SI UNIT OF RESISTANCE

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6. A metal resistance R is stretched to double its length. Its new resistance will be ....

Watch Video Solution

7. Potential difference between two terminals of a cell, when there is no currentflowing through it is called ....of the cell.

Watch Video Solution

8. While making a battery by connecting n cells in series is useful only when the load resistance is much ....than internal resistance of the cell.

Watch Video Solution

9. A meter-bridge is based on the principle of

Watch Video Solution

10. An ammeter is a device used to measure current flowing in a branch of a circuit. It is always connected in ....with the branch in which the current is to be measured.

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Revision Exercises Short Answer Questions

1. What is Krichhoff's junction rule?

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2. Show that drift velocity is in a direction opposite to the drirection of electric field applied across two ends of the conductor.

Watch Video Solution

3. Define relaxation time of the free electrons drifiting in a conductor. Establish a relation between drift. Velocity and time of relaxation. Use this relation to deduce the expression for the electrical resistivity of the material.

Watch Video Solution

4. Define velocity and derive the expression for it in a conductor in terms of relaxation time.

Watch Video Solution

5. Electron drift speed is estimated to be of the order of mms^{-1}. Yet large current of the order of few amperes can be set up in the wire. Explain briefly.

Watch Video Solution

6. A series combination of three resistors takes current 2 A from a 24 V supply. If the resistors are in the ratio $1:2:3$. Find the values of the unknown resistors.

Watch Video Solution

7. Derive an expression for the resistivity of a good conductor, in terms of the relaxation time of electrons.

Watch Video Solution

8. Write a relation between current and drift velocity of electrons in a conductor. Use this relaxation to explain how the resistance of a conductor change with the rise in temperature.

Watch Video Solution

9. State Ohm' law and deduce it from the knowledge of drift velocity of free electrons in a conductor carrying current.

Watch Video Solution

10. How will you campare emf of two cells by potentiometer?

Watch Video Solution

11. A set of 'n' identical resistors, each of resistance 'R' when connected in series have an effective resistance 'X'. When they are connected in parallel, their effective becomes 'Y'. Find out the product of X and Y.

Watch Video Solution

12. A wire of resistance R, length l and uniform area of cross-section A is stretched till its length becomes double. It is then cut into three pieces of equal length which are connected in parallel. Find the net resistance of the combination in terms of the resistance R.

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13. A given wire having resistance R is stretched so as to reduce its diameter to half of its previous value. What will be its new resistance and resistivity?

Watch Video Solution

14. Write the mathematical relation for the resistivity of a material in terms of relaxation time, number density and mass and charge of charge carriers in it.

Explain, using this relation, why the resistivity of the metal increases and that of a semiconductors decreases with rise in temperature.

Watch Video Solution

15. Explain with the help of a graph the variation of conductivity with temperature of a metallic conductor.

Watch Video Solution

16. Write two differences between ohmic circuit and non-ohmic circuit.

Watch Video Solution

17. Draw a graph showing the variation of resistivity with temperature for nichrome. Which property of nichrome is used to make standard resistance coils?

Watch Video Solution

18. Define the term resistivity of conductor. Give its SI units. Show that the resistance of a conductor is given by

$$R = \frac{ml}{\neq^2 \tau A}$$

where τ is average relaxation time.

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19. If n resistors each of resistance r are connected to get (i) maximum possible resistance (ii) minimum possible resistance. Compute the ratio between values of resistances obtained in (i) and (ii).

Watch Video Solution

20. (a) How will you represent a resistance of 3,700 + 10% ohm by a colour code?

(b) The sequence of bands marked on a carbon resistor are white, blue, orange and silver. What will be the resistance?

Watch Video Solution

21. (a) A wire of resistance R, length l and area of cross-section A is cut into parts, having their lengths in the ratio 1:2. The shorter wire is now stretched till its length becomes equal to that of the longer wire. If they are now connected in parallel, find the net resistance of the combination.

(b) Write the name of the materials having resistivity of the order of (i) $1.7 \times 10^{-8} \Omega m$ and (ii) $10^{15} \Omega m$ at $0^{\circ} C$.

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22. State Joule's law of heating by electric current. Name the materials used to making (i) standard resistors (ii) heater element.

Watch Video Solution

23. The circuit shown in the diagram contains a battery "B" a rheostat "Rh" and identical lamps P and Q. What will happen to the broghtness of the lamps, if the resistance through the rheostat is increased? Give reasons.

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24. Define internal resistance of a cell. Prove that $r \cong \left(\frac{E}{V} - 1\right)R$, where R is the external resistance used.

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25. What is emf of a cell? On what factors does its value depend?

Watch Video Solution

26. (a) Derive a relation between the internal resistance, emf and terminal potential difference of a cell from which current I is drawn. Draw V vs I graph for the cell and explain its significance.

(b) A voltmeter of resistance 988Ω is connected across a cell of emf 2 V and internal resistance 2Ω. Find the potential difference across the voltmeter and also across the terminals of the cell. Estimate the percentage error in the reading of the voltmeter.

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27. State the two Kirchhoff's laws.

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28. A number of indentical cells, n, each of emf ε, internal resistance r, connected in series are charged by a d.c. source of emf ε' , using a resistor R.(i) Draw the circuit arrangemnet. (ii) Deduce the expression for (a) the charging current and (b) the potential difference across the combination of the cells

Watch Video Solution

29. State Wheatstone bridge principle and deduce it using Kirchhoff's rules.

Watch Video Solution

30. How will you infer with the help of an experiment that the same current flows through every part of the circuit containing three resistors, R_1, R_2 and R_3 in series connected to a battery of V volts?

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31. With the help of circuit diagram, explain how a meter bridge can be used to find unknown resistance of a given wire?

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32. Explain the principle of Potentiometer. Draw the labelled circuit diagram for comparing of the emf of two cells?

Watch Video Solution

33. Write any two conditions when Ohm's Law fails?

Watch Video Solution

34. Draw the circuit diagram of a potentiometer to determine the internal resistance of a cell and briefly describe the procedure.

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35. Calculate the current flowing through the following circuit:

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36. A wire whose cross-sectional area is incereasing linearly from its one end to the other, is connected across a battery of V volts. Which of the following quantities remain constant in the wire ?

A. drift speed

B. current density

C. electric current

D. electric field

Answer:

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37. When two resistors are connected in series with a cell of emf 2 V and negligible internal resistance, a current of $\frac{2}{5}$A flows in the circuit. When the resistors are connected in parallel the main current is $\frac{5}{3}A$. Calculate the resistances.

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Revision Exercises Long Answer Questions

1. Define resistance of a conductor and its cause. Explain the factors on which its value depends. How will the resistance of a wire of metal be affected if its temperature is changed?

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2. Compare and explain the temperature dependence of resistivity in case of a conductor, a semiconductor and insulator with proper examples.

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3. State Ohm's law. Derive the laws of resistances, when they are connected: (i) in series (ii) in parallel.

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4. Use Krichhoff's rules to determine the value of the current I_1 flowing in the figure.

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5. Two cells of emfs ε_1 and ε_2 and internal resistances r_1 and r_2 respectively are connected in parallel . Obtain expressions for the equivalent (i) resistance and , (ii) emf of the combination.

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6. Find the condition dor maximum current in case of series combination and parallel combination of cells.

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7. Discuss the grouping of two unidentical cells in(i) series and (ii) parallel and find their equivalent emf and internal resistance.

Watch Video Solution

8. State Wheatstone bridge principle and deduce it using Kirchhoff's rules.

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9. In the circuit diagram given below, AB is a uniform wire of resistance 15Ω and length 1 m. It is connected to a cell E_1 of emf 2 V and negligible internal resistance and a resistance R. The balance point with another cell

E_2 of emf 75 mV is found at 30 cm from rnd A. Calculate the value of R.

(i) Why is the potentiometer preferred over a voltmeter for comparison of emf of cells?

(ii) Draw a circuit diagram to determine internal resistance of a cell in the laboratory.

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10. (a) State the principle of a potentiometer. Define potential gradient. Obtain an expression for potential gradient in terms of resistivity of the potentiometer wire.

(b) The figure shows a long potentiometer wire AB having a constant potential gradient. The null points for the two primary cells of emf ε_1 and ε_2 connected in the manner shown are obtained at a distance of $l_1 = 120cm$ and $l_2 = 300cm$ from th end A. Determine (i) $\varepsilon_1 / \varepsilon_2$ and (ii) position of null point for the cell ε_1 only.

View Text Solution

Revision Exercises Numerical Problems

1. How many electrons pass through a lamp in 2 minutes, if the current is 300 mA. Given that charge on an electron is $1.6 \times 10^{-19} C$.

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2. Calculate the resistivity of the material of a wire 1.0 m lomg, 0.4 mm diameter and having a resistance of 2.0 ohm.

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3. A wire of resistance R is stretched to thrice its original length keeping the volume constant. Calculate its new resistance.

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4. The resistance of a wire of $150^\circ C$ is 133Ω. What will be its resistance at $500^\circ C$. The temperature coefficient of resistance of a wire at $0^\circ C$ is $0.0045^\circ C^{-1}$?

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5. A copper wire is stretched so as to increase its length by 0.2%. Calculate the percentage change in the resistance of the wire.

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6. Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area $1.0 \times 10^{-7} m^2$ carrying a current of $1.5A$. Assume the density of conduction electrons to be $9 \times 10^{28} m^{-3}$.

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7. A uniform wire of resistance 12Ω is cut into three pieces so that the ratio of the resistances $R_1 : R_2 : R_3 = 1 : 2 : 3$ and the three pieces are connected to form a triangle across which a cell of emf 8 V and internal resistance 1Ω is connected as shown.

Calculate the current through each part of the circuit.

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8. A battery of emf E and internal resistance when connected across an external resistance of 12 ohm produces a current of 0.5 A. When connected across a resistance of 25 ohm, it produces a current of 0.25 A. Determine the (i) emf and (ii) internal resistance of the cell.

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9. Three cells of emf, $\varepsilon_1 = 1.5V, \varepsilon_2 = 2.0V$ and $\varepsilon_3 = 3.0V$ having internal resistance $r_1 = 0.30\Omega, r_2 = 0.4\Omega$ and $r_3 = 0.6\Omega$ respectively are connected in parallel. Find out the equivalent emf and the equivalent resistance of a cell which can replace this combination.

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10. A 100 W heater coil is rated 200 V. Find the resistance of thwe coil.

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11. Two bulbs are reled (P_1, V) and (P_2, V). If they are connected (i) iin series and (ii) in perallel across a supply V, find th power dissipated in the two combinations in terms of P_1 and P_2.

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12. A 16Ω resistance wire is bent to form a square. A source of emf 9 V is connected across one of its sides as shown. Calculate the current drawn from the source. Find the potential difference between the ends C and D. If now the wire is stretched uniformly to double the length and once again the same cell is conected in the same way, across one side of the square formed, what will now be the potential difference across one of its diagonals?

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13. Use Kricchoff's rules to find out the values of the current I_1 and I_2 in the electrical network as shown.

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14. In the electric network shown in the figure use Krichhoff's rules to calculate the power consumed by the resistance $R = 8\Omega$

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15. A potentiometer wire of length 1 m is connected to a driver cell of emf 3 V as shown in the figure. When a cell of 1.5 V emf is used in the secondary circuit, the balance point is found to be 60 cm. On replacing this cell and using a cell of unknown emf, the balance point to 80 cm.

(i) Calculate unknown emf of the cell.

(ii) Explain with reason, whether the circuit works, if the drive cell is reprlaced with a cell emf 1 V.

(iii) Does the high resistance R, used in the secondary circuit affrct the balance point? Justify your answer.

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16. A potentiometer wire of length 1.0 m has a resistance of 10Ω. It is connected to a 6 V battery in seried with a resistance of 5Ω. Determine the emf of the primary cell which gives a balance point at 40 cm.

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17. In the circuit shown, $R_1 = 4\Omega, R_2 = R_3 = 15\Omega, R_4 = 30\Omega$ and E = 10 V. Calculate the equivalent resistance of the circuit and the current in each resistor.

View Text Solution

18. In the circuit shown in the figure, find the total resistance of the circuit and the current in the arm CD.

View Text Solution

19. A resistance of R Ω draws current from a potentiometer as shown in the figure. The potentiometer has a total resistance $R_0 \Omega$. A voltage V is supplied to the potentiometer. Drive an expression for the voltage across R when the sliding contact is in the middle of the potentiometer.

View Text Solution

20. For the circuit shown here, would tha balancing length increase, decrease or remain the same, if

(i) R_1 is decreased (ii) R_2 is increased

without any other change, (in each case) in the rest of the circuit? Justify your answers in each case.

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21. The potential difference applied across a given resistor is altered so that the heat produced per second increases by a factor of 9. By what factor does the applied potential difference change ?

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22. Thirty six cells each of emf 1.5 V and internal resistance 0.5Ω are used to send current through an external resistor of resistance 2Ω. What is the best mode of grouping them and the current through the external resistor

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23. A potentiometer has 10 wires each of 1 metre length and the total resistance is 20Ω. Find the resistance to be connected to the driving battery of emf 2 volts to produce a potential drop of $1\mu V$ per millimetre. (Graph sheet is not required.)

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24. A metallic wire of length l and resistance 5Ω is stretched to double its length. Find its new resistivity and new resistance. Assume that there is no change in the density on the stretching.

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Objective Type Questions Multiple Choice Questions A Multiple Choice Questions With Only One Correct Answer

1. There is one metallic rod AB whose area of cross section decreases from its end A towards the end B. End A of the rod is connected to positive terminal of a battery and end B is connected to its negative terminal. If one moves in a direction from B to A,

A. the magnitude of the current will increase

B. the magnitude of current will decrease

C. the magnitude of drift velocity will decrease

D. the magnitude of drift velocity will increase

Answer: C

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2. If n identicals cells, each of emf E and internal resistance r, are connected in series. If two ends of this combination of cells are joined to each other without any external resistance. What will be the terminal potential difference across each cell?

A. E

B. E/n

C. zero

D. cannot be determine

Answer: C

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3. The number of free electrons per unit volume in a material is n and when electric field E is applied, these electrons are found to aquire a drift velocity of v_d. What will be the resistivity of the material?

A. $\frac{E}{nev_d}$

B. $\frac{nE}{ev_d}$

C. $\frac{eE}{nv_d}$

D. $\frac{v_d}{neE}$

Answer: A

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4. What is the effect on the product of resistivity and conductivity of a conductor when its temperature is increased?

A. May increase or decrease

B. Increases

C. Decreases

D. Remains constant

Answer: D

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5. A ammeter should have small resistance. Why?

Watch Video Solution

6. Two batteries of difference emf's and internal resistance are connected in parallel to one another.

A. Equivalent emf will be grater than either of the emf's

B. Equivalent emf will be smaller than either of the emf

C. Equivalent internal resistance will be grater than either of the two internal resistances

D. Equivalent internal resistance will be smaller than either of the two internal resistances.

Answer: D

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7. Two resistors R and 3 R are connected in series. Ratio of rate of heat dessipated in R to that in 3 R is x_1. Similarly when R and 3 R are connected in parallel to each other, ratio of the heat dessipated in R to that in 3 R is x_2. What will be the value of x_2 / x_1?

A. 9

B. $1/9$

C. 6

D. $1/6$

Answer: A

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8. Drift velocity of free electrons when current passes through the conductor is of the order of

A. $10mm/s$

B. $10m/s$

C. $10km/s$

D. $10^6 m/s$

Answer: A

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9. When current passes through a conductor,

A. it creates an electric firld around it, directed towards the conductor

B. it creates an electric field, directed away from the conductor

C. none of the above

D. All of these

Answer: C

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10. In an experiment a student measures terminal potential difference (TPD) of a cell. When the same cell is connected to an external resistance of 5Ω then the TPD is 2 V and when the same is repeated for an external resistance of 10Ω then the TPD is 2.4 V. What is the emf and internal resistance of cell?

A. $2.5V, 3\Omega$

B. $2.5V, 3.5\Omega$

C. $3V, 2.5\Omega$

D. $3V, 3.5\Omega$

Answer: C

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11. When two terminals of a cell are directly connected to each other, current I passes through it. If 12 such cell are to be connected in such a mannat I is the maximum current then the combination would b

A. 2 cells in a row and 6 such rows in parallel

B. all 12 cells in series

C. all 12 cells in parallel

D. 4 cells in a row and 3 such rows in parallel

Answer: C

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12. n identical cells, each of emf ε and internal resistance r, are joined in series to form a closed circuit. One cell A is joined with reversed polarity. The potential difference across any one cell is

A. $\dfrac{(n+1)nE-4}{n}$

B. $\dfrac{n^2E-4}{n}$

C. $\dfrac{\left(n^2+1\right)E-3}{n}$

D. $\dfrac{(n+1)E-4}{n-1}$

Answer: A

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13. In the previous question what will be the terminal potential difference for the cells, which are connected with forward polarity?

A. $\dfrac{(n+1)nE-4}{n}$

B. $\dfrac{nE-4}{n}$

C. $\dfrac{(n+1)E-3}{n}$

D. $\dfrac{(n-1)nE+4}{n}$

Answer: D

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14. One capacitor and ammeter connected in series are connected to an ideal battery. Reading of the ammeter is plotted against time. Which graph represents it the best?

A.

B.

C.

D.

Answer: A

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15. How many time constants will elapse before a capacitor gains 99% of its steady state charge?

A. 1

B. 9.2

C. 4.6

D. 18.4

Answer: C

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16. How many time constans will elapse before a fully charged capacitor loses 99% of its stored charge when connected across a resistor?

A. 1

B. 9.2

C. 4.6

D. 18.4

Answer: C

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17. A resistance of 5Ω is connected across the left gap of a metrebridge and unknown resistance which is greater than 5Ω is connected across the right gap. When these resistances are interchanged the balancing length is found to change by 20cm. What is the value of the unknown resistance?

A. 5Ω

B. $15/2\Omega$

C. 4Ω

D. $10/7\Omega$

Answer: B

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18. Current flowing in 20Ω resistance in the given circuit is

A. 0A

B. 1A

C. 2A

D. 1.5 A

Answer: A

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19. Consider the following circuit diagram. $C_1/C_2 = 1/2$ A switch is initially connected to point 1 and after C_1 is fully charged then switch is connected to point 2. The percentage of stored energy dissipated as heat across the resistance after the switch is shifted to position 2 is

A. $\frac{100}{3}\%$

B. $\frac{200}{3}\%$

C. $\frac{50}{3}\%$

D. $\frac{75}{3}\%$

Answer: B

View Text Solution

20. A $4\mu F$ capacitor is connected to a battery of emf 24V. Through a resistance of $5M\Omega$ and a switch which is kept open initially. Internal resistance of the battery is negligible. Switch is closed at t=0. Potential difference across capacitor and resistor at t=0 are respectively.

A. 12V, 12V

B. 0V, 24V

C. 24V, 0V

D. 6V, 18V

Answer: B

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21. In the previous question, calculate the time required for the potential difference across capacitor to become equal to that across resistor.

A. 13.86s

B. 4.86s

C. 9.2s

D. 21.63s

Answer: A

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22. A current of 2A passes through a resistance of 50Ω, which in turn in used to heat an ideal gas constained in an insulated rigid constainer. By

What amount internal energy of the gas will increase in 3 minutes?

A. 18kJ

B. 36kJ

C. 72kJ

D. 9kJ

Answer: B

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23. A gavanometer shows full-scale deflection for a current of 1mA. Resistance of the coil of the galvanometer is 100Ω. What shunt is required to convert it into an ammeter which can measure a current of 1A?

A. 0.01Ω

B. 0.1Ω

C. 0.001Ω

D. 1Ω

Answer: B

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24. One ideal cell is used to drive current in a metre bridge circuit. In an experiment x is the balancing length obtained. If we replace the wire of the metre bridge with another wire of material having more rsistivity and lesser diameter, the new balancing length will be

A. less than x

B. more than x

C. equal to x

D. more or less that depends on the ratio of resistances used in the left and right gap of metre bridge.

Answer: C

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25. The potential difference across capacitor connected in the given circuit is

A. V

B. V/2

C. 3V/2

D. 2V

Answer: B

View Text Solution

26. In the given circuit, reading of a galvanometer remains the same when the switch is opened or closed. Then

A. $I_1 = I_3$

B. $I_1 = I_2$

C. $I_1 = I_4$

D. $I_2 = I_4$

Answer: B

View Text Solution

27. What should be the value of R in the given network so that maximum power can be delivered to it using a battery shown in the figure?

A. 1Ω

B. 2Ω

C. 3Ω

D. 4Ω

Answer: D

View Text Solution

28. Consider the following circuit

Current passing through the 2Ω resistor will be

A. 10/4A

B. 10/16A

C. 10/32A

D. 10/3A

Answer: B

View Text Solution

29. A galvanometer having coil of resistance 100Ω shows full-scale deflection when 1 mA current is passed through it. What resistance is needed to be connected in series with the coil so that it may be used as a voltmeter which may measure a potential difference of 5 volts?

A. 49Ω

B. 490Ω

C. $4, 900\Omega$

D. 49.000Ω

Answer: C

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30. There are N identical cells of emf E and internal resistance r connected in series with each other. But n cells are connected with reverse polarity and $n < N/2$. Effective emf and internal resistance of this combination are

A. $(n-2n)e, Nr$

B. $(N-2n)E, nr$

C. $(N-n)E, Nr$

D. $(N-n)E, nr$

Answer: A

Watch Video Solution

31. An ideal battery of emf 20V is connected in the given circuit. The voltmeter connected in the given circuit is also ideal

The reading of the voltmeter will be

A. 20 V

B. 10 V

C. 20/3 V

D. 10/3 V

Answer: C

View Text Solution

32. Two bulba A and B of 200 W and 25 W, respectively are designed for the same voltage wire used in both the cases are same. The ratio of radius of cross section of filament of bulb A to that of the bulb B is

A. $2\sqrt{3}$

B. $2\sqrt{2}$

C. 2

D. 4

Answer: B

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33. If the coil of a heater is cut to raduce its length by 20% then effect on its power will be

A. 0.125

B. 0.21

C. 0.25

D. 0.42

Answer: C

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34. In the given network, the capacitor is initially undercharged and switch is kept open.

The switch is closed at t = 0. Write the expression of charge on the capacitor as a function of time.

A. $q = CV\left(1 - e^{-t/2RC}\right)$

B. $q = 2CV\left(1 - e^{-t/2RC}\right)$

C. $q = CV\left(1 - e^{-t/2RC}\right)$

D. $q = CV\left(1 - e^{-2t/3RC}\right)$

Answer: A

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35. In precious question the switch is kept closed for a long time and then assume it is opened at t = 0. Write the expression of charge on the capacitor as a function of time.

A. $q = 2CVe^{-t/3RC}$

B. $q = CVe^{-t/3RC}$

C. $q = CVe^{-t/2RC}$

D. $q = CVe^{-2t/3RC}$

Answer: B

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36. A conducting wire of uniform cross section, having resistance R is bent to form a circle. O is the centre of this circle. Two points P and Q are selected on the ring in such a manner that $\angle POQ$ is θ. If a battery of emf E and negligible internal resistance is connected between P and Q, then the current drawn from the battery would be

A. $\dfrac{E\theta}{4\pi^2 R(2\pi - \theta)}$

B. $\dfrac{E(2\pi - \theta)}{4\pi^2 \theta R}$

C. $\dfrac{4\pi^2 E\theta}{R(2\pi - \theta)}$

D. $\dfrac{4\pi^2 E}{\theta R(2\pi - \theta)}$

Answer: D

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1. Across a metaalic conductor of non-uniform cross-section a constant potential difference is applied. The quantity which remains constant along the conductor is :

A. current

B. drift velocity

C. electric field

D. current density

Answer: A

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2. The charge flowing through a resistance R varies with time $tasQ = at - bt^2$. The total heat produced in R is

A. $\frac{a^3 R}{3b}$

B. $\frac{a^3 R}{2b}$

C. $\frac{a^3 R}{b}$

D. $\frac{a^3 R}{6b}$

Answer: A

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3. If voltage across a bulb rated 22 volt 100 watt drops by 2.5% of its rated value, the percentage of the rated value by which the power would decrease is

A. 0.1

B. 0.2

C. 0.025

D. 0.05

Answer: D

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4. A carbon resistor of $(47 \pm 4.7) k\Omega$ is to be marked with rings of different colours for its identification. The colour code sequence will be

A. Yellow-Green-Violet-Gold

B. Yellow-Violet-Orange-Silver

C. Violet-Yellow-Orange-Silver

D. Green-Orange-Violet-Gold

Answer: B

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5. A ring is made of a wire having a resistance $R_0 = 12\Omega$. Find the point 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 $\frac{8}{3}\Omega$.

A. $\frac{l_1}{l_2} = \frac{1}{2}$

B. $\frac{l_1}{l_2} = \frac{5}{8}l$

C. $\frac{l_1}{l_2} = \frac{1}{3}$

D. $\frac{l_1}{l_2} = \frac{3}{8}$

Answer: A

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6. A cell can be balanced against $110cm$ and $100cm$ of potentiometer wire, respectively with and without being short circuited through a resistance of 10Ω. Its internal resistance is

A. 0.5 ohm

B. 2.0 ohm

C. zero

D. 1.0 ohm

Answer: D

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7. A battery consists of a variable number n of identical cells having internal resistance connected in series. The terminals of the battery are short circuited and the current I measured. Which one of the graph below shows the correct relationship between I and n?

A.

B.

C.

D.

Answer: C

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8. A set of $'n'$ equal resistor, of value of $'R'$ each are connected in series to a battery of emf $'E'$ and internal resistance $'R'$. The current drawn is I. Now, the $'n'$ resistors are connected in parallel to the same battery. Then the current drawn from battery becomes 10.1. The value of $'n'$ is

A. 20

B. 11

C. 10

D. 9

Answer: C

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9. which of the following acts as a circuit protection device?

A. Fuse

B. Conductor

C. Inductor

D. Switch

Answer: A

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10. 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 :

A. 6 V

B. 4 V

C. 2 V

D. 12 V

Answer: C

View Text Solution

11. In a ammeter 0.2% of main current passes through the galvanometer. If resistance of galvanometer is G, the resistance of ammeter will be

A. $\frac{1}{499}G$

B. $\frac{499}{500}G$

C. $\frac{1}{500}G$

D. $\frac{500}{499}G$

Answer: C

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12. In the circuits shown below, the readings of the voltmeters and ammeters will be:

A. $V_2 > V_1$ and $i_1 > i_2$

B. $V_2 > V_1$ and $i_1 = i_2$

C. $V_1 = V_2$ and $i_1 > i_2$

D. $V_1 = V_2$ and $i_1 = i_2$

Answer: D

View Text Solution

13. In the circuit shown, the current through the 4Ω resistor is 1 amp when the points P and M are connected to a D>C. voltage source. The potential difference between the points M and N is:

A. 1.0 volt

B. 0.5 volt

C. 3.2 volt

D. 1.5 volt

Answer: C

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14. Consider the following two statement.

`(A) Kirchhoff's junction law follows from the conservation of charge.

(B) Krichhoff's loop law follows from the conservation of energy.

Which of the following is correct ?

A. (1) is wrong and (2) is correct

B. Both (1) and (2) are correct

C. Both (1) and (2) are wrong

D. (1) is correct and (2) is wrong.

Answer: B

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15. Six similar bulbs are connected are connected as shown in the figure with a DC source of emf E, and zero internal resistance. The ratio of power consumption by the bulbs when (i) all are glowing and (ii) in the situation when two from section A and one from section B are glowing, will be:

A. $2:1$

B. $4:9$

C. $9:4$

D. $1:2$

Answer: C

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16. The resistance in the two arms of the metre bridge are 5Ω and $R\Omega$ respectively. When the resistance R is shunted with an equal resistance, the new balanced point is at 25 cm. The resistance 'R' is:

A. 10Ω

B. 30Ω

C. 20Ω

D. 25Ω

Answer: B

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17. A potentiometer circuit has been setup for finding. The internal resistance of a given cell. The main battery used a negligible internal resistance. The potentiometer wire itsefl is $4m$ long. When the resistance, R, connected across the given cell, has value of

(i) Infinity 9.5Ω,

(ii) the 'balancing length' , on the potentiometer wire are found to be $3m$

and $2.85m$, respectively.

The value of internal resistance of the cell is

A. 0.25Ω

B. 0.95Ω

C. 0.5Ω

D. 0.75Ω

Answer: C

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18. A potentiometer wire has length $4m$ and resistance 8Ω. The resistance that must be connected in series with the wire and an accumulator of e.m.f. $2V$, so as the get a potential gradient $1mV$ per cm` on the wire is

A. 40Ω

B. 44Ω

C. 48Ω

D. 32Ω

Answer: D

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19. A potentiometer wire is $100cm$ long hand 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 obatined at $50cm$ and $10cm$ from the positive end of the wire in the two cases. The ratio of emfs is:

A. $5:4$

B. $3:4$

C. $3:2$

D. $5:1$

Answer: C

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20. 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

A. nR

B. $\frac{R}{2}$

C. n^2R

D. $\frac{R}{n^2}$

Answer: C

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Objective Type Questions Multiple Choice Questions B Multiple Choice Question Jee Main Other State Boards For Engineering Entrance

1. The resistance of a wire is 5 ohm at $50^\circ C$ and 6 ohm at $100^\circ C$. The resistance of the wire at $0^\circ C$ will be

A. 1 ohm

B. 5 ohm

C. 3 ohm

D. 2 ohm

Answer: B

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2. A 5 V battery with internal resistance 2Ω and 2 V battery with internal resistance 1Ω are connected to a 10Ω resistor as shown in the figure. The current in the 10Ω resistor is

A. $0.27AP_1$ to P_2

B. $0.27AP_2$ to P_1

C. $0.03AP_1$ to P_2

D. $0.03AP_2$ to P_1

Answer: D

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3. Shown in the figure below is a metre bridge set up with null deflection in the galvanometer. The value of the unknown resistance R is

A. 55Ω

B. 13.75Ω

C. 220Ω

D. 110Ω

Answer: C

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4. Two conductors have the same resistance at $0^\circ C$ but their temperature coefficient of resistanc are α_1 and α_2. The respective temperature coefficients of their series and parallel combinations are nearly

A. $\dfrac{\alpha_1+\alpha_2}{2}, \dfrac{\alpha_1+\alpha_2}{2}$

B. $\dfrac{\alpha_1+\alpha_2}{2}, \alpha_1+\alpha_2$

C. $\alpha_1+\alpha_2, \dfrac{\alpha_1+\alpha_2}{2}$

D. $\alpha_1+\alpha_2, \dfrac{\alpha_1\alpha_2}{\alpha_1+\alpha_2}$

Answer: A

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5. If 400Ω of resistance is made by adding four 100Ω resistance of tolerance 5%, then the tolerance of the combinations

A. 0.05

B. 0.1

C. 0.15

D. 0.2

Answer: A

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6. The current in the primary circuit of a potentiometer is $0.2A$. The specific resistance and cross-section of the potentiometer wire are 4×10^{-7} ohm meter and $8 \times 10^{-7} m^2$ respectively. The potential gradient will be equal to -

A. 1V/m

B. 0.5V/m

C. 0.1V/m

D. 0.2V/m

Answer: C

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7. A student measures the terminal potential difference (V) of a cell (of emf ε 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

A. $-r \text{ and } \varepsilon$

B. $r \text{ and } -\varepsilon$

C. $-\varepsilon \text{ and } r$

D. $\varepsilon \text{ and } -r$

Answer: A

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8. Two electric bulbs marked 25W-220V and 100W-220V are connected in series to a 440 V supply. Which of the bulbs will fuse ?

A. none

B. both

C. 100W

D. 25W

Answer: D

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9. The supply voltage to room is 120 V. The resistance of the lead wires is 6Ω. 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?

A. 2.9 volt

B. 13.3 volt

C. 10.04 volt

D. zero volt

Answer: D

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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 electric mains is 220 V. The minimum capacity fo the main fuse of the building will be :

A. 14A

B. 8A

C. 10A

D. 12A

Answer: D

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11. When 5 V potential difference is applied across a wire of length 0.1 m, the drift speed of electrons is $2.5 \times 10^{-4} ms^{-1}$. If the electron density in the wire is $8 \times 10^{28} m^{-3}$, the resistivity of the material is close to :

A. $1.6 \times 10^{-8} \Omega m$

B. $1.6 \times 10^{-7} \Omega m$

C. $1.6 \times 10^{-6} \Omega m$

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

Answer: D

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12. In the circuit shown, the current in the 1Ω resistor is:

A. 1.3 A, from P to Q

B. 0A

C. 0.13A, from Q to P

D. 0.13A, from P to Q

Answer: C

View Text Solution

13. A 200Ω resistor has a certain color code. If one replaces the red color by green in the code, the new resistance will be

A. 500Ω

B. 400Ω

C. 300Ω

D. 100Ω

Answer: A

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14. Two batteries with emf 12V and 13V are connected in parallel across a load resistor of 10Ω. The internal resistances of the two batteries are 1Ω and 2Ω respectively. The voltage across the load lies between

A. 11.4V and 11.5V

B. 11.7 V and 11.8V

C. 11.6V and 11.7V

D. 11.5 V and 11.6V

Answer: D

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15. Two cells of emf E_1 and E_2 are joined in opposition (such that $E_1 > E_2$). If r_1 and r_2 be the external resistance, then the terminal potential difference is

A. $\dfrac{E_1 + E_2}{r_1 + r_2} \times 2$

B. $\dfrac{E_1 + E_2}{r_1 + r_2 + R} / \times R$

C. $\dfrac{E_1 - E_2}{r_1 + r_2} \times R$

D. $\dfrac{E_1 - E_2}{r_1 + r_2 + R} \times R$

Answer: D

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16. In a potentiometer experiment it is found that no current passes through the galvanometer when the terminals of the cell are connected across $0.52m$ of the potentiometer wire. If the cell is shunted by a resistance of 5Ω balance is obtained when the cell connected across$0.4m$ of the wire. Find the internal resistance of the cell.

A. 2Ω

B. 2.5Ω

C. 1Ω

D. 1.5Ω

Answer: D

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17. The resistance of the bulb filament is 100Ω at a temperature of $100^\circ C$. If its temperature co-efficient of resistance be 0.005 per $5^\circ C$, its resistance will becomes 200Ω at a temperature

A. $300^\circ C$

B. $400^\circ C$

C. $500^\circ C$

D. $1,200^\circ C$

Answer: D

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

A. 3.3

B. 2.3

C. 3.7

D. 2.7

Answer: A

View Text Solution

19. Variation of resistance of the conductor with temperature is as shown

The temperature coefficient (α) of the conductor is

A. $\dfrac{R_0}{m}$

B. mR_0

C. m^2R_0

D. $\dfrac{m}{R_0}$

Answer: D

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20. Two heating coils of resistance 10Ω and 20Ω are connected in parallel and connected to a battery of emf 12V and internal resistance 1Ω. The power consumed by them is in the ratio

A. $1:4$

B. $1:3$

C. $2:1$

D. $4:1$

Answer: C

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21. A rigid container with thermally insulated walls contains a gas and a coil of resistance 50Ω, carrying a current of 1A. The change in internal energy of the gas after 2 min will be

A. 6kJ

B. 10kJ

C. 3kJ

D. 12kJ

Answer: A

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22. In the network shown below, if potential across XY is 4V, then the input potential across AB is

A. 16 V

B. 20V

C. 8V

D. 12V

Answer: A

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23. 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 $1k\Omega$. How much was the resistance on the left slot before interchanging the resistances ?

A. 550Ω

B. 910Ω

C. 990Ω

D. 505Ω

Answer: A

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24. In the given circuit all resistances are of value of R ohm each. The equivalent resistance between A and B is

A. $\frac{5R}{2}$

B. 3R

C. $\frac{5R}{3}$

D. 2R

Answer: D

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

If V_0 is almost zero, identify the correct statement:

A. The potential difference across the battery is 1.5V when it sends a current of 1000mA

B. The emf of the battery is 1.5V and the value of R is 1.5Ω

C. The emf of the battery is 1.5V and its internal resistance is 1.5Ω

D. The value of the resistance R is 1.5Ω

Answer: C

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26. A heating element has a resistance of 100 Ω at room temperature. When it is connected to a supply of 220 V, a steady current of 2A passes in it and temperature is $500^{\circ} C$ more than room temperature. What is the temperature coefficient of resistance of the heating element ?

A. $5 \times 10^{-4 \circ} C^{-1}$

B. $2 \times 10^{-4 \circ} C^{-1}$

C. $1 \times 10^{-4 \circ} C^{-1}$

D. $0.5 \times 10^{-4 \circ} C^{-1}$

Answer: B

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27. One kg of water, at $20^{\circ} C$, is heated in an electric kettle whose heating element has a mean (temperature averaged) resistance of 20Ω. The rms voltage in the mains is 200V. Ignoring heat loss from the kettle, time taken for water to evaporate fully, is close to: [specific heat of water= 4200J/kg $^{\circ}C$], Latent heat of water = 2260kJ/kgl

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28. A d.c. main supply of e.m.f. $220V$ is connected across a storage battery of e.m.f. 200 V through a resistance of 1Ω . The battery terminals are connected to an external resistance 'R'. The minimum value of 'R', so that a current passes through the battery to charge it is:

A. 7Ω

B. 9Ω

C. 11Ω

D. Zero

Answer: C

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29. In the circuit shown, current (in A) through the 50V and 30V batteries are, respectively:

A. 2,5 and 3

B. 3.5 and 2

C. 4.5 and 1

D. 3 and 2.5

Answer: C

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30. The circuit shown here has two batteries of 8.0V and 16.0V and three resistance 3Ω, 9Ω and 9Ω and a capacitor $5, 0\mu F$

How much is the current I in the circuit in steady state ?

A. 1.6A

B. 0.67A

C. 2.5A

D. 0.25A

Answer: B

View Text Solution

31. In a metre bridge as shown in the figure it is given that resistance $Y = 12.5\Omega$ and that the balance is obtained at a distance 395.5cm from end A (by Jockey J). After interchanging the resistance X and Y a new balance point is found at a distance l_2 from end A. What are the values of X and l_2?

A. 19.15Ω and $39.5cm$

B. 8.16Ω and $60.5cm$

C. 8.16Ω and $39.5cm$

D. 19.15Ω and $60.5cm$

Answer: B

View Text Solution

32. In the electric network shown, when no current flows through the 4Ω resistor in the arm EB, the potential difference between the points A and D will be

A. 3V

B. 4V

C. 5V

D. 6V

Answer: C

View Text Solution

33. Suppose the drift velocity v_d in a material varied with the applied electric field E as $v_d \propto \sqrt{E}$. Then V – I graph for a wire made of such a material is best given by :

A.

B.

C.

D.

Answer: B

Watch Video Solution

34. A 10 battery with internal resistance 1Ω and a 15V battery 0.6Ω are connected in parallel to a voltmeter (see figure). The reading in the voltmeter will be close to

A. 11.9V

B. 12.5V

C. 13.1V

D. 24.5V

Answer: C

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35. In the circuit shown, the resistance r is a variable resistance. If for r= f, R the heat generation in r is maximum then the value of f is

A. $\frac{1}{4}$

B. $\frac{1}{2}$

C. $\frac{3}{4}$

D. 1

Answer: B

View Text Solution

36. The resistance of an electrical toasterf has a temeprature dependence given by $R(T) = R_0[(T - T_0)]$ in its range of operation. At $T_0 = 300K, R = 100\Omega$ and $at T = 500K, R = 120\Omega$. The toasterf is connected to a voltage source at 200 V and its temperature is raised at a con- stant rate from 300 to 500 K in 30 s. The total work done in raising the temperature is :

A. $400 \ln\left(\frac{1.5}{1.3}\right) J$

B. $200 \ln\left(\frac{2}{3}\right) J$

C. $60, 000 \ln\left(\frac{6}{5}\right) J$

D. 300 J

Answer: C

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37. 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:

A. 8Ω

B. 6Ω

C. 16Ω

D. 1Ω

Answer: A

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38. In the given circuit diagram when the current reaches ateady atate in the circuit, the charge on the capacitor of capacitance C will be:

A. CE

B. $CE\frac{r_1}{r_2 + r}$

C. $CE\frac{r_2}{r + r_2}$

D. $CE\frac{r_1}{r + r}$

Answer: C

View Text Solution

39.

In the above circuit the current in each resistance is :

A. $1A$

B. 0.25 A

C. 0.5 A

D. 0

Answer: D

View Text Solution

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

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

A. 13/24

B. 44030

C. 11933

D. 20/3

Answer: C

41.

A 9 V battery with internal resistance of 0.5Ω is connected across an infinite network as shown in the figure. All ammeters A_1, A_2, A_3 and voltmeter V are ideal.

Choose correct statement.

A. Reading of A_1 is 2 A

B. Reading of A_1 is 18 A

C. Reading of V is 9 V

D. Reading of V is 7 V

Answer: A

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42. A potentiometer PQ is set up to compare two resistance as shown in the figure. The ammeter A in the circuit reads 1.0 A when two way key K_3 is open. The balance point is at amlength l_1 cm from P when two way key K_3 is plugged in between 2 and 1, while the balance point is at length l_2 cm from P when key K_3 is plugged in between 3 and 1. The ratio of two resistance $\frac{R_1}{R_2}$, is found to be:

A. $\dfrac{l_1}{l_1 + l_2}$

B. $\dfrac{l_2}{l_2 - l_1}$

C. $\dfrac{l_1}{l_1 - l_2}$

D. $\dfrac{l_1}{l_2 - l_1}$

Answer: D

View Text Solution

43. A uniform wire of length l and radius r has a resistance of 100Ω. It is recast into wire of radius $\dfrac{R}{2}$

A. 1600Ω

B. 400Ω

C. 200Ω

D. 100Ω

Answer: A

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44. In a metre bridge experiment resistance are connected as shown in the figure. Initially resistance $P = 4\Omega$ and the neutral point N is at 60 cm from A. Now an unknown resistance R is connected is series to P and from A. They value of unknown resistance R is :

A. $\frac{33}{5}\Omega$

B. 6Ω

C. 7Ω

D. $\frac{20}{3}\Omega$

Answer: D

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45. In the circuit shown, a four wire potentiometer is made of a 400 wire, which extends between A and B. The resistance per unit length of the potentiometer wire is $r = 0.01\Omega / cm$. 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 :

A. 0.75 V

B. 0.20 V

C. 0.25 V

D. 0.50 V

Answer: C

View Text Solution

Objective Type Questions Multiple Choice Questions B Multiple Choice Question Jee Advanced For Iit Entrance

1. Consider a thin square sheet of side L and thickness t, made of a material of resistivity ρ.

The resistance between two opposite faces, shown by the shaded areas in the figure is:

A. directly proportional to L

B. directly proportional to t

C. independent of L

D. independent of t

Answer: C

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2. In an aluminium (Al) bar of a square cross section, a square holw is drilled and is filled with iron (Fe) as shown in the figure. The electrical resistivity of Al and Fe are $2.7 \times 10^{-8} \Omega m$ and $1.0 \times 10^{-7} \Omega m$, respectively. The electrical resistance between the two faces P and Q of the composite bar is

A. $\dfrac{2,475}{64}\mu\Omega$

B. $\dfrac{1,875}{64}\mu\Omega$

C. $\dfrac{1,875}{49}\mu\Omega$

D. $\dfrac{2,475}{132}\mu\Omega$

Answer: B

View Text Solution

3. If current I is flowing through ABC, then the correct relationship is :

A. $V_{AB} = 2V_{BC}$

B. power across BC is four times power across AB

C. current densities in AB and BC are equal

D. electrical field due to current AB and BC are equal.

Answer: B

View Text Solution

4. The figure show three resistor configuration R_1, R_2 and R_3 connected to a 3V battery each. If the power dessipitate by the configuration R_1, R_2 and R_3 is P_1, P_2 and P_3 respectively then

A. $P_1 > P_2 > P_3$

B. $P_1 > P_3 > P_2$

C. $P_2 > P_1 > P_3$

D. $P_3 > P_2 > P_1$

Answer: C

View Text Solution

5. For the circuit shown in the figure

A. the current I through the battery is 7.5 mA.

B. the potential difference across R_L is 18 V.

C. ratio of powers dissipated in R_1 and R_2 is 3.

D. If R_1 and R_2 are interchanged, magnitude of the power dessipated in R_1 will decrease by a factor of 9

Answer: A

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6. A resistance of 2Ω is connected across one gap of a metre-bridge(the length of the wire is 100 cm) and an unknown resistance, greater than 2Ω, is connected across the other gap. When these resistances are interchanged, the balance points shifts by 20 cm. Neglecting any corrections, the unknown resistance is

A. 3Ω

B. 4Ω

C. 5Ω

D. 6Ω

Answer: A

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7. During an expriment with meter bridge, the galvanometer shows a null point when the jockey is pressed at 40.0 cm using a standard resistance of 90Ω, as shown in the figure. The least count of the scale used in the meterbrudge is 1 mm. The unknown resistance is

A. $60 \pm 0.15\Omega$

B. $135 \pm 0.56\Omega$

C. $60 \pm 0.25\Omega$

D. $135 \pm 0.23\Omega$

Answer: C

View Text Solution

8. A meterbridge is set up as shown, to determine an unknown resistance 'X' using a standard 10 ohm resistor. The galvanometer shows null point when the tapping key is at 52 cm mark. The end-corrections are 1 cm and 2 cm respectively for the ends A and B. The determine value of 'X' is

A. 10.2 ohm

B. 10.6 ohm

C. 10.8 ohm

D. 11.1 ohm

Answer: B

View Text Solution

9. A circuit is connected as shown in the figure with the awitch S open. When the switch is closed, the total amount of charge that flows from Y to X is

A. $10\mu C$

B. $54\mu C$

C. $27\mu C$

D. $81\mu C$

Answer: C

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Objective Type Questions Multiple Choice Questions C Multiple Choice Questions With More Than One Correct Answer

1. A circuit consists of a source of a constant $emf\xi$ and a resistance R amd a capacitor with capacitance C connected in series. The internal resistance of the source is negligible. At a moment $t = 0$ the capacitance of the capacitor is abruply decreased η-fold. FInd the current flowing through the circuit as a function of time t.

A.

B.

C.

D.

Answer: A::B

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2. Two plates of a charged capacitor are connected to each through a resistance and a switch which is kept open initially. The switch is closed at t= 0. If q is charge on capacitor and I is the current in the circuit at time t then the curves that correctly represent the variation of the change and current with time are:

A.

B.

C.

D.

Answer: B::D

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3. Two identical moving coil galvanometers have 10Ω resistance and full scale deflection at $2\mu A$ current. One of them is converted into a voltmeter of 100mA full scale reading and the other into an Ammeter of 1mA full scale current using appropriate resisters. These are then used to measure the voltage and current in the Ohm's law experiment with $R = 1000\Omega$ resistor by using an ideal cell. Which of the following statement(s) is(are) correct?

A. The measured value of R will be $978\Omega < R < 982\Omega$.

B. The resistance of the Voltmeter will be $100k\Omega$.

C. The resistance of Ammeter will be 0.02Ω (round off to 2^{nd} decimal place).

D. If the ideal cell is replaced by a cell having internal resistance of 5Ω then the measured value of R will be more than 1000Ω.

Answer: A::C

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4. Two different types of cells are connected as shown in the diagram.

A. Terminal potential difference of one cell will be greater than it emf.

B. Terminal potential difference of one cell will be less than it emf

C. One cell is supplying energy

D. One cell is consuming energy

Answer: A::B::C::D

View Text Solution

5. We have two identical fuses which are rated at 20 A. If these two are joined

A. in series then their combination will act as a fuse of 10 A rating

B. in series then their combination will act as a fuse of 20 A rating

C. in parallel then their combination will act as a fuse of 40 A rating.

D. in parallel then their combination will act as a fuse of 20 A rating.

Answer: B::C

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6. Two capacitors $C_1 = 2mF$ and $C_2 = 8mF$ are seperately charged from the same battery. These two capacitors are then allowed to discharge separately through resistors of same resistance with a switch in series which are kept open initially. Both switches are closed at t = 0.

A. Current at t = 0 will be zero in both the capacitors.

B. At t = 0 current in C_1 will be 4 times the current in C_2.

C. At t = 0 current in both the capacitors will be the same

D. Capacitor C_1 loses 25% of its initial charge in lesser time than capacitor C_2.

Answer: C::D

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7. A galvanometer with a coil of resistance 50Ω shows full-scale deflection when 10 mA current passes through it.

A. The galvanometer can measure a maximum voltage of 0.5 V.

B. 5 A current can be measured if a shunt of 0.1Ω is connected in parallel to it.

C. It can be used as voltmeter to measure a voltage of 5 V if 450Ω resistance is connected in series with the coil of the galvanometer.

D. It can be used as a voltmeter to measure a voltage of 50 V if $4,950\Omega$ resistance is connected in series with the coil of the galvanometer.

Answer: A::B::C::D

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8. A capacitor of capacitance $200\mu F$ is connected to a battery through a resistance of $5k\Omega$ at time t = 0. Charge stored in the capacitor in first second in larger than the charge stored in the next

A. 1s

B. 10s

C. 100 s

D. 1,000 s

Answer: A::B::C::D

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9. When no current is passed through a conductor,

A. free electrons come to rest

B. the avarage velocity of free electrons in a large time interval is zero

C. the average speed of free electrons in a large time interval is zero

D. the average of instantaneous velocities of all the lectrons at an instant is zero.

Answer: B::D

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10. When current passes through a conductor then its temperature increases due to heating effect. Which of the following quantities do change due to heating?

A. Number density of free electrons

B. Conductivity

C. Drift speed

D. Resistance

Answer: B::C::D

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11. How does the ratio of resistivity to conductivity changes when temperature of a conductor is increased?

A. Increases

B. Decreases

C. Remain constant

D. Cannot say anythings

Answer: A

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12. Select the correct statement.

A. Krichhoff's junction law follows from the conservation of energy.

B. Krichhoff's loop law follows from the conservation of enrgy

C. Krichhoff's junction law follows from the conservation of charge

D. Krichhoff's loop law follows from the conservation of charge.

Answer: B::C

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13. A graph between terminal potential difference and current flowing through a battery is plotted as shown in the figure when it is connected across an external resistor.

A. emf of the battery is 5V

B. Internal resistance of the battery is 2.5Ω.

C. Current flowing flowing through it is 0.5 A when external resistance of 7.5Ω is connected across it.

D. Maximum current that can flow in the battery is 2A.

Answer: A::B::C::D

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14. In the circuit shown, initially there is no charge on capacitors and keys S_1 and S_2 are open. The values of the capacitors are $C_1 = 10\mu F, C_2 = 30\mu F$ and $C_3 = C_4 = 80\mu F$, Which of the following(s) is/are correct?

A. The keys S_1 is kept closed for long time such that capacitors are fully charged. Now, key S_2 is closed, at the time, the instantaneous current across 30Ω resistor (between points P and Q) will be 0.2 A (round off to 1^{st} decimal place)

B. If key S_1 is kept closed for long time such that capacitors are fully charged, the voltage difference between points P and Q will be 10V.

C. At time t = 0, the key S_1 is closed, the instantaneous current in the closed circuit will be 25 mA

D. If key S_1 is kept closed for long time such that capacitors are fully charged, the voltage across the capacitors C_1 will be 4 V.

Answer: C::D

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15. Heater of an electric kettle is made of a wire of length L and diameter d. It takes 4 minutes to raise the temperature of 0.5 kg water by 40K. This heater is replaced by a new heater having two wires of the same material, each of length L and diameter 2d. The way these wires are connected is given in the options. How much time in minutes will it take to raise the temperature of the same amount of water by 40 K?

A. 4 if wires are in parallel

B. 2 if wires are in series

C. 1 if wires are in series

D. 0.5 if wires are in parallel

Answer: B::D

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16. Incandescent bulbs are designed by keeping in mind that the resistance of their filament increases with the increase in temperature. If at room temperature, $100W, 60W$ and $40W$ bulbs have filament resistances R_{100}, R_{60} and R_{40}, respectively, the relation between these resistances is

A. $\frac{1}{R_{100}} = \frac{1}{R_{40}} + \frac{1}{R_{60}}$

B. $(R_{100}) = (R_{40}) + (R_{60})$

C. $(R_{100}) > (R_{40}) > (R_{40})$

D. $\frac{1}{R_{100}} > \frac{1}{R_{60}} > \frac{1}{R_{40}}$

Answer: A::D

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17. Two ideal batteries of emfs V_1 and V_2 and three resistances R_1, R_2 and R_3 are connected as shown in the figure. The current in resistance R_2 would be zero if

A. $V_1 = V_2$ and $R_1 = R_2 = R_3$

B. $V_1 = V_2$ and $R_1 = 2R_2 = R_3$

C. $V_1 = 2V_2$ and $2R_1 = 2R_2 = R_3$

D. $2V_1 = V_2$ and $2R_1 = R_2 = R_3$

Answer: A::B::D

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18. For the resistance network shown in the figure, choose the correct option(s):

A. The current through PQ is zero

B. $I_1 = 3A$

C. The potential at S is less than that at Q

D. $I_2 = 2A$

Answer: A::B::C::D

View Text Solution

Objective Type Questions Multiple Choice Questions D Multiple Choice Questions Based On A Given Passage Comprehension

1. The given figure is part of a circuit. All the values of the voltages, currents, resistances and the capacitance are mentioned in the figure. Study the circuit for a steady state condition of the capacitor to answer the following questions.

Current flowing through the 8Ω resistance is

A. 1A

B. 2A

C. 3A

D. 6A

Answer: D

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2. The given figure is part of a circuit. All the values of the voltages, currents, resistances and the capacitance are mentioned in the figure. Study the circuit for a steady state condition of the capacitor to answer the following questions.

Charge stored in the capacitor is

A. $105\mu C$

B. $210\mu C$

C. $72\mu C$

D. $144\mu C$

Answer: A

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3. The given figure is part of a circuit. All the values of the voltages, currents, resistances and the capacitance are mentioned in the figure.

Study the circuit for a steady state condition of the capacitor to answer the following questions.

Energy stored in the capacitor is

A. $2202.5\mu J$

B. $1102.5\mu J$

C. $3303.5\mu J$

D. $1002.5\mu J$

Answer: B

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4. The given figure is part of a circuit. All the values of the voltages, currents, resistances and the capacitance are mentioned in the figure. Study the circuit for a steady state condition of the capacitor to answer the following questions.

Potential difference between points a and b is

A. 58 V

B. 19 V

C. 29 V

D. 39 V

Answer: C

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5. Here is a circuit for transient analysis of current flowing in several branches.

Given that the switch S_w is turned on at t = 0, make appropriate calculations to answer the following questions.

Charge stored in the capacitor as a function of time is given by

A. $\dfrac{CV}{2}\left(1 - e^{\frac{-2t}{3RC}}\right)$

B. $CV\left(1 - e^{\frac{-2t}{3RC}}\right)$

C. $\dfrac{3CV}{2}\left(1 - e^{\frac{-2t}{RC}}\right)$

D. $\dfrac{CV}{2}\left(1 - e^{\frac{-3t}{2RC}}\right)$

Answer: A

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6. Here is a circuit for transient analysis of current flowing in several branches.

Given that the switch S_w is turned on at t = 0, make appropriate calculations to answer the following questions.

What is the time constant for the given circuit?

A. 2RC/3

B. 3RC/2

C. 3RC

D. 2RC

Answer: B

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7. Here is a circuit for transient analysis of current flowing in several branches.

Given that the switch S_w is turned on at t = 0, make appropriate calculations to answer the following questions.

Current flowing in the branch containing capacitor as a finction of time.

A. $\dfrac{V}{3R}e^{\frac{-2t}{3RC}}$

B. $\dfrac{V}{2R}e^{\frac{-2t}{3RC}}$

C. $\dfrac{2V}{3R}e^{\frac{-3t}{2RC}}$

D. $\dfrac{V}{3R}e^{\frac{-t}{3RC}}$

Answer: A

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8. Here is a circuit for transient analysis of current flowing in several branches.

Given that the switch S_w is turned on at t = 0, make appropriate calculations to answer the following questions.

Calculate current supplied by the battery as function of time.

A. $\frac{V}{3R}\left(3+e^{\frac{-2t}{3RC}}\right)$

B. $\frac{V}{6R}\left(2+3e^{\frac{-2t}{3RC}}\right)$

C. $\frac{V}{6R}\left(3+e^{\frac{-2t}{3RC}}\right)$

D. $\frac{V}{6R}\left(3+2e^{\frac{-2t}{3RC}}\right)$

Answer: C

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9. A capacitor of capacitance $C_1 = 3C$ is charged to a potential difference V and connected to an unchanged capacitor of capacitance $C_2 = C$ through a resistor of resistance R and a switch. Switch is turned on at t = 0.

Calculate change on C_2 as a function of time.

A. $\frac{3CV}{2}\left(1 - e^{\frac{4t}{3RC}}\right)$

B. $\frac{3CV}{4}\left(1 - e^{\frac{4t}{3RC}}\right)$

C. $\frac{3CV}{4}\left(1 - e^{\frac{3t}{4RC}}\right)$

D. $\frac{3CV}{4}\left(1 - e^{\frac{8t}{3RC}}\right)$

Answer: B

View Text Solution

10. A capacitor of capacitance $C_1 = 3C$ is charged to a potential difference V and connected to an unchanged capacitor of capacitance $C_2 = C$ through a resistor of resistance R and a switch. Switch is turned on at t = 0.

Calculate the rate of heat generation across the resistor R

A. $\frac{V^2}{R} e^{-\frac{8t}{3RC}}$

B. $\frac{V^2}{R} e^{-\frac{4t}{3RC}}$

C. $\frac{V^2}{2R} e^{-\frac{8t}{3RC}}$

D. $\frac{V^2}{2R} e^{-\frac{4t}{3RC}}$

Answer: A

View Text Solution

11. A capacitor of capacitance $C_1 = 3C$ is charged to a potential difference V and connected to an unchanged capacitor of capacitance

$C_2 = C$ through a resistor of resistance R and a switch. Switch is turned on at t = 0.

What is the time constant for the charging of C_2?

A. 3RC/5

B. 3RC/7

C. 3RC/9

D. 6RC/8

Answer: D

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12. Consider a block of conducting material of resistivity 'ρ' shown in the figure. Current 'I' enters at 'A' and leaves from 'D'. We apply superposition principle to find voltage '$DelataV$' development between 'B' and 'C'. The calculation is done in the following steps:

(i) Take current 'I' entering from 'A' and assume it to spread over a hemispherical surface in the block.

(ii) Calculate field E(r) at distance 'r' from A by using Ohm's law E $= \rho J$, where J is the current per unit area at 'r'.

(iii) From the 'r' dependence of E(r), obtain the potential V(r) at r.

(iv) Repeat (i), (ii) and (iii) for current 'I' leaving 'D' and superpose results for 'A' and 'D'.

Now answer the following questions based on the above passage.

ΔV measured between B and C is:

A. $\dfrac{\rho I}{2\pi(a-b)}$

B. $\dfrac{\rho I}{\pi a} - \dfrac{\rho I}{\pi(a+b)}$

C. $\dfrac{\rho I}{a} - \dfrac{\rho I}{(a+b)}$

D. $\dfrac{\rho I}{2\pi a} - \dfrac{\rho I}{2\pi(a+b)}$

Answer: B

View Text Solution

13. Consider a block of conducting material of resistivity 'ρ' shown in the figure. Current 'I' enters at 'A' and leaves from 'D'. We apply superposition principle to find voltage '$DelataV$' development between 'B' and 'C'. The calculation is done in the following steps:

(i) Take current 'I' entering from 'A' and assume it to spread over a hemispherical surface in the block.

(ii) Calculate field E(r) at distance 'r' from A by using Ohm's law E $= \rho J$, where J is the current per unit area at 'r'.

(iii) From the 'r' dependence of E(r), obtain the potential V(r) at r.

(iv) Repeat (i), (ii) and (iii) for current 'I' leaving 'D' and superpose results for 'A' and 'D'.

Now answer the following questions based on the above passage.

For current entering at A, the electric field at a distance r from A is

A. $\dfrac{\rho I}{4\pi r^2}$

B. $\dfrac{\rho I}{8\pi r^2}$

C. $\dfrac{\rho I}{r^2}$

D. $\frac{\rho I}{2\pi r^2}$

Answer: D

View Text Solution

14. Consider an evacuated cylinder chamber of height h having rigid conducting plates at the ends and an insulating curved surface as shown as shown in the figure. A number of spherical balls made of a light weight and soft material and coated with a conducting material are placed on the bottom plate. The balls have a radius $r < < h$. Now a high voltage source (HV) is connected across the conducting plates such that the bottom plate is at $+V_0$ and the top plate at $-V_0$. Due to their conducting surface, the balls will get charged, will become equipotential with the plate and are repelled by it. The balls will eventually collide with the top plate, where the coefficient of restitution can be taken to be zero due to the nature of the material of the balls. The electric field in the capacitor. Assume that there are no collisions between the balls and the interaction between them is negligible. (Ignore gravity)

Which one of the following statements is correct?

A. The balls will stick to the top plate and remain there.

B. The balls will bounce back to the bottom plate carrying the same charge they went up with

C. The balls will bounce back to the bottom plate carrying the opposite charge they up with

D. The balls will execute simple harmonic motion between the two plates.

Answer: C

View Text Solution

15. Consider an evacuated cylinder chamber of height h having rigid conducting plates at the ends and an insulating curved surface as shown as shown in the figure. A number of spherical balls made of a light weight and soft material and coated with a conducting material are placed on the bottom plate. The balls have a radius $r < \; < h$. Now a high voltage source (HV) is connected across the conducting plates such that the bottom plate is at $+V_0$ and the top plate at $-V_0$. Due to their conducting surface, the balls will get charged, will become equipotential with the plate and are repelled by it. The balls will eventually collide with the top plate, where the coefficient of restitution can be taken to be zero due to the nature of the material of the balls. The electric field in the capacitor. Assume that there are no collisions between the balls and the interaction between them is negligible. (Ignore gravity)

The average current in the steady state registered by the ammeter in the circuit will be

A. zero

B. proportional to the potential V_0

C. proportional to $V_0^{1/2}$

D. proportional to V_0^2

Answer: D

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Objective Type Questions Multiple Choice Questions D Multiple Choice Questions Assertion Reason Type Questions

1. Assertion: Current is a scalar quantity.

Reason: Electric current arises due to continuous flow of charged particles or ions.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of the assertion

C. If assertion is correct but reason is incorrect

D. If assertion is incorrect but reason is correct

Answer: B

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2. Why is that the terminal potential difference is always less than the e.m.f. of a cell?

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of the assertion

C. If assertion is correct but reason is incorrect

D. If assertion is incorrect but reason is correct

Answer: D

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3. Assertion: Two identical cells of emf E and internal resistance r are connected to each other in such a manner that the positive terminal of one is connected to the positive terminal of the other. The net emf of its combination will be E.

Reason: Effective internal resistance of this combination will be $r/2$

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of the assertion

C. If assertion is correct but reason is incorrect

D. If assertion is incorrect but reason is correct

Answer: B

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4. Assertion: The rating of a bulb is done on the basis of steady state of its filament. When a bulb is connected to a rated power supply then the filament consumes more power than the rated power of the bulb immediately after it is switched on.

Reason: When current flows through the bulb then due to heating of its filament its resistance first increases and then becomes contant when steady state temperature is attained.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of the assertion

C. If assertion is correct but reason is incorrect

D. If assertion is incorrect but reason is correct

Answer: A

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5. Assertion: Drift velocity of electrons developed in a current-carrying conductor is of the order of $10^{-4} m / s$ but current in the conductor is established almost instantly the switch is closed.

Reason: Electric field in a conductor sets up with the speed of light.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of the assertion

C. If assertion is correct but reason is incorrect

D. If assertion is incorrect but reason is correct

Answer: A

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6. Assertion: Resistivity of a metal conductor increases with the increase in temperature.

Reason: When the temperature of a conductor is increased then the number of free electrons per unit volumic increases.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of the assertion

C. If assertion is correct but reason is incorrect

D. If assertion is incorrect but reason is correct

Answer: C

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7. Assertion: Two metallic cylinders of different materials and having the same cross section are connected in series with each other. Electric field in both of them would be equal each other. Electric field in both of them would be equal when current passes through them.

Reason: When two conductors are connected in series then the same current is passed through them.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of the assertion

C. If assertion is correct but reason is incorrect

D. If assertion is incorrect but reason is correct

Answer: D

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8. Assertion: When we increase the temperature of a metal wire then its electrical resistance increases.

Reason: When we increase the temperature of a conductor then its relaxation time also increases.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of the assertion

C. If assertion is correct but reason is incorrect

D. If assertion is incorrect but reason is correct

Answer: C

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9. Statement-1 : In a Meter Bridge experiment, null point for an unknown resistance is measured. Now, the unknown resistance is put inside an enclosure maintained at a higher temperature. The null point can be obtained at the same point as before by decreasing the value of the standard resistance.

Statement-2 : Resistance of metal increases with increase in temperature.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of the assertion

C. If assertion is correct but reason is incorrect

D. If assertion is incorrect but reason is correct

Answer: D

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10. Assertion: The resistance of a conductor increases with an increase in temperature.

Reason: While experimenting, a jockey is touched gently on a wire and it should not be pressed hard.

A. If both assertion and reason are correct and reason is a correct explanation of the assertion

B. If both assertion and reason are correct but reason is not the correct explanation of the assertion

C. If assertion is correct but reason is incorrect

D. If assertion is incorrect but reason is correct

Answer: B

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Objective Type Questions Multiple Choice Questions D Multiple Choice Questions Matrix Match Type Questions

1.

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Objective Type Questions Multiple Choice Questions D Multiple Choice Questions Integer Type Questions

1. An uncharged capacitor is connected to a battery through a resistor. Till the time the steady state is reached U is the total energy stored in the capacitor and H is the total heat dissipated by the resistor in this process of charging. What is value of U/H?

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2. Each resistor in the network is of resistance 5Ω. What will be the equivalent resistance between A and B?

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3. A charged capacitor of capacitance C is connected to an uncharged capacitor of capacitance 2C through a resistor of resistance R. If H is the heat lost across the resistor during charge redistribution process and E is the total energy stored in the capacitors after redistribution then calculate H/E

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4. One electric kettle has two coils. Coils-1 takes time 2 minutes to boil the water and coil -2 takes 4 minutes to boil the water and coil-2 takes 4 minutes to boil the water. When both the coils are connected in series then how many minutes will it take to boil the water?

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5. A current of 6.4 A flows in a conductor having area of cross section $10^{-4}m^2$. The number of free electrons per unit volume is $8 \times 10^{28}m^{-3}$. The drift velocity of electrons is found to be $n \times 10^{-6}m/s$. Calculate the valeu of n.

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6. The balancing length for a cell in a potentiometer is 110cm and 100cm, when in open circuit and when the cell is short circuited with resistance of 10Ω. Find the internal resistance of the cell in SI units.

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7. What potential difference in volts will appear between point C and D when 10V potential difference is applied between A and B. All resistances are equal?

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8. Consider the following circuit $E_1 = 6V, E_2 = 3V, r_1 = 1\Omega, r_2 = 2\Omega$.

Calculate the potential difference between P and Q

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9. In the following circuit V=10V, R = $2M\Omega$ and $C = 2\mu F$. The capacitors are initially uncharged.

At time t=0 the switch is closed. Calculate the time in seconds when voltage across the capacitors becomes 4V. (ln 5=1.6, ln 3= 1.1)`

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10. The equivalent resistance between A and B is found to be nR. What is the value of n?

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11. In the following circuit, the current through the resistor $R(=2\Omega)$ is I amperes. The value of I is

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Objective Type Questions Multiple Choice Questions Ncert Exemplar Problems

1. Consider a current carrying wire (current I) in the shape of a circle. Note that as the current progresses along the wire, the direction of $\vec{J}$

(current density) changes in an exact manner, while the current I remains unaffected. The agent that is essentially responsible for is

A. the source of emf

B. electric field produced by charges accumulated on the surface of wire.

C. the charges just behind a given segment of wire. Which push them just the right way by repulsion

D. the charges ahead

Answer: B

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2. Two batteries of emf ε_1 and $\varepsilon_2(\varepsilon_2 > \varepsilon_1)$ and internal resistance r_1 and r_2 respectively are connected in parallel as shown in following figure.

A. The equivalent emf ε_{eq} of the two cells is between

ε_1 and ε_2 i.e$\varepsilon_1 < \varepsilon_{eq} < \varepsilon_2$.

B. The equivalent emf ε_{eq} is smaller than ε_1

C. The ε_{eq} is given by $\varepsilon_{eq} = \varepsilon_1 + \varepsilon_2$ always

D. ε_{eq} is independent of internal resistances r_1 and r_2

Answer: A

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3. A resistance R is to be measured using a meter bridge. Student chooses the standared resistance S to be 100Ω. He finds the null point at $l_1 = 2.9cm$. He is told to attempt to improve the accuracy. Which of the folllowing is a useful way?

A. He should measure l_1 more accurately

B. He should charge S to $1,000\Omega$ and repeat the experiment

C. He should change S to 3 Ω and repeat the experiment

D. He should give up hope of a more accurate measurement with a metrebridge

Answer: C

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4. Two cells of emfs approximately 5V and 10V are to be accurately compared using a poteniometer of length 400 cm.

A. The battery that runs the potentiometer should have voltage of 8V

B. The battery of potentiometer an have a voltage of 15V and R adjusted so that the potential drop across the wire slightly exceeds 10V

C. The first portion of 50cm of wire itself should have a potential drop of 10V

D. The potentiometer is generally used for comparing resistances and not voltages.

Answer: B

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5. A metel rod of the length 10cm and a rectangular cross-section of 1 cm xx $1/2$ cm is connected to a battery across opposite faces. The resistance will be

A. maximum when the battery is connected across $1cm \times \frac{1}{2}cm$ faces

B. maximum when the battery is connected across $10cm \times 1cm$ faces

C. maximum when the battery is connected across $10cm \times \frac{1}{2}cm$ faces

D. same irrespective of the three faces

Answer: A

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6. Which of the follwing characteristies of electrons determines the current in a conductor?

A. Drift velocity alone

B. Thermal velocity alone

C. Both drift velocity and thermal velocity

D. Neither drift nor thermal velocity.

Answer: A

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7. Kirchoff's junction rule is a reflection of

A. conservation of current density vector

B. conservation of charge.

C. the fact that momentum with which a charged particle approaches a junction is unchanged (as a vector) as the charged particle leaves the junction.

D. the fact that there is no accumulation of charges at a junction.

Answer: B::D

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8. Consider a simple circuit shown in the figure given with question.

stands for a variable resistance R'. R' can vary from R_0 to infinity. r is internal resistance of the battery $(r < < R < < R_0)$.

A. Potential drop across AB is nearly constant as R' is varied.

B. Current through R' is nearly a constant as R' is varied.

C. Current I depends sensitively on R'

D. $I \geq \frac{V}{r+R}$ always

Answer: A::D

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9. Temperature dependence of resistivity p(T) of semiconductors, insulators and metals is significantly based on the following factors:

A. number of charge carries can change with temperature T.

B. time interval between two successive collisions can depend on T.

C. length of material can be a function of T

D. mass of carriers is a function of T.

Answer: A::B

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10. The measurement of an unknown resistance R is to be carried out using Wheatstone bridge (see Fig. 2(EP).3). Two students perform an experiment in two way. The first student takes $R_2 = 10\Omega$ and $R_1 = 5\Omega$. The other student takes $R_2 = 1000\Omega$ and $R_1 = 500\Omega$. In the standard arm, both take $R_3 = 5\Omega$. Both find $R = \frac{R_2}{R_1}R_3 = 10\Omega$ within errors.

A. The errors of measurement of the two students are the same

B. Errors of measurement do depend on the accuracy with which R_2 and R_1 can be measured.

C. If the student uses large values of R_2 and R_1, the currents through the arms will be feeble. This will make determination of null point accurately more difficult.

D. Wheatstone bridge is a very accurate instrument and has no errors of measurement.

Answer: B::C

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11. In a metrebride, the point D is a neutral point (Refer the figure given below).

A. The metrebridge can have no other neutral point for this set of resistances.

B. When the jockey contacts a point on metre wire left of D, current flows to B from the wire.

C. When the jockey contacts a point on the metre wire to the right of D, current flows from B to the wire through galvanometer.

D. When R is increased, the neutral point shifts to left.

Answer: A::B::C

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Chapter Practice Test

1. Is current density a vector or a scalar? Express its relation with electric field.

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2. State the direction of drift velocity of electron with respect to the appliled electric field.

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3. Why is manganin preferred over conductors like copper to construct standard resistors?

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4. Is the graph showing variation of current versus voltage for a diode linear or non-linear?

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5. On increasing the temperature of a copper conductor, its resistivity increases. State the reason behind this observation.

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6. Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons.

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7. Deduce Ohm's law using the concepts of drift velocity and relaxation time.

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8. Define mobility of a charge carrier.What is its relation with relaxation time?

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9. Write the sequence of colours in a carbon resistor having resistances $25 \times 10^6 \Omega \pm 10\,\%$. How will the sequence change if the tolerance becomes 20%?

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10. A cell of emf E and internal resistance r is connected across an external resistance R. Plot a graph showing the variation o $P. D.$ Across R, verses 'R`.

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11. State the principle of potentiometer. Draw a circuit diagram used to compare the emfs of two primary cells. Write the formula used. How can the sensitivity of a potentiometer be increased.

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12. With the help of a circuit diagram, explain the working principle of a metre bridge. How is it used to determine the unknown resistance of a given wire? Write the necessary precautions to minimise the error in the result?

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13. Obtain the condition for bridge balance in Wheatstone's bridge.

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14. Answer the following :

(a) Why are the connections between the resistors in a meter bridge made of thick copper strips?

(b) Why is it generally preferred to obtain the balance point in the middle of the meter bridge wire?

(c) Which material is used for the meter bridge wire and why?

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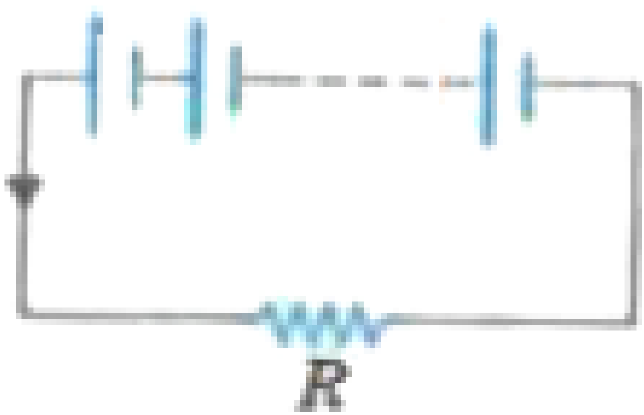
15. n-identical cells each of emf E and internal resistance r are connected in series. Find the expression for current in the circuit given below



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