PHYSICS

BOOKS - JEEVITH PUBLICATIONS PHYSICS (KANNADA ENGLISH)

CURRENT ELECTRICITY

One Mark Questions And Answers

1. What constitutes an electric current?

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2. What is the net flow of charge at the given cross section of a conductor?

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3. Define electric current.

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4. Mention the S.I. unit of current.

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5. What is the direction of conventional current?

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6. What is the direction of flow of electrons in a conductor?

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7. Define 'drift velocity' of free electrons .

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8. Define relaxation time or mean free time.

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9. Define electron mobility.

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10. What is the order of relaxation time?

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11. Mention the SIU of electron mobility.

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12. How does drift velocity depend on electric current?

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13. What is the average electron thermal velocity at room temperature?

14. What is the order of drift velocity of electrons?

15. State Ohm's law.

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16. Define electrical resistance.

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17. Mention the SIU of electrical resistance.

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18. Define the unit one ohm.

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19. How does the resistance of a conductor depend on its length?

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20. How does electrical resistance depend on the area of cross-section of a conductor?

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21. Define electrical conductance?

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22. Mention the SI units of electrical conductance?

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23. What is ohmic device? Give one example.

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24. What is ohmic device? Give one example.

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25. A graph of electric current along the y-axis and potential difference along the x-axis gives

a straight line passing through the origin. What does the slope determine?

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26. What are non ohmic devices?

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27. Write the dimensional formula for electrical resistance?

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28. Define resistivity.

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29. Mention the SIU of resistivity.

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30. Write the dimensional formula for resistivity.

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31. What is meant by electrical conductivity?

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32. Mention the SI unit of electrical conductivity.

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33. Write the equivalent mathematical form for Ohm's law.

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34. Express the range of resistivity of conductors.

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35. What is the range of resistivity of semiconductors?

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36. What is the range of resistivity of insulators?

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37. Show variation of resistivity of copper as a function of temperature in a graph.

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38. Draw a graph of resistivity of nichrome as a function of absolute temperature.

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39. Plot a graph of resistivity of a semiconductor as a function of absolute temperature.

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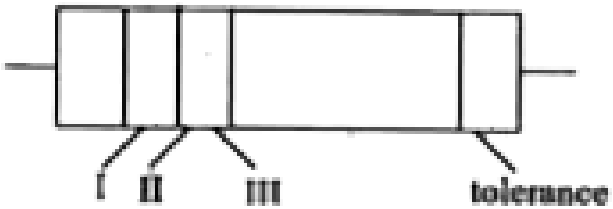
40. The first three colour bands are Red, Red, Orange. What will be the value of resistance of the resistor?



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41. Define temperature coefficient of resistance of a conductor. Give the expression for temperature coefficient.

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42. What is meant by 'Critical temperature?

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43. What are super conductors?

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44. A carbon resistor is marked Red, Red, Red, Gold. What is the value of its resistance?

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45. Compare R_s with R_p for 'n' identical resistors connected in series and parallel

combinations.

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46. Define EMF of a cell.

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47. What amount of energy is derived from a cell by a capacitor, to charge it completely?

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48. Define internal resistance of a cell.

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49. Define one volt of emf

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50. What happens to the effective resistance when two resistors are connected in series?

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51. Two resistors are connected in parallel. What will happen to its equivalent resistance?

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52. Define effective resistance of a number of resistors connected in a series or parallel combination

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53. Obtain an expression for equivalent resistance of two resistors connected in parallel.

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54. What is the reciprocal of resistance called?

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55. What is the reciprocal of resistivity called?

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56. Why is that the terminal potential difference is always less than the e.m.f. of a cell?

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57. What is the unit of e.m.f?

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58. Give the colour code for $10\Omega \pm 10\,\%$ tolerance resistor.

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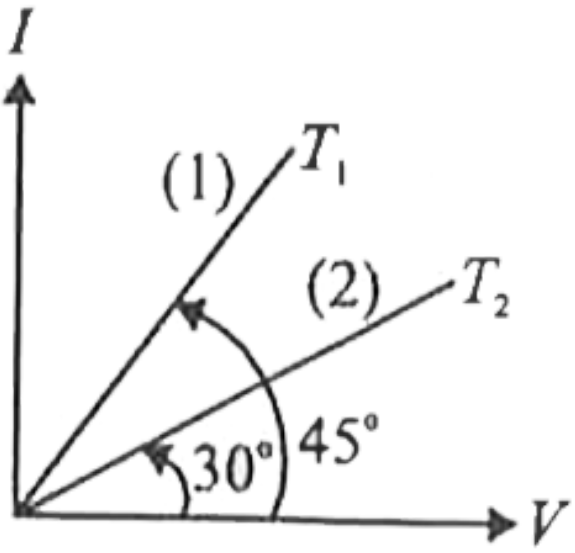
59. In the following graph, say whether $T_1 > T_2$ or not.



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60. How does resistivity depend on number density of electrons?

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61. The length of a conductor is increased two folds. What will happen to the resistivity of the material?

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62. Why are Manganin and Constantan used in making resistance coils?

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63. Define the term current density.

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64. What is an electrical network?

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65. What is a node?

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66. What is a mesh or loop?

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67. What principle is involved in Kirchhoff's first law?

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68. What is the significance of Kirchhoff's voltage law?

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69. Can Kirchhoff's laws be applied to AC circuits?

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70. What is the principle of a metre bridge?

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71. Write the balanced condition of Wheatstone's network.

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72. Why are the connections between the resistors in a meter bridge made of thick copper strips ?

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73. What is generally connected in the right gap of a metre bridge?

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74. If the galvanometer in the Wheatstone's network is removed under the balanced condition, then say whether the network is still balanced or not.

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75. In a balanced Wheatstone's network, galvanometer and cell are interchanged. Will the network be still balanced?

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76. In a balanced Wheatstone's network, the galvanometer resistance is increased by 20Ω. What happens to the balance of the network?

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77. At what point of a closed circuit, conservation of charge is valid?

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78. Name the instrument which can measure the emf of a cell and its internal resistance accurately.

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79. Name the physical quantity which gives the rate of flow of charge per unit area normal to the flow?

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80. Name any one device that works based on balanced condition of the Wheatstone's bridge or network.

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81. What will be the resistance of a semiconductor near absolute zero.

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82. What will be the resistance of a conductor near absolute zero?

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83. A resistor draws energy from a battery. Where does this energy come from?

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84. What are semiconductors?

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85. What is meant by electrical grounding or earthing?

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86. What is Super conductivity?

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Two Mark Questions And Answers

1. Mention any two effects of current.

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2. Mention any two factors on which the internal resistance of the cell depends.

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3. Mention the unit of current density. Say whether current density is a scalar or a vector physical quantity.

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4. Write the dimensional formula for voltage

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5. Write the dimensional formula for resistivity.

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6. State Kirchhoff's laws of Electrical network.

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7. P, Q, S, R are four resistances arranged in a cyclic order in a Wheatstone's network. Under a balanced condition, what will be the potential difference between the junction of P and Q and Rand S?

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8. What are electrical conductors? Give an example.

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9. What are insulators? Give an example.

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10. Two bulbs 110 V / 10 Wand 110 V / 40W are connected in series and across a 110 V. Which

of these will glow brighter? Explain why.

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11. Two heaters rated 220 V / 1 kW and 220 V / 3 kW are connected in parallel across a 220V source. Which of these will heat up faster? Explain why.

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12. If $E_1, E_2, E_3 \ldots E_n$ represent emfs of a number of cells of internal resistances $r_1, r_2, \ldots r_n$ then mention their equivalent emf and internal resistance when these are connected in series.

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13. If a number of cells are connected in parallel then write their equivalent emf and internal resistance.

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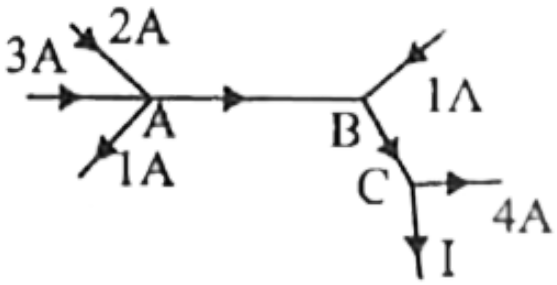
14. In the network shown below, find I.



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15. What is a potentiometer?

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16. Give the formula to determine internal resistance of a cell using a potentiometer.

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17. How does the emf of a cell depend on the balancing length obtained in a potentiometer? Give the expression for ratio of emfs in terms of balancing lengths.

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18. Give the expression for power wasted in connecting wires.

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19. Give any two practical limitations of Ohm's law.

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Three Mark Questions And Answers

1. A uniform wire of resistance 9Ω is bent to form an equilateral triangle. What is the effective resistance between any two corners of the triangle.

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2. State and explain ohm's law

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3. Define temperature coefficient of resistance of a conductor. Give the expression for temperature coefficient.

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4. Derive the expression for current in a simple circuit based on Ohm's law.

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5. If 10 Ω is unplugged from a standard resistance box and $33\frac{1}{3}$ cm is the balancing length obtained in the metre bridge, then calculate the resistance of the wire.

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6. Four resistors of resistances 2Ω, 4Ω, 6Ω and 2Ω are connected in a cyclic order of a Wheatstone's network. What resistance

should be connected with 2Ω in the arm AD so as to balance the network?

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7. Four resistors $4\Omega, 8\Omega, 18\Omega$ and 6Ω are connected in a cyclic order to form a Wheatstone's network. How and what value of resistance should be connected in the 18Ω branch to balance the network?

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8. Write a note on Wheatstone's network.

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9. If two parallel resistors P and R of Wheatstone's network, are short circuited, then find the equivalent resistance of the circuit, when G = S = Q = 10Ω.

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10. Show that $j = \sigma E$ where symbols have their usual meanings.

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11. Distinguish between Current and Current density.

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Five Mark Questions And Answers

1. Derive an expression for electrical conductivity.

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2. State the laws of resistance of a conductor. Define specific resistance of material of a conductor. Mention the SI unit of specific resistance.

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3. Write a note on the variation of resistance of a metallic conductor with temperature.

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4. Obtain an expression for equivalent resistance of two resistors connected in a series combination.

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5. Obtain an expression for equivalent resistance of two resistors connected in parallel.

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6. Obtain an expression for the equivalent emf and internal resistance of two cells connected in parallel.

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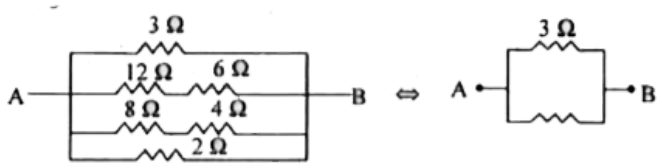
Numerical Problems And Answers

1. In the given circuit, calculate the effective resistance between A and B.



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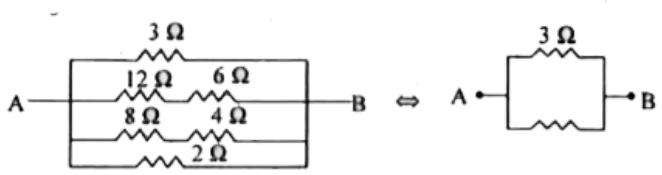
2. In the given circuit, calculate the current through the circuit when connected with $12V$

supply.



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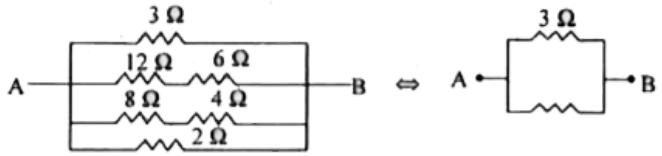
3. In the given circuit, calculate the current through 3Ω resistor, when circuit is connected to $12V$ battery.



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4. A battery of internal resistance 3Ω is connected to 20Ω resistor and the potential difference across the resistor is 10V. If another resistor 30Ω is connected in series with the first resistor and battery is again connectecl to the combination, then calculate the e.m.f and terminal potential difference across the combination..

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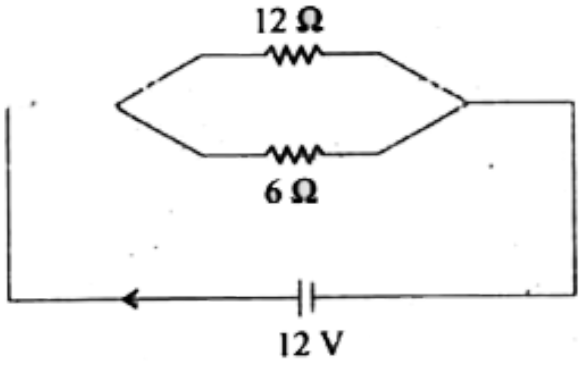
5. A network of resistors is connected to a 12V battery as shown in the figure. Calculate the equivalent resistance of the network.



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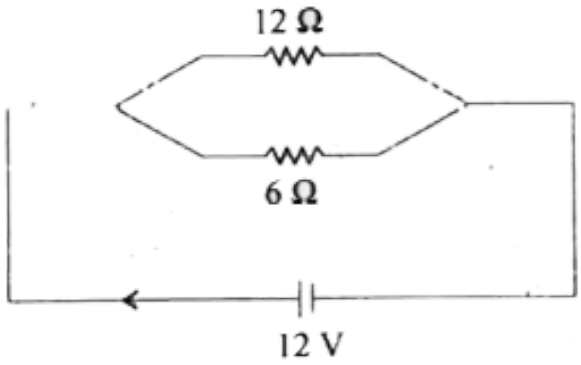
6. A network of resistors is connected to a 12V battery as shown in the figure. Obtain current in 12Ω and 6Ω resistors.



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7. Two cells of emf 2V and 4V and internal resistance 1Ω and 2Ω respectively are connected in parallel so as to send the current in the same direction through an external resistance of 10Ω. Find the potential difference across 10Ω resistor.

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8. Which two resistors are connected in series with a cell of emf 2V and negligible internal

resistance, a current of (2/5)A flows in the circuit. When the resistances are in parallel, the main current is (5/3)A. Calculate the resistances.

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9. Two resistors of resistances 2Ω and 4Ω are connected in parallel. Two more resistors 3Ω and 6Ω are also connected in parallel. These two combinations are in series with a battery

of emf 5 V and internal resistance 0.7Ω. Calculate current through the 6Ω resistor.

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10. Three equal resistors connected in series across a source of emf of negligible internal resistance together dissipate 10 W of power. What would be the power dissipated if the resistors are connected in parallel across the same source of e.m.f.

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11. A copper wire has 3×10^{22} free electrons in $0.021m$ length. The drift velocity of electrons is found to be $2 \times 10^{-5} ms^{-1}$.

How large a current will flow through the wire?

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12. A copper wire has 3×10^{22} free electrons in 0.021 m length. The drift velocity of electrons is found to be $2 \times 10^{-5} ms^{-1}$.

How many electrons would pass through a given cross-section of the wire in one second?

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13. A cube of side $0.05m$ of a material of conductor is drawn into a wire of thickness $0.20mm$. If the specific resistance of the wire is $10^{-6}\Omega m$ then calculate the resistance of the wire.

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14. If the number density of electrons in a conductor is 3×10^{28} and thickness of the conductor is 5 mm, then calculate the current in that conductor for a drift velocity of $2 \times 10^{-4} ms^{-1}$. If the voltage applied is $500V$, then calculate relaxation time. Given specific charge of electron = 1.76×10^{11} C kg^{-1}, length of the conductor = 10 m

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15. Two resistors 10Ω and 25Ω are connected in series and the combination is connected across a 25 V source of negligible internal resistance. A voltmeter of resistance 25Ω is connected across the 10Ω resistor. Find the reading in the voltmeter. If another voltmeter of a very large resistance replaces the voltmeter, then find the reading of voltmeter.

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16. Four resistors of resistances $2\Omega, 1\Omega, 3\Omega, 4\Omega$ are arranged in a cyclic order to form a Wheatstone's network ABCD. The junctions B and D are connected to a galvanometer of resistance 2Ω. A current of 0.1 A enters the junction 'A'. Calculate the current in the galvanometer.

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17. ABCD forms the four arms of a Wheatstone's network. The arms AB, BC, CD, DA are of $10\Omega, 15\Omega, 25\Omega$ and 20Ω respectively. The junctions B and D are connected to the ends of galvanometer of resistance 25Ω. If the source voltage is 5V, r = 0, then calculate the current in the galvanometer. Assume the branch currents across AB, BC, CD, DA and BD as $i_1, i_3, -i_4, -i_2,$ and i_g respectively.

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18. A battery of emf $10V$ and internal resistance 3Ω is connected to a resistor. If the current in the circuit is $0.5A$, what is the resistance of the resistor? What is the terminal voltage of the battery when the circuit is closed?

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19. Three resistors $2\Omega, 4\Omega$ and 5Ω are connected in parallel. What is the total resistance of the combination?

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20. Three resistors $2\Omega, 4\Omega$ and 5Ω are connected in parallel.If the combination is connected to a battery of emf $20V$ and negligible internal resistance, determine the current through each resistor and the total current drawn from the battery.

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21. A negligbly small current is passed through a wire of length 15m, 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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22. A heating element using nichrome connected to a 230V supply draws an initial

current of 3.2A which settles after a few seconds to a steady value of 2.8A. What is the steady temperature of the heating -element, if the room temperature is 27.0° C? Temperature cofficient of resistance of nichrome averaged over the temperature range involved is $1.70 \times 10^{-4 \circ} C^{-1}$.

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23. The number density of free electrons in a copper conductor is estimated as

$8.5 \times 10^{28} m^{-3}$. How long does an electron take to drift from one end of a wire 3.0m 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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24. The earth's surface has-a negative surface charge density of $10^{-9} Cm^{-2}$. The potential difference of 400kV between the top of the atmosphere and the surface results in a

current of only 1800A over the entire globe. If there were no mechanism of sustaining atmospheric electric field, how much time would be required to neutralize the earth's surface charge? Take radius of earth $= 6.37 \times 10^6$ m.

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25. Six lead - acid type of secondary celJs each of emf 2.0V and internal resistance 0.015Ω are joined in series to provide supply to a

resistance of 8.5Ω. What is the current drawn from the supply and its terminal voltage?

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

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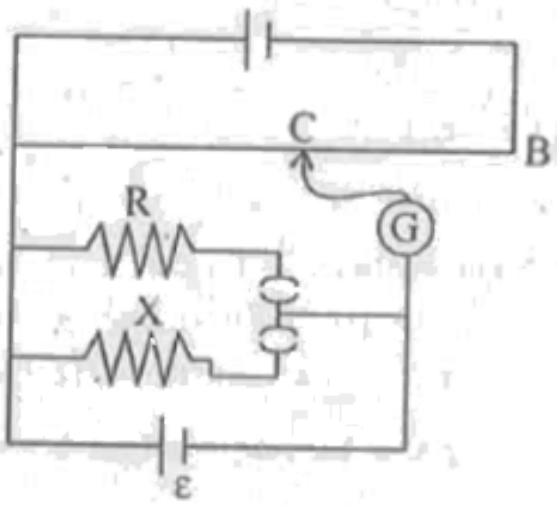
27. The figure shows a potentiometer circuit for comparison of two resistances. The balance point with a standard resistor $R = 10.0\Omega$ is found to be 58.3cm, while that the unknown resistance 'X' is 68.5 cm. Determine the value of x. What might you do if you failed to find a balance point with the

given cell of emf ε?



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28. A battery of internal resistance 3Ω is connected to 20Ω resistor and the potential difference across the resistor is 10V. If another

resistor 30Ω is connected in series with the first resistor and battery is again connectecl to the combination, then calculate the e.m.f and terminal potential difference across the combination..

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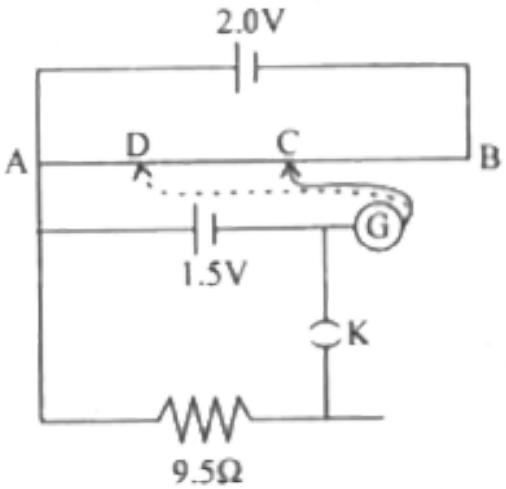
29. The figure shows a 2.0V potentiometer used for the determination of internal resistance of a 1.5V cell. The balance point of the cell in open circuit is 76.3 cm. When a

resistor of 9.5Ω is used in the 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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