PHYSICS

BOOKS - AAKASH SERIES

CURRENT ELECTRICITY

Examples

1. The number of electrons striking the screen of CRT is 7.5×10^{15} in 10 s. Calculate the electric current.

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2. In hydrogen atom, the electron moves in an orbit of radius $5 \times 10^{-11} m$ with a speed of $2.2 \times 10^{6} m / \text{sec}$. Calculate the equivalent current.

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3. A rectangular block has dimensions 5 cm $\times$ 5 cm $\times 10 cm$. Calculate the resistance measured between (a) two square ends and (b) the opposite rectanglar ends specific resistance of the material is 3.5×10^{-5} Ω m

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4. Two wires of same material have their lengths in the ratio 2:3 and radii 8:9 . Equal value of p.d is applied between their ends (separately). Calculate the ratio of current through those two

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5. Two wires of equal diameters of resistivities ρ_1. and ρ_2 , lengths X_1 and X_2 respectively are joined in series. The equivalent resistivity of the combination is

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6. A long round conductor of cross-sectional area S is made of material whose resistivity depends only on a distance r from the axis of the conductor as $\rho = \alpha / r^2$, where α is a constant. Find the total resistance per unit length of the rod when potential difference is applied across its length.

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7. A wire of silver has a resistance of 1 ohm. Specific resistance of constantan is 30 times the specific resistance of silver. Find the resistance of a constantan wire whose length is one third length of the silver wire and radius half the radius of the silver wire.

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8. A currrent of 5A is passing through a metallic wire of cross sectional area $14 \times 10^{-6} m^2$. If the density of the charge carries in the wire is $5 \times 10^{26} / m^3$, find the drift speed of the electrons (charge carries).

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9. Potential difference of 100 V is applied to the ends of a copper wire one metre long. Calculate the average drift velocity at $27^\circ C$. Assume that there is one conduction electron per atom. The density of copper is $9.0 \times 10^3 kg / m^3$, Atomic mass of copper id 63.5 g.

Avogadro's number $= 6.0 \times 10^{23}$ per gram- mole. Conductivity of copper is $5.81 \times 10^{7} \Omega^{-1}$. Boltzmann constant $= 1.38 \times 10^{-23} JK^{-1}$.

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10. The temperature coefficient of resistance of a wire is 0.00125 per $\hat{} \circ C$ At 300 K. its resistance is1Ω The resistance of this wire will be 2Ω at :

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11. A wire has a resistance of 2.5Ω at 100° C. Temperature coefficient of resistance of the material

$\alpha = 3.6 \times 10^{-3} K^{-1}$ at 25° C. Find its resistance at $25^{\circ} C$.

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12. The temperature coefficient of resistance of platinum is $\alpha = 3.92 \times 10^{-3} K^{-1}$ at $0^{\circ} C$. Find the temperature at which the increase in the resistance of platinum wire is 10% of its value of $0^{\circ} C$.

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13. The temperature coefficient of resistivity of material is 0.0004/k. When the temperature of the material is increased by $50^\circ C$, its resistivity increases by 2×10^{-8} ohm-m. The initial resistivity of the material in ohm-m is

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14. A total of 6.0×10^{16} electrons pass through any cross - section of a conducting wire per second. Find the current.

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15. Calculate the drift speed of the electrons when 1A of current exists in a copper wire of cross section 2 mm^2 .The number of free electrons in $1cm^3$of copper is 8.5×10^{22}.

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16. Two wires A and B of equal masses and of the same material are taken. The diameter of wire A is half the diameter of wire B. if the resistance of wire A is 24Ω, calculate the resistance of wire B.

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17. Two electric bulbs have their resistances in the ratio 2:3 . They are connected (a) first in series and then (b) in parallel across the same voltage . Find the ratio of powers consumed by each of the two bubls in the two combinations.

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18. Two electric lamps of 40 W each are connected in parallel across the mains supply. Find the total power consumed by the two bulbs together.

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19. Three equal resistors connected in series across a source of e.m.f. together dissipate 10 W of power. What should be the power dissipated if the same resistors are connected in parallel across the same source of e.m.f.

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20. Two heater coils separately take 10 minutes and 5 minutes to boil a certain amount of water. Find the time taken by both the coils connected in series to boil the same amount of water .

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21. Ten 50 W bulbs are operated on an average for 10 hours a day. Find the energy consumed in kWH in one month of 30 days.

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22. An electric bulb rated 220 V and 100 W. When it is operated on 110 V, the power consumed will be -

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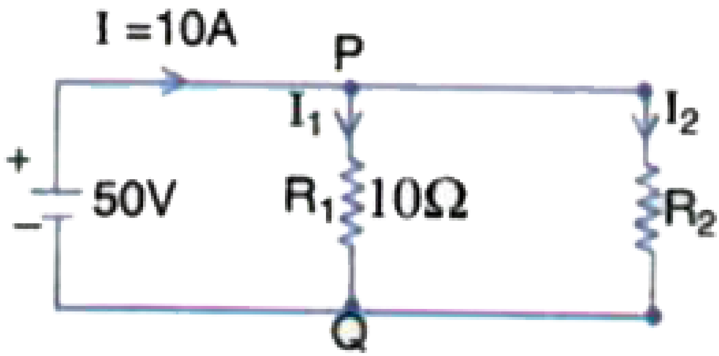
23. For a circuit shown in Fig. find the value of resistance R_2 and current I_2 flowing through R_2



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24. Find the equivalent resistance of the network in fig. between points A and B .

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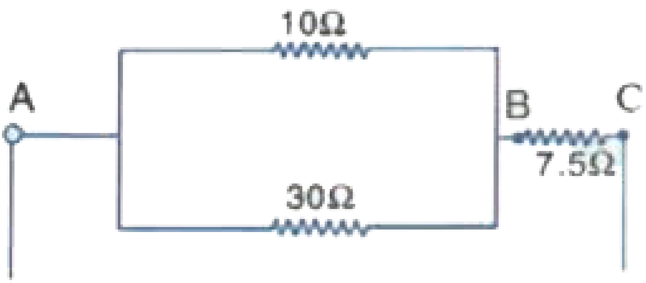
25. Find the equivalent resistance of the network in fig. between points A and C.



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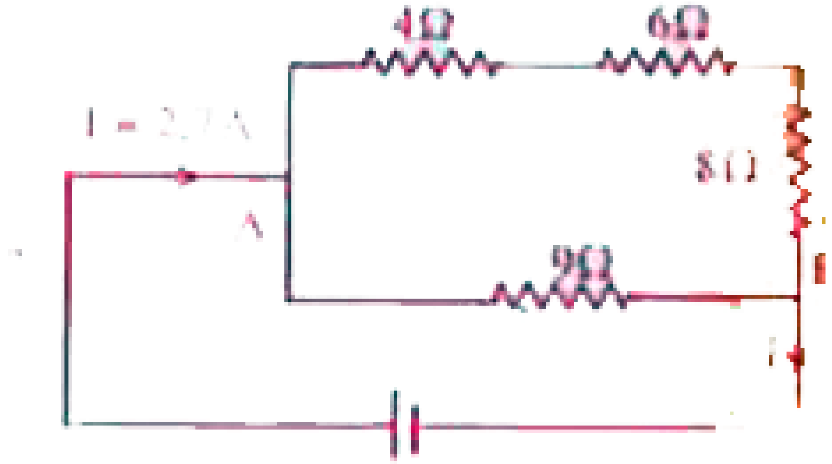
26. Find potential difference between points A and B of the network shown in Fig. and distribution of given main current through different resistors.



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27. Consider thr network as shown in fig. Current is supplied to the network by two batteries as shown. Find the values of currents I_1, I_2, I_3 . The direction of the currents are as indicated by the arrows.

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28. Find the current in each cell considering circuit given in fig.

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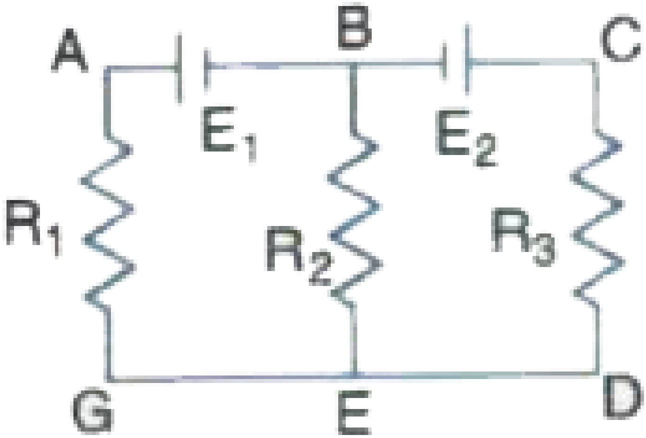
29. In the given circuit values are as follows

$\varepsilon_1 = 2V, \varepsilon_2 = 4V, R_1 = 1\Omega$ and $R_2 = R_3 = 1\Omega$

Calculate the currents through R_1, R_2 and R_3



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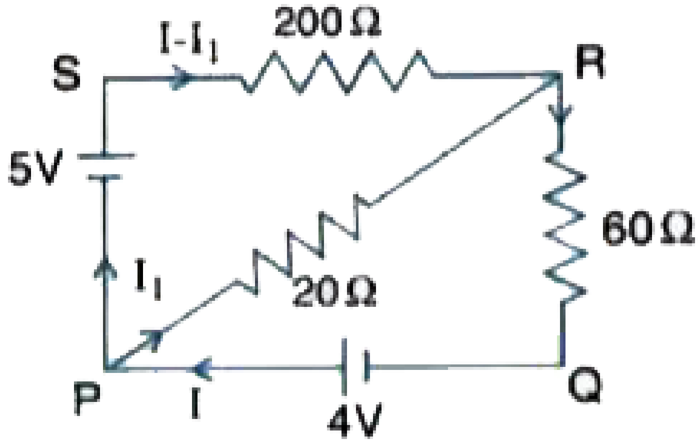
30. In the given circuit , the two cells have no internal resistance. Calculate the potential difference across the 20Ω

resistor .



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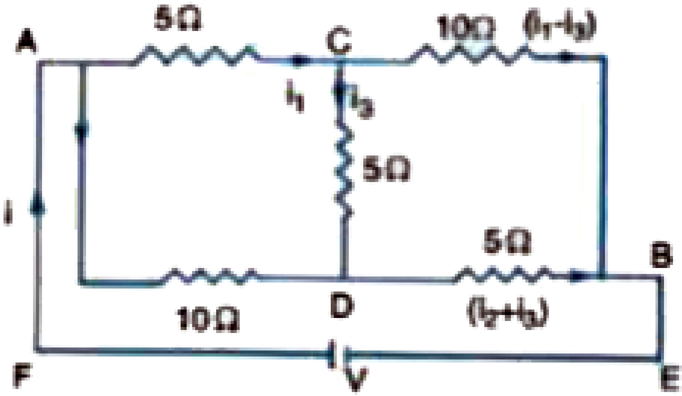
31. Find the equivalent resistance between the points A and B of the circuit shown in the fig.



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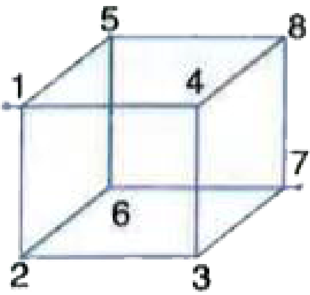
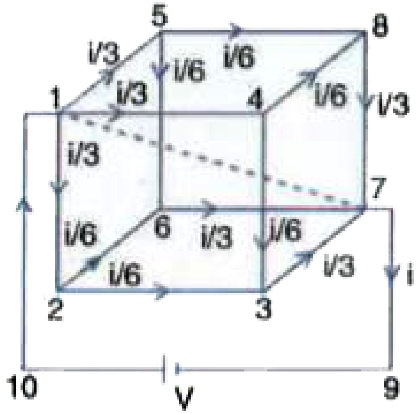
32. Twelve equal wires , each of resistance r ohm are connected so as to form a skeleton cube. Find the equivalent resistance between the diagonally opposite points 1 and 7.



Fig(a)



Fig(b)

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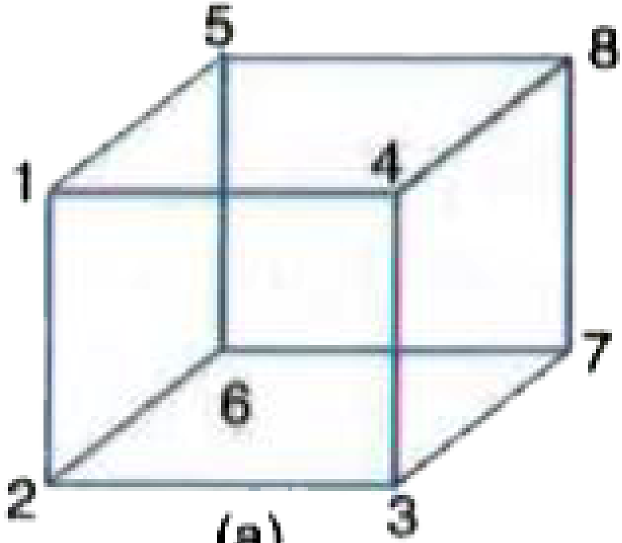
33. Twelve equal wires each of resistance r are joined to form a skeleton cube. Find the equivalent resistance between two corners on the same edge of the cube.



(a)

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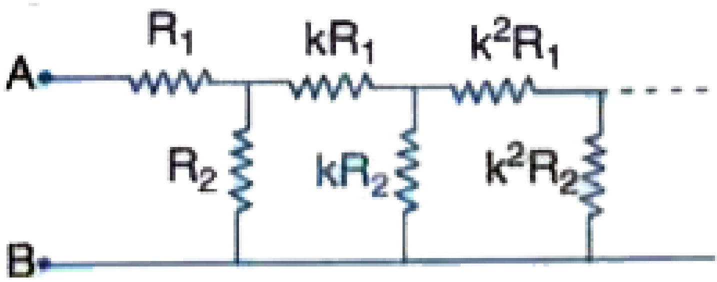
34. The circuit diagram shown in fig consists of a very large (infinite) number of elements . The resistances of the resistors in each subsequent element differ by a factor k from the resistance of the resistors in the previous element.

Determine the resistance R_{AB} between points A and B if the resistances of the first element are R_1 and R_2



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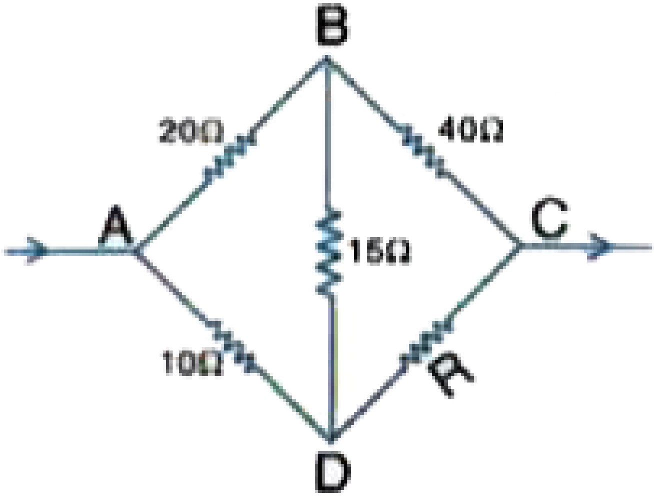
35. Find the value of R in fig. so that there is no current in the 15 Ω resistor



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36. In a metre bridge , the null point is found at a distance of 33.7 cm from A. If now a resistance of 10Ω 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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37. A balance point in a meter bridge experiment is obtained at 30 cm from the left. If right gap contains 3.5Ω , what is the resistance in the left gap ?

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38. When a current drawn from a battery is 0.5 A, its terminal potential difference is 20 V. And when current drawn from it is 2.0 A , the terminal voltage reduces to 16 V . Find out e.m.f and internal resistance of the battery.

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39. When a battery is connected to the resistance of 10Ω the current in the circuit is 0.12 A . The same battery gives 0.07A current with 20Ω Calculate e.m.f and internal resistance of the battery.

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40. A cell on open circuit has e.m.f 2.0 V and in closed circuit having current of 0.05 A , the p.d is 1.5 V . Calculate internal resistance of the cell.

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41. A battery of e.m.f 6 V and internal resistance 1Ω gives a p.d of 5.8 V when connected to a resistance . Find the external resistance .

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42. An ideal battery sends a current of 5A in a resistor. When another resistor of value 10Ω is connected in parallel ,the current through the battery is increased to 6A.Find the resistance of the first resistor.

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43. Two batteries A and B each of e.m.f. 2V are connected in series to an external resistance $R = 1\Omega$. If the internal resistance of battery A is 1.9Ω and that of B is 0.9Ω. What is the potential difference between the terminals of battery A ?

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44. When a resistance of 11 Ω is connected in series with an electric cell, 0.5 A current flows thrugh it . If the 11 Ω resistor is replaced by 5Ω resistor the current flowing through it is 0.9 A . Find the internal resistance of the cell.

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45. Two cells A and B with same e.m.f. of 2 V each and with internal resistance $r_A = 3.5\Omega$ and $r_B = 0.5\Omega$ are connected in series with an external resistance R =ΩR Find the terminal voltages across the two cells.

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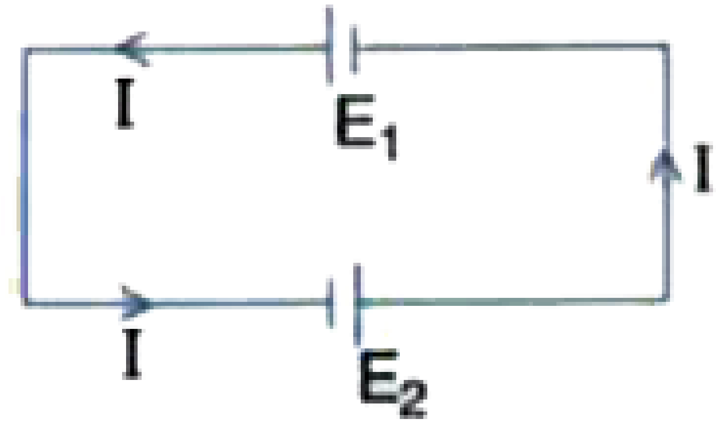
46. Two cells of e.m.f. 's E_1 and E_2 are connected in series in a circuit . Let r_1 and r_2 be the internal resistance of the cells. Find the current through the circuit.



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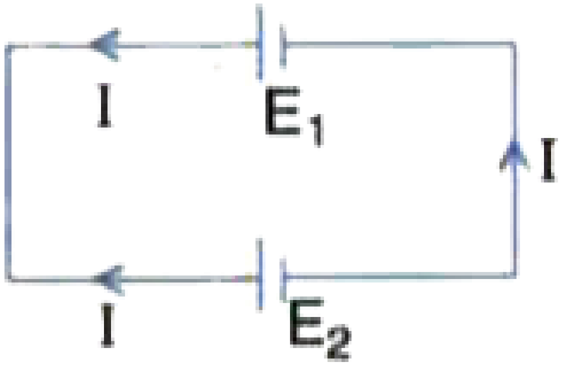
47. Let two cells of e.m.f.'s E_1 and E_2 be connected in parallel in a circuit . Let r_1 and r_2 be the internal resistances of the cells . Find the value of the current



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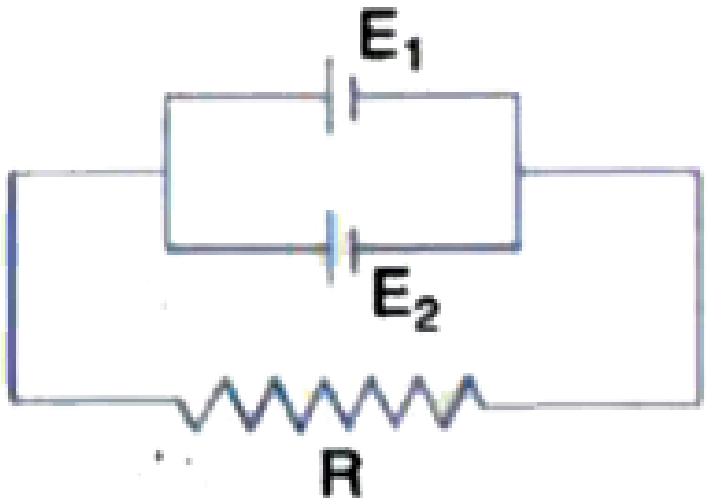
48. Let two cell of e.m.f's E_1 and E_2 and internal resistances r_1 and r_2 be connected in parallel to a circuit with an external resistance R. Find the value of the current I through the given resistor .



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49. An electric current passes through a circuit containing two wires of the same material connected in parallel. If the lengths of the wires are in the ratio of $4/3$ and radius of the wires are in the ratio of $2/3$, then the ratio of the currents passing through the wires will be :

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50. Twelve cells each having the same emf are connected in series and are kept in a closed box. Some of the cells are wrongly connected. This battery of cells is connected in series with an ammeter and two cells identical with the others. The current is 3A when the cells and the battery aid each other and is 2A when the cells and the battery oppose each other. How many cells in the battery are wrongly connected?

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51. A cell is e.m.f 2V and internal resistance 1Ω is connected to a potentiometer of length 1m and resistance 4Ω Calculate the potential drop per cm.

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52. A battery of unknown emf connected to a potentiometer has balancing length 560 cm. If a resistor of resistance 10 ohm, is connected in parallel with the cell the balancing length change by 60 cm. If the internal resistance of the cell is $\frac{n}{10}$ ohm, the value of 'n' is

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53. Length of potentiometer wire is 5 m. It is connected with a battery of fixed e.m.f Null point is obtained for Daniel cell at 100 cm on it. If the length of the wire is made 7 m, then what will be the position of null point ?

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54. In a potentiometer experiment when a battery of e.m.f . 2 V is included in the secondary circuit, the balance point is at 500 cm . Find the balancing length from the same end when a cadmium cell is e.m.f 1.018V is connected to the secondary circuit.

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55. In the secondary circuit of a potentiometer , a cell of internal resistance 1.5Ω gives a balancing length of 52 cm. To get a balancing length of 40 cm , how much resistance is to be connected across the cell ?

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56. A circuit having resistor of 2 mega-ohm and capacitor of $1\mu F$ is placed in series with a battery of 2 volt. Find the time after which the charge reaches 86.4% of its maximum value.

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57. A capacitor is being charged through a resistance of 3 mega ohm. If it reaches 75% of its final potential in 0.5 sec, find its capacitance.

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58. A capacitor, charged to 10 V , is being discharged through a resistance R. At the end of 1s the voltage across the capacitor is 5V. What will be the voltage after 2s ?

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59. A capacitor of capacitance C fared is being charged from a.d.c supply of E volts through a resistance of R ohms, i)

Show that most of the voltage across the capacitor builds up during the first time constant . Ii) Show that capacitor is almost fully charged after time equal to 5 time constants.

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60. A $2\mu F$ Capacitor is connected to a.d.c source of 100 volt through $1M\Omega$ series resistance . Calculate time constant .

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61. A $2\mu F$ Capacitor is connected to a.d.c source of 100 volt through $1M\Omega$ series resistance . Calculate initial charging current .

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62. A $2\mu F$ Capacitor is connected to a.d.c source of 100 volt through $1M\Omega$ series resistance . Calculate initial rate of rise of p.d across the capacitor.

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63. A $2\mu F$ Capacitor is connected to a.d.c source of 100 volt through $1M\Omega$ series resistance . Calculate voltage across the capacitor 6 seconds after the application of voltage .

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64. A $2\mu F$ Capacitor is connected to a.d.c source of 100 volt through $1M\Omega$ series resistance . Calculate initial charging current .

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65. A resistor R and a $4\mu F$ capacitor are connected in series across a 200 V d.c. supply. Across the capacitor is connected a neon lamp that strikes at 120 V in 5 seconds . Find R.

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66. A capacitor of $1\mu F$ and resistance $82k\Omega$ are connected is series with a d.c. source of 100 volt. Calculate the magnitude of energy and the time in which energy stored in the capacitor will reach half of its maximum value.

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Exercise Long Answer Questions

1. What is drift velocity of free electrons in a metallic conductor ? For a current carrying conductor establish relation between current, drift velocity v_d concentration of conduction electrons and electronic charge.

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2. Define electric current. What is its SI unit?

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3. Three resistors $R_1, R_2, \text{ and } R_3$, and are connected in series. Find out equivalent resistance of combination.

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4. Three resistors $R_1, R_2, \text{ and } R_3$, and are connected in parallel. Find out equivalent resistance of combination.

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5. Give the difference between e.m.f. and potential difference.

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6. What are Kirchhoff's laws governing the currents and electromotive forces in an electrical network?

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7. Potentiometer measures the potential difference more accurately than a voltmeter, because

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8. Draw a labelled circuit diagram of a potentiometer to compare emfs of two cells. Write the working formula (Derivation not required).

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9. In order to determine the internal resistance of a primary cell by means of potentiometer the emf of the battery connected across the ends of the potentiometer wire should be

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10. (c) Derive the expression for the affective capacitance of a series combination of n capacitors.

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11. Derive expressions for the equivalent emf of series combination of electric cell.

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12. Derive expressions for the equivalent emf of series combination of electric cell.

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Exercise Short Answer Questions

1. The resistivity of a wire

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2. The unit of electrical conductivity is

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3. Give two differences between an ohmic and non ohmic resistor.

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4. why does the electrical conductivity of semiconductors increase with rise in temperature?

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5. State and explain Ohm.s law and hence defined one ohm.

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6. On what factors does the resistance of a conductor depend ?

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7. Define conductance. What are its units? How does it change with temperature?

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8. (a) State and explain Kirchhoff's law.

(b) Describe an experiment to verify it.

(c) Give two examples to illustrate Kirochhoff's law.

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9. What is is a wheatstone bridge ?

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10. (a) State the working principle of a potentiometer. With the help of the circuit diagram, explain how a potentiometer is used to compare the emf's of two primary cells. Obtain the required expression used for comparing the emfs.

(b) Write two possible causes for one sided deflection in a potentiometer experiment.

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11. With the help of a neatly drawn and labelled diagram, obtain balancing condition of a Wheatstone bridge.

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12. Combination of Cells

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Exercise Very Answer Questions

1. An uncharged conductor A is brought near a positively charged conductor B. Then.

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2. What do you mean by thermal motion of free electrons in conductors ?

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3. How can you determine the displacement and the acceleration of an object from its velocity-time graph?

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4. The direction of the flow of current through electric circuit is

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5. What is a fuse ? Name the material of fuse. State one characteristic of the material used for fuse.

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6. A given conductor has got different areas of cross section. From the formula for drift speed can we say the current i will be different at different cross sections?

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7. A beam of electrons projected along + x-axis , experiences a force due to a magnetic field along the +y-axis . What is the direction of the magnetic field ?

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8. When no external electric field is applied (that is when no current is passing through the conductor) the average velocity of a conduction electron over a large time will be zero and at any given time the average velocity of all the free electrons will also be zero. Will the situation be same when current is passing (electric field is applied)?

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9. Define the term 'drift velocity` of electrons in a current carrying conductor. Obtain the relationship between the current density and the drift velocity of electrons.

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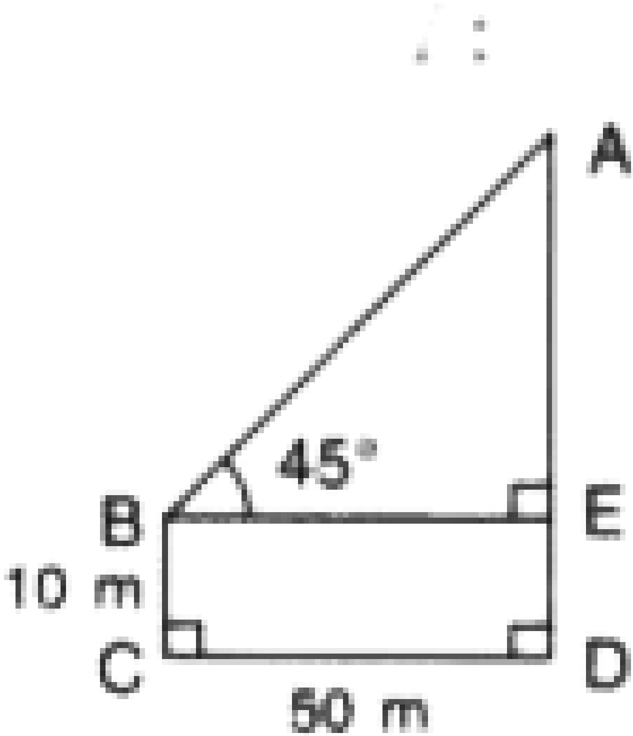
10. Find AD, if : (i)



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11. What is a non-ohmic resistor ?

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12. A battery of emf 2V and internal resistance $0.5(\Omega)$is connected across a resistance 1.5(Ω). Find the current flow through battery ?

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13. The constant k in Coulomb's law depends on

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14. A mete bridge is used to determine the resistance of an unknown wire by measuring the balance point length l. If the wire is replaced by another wire of same material but with double the length and half the thickness the balancing point is expected to be

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15. The resistance in the gap of a metre bridge is 10Ω and the balance point 40 Cm from the left end .Calculate the value of unknwon resistance .

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16. Define drift velocity of charge carriers in a conductor. Mention the units of drift velocity.

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17. Define mobility of charge carriers in a conductor. Mention the units of mobility.

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18. A given conductor has got different areas of cross section. From the formula for drift speed can we say the current i will be different at different cross sections?

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19. State and explain Ohm.s law and hence defined one ohm.

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20. Differentiate between ohmic and non -ohmic devices .

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21. Define one ohm.

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22. The conductance (G) is

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23. On what factors does the resistance of a conductor depend ?

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24. The microbe used in the preparation of butyric acid ,is

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25. What is the temperature coefficient?

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26. Is Ohm's law a fundamental law?

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27. What is a primary cell? Give an example.

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28. What is the terminal voltage of a cell ? When it will be equal to the emf of the cell?

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29. When a cell is charged by sending current into the cell, what will be the terminal potential difference of the cell.

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30. What are good conductors? Give examples.

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31. Which of the two, namely voltmeter and potentiometer is preferable to measure the emf of a battery? Why?

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32. Define kilowatt hour.How is it reltated to joule?

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33. On what conservation principles the first and the second laws of Kirchhoff are based?

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34. What is the advantage of a meter bridge over a Wheatstone bridge?

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35. What is the principle of potentiometer?

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36. When is the series combination of cells advantageous and why?

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37. When is the parallel combination of cells advantageous and why?

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38. What are the advantages of using a potentiometer?

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39. "Electrons alone are the current carriers in conductors". Explain whether this statement is correct or not?

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40. What conclusion can you draw from the following observation on a resistor made of alloy manganin?

Current A	Voltage V	Current A	Voltage V
0.2	3.94	3.0	59.2
0.4	7.87	4.0	78.8
0.6	11.8	5.0	98.6
0.8	15.7	6.0	18.5
1.0	19.7	7.0	38.2
2.0	39.4	8.0	58.0

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41. A steady current flows in a metallic conductor of non-uniform cross-section. Which of these quantities is constant along the conductor : current, current density, electric field, drift speed?

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42. Is Ohm's law universally applicable for all condcuting elements? If not, give examples of elements which do not obey Ohm's law.

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43. A low voltage supply from which one needs high currents must have very low internal resistance. Why?

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44. A high tension (HT) supply of, say, 6kV must have a very large internal resistance. Why?

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Exercise Very Answer Questions Choose The Correct Alternative

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

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2. The resistivity of alloy manganin is

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3. The resistivity of a typical insulator (e.g., amber) is greater than that of a metal by a factor of the order of $(10^{22}/10^{3})$

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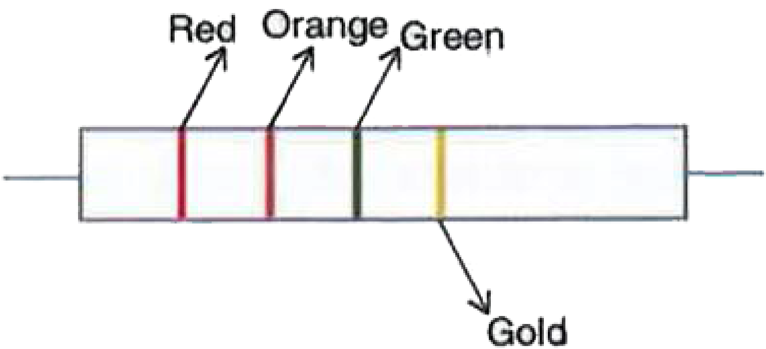
Problems Level 1

1. The colours on the resistor shown in Fig., are red orange, green and gold as read from left to right. What is the resistance of it according to colour code?



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2. A wire of length 1 m and radius 0.1mm has a resistance of $100(\Omega)$.Find the resistivity of the material .

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3. Consider a wire of length 4m and cross-sectional areal $1mm^2$ carrying of 2A. If each cubic metre of the material contains 10^{29}free electrons, find the average time taken by an electron to cross the length of the wire.

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4. Suppose you have three resistor each of value (30Ω).List all the different resistances you can obtian using them.

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5. The potential difference between the terminals of a battery of emf 6.0V and internal resistance$1(\Omega)$drops to 5.8 V when connected across an external resistor. Find the resistance of the external resistor.

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6. Four resistors P.Q, R and X whose values are 2,2,2 and 3 ohms respectively are joined to form a Wheatstone Bridge.

Calculate the value of resistance with which the resistance X must be shunted in order that the bridge may be balanced.

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

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8. Three resistors $\Omega, 2\Omega$ and 3Ω are combined in series. What is the total resistance of the combination?

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9. If the combination is connected to a battery of emf 24 V and negligible internal resistance, obtain the potential drop across each resistor.(here $R_1 = 1ohm$,$R_2 = ohm$ and $R_3 = 3ohm$)

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10. Three resistors 3Ω, 5Ω and 6Ω are combined in parallel. What is the total resistance of the combination ?

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11. If the combination is connected to a battery of emf 30 V and negligible internal resistance, determine the current through each resistor, and the total current drawn from the battery.(here $R_1 = ohm, R_2 = 5ohm$ and $R_3 = 6ohm$)

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12. A negligibly small current is passed through a wire of length 15 m 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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13. A silver wire has a resistance of 3.0Ω at $27.5^\circ C$, and a resistance of 3.8Ω at 100° C. Determine the temperature coefficient of resistivity of silver at 27.5° C.

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14. In a potentiometer arrangement, 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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15. In a metre bridge, 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 meter bridge made of thick copper strips?

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16. In a metre bridge, the balance point is found to be at $39.5cm$ from the end A, when the resistor Y is of 12.5Ω. (value of $X = 19.14\Omega$) Determine the balance point of the above bridge if X and Y are interchanged.

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17. (a) In a meter bridge [Fig. 3.27], 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 meter bridge made of thick copper strips?

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

(c) What 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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Problems Level Ii

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

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2. 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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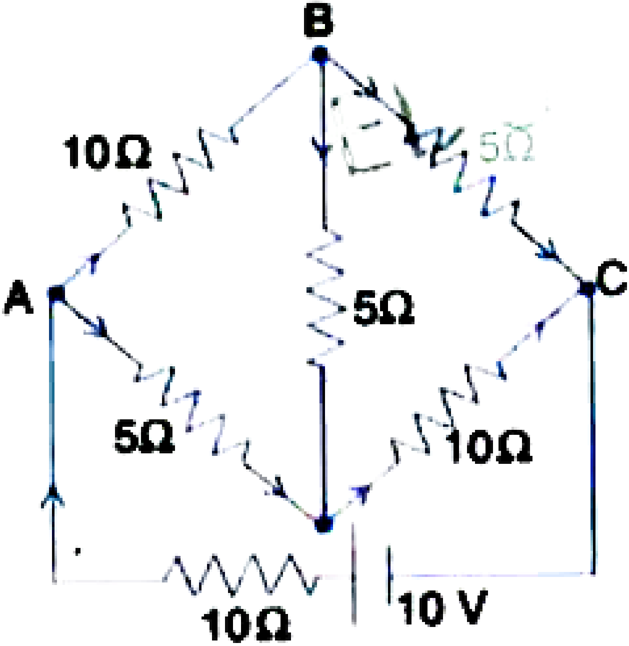
3. Determine the current in each branch of the network shown in figure.



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4. A storage battery of emf 8.0 V and internal resistance 0.5Ω is being charged by a 120 V dc supply using a series resistor of 15.5Ω. What is 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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5. 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 preferred for overhead power cables. $(\rho_{Al} = 2.63 \times 10^{-8} \Omega m)$, $\rho_{Cu} = 1.72 \times 10^{-8} \Omega m,$ relative density of Al= 2.7, Cu = 8.9.)

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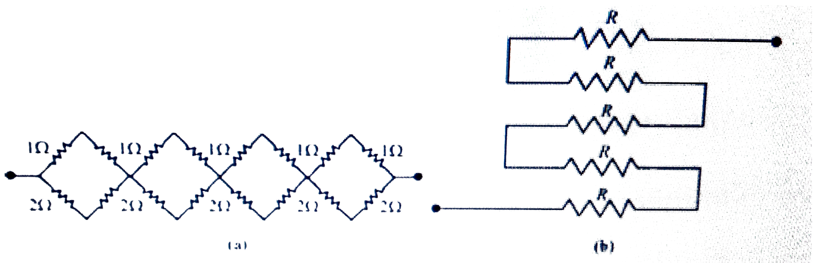
6. (a) Given n resistors each of resistance R, how will you combine them to get the (i) maximum (ii) minimum effective resistance? What is the ratio of the maximum to minimum resistance?

(b) Given the resistances of $1\Omega, 2\Omega, 3\Omega,$ how will be combine them to get an equivalent resistance of (i) $(11/3)\Omega$ (ii) $(11/5)\Omega,$ (iii) $6\Omega,$ (iv) $(6/11)\Omega$?

(c) Determine the equivalent resistance of networks shown in Fig. 3.31.



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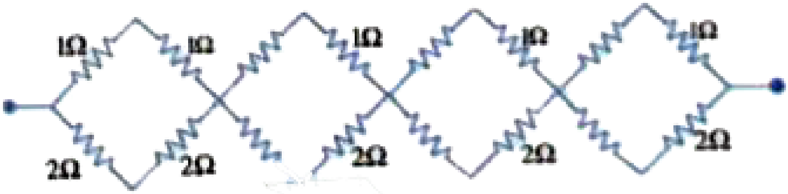
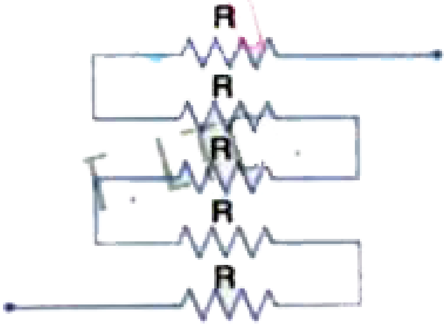
7. Determine the equivalent resistance of networks shown in figures above



(a)



(b)

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8. Given the resistances $2\Omega, 3\Omega, 4\Omega$ how will you combine them to get an equivalent resistance of $\left(\frac{26}{5}\right)\Omega$

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9. The correct combination of three resistances $1\Omega, 2\Omega$ and 3Ω to get equivalent resistance $\frac{11}{5}\Omega$ is

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10. Given the resistances $1\Omega, 2\Omega, 3\Omega$ how will you combine them to get an equivalent resistance of 6Ω

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11. $(6/11)\Omega$

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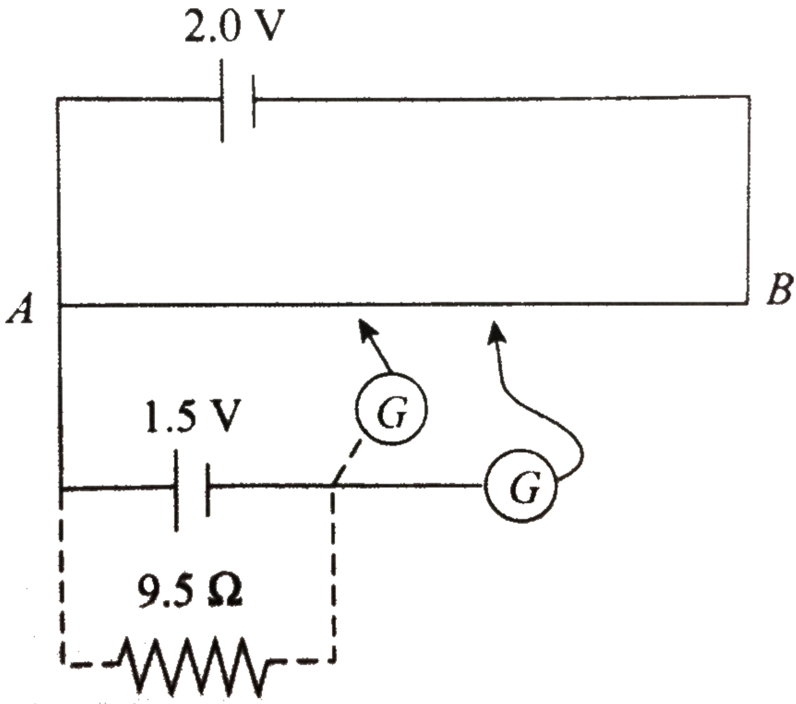
12. Figure 6.13 shows a $2.0V$ potentiometer used for the determination of internal resistance of a $1.5V$ cell. The balance point of the cell in open circuit is $76.3cm$. Whan a resistor of 9.5Ω is used in the external circuit of the cell, the balance point shifts to $64.8cm$, length of the potentiometer. Dentermine the internal resistance of the cell.



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13. 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 the low conductivity of the lower atmosphere) in a current of only 1800 A over the entire globe. If there were no mechanism of sustaining atmospheric 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 thunderstorms and lightning in different parts of the globe). (Radius of earth $= 6.37 \times 10^6 m$.)

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14. Siix lead-acid type of secondary cells, each of emf 2.0 V and internal resistancce 0.015Ω are joined in series to provide a supply to a resistance of 8.5Ω. Determine : (i) the current draw from the fupply and (ii) its terminal voltage.

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15. A secondary cell after long use has an emf of 1.9 V and a 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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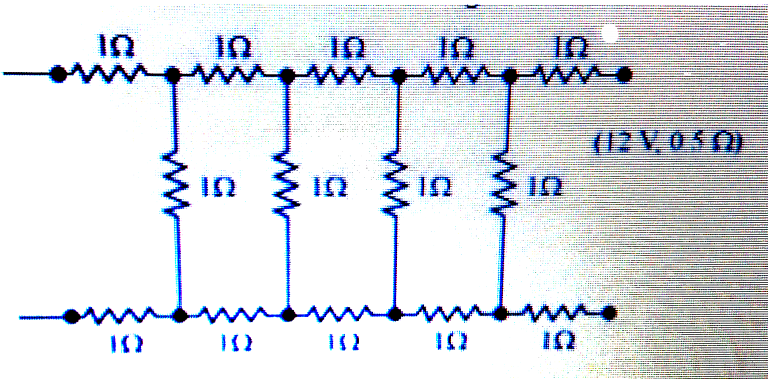
16. Determine the current drawn from a 12V supply with internal resistance 0.5Ω by the infinite network shown in Fig. 3.32. Each resistor has 1Ω resistance



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17. Figure 6.36 shows a potentiometer with a cell of emf $2.0V$ and internal resistance 0.4Ω maintaining a potential drop across the resistor wire AB. A standard cell that maintains a constant emf of $1.02V$ (for very moderate current up to emf μA) gives a balance point at $67.3cm$ length of the wire. To ensure very low current is drawn 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 ε and the balance point found, similary, turns out to be at $82.3cm$ length of the wire.

a. What is the value of ε?

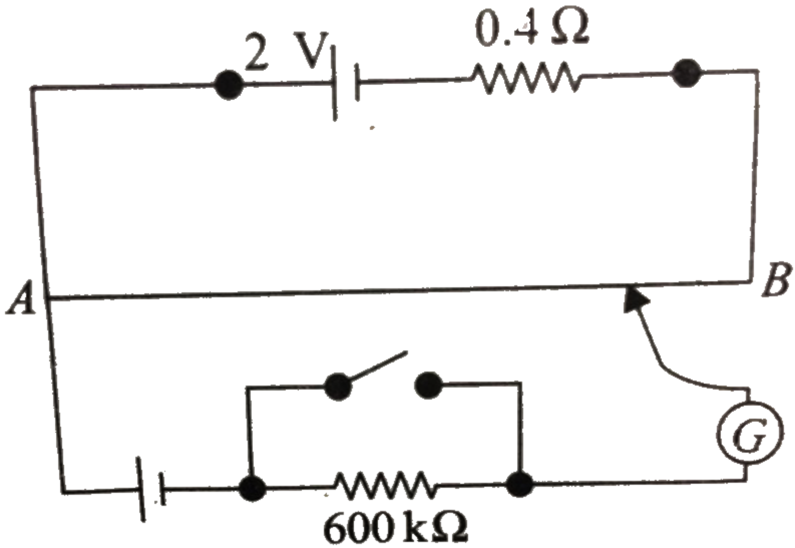
b.What purpose does the high resistance of $600k\Omega$ have?

c. Is the balance point affected by this high resistance?

d. Is the balance point affected by 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 $1.0V$ instead of $2.0V$?

f. Would the circuit work well for determining an extermely small emf, say of the order of a few mV (such as the typical emf of a thermocouple)? If not, how will you modify the circuit ?



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18. Figure 6.36 shows a potentiometer with a cell of emf $2.0V$ and internal resistance 0.4Ω maintaining a potential drop across the resistor wire AB. A standard cell that maintains a constant emf of $1.02V$ (for very moderate current up to emf μA) gives a balance point at $67.3cm$ length of the wire. To ensure very low current is drawn 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 ε and the balance point found, similary, turns out to be at $82.3cm$ length of the wire.

a. What is the value of ε?

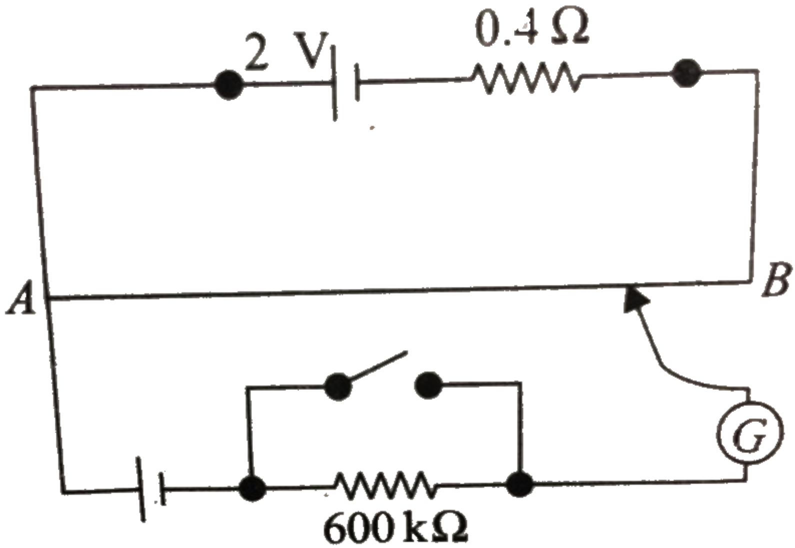
b.What purpose does the high resistance of $600k\Omega$ have?

c. Is the balance point affected by this high resistance?

d. Is the balance point affected by 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 $1.0V$ instead of $2.0V$?

f. Would the circuit work well for determining an extermely small emf, say of the order of a few mV (such as the typical emf of a thermocouple)? If not, how will you modify the circuit ?



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19. Figure 6.36 shows a potentiometer with a cell of emf $2.0V$ and internal resistance 0.4Ω maintaining a potential drop across the resistor wire AB. A standard cell that maintains a constant emf of $1.02V$ (for very moderate current up to emf μA) gives a balance point at $67.3cm$ length of the wire. To ensure very low current is drawn 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 ε and the balance point found, similary, turns out to be at $82.3cm$ length of the wire.

a. What is the value of ε?

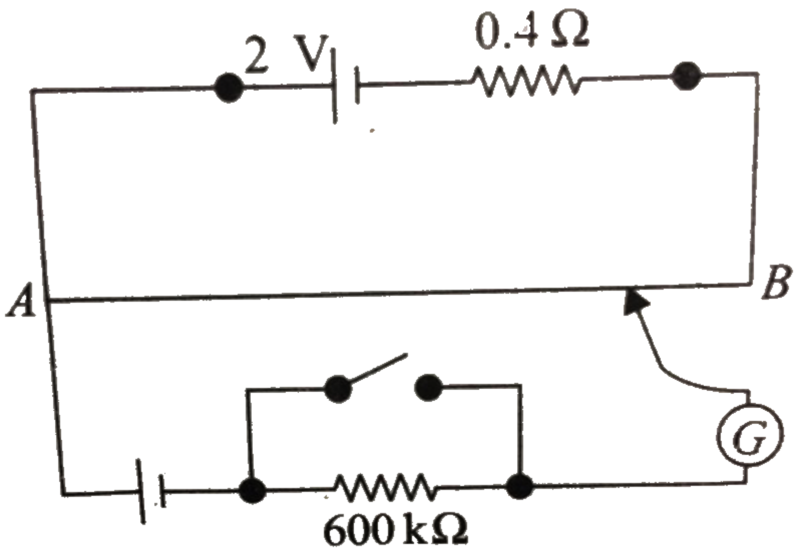
b.What purpose does the high resistance of $600k\Omega$ have?

c. Is the balance point affected by this high resistance?

d. Is the balance point affected by 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 $1.0V$ instead of $2.0V$?

f. Would the circuit work well for determining an extermely small emf, say of the order of a few mV (such as the typical emf of a thermocouple)? If not, how will you modify the circuit ?



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20. Figure 6.36 shows a potentiometer with a cell of emf $2.0V$ and internal resistance 0.4Ω maintaining a potential drop across the resistor wire AB. A standard cell that maintains a constant emf of $1.02V$ (for very moderate current up to emf μA) gives a balance point at $67.3cm$ length of the wire. To ensure very low current is drawn 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 ε and the balance point found, similary, turns out to be at $82.3cm$ length of the wire.

a. What is the value of ε?

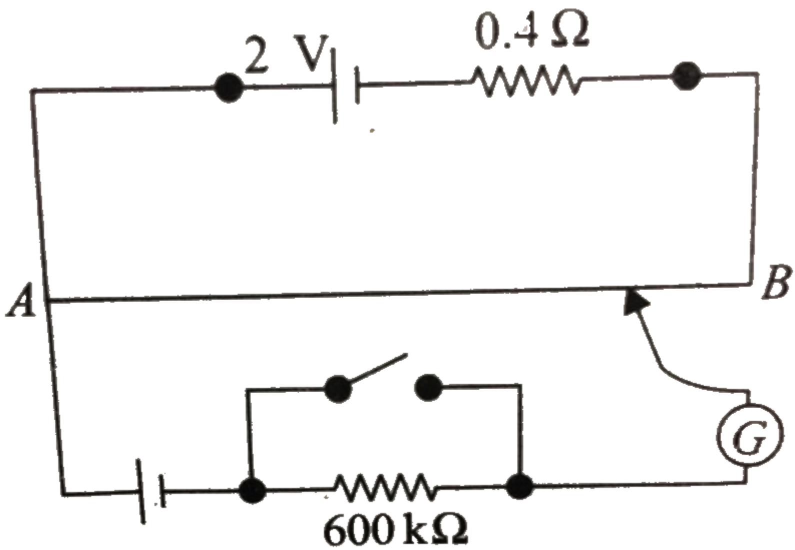
b.What purpose does the high resistance of $600k\Omega$ have?

c. Is the balance point affected by this high resistance?

d. Is the balance point affected by 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 $1.0V$ instead of $2.0V$?

f. Would the circuit work well for determining an extermely small emf, say of the order of a few mV (such as the typical emf of a thermocouple)? If not, how will you modify the circuit ?



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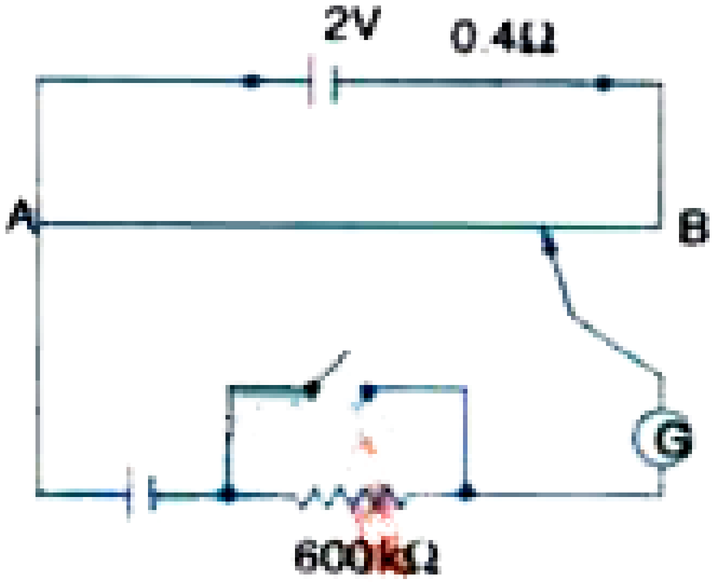
21. Figure shows a potentiometer with a cell of 2.0 V and internal resistance 0.40 Ω maintaining a potential drop across the resistor wire AB. A standard cell which maintains a constant emf of 1.02 V (for every moderate currents upto a few mA) gives a balance point at 67.3 cm length of the wire. To ensure very low currents drawn from the standard cell, a very high resistance of 600 Ω 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 ε and the balance point found similarly, turns out to be at 82.3 cm length of the wire.



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?

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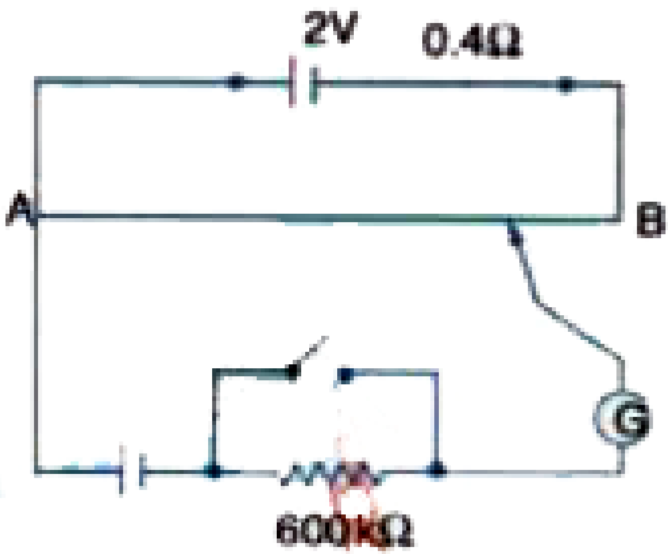
22. Figure shows a potentiometer with a cell of 2.0 V and internal resistance 0.40 Ω maintaining a potential drop across the resistor wire AB. A standard cell which maintains a constant emf of 1.02 V (for every moderate currents upto a few mA) gives a balance point at 67.3 cm length of the wire. To ensure very low currents drawn from the standard cell, a very high resistance of 600 Ω 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 ε and the balance point found similarly, turns out to be at 82.3 cm length of the wire.



Would the circuit work well for determining an extremely small emf, say of the order of a few mV (such as the typical emf of a thermo-couple)? If not, how will you modify the circuit?

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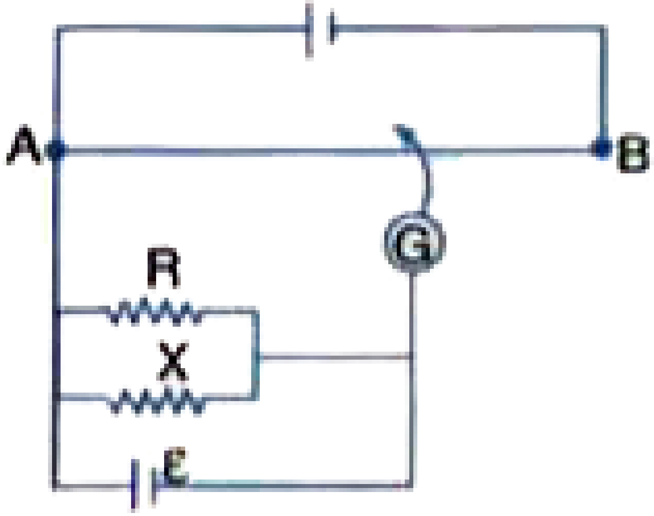
23. Figure shows a potentiometer circuit for comparison of two resistances. The balance point with a standard resistor R= 10.0Ω is found to be 72.6 cm, while that with the unknown resistance X is 68.5 cm. Determine the value of X. What might you do if you failed to find a balance point with the given cell of emf ε ? (Take internal resistance r=1Ω)



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24. Two resistors with temperature coefficients of resistance α_1 and α_2 have resistances R_1 and R_2 at 0°C. Find the temperature coefficient of the compound resistor consisting of the two resisters connected in series .

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25. Two resistors with temperature coefficients of resistance α_1 and α_2 have resistances R_1 and R_2 at 0°C. Find the temperature coefficient of the compound resistor consisting of the two resisters connected in parallel.

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26. It is desired to make a 20Ω coil of wire, which has a zero thermal coefficient of resistance. To do this, a carbon resistor of resistance R_1 is placed in series with an iron resistor of resistance R_2. The proportions of iron and carbon are so chosen that $R_1 + R_2 = 20\Omega$ for all temperatures near $20^{\circ} C$. How long are R_1 and R_2?

$\alpha_{carbon} = -0.5 \times 10^{-3} .^{\circ} C^{-1}, \alpha_{iron} = 5 \times 10^{-3} .^{\circ} C(-1)$

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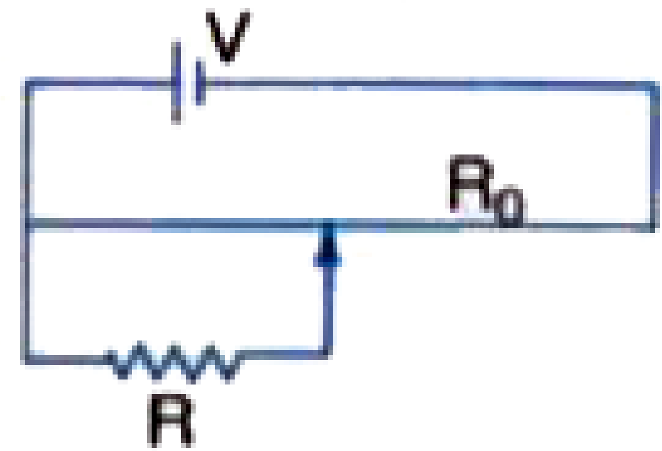
27. A voltage V is supplied to a potentiometer wire of resistance R_0. A resistance R is connected as shown. Find voltage across R when the sliding contact is at the middle of potentiometer wire



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